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Why is Labor Receiving a Smaller Share of Global Income? [1]

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Abstract

The labor share of income has been on a downward trend in both advanced and emerging economies. Declining labor shares in emerging economies presents an important puzzle as it contradicts the predictions of classical trade theory. This paper presents a stylized mechanism to reconcile these findings, at the center of which is routinization, i.e., the automation of labor in occupations highly exposed to substitution by computer capital. We assemble a novel dataset and introduce a new measure of the exposure to routinization to analyze the drivers of falling labor shares. While technological progress and exposure to routinization explain over half the overall decline in advanced economies, in emerging markets the globalization of trade and the accompanying capital deepening is the most significant driver, with technological progress and routinization playing a negligible role. This result rests on the key finding that in emerging markets the relative price of investment goods has only mildly declined and the exposure to routinization is very low.

JEL Classification Numbers: E25, F66, O33

Keywords: labor share, routinization, automation, global value chains, relative priceof investment goods, offshoring

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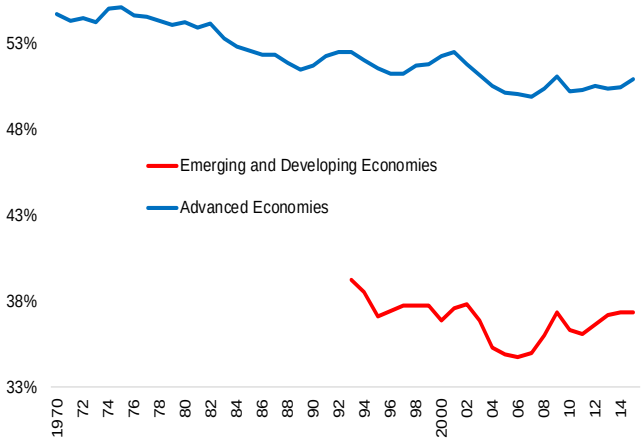
I. INTRODUCTION

The labor share of income has been on a downward trend in many countries (Figure 1). In advanced economies, labor shares began trending down in the 1980s, reaching their lowest level of the past half century just prior to the global financial crisis. Data are more limited for emerging economies, but in more than half of them labor shares have also declined since the early 1990s. Nevertheless, the extent of the decline has been diverse within the advanced and emerging economy groups.

Figure 1. Evolution of the Labor Share of Income
(Percent)



Sources: National authorities; Organisation for Economic Co-operation and Development; Karabarbounis and Neiman (2014); IMF, World Economic Outlook database; and IMF staff calculations
Note: This figure shows year fixed effects from regressions that also include country fixed effects to account for entry and exit during the sample. The regressions are weighted by nominal GDP in current U.S. dollars. Fixed effects are normalized to reflect the respective levels of the labor share in the year 2000.

The downward trends in labor shares of income can have potentially large and complex social implications. A falling labor share implies that product wages are growing more slowly than average labor productivity.[2] If labor productivity rises due to technological progress and is accompanied by rising labor incomes, a declining labor share may be viewed as a byproduct of a favorable development. However, in several economies, declining labor shares have resulted from the failure of product wage growth to keep up with weak productivity growth.[3] Furthermore, the decline in the labor share has been accompanied by rising income inequality for two reasons. The first is that within the workforce, lower-skilled workers have borne the brunt of the fall in labor share (Autor and Dorn 2013; Goos, Manning, and Salomons 2014). The second is that capital ownership is typically concentrated among the top of the income distribution (Wolff 2010) and hence an increase in the share of returns accruing to capital tends to raise income inequality.

The forces behind the apparently widespread decline in labor income shares and the diversity of country experiences are not yet well understood. Yet, the global nature of its evolution and its steadfast decline—through domestic business cycles and over a period of profound structural transformation in advanced and emerging economies alike—suggests that

[2] The labor share of income can be written as: $(wL)/(PY) = (w/P) / (Y/L)$, in which w is the money wage (including benefits) per worker, L is employment (hours worked), Y is real output, Y/L is therefore labor productivity, and P is the GDP deflator. Because w/P is the wage expressed in units of domestic output, it is also called the *(real) product wage*.

[3] See e.g. Ollivaud, Guillemette, and Turner 2016; IMF 2017a.

the primary forces behind this evolution are global, with varying impacts across countries, industries and skill groups of labor reflecting their different exposures to these common global trends (Figure 2).

Analysts focusing predominantly on the United States and other advanced economies have concentrated on two leading explanations for the downward trends in labor shares: the rapid advance of technology, and the globalization of trade and capital.[4] Empirical analysis has shown that in some advanced economies the automation of jobs, along with import competition, has led to persistent losses of jobs in middle-skilled occupations.[5] One way in which technological advancement has affected factor shares is through a steep decline in the relative price of investment goods, giving firms incentives to replace labor with capital (Karabarbounis and Neiman 2014). The mechanism is that technological progress leads to more efficient production of investment goods, lowering the price of capital and thus the user cost of capital. A decline in interest rates or capital depreciation rates can reinforce the impact of technology in lowering the user cost of capital.

The paper extends the literature in two dimensions on this front. First, it explores whether the rapid advance in information and communications technology (ICT), which lies behind much of the decline in the price of investment goods (see e.g. Krusell 1998), has lowered labor shares by encouraging the automation of routine tasks. To this end, we introduce measures of the exposure to routinization to assess whether the declining price of investment has led to a greater decline in labor shares in more exposed countries and industries. Second, a finding new to this paper is that, while the relative price of investment has declined steeply in advanced economies, it has experienced a milder decline in emerging market economies, where it has even risen in some.[6]

Trade and financial integration have increased dramatically over the past twenty-five years. Classical trade theory, such as Stolper-Samuelson, predicts that trade integration will reduce labor shares in capital-abundant advanced economies but raise them in labor-abundant emerging markets. The actual evolution of labor shares in the latter group of countries is however at odds with this prediction. In fact, the process of integration is more complex than captured by classical trade models, as it involves movement of factors across borders, technology transfers, and shifts in relative bargaining power between capital and labor.

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[4]See, for example, Blanchard 1997; Elsby, Hobijn, and Şahin 2013; Autor et al 2017; and Acemoglu and Restrepo 2016 for analyses of the United States and other advanced economies; and Harrison 2002 and Karabarbounis and Neiman 2014 for analyses that include emerging market economies.

[5] See Autor and Dorn 2013; Pierce and Schott 2016; and Goos, Manning, and Salomons 2014.

[6] In the majority of countries for which there is a disaggregation of the relative price of capital by category, the decline is driven by the computers and equipment category.

Our key contributions are as follows. First, we highlight a mechanism by which the simultaneous rise in routinization and the growth of global value chains can lead to lower labor shares in both advanced and emerging economies. Second, we introduce a measure of the exposure to routinization across countries and industries and illustrate its role in lowering the labor share of income. Third, we find strong corroborating evidence for the stylized mechanism in the empirical analysis.[7] Specifically, in sharp contrast to the well-known finding that technological progress lies behind the decline in labor shares, we find that this is true only for advanced economies whereas in emerging markets it is the globalization of trade, more precisely the expansion of global value chains, which has raised the capital-intensity of production, that has driven the decline of labor shares.

We begin by documenting stylized facts about recent trends in labor shares of income in Section II. We present the mechanisms by which key drivers can influence labor share dynamics in Section III. In Section IV, we employ two complementary approaches to empirically analyze long-term changes in labor shares. The first is a shift-share analysis. The second, which constitutes the core of the empirical analysis, quantifies the extent to which drivers can track long-term changes in labor income shares. Section V concludes.

II. Data and Stylized Facts

A. Data

The paper assembles a new data set on labor shares based on primary sources from national authorities for most major economies, expanding sources beyond the Organisation for Economic Cooperation and Development and the data set of Karabarbounis and Neiman (2014), now including a much larger set of emerging economies drawing on data from national authorities for several lower-income economies.

The analysis is based on countries with at least 10 years of data on labor shares over the 1991–2014 period, resulting in a sample of 31 advanced economies and 18 emerging economies for the aggregate analysis and a sample of 27 advanced economies for the sectoral analysis. For the results on labor shares by skill groups, a sample of 27 advanced economies and 10 emerging economies is included (see Annex Table A1). A summary of variable descriptions and data sources is given in Annex Table A2.

Motivated by a literature that links the polarization of labor markets to the steep decline in the price of substituting *routine* labor with ICT capital (see e.g. Autor and

[7] Other explanations for the downward trends in labor shares are also possible, including the regulation of labor and product markets and labor (Blanchard and Giavazzi 2003); rise in market power (Council of Economic Advisers 2016; Autor et. al. 2017); the decline in unionization rates and the rising role of housing (see e.g. Bonnet et. al. 2014; Rognlie 2014). Further, Kehrig and Vincent (2018) argue that reallocation of value-added to 'hyper-productive' low-labor share establishments is a key factor driving the decline in the US labor share, with more limited reallocation of inputs.

Acemoglu 2011; Autor and Dorn 2013), we conjecture that the greater the exposure to routine occupations the greater the decline in the labor share of income. To that end, we introduce measures of the country- and industry-level exposure to routine tasks. Construction of these exposures draws on the routine-intensity scores of 330 occupations at the 3-digit level from Autor and Dorn (2013). The scores contain no information other than the ordinal position of occupations, in increasing order of routinizability.

To measure aggregate routine exposures, we use employment-weighted scores of occupations in the economy and across industries (for details, see Das and Hilgenstock, 2018). A key assumption of this approach is that the intrinsic routinizability of a task (i.e. the propensity of a routine task to be automated) is fixed across industries, countries and over time.[8] Thus, for occupation category *l*, industry *j* and country *i* at time *t*, industry and country level routine exposures are respectively:

$$RTI_{jit} = \sum_{l} \omega_{ljit} \times RTI_{l}, \qquad RTI_{it} = \sum_{l} \omega_{lit} \times RTI_{l}$$

where ω_{ljit} and ω_{lit} are respectively occupation *l*'s share of employment in industry *j*, country *i* at *t*; and occupation *l*'s share of employment in country *i* at *t*.

Using employment data from population censuses, the exposures are constructed for all years in which a national census was conducted. Between 1960 and 2015, this yields time-varying exposures for 162 countries at either annual, biennial, quinquennial or, most often, decennial frequency; industry exposures are available for a subset of years and countries reflecting fewer censuses that record the industrial affiliation of workers. The measures are standardized to have mean zero and standard deviation one in each country or industry.

B. Stylized Facts in Labor Income Shares

The global labor share of income began a downward trend in the 1980s, declining 5 percentage points to its trough in 2006. This downward trend has overturned one of Kaldor's (1957) stylized facts about the constancy of the labor share of income, and thus raised complex questions about the rising role of capital in production and its implications for the future of employment and labor income.

This paper focuses on the period 1991-2014, which is a period of significant flux in the global economy through trade, technology, and the transformation of global labor markets following the entry of China, India, and former Eastern bloc countries into the global trading system in the early 1990s. In particular, the period since 2000 witnessed an acceleration of

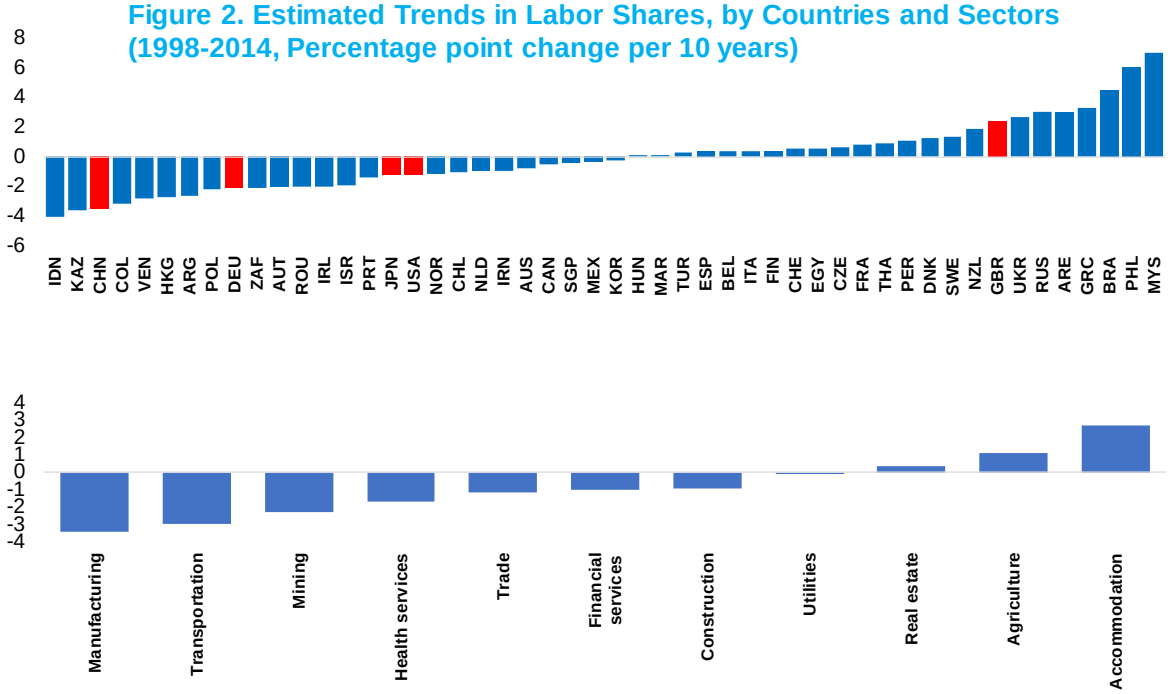
[8] This assumption only entails that tasks performed by, e.g. a babysitter present inherent challenges to being computerized while tasks performed by, e.g., an assembly plant worker are inherently automatable, regardless of where or when they are performed. Importantly, the assumed intrinsic quality of the task is *distinct* from whether the task is actually automated, which may indeed vary with time or across industries or countries.

global integration following China's accession to the WTO, along with rapid increases in emerging market investment infrastructure that led to a surge in offshoring to these economies (Obstfeld, 2016). As a result of both offshoring and technological advances, routine occupations in advanced economies became increasingly automated in this period, contributing to a deep decline in middle-skilled employment (Autor and Dorn 2013 and Goos, Manning and Salomons 2014). In recent years, the global economy has undergone further structural changes—a protracted period of weak growth, a trade slowdown, and a deceleration of total factor productivity growth—which, coupled with demographic shifts, have all likely affected labor income shares.

A less well-known fact about the global decline in labor shares is that it reflects declining shares in both advanced and emerging economies.[9] Indeed, the labor share of income has declined in four of the world's five largest economies, led by a steep decline in China (Figure 2, panel 1). Meanwhile, the evolution of the labor share within each of these country groups has been heterogeneous. In a sample of 35 advanced economies, between 1991 and 2014 the labor share declined in 19 (which accounted for 78 percent of their aggregate 2014 GDP), and rose or remained relatively stable in the remainder. The overall cross-country dispersion of labor shares is considerably larger in emerging economies than in advanced economies. In a sample of 54 emerging economies, the labor share declined in 32 economies, which accounted for about 70 percent of 2014 emerging market GDP, while rising or remaining roughly constant in the rest. Given the marked heterogeneity in individual emerging market experiences, findings for emerging economies as a whole should be interpreted with some qualification.

[9] This finding corroborates that of Karabarbounis and Neiman (2014). Relative to that paper, our paper's data cover a larger number of countries and extend their time period by up to four years. Importantly, the data used in this paper includes significant revisions to the official labor share data for systemically large countries such as Germany, the United Kingdom, China, and Brazil.

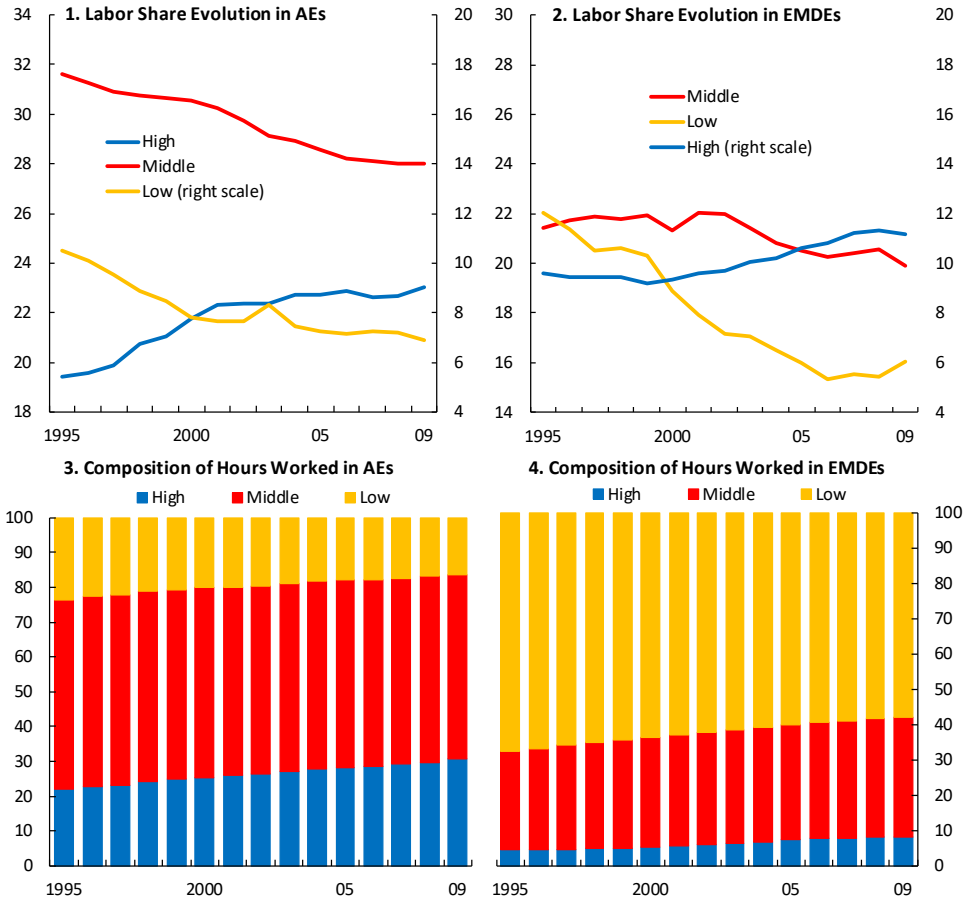
Figure 2. Estimated Trends in Labor Shares, by Countries and Sectors (1998-2014, Percentage point change per 10 years)



Sources: CEIC database; EU KLEMS database; National sources; Organisation for Economic Co-operation and Development; Karabarbounis and Neiman (2014), IMF, World Economic Outlook database; and authors' calculations.

The decline in the global labor share of income also conceals a heterogeneous evolution across industries (Figure 2, panel 2). At the global level, the sharpest decline in the labor share is in manufacturing followed by transportation and communication, while some sectors (e.g. agriculture) witnessed an increase. This global picture largely reflects developments in advanced economies; in emerging economies, the sharpest decline was observed in agriculture, while labor shares rose in manufacturing and, particularly, in health services and construction. This partly reflects the industrial labor share evolution in China, given its increasing GDP weight in this country group since 1993.

Figure 3. Labor Share Evolutions and Labor Force Composition by Skill Level
(Percent)



Sources: World Input-Output Database; and IMF staff calculations.
Note: AEs = advanced economies; EMDEs = emerging market and developing economies.

The decline in the global labor share has been borne by low- and middle-skilled labor. During 1995–2009 their combined labor income share was reduced by more than 7 percentage points, while the global high-skilled labor share rose by more than 5 percentage points (Figure 3, panels 1–2). The decline in middle-skilled labor's income share was driven primarily by a drop in their relative wage rate. The share of middle-skill employment in the total workforce remained stable or even rose (Figure 3, panels 3–4), while the labor share decline for low-skilled labor and the increase for high-skilled labor was largely driven by their diverging trend in employment composition, reflecting rising levels of education. This pattern is consistent with the notion that technological progress has been biased in favor of high-skilled labor (see Karabarbounis and Neiman 2014). Furthermore, while the broad patterns hold for both advanced and emerging economies, they are more pronounced in advanced economies, consistent with evidence of wage and employment polarization in these economies (e.g. Autor and Dorn 2013; Goos et. al. 2015).

III. Drivers of the Labor Share of Income: Key Concepts and Mechanisms

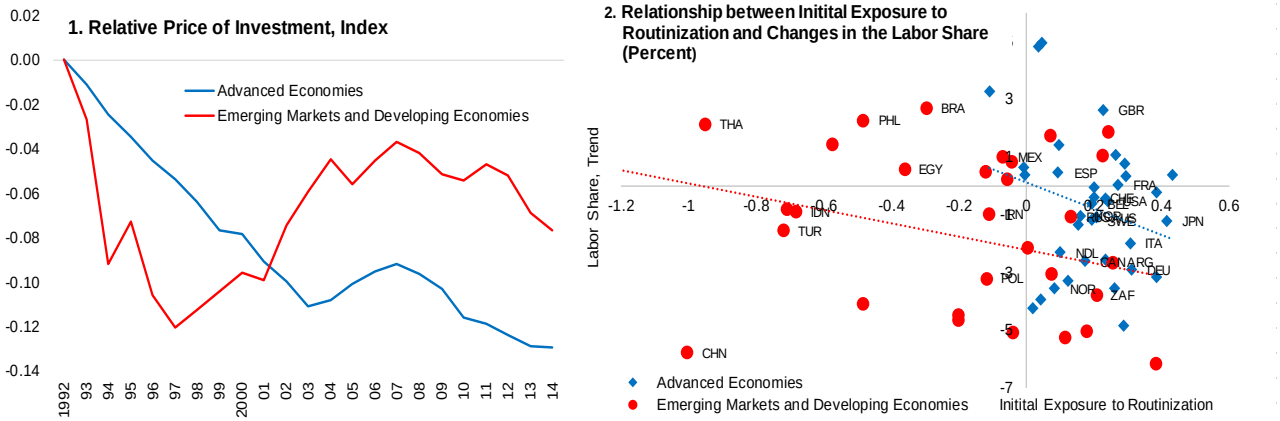
This section provides a brief description of the key concepts, as well as the mechanisms by which the main drivers can influence the labor share of income. We divide the main drivers into four broad categories: technological advancement; global integration; policies, institutions, and regulation of labor and product markets; and measurement issues. Although the first three drivers are treated as distinct channels for exposition, this is an artificial separation, as they are all potentially inter-related. In addition to the mutually reinforcing forces of technology and global integration, the decline in corporate taxation may reflect inter-country competition to attract capital (Rodrik 1998), while falling unionization rates could emerge from the decline of labor's bargaining power, itself a result of trade integration (Elsby, Hobijn, and Şahin 2013).

Technological Advancement*:* Technological progress, embodied in faster productivity growth in the capital goods sector relative to the rest of the economy, lowers the price of investment goods and thus induces firms to substitute capital for labor (see also OECD 2012). This paper puts particular emphasis on the rapid advance of ICT, which accelerates the automation of routine tasks and thus induces firms to disproportionately substitute capital for labor where the exposure to such tasks is larger. The two mechanisms are likely to interact: a decline in the relative price of investment goods will trigger greater substitution away from labor, and this impact is likely more pronounced where labor performs more routine tasks.

A finding new to this paper is that the steep global decline in the price of investment is by and large an advanced economy phenomenon (Figure 4, panel 1).[10] The milder overall decline experienced by emerging economies is explained, in large measure, by the smaller weight of ICT (the group of capital goods that has led the decline in the relative price of investment) in their investment goods basket and the greater commodity intensity of their investment. Countries also differ widely in their initial exposure to routinization, which exhibits a negative correlation with the subsequent change in labor shares of income (Figure 4, panel 2). On this aspect as well, emerging economies differ systematically from advanced economies, exhibiting substantially lower initial exposure to routinization.

[10]Between 1993 and 2014 the relative price of investment declined by about 12 percent in advanced economies, reflecting declines in the vast majority of individual economies; but by about 7 percent in emerging economies as a whole, declining by less in several individual economies and even rising in some.

Figure 4. Technology as a potential driver of labor shares



Notes: Panel 1 shows fixed effects from regressions that also include country fixed effects to account for entry and exit during the sample. The regressions are weighted by nominal GDP in current U.S. dollars. Fixed effects are normalized to reflect the respective variable's level in 1993. Panel 2 shows estimated trends in the labor share. Trend coefficients are reported on the *y*-axis in units per 10 years. Initial routine exposure is measured as the first available observation between 1990 and 1995. Sources: Autor and Dorn (2014); Eurostat, European Labor Force Survey; Integrated Public Use Microdata Series International; Integrated Public Use Microdata Series USA; Karabarbounis and Neiman (2014); national authorities; Organisation for Economic Co-operation and Development; United Nations database; and authors' calculations.

Taken together, these two stylized facts suggest that advances in technology must have triggered greater substitution of capital for labor in advanced economies than in emerging markets because the former were more exposed to automation of routine tasks and experienced a larger fall in investment good prices than the latter.

Global integration*:* Trade and financial integration are other factors widely viewed as a significant determinant of the evolution of labor shares (see Harrison 2002; Elsby, Hobijn, and Şahin 2013). Several interrelated mechanisms—with potentially offsetting impacts—may be at play.

Trade integration: Traditional theory predicts that trade integration will lead capital-abundant advanced economies to specialize in the production of capital-intensive goods, triggering resource reallocation across sectors that lowers the labor share of income. The opposite is predicted to occur in labor-abundant emerging economies. Although this model is at odds with the decline in labor shares of emerging economies as a whole, it could well play a role in the evolution of labor shares in specific economies, such as those where the labor share of income has risen.

Participation in global value chains: The rising trend in global value chain participation, measured as the sum of so-called forward and backward linkages in vertical

specialization, has been widely documented.[11] Among advanced economies, this reflects an offshoring of production of intermediate goods, and since the late 1990s a steady increase in offshoring of services as well (Amiti and Wei 2009). Among emerging economies, it reflects an increase in importing components for assembly and re-exportation in global value chains (Koopman, Wang, and Wei 2014).

An important insight in modern trade theory is that most trade flows occur within narrowly defined industries and that the production of a final good is often broken up into a set of tasks that can each be carried out in the most cost-efficient location (Grossman and Rossi-Hansberg 2008). We advance a mechanism by which the expansion of global value chains has the potential to account for a decline in labor shares in both advanced and emerging economies. The mechanism described here is one of several possibilities but is supported by a key stylized fact about global value chain participation and capital deepening.

The expansion of global value chains has been enabled by a collapse in the costs of communication and transportation, which has allowed firms to unbundle production into many tasks and minimize production costs by exploiting factor cost disparities across countries (Feenstra and Hanson 1997; Grossman and Rossi-Hansberg 2008). Because wages are higher in advanced economies than in emerging economies, tasks that are relatively labor-intensive are likely to be offshored from the former to the latter. For advanced economies, the implications are straightforward: because offshored tasks are relatively labor-intensive, the composition of production becomes more capital-intensive, and a decline in labor income shares ensues. In addition, offshoring—or the threat thereof—lowers labor's bargaining power (Harrison 2002), further reducing the labor share *within* remaining tasks.

To consider how participation in global value chains can also reduce labor income shares in emerging economies, a key observation is that the expansion of global value chains has coincided with the steep decline in the relative price of investment goods in advanced economies, leading to automation of more routine tasks in these economies. In particular, tasks most likely to be automated in advanced countries are those for which labor is most substitutable by capital (high elasticity of substitution), thus implying that tasks with *low* elasticity of substitution between capital and labor are most likely to be offshored . The key insight is that insofar as tasks offshored have limited substitution between capital and labor, participation in global value chains can also reduce labor income shares in emerging economies.[12] The crucial mechanism is that in an environment of *high local relative cost of*

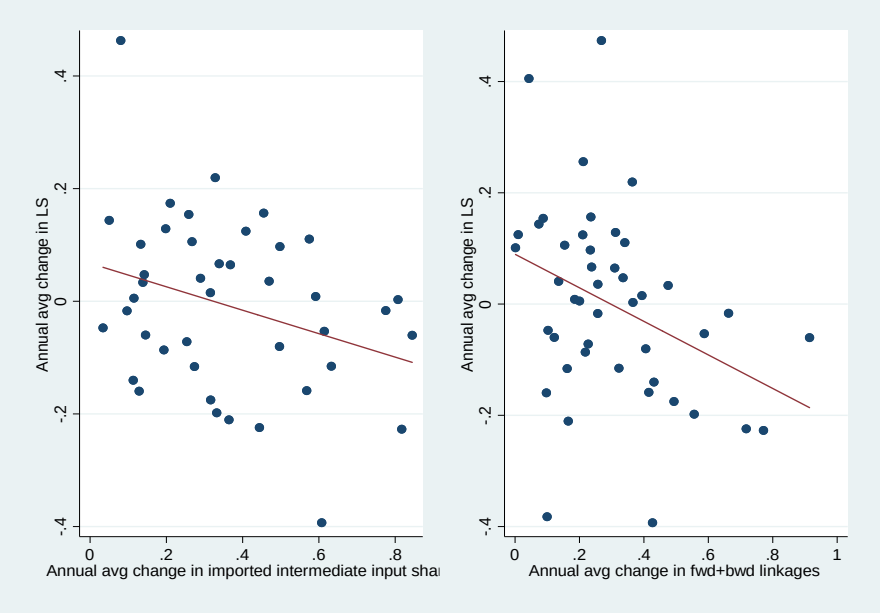
[11]Backward linkages capture the extent of offshoring intermediate inputs used in exports and are defined as the share of foreign value added in gross exports. Forward linkages measure the extent of vertical specialization and are defined as the share of exports consisting of intermediate inputs used by trading partners for production of their exports to third countries (Koopman, Wang, and Wei 2014).

[12] For a more complete derivation of the stylized model underlying this mechanism, see Dao, Das, Koczan and Lian (2017), Annex 2.

capital—as would be the case in capital-scarce emerging market economies (see World Bank 2015)—tasks with high substitutability between factors will have lower capital shares than the average task, as firms exploit low relative labor costs to substitute labor for capital. Symmetrically, tasks with low substitutability between capital and labor will have high capital shares. It follows that by raising the proportion of tasks for which it is difficult to replace capital with labor, offshoring can shift the composition of production to tasks with higher capital shares, thus lowering the average labor income share in receiving countries.[13]

Figure 5. Global integration as potential driver of labor shares

(Long-run increase in global value chain integration vs. long-run change in labor shares)



Note: Each dot corresponds to one country in the sample. Global value chain integration is measured as change in imported intermediate inputs (as a share of total intermediate usage) in the left panel, and change in the sum of forward and backward linkages (as defined in text) in the right panel. All changes are taken as annual averages over the entire sample available for each country (1992-2013 for most countries). Sources: see Annex Table A2.

Whether participation in global value chains lowers or raises overall labor shares is ultimately an empirical question. However, simple correlations in Figure 5 suggest that rising global value chain participation does appear to be indeed associated with larger declines in

[13] Elsby, Hobijn and Şahin (2013) hypothesize that one way to rationalize declining global labor shares is that tasks which are labor-intensive in advanced economies are nevertheless capital-intensive compared with those same tasks in the economies to which they are offshored; this would raise capital shares in both sending and receiving economies. This idea resembles that in Feenstra and Hanson (1997), in which low-skill tasks offshored from advanced economies are relatively high-skill tasks in recipient emerging economies. By clarifying the nature of tasks likely to be offshored, the mechanism proposed in this paper provides a conceptual foundation for the hypothesis in Elsby, Hobijn and Şahin (2013).

labor shares in the long run, consistent with our proposed mechanism and Elsby, Hobijn and Sahin (2013). This negative correlation is tested in further regression analyses below.

Financial integration: Fewer barriers to the mobility of capital across borders may also play a role in labor share dynamics. This may happen through two distinct channels. First, by facilitating the relocation of production to countries with cheaper inputs, capital mobility lowers labor's bargaining position in the sending economy.[14] Second, by increasing access to capital, financial integration lowers the cost of capital in capital-scarce countries, facilitating capital deepening and potentially inducing greater substitution of capital in favor of labor. The second channel may be especially relevant in emerging economies where credit rationing is prevalent, and where the benefits of financial integration accrue largely to high-skilled workers, whose skills are more complementary to capital.[15]

Policies, institutions, and regulations*:* Labor and product market policies, institutions, and regulations can also play a role in the evolution of labor shares. While policies themselves may have changed partly in response global integration and technology, they may also have had independent impacts on labor income shares. A decline in corporate income tax rates, for instance, can raise the relative return to capital, which may induce a further substitution of capital for labor and lower the labor share of income. Moreover, changes in market regulations over the past two decades—for example, those that regulate worker hiring and dismissal or competition in product markets—may have affected factor shares through their impact on the size and distribution of rents. Changes in product market structure could also emerge independently of regulation and may reflect, for example, technological advances and the integration of global product markets that result in a rising concentration of industries. Autor et. al. (2017) describe a "winner-take-most" dynamic to explain rising profit shares, and consequent declining labor shares, consistent with evidence in De Loecker and Eeckhout (2017).[16]

Measurement*:* Two measurement challenges could account for some of the apparent decline in labor shares. The first has to do with the labor income of the self-employed which is not recorded separately in national accounts, and are particularly relevant in developing countries (Gollin, 2002). The second concerns the depreciation of capital, which should

[14]Kramarz (2016) discusses this channel and provides supporting empirical evidence using firm-level data.

[15] This implies that the elasticity of substitution may be lower than one for specific groups of workers or in specific sectors while nevertheless being larger than one in the economy as a whole; see Karabarbounis and Neiman (2014). One explanation consistent with this explanation is that the decline in the price of investment affects only certain types of investment (e.g. computer equipment) but not others (structures) and that the substitution pattern between labor and capital differs depending on the type of capital. We thank an anonymous referee for this insight.

[16] We are not able to pursue this hypothesis in our paper because the data required to construct market power and concentration is only available for a limited number of advanced economies.

arguably be discarded from the calculation of factor income shares as it cannot be consumed by either workers or capital owners (see Rognlie 2015). Adjustments for self-employment and depreciation could affect both the level and evolution of labor shares over time. For instance, falling self-employment would make the labor share decline steeper, while rising capital depreciation rates would make the decline less pronounced.[17] Given data limitations, this paper treats measurement issues as a fourth factor in explaining the evolution and cross-country comparison of labor shares and considers some tests of robustness to different measures of the labor share of income in the online Annex.

In summary, the factors discussed so far can affect labor shares differentially in different country groups. Furthermore, different facets of globalization—such as participation in global value chains and financial integration—may have offsetting or reinforcing impacts. Assessing their relative contributions to labor share trends is thus ultimately an empirical exercise.

IV. Analyzing Trends in the Labor Share of Income: Empirical Analysis

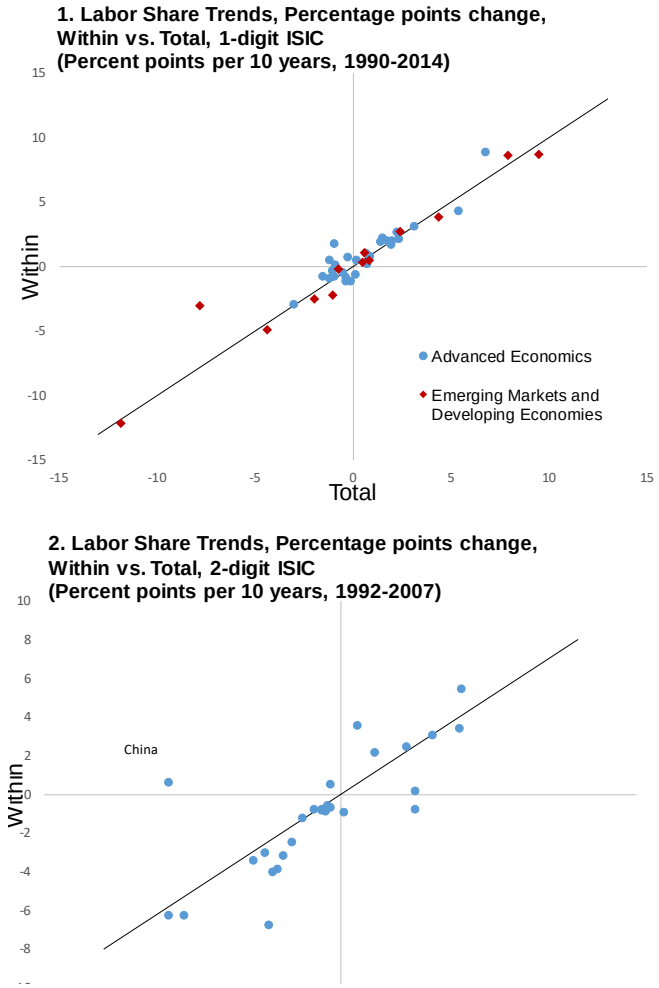
The analysis begins with a shift-share analysis analogous to Karabarbounis and Neiman (2014), extending their analysis to 12 more countries and up to 5 more years, as well as more granular industries. The shift-share empirically quantifies how much of the global decline in labor shares is attributable to decreases *within* industries and how much to compositional changes—that is, a reallocation of labor *between* industries, from those with high labor shares to those with lower labor shares. This exercise is an important first step for two reasons. First, it gauges the role of structural transformation—for example, from manufacturing to services in advanced economies and from agriculture to manufacturing and services in emerging markets—in the decline in labor shares. Second, the shift-share analysis can help assess whether the empirical analysis should focus on analyzing within-industry changes in labor shares or those arising from reallocation of resources between industries.

[17] A third measurement problem concerns the capitalization of intellectual property products in national accounts in SNA08 as opposed to intermediate expense prior to that. However, as shown in Aum, Koh and Santaeulalia-Llopis (2018), this measurement issue is unlikely to affect the trend change in labor shares during our sample period.

A. Shift-Share Analysis

The shift-share analysis is performed across 10 one-digit industries, decomposing the trend changes in labor shares into their within-industry and between-industry components.[18] The results of this exercise are shown in Figure 6 (panel 1), which plots the total trend change on the horizontal axis against the within component on the vertical axis.

Figure 6. Shift-Share Analysis



Sources: CEIC database; Organisation for Economic Co-operation and Development database; World Input-Output database; and authors' calculations. Note: AEs = advanced economies; EMDEs = emerging economies; ISIC = International Standard Industrial Classification of all Economic Activities, Revision 4.

The shift-share analysis suggests that the reallocation of factors across broad industrial categories has generally not been a significant driver of labor share trends. Most countries are clustered around the 45-degree line, indicating that trend changes in labor shares emerge overwhelmingly from trend changes in within-industry labor shares rather than from the reallocation of factors across industries. An important exception is China, where reallocation from industries with relatively high labor shares, most notably agriculture, to expanding industries with lower labor shares, such as transportation and communication, accounts for some 60 percent of the total decline in the labor share during 1991–2014.[19] Similar findings are obtained when the analysis is performed for a subset of 22 OECD economies using more disaggregated (two-digit level) data covering 31 sectors (Figure 6, panel 2). Although several countries now deviate a little farther from the 45-degree line, they typically lie below the line, indicating that factor

[18]The total change is decomposed for each yearly change as $\triangle LS_{i,t} = \sum_{k=1}^{n}\left(w_{i,k,t-1} \triangle LS_{i,k,t}\right) + \sum_{k=1}^{n}\left(\triangle w_{i,k,t} LS_{i,k,t-1}\right)$ (where the first sum is the within change and the second is the between change) and summed over all years in the sample.

[19]This finding contrasts with that of Karabarbounis and Neiman (2014), reflecting both a different timeframe in this paper's analysis and, quite significantly, non-trivial revisions to China's labor share data in official sources.

reallocation between industries has often tended to *increase* labor shares in advanced economies. These findings do not provide much support for the predictions of traditional trade theory and suggest analyzing the drivers of within-industry changes to understand overall trends in labor shares. The empirical analysis turns to these drivers next, starting with an analysis of country-level data.

B. Analysis of Long-Term Changes in the Aggregate Labor Share of Income

This section examines the empirical relationship between trends in labor shares and technology, global integration, and other factors. Following the literature, the approach focuses on long-term changes in labor shares and relates them to long-term changes in potential drivers (see e.g. by Karabarbounis and Neiman 2014; Elsby, Hobijn, and Şahin 2013 and Acemoglu and Restrepo 2016). This strategy is motivated by important considerations, particularly the long horizons over which countries adjust to structural changes triggered by technological advances and global integration.

The regression model is estimated on a sample of 31 advanced economies and 18 emerging markets. The baseline estimation equation of the aggregate regression is:

$$\widehat{LS_c} = \alpha + \beta_2\widehat{PI_c} + [\beta_3 RTI_{0,c} + \beta_4 RTI_{0,c}\widehat{PI_c}] + \beta_1{}'\widehat{G_c} + \beta_5{}'\widehat{Pol_c} + \varepsilon_c,$$

in which (hat) variables are long-term annualized changes during 1991–2014 at the country level.

To estimate the effect of technology, we follow Karabarbounis and Neiman (2014) by using the change in the relative price of investment goods, *PI*, to proxy firms' incentives for capital-labor substitution. Recognizing that such substitution will be stronger in countries that are more exposed to routinization, we include a measure of a country's initial exposure to routinization, RTI_0. By measuring exposure to routinization at the start of the sample period, our approach mitigates concerns that high initial exposure to routinizable jobs will itself lead to greater adoption of routine technology and thereby *lower* subsequent exposure to routinizability.

G subsumes variables measuring the evolution of globalization: changes in total goods trade (value-added exports and non-oil imports in percent of GDP), as well as trade in intermediate goods and global value chain participation (measured alternatively by the sum of forward and backward linkages as defined in the text, or by imported intermediate inputs in percent of gross value added), and changes in financial globalization (external assets and liabilities, excluding international reserves, in percent of GDP). The results consider

alternative measures for both the technology and global integration variables to assess robustness of the results.[20]

Variables in *Pol* are policy and institutional factors, including changes in union density, corporate taxation, employment protection legislation, and product market reforms. In addition, to assess whether reforms to the regulation of product and labor markets during 1991–2014 affected labor shares, the regressions include an indicator for countries that enacted significant reforms in deregulating employment protection and product markets, using data from the Fraser Institute's Economic Freedom of the World data set (see Gwartney, Lawson, and Hall 2016).[21] Major regulations are assigned the value 1 and major deregulations are assigned the value −1.

Table 1 summarizes the baseline aggregate regression results. Columns 1 to 4 present the estimates for each block of variables, column 5 estimates all drivers jointly, and column 6 interacts the variables that are statistically significantly different between advanced and emerging economies, using an indicator for advanced economies.

Regarding the role of technology, the empirical estimates imply that a decline of 15 percent in the relative price of investment goods (the average decline in the sample) leads to a 0.4 percentage point decline in the labor share in a country with relatively low initial exposure to routinization, and about a 1.5 percentage point decline in a country with high exposure to routinization.[22] Therefore, an important implication of our results is that in emerging economies, which have vastly lower exposures to routinization, technological advancement has a significantly smaller impact on labor shares.

Turning to globalization, while overall trade in goods and services does not appear to matter much for labor shares, participation in global value chains does. Participation in global value chains is estimated to have exerted a strong negative effect on the labor share of income in both advanced economies and emerging markets, supporting the notion that offshored tasks are labor-intensive for the former group of countries but raise capital intensity in the latter (consistent with a convergence in capital intensity between advanced economies and emerging market economies). The empirical estimates indicate that an increase in intermediate goods imports of 4 percent of GDP (corresponding to the median increase in global value chain integration in the sample) is associated with a 1.6 percentage point decline in the aggregate

[20]These include, for example, a measure of intermediate imports excluding commodities as well as volumes of intermediate imports in lieu of global value chain participation; gross stocks of inward and outward foreign direct investment for financial integration; and a measure of the user cost of capital in lieu of the price of investment goods.

[21] See IMF 2017b for a detailed description of the calculation of these indicators.

[22]High exposure refers to those economies whose initial exposure to routinization is at the 75th percentile of the distribution of exposures, while low exposure refers to those where the initial exposure is at the 25th percentile.

labor share, on average, with a significantly larger impact in emerging markets.[23]

Table 1. Baseline Aggregate Results

	(1)	(2)	(3)	(4)	(5)	(6)
	Technology	**Globalization**	**Policies**		**All**	
Initial Routinization	-0.000135				0.0000178	-0.000119
	(0.00119)				(0.00110)	(0.00137)
Relative PI * Initial Routinization	0.267***				0.247***	0.524***
	(0.0969)				(0.0779)	(0.124)
Relative PI	0.0847**				0.0444	0.183**
	(0.0380)				(0.0336)	(0.0734)
Value Added Export/GDP		-0.123			-0.110	
		(0.128)			(0.155)	
Import/GDP		0.0286			0.0131	
		(0.0204)			(0.0174)	
Financial Globalization		-0.00234***			-0.00205***	0.0172*
		(0.000806)			(0.000607)	(0.00895)
Global Value Chain Participation		-0.288***			-0.253***	-0.574***
		(0.0717)			(0.0796)	(0.0962)
Employment Protection Legislation Reform			0.00144	0.000786		
			(0.00294)	(0.00266)		
Product Market Reform			-0.0000306	0.00125		
			(0.00154)	(0.00123)		
Unionization				0.0285		
				(0.0563)		
Corporate Taxation				0.194**	0.0384	0.0170
				(0.0710)	(0.0373)	(0.0316)
Relative PI * Aes						-0.177*
						(0.0954)
Global Value Chain Participation * Aes						0.483***
						(0.101)
Financial Globalization * Aes						-0.0188**
						(0.00897)
Aes						-0.00117
						(0.000820)
Number of Observations	49	50	50	26	49	49
R^2	0.196	0.288	0.004	0.377	0.448	0.636

Source: IMF staff calculations.

Note: All variables (except initial routinization) are expressed as long-term trend changes. Robust standard errors are in parentheses. AEs = advanced economies; PI = price of investment.

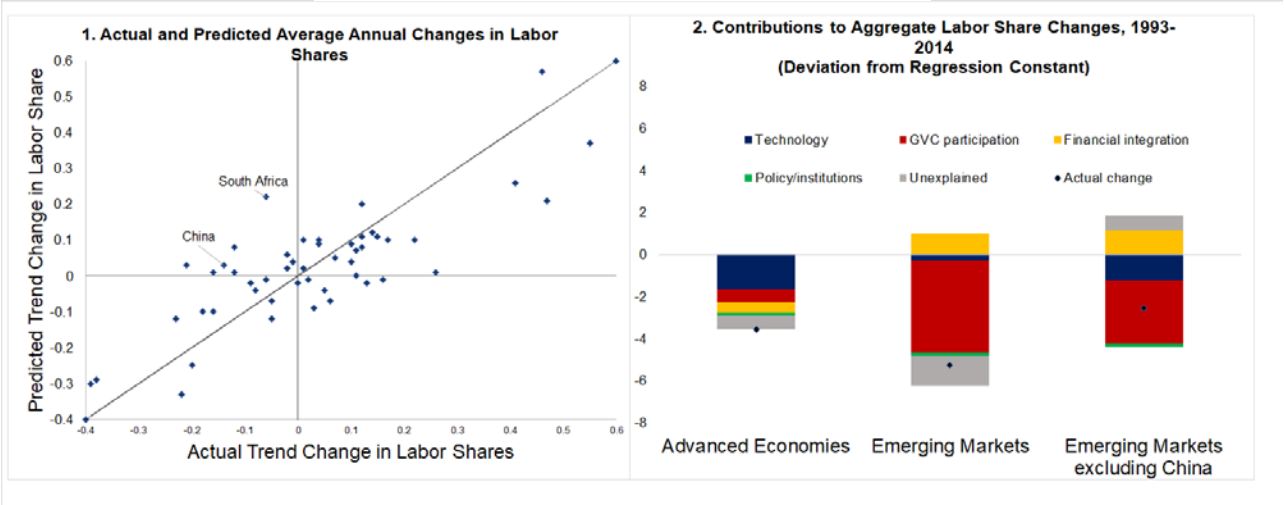
*** p <0.01, ** p <0.05, * p <0.1

Financial integration has contrasting effects on the two country groups, depressing labor shares in advanced economies while raising them in emerging economies. It has long

[23]The smaller impact of offshoring in advanced economies may reflect the reallocation of displaced workers in advanced economies from manufacturing to low-skill (but labor-intensive) service industries, which may itself raise the labor share and work against the negative impact of offshoring on labor shares. In emerging market economies, the impact on labor shares due to reallocation from labor- to more capital-intensive jobs is more straightforward. Another possible reason for the smaller impact of offshoring in advanced economies is that imported intermediate inputs may raise the labor share in some tasks or sectors through their positive effect on productivity, if such tasks have a relatively low elasticity of substitution.

been argued that rising capital mobility increases the bargaining power of capital relative to that of labor by facilitating the relocation of production (see e.g. Harrison 2002). The empirical estimates are consistent with this notion for advanced economies, which are, in general, the source countries of cross-border capital flows. The finding for emerging markets, on the other hand, is consistent with the notion that capital inflows lower the overall user cost of capital and, so long as production has limited substitutability of capital for labor (the elasticity of substitution is lower than one), raises the labor share of income. The lower substitutability of capital for labor in turn, can be due to different production structures and the type of capital, consistent with the lower exposure to routinization in emerging markets (Figure 4).

Figure 7. Aggregate results



Notes: Panel 1 shows actual average annual changes in labor shares for countries with at least 10 years of data and predictions based on the aggregate trend regression model (Table 1). Derived contributions are scaled to show total changes over 25 years. Source: authors' calculations.

The measures of trend changes in labor and product market regulation, as well as changes in corporate taxation, are not found to have robust effects on labor share trends over the sample period. Declines in corporate income taxation have a strong bivariate correlation with the trend changes in labor shares, but these are not estimated to be statistically significant in a richer setting that controls for the strong contemporaneous trends in globalization and technological progress.

The empirical model closely tracks changes in labor shares during 1991–2014 across countries, and confirms the significant roles played by technological advancement, exposure to routinization, and global integration in the decline in labor shares (Figure 7, panel 1). One notable outlier is China where—consistent with the findings of the shift-share analysis—a significant change in industrial composition has contributed to the decline in the labor share. Another outlier is South Africa, where a substantial increase in financial integration is the key

contributor to the predicted rise in the labor share, while in fact much of the cross-border financial flows has been driven by extractive industries and thus is not likely to contribute as much to higher wages and labor share as in other emerging markets.

With the caveat that it is difficult to cleanly separate the impacts of technology from global integration, or from policies and reforms, Figure 7 (panel 2) presents a decomposition into these various factors to gauge their relative contributions to changes in labor shares. In advanced economies as a whole, technology, proxied by the declining relative price of investment goods and the initial exposure to routinization, has been the largest contributor to the decline in labor shares, accounting for almost half of the overall decline. Global integration—in particular, participation in global value chains and financial integration—is estimated to have contributed about half as much as technology.

The results for advanced economies as a group also hold for many individual economies. For example, the joint negative effect of technology and global integration can explain roughly three-quarters of the decline in labor shares in Germany and Italy and more than half of the decline in the United States (all countries with relatively high exposure to routinization and, in the case of the United States and Germany, rising integration into global value chains). However, the increase in labor share in the United Kingdom, though modest, fails to conform to this general pattern. Finland and Norway, on the other hand, are examples of countries that had low exposure to routinization and, as predicted by the empirical analysis, experienced a trend increase in labor shares.

For emerging economies, the forces of global integration have had large but partially offsetting effects, with participation in global value chains lowering the labor share of income and financial integration raising it. Technology has played a very small role in the aggregate,[24] although its impact on labor shares is heterogeneous across individual countries. More generally, there is more variation in the relative contribution of different drivers to labor share trends across the sample of emerging markets than in advanced economies. For example, the increase in the relative price of investment goods, together with financial integration, explain about half of the trend rise in labor share in Brazil, while participation in global value chains plays a negligible role. In Turkey, by contrast, the decline in labor share is explained almost exclusively by the rapid rise in its participation in global value chains, while technology plays a limited role, reflecting its very low exposure to routinization.

[24] See also Hemous and Olsen (2014) who highlight that only when low-skill wages are sufficiently high will firms invest in automation.

C. Stacked regressions

The baseline aggregate regressions collapse observations of each variables into long differences over the entire sample period for each country and hence result in a set of cross-sectional regressions whose sample size is limited by the number of countries. We explore whether results are maintained when the sample size is augmented by computing 5-year differences (instead of 15-year differences) and stacking such differences for each country (e.g. Acemoglu and Restrepo 2016).

Table 2 summarizes the results of the stacked-differences estimation according to the following regression equation:

$$\widehat{LS}_{c,t} = \alpha + \beta_2 \widehat{PI}_{ct} + [\beta_3 RTI_{0,ct} + \beta_4 RTI_{0,ct}\widehat{PI_{ct}}] + \beta_1{}'\widehat{G_{ct}} + \beta_5{}'\widehat{Pol_{ct}} + \gamma FE_c + \delta FE_t + \varepsilon_{ct},$$

in which all variables are defined as in the baseline aggregate regression equation, but with *t* denoting nonoverlapping consecutive five-year periods (*t* = 1992–96, 1997–2001, 2002–06, 2007–11), stacked for each country *c*. The panel structure makes it possible to control for country-specific trends and period-specific unobservables, while significantly increasing the number of observations compared with the baseline cross-sectional trend regression.

Results in Table 2 strongly confirm findings in the baseline. The impact of technology is similar in magnitude, but less precisely estimated, arguably because adjustments to technological change materialize only over a long horizon. That said, the effect of global value chain participation is very similar to the trend results, implying a faster adjustment to forces of trade than to technology. The effect of employment protection legislation reforms is also statistically significantly negative for labor shares within five years of the reform. However, they are again swamped out by the impact of technology and trade in the joint specification.

Table 2. Stacked Aggregate Results

	(1)	(2)	(3)	(4)	(5)	(6)
		Ordinary Least Square Estimations				**Robust regression**
Technology						
Initial Routinization	-0.00222*	-0.0150*		-0.0126	-0.0149**	-0.0293***
	(0.00120)	(0.00887)		(0.00819)	(0.00644)	(0.00459)
Relative PI	0.0339	0.0535		0.0112	0.0615	0.0223
	(0.0279)	(0.0434)		(0.0457)	(0.0489)	(0.0350)
Relative PI * Initial Routinization	0.128**	0.101		0.233	0.207	0.273**
	(0.0530)	(0.201)		(0.193)	(0.172)	(0.116)
Globalization						
Global Value Chain Participation	-0.152**	-0.207***		-0.253***	-0.174*	-0.131**
	(0.0655)	(0.0627)		(0.0632)	(0.0911)	(0.0628)
Financial Globalization	0.000890***	0.000726*		0.000744**	0.000312	0.000784
	(0.000219)	(0.000369)		(0.000338)	(0.000460)	(0.000568)
Policy						
Corporate Taxation	0.0201	0.0709		0.0651	0.0511	0.127***
	(0.0524)	(0.0711)		(0.0646)	(0.0573)	(0.0425)
Employment Protection Legislation Reforr			-0.00207**	-0.0000182	0.000291	-0.000626
			(0.000806)	(0.000854)	(0.00104)	(0.000794)
Product Market Reform			-0.000780			
			(0.000771)			
Country Fixed Effects	N	Y	Y	Y	Y	Y
Period Fixed Effects	N	N	N	N	Y	Y
Number of Observations	165	165	181	154	154	153
R^2	0.157	0.197	0.038	0.238	0.501	0.834

Source: IMF staff calculations.

Note: All variables (except initial routinization) are expressed as long-term trend changes. Robust standard errors are clustered at country level. PI = price of investment.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Finally, our aggregate results are robust to several variations in the measurement of key variables (labor shares adjusted for self-employment and depreciation, alternative measures of the relative price of capital, alternative measures of trends in offshoring), estimation methods (OLS, weighted, robust regression), and additional controls such as demographic trends, human capital accumulation trends, trends in financial deepening, and migration (see online Annex Tables B1-B4).

D. Analysis of Long-Term Changes in Labor Shares by Skill

We now turn to the analysis of labor shares of different skill levels. Due to data limitations, this sample is dominated by advanced economies.[25] The goal is to examine the distributive effects of technology and trade, including whether these have contributed to polarization and the so-called hollowing out of the middle class in advanced economies. The approach is to analyze the evolution of the labor shares of high-, middle-, and low-skilled

[25]Aggregate analysis by skill focuses on a sample of 27 advanced economies and 10 emerging market economies, while sectoral analysis by skill is based on a sample of 27 advanced economies and 5 emerging market economies (Annex Table A1).

workers separately.[26]

Labor compensation by skill is constructed using the World Input-Output database's skill level labor compensation as a percent of total labor compensation, multiplied by labor compensation data, at the country and sector levels, respectively. Labor share by skill is then computed by taking the ratio of labor compensation by skill and value added, at both the country and sector levels.

The regression specification for the labor income share of different skill groups is analogous that of the aggregate analysis. In addition, as much of the diverging trends in skill-specific labor shares may reflect the changing skill composition of the labor force, the skill-level regressions also control for skill composition (measured by educational attainment).

Table 3. Aggregate Results by Skill Level

	High Skilled	Medium Skilled	Low Skilled
Technology			
Relative PI	0.0317	0.224**	-0.0293
	(0.0338)	(0.104)	(0.0686)
Initial Routinization	-0.001	0.002	-0.0001
	(0.00110)	(0.00263)	(0.00187)
Relative PI * Initial Routinization	0.0460	0.408**	-0.104
	(0.0616)	(0.169)	(0.146)
Globalization			
Global Value Chain Participation	0.0315	-0.811**	-0.100
	(0.0989)	(0.354)	(0.187)
Financial Globalization	0.00839***	-0.00195	-0.00316
	(0.00266)	(0.00301)	(0.00339)
Policies and Institutions			
Corporate Taxation	0.0268	-0.237	-0.0701
	(0.0576)	(0.151)	(0.0847)
Relative Skill Supply	0.666**	1.738	-0.156
	(0.308)	(1.545)	(2.152)
Number of Observations	37	37	37
R^2	0.299	0.351	0.047

Source: IMF staff calculations.
Note: All variables (except for initial routinization) are expressed as long-run trend changes. Robust standard errors are clustered at country level. PI = price of investment.
*** p <0.01, ** p <0.05, * p <0.1

Table 3 provides the aggregate regression results by skill level and Figure 8 uses these results to decompose the actual change in labor share for each skill group by the different drivers. The results suggest that both technological advancement and participation

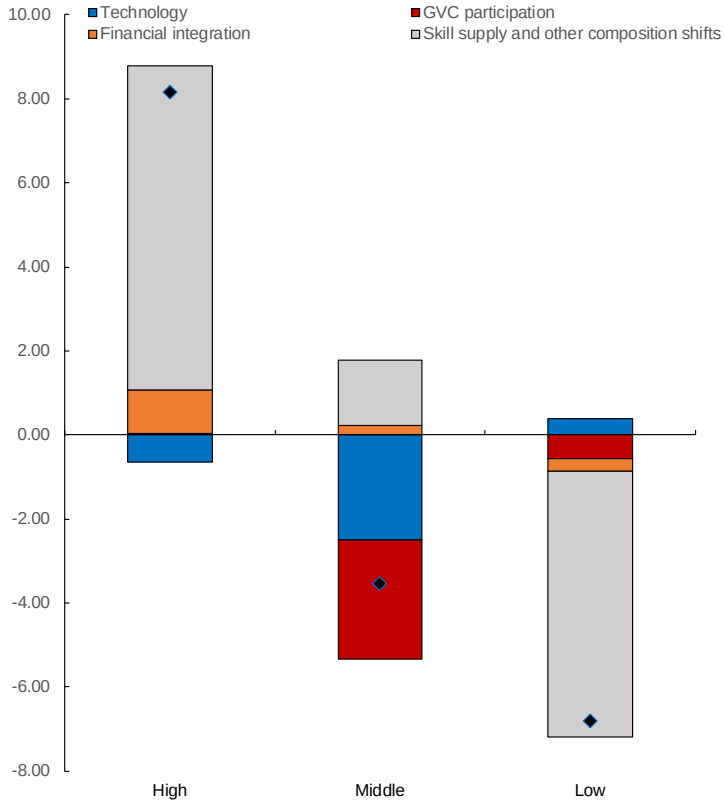
[26]The definition of skill types is based on the level of education of workers. The World Input-Output database uses the 1997 International Standard Classification of Education (ISCED) to define low skilled as workers with primary and lower secondary education, middle skilled as those with upper secondary or postsecondary, nontertiary education, and high skilled as those with first-stage tertiary education or higher.

in global value chains have lowered the income share of middle-skilled workers but have had little discernible effect on those of low- or high-skilled workers.[27] Moreover, countries with higher exposure to routinization and greater increase in participation in global value chains have experienced stronger declines in the middle-skilled labor income share, which has been especially pronounced in Austria, Germany, and the United States. [28]

This result on the differential effect across skill groups is consistent with evidence for the United States and European economies, where declining costs of automating routine tasks have caused a polarization of employment and wages along the skill spectrum (Autor and Dorn 2013; Goos, Manning, and Salomons 2014). This finding also strongly suggests that the decline in the aggregate labor income share has been borne disproportionately by middle-skilled workers.

The skill-level analysis is also conducted at the sectoral level, where sector-skill-specific labor shares are computed as labor income by skill in a specific (2-digit) sector, divided by the sector's value added in each country (see online Annex Tables B5-

Figure 8. Contribution to Aggregate Labor Share Change by Skill, 1995-2009



Sources: World Input-Output database and authors' calculations. Notes: Decomposition derived from aggregate labor share regressions by skill groups. Data for labor share by skill from WIOD. Contribution of "Skill supply and other shifts in composition" is combined effect of educational composition and regression constant term.

[27]"Skill supply and other composition shifts" refers to the impact of relative skill supply measured by the share of low, middle, and high educational attainment in the total population and the contribution of the regression constant, which measures other deterministic trends in each group's labor share. Since this is the averaged decomposition for all countries in the sample, there is no contribution from the residual.

[28]The stronger negative effect of global value chain participation over technology for the middle-skilled labor share is based on a sample that includes emerging economies, for whom the aggregate labor share results find that global value chain participations exerts a stronger downward pressure on labor shares than technology. Estimating and decomposing the fall in middle-skill labor share for a sample consisting only of advanced economies delivers the same ranking as for the aggregate labor share, that is, a much larger role of technology relative to global value chain participation.

B6). Findings from the sectoral-skill analysis also suggest that measures of technological change have a stronger effect on the middle-skilled labor income share, and that sectors more exposed to routine-biased technological progress experience a stronger decline in the labor income shares of middle-skilled workers, consistent with the aggregate-level skill results.

V. SUMMARY AND CONCLUSIONS

The analysis in this paper highlights that the global downward trend in the labor share of income is not just concentrated in advanced economies but extends to emerging economies as well. We illustrate the significant heterogeneity in the evolution of labor shares since the early 1990s across countries, sectors, and skill groups. In the majority of economies, within-sector declines, rather than labor reallocation toward low-labor-share sectors, have driven the overall decline in labor's share of income.

The empirical analysis points to a dominant role of technology and global integration in explaining this trend, although to different degrees between advanced and emerging economies. Technological progress, reflected in the steep decline in the relative price of investment goods, along with high exposure to routine occupations, has been the key driver in advanced economies with global integration playing a smaller role.

The evidence also suggests that in advanced economies the impact of technological advancement and participation in global value chains on declining labor shares comes through a reduced share for middle-skilled labor. This finding corroborates existing evidence that automation and import competition and offshoring have led to long-term losses in middle-skill occupations and displacement of middle-skilled workers to lower-wage occupations in advanced economies.

In emerging economies, the evolution of labor shares is explained predominantly by the forces of global integration, with a limited role for technology. These averages conceal some heterogeneity in individual countries and should thus be interpreted more cautiously than findings for advanced economies as a group. This difference, compared with advanced economy experiences, reflects, in part a much less pronounced decline in the relative price of investment goods, as well as lower exposure to routinization, which has limited the ability of technology to displace labor. As noted above, this effect of global integration could be interpreted as benign—it results from capital deepening and has been associated with strong growth in wages and employment.

What do these findings imply for policies? Two of the key drivers of growth, productivity and prosperity worldwide—technological advancement and globalization—are the main forces behind the downward trend in labor shares, which in turn have manifested themselves in significant dislocations for some groups of workers. Furthermore, insofar as robotics, artificial intelligence and digital technologies continue to develop at their relentless pace, the downward pressure on the wages, employment and labor shares of middle-skilled workers may continue. The chapter's findings, together with existing evidence that

technology and globalization have contributed to job polarization and long-term unemployment for some groups of workers present challenges to policymakers to find new ways to keep on harnessing the benefits of globalization and the rapid advancements in technology, while spreading those benefits more widely to all groups of workers.

In general, policies in advanced economies should be designed to help workers better cope with disruptions caused by technological progress and global integration, including through skill upgrading. Some of the required policies will have transitory effects in nature, such as "trampoline policies" needed to facilitate the reallocation of displaced workers to new jobs. These include social safety nets such as unemployment benefits, as well as strong job search support, retraining programs and well-designed temporary subsidies. But to the extent that some workers are permanently affected by the growth-enhancing forces of technology and trade, as suggested by the chapter's skill-level analysis, longer-term redistributive measures might be required as well, including redesigning tax and benefit policies by introducing or scaling up negative income taxes or universal basic incomes. With the prospect of an AI-led economy at hand, prospectively redesigning education and training for a future AI-led economy will also be needed.

In emerging economies, global integration has allowed for expanded access to capital and technology and, by raising productivity and growth, led to a rise in living standards. In principle, the decline in the labor share of income may not by itself call for policy intervention but, as in advanced economies, policies should work to make access to opportunities as well as gains from growth broadly shared. Moreover, challenges similar to those in advanced economies could arise as automation progresses. Policies to promote skill deepening may therefore have an important role to play in preparing workers in emerging economies for further structural transformation in addition to facilitating the income convergence process.

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Annex Tables

Table A1. Country Coverage

Aggregate Long-Term Trend Analysis	Australia, Austria, Belgium, Canada, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Korea, Latvia, Lithuania, Malta, Netherlands, New Zealand, Norway, Portugal, Singapore, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom, United States Brazil, Bulgaria, Chile, China, Costa Rica, Egypt, Hungary, Indonesia, Kyrgyz Republic, Mexico, Morocco, Peru, Philippines, Poland, Romania, South Africa, Thailand, Turkey
Aggregate Stacked Five-Year Trend Analysis	Australia, Austria, Belgium, Canada, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Korea, Latvia, Lithuania, Malta, Netherlands, New Zealand, Norway, Portugal, Singapore, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom, United States Bolivia, Brazil, Bulgaria, Chile, China, Croatia, Egypt, Hungary, Indonesia, Jamaica, Kyrgyz Republic, Mexico, Morocco, Namibia, Peru, Philippines, Poland, Romania, South Africa, Tanzania, Thailand, Turkey, Venezuela
Sectoral Analysis	Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Korea, Netherlands, New Zealand, Norway, Portugal, Singapore, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom, United States
Aggregate Analysis by Skill	Australia, Austria, Belgium, Canada, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Japan, Korea, Latvia, Lithuania, Malta, Netherlands, Portugal, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom, United States Brazil, Bulgaria, China, Hungary, India, Indonesia, Mexico, Poland, Romania, Turkey
Sectoral Analysis by Skill	Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Korea, Netherlands, New Zealand, Norway, Portugal, Singapore, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom, United States Brazil, China, Mexico, Romania, Turkey

Table A2. Data Sources

Indicator	Source
Labor Share (Aggregate)	Karabarbounis and Neiman (2014); national authorities; Organisation for Economic Co-operation and Development
Labor Share (Sectoral)	CEIC database; EU KLEMS database; Organisation for Economic Co-operation and Development
Labor Share by Skill	World Input-Output Database, Socio Economic Accounts, Release of July 2014.
Price of Investment	IMF, World Economic Outlook database
Intermediate Imports	EORA MRIO database; World Input-Output Database
Global Value Chain Participation	EORA MRIO database; IMF staff calculations
Domestic Value Added	EORA MRIO database
Imports and Exports of Goods and Services	IMF, World Economic Outlook database
Union Density Rate	Database on Institutional Characteristics of Trade Unions, Wage Setting, State Intervention and Social Pacts; Organisation for Economic Co-operation and Development
Routinization	Autor and Dorn (2014); European Union Labor Force Survey; Eurostat; IPUMS International; IPUMS USA; International Labour Organization; national authorities; United Nations
Offshorability	Blinder (2007); European Union Labor Force Survey; Eurostat; IPUMS International; IPUMS USA; International Labour Organization; national authorities; United Nations database
Corporate Income Tax	IMF, Fiscal Monitor database
GDP, Per Capita GDP	IMF, World Economic Outlook database
External Assets and Liabilities	External Wealth of Nations Mark II database
Credit to Private Sector	World Bank World Development Indicators database
Inflation Expectations	Consensus Forecast database; IMF, World Economic Outlook database
Capital Depreciation Rate	World Bank database
Old-Age Dependency Ratio	World Bank database
Migrant Stock	United Nations database
Relative Skill Supply (Percent of population with primary, secondary, tertiary education)	Barro Lee Educational Attainment for Population Aged 15 and over database (2013); World Input-Output Database; IMF staff calculations
Long-Term Treasury Yield	IMF, International Financial Statistics database; IMF, World Economic Outlook database