The Decline of Labour Share in OECD and Non-OECD Since the 1980s

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Abstract

This paper examines the causes of falling labour share in OECD and non-OECD countries since the 1980s by using Karabarbounis and Neiman's (2014) labour share model. While both groups of countries experience an elasticity of substitution between capital and labour, the factors driving down labour share are different. In OECD countries, export and volatility are key drivers, but in non-OECD countries, the significant factors are financial openness and the capital's relative price. Overall, technological advancement – as reflected by declining capital's relative price – coupled with globalisation and low economic risk are key factors in explaining a long-term decline of labour share worldwide.

Keywords: Elasticity of substitution; Financial openness; Labour share; Trade; Volatility

JEL Classification: E25; F66; O33

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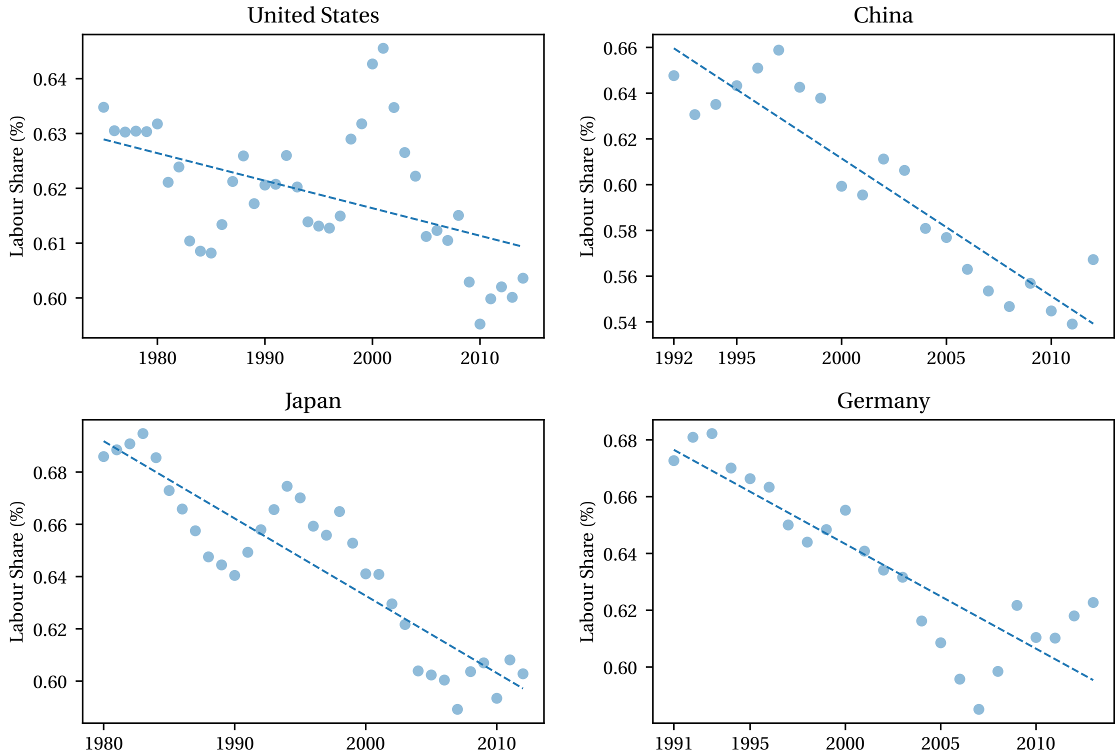
1 Introduction

Since the work of Kaldor (1957), labour's income share has been believed to be constant. This factor share consistency is known as one of Kaldor's (1957) stylised facts in macroeconomic models, particularly the growth model (Elsby et al., 2013; Karabarbounis and Neiman, 2014). However, many countries have experienced a decline in share of income going to labour over the past three decades, which has lead to this stylised fact being questioned or even outright rejected. Figure 1 for example, shows the declining labour share of the four largest economies, whose aggregate GDP accounts for almost half of the world's total GDP. These downward trends have not only occurred in these four economies, but also has been seen in most of the world, as documented comprehensively by Karabarbounis and Neiman (2014).

Figure 1: Declining labour share in the four largest economies



Note: The figure shows the labour share and its linear trend for the world's four largest economies from 1975. Data were sourced from the Penn World Table version 9.0.

This worldwide phenomenon has led to a large body of research investigating what factors have attributed to this decline. Two recent work in this vein, from Piketty (2014) and Karabarbounis and Neiman (2014), have drawn worldwide attention. Piketty (2014) offers the fundamental laws of capitalism that help explain the evolution of capital share in the long run. His first law simply shows that the share of GDP going to capitalists increases as capital accumulates. However, this conclusion holds only if the elasticity of substitution between labour and capital exceeds unity. Based on this logic, Karabarbounis and Neiman (2014) provide evidence that labour and capital have been highly substitutable since the 1980s. This high elasticity (around 1.28) enables Karabarbounis and Neiman (2014) to conclude that the falling relative price of investment goods induces firms to replace labour with capital to such a large extent that the income share of labour falls[1].

This paper contributes to the existing literature by using Karabarbounis and Neiman (2014)'s labour share model as a baseline from which we specify our expanded econometric models to test the determinants of the labour share in Organisation for Economic Co-operation and Development (OECD) and non-OECD countries.

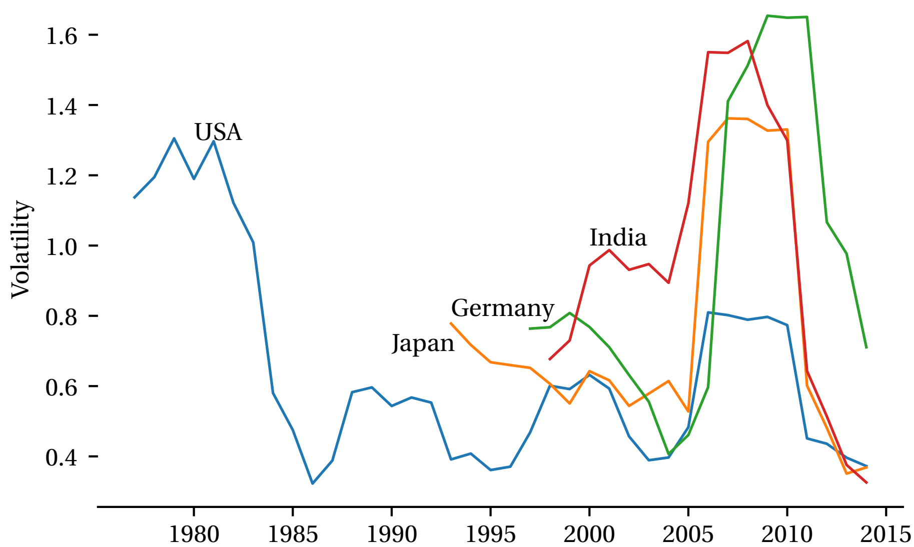
This paper expands on the works of Elsby et al. (2013) and Karabarbounis and Neiman (2014) by dealing with endogeneity bias. To do so, we include a new explanatory variable, *risk*, measured by the real GDP volatility, which affects both the labour share and the return rate of investment. Times of low risk tend to encourage firms to invest in capital and hire more labour, but in times of high risk, such as the 2007-2009 recession (see Figure 2), firms tend to disinvest and lay off workers (Kang et al., 2016). Because of the high substitution between capital and labour, firms utilise capital more proportionally than labour at times of low risk, thus leading to the decline of labour share. Our second contribution is that we also compare the falling labour shares between OECD and non-OECD countries. The economic performances and risk status of the OECD and non-OECD countries vary, leading to different labour share outcomes for the two groups.

We analyse factors contributing to the labour share using data for 30 OECD and 23 non-OECD countries, spanning over the period 1975 to 2014. We use two estimation methods

[1] The elasticity of substitution between capital and labour, denoted as σ, measures how easily capital and labour can replace each other based on their relative prices. For instance, if $\sigma > 1$, capital and labour become more highly substitutable. This implies that as capital's price is relatively cheaper than labour's wage, firms tend to replace labour with capital.

for this analysis. The first is a robust regression estimation,[2] which deals with the long-run growth rates (at least 15 years) of variables, and the second is a fixed-effect estimation to deal with the short-run growth rates (5 years) of variables. These estimations show that both groups of countries experience an elasticity of substitution greater than one between capital and labour. However, the forces driving the declining labour share differ between the groups. The results indicate that exports and volatility are driving labour share in the developed countries. In particular, a 10 percent increase in export growth leads to a 1 percent decrease in the growth of labour share, and a 10 percent decrease in volatility leads to a 2.5 percent decline in labour share growth. In the non-OECD countries, the relative price of investment goods and financial openness appear to be the factors driving labour share. As the growth of the relative price of investment goods decline by 10 percent, the labour share growth also falls by about 2 percent. Similarly, an increase in financial openness by 10 percent leads to a 0.4 percent decline in the labour share growth.

Figure 2: The volatility trends of the four largest economies



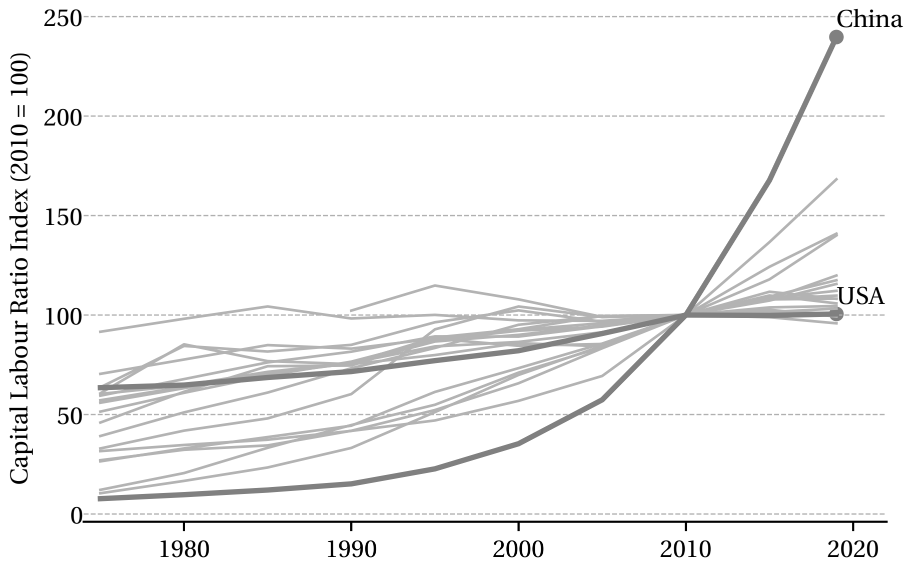
Note: The figure shows the volatility trend of the world's four largest economies with available data since the 1980s. The volatility is measured by the standard deviation of the quarterly five-year moving average of GDP growth. China's quarterly GDP is not available, we therefore use India's data instead. Data were sourced from the Penn World Table version 9.0.

Foreshadowing the main results, we find that as labour and capital become more substitutable, the relative price of investment goods declines. Firms are incentivised to become

[2] A brief explanation of robust regressions can be found in Appendix A.

more capital intensive because of technological improvements in the production of investment goods, the availability of investment funds, low risk to capital investments, and increasingly global competition (see Figure 3). To stay globally competitive, firms must suppress production costs, particularly wages, leading to falling labour share in high-income as well as low- and middle-income countries (LMICs). This co-occurrence repudiates the prediction by conventional theories of trade based on international differences in factor endowment that labour share should fall in a capital-abundant country but rise in a labour-abundant country.

Figure 3: The trends of capital labour ratio of the twenty largest economies



Note: The capital labour ratio is measured by capital stock at constant 2017 national prices divided by a number of employed persons. Data were sourced from the Penn World Table version 9.0.

The remainder of the paper is organised as follows. Section 2 reviews relevant literature. Section 3 describes the estimation of elasticity of substitution between capital and labour by using the model of the labour share by Karabarbounis and Neiman (2014). Section 4 extends the model of the labour share by including other identified factors of labour share. Section 5 outlines estimation methods, describes data, and presents results. Section 6 concludes.

2 Related Literature

This paper relates to two strands of literature. One estimates the elasticity of substitution between capital and labour, denoted σ, whose value plays a crucial role in pointing the direction of the relationship between a factor's relative price and its income share. The empirical evidence gathered so far are inconclusive because the estimates of σ appear to systematically depend on the functional form of econometric models chosen and are extremely sensitive to variations in measurement and data construction (Berndt, 1976). While some researchers such as Berndt (1976) support unit elasticity, others such as Klump et al. (2008) against it. Chirinko (2008) surveys the literature on capital-labour elasticity and concludes that the value of σ is in the range of 0.40-0.60. More recently, Karabarbounis and Neiman (2014) and Koh et al. (2020) find capital-labour elasticity to be greater than one, but Carbonero et all. (2022) find it to be less than unity when aggregate capital is employed.

The second strand of literature looks at possible explanations behind the downward trend of labour share. Blanchard et al. (1997) attribute the upward trends of capital shares in most European countries to changes in labour market institutions, such as more generous treatment of unemployment, increases in employment protection, and minimum wage legislation. Over time, these labour market conditions have induced firms to move away from labour, increasing unemployment and capital accumulation, leading to a lower income share to labour in European economies.

However, one of the changes in market condition, namely de-unionisation, is not empirically supported by Elsby et al. (2013), who elaborated on the decline of the US labour share at the country and industry levels. Instead, they provide evidence that features the global integration – the offshoring of the labour-intensive component of the US supply chain – as a leading potential factor of the decline in the US labour share over the last three decades. They argue that by offshoring the more labour-intensive part of US production, the rest of production in the US economy is more likely to become capital intensive. As capital is more than unit-elastic with respect to labour, as shown by Karabarbounis and Neiman (2014) and Koh et al. (2020), the US labour share will fall when the relative price of investment goods declines.

3 The Estimation of Elasticity of Substitution

To empirically investigate labour share factors, we use Karabarbounis and Neiman's (2014) model of labour share,[3] as in Equation (1).

$$\left(\frac{S_{L,j}}{1-S_{L,j}}\right)\hat{S}_{L,j} = \gamma + (\sigma - 1)\,\hat{\xi}_j + e_j, \tag{1}$$

where j denotes observations, S_L stands for labour income share, ξ refers to relative price of investment, e is error term, γ is a constant, σ represents elasticity of substitution between capital and labour, and $\hat{x} = \frac{\Delta x}{x} \approx \Delta lnx$ denotes proportional change of some variable x from t_1 to t_2. The variable, S_L, is measured as the share of labour compensation in GDP at current national prices.[4] The relative price of investment, (ξ), is a ratio of the investment deflator to the consumer price index. The proportionate change of a variable (denoted as "hat"variable) is measured by the linear trend in the log of the variable and its level is approximated by its average value.

Initially, to see whether we can replicate Karabarbounis and Neiman (2014)'s results and to ensure data reliability, we follow their steps in selecting the sample and recreate their dataset. We select 53 countries based on data availability from 1975 to 2014 in the Penn World Table 9.0. Our selection is in the range of Karabarbounis and Neiman (2014)'s sample, reducing the sample of countries with available data from 58 to 47 nations.

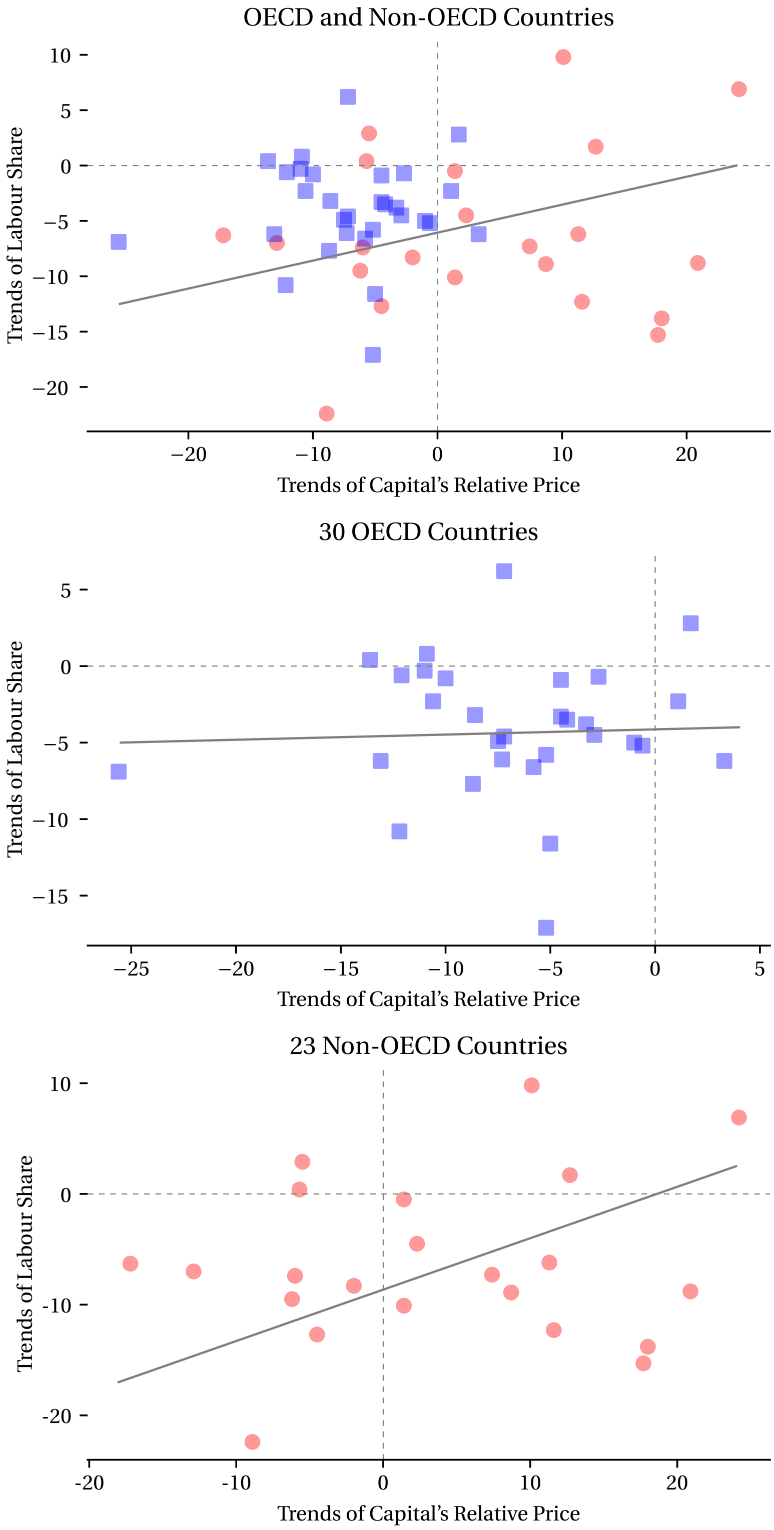
Panel 1 of Figure 4 presents a scatter plot between the trends of the relative price of investment goods and labour share. The fitted line of their relationships is upward, implying the elasticity of substitution, σ, is greater than one. Using Karabarbounis and Neiman (2014)'s "robust regression" method, we obtain an estimate of 1.18 for σ, statistically significant at 10 percent level. Our estimate[5] is not statistically different from the point estimate of 1.25 obtained by Karabarbounis and Neiman (2014), implying the data we use at national levels yields similar results to those of Karabarbounis and Neiman (2014) using data at firm levels.

[3] Appendix B shows how the model was derived based on Dynamic Stochastic General Equilibrium.

[4] The labour share measures the fraction of national income accruing to labour. It is calculated as the ratio of total compensation of employees — wages and salaries before taxes, plus employers' social contributions – over a national product or income aggregate. This measure excludes the income from self employment.

[5] The 95% confidence interval is between 0.98 and 1.39.

Figure 4: Trends of labour share and capital's relative price for 53 countries



Note: The figure plots the trend in the log labour share against the trend in the log relative price of capital for two groups of countries. All values are scaled to represent percent changes per 10 years. For example, a value of 10 for the trend in the log relative price of capital means a 10% increase in capital's relative price every 10 years. We drop one outlying observation (Azerbaijan) from the non-OECD sample because of its extremely low value. The solid line is the fitted line. The fitted line for all countries has the R-squared of 7.5%, for OECD countries the R-squared of 0.1% and for non-OECD countries the R-squared of 26%. Data were sourced from the Penn World Table version 9.0.

Interestingly, when we separate the sample into two groups[6] – 30 OECD countries and 23 non-OECD countries – we observe that non-OECD countries appear to drive our estimation results which can be seen in panels 2 and 3 of Figure 4. This begs the question, do disaggregated results from OECD nations differ from the non-OECD nations?

4 Econometric Model Specifications

To empirically investigate other factors identified in the existing literature, we modify the baseline model of labour share in Equation (1) by including other omitted factors, buried in the error term, e_j. Dao (2017) categorise determinants of labour share into three groups: technology, trade/globalisation and labour market institutions.[7] In addition, we introduce the role of volatility (i.e. risk) in reducing labour share. However, we put labour market conditions (namely, bargaining power as measured by unionisation) into the error term for two reasons that were first recognised by Blanchard et al. (1997). The first reason is data availability, and the second is that the effect of unionisation on labour share is statistically insignificant (Elsby et al., 2013). Since we do not know a true functional form of the relationships between those factors and labour share, we assume that they relate to labour share in the same way as the rental price of capital does.

Like Karabarbounis and Neiman (2014), we fundamentally treat the relative price of investment goods as a given variable[8] and obtain the following econometric model:

$$\hat{S_{L,j}} = \gamma_0 + \gamma_1 \hat{\xi}_j + \gamma_2 \hat{Z}_j + \gamma_3 v_j + \varepsilon_j, \quad (2)$$

where γ_o is a constant, ε is an error term, v is volatility of real GDP, and Z is a vector of other explanatory variables: export, import, and financial openness. In Equation (2), we cannot estimate the value of σ as in Equation (1), but we can point out whether it is greater than or equal to unity based on the sign and significance of the coefficient of the relative price of

[6]The OECD classification in this study is from the time of data selection in early 2018.

[7]Carbonero et all. (2022) find that technological progress and labour market friction play an important role in the fall of the labour income share.

[8]We also consider the possibility that this relative price may be influenced by other factors. See appendix D for details.

investment goods.

Volatility is an indicator used to capture risk, affecting firms' investment and hiring behaviour and reflects the return rate of investment. Kang et al. (2016) show that high volatility makes firms temporarily reduce employment and investment. For instance, the 2007-2009 financial recession was exacerbated in most parts of the world by heightened economic volatility (Ozturk and Sheng, 2018). In a period of low volatility, firms tend to invest and hire more, but it also reflects a low return rate of investment, implying that capital's rental price is low. Since labour and capital are highly substitutable, as shown by Karabarbounis and Neiman (2014), firms use capital more proportionally than labour. As a result, the labour share of income falls. We measure this volatility using the standard deviation of the real GDP growth rate.

Current research, using firm-level data, shows that export firms are likely to be more productive, larger, and have a higher capital-labour ratio than non-export companies (Forslid and Okubo, 2016). More exports imply that a higher share of income goes to capital. In contrast, more imports lead to shrinking outputs, reflecting an increasing labour share. We measure the variables – export and import – as ratios of nominal export and import to nominal GDP.

Financial openness measures a country's degree of capital account openness (Chinn and Ito, 2006). The current theory proposes that capital account liberalisation can enhance the development of the financial system through three channels. First, financial openness helps reduce financial control in protected financial markets, thus driving an interest rate to its competitive market equilibrium (Shaw, 1973). Second, it allows foreign and domestic investors to pursue more portfolio diversification. Third, the liberalisation process improves the efficiency level of the financial system by removing inefficient financial institutions and building up pressure to reform the financial infrastructure. This improvement helps alleviate information asymmetry, therefore reducing moral hazard and adverse selection. These points indicate that financial openness raises the availability of funds and reduces the cost of capital for investors. Consequently, the labour share declines as firms use more capital because of its lower cost. We measure financial openness by Chinn-Ito Index constructed by (Chinn and Ito, 2006).

Dao (2017) emphasises that technological advancement, particularly the rapid advancement of information and communication, accelerates the automation of routine tasks. Thus, labour performing such tasks tends to be replaced by capital, leading to a lower income share going to labour. Autor et al. (2020) show that technological progress leads to the rise of “superstar firms" that tend to reap disproportionate rewards (e.g. high profits), implying a declining labour share. The relative price of investment goods reflects this technological advancement.

5 Estimation Methods, Data and Results

5.1 Estimation methods and data

For robustness, we use two estimation methods to operationalise Equations (1) and (2). First, following Karabarbounis and Neiman (2014), we employ the robust regression[9] to deal with long-run growth rates (at least 15 years) of variables ($\hat{V}$), which result in the cross-country dataset. Because our cross-section sample sizes are small, estimated results can be sensitive to one or a few outlying observations. The robust regression method can help mitigate this sensitivity by giving less weight to those observations that lie further from the regression line. This method starts by dropping observations with a Cook's distance greater than one. Then an iterative process calculates weights based on absolute residuals. The process stops when the maximum change between the weights from one iteration to the next is below some tolerant level (Karabarbounis and Neiman, 2014).

Second, we apply the fixed effect estimation procedure[10] to deal with the short-run growth rates of variables ($\hat{V}$) by slicing a whole period into non-overlapping consecutive five-year periods. For example, for the entire period, 1995-2014, we obtain four subdivided periods: 1995-1999, 2000-2004, 2005-2009, and 2010-2014. This method allows us to increase the number of observations in our samples and helps capture time-invariant heterogeneity in each nation while controlling for any shocks that are common to all nations in a given year.

[9] This method helps reduce the sensitive effects caused by a few outlier data, but we lose some information as a result.

[10] One major limitation of this method compared to the robust regression is serial correlation.

We estimate these econometric models using data from 30 OECD countries and 23 non-OECD countries over the period 1975 to 2014. Financial openness index data is sourced from Chinn and Ito (2006)'s dataset. Data for the remaining variables are obtained from the Penn World Table version 9.0, and are restricted to countries with at least 15 years of available data (Table E in Appendix E for details). Table 1 presents descriptive statistics for all variables used in our empirical analysis.

Table 1: Descriptive statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
Labour Share	1370	0.57	0.09	0.21	0.80
Investment Deflator	1370	0.71	0.29	0.00	1.78
Consumer Price Index	1370	0.68	0.28	0.00	1.58
Export (% of GDP)	1370	0.45	0.36	0.07	2.30
Import (% of GDP)	1370	0.45	0.33	0.07	2.24
Growth rate of GDP	1317	3.33	4.38	-54.05	29.61
Chinn-Ito index	1329	0.71	0.34	0.00	1.00

Note: Table 1 reports key statistics of variables used in the empirical analysis. Investment deflator is a ratio of nominal investment to real investment. Chinn-Ito index is normalised between zero and one. Zero indicates a country with the least financial openness. One is the most financial openness. Since most non-OECD countries do not have quarterly data on GDP, we use annual data to estimate volatility. Chinn-Ito index was obtained from Chinn and Ito (2006)'s dataset. The data of all remaining variables were sourced from the Penn World Table version 9.0.

5.2 Results

Table 2 shows the results[11] based on Equations (1) and (2). Using the robust regression, we find the elasticity of substitution between capital and labour are significantly greater than one: $\sigma = 1.36$ for non-OECD countries and $\sigma = 1.18$ for pooled countries.[12] This high elasticity indicates that the labour share and capital's relative price are positively associated. However, capital's relative price does not appear to have any significant association on labour share when we include other determinants. This finding lends support to the aggregate analysis by Elsby et al. (2013), which concluded that firms shift to be capital-intensive to exploit declining equipment prices, has not been a critical factor behind the evolution of the payroll share over the past 25 years in the US.

[11]This paper – like other studies that use macroeconomic data – is susceptible to measurement issues of variables, such as labour share, as mentioned in Autor et al. (2020).

[12]Note that for OECD, σ is not statistically different from unity. This is in line with the finding by Carbonero et al. (2022) who use aggregate capital in 8 European countries and the US.

Table 2: Results for long-run growth rates using the robust regression method

OECD Countries				
Regressors	(1)	(2)	(3)	(4)
Relative Price of Investment Goods	0.06	0.02	0.16	0.16
	(-0.19)	(-0.12)	(-0.14)	(-0.14)
Export		-0.31**	-0.41***	-0.46***
		(-0.14)	(-0.14)	(-0.16)
Import		0.35**	0.43***	0.45**
		(-0.15)	(-0.15)	(-0.17)
Volatility			0.1	0.1
			(-0.07)	(-0.07)
Financial Openness				0.03
				(-0.02)
Observations	30	30	30	29
R-squared	0	0.18	0.28	0.31
Non-OECD Countries				
Regressors	(5)	(6)	(7)	(8)
Relative Price of Investment Goods	0.36**	0.11	0.15	0.21
	(-0.16)	(-0.17)	(-0.18)	(-0.19)
Export		-0.04	-0.08	-0.26*
		(-0.15)	(-0.16)	(-0.13)
Import		0.18	0.19	0.41***
		(-0.16)	(-0.17)	(-0.12)
Volatility			-0.04	-0.07
			(-0.07)	(-0.07)
Financial Openness				0.04
				(-0.05)
Observations	23	22	22	21
R-squared	0.2	0.1	0.12	0.69
Pooled Data				
Regressors	(9)	(10)	(11)	(12)
Relative Price of Investment Goods	0.18*	0.04	-0.03	-0.06
	(-0.1)	(-0.08)	(-0.09)	(-0.08)
Export		-0.26***	-0.14	-0.26***
		(-0.08)	(-0.09)	(-0.09)
Import		0.28***	0.16	0.29***
		(-0.09)	(-0.1)	(-0.09)
Volatility			-0.05	-0.06*
			(-0.04)	(-0.03)
Financial Openness				0.05**
				(-0.02)
Observations	53	52	52	49
R-squared	0.06	0.19	0.09	0.26

Note: *,**,*** denote significance at the 10%, 5%, and 1% levels, respectively. Standard errors are in the parentheses. Robust regression is used to give less weight to outlying observations, which can significantly affect regression results when a sample is relatively small. Long-run refers to at least 15 years.

The variables, export and import, have the correct signs in most of our model specifications for all three sample specifications: OECD, non-OECD and the pooled data. Export and import appear to be positively related to labour share throughout all samples and models. As an average, their magnitudes of coefficients are twice as much for OECD countries than non-OECD countries. This result implies that workers in advanced countries, particularly those employed by labour-intensive firms, have borne the brunt of the declining labour share more than their counterparts in LMICs because of global integration.

The coefficients of the other two variables – volatility and financial openness – are contrary to what we expected but are statistically insignificant for most cases. These counter-intuitive results are likely to be a result of either the small sample sizes (23 for non-OECD study and 30 for OECD) or the estimation method used. The robust regression cannot capture other unobserved effects such as time and country fixed effects.

To overcome these potential issues, we adopt the fixed effect estimation. As shown in Table 3, all regressors, except for imports, have the expected signs. While capital's relative price still has no significant relationship with labour share in the OECD model, its association become statistically significant for more than half of model specification in the non-OECD model and the pooled model.

Although export's relationship with the labour share is still strong and significant in the model for OECD countries, this is not the case in the non-OECD or pooled countries model. Most of the time, import's effects on labour share are statistically insignificant. We find that risk has a significant association with the labour share in OECD countries but not in non-OECD and pooled countries. On the other hand, financial liberalisation is significantly related to the labour share in non-OECD and pooled countries, but not in OECD countries. We also find a significant estimate for the elasticity of substitution between capital and labour for the pooled sample and OECD sample of 1.14 and 1.34, respectively. However, this estimate was not significant for the non-OECD sample.

Table 3: Results for short-run growth rates using the fixed effect method

OECD Countries				
Regressors	(13)	(14)	(15)	(16)
Relative Price of Investment Goods	0.34**	0.1	0	0
	(-0.14)	(-0.08)	(-0.09)	(-0.09)
Export		-0.10**	-0.10**	-0.11**
		(-0.05)	(-0.05)	(-0.05)
Import		-0.08	-0.09	-0.08
		(-0.05)	(-0.06)	(-0.06)
Volatility			0.25**	0.23*
			(-0.12)	(-0.13)
Financial Openness				0.01
				(-0.02)
Observations	138	138	113	110
R-squared	0.24	0.34	0.44	0.45
Numberof Countries	30	30	30	29
Non-OECD Countries				
Regressors	(17)	(18)	(19)	(20)
Relative Price of Investment Goods	0.06	0.14*	0.20*	0.18
	(-0.09)	(-0.08)	(-0.11)	(-0.11)
Export		-0.01	0	-0.03
		(-0.05)	(-0.05)	(-0.05)
Import		-0.01	-0.04	0
		(-0.05)	(-0.06)	(-0.06)
Volatility			0.05	0.02
			(-0.08)	(-0.08)
Financial Openness				-0.04**
				(-0.02)
Observations	94	94	78	72
R-squared	0.1	0.16	0.17	0.29
Number of Countries	23	23	23	21
Pooled Data				
Regressors	(21)	(22)	(23)	(24)
Relative Price of Investment Goods	0.14*	0.18***	0.21***	0.18***
	(-0.07)	(-0.05)	(-0.07)	(-0.07)
Export		-0.02	-0.01	-0.02
		(-0.03)	(-0.03)	(-0.03)
Import		-0.06	-0.08**	-0.06
		(-0.04)	(-0.04)	(-0.04)
Volatility			0.07	0.07
			(-0.06)	(-0.06)
Financial Openness				-0.03**
				(-0.01)
Observations	232	232	191	182
R-squared	0.06	0.11	0.16	0.19
Number of Countries	53	53	53	50

Note: *,**,*** denote significance at the 10%, 5%, and 1% levels, respectively. Standard errors are in the parentheses. Fixed effect estimation includes both time and country fixed effects. Short-run is a five years period.

The robust regression and fixed effects methods produce somewhat different results. However, looking at the combined effects of capital's relative price, exports, volatility, and financial openness altogether, we can conclude that the drivers behind the evolution of the labour share in OECD and non-OECD countries are different.

For OECD countries, export and risk appear to be major factors associated with the labour share since the 1980s. This suggests that large, export-orienting firms, and their decisions to invest in a globally competitive world, play a significant role in determining the income share going to workers. These large firms tend to have more bargaining power to drive wages and benefits down by offshoring some of their labour-intensive components or by relocating their productions to labour-abundant countries.

In contrast, for non-OECD countries, the key drivers of the labour share appear to be financial openness and capital's relative price. Firms operating in a country with a more liberalised financial system have greater access to affordable funding that they can use for capital investment. This access can make firms more capital-intensive by exploiting the falling prices of investment goods and new technologies that these investment goods provide. Given the high elasticity of substitution between capital and labour, the labour share of income falls.

Looking at the results of the pooled data, we can understand why the income share going to labour has declined for the last three decades in both OECD and non-OECD countries alike. There are several factors driving firms to become more capital-intensive. First, as labour and capital become more highly substitutable, the price of investment goods falls (because of technological improvement in the intermediate sector). Firms are further enticed to become more capital-intensive by the availability of affordable investment funds, low risk, and increasingly global competition. For firms to stay globally competitive, they need to suppress production costs, and reducing costs through wages is a commonly used solution.

6 Conclusion

In this paper, we use Karabarbounis and Neiman (2014)'s model of labour share as the framework to empirically investigate the factors behind declining labour share in both OECD and non-OECD countries since the 1980s. We find that while factors of production (capital and labour) are highly substitutable in OECD and non-OECD countries, the drivers of falling labour share differ in each group. In high-income countries, exports and economic risk – measured by the volatility of real GDP – are the key factors driving the reduction of labour share. However, in LMICs, the major factors are financial liberalisation and the relative price of investment goods. All in all, we conclude that advanced technology – reflected by the declining relative price of investment goods – combined with globalisation and low economic risk is a key factor in understanding the decline of labour share worldwide. The declining labour share occurs because large firms tend to be more capital-intensive by exploiting the low costs of investment funds and the low price of investment goods. Large firms also tend to have more bargaining power over labour by offshoring some of their labour-intensive products or moving their productions overseas, mainly to labour-abundant countries.

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Appendix A

We briefly introduce the robust regression methods.[13] For linear regression, the ordinary least squares (OLS) estimates are not optional when some of the regression assumptions are invalid. Robust regression approaches[14] give an alternative to OLS by having less restrictive assumptions. These approaches seek to identify outliers and minimise their influence on the coefficient estimates.

Outliers tend to pull the fitted line too far in their direction by getting more weight. We would normally expect that each observation's weight would be $1/n$ in a dataset of size n. However, outliers may be so weighted that they distort the coefficient estimates.

For the first approach, suppose that we have a data set with n observations such that

$$y_i = \beta x_i + \epsilon_i$$
$$\Rightarrow \epsilon_i(\beta) = y_i - \beta x_i,$$

where $i = 1, \ldots, n$ and the error term $\epsilon_i(\beta)$ depends on the regression coefficient. OLS is known as L_2**-norm regression** because it minimizes the L_2-norm of the residuals. L_1**-norm regression (known as least absolute deviation)** –an alternative to OLS – minimises the L_1-norm of the residuals. That is, the least absolute deviation estimator is

$$\hat{\beta}_{LAD} = arg\ min_\beta \sum_{i=1}^{n} |\epsilon_i(\beta)|.$$

Another widely used robust regression approach is a class of estimators known as **M-estimators**, which attempt to minimise the sum of a selected function $\rho\left(\epsilon_i(\beta)\right)$. That is, M-estimators are given by

$$\hat{\beta}_M = arg\ min_\beta \sum_{i=1}^{n} p\left(\epsilon_i(\beta)\right).$$

The subscript M stands for "maximum likelihood" because $\rho\left(\epsilon_i(\beta)\right)$ is related to the likelihood function for a suitable assumed residual distribution. If assuming normality, $\rho(x) = x^2/2$ leads to the ordinary least squares estimate.

[13] For a more thorough discussion see Andersen (2007).
[14] For details on applying the robust regression method in Stata see Verardi and Croux (2009).

Appendix B: A Model of Labour Share

The model of labour share mainly relates the income shares of factors to their relevant prices. However, the direction of their relationships depends on the value of the elasticity of substitution. In this model, the economy consists of two sectors. In the first sector, final consumption and investment goods are produced by assembling intermediate inputs using a constant elasticity of substitution (CES) production technology. In the second sector, those intermediate inputs are, in turn, produced by a combination of physical, capital, and labour with the same CES technology and Hicks-neutral technological progress.

Time is a discrete, infinite horizon, $t = 0, 1, 2, \ldots$. All payments in this economy are made in terms of the final consumption goods price - denoted p_t^c - which is the numeraire.

Final consumption good

Competitive producers use a CES aggregate of a continuum of intermediate inputs, $i \in [0, 1]$, to produce the final consumption good C_t as follows:

$$C_t = \left(\int_0^1 c_t(i)^{\frac{\epsilon-1}{\epsilon}} di \right)^{\frac{\epsilon}{\epsilon-1}}, \tag{B.1}$$

where ϵ is the elasticity of substitution between input varieties, elasticity is assumed to be constant over time and exceeds one because intermediate inputs are numerous and thus easily substitutable. The input quantity for each individual, i, is $c_t(i)$. Producers purchase inputs from monopolistically competitive firms that charge prices $p_t(i)$ equal to the markups μ over marginal cost. The markups – depending on the parameter ϵ – are also constant over time.

The profit maximisation implies that the demand for input variety i for use in producing the final consumption good is $c_t(i) = \left(\frac{p_t(i)}{p_t^c}\right)^{-\epsilon} C_t$. This consumption good is assumed to be the numeraire and has a price equal to one. Because the final goods market is competitive, the consumption good has the price equal to the marginal cost of production. That is,

$$P_t^c = \left(\int_o^1 p_t(i)^{1-\epsilon} di \right)^{\frac{1}{1-\epsilon}} = 1.$$

Final investment good

Similar to modelling the final consumption goods, competitive producers of the final investment good, X_t, employ the same production technology and continuum of inputs i to produce X_t as follows:

$$X_t = \left(\frac{1}{\xi_t}\right)\left(\int_0^1 x_t(i)^{\frac{\epsilon-1}{\epsilon}} di\right)^{\frac{\epsilon}{\epsilon-1}}, \tag{B.2}$$

where the exogenous variable ξ_t is the relative level of technology used to produce the final consumption good at time t, when the technology used to produce the investment good advances more than the technology used to produce the consumption good, the relative level of technology ξ_t falls.

To maximise their profits, the final investment good producers choose the level of the demand for input variety $x_t(i) = \xi_t^{1-\epsilon}\left(\frac{p_t(i)}{p_t^X}\right)^{-\epsilon} X_t$ for use in the production of the final investment good X_t whose price equals the marginal cost of production:

$$P_t^X = \xi_t\left(\int_0^1 p_t(i)^{1-\epsilon} di\right)^{\frac{1}{1-\epsilon}} = \xi_t. \tag{B.3}$$

Equation (B.3) implies that the relative price of the investment goods – denoted $\frac{P_t^X}{P_t^c}$ – is equal to the relative level of technology ξ_t. This equality shows that the relative price of the investment goods declines when the production technology in investment goods improves relative to that in consumption goods production and vice versa.

Producers of intermediate inputs

To supply outputs – denoted $y_t(i) = c_t(i) + x_t(i)$ – to the above two types of final producers, a producer of the immediate input variety i rents capital (k) and labour (l) from households at a given rate R_t and a given wage W_t respectively and assembles them using a constant return to scale technology: $y_t(i) = F(k_t(i), l_t(i))$. This producer of intermediate inputs takes input prices and the aggregate demand, $Y_t = C_t + \xi_t X_t$, as given and faces the following profit-maximisation problem:

$$\max_{p_t(i), y_t(i), k_t(i), l_t(i)} \Pi(i) = p_t(i) y_t(i) - R_t k_t(i) - W_t l_t(i), \tag{B.4}$$

subject to the constrained output: $y_t(i) = c_t(i) + x_t(i) = p_t(i)^{-\epsilon} Y_t$. The first-order conditions with respect to capital and labour are given respectively by

$$p_t(i) F_{k,t}(i) = \mu R_t,$$
$$p_t(i) F_{l,t}(i) = \mu W_t.$$

Unlike the competitive producers of final goods, this monopolistically competitive producer has a certain degree of market power to set the marginal revenue product of factors as a markup $\mu = \frac{\epsilon}{\epsilon - 1}$ over factor prices.

Household

The household derives its utility from consuming goods, C_t, and its dis-utility by supplying labour, l_t. A representative household buys final goods, (C_t and X_t), from final goods producers. Each of them uses the investment goods to build up the existing capital stock, and supplies it and labour to the intermediate input producers at the rate, R_t, and the wage, W_t, respectively. The household also owns all firms in the economy and receives firm profits as dividends in every period. In addition, each of them holds some assets, B_t, that yield a real interest rate, r_t, and is in zero net supply. At some period t_0, the household solves:

$$\max_{\{C_t, l_t(i), X_t, K_{t+1}, B_{t+1}\}_{t=t_o}^{\infty}} E_{t_o} \left(\sum_{t=t_0}^{\infty} \beta^{(t-t_o)} U(C_t, L_t; \chi_t) \right), \tag{B.5}$$

subject to initial capital, K_0, and assets, B_0, the law of motion for the capital stock, $K_{t+1} = (1-\delta) K_t + X_t$, and its budget constraint as follows:

$$C_t + \xi_t X_t + B_{t+1} = \int_0^1 \left[W_t l_t(i) + R_t k_t(i) + \Pi_t(i) \right] di + (1 + r_t) B_t,$$

where β is a discount factor, χ_t is a household preference shifter, δ is depreciation rate, and the aggregate capital stock and labour supplied are as below:

$$K_t = \int_0^1 k_t(i) di,$$
$$L_t = \int_0^1 l_t(i) di.$$

The condition leading to the household optimisation is when the household invests in physical capital up to the point where the marginal benefit of investing in capital (rental rate) equals the marginal cost of investing in capital (rental cost): $R_{t+1} = \xi_t (1 + r_{t+1}) - \xi_{t+1} (1 - \delta)$, where $1+r_{t+1}=\frac{U_C(C_t,L_t)}{\beta E_t(U_C(C_{t+1},L_{t+1}))}$ is the gross real interest rate. By denoting a variable with an asterisk to signal that it is in the steady state, we obtain:

$$R^* = \xi^*(\frac{1}{\beta}+\delta-1) = \xi^*(r^*+\delta). \tag{B.6}$$

Equilibrium

The general equilibrium in this hypothetical economy occurs when, given a path of exogenous variables, (a) all markets for labour, capital, assets, final goods, and intermediate inputs are clear in every period; (b) final goods producers and intermediate input producers maximise their profits, and (c) the household maximises its expected utility. This equilibrium is symmetric, such that, $p_t(i) = P_t^c = 1,\ k_t(i) = K_t,\ l_t(i) = L_t,\ c_t(i) = C_t,\ x_t(i) = \xi_t X_t$, and $y_t(i) = Y_t = F(K_t, L_t)$.

The production function

The intermediate input producers use the CES production technology – introduced by Arrow et al. (1961) – to produce the inputs by nesting capital and labour with the Hicks-neutral technological progress as follows:

$$Y_t = F(K_t, L_t) = A_t\left[\alpha(K_t)^{\frac{\sigma-1}{\sigma}} + (1-\alpha)(L_t)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}. \tag{B.7}$$

In this specification, the parameter α governs the income share of capital, A_t refers to Hicks-neutral technology, and σ is the elasticity of substitution between capital and labour.[15] From Equation (B.7), the marginal products of capital and labour are given respectively by:

$$F_{K,t} = \alpha(A_t)^{\frac{\sigma-1}{\sigma}}\left(\frac{Y_t}{K_t}\right)^{\frac{1}{\sigma}} = \mu R_t,$$
$$F_{L,t} = (1-\alpha)(A_t)^{\frac{\sigma-1}{\sigma}}\left(\frac{Y_t}{L_t}\right)^{\frac{1}{\sigma}} = \mu W_t,$$

The labour Share

The total income is composed of three parts: (1) wages for labour services, (2) rentals for capital services, and (3) profits as dividends. Thus, the income share of labour, capital, and

[15]As σ approaches 1, Equation (B.7) becomes the Cobb-Douglas production function: $F(K_t, L_t) = A_t K_t^{\alpha} L_t^{1-\alpha}$.

profit are respectively given by:

$$S_{L,t} = \frac{W_t L_t}{Y_t} = \left(\frac{1}{\mu}\right)\left(\frac{W_t L_t}{W_t L_t + R_t K_t}\right),$$
$$S_{K,t} = \frac{R_t K_t}{Y_t} = \left(\frac{1}{\mu}\right)\left(\frac{R_t K_t}{W_t L_t + R_t K_t}\right),$$
$$S_{\Pi} = \frac{\Pi_t}{Y_t} = \frac{\mu - 1}{\mu},$$

where $S_{L,t} + S_{K,t} + S_{\Pi} = 1$. Given these income shares along with the marginal product of capital, we can derive the labour share as a function of the markups, capital's rental price for some values of the distribution parameter and the elasticity of substitution as:[16]

$$1 - S_{L,t}\mu = \alpha^{\sigma}\left(\mu R_t\right)^{1-\sigma}. \tag{B.8}$$

Equation (B.8) shows that if $\sigma = 1$, then the labour share, becomes $S_{L,t} = (1-\alpha)/\mu$, which is constant. If $\sigma > 1$, the labour share is positively related to capital's rental price, but this relationship becomes negative if $\sigma < 1$. This indicates that values of σ plays a vital role in determining the direction of the relationship between labour share and capital's rental price.[17] However, this parsimonious model, like others, is weakened by excluding some other determinants of the labour share.

The following section deals with estimating the parameter σ, followed by a discussion on some other factors we have identified as main drivers of the falling labour share.

Following Karabarbounis and Neiman (2014)'s strategy to control for cross-country heterogeneity in both economic parameters and measurement practices, we rewrite Equation (B.8) in proportionate changes between two arbitrary periods $t_2 > t_1$ as:

$$\left(\frac{1}{1 - S_L\mu}\right)\left[1 - S_L\left(1 + \hat{S_L}\right)\mu\right] = \left(1 + \hat{R}\right)^{1-\sigma}, \tag{B.9}$$

where $\hat{V} = \frac{\Delta V}{V} \approx \Delta lnV$ denotes the proportional change of some variable V from t_1 to t_2. We drop subscripts of variables corresponding to the initial period t_1 for convenience of notation. Taking a linear approximation of Equation (B.9) around $\hat{R} = 0$, setting[18] $\mu = 1$ and

[16]We can also derive the labour share through the marginal product of labour: $S_{L,t} = (\frac{1-\alpha}{\mu})^{\sigma} w^{1-\sigma}$. Equation (B.6) shows that in the steady state, the growth rate of R equals that of ξ given that constant discount factor β and constant depreciation rate δ over time but not necessarily across countries. Since internationally comparable data on growth in ξ are more readily available than wage growth, the labour share in Equation (B.8) is preferred to estimate the value of σ.

[17]Appendix C provides a general form of neoclassical production function.

[18]For the rest of this work, the markups are assumed to be unity for two main reasons. First, data of markups are not observable, particularly at macro levels. Second, when Karabarbounis and Neiman (2014) use the imputed data of markups, they still find the magnitude of coefficient of the regressor in Equation (B.10)

adding a constant (γ) and an idiosyncratic error term (e) yields the following basic econometric model:

$$\left(\frac{S_{L,j}}{1-S_{L,j}}\right)\hat{S_{L,j}} = \gamma + (\sigma - 1)\,\hat{R}_j + e_j, \tag{B.10}$$

where j denotes observations. We measure the proportionate change of all variables (denoted as – "hat" variables) as the linear trend in the log of the variable and substitute variables' average values for their respective levels. From Equation (B.6), the growth rate of capital's rental price, ($\hat{R}$), is equivalent to that of the relative price of investment goods, ($\hat{\xi}$), when discount factor, (β), and depreciation rate, (δ), are assumed to be fixed over time, but vary across countries.

does not differ much:
- The average of coefficients of the regressor is 1.28 when the markups are unity.
- The average is 1.26 when the markups are not unity and not constant.

Appendix C

Given the neoclassical production function : $Y = F(K, L)$ where K is capital and L is labour, we can derive the capital's income share – denoted S_K – as:

$$S_K = \frac{KF_K}{F},$$

where the subscript of the function denotes as the derivative. Differentiating this equation with respect to capital yields

$$\frac{\partial S_K}{\partial K} = \frac{KF_{KK}}{F} + \frac{F_K (F - KF_K)}{F^2} \tag{C.1}$$

Because production function F is homogenous of degree 1 in (K, L), we get $LF_L = F - KF_K$. Substituting this into Equation (C.1) and using the definition of elasticity of substitution by Hicks (1932) – $\sigma = (F_K F_L)/(FF_K L)$ – we obtain:

$$\frac{\partial S_K}{\partial K} = \frac{KF_{KK}}{F} + \frac{\sigma LF_{KL}}{F} \tag{C.2}$$

Taking the partial derivative of the expression $LF_L = F - KF_K$ with respect to capital and using Young's theorem $(F_K L = F_L K)$ yields $LF_{KL} = -KF_{KK}$. Replacing this equality in Equation(C.2) yields:

$$\frac{\partial S_K}{\partial K} = (1-\sigma)\frac{KF_{KK}}{F} \tag{C.3}$$

Because of the diminishing return of capital, $F_{KK} \leq 0$, the sign of Equation (C.3) depends on whether σ is greater than 1. This implies that all other things remain the same, when $\sigma > 1$, the capital's income share rises as capital increases more proportionally than R declines. However, if $\sigma = 1$, the factor shares are constant.

Appendix D

We consider the possibilities that the price of investment goods appears to be influenced by the other factors in the model as well. That is,

$$\hat{\xi_j} = \lambda_o + \lambda_1 \hat{Z_j} + \lambda_2 v_j + u_j \tag{D.1}$$

Substituting Equation (D.1) into Equation (2) ($\hat{S_{L,j}} = \gamma_0 + \gamma_1 \hat{\xi_j} + \gamma_2 \hat{Z_j} + \gamma_3 v_j + \varepsilon_j$), we obtain the following reduced form equation:

$$\hat{S_{L,j}} = \pi_0 + \pi_1 u_j + \pi_2 \hat{Z_j} + \pi_3 v_j + \omega_j. \tag{D.2}$$

Equation (D.2) shows total effects of the other explanatory variables (Z & v) on the labour share and the impact of other omitted variables (u_j) influencing capital's relative price on the labour share.

When we estimate the system of two Equation (D.1) and (D.2), we perform two-stage residual inclusion estimation (2SRI). First, we regress Equation (D.1) to obtain the estimated residual ($\hat{u_j}$). Second, we replace the error term u_j by its estimated value in Equation (D.2) and then apply 5000-replication bootstrap.

Table D.1 presents the results based on the system of these two equations. Under the robust regression for the long run growth rates, capital's relative price is not significantly influenced by the other factors in all model specifications for the OECD countries, but it becomes significantly impacted by export and import only in the model specification (1.D.1.8) and (1.D.1.12) for the non-OECD countries and pooled countries respectively.

While export is a significant driver of labour share in all model specifications for the OECD sample, it is not for the other two samples. Import significantly impacts labour share only in one model specification (1.D.2.4) for the OECD sample, but not for the non-OECD and pooled samples. The residual – the other factors affect the capital's relative price – and volatility do not have significant impacts on labour share in all model specifications for all three samples. Financial openness has significant effects on labour share for just the pooled sample, but its effects are counter-intuitive.

Table D.1: Results for long-run growth rates using robust regression method

			OECD Countries			
Regressors	(1.D.1.2)	(1.D.2.2)	(1.D.1.3)	(1.D.2.3)	(1.D.1.4)	(1.D.2.4)
Residual (uhat)		0.02		0.16		0.16
		(-0.12)		(-0.14)		(-0.14)
Export	0.1	-0.31**	0.13	-0.39**	0.22	-0.43**
	(-0.21)	(-0.14)	(-0.21)	(-0.14)	(-0.22)	(-0.16)
Import	-0.17	0.35**	-0.19	0.40**	-0.29	0.41**
	(-0.22)	(-0.15)	(-0.23)	(-0.15)	(-0.24)	(-0.17)
Volatility			-0.12	0.08	-0.13	0.08
			(-0.1)	(-0.06)	(-0.1)	(-0.06)
Financial Openness					-0.03	0.03
					(-0.03)	(-0.02)
Observations	30	30	29	30	28	29
R-squared	0.03	0.18	0.1	0.28	0.16	0.31
			Non-OECD Countries			
Regressors	(1.D.1.6)	(1.D.2.6)	(1.D.1.7)	(1.D.2.7)	(1.D.1.8)	(1.D.2.8)
Residual (uhat)		0.11		0.15		0.21
		(-0.17)		(-0.18)		(-0.19)
Export	-0.14	-0.06	-0.05	-0.08	-0.39**	-0.34***
	(-0.22)	(-0.14)	(-0.23)	(-0.16)	(-0.17)	(-0.11)
Import	0	0.18	0.01	0.19	0.35**	0.49***
	(-0.24)	(-0.16)	(-0.24)	(-0.17)	(-0.16)	(-0.1)
Volatility			0.11	-0.02	0.04	-0.06
			(-0.1)	(-0.07)	(-0.1)	(-0.07)
Financial Openness					0.06	0.05
					(-0.08)	(-0.05)
Observations	22	22	22	22	21	21
R-squared	0.04	0.1	0.1	0.12	0.33	0.69
			Pooled Data			
Regressors	(1.D.1.10)	(1.D.2.10)	(1.D.1.11)	(1.D.2.11)	(1.D.1.12)	(1.D.2.12)
Residual (uhat)		0.04		-0.03		-0.06
		(-0.08)		(-0.09)		(-0.08)
Export	-0.16	-0.27***	0	-0.14	-0.31***	-0.24***
	(-0.15)	(-0.08)	(-0.15)	(-0.09)	(-0.1)	(-0.09)
Import	0.05	0.28***	-0.1	0.16	0.26***	0.27***
	(-0.16)	(-0.09)	(-0.16)	(-0.1)	(-0.1)	(-0.09)
Volatility			0.13**	-0.05	0.05	-0.06*
			(-0.06)	(-0.04)	(-0.06)	(-0.03)
Financial Openness					-0.02	0.05**
					(-0.04)	(-0.02)
Observations	52	52	52	52	50	49
R-squared	0.04	0.19	0.14	0.09	0.25	0.26

Note: *,**,*** denote significance at the 10%, 5%, and 1% levels, respectively. Standard errors are in the parentheses. Standard errors in the model specifications (16.) are obtained by 5000-replication bootstrap. Robust regression is used to give less weight to outlier observations, which can significantly affect regression results when a sample is relatively small. Long-run refers to at least 15 years.

Table D.2: Results for short-run growth rates using fixed effect method

			OECD Countries			
Regressors	(1.D.1.14)	(1.D.2.14)	(1.D.1.15)	(1.D.2.15)	(1.D.1.16)	(1.D.2.16)
Residual (uhat)		0.1		0		0
		(-0.08)		(-0.09)		(-0.09)
Export	-0.16**	-0.11**	-0.13**	-0.10**	-0.12**	-0.11**
	(-0.06)	(-0.05)	(-0.06)	(-0.04)	(-0.06)	(-0.05)
Import	0.04	-0.07	0.06	-0.09	0.06	-0.08
	(-0.07)	(-0.05)	(-0.07)	(-0.05)	(-0.07)	(-0.06)
Volatility			0.12	0.25**	0.16	0.23*
			(-0.16)	(-0.12)	(-0.16)	(-0.13)
Financial Openness					-0.02	0.01
					(-0.02)	(-0.02)
Observations	138	138	113	113	110	110
R-squared	0.16	0.34	0.21	0.44	0.22	0.45
Number of Countries	30	30	30	30	29	29
			Non-OECD Countries			
Regressors	(1.D.1.18)	(1.D.2.18)	(1.D.1.19)	(1.D.2.19)	(1.D.1.20)	(1.D.2.20)
Residual (uhat)		0.14*		0.20*		0.18
		(-0.08)		(-0.11)		(-0.11)
Export	-0.02	-0.01	-0.03	-0.01	-0.03	-0.04
	(-0.08)	(-0.05)	(-0.07)	(-0.05)	(-0.07)	(-0.05)
Import	0.28***	0.03	0.33***	0.03	0.32***	0.06
	(-0.08)	(-0.05)	(-0.07)	(-0.05)	(-0.07)	(-0.05)
Volatility			0.15	0.08	0.21*	0.06
			(-0.1)	(-0.08)	(-0.1)	(-0.08)
Financial Openness					-0.04	-0.05**
					(-0.03)	(-0.02)
Observations	94	94	78	78	72	72
R-squared	0.26	0.16	0.43	0.17	0.48	0.29
Number of Countries	23	23	23	23	21	21
			Pooled Data			
Regressors	(1.D.1.22)	(1.D.2.22)	(1.D.1.23)	(1.D.2.23)	(1.D.1.24)	(1.D.2.24)
Residual (uhat)		0.18***		0.21***		0.18***
		(-0.05)		(-0.07)		(-0.07)
Export	-0.07	-0.04	-0.07	-0.02	-0.07*	-0.03
	(-0.05)	(-0.03)	(-0.04)	(-0.03)	(-0.04)	(-0.03)
Import	0.23***	-0.02	0.27***	-0.02	0.28***	-0.01
	(-0.05)	(-0.03)	(-0.05)	(-0.03)	(-0.04)	(-0.03)
Volatility			0.14*	0.10*	0.20***	0.11*
			(-0.07)	(-0.05)	(-0.07)	(-0.06)
Financial Openness					-0.04**	-0.04***
					(-0.02)	(-0.01)
Observations	232	232	191	191	182	182
R-squared	0.16	0.11	0.29	0.16	0.34	0.19
Number of Countries	53	53	53	53	50	50

Notes: *,**,*** denote significance at the 10%, 5%, and 1% levels, respectively. Standard errors are in the parentheses. Standard errors in the model specifications (16.) are obtained by 5000-replication bootstrap. Fixed effect estimation includes both time and country fixed effects. Short-run is a 5-year span.

Table D.2 reports the results of the system based on the fixed effect estimation. Only export has significant impacts on both capital's relative price and labour share for the OECD sample. For the non-OECD sample, while only import and volatility significantly impact capital's relative price, no factors have significant impacts on labour share. For the pooled sample, while all factors – export, import, volatility, and financial openness – significantly affect capital's relative price, only residual has significant impacts on labour share in models (1.D.2.22) and (1.D.2.23) but not in (1.D.2.24). Overall, the results show that while some of the factors – export, import, volatility and financial openness – appear to have significant impacts on capital's relative price in some model specifications for all three samples, their overall effects on labour share are insignificant in most model specifications. Therefore, we conclude our findings based on the results from the economic model specification (1).

Appendix E

Table E: A list of countries with at least 15 years data for labour share

30 OECD Countries			23 Non-OECD Countries		
Country	Begin	End	Country	Begin	End
Australia	1975	2012	Armenia	1991	2011
Austria	1995	2013	Azerbaijan	1994	2012
Belgium	1985	2013	Bahrain	1995	2013
Canada	1975	2013	Belarus	1990	2012
Czech Republic	1992	2014	Bolivia	1975	2013
Denmark	1995	2014	Brazil	1992	2009
Estonia	1994	2013	China	1992	2012
Finland	1975	2014	Hong Kong	1980	2012
France	1975	2013	Macao	1996	2012
Germany	1991	2013	Colombia	1992	2012
Hungry	1995	2013	Costa Rica	1975	2012
Iceland	1975	2005	Kyrgyzstan	1990	2012
Italy	1980	2014	Lithuania	1995	2013
Japan	1980	2012	Namibia	1995	2013
Latvia	1994	2013	Niger	1995	2013
Luxembourg	1995	2012	Peru	1978	2010
Mexico	1993	2012	Philippines	1992	2012
Netherlands	1980	2014	Moldova	1995	2012
New Zealand	1982	2013	Singapore	1980	2010
Norway	1978	2013	South Africa	1985	2013
Poland	1995	2013	Taiwan	1995	2009
Portugal	1995	2014	Thailand	1975	2010
Republic of Korea	1975	2013	Tunisia	1992	2011
Slovakia	1993	2013			
Slovenia	1995	2013			
Spain	1995	2013			
Sweden	1994	2014			
Switzerland	1995	2012			
United Kingdom	1987	2013			
United States	1975	2014			