Are Your Labor Shares Set in Beijing? The View Through the Lens of Global Value Chains*

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Abstract

We study the evolution of labor shares while taking into account international trade based on value added concepts. On average, labor shares decline significantly in 1995–2007 and then recover somewhat in 2007–2014. *Skilled* labor shares increase strongly and uniformly throughout 1995–2014. Globalization consistently pushes labor shares down due to greater reliance on intermediate input trade, which is relatively capital intensive; complex global value chains are an important dimension of this process. Within-industry changes account for the reversal in the decline in labor shares after 2007, and almost all of the increase in skilled labor shares; we explain this by declines in the price of capital in the presence of capital-skill complementarity. Compared to shares in GDP, declines in labor shares in *national* income are larger in countries that have large net FDI positions, exacerbating increases in inequality.

JEL classifications: E25, F14, F15, F16, F66, J00

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1 Introduction

The decline in labor shares in recent decades in many advanced economies has caught the attention and concerns of both academics and policymakers. Apart from being a fascinating phenomenon in its own right (with important consequences for economic modeling), the interest in declining labor shares stems from concerns about its implications for income inequality.[1] Just like labor income, capital income accrues to people, but the ownership of capital is concentrated in the hands of relatively few; moreover, capital ownership among capital owners—and thus capital income—are more concentrated than human capital and labor income among workers.[2] A smaller share of value added that is paid to labor implies that income inequality among people rises. This is particularly acute given relatively weak productivity growth in recent times.[3]

Deepening of geographical links through trade in intermediate inputs and complex global value chains (GVCs) implies that studying the evolution of factor shares from a purely closed economy perspective is bound to miss much of the underlying forces that drive these evolutions. In order to better understand the mechanisms behind these evolutions we decompose changes in labor shares into several dimensions, using data from the World Input-Output Database (WIOD). The advantage of this approach is that it allows studying the effects of globalization and international trade on labor shares based on value added concepts, which is mandated by the ever-deepening of production sharing across international borders.[4] Standard gross trade sales statistics are misleading, a point forcefully made in Timmer, Miroudot, and de Vries (2018).[5] This has become particularly acute

[1] Changing shares contradict the first of the so-called "Kaldor facts" and lead to rejecting the Kaldor (1957) model of growth, along with other models that imply the same constancy of shares. Varying shares also have ramifications for computation of total factor productivity and long run macroeconomic projections.

[2] For example, see Piketty (2014), as well as up to date and more comprehensive statistics from the World Inequality Database, https://wid.world/. This goes beyond the classic "functional inequality" between workers, "capitalists" and "rentiers", due to Adam Smith and David Ricardo.

[3] An additional concern relates to how income inequality affects overall growth and political economy; see, e.g., Persson and Tabellini (1994), Alesina and Rodrik (1994), Alesina and Perotti (1996), and more recently Ostry and Berg (2011).

[4] As noted in the conclusion of Grossman and Rossi-Hansberg (2008): "...almost all current goods' trade data pertain to gross flows rather than to value added. The globalization of production processes mandates a new approach to trade data collection, one that records international transactions, much like domestic transactions have been recorded for many years."

[5] Timmer, Miroudot, and de Vries (2018) show that revealed comparative advantage indices based on gross trade statistics deliver surprising results and deviate significantly from those based on and trade in value added, which are more sensible. Using gross instead of value added export data is also one of the the conceptual flaws underlying the so-called Leontief (1953) paradox. Trefler and Zhu (2010) show that taking into account intermediate inputs helps align factor content of trade predictions of the Heckscher-Ohlin with the data. Related to this, Ito, Rotunno, and Vézina (2017) show that predictions of Heckscher-Ohlin trade theory hold much better in value added trade data than in gross value added data. See also Koopman, Wang, and Wei (2014) on the importance of double-counting in gross exports data. See Johnson (2014) for a portrait of differences between gross trade and value added trade flows, as well as several implications. Los and Timmer (2018) distinguish among different concepts of value added in exports. Johnson (2018) provides a recent survey of all these issues.

since China joined the World Trade Organization in 2001 and the subsequent increase in its presence in global trade.[6] While Freeman (1995) famously asked "Are your wages set in Beijing?", answering such questions increasingly requires a different data approach.

We start by comparing adjustment within industries versus changes in composition, the latter driven by changes in production linkages and by changes in the pattern of global final demand. We then evaluate how much of the changes in composition occur due to globalization: exports, complex GVCs, and foreign demand. We split our sample into two sub-periods: 1995–2007 and 2007–2014. This is driven by the following observation: while labor shares decrease on average in the first sub-sample, after 2007 labor shares increase on average, albeit less than the initial decrease.[7]

We find that changes in composition explain much of the decline in labor shares in 1995–2007, accounting for 35% of decline, on average. This is associated with globalization: a shift towards greater reliance on foreign sources of factor income, which manifests both in terms of exports and even more so in terms of deepening of complex GVCs. Changes in composition continue to reduce labor shares in 2007–2014, although much more modestly. This is related to the global slowdown in trade and GVC growth after 2007. On average, the within industry component accounts for 43% of the decline in labor shares in 1995–2007, and more than all of the (more modest) increase in labor shares in 2007–2014, on average. In manufacturing, where trade and GVC participation are generally more intensive, changes in composition and globalization have more pronounced effects.

Despite significant declines in the overall labor share in 1995–2007, we find large increases in the share of *skilled* labor in this period, as well as in 2007–2014. For the 1995–2007 period we find that changes in composition account for only 10% of the increase; within-industry forces account for 93% of the increase.[8] Within-industry forces account for more than the entire increase in skilled labor shares in manufacturing, despite the relative importance of GVC participation in manufacturing. The stark difference between the role of within-industry evolutions for the increase in skilled labor shares and for the decline in overall labor shares is driven by the fact that, on average, changes in industries' expenditure shares on skilled labor in all countries increase at roughly the same rate. In contrast, there are significant differences in capital and labor intensities between when they are applied to produce for domestic industries and when they are applied to produce inputs for (downstream) foreign industries. An under-emphasized corollary of the overall decline in labor shares and the increase in skilled-labor shares is that more than the entire drop in overall labor shares is shouldered by unskilled labor, and that this difference is mostly due to globalization. This

[6] This is demonstrated in Koopman, Wang, and Wei (2012) and in Kee and Tang (2016).

[7] The 1995–2007 period is covered by WIOD 2013 edition, while the 2007-2014 period is covered by WIOD 2016 edition. There are some differences in methodology and coverage between the two, on which we elaborate below. These differences reinforce the decision to treat each sample separately.

[8] We are unable to perform these decompositions in 2007–2014 due to data constraints.

is reminiscent of, *inter alia*, Richardson (1995) and especially Wood (1995).

The importance of within-industry adjustment is likely associated with skill-biased technological (or technical) change (SBTC) or reductions in the price of capital equipment.[9] We offer a theoretical framework that rationalizes the concurrent rise of skilled labor shares with the initial decline in overall labor shares, together with the subsequent increase of the overall labor share around 2007 through within-industry adjustment. We assume capital-skill complementarity featuring an elasticity of substitution between unskilled labor and capital that is greater than one and an elasticity of substitution between skilled labor and capital that is less than one. In this case a decline in the price of capital reduces the unskilled labor share through strong substitution towards capital. At the same time, the decline in the price of capital causes substitution towards skilled labor and away from capital. When unskilled labor shares are initially high, the substitution away from unskilled labor is greater than the substitution towards skilled labor, causing a decline in the overall labor share. As this process continues, substitution away from unskilled labor becomes less than the substitution towards skilled labor, causing an increase in the overall labor share. We illustrate this mechanism by means of a simple quantitative evaluation based on observable data.

Finally, we associate variation in payments to domestically-installed capital by downstream foreign industries to indicators of foreign ownership in the countries in which these downstream industries are located. More specifically, we find that capital income in country o due to sales of intermediate inputs to country d is associated with ownership by country d of capital installed in country o. This suggests that part of this capital income accrues to entities in d. This is an important contribution of our work. The entire debate about labor and capital shares involves domestic production data, which says nothing about the local versus foreign composition of ownership of capital. Given the uneven distribution of foreign capital ownership across countries, our findings imply that the labor share in *national* income decreases more than it's share in domestic income (GDP) in countries that have greater net outward FDI positions and/or are hubs of multinational headquarters.

Since most countries and most industries within them have experienced declines in labor shares, it is plausible that the cause is common to all. One of the leading explanations for this change, due to Karabarbounis and Neiman (2014), is the widespread decline in the price of new capital goods, i.e., investment, which may have caused a shift in expenditures towards capital (this would be the

[9] A note of caution is in order, since within-industry changes, even at greater degrees of disaggregation than what we use, can mask significant and equally large changes in firm composition, which are associated with globalization. This can be seen by juxtaposing the 4-digit SIC industry-level analysis of U.S. manufacturing in Berman, Bound, and Griliches (1994) with the analysis of the plant-level data that underlies the 4-digit SIC industries in Bernard and Jensen (1997).

case if the elasticity of substitution between capital and labor were greater than unity).[10] Indeed, they document that in countries and industries where the decline in investment goods' prices were deeper, labor shares dropped more. This explanation emphasizes adjustment within industries and countries in response to pervasive lower prices of investment goods. This includes embodied technological change (computers, robots, etc.), as argued in Martinez (2018).[11] In contrast, Oberfield and Raval (2014) find that the drop in labor shares in United States manufacturing cannot be associated with price reductions for capital because they estimate that the elasticity of substitution between labor and capital is less than unity.[12]

An alternative and equally pervasive phenomenon is the deepening of integration of economic units across the globe in recent decades. A salient characteristic of this process of globalization in recent decades is the geographic fragmentation of production value chains. By this we mean that the location of production of final goods has become less and less concentrated in one country. This is associated to declines in transport and communication costs across countries, giving rise to deepening GVCs. Changes in GVC participation are driven by how intermediate input production spreads across borders, including offshoring. For example, of the value added that is generated by the average manufacturing industry, the share that is paid to factors that are located in a different country has increased significantly by 7.6 percent points from 15.8 percent in 1995 to 23.4 percent in 2007. In 2007–2014 the foreign payments share increased more modestly, by 1.3 additional percent points. This phenomenon is sometimes called backward deepening of GVCs, and it refers to payments to primary production factors (capital and labor) that are employed in upstream (input-supplying) industries that are located in other countries.[13] Similarly, payments to domestic factors rely ever more on foreign downstream industries. This is sometimes called forward deepening of GVCs. The share of GDP that is paid by such foreign downstream industries increases in manufacturing by 7.1 percent points from 18.9 percent in 1995 to 26 percent in 2007. In 2007–2014 the foreign downstream share in GDP increased more modestly, by 1.6 additional percent points.[14]

[10] When the elasticity of substitution between labor and capital is greater than unity and when factor markets are competitive, then a lower relative price of capital causes an increase in the share of expenditures on capital due to strong substitution towards capital usage.

[11] See also Graetz and Michaels (2018).

[12] Karabarbounis and Neiman (2014) consider the aggregate economy elasticity of substitution, while Oberfield and Raval (2014) consider only the elasticity in manufacturing. It is possible that the two differ markedly, as shown in Reshef (2013) for the case of substitution between skilled and unskilled labor.

[13] Backward GVC participation for the entire economy, the share that is paid to factors that are located in a different country, increased less, by 3.1 percent points, and from more modest levels, from 8.1 percent in 1995 to 11.3 percent in 2007. These figures are smaller compared to manufacturing (about half), because the non-manufacturing sectors (services and public) participate less directly in GVCs.

[14] As with backward GVC participation, forward GVC participation for the entire economy, the share of payments to domestic factors that originate in foreign industries increased less, by 2.8 percent points, and from more modest

The rise of GVCs can contribute to the reduction in labor shares through a change in composition of production. This can occur via backward GVC deepening, by shifting production from high labor share local supplying industries to low labor share foreign supplying industries. Alternatively, forward GVC deepening may shift employment of factor services from high labor share activities to support production of domestic final goods to low labor share activities to support production of foreign final goods. Importantly, since industrial composition and international linkages vary across countries, this may lower labor shares everywhere. We find that compositional changes are an important dimension of the decline in labor shares in manufacturing, accounting for 40% of the average decline in 1995–2007, and that this is mostly driven by changes in between-industry linkages (both domestic and international), alone accounting for 23% of the decline. Dao, Das, Koczan, and Lian (2017) estimate that GVC deepening within an industry lowers *within*-industry labor shares; in contrast, we associate GVC deepening only to composition. In this sense, our findings on the importance of GVC participation is a lower bound, as it may have additional effects on within-industry changes in labor shares.

Timmer, Los, Stehrer, and de Vries (2013) argue that the rise of GVCs is associated with a shift towards skilled labor employment in 1995–2008. They find greater growth in skilled employment in GVC activities than in the economy overall. In contrast, we find little role for composition in increasing skilled labor shares. Although Timmer, Los, Stehrer, and de Vries (2013) study quantities while we study expenditures (= quantity × price), given the general increase in relative wages of skilled versus unskilled labor, it is difficult to reconcile the two contrasting findings. Our results are more consistent with a greater importance of SBTC in the shift of labor income from low skilled to high skilled; GVC deepening do not contribute much to this shift.[15]

Both Dao, Das, Koczan, and Lian (2017) and Karabarbounis and Neiman (2014) argue that changes in industry composition do not account for much of the changes in aggregate labor shares. There are at least two reasons for this. The first is that they use industry value added shares to aggregate industry-level value added labor shares. This can generate misleading results on the role of composition, which does not take into account changes in composition due to sourcing decisions. A similar point is made in Baqaee (2019), although confusingly, when Baqaee (2019) uses a similar decomposition of labor shares in value added with value added weights—as in Dao, Das, Koczan, and Lian (2017) and Karabarbounis and Neiman (2014)—he finds the opposite result:

levels, from 8.9 percent in 1995 to 11.7 percent in 2007. These figures are smaller compared to manufacturing (about half), because the non-manufacturing sectors (services and public) participate less in GVCs.

[15] Timmer, Miroudot, and de Vries (2018) also study sub-components of labor income in a context of GVCs. They introduce the concept of "functional specialization, which is an indicator of income shares in value added exports that are paid to specific subsets of labor (relative to the world average for this subset), defined by their occupations (in theory, functions or "tasks". They do not study the underlying mechanics of these changes, as we do.

within industry changes explain little of the decline, while composition explains almost all of it. In contrast, we use industry labor shares in gross output, which are aggregated by using the entire input-output and demand structure, to give the labor share in GDP.

The second reason for differences in results is variation in data sources, measurement, and level of aggregation. For example, the data used by Dao, Das, Koczan, and Lian (2017) has only 10 industries, which mechanically causes more variation to occur within industries compared to our data, which include 35 or 56 industries in 1995–2007 or 2007–2014, respectively. In the limit, if there is only one industry, all of the variation is within this single industry. The sample of countries is also different across studies. Karabarbounis and Neiman (2014) consider value added shares in corporate income, while we consider the entire economy.[16]

Most previous research focuses on the United States and other developed economies in the medium-run, e.g., Blanchard (1997), Elsby, Hobijn, and Şahin (2013), Rognlie (2016).[17] Different forces play a role in these and other papers, but their relative importance is not clear. Autor, Dorn, Katz, Patterson, and Van Reenen (2017) consider the role of concentration and greater competition. Related to this, Kyyrä and Maliranta (2008) also consider changes in the size and age composition of firms. The decline and then increase in labor shares may also be related to endogenous directed technological change as in Kennedy (1964) and Acemoglu (2003), where the decline in the relative price of capital leads to innovation that corrects initial changes in factors income shares. Acemoglu and Restrepo (2018) discuss the possible implications of technological change and robotization, and vom Lehn (2018) discusses how this manifests across occupations. The recent decline in the labor shares has been also related to structural change (Ngai and Pissarides (2007), Buera and Kaboski (2012), McAdam and Willman (2013)), the difference between capital returns and output growth (Piketty (2014)), deregulation of labor markets (Blanchard and Giavazzi (2003)), deregulation of bank branching in the U.S. (Weinberger and Leblebicioglu (forthcoming)). Gutiérrez and Piton (2019) study the role of real estate in the dynamics of the labor share in advanced economies. See Harrison (2005) and Rodriguez and Jayadev (2010) for treatments of less developed countries. Weinberger and Leblebicioglu (2018) studies the effect of capital import liberalization in India, and finds that this actually increased firm-level labor shares, probably by increasing quality of capital equipment while lowering it's effective price. Our contribution is to shed light on the relative contributions of technological change and globalization in the evolution of the labor share in a sample of mostly developed, mid-income and transition economies, but also important developing

[16] See Mućk, McAdam, and Growiec (2018) for an overview of different measures of the labor share. For the United States, all measures show common trends from 2001 and on.

[17] For business cycle properties of the labor share see McAdam and Willman (2013), Young (2004) and Mućk, McAdam, and Growiec (2018).

and emerging economies (e.g., India and China). Brooks, Kaboski, Li, and Qian (2019) argue that employers' monopsony power in China and India lowers labor shares there, and this effect has declined over time.

The closest paper to ours is Baqaee (2019), who finds a much smaller impact of compositional changes and attributes almost all of the decline in labor shares to within-industry variation. While both studies use labor shares in gross output to compute aggregate labor shares in GDP and take into account the entire global input-output structure, there are important differences that can help explain this discrepancy. First, the methodology in Baqaee (2019) uses fixed labor shares by industry at every link of the value chain to compute aggregate labor shares. In contrast, we compute aggregate labor shares only based on gross output after the entire value chain manifests in final demand. Both approaches do not allow factor shares to differ depending on downstream use, while virtually all firm level evidence indicates that exporting firms are significantly more capital and skill intensive.[18] Which approach is better depends on how factor shares differ depending on downstream use, which is impossible to gauge using our data. Second, Baqaee calculates aggregate labor shares by first imputing "network-adjusted labor shares" and then aggregating them by applying equilibrium conditions that may not hold in the data. Our methodology relies only on data, and does not require such assumptions.[19]

Third, the decomposition used by Baqaee (2019) may understate the role for composition in explaining changes labor shares. This is because the contribution of changes in composition patterns are evaluated using labor shares at the end of the period. Since labor shares decline, this can make the contributions of these components mechanically small compared to other decompositions.[20] The decompositions that we apply are not biased in this way or other. In addition, our paper studies sub-components of changes in composition, whereas Baqaee does not.

The rest of the paper is organized as follows. Section 2 describes the data and methodology underlying international input-output calculations. Section 3 documents changes in factor shares

[18] See, for example, Bernard, Jensen, Redding, and Schott (2007) for the U.S., Harrigan and Reshef (2015) in Chile.

[19] In particular, both sides of equations (2) and (4) below are data in our methodology, and so are internally consistent.

[20] Simplifying the relevant equations, Baqaee (2019) decomposes Δlabor share in GDP = Δcomposition$\cdot$gross labor share$_2$ + composition$_1 \cdot \Delta$gross labor share, where 1 and 2 represent the first and last period, 1995 and 2007, respectively, and where "composition" and "gross labor share" are vectors. Since gross labors shares have declined over this period, the contribution of changes in composition mechanically play a smaller role than in other decomposition equations. To see this point, note that Δlabor share in GDP can also be decomposed as Δlabor share in GDP = Δcomposition$\cdot$gross labor share$_1$ + composition$_2 \cdot \Delta$gross labor share. If all gross labor shares decline by half from period 1 to period 2 (from heterogenous starting levels), the first decomposition assigns half the importance to the "between" component, which is the first term in both decompositions. In fact, when we implement the two decompositions above in our data they imply opposite relative importance of composition, compared to within-industry variation. This is why the classic decomposition used by many authors, starting with Berman, Bound, and Griliches (1994), is the average of the two decompositions.

and in GVC participation that we analyze in Section 4. In Section 5 we study the relationship between foreign ownership of capital and capital income. Section 6 offers concluding remarks.

2 Data and methodology

The main source of data is the World Input-Output Database (WIOD). Most of the analysis rely on the 2013 release of the data, covering the period 1995–2011. We use these to compute statistics over the pre-crisis period of 1995–2007. Along with detailed Input-Output tables for 40 countries and 35 industries (ISIC rev. 3), this release also provides the Socio-Economic Accounts with data on employment, labor compensation and capital stocks, all by country and industry. In addition, the 2013 release reports employment and labor compensation by educational attainment within each country and industry. We also use the more recent 2016 WIOD release, covering 43 countries and 56 sectors (ISIC rev. 4) for the period 2000–2014. We use these to compute statistics over the post-crisis period of 2007–2014. The Socio-Economic Accounts in the 2016 release do not include breakdowns of labor concepts by educational level. For this reason we use EU KLEMS 2017 release in order to complement the country-level breakdowns of labor concepts by educational level; these data are available for only 26 countries, in 2008–2014.[21]

One major caveat in using these data arises from the proportionality assumptions in constructing the WIOD. Value added shares within industry gross output and factor expenditure shares within value added are the same within an industry and country, regardless of the using industry and country or final consumption destination. This means that the WIOD data do not allow the value added intensity of global sourcing or of inputs to depend on the use of output (downstream industries across countries or consumption). de Gortari (2017) demonstrates that the latter can have significant quantitative implications.

Data on the location, production and sales of multinational affiliate firms are from Ramondo, Rodríguez-Clare, and Tintelnot (2015). Control variables used in the estimation in Section 5 are from the CEPII gravity database.

The labor share is defined as the total labor compensation divided by value added within a country. The capital share is one minus the labor share, and thus includes not only direct payments to capital but also profits, the latter reflecting markups among other things. Thus, an increase in the capital share can also reflect an increase in markups, which has been documented by De Loecker and Eeckhout (2017) and De Loecker and Eeckhout (2018), which is not distributed equally to

[21] For WIOD 2013 release documentation see Timmer, Dietzenbacher, Los, Stehrer, and de Vries (2015). For WIOD 2016 release documentation see Timmer, Los, Stehrer, and de Vries (2016). See http://www.wiod.org/home for further details on WIOD country coverage and data availability. For EU KLEMS 2017 release documentation see Jäger (2017), available at http://www.euklems.net/.

capital and labor, as well as income from self-employment. The latter is not an important share of GDP, and does not alter materially trends in the labor share, as shown in Dao, Das, Koczan, and Lian (2017).

Our calculations rely on the methodology in Leontief (1936), applied to an international setting (made possible by the WIOD), and further extended to splitting value added (VA) into remuneration of primary factors, i.e. capital and labor.[22] We outline the main features of the methodology here and relegate more details to the Appendix. Gross output for any industry located in any country is the sum of intermediate demand from all other industries located in all other countries, plus final demand. In matrix notation, this is

$$X = AX + Y \ , \tag{1}$$

where X is the vector of gross outputs, AX is intermediate demand and Y is final consumption, or demand for final goods by households. A is the matrix of technical coefficients, whose typical entry a_{ij}^{od} is the value of input from industry i located in country o that is needed to produce one dollar worth of product j in country d. From (1) one can derive

$$X = (I - A)^{-1} Y = BY \ , \tag{2}$$

where $B = (I - A)^{-1}$ is the well-known Leontief (inverse) matrix, which takes into account the indirect production linkages across industries. A typical entry of the B matrix b_{ij}^{od} indicates the value of production in industry i located in country o that is required in order to satisfy one unit of final demand for product j in country d, while taking into account direct and indirect intermediate demand from all other using industries. In other words, B summarizes all value chains, be they domestic or global. It is useful to define Y as a diagonal matrix, with the corresponding values on the diagonal, and zeros elsewhere. This implies that X is a matrix as well.

Equation (2) is expressed in gross output terms, in US dollars. In order to convert (2) into value added (VA) terms (also in US dollars), pre-multiply (2) by V, defined as a diagonal matrix with the value added to gross output ratios (intensities) of each sector on the diagonal, and zeros elsewhere:

$$VX = VBY \ . \tag{3}$$

The left hand side, VX, is industry value added produced and the right hand side, VBY, is demand for final goods in value added terms.[23]

[22] See, for example, Timmer, Erumban, Los, Stehrer, and de Vries (2014).

[23] By construction, summing all elements of VBY or of VX gives world GDP, i.e. the value of global expenditures on final goods accrues to primary production factors, which is also equal to their income. Summing all elements within the rows that pertain to a country's industries gives that country's GDP; summing all elements within the columns that pertain to a country's industries gives that country's production of final goods and services (in value

We compute factor payments for labor L, high skill labor H, low skill labor N, and capital K as follows. For each factor $f \in \{L, H, N, K\}$ we pre-multiply (3) by a diagonal matrix of the corresponding factor share in value added in each industry and country F_f

$$F_f V X = F_f V B Y \ .$$

Denote by

$$V_f = F_f V \tag{4}$$

the diagonal matrix of shares of factor f in gross outputs. Then we have

$$V_f X = V_f B Y \ . \tag{5}$$

This is a square matrix with typical element $(v_f by)_{ij}^{od}$, which is the payments to factor f located in country o and employed in industry i (row o-i) that are induced by demand for final goods that are manufactured by industry j located in country d (column d-j). Total payments to factor f in country o are thus $(v_f by)^o = \sum_i \sum_j \sum_d (v_f by)_{ij}^{od}$ and this is equal to the GDP share of factor f. Once factor income for any factor in each location is calculated, factor income shares and changes thereof are straightforward, since $V_L BY + V_K BY = VBY$ and $V_H BY + V_N BY = V_L BY$.

An important caveat to the methodology leading to equation (5) is driven by a proportionality assumption for factor payments: factor shares in any industry in any country are invariant to the using industries. In particular, they are the same whether the using industry is domestic or foreign. If capital intensities are higher for exporting activities versus domestic sales, then we will underestimate of the role of increases in GVC participation in driving down the labor share.[24] In other words, inasmuch as our results indicate that GVC deepening contributes to the decline in labor shares, this should be understood as a lower bound. Another caveat is that we do not make allowances for capital depreciation and do not add to labor income the earnings of self-employed. Dao, Das, Koczan, and Lian (2017) demonstrate that although affecting levels, adjusting for these factors hardly alters trends.

3 Facts: changes in factor shares and in GVC participation

In this section we characterize changes in factor shares and in GVC participation. Given our data constraints, and given the financial crisis that occurred in 2008, we organize the discussion in two

added terms).

[24] It is well-known that within industries exporters are more capital and skill intensive; see, e.g., Bernard, Jensen, Redding, and Schott (2007) and Harrigan and Reshef (2015).

periods: 1995–2007 and 2007–2014.[25] Three facts emerge from the calculations in 1995–2007: on average, (1) labor shares decline, (2) high skill labor shares increase, and (3) GVC participation deepens. In contrast, we find that on average in 2007–2014: (4) labor shares increase, but less than the decrease in 1995–2007, (5) high skill labor shares continue to increase, and (6) GVC participation deepens, but slows down considerably compared to 1995–2007. The reversal of the average direction in which labor shares have evolved around 2007, as well as the increase in skilled labor shares are consistent with findings in Dao, Das, Koczan, and Lian (2017). The slowdown in GVC participation is consistent with Timmer, Los, Stehrer, and de Vries (2016), who rely on the same data and use somewhat different methodology.

3.1 The evolution of labor shares

l illustrates the average decline in labor shares in 1995–2007 (Panel A), and the average increase in 2007–2014 (Panel B). The average decline in 1995–2007 is 1.6 percent points, while the weighted average (using GDP in 1995 as weights) declines by 2.4 percent points. In large part the discrepancy between the average and the weighted average are very large declines in large developing economies. Countries below the 45-degree line exhibit declines, and those that are above exhibit increases in labor shares. Among the 39 countries in the 1995–2007 sample, 25 see their labor shares decrease, while the others see increases. Among the largest declines in 1995–2007 we see India, Indonesia and China, three Asian countries experiencing rapid development; among the countries that see large increases in labor shares we see Brazil, Turkey and the United Kingdom. Among the 42 countries in the 2007–2014 sample, 24 see their labor shares increase, while the others see decreases. Among the largest increases in 2007–2014 we see Brazil, China and Indonesia, as well as Germany and France; among the countries that see their labor shares decrease we see Canada, United Kingdom and the United States. Several countries reverse trend, notably China.[26]

[25] Data for 1995-2007 come from the WIOD 2013 release, and data for 2007-2014 come from the WIOD 2016 release. The correlation between factor shares and GVC participation indicators in 2007 coming from either release of the WIOD is over 0.85. Differences in levels can arise partly from methodological differences, but the changes over time within each dataset are comparable. We drop Poland from the analysis in 1995–2007 because it is an extreme outlier in 1995, and thus creates unreasonable variation from 1995 to 2007 for that country.

[26] Table A1 and Table A2 in the appendix contains all data for Figure 1.

Figure 1. The Evolution of Labor Shares in GDP

Notes. Share of labor compensation in GDP (total value added) by country. Each circle represents one country. The size of the circle is proportional to GDP in the first year (1995 in Panel A; 2007 in Panel B). The solid diamond represents the weighted average, using GDP in the first year as weights. The solid line represents the 45-degree line. Source: own computations using WIOD releases 2013 and 2016.

3.2 Rising skilled labor shares

In Figure 2 we demonstrate an overall increase in skill intensity across virtually all economies in our sample, where skill is captured by workers with tertiary education.[27] This increase manifests both as a share of total payments to labor (Panels A and C), i.e. an increase in skill intensity for a given level of overall labor intensity, but also as a share of GDP (Panels B and D).[28] Together with the overall decline in labor shares displayed in Figure 1 in 1995–2007, the corollary of this is that

[27] While the definition of tertiary education varies slightly across countries, it is consistently defined within a country over time, typically as having at least a three-year university degree.

[28] Tables A1 and A2 in the appendix contains all data for Figure 2.

the decline in the share of payments to less-educated workers is greater than the decline in labor shares overall. Given the magnitudes we report below,

The average increase in the skilled labor share out of total payments to labor in 1995–2007 is 7.6 percent points (Panel A), while the weighted average (using GDP in 1995 as weights) increases by 8.1 percent points. Over the same period, the average increase in the skilled labor share out of GDP is 4.1 percent points, while the weighted average increases by 4.3 percent points (Panel B). Compared to the heterogeneity in changes in payments to labor overall (Figure 1), it is striking how uniformly all countries see their skilled labor shares increase. Only Mexico and Estonia see their skilled labor shares decline in this period. Moreover, the magnitudes of changes in composition within labor income are much larger than between labor and capital overall.[29]

The average increase in the skilled labor share out of total payments to labor in 2008–2014 is 5.6 percent points (Panel C), while the weighted average (using GDP in 2007 as weights) increases by 3.3 percent points. Over the same period, the average increase in the skilled labor share out of GDP is 2.4 percent points, while the weighted average increases by 1.9 percent points (Panel D). Notably, Germany, Italy and the Netherlands exhibit significant declines. Note that since these changes occur over half the time, the overall pace of change is similar to that exhibited in Panels A and B, on average.

Overall, the data displayed in Figure 1 and Figure 2 exhibit the following pattern of changes in the distribution of income across factors: an average (but mixed) decrease in labor shares and the commensurate increase in capital shares in 1995–2007 and a partial reversal in 2007–2014; a larger (and almost uniform) increase in skilled labor shares throughout the sample, with the result of and larger decreases in unskilled labor shares.

One explanation of these findings involves a decline in the relative price of capital in the presence of capital-skill complementarity, on which we elaborate in Section 4.3 below. Suppose that skilled labor and capital are bundled together with an elasticity of substitution less than 1, and that this skilled labor-capital bundle has an elasticity of substitution with unskilled labor that is greater than 1.[30] A decline in the relative price of capital will increase the share of payments to skilled labor due to two forces: a shift of income from capital to skilled labor, and a shift of income from unskilled labor to the skilled labor-capital bundle (the bundle as a whole becomes cheaper, and

[29] Baqaee (2019) also makes this observation, although with a different concept of skilled labor shares.

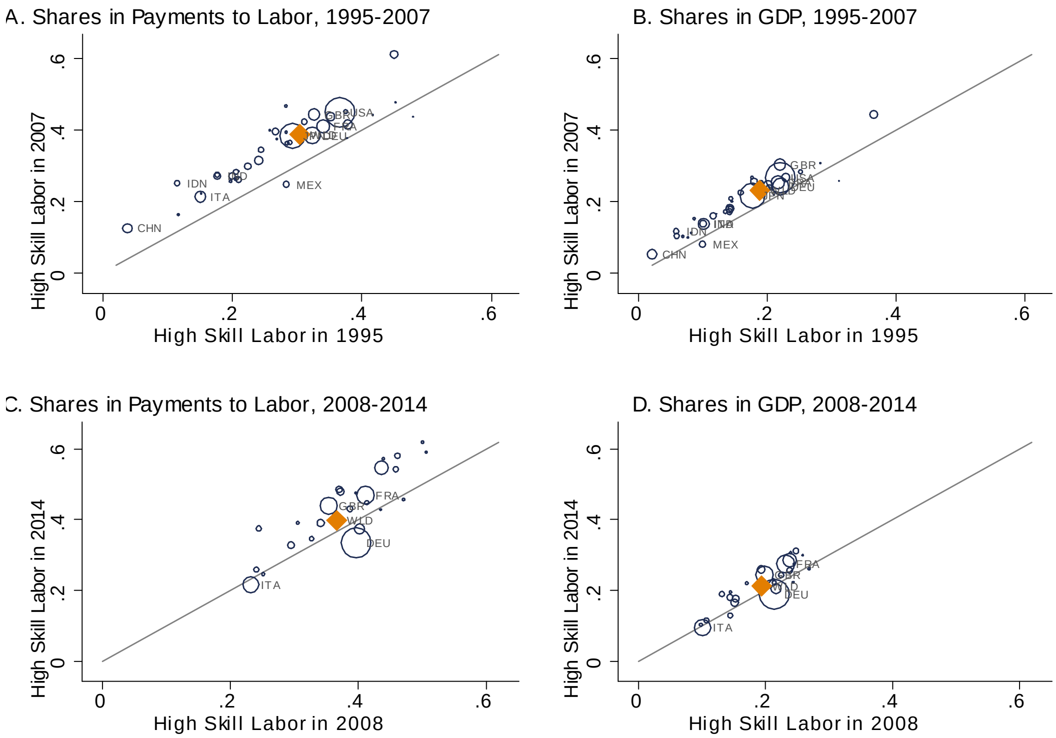
[30] This description is consistent with findings for the United States in, for example, Krusell, Ohanian, Rios-Rull, and Violante (2000). This finds mixed support in a cross-country setting in Duffy, Papageorgiou, and Perez-Sebastian (2004). Instability and heterogeneity across countries can arise from heterogeneity in the quality and composition of the capital stock, as argued in Raveh and Reshef (2016). Estimates of the elasticity between capital and total labor tend to be less than one, e.g., in manufacturing by Oberfield and Raval (2014) and at the aggregate level by Antràs (2004). In contrast, Karabarbounis and Neiman (2014) estimate the aggregate elasticity of substitution between capital and labor to be greater than one.

the elasticity is greater than 1). The overall share of labor may increase or decrease. On the one hand, it increases as income shifts to skilled labor within the skilled labor-capital bundle; on the other hand, it decreases due to a shift in income towards the skilled labor-capital bundle. Which force dominates depends on the values of the elasticities of substitution and on factor shares. The surprising result is that if the price of capital decreases consistently for long enough, the overall labor share initially decreases and then increase. We illustrated in Section 4.3 that this is not merely a theoretical possibility, using elasticities estimated in Krusell, Ohanian, Rios-Rull, and Violante (2000) and the actual factor shares in our data.

Another possibly is that different mechanisms govern the split of payments to capital and labor versus the split between skilled labor and unskilled labor. One such explanation has less to do with economics and more to do with accounting. As labor forces become more educated, the share of income paid to skilled/educated workers may increase, even if the allocation of tasks across workers does not change, and irrespective of the split of income between capital and labor. If tertiary education is more about signaling and less about gaining productive skills, then the increase in the share of income paid to skilled labor will increase mechanically as more workers get tertiary education.

Yet another explanation that involves different mechanisms is that (disembodied) skill-biased technological change may have driven the change in the split of income between skilled and unskilled labor, while globalization may have been driving the decline in labor shares overall. In order to address this we look next at how GVC deepening and variation in global demand may affect the split of income between domestic and foreign factors of production in general. In Section 4 we asses this idea more directly.

Figure 2. The Evolution of Skilled Labor Shares



Notes. Panels A and C display shares of skilled labor in total payments to labor (skilled plus unskilled) by country. Panels B and D display shares of skilled labor in GDP by country. Each circle represents one country. The size of the circles in Panels A and B is proportional to GDP in 1995. The size of the circles in Panels C and D is proportional to GDP in 2007. The solid diamond represents the weighted average, using GDP in the first year as weights. The solid line represents the 45-degree line. There are only 26 countries in Panels C and D, compared to 39 countries in Panels A and B, where the missing countries include many large economies like Brazil, China, India and the USA. Source: own computations using WIOD 2013 release and EU KLEMS 2017 release.

3.3 Deepening of global value chains

Figure 3 illustrates the deepening in GVC participation, and that it has slowed down from 1995–2007 to 2007–2014. Participation in GVCs has two main dimensions: forward linkages and backward linkages.[31] Forward linkages imply payments to domestic factors that are generated by downstream foreign industries. It is important to understand that this is driven by more than just direct exports

[31] Table A3 and Table A4 in the appendix contains all data for Figure 3.

of intermediate goods and services to businesses, as it takes into account the entire network of GVCs, where value can "travel" across borders and return to the originating country (e.g., buyers of buyers' of my output, etc.).[32]

Each element of the VBY matrix (see above) contains the payments to factors (capital and labor) that are employed in sector i in origin country o that contribute to the production of sector j in destination country d: $(vby)_{ij}^{od}$. By summing over all industries i and j within each country pair we obtain payments to factors that are located in country o by country d's industries: $vby^{od} = \sum_i \sum_j (vby)_{ij}^{od}$. The sum over all destinations is country o's GDP, because it encompasses all payments to capital and labor: $\sum_d (vby)^{od} = GDP^o$. By taking the share of payments by countries d that are not o to country o's GDP we have the contribution of forward linkages to domestic factors' income, or the foreign value added share in GDP: $forward^o = \sum_{d \neq o} (vby)^{od} / GDP^o$. This is the share of payments to domestic factors that originate in foreign industries, and is what Panel A and Panel C of Figure 3 display, for 1995–2007 and 2007–2014, respectively.

Backward linkages imply payments to foreign factors by domestic industries though supply of intermediate inputs and services. As with forward linkages, this is driven by more than just direct imports of intermediate goods and services, as it takes into account the entire GVC network (e.g., suppliers of the suppliers, etc.). Here, after obtaining payments to factors that are located in country o by country d, $(vby)^{od}$, we sum over all o's to get value added that is generated by all industries located in d, which is equal to final demand for country d's industries: $\sum_o (vby)^{od} = FD^d = Y^d$. By taking the share of payments to countries o that are not d to country d's final demand we have the share of payments to foreign factors (capital and labor) by domestic industries of country d, or backward linkages intensity: $backward^d = \sum_{o \neq d} (vby)^{od} / FD^d$. This is what Panel B and Panel D of Figure 3 display, for 1995–2007 and 2007–2014, respectively.

The average increase in $forward$ in 1995–2007 is 3.7 percent points, while the weighted average (using GDP in 1995 as weights) increases by 2.8 percent points. The average increase in $backward$ in the same period is 3.5 percent points, while the weighted average increases by 3.1 percent points.[33] Apart for one country (Latvia), $forward$ increases everywhere in this period. Among the largest increases we see Taiwan, Germany, Ireland, Denmark and China. In addition, Hungary, Bulgaria and Slovenia also exhibit large increases in forward linkages, as their economies integrated into the European market by serving as sources of intermediate inputs. Only two countries see significant declines in $backward$ in 1995–2007 (Lithuania and Estonia). Among the largest increases we see again eastern European countries (Bulgaria, Hungary and Slovakia), which integrated rapidly into

[32] See Hummels, Ishii, and Yi (2001) and Yi (2003) on the importance of vertical specialization and integration.
[33] The weighted averages here are smaller, as bigger economies are more likely to be their own suppliers.

the European market. India, China and Turkey also exhibit large increases, which indicates that much of their inputs originate in other countries. Germany and Denmark also feature large increases in $backward$, for the same reason.

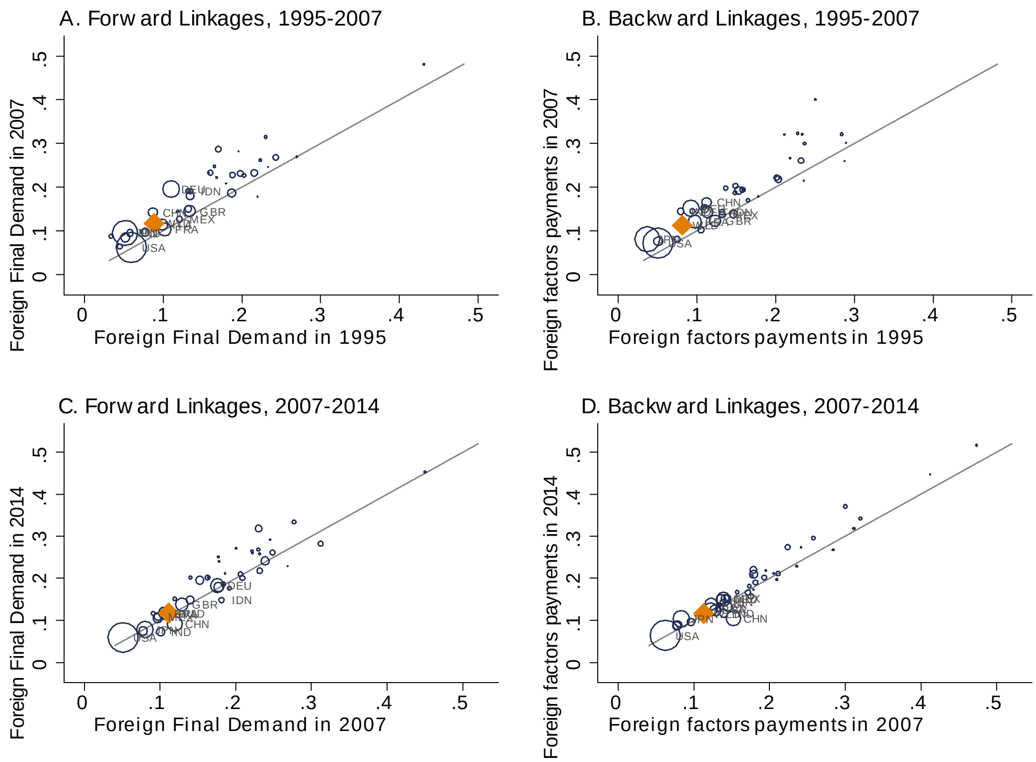
In contrast to the almost uniform deepening of GVCs in 1995–2007 across all countries, the picture is more mixed in 2007–2014. The average increase in $forward$ is only 1.7 percent points, while the weighted average (using GDP in 2007 as weights) increases by 0.8 percent points. The average increase in $backward$ in the same period is 1 percent point, while the weighted average increases by 0.5 percent points. Among the 42 countries in this sample, 32 see increases in $forward$, and 31 see increases in $backward$. Among the largest increases in $forward$ in 2007–2014 we see again eastern European and Baltic countries, as their economies integrated into the European supply chains and thus receive much of their inputs for assembly from Europe. In addition, The Netherlands and Ireland also exhibit large increases in $forward$ in this period. Among the largest decreases in $forward$ we see China, Indonesia and India. Among the largest increases in $backward$ in 2007–2014 we see centrally located European countries like Belgium, Luxembourg, The Netherlands and Ireland, as well as eastern European and Baltic countries like The Czech Republic, Estonia. Among the largest decreases in $backward$ we see again China and India.[34]

Overall, levels of both measures of GVC participation are strongly positively correlated across countries within each sample (correlation of 0.73–0.81), but changes are much less so (correlation of 0.36 in both cases). For the countries that appear in both periods, the correlations in changes within each measure are very low, -0.14 for $forward$ and -0.06 for $backward$, and not statistically significant.

Overall, we find declining labor shares in conjunction with GVC deepening in 1995–2007, versus increasing labor shares in 2007–2014 when GVC deepening slows down considerably. This suggests that GVC participation may play an important role in the evolution of labor shares. Of course, the financial crisis, by taking a greater toll on capital shares, may have also played an important role. We now turn to asking how much of the changes in factor shares are explained by within-industry and country factors versus changes in composition due to changes in GVC participation and changes in demand.

[34] On the manifestation of the "so-called" trade collapse after 2008 on value added trade see Bems, Johnson, and Yi (2011) and Nagengast and Stehrer (2016).

Figure 3. Deepening of Global Value Chains



Notes. Panel A displays forward linkages in GVCs: shares of foreign industries final demand (in value added terms) in GDP. Panel B displays backward linkages in GVCs: shares of foreign factor payments (in value added terms) in domestic industries value added. Each circle represents one country. The size of the circle is proportional to GDP in the first year (1995 in Panels A and B; 2007 in Panels C and D). The solid diamond represents the weighted average, using GDP in the first year as weights. The solid line represents the 45-degree line. Source: own computations using WIOD releases 2013 and 2016.

4 Accounting for sources of change in factor shares

We assess how much of the overall changes in factor shares are due to changes that occur within industries, versus changes in composition, e.g., changes in GVC participation and changes in the global pattern of demand. In order to do this, we allow changes in only part of the $V_f BY$ matrices, compute counter-factual income shares, and compare to the actual changes. We first associate changes in factor shares to within-industry intensities that are captured in V_f and to compositional changes that are captured in (BY). We also split compositional changes into the part that is driven by changes in the global input-output structure (B) and changes in global demand for final goods (Y). In these cases, the calculations take into account more than just direct linkages, as it takes into account the entire GVC network. We further break down changes in B into changes in strictly domestic linkages, changes in direct international linkages (export and imports), and changes in more complex linkages that include both domestic and foreign value chains, which potentially cross borders more than once (e.g., suppliers of suppliers, etc.). We also separate changes in Y into domestic and foreign demand for final goods. In all of the above we differentiate factor payments arising from from domestic industries and foreign industries.

4.1 Composition versus within-industry intensities

We decompose changes in factor income $V_f BY$ into within-industry changes captured in V_f, and changes in composition due to evolving global input-output structure B, as well as changes in the pattern of global demand Y.

The change in the product $V_f BY$ (indeed, of any three conformable matrices) can be written as

$$\begin{aligned} V_{f2}B_2Y_2 - V_{f1}B_1Y_1 &= \Delta\left(V_f BY\right) \\ &= \Delta V_f B_1 Y_1 + V_{f1}\Delta B Y_1 + V_{f1}B_1\Delta Y \\ &\quad + V_{f1}\Delta B\Delta Y + \Delta V_f B_1 \Delta Y + \Delta V_f \Delta B Y_1 \\ &\quad + \Delta V_f \Delta B \Delta Y \ . \end{aligned} \tag{6}$$

where Δ denotes the element-by-element change operator.[35] While other decompositions of changes exist, (6) offers a natural way to contemplate counterfactual scenarios, where we consider the exclusive role of each component of $V_f BY$, while fixing other components to their values in the initial period (technically, setting changes in all other dimensions to zero):

- Changes only in V_f (within-industry)

$$\Delta V_f B_1 Y_1$$

- Changes only in B (composition, I/O)

$$V_{f1}\Delta B Y_1$$

[35] See Appendix for proof.

- Changes only in Y (composition, demand)

$$V_{f1} B_1 \Delta Y$$

- Changes only in BY (composition, overall)

$$V_{f1} \Delta (BY) = V_{f1} \Delta B Y_1 + V_{f1} B_1 \Delta Y + V_{f1} \Delta B \Delta Y$$

Considering changes in BY is methodologically desirable, because the same data are used to construct both B and Y.

Once we perform these decompositions for $V_f BY$, we compute the corresponding factor shares. Changes in the matrix of value added shares in output V do not matter for factor shares, because $V_f = F_f V$ and V is common in all factor shares in value added. Changes in factor shares that are driven by changes in F_f occur exclusively within industries; technically, this is because F_f is a diagonal matrix.

Table 1 reports the results for this decomposition of changes in factors shares in value added, along with other informative statistics. Panel A reports this for the entire economy, while Panel B focuses on manufacturing industries.[36] Columns 1–4 report the shares of income accruing to capital and labor from domestic industries and from foreign industries. All other columns are derived from these. Columns 5 and 6 report the overall capital and domestic shares in value added. The split between domestic and foreign industries is given by different entries within rows in $V_f BY$. The contribution of foreign industries to factor shares in country o is given by the *forward* part of GDP: $v_f by^o = \sum_i \sum_j \sum_{d \neq o} v_f by_{ij}^{od}$, which is the off-block-diagonal part of $V_f BY$. The contribution of domestic industries is given by the complement of this to GDP: $v_f by^o = \sum_i \sum_j \sum_{d=o} v_f by_{ij}^{od}$, which is the block-diagonal part of $V_f BY$. Columns 7 and 8 report the shares in value added arising from all domestic and international sources (*forward*, as in Figure 3). Columns 9 and 10 report capital and labor shares in payments by domestic final goods industries, while columns 10 and 11 report capital and labor shares in payments by foreign final goods' industries. The rows labeled "Levels" report levels in 1995 and in 2007. Rows labeled as "Changes" report true and counterfactual changes. All numbers are weighted averages using GDP in 1995 as weights.

Table 1 reveals several interesting facts. First, the increase of 2.45 percent points in capital shares is driven both by domestic industries (0.87 pp), and even more so by foreign industries (1.57 pp). The decline in labor shares is driven by domestic industries (-3.72 pp), where the increase in payments from foreign industries (+1.27 pp) is far from enough to compensate for this decline. The

[36] It is important to remember that although all factors in Panel B are employed in manufacturing, services industries, both domestic or foreign, can also be a source of demand for manufacturing.

upshot is that the decline in labor shares is at least partly due to a shift of income derived from domestic to foreign industries, where foreign activities are more capital intensive than domestic activities. This last point can be seen by comparing columns 9 and 11 in levels. Moreover, the increase in capital intensity associated with of foreign industries is greater than the one for domestic activities. This can be seen by comparing the changes in columns 9 and 11.

In line with these findings, Elsby, Hobijn, and Şahin (2013) rationalize declining labor shares along the lines of Feenstra and Hanson (1997): tasks or inputs that are relatively labor intensive within rich countries are offshored to poorer countries, in which they are relatively less labor intensive. Importantly, this can lower labor shares in both countries. Alternatively, the same task or input may be simply performed at a higher capital intensity abroad. This may be the case if offshored tasks are performed by vertically integrated firms, as suggested by Antràs (2003). While it is impossible to distinguish among these in our data, in Section 5 we provide evidence that is consistent with this last idea, where we find that capital income outflows are associated with foreign direct investment and with indicators of multinational activity.

Of the overall average decline of 2.45 percent points in labor share, 1.06 percent points—or 43 percent of the actual change—are accounted for by within-industry changes in factor shares ($V_{2007}B_{1995}Y_{1995} - VBY_{1995}$). This operates both through income from domestic and from foreign industries. Changes in composition due to ΔB alone account for 0.47 percent points, and changes due to ΔY account for 0.44 percent points. Together, $\Delta(BY)$ accounts for 0.87 percent points decline in the labor share—which is 35 percent of the actual change. Composition explains the contrast between increasing labor income from activities related to foreign industries versus the decline related to domestic industries. A residual of 22 percent is explained by the interaction of changes in within-industry intensities and composition. The upshot is that within-industry changes and changes in composition are almost equally important, and that changes in B alone (holding constant demand and within-industry intensities) is almost half as important as within-industry changes. Variation in composition entails shifting income sources from domestic to foreign sources, which are more capital intensive.

The changes within manufacturing industries are, in general, larger. The labor share falls by 4.04 percent points. Within-industry changes account for 1.51 percent points of this drop—37 percent of the total—while compositional changes account for 1.63 percent points of the drop—40 percent of the total. Changes in B alone account for 0.92 percent points of the decline in labor shares within manufacturing—or 23 percent of the total. The role of globalization is, not surprisingly, larger in manufacturing, which is manifested in the large shift of 7.13 percent points in sources of income from domestically-produced final goods to foreign-produced final goods.

A few additional interesting observations emerge when considering the breakdown for different counterfactuals in Table 1. In the $V_{2007} \times B_{1995} \times Y_{1995}$ counterfactual, changes in labor shares due to within domestic industries forces (-0.77 pp) are more than twice as large as changes due to within foreign industries forces (-0.29 pp)—but they work in the same direction. In contrast, in the $V_{1995} \times B_{2007} \times Y_{2007}$ counterfactual, changes in composition affect the labor share in opposite ways due to domestic industries activities (-2.71 pp) versus foreign industries ($+1.85$ pp). The upshot is that, while overall reducing the labor share, the forces of globalization combine opposite forces, while within-industry forces uniformly reduce the labor share.

We now describe changes in labor shares in 2007–2014. Table 2 has the exact same structure as Table 1. In contrast to the decline in the previous period, labor shares on average increase in 2007–2014, as observed above in Figure 1. Also in contrast to the important role played by composition in the decline of labor shares in 1995–2007, composition has a small—and offsetting—effect on the (more modest) increase in labor shares in 2007–2014. In both periods changes in composition contribute to lower labor shares, but much less in 2007–2014, which is consistent with the general slowdown in the increase in GVC deepening, depicted in Figure 3, Panels C and D. This is seen also in columns 7 and 8 in Table 2, with a much more modest shift of income towards foreign sources.

The shift towards foreign sources of income in 2007–2014 lowers the capital share because the reduction in capital intensity in activities related to foreign industries is much larger than in domestic industries; this, despite the fact that in levels capital intensity in activities related to foreign industries is much larger than in domestic industries (see columns 9 and 11). More than all of the increase in labor shares in 2007–2014 (1.07 pp) is driven by within-industry changes (1.37 pp)—128 percent. In manufacturing the increase in the labor share is double that of the entire economy, but the sources of this change are the same, where within-industry changes (2.89 pp) account for 140 percent of the actual increase (2.07 pp). Compositional changes work to mitigate this.[37]

Finally, we turn to discussing changes in skilled and unskilled labor shares in 1995–2007. Table 3 reports the results using the same taxonomy as above in order to describe levels, changes and counterfactual changes. Panel A reports this for the entire economy, while Panel B focuses on manufacturing industries. Columns 1–4 report the shares of value added accruing to high skill and low skill labor from domestic demand and from foreign demand. All other columns are derived from these four. Columns 5 and 6 report the overall high skill and low skill labor shares in value

[37] In the Appendix we report results for factor income shares in final demand in a similar fashion as Tables 1 and 2, for the weighted-average country, using GDP as weights. These results display very similar patterns as for shares in GDP. This is a mechanical consequence of the fact that we obtain global GDP whether we sum all rows or all columns in VBY.

added. Columns 7 and 8 report the overall high skill and low skill labor shares in total labor income. Columns 9–12 report high skill and low skill labor shares within domestic payments to labor and within foreign-sourced payments to labor. All numbers are weighted averages using GDP in 1995 as weights.

The results indicate that the shift away from unskilled towards skilled labor in 1995–2007 is almost entirely driven by within-industry forces, with a small role for composition.[38] Of the 4.26 percent point increase in the share of skilled labor in GDP, 3.97 percent points, or 93 percent of the total, is driven by within-industry changes. The decline in the low skilled labor share in 1995–2007 is also driven mostly by within-industry changes, with a more modest role for composition, compared to the overall decline in labor shares. Of the -6.7 percent point decrease in the share of low skilled labor in GDP, 5.03 percent points, or 75 percent of the total, is driven by within-industry changes; composition accounts for another 20 percent.[39] Looking within total payments to labor, of the 8.48 percent point increase in the share of skilled labor, 7.11 percent points, or 83 percent of the total, is driven by within-industry forces. Changes in composition (ΔBY) account for 10 to 13 percent of the total changes. This pattern is even more salient in manufacturing, where within-industry variation explains more than all of the increase in skilled labor share in GDP, and virtually 100 percent of increase within total labor income. The 6.7 percent point drop in the share of unskilled labor in GDP is much greater than the drop for total labor income (2.45 pp). Here within-industry forces alone account for 5 percent points, or 75 percent, of the drop, while composition accounts for a non-negligible 1.3 percent point decline, or 19 percent of the total.

4.2 Domestic versus foreign sources of compositional changes

We saw above that compositional changes arise due to changes in value chains captured in B, and due to changes in the pattern of demand for final goods Y. Here we ask to what degree are compositional changes driven by domestic versus foreign sources. Part of the answer is already in Tables 1–3, where we see that the increase in factor income accruing from foreign industries (final goods produced in foreign countries) is an important part of the explanation for why labor shares decrease: foreign income is more capital intensive. Here we ask to what degree do such compositional changes arise due to changes in domestic value chains, direct trade in intermediate inputs, and more complex GVCs. Dao, Das, Koczan, and Lian (2017) estimate that GVC deepening within an industry lowers *within*-industry labor shares; in contrast, we associate GVC deepening only to composition. In this sense, our findings on the importance of GVC participation is a lower

[38] Baqaee (2019) also makes this observation, although using a different concept of skilled labor shares.

[39] This is a corollary of following facts: (1) the overall labor share declines roughly equally by composition and within-industry changes (Table 1), and (2) the skilled labor share is almost entirely driven by within-industry changes.

bound, as it may have additional effects on within-industry changes in labor shares. Finally, we ask what is the role of domestic and foreign demand in driving the same changes.

Changes in B manifest in various dimensions. We decompose B and the corresponding ΔB into three parts, applying Stone's additive decomposition (see Appendix for details, based on Miller and Blair (2009)):

$$B = I + (B^d - I) + \underbrace{B^d A^f B^d}_{B^x} + \underbrace{(B - B^d - B^d A^f B^d)}_{B^g} \ . \tag{7}$$

Here I captures the direct effect of demand on output. Next, $B^d - I$ captures output that is induced by all strictly *domestic* indirect linkages. To see this, note that $B^d = (I - A^d)^{-1}$, where A^d is the matrix of block diagonal elements from A, capturing only domestic linkages. Next, B^x captures output that is induced by all strictly *bilateral trade* in intermediate inputs *that cross borders only once* (exports from the standpoint of the producing country). To see this, note that $A^f = A - A^d$, i.e. the off-block-diagonal elements of A. B^x takes all domestic output requirements (the first B^d on the right), computes the implied international demand for intermediate inputs captured in A^f, and then the implied total domestic requirements in the producing country (the second B^d on the left). Finally, B^g captures all other types of linkages, essentially net interregional feedback effects (net of strictly direct intra- and direct inter-national effects captured B^d and B^x, respectively). I.e., B^g captures the effect of *complex global value chains*: output that is induced by combining both domestic and foreign linkages, that may cross borders more than once, and that may include return effects.[40] Equation (7) allows us to write

$$V_f \Delta B Y = V_f \Delta B^d Y + V_f \Delta B^x Y + V_f \Delta B^g Y \ . \tag{8}$$

When computing changes we can ignore I because it does not change.[41]

Global demand for final goods Y can be written as $Y = Y^d + Y^f$, where Y^d is *domestic* demand for final goods and Y^f is *foreign* demand for final goods. Both domestic and foreign demand for a given country include goods produced anywhere in the world. Domestic demand is the part of global demand for final goods by the country providing factor services (defined by matrix rows), regardless of where they are produced, and thus includes both domestic purchases and imports of final goods. An immediate extension of any calculation involving ΔY is

$$\Delta Y = \Delta Y^d + \Delta Y^f \ . \tag{9}$$

[40] For example, consider a hypothetical German car door producer that ships doors to Czech Republic, where windows are manufactured and installed in the doors, which get shipped back to Germany and installed in cars that are either purchased domestically or are exported.

[41] Similar analysis is performed by Nagengast and Stehrer (2016) for analyzing the manifestation of the "so-called" 2008 trade collapse.

Since Y^d post-multiplies B, variation in Y^d effects factor demand both through domestic industries but also through foreign industries' demand for factor services, and similarly for variation in Y^f. Equation (9) allows us to write

$$V_f B \Delta Y = V_f B \Delta Y^d + V_f B \Delta Y^f \ . \tag{10}$$

Table 4 displays the results of the analysis for labor shares ($V_f = V_L$) for both periods (1995–2007 and 2007–2014), for the entire economy level and separately for manufacturing. The four "Total" rows report in columns 1–3 and 7–9 labor shares in value added that are paid by domestic industries, foreign industries, and overall in the initial year (1995 or 2007); these are the same numbers for the initial year in columns 2, 4 and 6 in Tables 1 and 2.[42] The "Total" rows report in columns 4–6 and 10–12 the changes in the same concepts; these are the same numbers in columns 2, 4 and 6 in Tables 1 and 2 for either changes in B or changes in Y.[43] The rows above the "Total" rows indicate the contributions of sub-components of either B or Y to levels in columns 1–3 and 7–9, and to changes in columns 4–6 and 10–12.

We start with describing the results for the breakdown of B. Overall, most of payments to labor are generated due to domestic linkages (roughly 90% for all industries and 80% in manufacturing in 1995). Almost all of demand in levels from domestic industries occurs due to domestic linkages (B^d), while most of the demand from foreign industries occurs due to bilateral trade linkages (B^x) (roughly 84% in 1995 and 77% in 2007). Complex GVCs (B^g) originate mostly from foreign industries; "loop" value chains from domestic back to domestic are much less important in levels. These findings are consistent with Miroudot and Nordstrom (2015).

What is more interesting are the contributions to changes (ΔB). The shift of income generated from domestic to foreign industries is driven by a reduction in the importance of domestic linkages which are counterbalanced by both exports (ΔB^x) and by more complex GVCs (ΔB^g). Complex GVCs account for more than 50% more than exports linkages in explaining the shift towards foreign industries. In manufacturing complex GVCs are four times as important as exports in explaining the shift towards foreign industries in 1995–2007; the relative importance of complex GVCs is even more important in 2007–2014, although the overall changes are much more modest.

Turning to the breakdown of Y, we see that domestic demand for final goods (Y^d) accounts for the lion's share of labor payments (93% overall, although only 80% in manufacturing, both in 1995), and less so over time (90% for the entire economy and 73% in manufacturing in 2007).

[42] For example, 61.51 is the same in the "Total" row of column 3 of Table 4 and the "VBY_{1995}" row of column 6 of Table 1.

[43] For example, -1.53 is the same in the "Total" row of column 4 of Table 4 and the "V_{1995}*B_{2007}*$Y_{1995} - VBY_{1995}$" row of column 2 of Table 1.

Considering the contributions to changes (ΔY), there are different patterns before and after 2007. In 1995–2007 the source of the decline in labor shares is a shift to foreign demand that does not fully compensate the decline in the contribution of domestic demand. In contrast, in 2007–2014 foreign demand accounts for the decline in the labor share driven by compositional changes in demand. In manufacturing this picture is even more pronounced. This is likely a result of the 2007–8 crisis and the so-called "trade collapse" associated with it.

The increase in importance of foreign demand in 1995–2007 operates both through domestic and—less so—through foreign industries. In contrast, the incidence of the overall decline in importance of domestic demand in the same period is on domestic industries, while concurrently contributing to an increase in factor payments due to foreign industries. This last point is the result of complex value chains by which increases in domestic demand for foreign final goods affects domestic factors. The changes in manufacturing are larger, and overall in the same direction as the entire economy.

In 2007–2014 domestic demand decreases in importance overall, but as in the previous period, domestic demand shifts from domestic to foreign final goods (industries). At the same time, changes in foreign demand operate mostly though a reduction in domestic final goods (industries). As in the previous period, the cross-effects of domestic (foreign) demand through foreign (domestic) industries reflects the complexity of GVCs.

The overall message from Table 4 is as follows. Most labor income arises from domestic industries, but shift towards foreign ones; in 1995–2007 this is driven more by complex GVCs (0.70) than bilateral exports (0.42). Most labor income arises from domestic demand, but shifts towards foreign; in 1995–2007 decline in the contribution of domestic demand occurs through a reduction in demand for goods that are more locally produced in the GVC sense (-2.45) that is not compensated by an increase in domestic demand for foreign industries ($+0.75$).

4.3 Within-industry theoretical framework

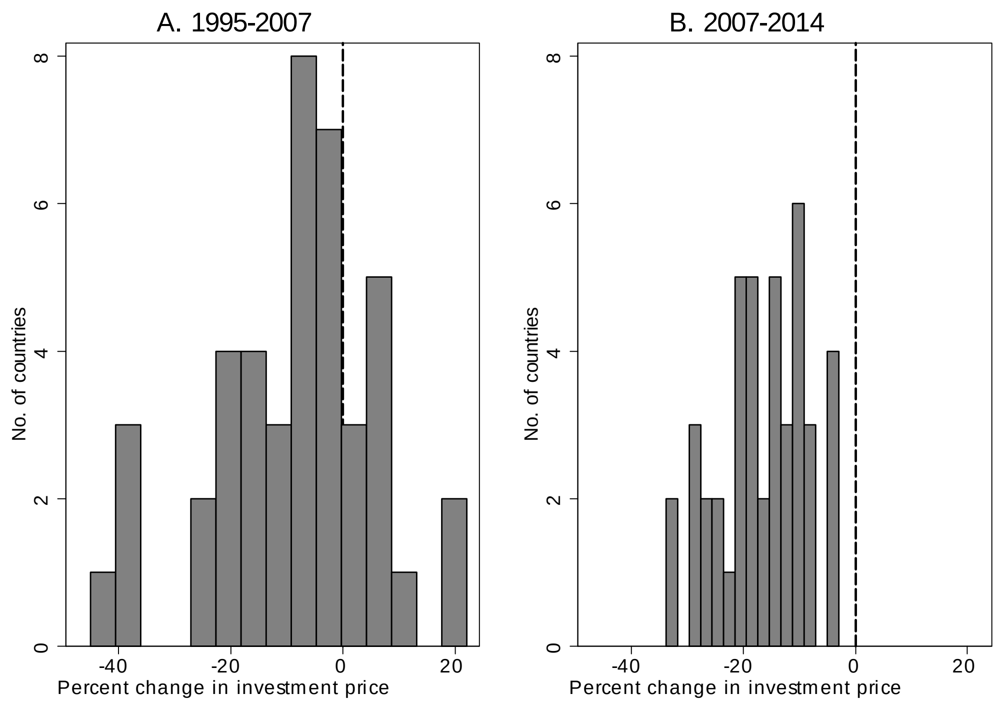
As shown in Figure 1, labor shares first decline in 1995–2007 and then redound somewhat in 2007–2014. The decompositions in Tables 1–3 reveal that within-industry changes in factor intensities first reduce labor shares in 1995–2007 and then increase them in 2007–2014. At the same time, skilled labor shares increase in throughout 1995–2014. In this section we seek to explain these within-industry evolutions in one framework.

One of the central explanations for the evolution of labor shares within economic units (industries or countries) is the decline in the price of capital equipment investment, as in Karabarbounis and Neiman (2014).[44] In their model, when the elasticity of substitution between labor and capital is greater than unity (which they estimate to be so) the continuous decrease in the price of investment lowers the capital user cost r and causes a shift in expenditures towards capital. However, since r continues to decrease after 2007, then this mechanism cannot account for the within-industry increases in the labor share after 2007. Moreover, it is silent about the division of income between skilled and unskilled labor. In Figure 4 we report that indeed the price of investment has decreased on average across countries in our WIOD sample, and that this has continued after 2007 at a somewhat faster pace and in a more uniform fashion.[45] The weighted average decline in 1995–2007 is roughly 12%, or 1% per year, while the weighted average decline in 2007–2014 is roughly 15%, or 2% per year—twice the annual rate in the previous period. Interestingly, the greater decline in the price of investment after 2007 coincides not only with an increase in the labor share, it coincides with an even larger role for within-industry changes in intensities: the decline in labor shares in 1995–2007 due to ΔV is -1.06 percent points over 12 years, whereas the increase in 2007–2014 due to ΔV is $+1.37$ percent points over seven years. This implies that the rate of the increase is more than twice as large in 2007–2014 compared to the rate of decline in 1995–2007.

[44] It is also possible that offshoring increases intra-industry capital intensity both for the source and destination country, along the lines of Feenstra and Hanson (1997). This may occur if the least capital intensive activities are offshored to locations where they become the most capital intensive activities.

[45] The data are from the Penn World Tables mark 9.0 (PWT, see Feenstra, Inklaar, and Timmer (2015)) and from the United States' Bureau of Economic Analysis (BEA), applying the same methodology as in Karabarbounis and Neiman (2014) with updated data (their sample ends in 2010). In particular, for each country c in year t we divide the investment price index (P_{ct}^{inv}) by the consumption price index (P_{ct}^{con}), both in terms of their corresponding PPP US prices (PWT data). This means that $P_{ct}^{inv}/P_{ct}^{con}$ is the relative price of investment *relative to that of the United States' ratio*. In order to convert this to the relative price from the domestic standpoint we divide $P_{ct}^{inv}/P_{ct}^{con}$ by $P_{USA,t}^{inv}/P_{USA,t}^{con}$ and then multiply by the ratio of the price index for private fixed investment ($P_{USA,t}^{pfi}$) to the personal consumption expenditures price index ($P_{USA,t}^{pce}$) (BEA data). Figure 4 reports percent changes in the resulting $q_{ct} = (P_{ct}^{inv}/P_{ct}^{con})/(P_{USA,t}^{inv}/P_{USA,t}^{con}) \cdot (P_{USA,t}^{pfi}/P_{USA,t}^{pce})$.

Figure 4: Changes in Investment Price



Notes. The figure reports the change in investment prices (relative to the price of consumption). Source: authors' calculations using data from Penn World Tables mark 9.0 and from the United States' Bureau of Economic Analysis.

Can the continuous decrease in r explain both the decrease in labor shares before 2007 and the increase in labor shares after 2007, as well as the concurrent increase in skilled labor shares? In order to entertain this possibility we lay out a three factor nested CES production function as follows,

$$\begin{aligned} dQ &= A\left[\alpha^{\frac{1}{\sigma}}X^{\frac{\sigma-1}{\sigma}} + (1-\alpha)^{\frac{1}{\sigma}}L^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \\ X &= \left[\beta^{\frac{1}{\eta}}K^{\frac{\eta-1}{\eta}} + (1-\beta)^{\frac{1}{\eta}}H^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}} \end{aligned}$$

so that

$$Q = A\left[\alpha^{\frac{1}{\sigma}}\left[\beta^{\frac{1}{\eta}}K^{\frac{\eta-1}{\eta}} + (1-\beta)^{\frac{1}{\eta}}H^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}\frac{\sigma-1}{\sigma}} + (1-\alpha)^{\frac{1}{\sigma}}L^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}, \quad (11)$$

where L is labor, H is high skill labor, and K is capital. The elasticity of substitution between K and H is η, and the elasticity of substitution between L and the capital-skilled labor aggregate X

is σ. Define cost shares of factor $f \in \{L, H, K\}$ in total value of output as θ_f, and the cost share of factor f in X as θ_f^X ($\theta_L^X = 0$).[46] We obtain the following results:

$$\frac{\partial \theta_L}{\partial r} r = (\sigma - 1)\, \theta_L \theta_K \tag{12}$$

$$\frac{\partial \theta_H}{\partial r} r = -\left[(\sigma - 1)\, \theta_L \theta_H^X + (1 - \eta)\, \theta_H^X\right] \theta_K \tag{13}$$

$$\frac{\partial \theta_K}{\partial r} r = -\left[(\sigma - 1)\, \theta_L \theta_K^X - (1 - \eta)\, (1 - \theta_K^X)\right] \theta_K \tag{14}$$

$$\frac{\partial \theta_K^X}{\partial r} r = (1 - \eta)\, \theta_K^X \theta_H^X \ . \tag{15}$$

Here $(\partial \theta_f / \partial r)\, r$ is the half-elasticity of the factor share of f in percent points with respect to a one percent change in r.[47]

Suppose that $\sigma > 1$ and $\eta < 1$, implying capital-skill complementarity. Then a decrease in r will (i) unambiguously lower unskilled labor's share (θ_L); (ii) unambiguously increase skilled labor's share (θ_H); and (iii) unambiguously decrease capital's share in X (θ_K^X). In addition, (iv) if θ_L and θ_K^X are large enough, then a decrease in r will increase capital's share θ_K and decrease the labor share $\theta_N = \theta_L + \theta_H = 1 - \theta_K$; and (v) if the decrease in r continues for some time—contributing to decreases in θ_L and in θ_K^X—then it is possible that the derivative (15) changes sign, and the additional decrease in r lowers capital's share. The reason that the sign of $\partial \theta_K / \partial r$ can change is that it combines two opposing forces: substitution of expenditures towards X and substitution away from capital within X.[48]

We now demonstrate that conjectures (iv) and (v) are plausible by quantitatively evaluating (12)–(15). To do so, we use $\sigma = 1.6$ and $\eta = 0.6$, quite close to the values estimated in Krusell, Ohanian, Rios-Rull, and Violante (2000), and compute (12)–(15) for average values of factor income shares in our data in 1995 and in 2007 (taken directly from Tables 1 and 2). Table 5 presents the results. We see that, indeed, the sign of the derivative for θ_N (which is $\partial \theta_N / \partial r = -\partial \theta_K / \partial r$) changes from positive in 1995 to negative in 2007, implying that in 1995 reductions in r are associated with a decrease in the labor share, while in 2007 reductions in r are associated with an increase in the labor share.[49] At the same time the derivatives of the unskilled labor and of the skilled labor shares do not change sign (and remain quantitatively similar), implying continuous reductions in

[46] See Appendix for derivations.

[47] Embedding this production function in the general equilibrium model of Karabarbounis and Neiman (2014) delivers no additional essential insights.

[48] Substitution towards X arises from the fact that X becomes cheaper as the price of capital, one of it's components, becomes cheaper, combined with a large elasticity of substitution between L and X, $\sigma > 1$. Substitution away from capital within X arises from the reduction in the user cost of capital combined with a small elasticity of substitution between K and H, $\eta < 1$.

[49] The change in the derivative is mostly driven by the drop in θ_L, less so by the relatively small drop in θ_K^X.

the former and increases in the latter.

While testing conjectures (iv) and (v) is beyond the scope of this paper, the quantitative evaluation is reassuring and suggests that this may be part of the explanation for falling and then rising labor shares, their pace of change, and the continuous increase in the share of skilled labor, all driven by within-industry (or within-country) dynamics. One disadvantage of the production-side approach taken in this section is that ignores completely inputs (let alone imported inputs) and their associated labor intensities, which is the focus—and strength—of the rest of this paper.[50] The analysis here should be viewed as complementary, although partial.

5 Foreign capital income and foreign ownership

Part of the motivation for our investigation is the distribution of income. Since capital ownership is much more concentrated than labor income, the increase in capital shares in 1995–2007 implies a disproportionate increase in income for capital owners. But because the data is based on gross *domestic* production concepts, it does not say whether the claimants to capital income—i.e., the owners of the underlying capital stocks—are local or foreign.[51]

In this section we illustrate that variation in capital income from foreign industries due to production of intermediate inputs is strongly associated with foreign direct investment and multinational enterprise (MNE) activity through vertical integration. The implication is that part of the capital income that is paid to locally installed capital accrues to foreign owners of this capital. As suggested by Antràs (2003), vertical integration (within an MNE) is associated with greater capital intensity of the upstream supplier, compared to arms-length offshoring. Since this occurs through cost sharing of capital expenditures, i.e. foreign ownership of this capital, more MNE activity can also help explain the greater capital intensity for foreign upstream activities.[52]

More specifically, we ask whether capital income in country o that is derived from value chains that involve end users of intermediate inputs in country d is associated with more foreign ownership of capital installed in o by owners in country d, or with MNEs with headquarters in d and affiliates in o. In order to examine these ideas we estimate the following gravity equation in a cross section

[50] A similar point is also made in Baqaee (2019).

[51] This point is appreciated in Lipsey (2010). This may be more important in less developed countries in the so-called "South", where net inflows of foreign direct investment are large; see Timmer, Erumban, Los, Stehrer, and de Vries (2014).

[52] A well-known fact is that a very large share of global trade happens within the boundaries of MNEs. For example, 50% of U.S. total imports in 2010 occurred within MNE boundaries, i.e. between U.S foreign affiliates and their U.S. parents (or other affiliates located in the U.S.). MNEs account for 90% of total U.S. imports (and exports) in 2010. The difference between this and the 50% that takes place within MNE boundaries is trade between U.S. and other firms at arms length. Data from the U.S. Bureau of Economic Analysis and the World Trade Organization International Trade Statistics.

in 2007:

$$\ln V_K B^z Y_{od} = \beta \cdot \ln ownership_{od} + \gamma' gravity_{od} + \alpha_o + \alpha_d + \varepsilon_{od} \ , \tag{16}$$

where $V_K B^z Y_{o \to d}$, $z \in \{x, g\}$, is capital income accruing to capital installed in o that originates from supplying intermediate inputs for final goods production in country d. Here B^z is either B^x or B^g (defined above in 7), implying capital income accruing to factors in o due to sales of intermediate inputs that are demanded in d either through direct bilateral exports of intermediate inputs ($V_K B^x Y_{od}$) or due to complex GVCs ($V_K B^g Y_{od}$). We separate the two sources of income since $V_K B^x Y_{od}$ should be more closely related to bilateral income links. Note that $V_K B^x Y_{od} + V_K B^g Y_{od}$ exhausts all foreign capital income accruing to o from final goods production in d (this is illustrated in Table 4).

The main coefficient of interest is β, indicating the elasticity of a flow of income with respect to $ownership_{od}$, a measure of ownership of capital installed in o by entities located in d. We consider several such indicators. We use the stock of FDI in o that is owned by d (OECD data), as well as multinational production data from Ramondo, Rodríguez-Clare, and Tintelnot (2015): total sales of affiliates in o with parents in d and the number of affiliates that underlie these sales. Number of affiliates is a better indicator of MNE ownership compared to total sales of affiliates because affiliates in o may (and do) sell both domestically and to third countries.

We control for standard bilateral control variables: distance, common border, colonial ties, common language, free trade agreements, both countries in EU 15, one country in the EU enlargement (13 countries) while the other is an EU 15 member, common currency. We include origin and destination fixed effects to control for overall attractiveness of o for production and investment, and overall prowess of d in MNE activity. We report estimates of (16) by ordinary least squares (OLS) and Poisson pseudo maximum likelihood (PPML). Differences in estimates arise from the fact that PPML emphasizes more large flows compared to OLS. We compute two-way clustered standard errors at the country o and country d level in order to account for correlations in errors within origins and destinations (Cameron, Gelbach, and Miller (2011)).

Table 6 reports the results. First, we see that all ownership indicators are associated with both types of income flows. Second, the strength of the relationship is much stronger for $V_K B^x Y$. This is true both on the margin, as the elasticities are much larger in columns 1–6 compared to the corresponding columns 7–12, but also quantitatively: a one standard deviation increase in $\ln ownership$ is associated with a 4–6.5 times larger increase in $\ln V_K B^x Y$ compared to increases $\ln V_K B^g Y$ for OLS estimates of β, and 1.4–3.8 times for PPML estimates.[53] The standardized coefficients for

[53] To make this statement we compute standardized coefficients, i.e. divide the estimate of β in (16) by the standard deviation of the dependent variable and then multiply by the standard deviation of the explanatory variable. The

$\ln V_K B^x Y$ in both estimators are roughly 0.11, implying that a one standard deviation increase in percents of any of the measures of ownership is associated with an increase of 0.11 of a standard deviation of capital income in percents.

A few other interesting patterns emerge from Table 6. Bilateral distance, free trade agreements and common language matter much more so for $V_K B^x Y$. Common borders affect $V_K B^x Y$ positively and $V_K B^g Y$ negatively. These results make sense since $V_K B^g Y$ necessarily passes through third countries.

The interpretation of our estimates in Table 6 is not causal. However, the estimates are informative from an accounting perspective, as long as one accepts that foreign ownership of capital entitles the owners to part of the income that this capital generates, whatever the driving force may be.[54]

Overall, the message from Table 6 is this: payments to capital located in country o that accrue due to sales of intermediate inputs to country d is associated with ownership by country d of capital installed in country o. This suggests that part of this capital income accrues to entities in d through vertical integration within MNEs. Given the uneven distribution of MNE headquarters and capital ownership across countries, these findings imply additional effects on income distribution that domestic production concepts do not reveal. The labor share in *national* income decreases more than it's share in domestic income (GDP) in countries that are hubs of MNE headquarters, with significant net external capital positions. Conversely, countries which are net recipients of capital inflows experience less of an increase in capital shares in national income compared to shares in GDP, since part of capital payments to domestically-installed capital accrues to foreign owners.

6 Concluding remarks

In this paper we studied the evolution of labor shares in a sample of around 40 countries, both developed and less developed, in 1995–2014. Our main message is that globalization, especially through the deepening of GVCs, has significantly decreased labor shares, on average. This force is weaker after 2007, where labor shares actually increase. Within-industry changes in labor shares first drive labor shares down (in the same direction as globalization) and after 2007 they account

ratios of standardized coefficients for $\ln V_K B^x Y$ relative to $\ln V_K B^g Y$ are, for OLS: 6.5 for ln FDI stock, 6 for ln affiliate sales, and 4 for ln number of affiliates. The respective figures for PPML are: 2.4 for ln FDI stock, 3.8 for ln affiliate sales, and 1.4 for ln number of affiliates.

[54]For example, Guvenen, Mataloni, Rassier, and Ruhl (2017) demonstrate that profit shifting through tax havens is more prevalent in R&D-intensive industries in the United States. We also know that FDI is more prevalent in R&D-intensive industries; e.g., see Markusen (2004). Suppose also that this also entails more imports of intermediate inputs within the boundaries of multinational enterprises. Then industry composition can potentially explain both levels of bilateral FDI positions and of bilateral flows of $V_K B^x Y$ and $V_K B^g Y$. However, this does not mean that capital income does not flow bilaterally as a consequence, which is the point we are trying to make.

for increases in labor shares. At the same time, skilled labor shares increase almost entirely due to within-industry evolutions. We demonstrate that all within-industry dynamics can be rationalized in the presence of capital-skill complementarity. Finally, we show a positive association between FDI and multinational activity with foreign capital income.

Our findings have important policy implications. First, we find that the role of globalization is not negligible. To the extent that inequality is a concern, and given that redistribution of the gains from globalization is far from perfect (and potentially very costly), this finding raises concerns about the costs of further economic integration. Second, the positive association between FDI and multinational activity with foreign capital income implies that in countries with large positive net FDI positions labor shares decrease even more as a share of national income, compared to their share in GDP (net factor income in balance of payments is predominantly capital income). This implies that studying the effects of the evolution of the labor share and the effects of globalization on inequality should take into account national income, rather than rely on domestic production approach. Technological explanations may still be well approximated based on a domestic production approach.

One important caveat of our study is that we cannot cleanly separate the roles of globalization from technological or other explanations. For example, globalization and, in particular, GVC deepening may affect within-industry labor shares by changing the composition of firms, along the lines of Melitz (2003) and Harrigan and Reshef (2015). At the same time, differential declines in the price of capital across industries, or differential effects of the same decline across industries (due to different capital intensities) can also cause part of the compositional changes that we associate with globalization. To completely separate the two, an appropriate structural model is needed. Such endeavor is left for future research.

Appendix

A WIOD data and computations

A.1 Data structure

Our calculations are based on data from the World Input-Output database (WIOD). The 2013 release of the data covers the period 1995–2011. Along with detailed Input-Output tables for 40 countries and 35 industries (ISIC rev. 3), this release also provides the Socio-Economic Accounts with data on employment, labor compensation and capital stocks, all by country and industry. In addition, the 2013 release reports employment and labor compensation by educational attainment within each country and industry. We also use the more recent 2016 release, covering 43 countries and 56 sectors (ISIC rev. 4) for the period 2000–2014. The Socio-Economic Accounts in the 2016 release do not include employment breakdown by educational level. Figure A1 depicts a schematic outline for the structure of the WIOD for the exemplary case of 3 countries and 2 sectors. See http://www.wiod.org/home for further details on the country coverage and data availability.

Figure A1: Schematic Outline of a World Input-Output Table

		A						Y			
Cty	**Ind**	**S**		**R**		**T**		**S**	**R**	**T**	**X**
		1	**2**	**1**	**2**	**1**	**2**				
S	**1**	A_{11}^{ss}	A_{12}^{ss}	A_{11}^{sr}	A_{12}^{sr}	A_{11}^{st}	A_{12}^{st}	Y_1^{ss}	Y_1^{sr}	Y_1^{st}	$X_1^s = \sum_{c\in\{s,r,t\}}\sum_{i\in\{1,2\}} A_{1i}^{sc} + \sum_{c\in\{s,r,t\}} Y_1^{sc}$
	2	A_{21}^{ss}	A_{22}^{ss}	A_{21}^{sr}	A_{22}^{sr}	A_{21}^{st}	A_{22}^{st}	Y_2^{ss}	Y_2^{sr}	Y_2^{st}	$X_2^s = \sum_{c\in\{s,r,t\}}\sum_{i\in\{1,2\}} A_{2i}^{sc} + \sum_{c\in\{s,r,t\}} Y_2^{sc}$
R	**1**	A_{11}^{rs}	A_{12}^{rs}	A_{11}^{rr}	A_{12}^{rr}	A_{11}^{rt}	A_{12}^{rt}	Y_1^{rs}	Y_1^{rr}	Y_1^{rt}	$X_1^r = \sum_{c\in\{s,r,t\}}\sum_{i\in\{1,2\}} A_{1i}^{rc} + \sum_{c\in\{s,r,t\}} Y_1^{rc}$
	2	A_{21}^{rs}	A_{22}^{rs}	A_{21}^{rr}	A_{22}^{rr}	A_{21}^{rt}	A_{22}^{rt}	Y_2^{rs}	Y_2^{rr}	Y_2^{rt}	$X_2^r = \sum_{c\in\{s,r,t\}}\sum_{i\in\{1,2\}} A_{2i}^{rc} + \sum_{c\in\{s,r,t\}} Y_2^{rc}$
T	**1**	A_{11}^{ts}	A_{12}^{ts}	A_{11}^{tr}	A_{12}^{tr}	A_{11}^{tt}	A_{12}^{tt}	Y_1^{ts}	Y_1^{tr}	Y_1^{tt}	$X_1^t = \sum_{c\in\{s,r,t\}}\sum_{i\in\{1,2\}} A_{1i}^{tc} + \sum_{c\in\{s,r,t\}} Y_1^{tc}$
	2	A_{21}^{ts}	A_{22}^{ts}	A_{21}^{tr}	A_{22}^{tr}	A_{21}^{tt}	A_{22}^{tt}	Y_2^{ts}	Y_2^{tr}	Y_2^{tt}	$X_2^t = \sum_{c\in\{s,r,t\}}\sum_{i\in\{1,2\}} A_{2i}^{tc} + \sum_{c\in\{s,r,t\}} Y_2^{tc}$
Total intermediate consumption A_i^c		$A_1^s = \Sigma_{k,j} A_{j1}^{ks}$	$A_2^s = \Sigma_{k,j} A_{j2}^{ks}$	$A_1^r = \Sigma_{k,j} A_{j1}^{kr}$	$A_2^r = \Sigma_{k,j} A_{j2}^{kr}$	$A_1^t = \Sigma_{k,j} A_{j1}^{kt}$	$A_2^t = \Sigma_{k,j} A_{j2}^{kt}$				
Value added V_i^c		$V_1^s = X_1^s - A_1^s$	$V_2^s = X_2^s - A_2^s$	$V_1^r = X_1^r - A_1^r$	$V_2^r = X_2^r - A_2^r$	$V_1^t = X_1^t - A_1^t$	$V_2^t = X_2^t - A_2^t$				

In Figure A1 the area shaded in light grey includes intermediate value flows, A, among industries (indexed by $i \in \{1,2\}$) located in countries (indexed by $c \in \{s,r,t\}$). For example, A_{12}^{sr} describes the total value of intermediate use by industry 2 located in country r (indicated by the column) of input from industry 1 located in country s (indicated by the row). The area shaded in dark grey indicates demand for final goods, Y. For example, Y_2^{rt} is total demand for final goods in country t for good 2 sourced from country r. The WIOD distinguishes among five final demand use categories. In order to conserve on space, these five categories are not displayed in Figure A1 (the categories are: final consumption expenditure by households, final consumption expenditure by non-profit organizations, final consumption expenditure by government, gross fixed capital formation and changes in inventories and valuables). Furthermore, X is a vector of total gross outputs for industries by location (indicated by the row). Total intermediate consumption for an industry i located in a country c (indicated by the column) A_i^c is the sum of all A elements within a column. Value added V_i^c of an industry i located in a country c (indicated by the column) is obtained by deducting A_i^c from the corresponding total gross output entry X_i^c for that industry i and country c (indicated by the row).

Summing all Y elements gives global consumption of final goods. From the expenditure approach to national accounting this is also global GDP.

A.2 Value added computations

Value added computations are based on Timmer, Los, Stehrer, and de Vries (2013), which is rooted in the seminal work of Leontief (1936). The goal is to decompose the value of final goods production (i.e., final demand) according to the industry and location where the value added originated. Conversely, one can also compute the allocation of payments to primary factors (capital and labor) according to the industries where these value added payments originate. Technically, the computation relies on a diagonal matrix of final demand Y, the Leontief inverse matrix B, as well as a diagonal matrix of direct value added coefficients per sector, V. All these are obtained from the values depicted in Figure A1.

The elements of the diagonal matrix of final goods demand Y are obtained by a row-wise summation of the "Y-area" in Figure A1 across all countries (and use categories; see above for details):

$$Y_i^c = \sum_k Y_i^{ck} \ .$$

The elements of the diagonal matrix of value added coefficients V are obtained by subtracting the entire intermediate consumption of a sector (column sum in the input-output matrix A) from the sectoral gross output and dividing this by the gross output of the sector

$$v_i^c = \frac{X_i^c - \sum_{k,j} A_{ji}^{kc}}{X_i^c} \ .$$

The Leontief inverse matrix is $B = (I - A)^{-1}$, where A is the matrix containing all sub-elements equal to

$$a_{ij}^{sr} = \frac{A_{ij}^{sr}}{X_j^r}$$

and I is the identity matrix. We compute the B matrix in a few steps. In the first, we derive the input-output coefficients, a_{ij}^{sr}. We obtain these coefficients by dividing each cell in the A region in Figure A1 along a column by the gross output X of the respective column sector. This gives the matrix A. A typical element a_{ij}^{sr} of A indicates the amount of output from industry i located in source country s (indicated by the row) that is needed to sustain the production of one unit of output in industry j in destination country r (indicated by the column). In the second step we compute an auxiliary matrix by subtracting the A matrix of input-output coefficients from an identity matrix I. Finally, we invert the auxiliary matrix to obtain the required Leontief matrix B. A typical element b_{ij}^{sr} of B indicates the amount of output from industry i located in source country s (indicated by the row) that is needed to sustain the production of one unit of final demand of product j in destination country r (indicated by the column).

In order to obtain the gross output needed to sustain final demand we multiply BY. In order to get the corresponding concept in value added terms, we pre-multiply BY by the diagonal matrix V

with elements V_i^c on the diagonal (appropriately ordered) to get VBY. For illustration, an example of the matrix VBY for the case of two countries and two industries is

$$\begin{aligned} VBY &= \begin{bmatrix} v_1^s & 0 & 0 & 0 \\ 0 & v_2^s & 0 & 0 \\ 0 & 0 & v_1^r & 0 \\ 0 & 0 & 0 & v_2^r \end{bmatrix} \begin{bmatrix} b_{11}^{ss} & b_{12}^{ss} & b_{11}^{sr} & b_{12}^{sr} \\ b_{21}^{ss} & b_{22}^{ss} & b_{21}^{sr} & b_{22}^{sr} \\ b_{11}^{rs} & b_{12}^{rs} & b_{11}^{rr} & b_{12}^{rs} \\ b_{21}^{rs} & b_{22}^{rs} & b_{21}^{rr} & b_{22}^{rr} \end{bmatrix} \begin{bmatrix} y_1^s & 0 & 0 & 0 \\ 0 & y_2^s & 0 & 0 \\ 0 & 0 & y_1^r & 0 \\ 0 & 0 & 0 & y_2^r \end{bmatrix} \\ &= \begin{bmatrix} v_1^s b_{11}^{ss} y_1^s & v_1^s b_{12}^{ss} y_2^s & v_1^s b_{11}^{sr} y_1^r & v_1^s b_{12}^{sr} y_2^r \\ v_2^s b_{21}^{ss} y_1^s & v_2^s b_{22}^{ss} y_2^s & v_2^s b_{21}^{sr} y_1^r & v_2^s b_{22}^{sr} y_2^r \\ v_1^r b_{11}^{rs} y_1^s & v_1^r b_{12}^{rs} y_2^s & v_1^r b_{11}^{rr} y_1^r & v_1^r b_{12}^{rs} y_2^r \\ v_2^r b_{21}^{rs} y_1^s & v_2^r b_{22}^{rs} y_2^s & v_2^r b_{21}^{rr} y_1^r & v_2^r b_{22}^{rr} y_2^r \end{bmatrix}. \end{aligned} \tag{17}$$

The elements of the VBY matrix can be interpreted in two ways. First, the values of the matrix along a *column* indicate *backward* linkages of production. The sum within a column is the value added that an industry located in a country generates in order to satisfy demand for final goods that it produces. Values within a column denote the value contribution of all industries and countries (given by the row) to the production of another industry located in a country (given by the column). For example, $v_1^r b_{12}^{rs} y_2^s$ indicates the value added of sector 1 located in country r that is supplied in order to produce final goods of industry 2 in country s. By summing across all rows within a column one obtains the total value of final goods production y_2^s, which is also final demand for industry 2 located in country s, no matter where this is sold around the world (i.e., no matter where demands arises from). For example, $\sum_{i,k} v_i^k b_{i2}^{ks} y_2^s = FD_2^s = y_2^s$. Summing all y_j^s across columns j within a country s does not give the GDP of country s because trade may not be balanced (if trade were balanced, then this sum does give GDP of country s). However, summing all y_j^s across all j and s gives global GDP.

The second interpretation considers the values of the VBY matrix within a *row*, indicating the *forward* linkages of production. In this interpretation values indicate how payments to primary factors employed in a country-industry (given by the row) are "financed" by the production processes that satisfy final demands (in terms of value added) of other industries and countries (given by the columns). Thus, in the context of forward linkages, $v_1^r b_{12}^{rs} y_2^s$ is the part of GDP paid to factors employed in industry 1 in country r by final demand for product 2 of country s. The sum across all columns within a row is thus equal to the country-industry's value added of the considered row, for example, $\sum_{j,k} v_1^r b_{1j}^{rk} y_j^k = VA_1^r$. Therefore, summing the industry rows for a given country gives GDP of that country, for example $\sum_i VA_i^r =$GDP^r.

A.3 Foreign value added shares

We compute two foreign value added shares. The first is foreign value added shares in final goods production based on the *backward* perspective. These are payments to factors located in foreign countries. This is calculated by summing within a column entries across rows of all industries located in foreign countries:

$$backward_i^c = \frac{\sum_{s \neq c} \sum_j v_j^s b_{ji}^{sc} y_i^c}{y_i^c} = \frac{\sum_{s \neq c} \sum_j v_j^s b_{ji}^{sc} y_i^c}{\sum_s \sum_j v_j^s b_{ji}^{sc} y_i^c}$$

Using the example in (17), the foreign value added (not share thereof) in production of sector 1 in country s, is the sum of $v_1^s b_{11}^{ss} y_1^s$ and $v_2^s b_{21}^{ss} y_1^s$. To get the foreign value added share divide by y_1^s.

The second foreign value added share concept entails shares in factor payments (value added) paid by foreign industries, based on the *forward* perspective. This is calculated by summing within a row entries across columns of all industries located in foreign countries:

$$forward_i^c = \frac{\sum_{s \neq c} \sum_j v_i^c b_{ij}^{cs} y_j^s}{\sum_s \sum_j v_i^c b_{ij}^{cs} y_j^s}$$

Using the example in (17), the foreign value added (not share thereof) in factor payments of sector 1 in country s, is the sum of $v_1^s b_{11}^{sr} y_1^r$ and $v_1^s b_{12}^{sr} y_2^r$. To get the foreign value added share divide by the sum $v_1^s b_{11}^{ss} y_1^s + v_1^s b_{12}^{ss} y_2^s + v_1^s b_{11}^{sr} y_1^r + v_1^s b_{12}^{sr} y_2^r$, which is the total value added of sector 1 in country s.

A.4 Production factors computations

As described in Timmer, Erumban, Los, Stehrer, and de Vries (2014), the methodology described above can also be applied to decompose the value of final goods production according to capital and labor. The only difference consists the use of a different vector of coefficients. The calculations above transform gross outputs $X = BY$ into value added by pre-multiplying by the diagonal matrix V. Instead, we only need to pre-multiply X by a different diagonal matrix, one that transforms gross outputs into factor payments.

In order to derive this it is necessary to divide sector level data on capital and labor compensation by sectoral output

$$v_{f,i}^c = \frac{F_i^c}{X_i^c} \ ,$$

where F and f denote payments and the share of payments to a particular factor. Thus, $v_{f,i}^c$ is the gross output share of factor f. Values for F_i^c are given by the Socio-Economic Accounts in the WIOD. Pre-multiplying BY by a diagonal matrix V_f with elements $v_{f,i}^c$ on the diagonal gives a matrix of factor shares in production, $V_f BY$, which can be read like the VBY matrix above, only in terms of payments to factor f. The decomposition of the final goods' value into to capital, high- and less-skilled labor incomes requires three different matrices.

B Proof of decomposition equation (6)

The change in the product VX (indeed, of any two conformable matrices) can be written as

$$\Delta (VX) = \Delta V X_1 + V_1 \Delta X + \Delta V \Delta X \ , \tag{18}$$

To see this, start with

$$\Delta VX = V_2 X_2 - V_1 X_1 \ .$$

Add and subtract $V_2 X_1$ and rearrange to get

$$\begin{aligned} \Delta VX &= V_2 X_2 - V_1 X_1 + (V_2 X_1 - V_2 X_1) \\ &= V_2 (X_2 - X_1) + (V_2 - V_1) X_1 \\ &= \Delta V X_1 + V_2 \Delta X \ . \end{aligned}$$

Now add and subtract $V_1 \Delta X$ and rearrange to get

$$\begin{aligned} \Delta V X &= \Delta V X_1 + V_2 \Delta X + (V_1 \Delta X - V_1 \Delta X) \\ &= \Delta V X_1 + V_1 \Delta X + V_2 \Delta X - V_1 \Delta X \\ &= \Delta V X_1 + V_1 \Delta X + (V_2 - V_1)\, \Delta X \\ &= \Delta V X_1 + V_1 \Delta X + \Delta V \Delta X \ . \end{aligned}$$

Applying the same algebra in (18) to $X = (BY)$ and plugging this back into (18) yields (6).

C Stone's additive decomposition

This is based on Miller and Blair (2009), pages 285–290, originally from Stone (1961).

Consider $\widetilde{A}$, an $n \times n$ matrix. Start with

$$X = AX + Y$$

and subtract $\widetilde{A}X$

$$X - \widetilde{A}X = AX - \widetilde{A}X + Y \implies (I - \widetilde{A})X = (A - \widetilde{A})X + Y$$

to get

$$X = (I - \widetilde{A})^{-1}(A - \widetilde{A})X + (I - \widetilde{A})^{-1}Y$$

Define

$$A^* \equiv (I - \widetilde{A})^{-1}(A - \widetilde{A})$$

and write

$$X = A^*X + (I - \widetilde{A})^{-1}Y \tag{19}$$

Pre-multiply by A^* to get

$$A^*X = (A^*)^2X + A^*(I - \widetilde{A})^{-1}Y \tag{20}$$

and use (20) in (19) to get

$$\begin{aligned} X &= (A^*)^2X + A^*(I - \widetilde{A})^{-1}Y + (I - \widetilde{A})^{-1}Y \\ &= (A^*)^2X + (I + A^*)(I - \widetilde{A})^{-1}Y \end{aligned}$$

Now solve again for X to get

$$X = \underbrace{[I - (A^*)^2)]^{-1}}_{M_3} \cdot \underbrace{(I + A^*)}_{M_2} \cdot \underbrace{(I - \widetilde{A})^{-1}}_{M_1} \cdot Y \tag{21}$$

Stone's additive decomposition starts with $X = M_3 M_2 M_1 Y$ in (21) and arrives at:

$$X = IY + \underbrace{(M_1 - I)}_{\widetilde{M}_1} Y + \underbrace{(M_2 - I)\, M_1}_{\widetilde{M}_2} Y + \underbrace{(M_3 - I)\, M_2 M_1}_{\widetilde{M}_3} Y \tag{22}$$

Here is the derivation of (22) starting with (21):

$$
\begin{aligned}
B &= M_1 M_2 M_3 \\
&= M_2 M_1 + M_1 M_2 M_3 - M_2 M_1 \\
&= M_2 M_1 + (M_3 - I)\, M_2 M_1 \\
&= M_1 + M_2 M_1 - M_1 + (M_3 - I)\, M_2 M_1 \\
&= M_1 + (M_2 - I)\, M_1 + (M_3 - I)\, M_2 M_1 \\
&= I + (M_1 - I) + (M_2 - I)\, M_1 + (M_3 - I)\, M_2 M_1
\end{aligned}
$$

In the context of international analysis, $\widetilde{A} = A^d$ is the matrix of diagonal (or block-diagonal, if industries are not aggregated) elements such that

$$
A^d = \begin{bmatrix} A_{11} & 0 & 0 & 0 \\ 0 & A_{22} & 0 & 0 \\ 0 & 0 & \ddots & 0 \\ 0 & 0 & 0 & A_{nn} \end{bmatrix}
$$

and

$$
A^f = \begin{bmatrix} 0 & A_{12} & \cdots & A_{1n} \\ A_{21} & 0 & & \vdots \\ \vdots & & \ddots & A_{n-1,n} \\ A_{n1} & \cdots & A_{n,n-1} & 0 \end{bmatrix}.
$$

Then

$$
B^d = \left(I - A^d\right)^{-1} = \begin{bmatrix} (I - A_{11})^{-1} & 0 & 0 & 0 \\ 0 & (I - A_{22})^{-1} & 0 & 0 \\ 0 & 0 & \ddots & 0 \\ 0 & 0 & 0 & (I - A_{nn})^{-1} \end{bmatrix}
$$

Using these in A^* gives

$$
\begin{aligned}
A^* &= \left(I - A^d\right)^{-1} A^f = B^d A^f \\
&= \begin{bmatrix} (I - A_{11})^{-1} & 0 & 0 & 0 \\ 0 & (I - A_{22})^{-1} & 0 & 0 \\ 0 & 0 & \ddots & 0 \\ 0 & 0 & 0 & (I - A_{nn})^{-1} \end{bmatrix} \begin{bmatrix} 0 & A_{12} & \cdots & A_{1n} \\ A_{21} & 0 & & \vdots \\ \vdots & & \ddots & A_{n-1,n} \\ A_{n1} & \cdots & A_{n,n-1} & 0 \end{bmatrix} \\
&= \begin{bmatrix} 0 & (I - A_{11})^{-1} A_{12} & \cdots & (I - A_{11})^{-1} A_{1n} \\ (I - A_{22})^{-1} A_{21} & 0 & & \vdots \\ \vdots & & \ddots & (I - A_{n-1,n-1})^{-1} A_{n-1,n} \\ (I - A_{nn})^{-1} A_{n1} & \cdots & (I - A_{nn})^{-1} A_{n,n-1} & 0 \end{bmatrix}
\end{aligned}
$$

and also the related M_2 matrix $M_2 = I + A^*$. The typical off-diagonal $(i,j)_{i \neq j}$ element of A^* (and also of M_2) is $(I - A_{ii})^{-1} A_{ij}$; it captures demand for factors in i that originate from intermediate inputs demand in production in j that cross borders from j to i *once*.

Now consider

$$(A^*)^2 = \left[\sum_{l \neq i,j} (I - A_{ii})^{-1} A_{il} (I - A_{ll})^{-1} A_{lj} \right]_{i,j}$$

which has a typical (i, j) element $\sum_{l \neq i,j} (I - A_{ii})^{-1} A_{il} (I - A_{ll})^{-1} A_{lj}$. This captures demand for factors in i that originate from intermediate inputs demand in production in j that cross borders *twice* from j to i. The first matrix on the right A_{lj} gives demand from j's industries in l. The second matrix $(I - A_{ll})^{-1}$ calculates the output that needs to be produced in l in order to satisfy the demand from j. The third matrix A_{il} gives the implication of this for demand from i's industries. And the fourth matrix $(I - A_{ii})^{-1}$ calculates the output that needs to be produced in i in order to satisfy the demand from l.

Applying the above to Stone's additive decomposition gives

$$X = IY + \underbrace{[B^d - I]}_{\widetilde{M}_1} Y + \underbrace{B^d A^f B^d}_{\widetilde{M}_2} Y + \underbrace{(B - B^d - B^d A^f B^d)}_{\widetilde{M}_3} Y \ .$$

If we consider $\widetilde{A} = A^f$, we have

$$M_1 = B^f = \left(I - A^f\right)^{-1}$$

Here B^f captures total demand for output (including the initial injection of direct demand from Y) due to value chains that always cross borders. For example, B^f includes chains like $A_{ij}A_{jk}A_{kl}A_{lm}...$, where $i \neq j$, $j \neq k$, $k \neq l$, $l \neq m...$, but it is possible to have, for example, $i = k$. Thus domestic feedbacks are possible in B^f. Here $\widetilde{M}_1 = B^f - I$ in Stone's additive decomposition nets out the direct effect of the initial injection by deducting I. However, $\widetilde{M}_2 = B^f A^d B^f$ does not have a clear interpretation, despite clearly capturing some of the possible value chains. Similarly for $\widetilde{M}_3$. However, we can say that $\widetilde{M}_2 + \widetilde{M}_3$ gives the remainder of output that is induced by demand after taking into account the direct injection and $\widetilde{M}_1$.

C.1 Domestic versus foreign sources of compositional changes: GDP

Here we describe the results of the Stone decomposition in changes

$$V \Delta BY = V \Delta B^d Y + V \Delta B^x Y + V \Delta B^g Y$$

and the decomposition of demand into domestic and foreign demand

$$VB\Delta Y = VB\Delta Y^d + VB\Delta Y^f \ ,$$

where, compared to (8) and (10), we set $V_f = V$, i.e. consider changes in sources of compositional changes of GDP.

Table A8 in the appendix displays the results of the analysis for both periods (1995–2007 and 2007–2014), for the entire economy level and separately for manufacturing. The four "Total" rows report in columns 1–3 and 7–9 shares of total factor payments (or GDP) that are paid by domestic industries versus foreign industries in the initial year (1995 or 2007); these are the same numbers for the initial year in columns 7 and 8 in Tables 1 and 2.[55] The "Total" rows report in columns 4–6 and 10–12 the changes in the same concepts; these are the same numbers in columns 7 and 8 in Tables 1 and 2 for either changes in B or changes in Y.[56] The rows above the "Total" rows indicate the contributions of sub-components of either B or Y to levels in columns 1–3 and 7–9, and to changes in columns 4–6 and 10–12.

We start with describing the results for the breakdown of B. Overall, almost all of demand in levels from domestic industries occurs due to domestic linkages (B^d), while most of the demand from foreign industries occurs due to bilateral trade linkages (B^x) (roughly 83% in 1995 and 77% in 2007). Not surprisingly, most the factor payments are generated due to domestic linkages (roughly 90% for all industries and 80% in manufacturing in 1995). Complex GVCs (B^g) originate mostly from foreign industries; "loop" value chains from domestic back to domestic are much less important.

What is more interesting are the contributions to changes (ΔB). The shift of income generated from domestic to foreign industries is driven by a reduction in the importance of domestic linkages which are counterbalanced by both exports (ΔB^x) and by more complex GVCs (ΔB^g). Complex GVCs account for slightly more than exports linkages in explaining the shift towards foreign industries. In manufacturing complex GVCs are twice as important as exports in explaining the shift towards foreign industries in 1995–2007; while the opposite is true in 2007–2014, the overall changes are much more modest in the latter period.

Turning to the breakdown of Y, we see that domestic demand for final goods (Y^d) accounts for the lion's share of factor payments (almost 93% for the entire economy in 1995), although less in manufacturing (81.5%), and less so over time (90% for the entire economy and 74% in manufacturing in 2007). Considering the contributions to changes (ΔY), there are different patterns before and after 2007. In 1995–2007 the source of factor payments shifts from domestic demand to foreign demand, while in 2007–2014 the opposite is true. This is likely a result of the 2007–8 crisis and the so-called "trade collapse".

The increase in importance of foreign demand in 1995–2007 operates both through domestic and—more so—through foreign industries. In contrast, the incidence of the overall decline in importance of domestic demand in the same period is on domestic industries, while concurrently contributing to an increase in factor payments due to foreign industries. This last point is the result of complex value chains by which increases in domestic demand for foreign final goods affects domestic factors. The changes in manufacturing are larger, and in the same direction as the entire economy, on average.

In 2007–2014 domestic demand increases in importance overall, but as in the previous period, domestic demand shifts from domestic to foreign final goods (industries). At the same time, the reduction in importance of foreign demand operates mostly though a reduction in domestic final goods (industries). As in the previous period, the cross-effects of domestic (foreign) demand through foreign (domestic) industries reflects the complexity of GVCs.

The overall message from Table A8 is as follows. Most income arises from domestic industries, but shift towards foreign ones; in 1995–2007 this is driven more by complex GVCs (1.25) than bilateral exports (1.04). Most income arises from domestic demand, but shift towards foreign; in 1995–2007 decline in the contribution of domestic demand occurs through a reduction in demand for goods that are more locally produced in the GVC sense (-3.08) that is not compensated by an increase in domestic demand for foreign industries ($+1.05$).

[55] For example, 91.12 is the same in the "Total" row of column 1 of Table A8 and the "VBY_{1995}" row of column 7 of Table 1.

[56] For example, -2.19 is the same in the "Total" row of column 4 of Table A8 and the "$V_{1995}*B_{2007}*Y_{1995}-VBY_{1995}$" row of column 7 of Table 1.

D Within-industry theoretical framework: derivations

Start with nested CES:

$$Q = A\left[\alpha^{\frac{1}{\sigma}}X^{\frac{\sigma-1}{\sigma}} + (1-\alpha)^{\frac{1}{\sigma}}L^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \tag{23}$$

$$X = \left[\beta^{\frac{1}{\eta}}K^{\frac{\eta-1}{\eta}} + (1-\beta)^{\frac{1}{\eta}}H^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}} \tag{24}$$

so that

$$Q = A\left[\alpha^{\frac{1}{\sigma}}\left[\beta^{\frac{1}{\eta}}K^{\frac{\eta-1}{\eta}} + (1-\beta)^{\frac{1}{\eta}}H^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}\frac{\sigma-1}{\sigma}} + (1-\alpha)^{\frac{1}{\sigma}}L^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} . \tag{25}$$

D.1 Cost shares

The unit cost function (marginal and average due to CRS) associated with X is

$$z \equiv c_X(r,s) = \left[\beta r^{1-\eta} + (1-\beta)s^{1-\eta}\right]^{\frac{1}{1-\eta}} \tag{26}$$

and for Q it is

$$c(z,w) = \frac{1}{A}\left[\alpha z^{1-\sigma} + (1-\alpha)w^{1-\sigma}\right]^{\frac{1}{1-\sigma}} \tag{27}$$

$$= \frac{1}{A}\left[\alpha\left[\beta r^{1-\eta} + (1-\beta)s^{1-\eta}\right]^{\frac{1-\sigma}{1-\eta}} + (1-\alpha)w^{1-\sigma}\right]^{\frac{1}{1-\sigma}} \tag{28}$$

$$= c(r,s,w) . \tag{29}$$

Using Shephard's Lemma, unit demand for L is

$$L^1(z,w) = \frac{\partial c(z,w)}{\partial w} \tag{30}$$

$$= \frac{1}{A}\frac{1}{1-\sigma}\left[\alpha z^{1-\sigma} + (1-\alpha)w^{1-\sigma}\right]^{\frac{1}{1-\sigma}-1}(1-\alpha)(1-\sigma)w^{-\sigma} \tag{31}$$

$$= \frac{1}{A}\left[\alpha z^{1-\sigma} + (1-\alpha)w^{1-\sigma}\right]^{\frac{1}{1-\sigma}}\frac{(1-\alpha)w^{-\sigma}}{\alpha z^{1-\sigma} + (1-\alpha)w^{1-\sigma}} \tag{32}$$

$$= c(z,w)\frac{(1-\alpha)w^{-\sigma}}{\alpha z^{1-\sigma} + (1-\alpha)w^{1-\sigma}} \tag{33}$$

$$= c(z,w)\frac{(1-\alpha)w^{1-\sigma}}{\alpha z^{1-\sigma} + (1-\alpha)w^{1-\sigma}}\frac{1}{w} . \tag{34}$$

Unit demand for K is

$$K^1(r,s,w) = \frac{\partial c(r,s,w)}{\partial r} \tag{35}$$

$$= \frac{1}{A}\frac{1}{1-\sigma}\left[\alpha z^{1-\sigma} + (1-\alpha) w^{1-\sigma}\right]^{\frac{1}{1-\sigma}-1} \alpha(1-\sigma) z^{-\sigma}\frac{\partial z}{\partial r} \tag{36}$$

$$= \frac{1}{A}\left[\alpha z^{1-\sigma} + (1-\alpha) w^{1-\sigma}\right]^{\frac{1}{1-\sigma}} \frac{\alpha z^{-\sigma}}{\alpha z^{1-\sigma} + (1-\alpha) w^{1-\sigma}}\frac{\partial z}{\partial r} \tag{37}$$

$$= c(r,s,w)\frac{\alpha z^{-\sigma}}{\alpha z^{1-\sigma} + (1-\alpha) w^{1-\sigma}}\frac{\partial z}{\partial r}\ . \tag{38}$$

Now,

$$\frac{\partial z}{\partial r} = \frac{1}{1-\eta}\left[\beta r^{1-\eta} + (1-\beta) s^{1-\eta}\right]^{\frac{1}{1-\eta}-1} \beta(1-\eta) r^{-\eta} \tag{39}$$

$$= \left[\beta r^{1-\eta} + (1-\beta) s^{1-\eta}\right]^{\frac{1}{1-\eta}} \frac{\beta r^{-\eta}}{\beta r^{1-\eta} + (1-\beta) s^{1-\eta}} \tag{40}$$

$$= z\frac{\beta r^{1-\eta}}{\beta r^{1-\eta} + (1-\beta) s^{1-\eta}}\frac{1}{r} \tag{41}$$

Using this in the above gives

$$K^1(r,s,w) = c(r,s,w)\frac{\alpha z^{1-\sigma}}{\alpha z^{1-\sigma} + (1-\alpha) w^{1-\sigma}}\frac{\beta r^{1-\eta}}{\beta r^{1-\eta} + (1-\beta) s^{1-\eta}}\frac{1}{r}\ . \tag{42}$$

Using similar steps gives

$$H^1(r,s,w) = c(r,s,w)\frac{\alpha z^{1-\sigma}}{\alpha z^{1-\sigma} + (1-\alpha) w^{1-\sigma}}\frac{(1-\beta) s^{1-\eta}}{\beta r^{1-\eta} + (1-\beta) s^{1-\eta}}\frac{1}{s}\ . \tag{43}$$

The cost share of labor θ_L is

$$\theta_L = \frac{wL^1(z,w)}{c(z,w)} \tag{44}$$

$$= \frac{(1-\alpha) w^{1-\sigma}}{\alpha z^{1-\sigma} + (1-\alpha) w^{1-\sigma}}\ . \tag{45}$$

The cost share of capital θ_K is

$$\theta_K = \frac{rK^1(r,s,w)}{c(r,s,w)} \tag{46}$$

$$= \frac{\alpha z^{1-\sigma}}{\alpha z^{1-\sigma} + (1-\alpha) w^{1-\sigma}}\frac{\beta r^{1-\eta}}{\beta r^{1-\eta} + (1-\beta) s^{1-\eta}} \tag{47}$$

$$= (1-\theta_L)\frac{\beta r^{1-\eta}}{\beta r^{1-\eta} + (1-\beta) s^{1-\eta}}\ . \tag{48}$$

The cost share of high skill labor θ_H is

$$\theta_H = \frac{sH^1(r,s,w)}{c(r,s,w)} \tag{49}$$

$$= \frac{\alpha z^{1-\sigma}}{\alpha z^{1-\sigma}+(1-\alpha)w^{1-\sigma}}\frac{(1-\beta)s^{1-\eta}}{\beta r^{1-\eta}+(1-\beta)s^{1-\eta}} \tag{50}$$

$$= (1-\theta_L)\frac{(1-\beta)s^{1-\eta}}{\beta r^{1-\eta}+(1-\beta)s^{1-\eta}}\ . \tag{51}$$

The cost shares of capital and high skill labor are the product of the cost share of X ($\theta_X = 1-\theta_L$), multiplied by the corresponding shares in expenditures within X:

$$\theta_K^X = \frac{\beta r^{1-\eta}}{\beta r^{1-\eta}+(1-\beta)s^{1-\eta}} \tag{52}$$

$$\theta_H^X = \frac{(1-\beta)s^{1-\eta}}{\beta r^{1-\eta}+(1-\beta)s^{1-\eta}}\ , \tag{53}$$

so that writing concisely

$$\theta_K = (1-\theta_L)\theta_K^X \tag{54}$$

$$\theta_H = (1-\theta_L)\theta_H^X\ . \tag{55}$$

Summarizing all cost shares,

$$\theta_L = \frac{(1-\alpha)w^{1-\sigma}}{\alpha z^{1-\sigma}+(1-\alpha)w^{1-\sigma}} \tag{56}$$

$$\theta_X = \frac{\alpha z^{1-\sigma}}{\alpha z^{1-\sigma}+(1-\alpha)w^{1-\sigma}} \tag{57}$$

$$\theta_K^X = \frac{\beta r^{1-\eta}}{\beta r^{1-\eta}+(1-\beta)s^{1-\eta}} \tag{58}$$

$$\theta_H^X = \frac{(1-\beta)s^{1-\eta}}{\beta r^{1-\eta}+(1-\beta)s^{1-\eta}} \tag{59}$$

$$\theta_K = \frac{\alpha z^{1-\sigma}}{\alpha z^{1-\sigma}+(1-\alpha)w^{1-\sigma}}\frac{\beta r^{1-\eta}}{\beta r^{1-\eta}+(1-\beta)s^{1-\eta}} = \theta_X\theta_K^X \tag{60}$$

$$\theta_H = \frac{\alpha z^{1-\sigma}}{\alpha z^{1-\sigma}+(1-\alpha)w^{1-\sigma}}\frac{(1-\beta)s^{1-\eta}}{\beta r^{1-\eta}+(1-\beta)s^{1-\eta}} = \theta_X\theta_H^X\ . \tag{61}$$

D.2 Changes in factor cost shares induced by changes in the price of capital

D.2.1 Unskilled labor's share

Start with unskilled labor

$$\frac{\partial\theta_L}{\partial r} = \frac{\partial}{\partial r}\frac{(1-\alpha)\,w^{1-\sigma}}{\alpha z^{1-\sigma}+(1-\alpha)\,w^{1-\sigma}} \tag{62}$$

$$= \frac{(1-\alpha)\,w^{1-\sigma}}{\left[\alpha z^{1-\sigma}+(1-\alpha)\,w^{1-\sigma}\right]^2}(-1)\,\alpha\,(1-\sigma)\,z^{-\sigma}\frac{\partial z}{\partial r} \tag{63}$$

$$= (\sigma-1)\,\frac{(1-\alpha)\,w^{1-\sigma}}{\left[\alpha z^{1-\sigma}+(1-\alpha)\,w^{1-\sigma}\right]^2}\alpha z^{-\sigma} z\frac{\beta r^{1-\eta}}{\beta r^{1-\eta}+(1-\beta)\,s^{1-\eta}}\frac{1}{r} \tag{64}$$

$$= (\sigma-1)\,\frac{(1-\alpha)\,w^{1-\sigma}}{\alpha z^{1-\sigma}+(1-\alpha)\,w^{1-\sigma}}\frac{\alpha z^{1-\sigma}}{\alpha z^{1-\sigma}+(1-\alpha)\,w^{1-\sigma}}\frac{\beta r^{1-\eta}}{\beta r^{1-\eta}+(1-\beta)\,s^{1-\eta}}\frac{1}{r} \tag{65}$$

$$= (\sigma-1)\,\theta_L\theta_X\theta_K^X\frac{1}{r}\ , \tag{66}$$

so that

$$\frac{\partial\theta_L}{\partial r}r = (\sigma-1)\,\theta_L\theta_K\ . \tag{67}$$

D.2.2 Capital's share

Turning to capital,

$$\frac{\partial\theta_K}{\partial r} = \frac{\partial}{\partial r}\left[(1-\theta_L)\,\frac{\beta r^{1-\eta}}{\beta r^{1-\eta}+(1-\beta)\,s^{1-\eta}}\right] \tag{68}$$

$$= \frac{\partial}{\partial r}(1-\theta_L)\cdot\frac{\beta r^{1-\eta}}{\beta r^{1-\eta}+(1-\beta)\,s^{1-\eta}}+(1-\theta_L)\cdot\frac{\partial}{\partial r}\frac{\beta r^{1-\eta}}{\beta r^{1-\eta}+(1-\beta)\,s^{1-\eta}} \tag{69}$$

$$= \underbrace{-(\sigma-1)\,\theta_L\frac{\theta_K}{r}}_{-\partial\theta_L/\partial r}\theta_K^X+(1-\theta_L)\cdot\underbrace{\frac{\partial}{\partial r}\frac{\beta r^{1-\eta}}{\beta r^{1-\eta}+(1-\beta)\,s^{1-\eta}}}_{\partial\theta_K^X/\partial r}\ . \tag{70}$$

Focus on

$$\frac{\partial}{\partial r}\frac{\beta r^{1-\eta}}{\beta r^{1-\eta}+(1-\beta)\,s^{1-\eta}} = \frac{(1-\eta)\,\beta r^{-\eta}\left[\beta r^{1-\eta}+(1-\beta)\,s^{1-\eta}\right]-\beta r^{1-\eta}\beta\,(1-\eta)\,r^{-\eta}}{\left[\beta r^{1-\eta}+(1-\beta)\,s^{1-\eta}\right]^2} \tag{71}$$

$$= \frac{\beta^2\,(1-\eta)\,r^{1-2\eta}+(1-\eta)\,\beta r^{-\eta}\,(1-\beta)\,s^{1-\eta}-\beta^2\,(1-\eta)\,r^{1-2\eta}}{\left[\beta r^{1-\eta}+(1-\beta)\,s^{1-\eta}\right]^2} \tag{72}$$

$$= (1-\eta)\,\frac{\beta r^{-\eta}}{\beta r^{1-\eta}+(1-\beta)\,s^{1-\eta}}\frac{(1-\beta)\,s^{1-\eta}}{\beta r^{1-\eta}+(1-\beta)\,s^{1-\eta}} \tag{73}$$

$$= (1-\eta)\,\frac{\beta r^{1-\eta}}{\beta r^{1-\eta}+(1-\beta)\,s^{1-\eta}}\frac{(1-\beta)\,s^{1-\eta}}{\beta r^{1-\eta}+(1-\beta)\,s^{1-\eta}}\frac{1}{r} \tag{74}$$

$$= (1-\eta)\,\theta_K^X\theta_H^X\frac{1}{r}\ . \tag{75}$$

Plugging this back in the equation above gives

$$\frac{\partial \theta_K}{\partial r} = \left[-(\sigma-1)\theta_L\theta_K\theta_K^X + (1-\eta)(1-\theta_L)\theta_K^X\theta_H^X\right]\frac{1}{r} \tag{76}$$

$$= \left[-(\sigma-1)\theta_L\theta_K\theta_K^X + (1-\eta)\theta_X\theta_K^X\theta_H^X\right]\frac{1}{r} \tag{77}$$

$$= \left[-(\sigma-1)\theta_L\theta_K\theta_K^X + (1-\eta)\theta_K\theta_H^X\right]\frac{1}{r} \tag{78}$$

$$= \left[-(\sigma-1)\theta_L\theta_K^X + (1-\eta)\left(1-\theta_K^X\right)\right]\frac{\theta_K}{r}\ , \tag{79}$$

so that

$$\frac{\partial \theta_K}{\partial r} r = \left[-(\sigma-1)\theta_L\theta_K^X + (1-\eta)\left(1-\theta_K^X\right)\right]\theta_K\ . \tag{80}$$

D.2.3 Skilled labor's share

Turning to skilled labor,

$$\frac{\partial \theta_H}{\partial r} = \frac{\partial}{\partial r}\left[(1-\theta_L)\frac{(1-\beta)s^{1-\eta}}{\beta r^{1-\eta}+(1-\beta)s^{1-\eta}}\right] \tag{81}$$

$$= \frac{\partial}{\partial r}(1-\theta_L)\cdot\frac{(1-\beta)s^{1-\eta}}{\beta r^{1-\eta}+(1-\beta)s^{1-\eta}} + (1-\theta_L)\cdot\frac{\partial}{\partial r}\frac{(1-\beta)s^{1-\eta}}{\beta r^{1-\eta}+(1-\beta)s^{1-\eta}} \tag{82}$$

$$= \underbrace{-(\sigma-1)\theta_L\frac{\theta_K}{r}}_{-\partial\theta_L/\partial r}\theta_H^X + (1-\theta_L)\cdot\underbrace{\frac{\partial}{\partial r}\frac{(1-\beta)s^{1-\eta}}{\beta r^{1-\eta}+(1-\beta)s^{1-\eta}}}_{\partial\theta_H^X/\partial r}\ . \tag{83}$$

Focus on

$$\frac{\partial}{\partial r}\frac{(1-\beta)s^{1-\eta}}{\beta r^{1-\eta}+(1-\beta)s^{1-\eta}} = -\frac{(1-\beta)s^{1-\eta}\beta(1-\eta)r^{-\eta}}{\left[\beta r^{1-\eta}+(1-\beta)s^{1-\eta}\right]^2} \tag{84}$$

$$= -(1-\eta)\frac{(1-\beta)s^{1-\eta}}{\beta r^{1-\eta}+(1-\beta)s^{1-\eta}}\frac{\beta r^{-\eta}}{\left[\beta r^{1-\eta}+(1-\beta)s^{1-\eta}\right]^2} \tag{85}$$

$$= -(1-\eta)\frac{(1-\beta)s^{1-\eta}}{\beta r^{1-\eta}+(1-\beta)s^{1-\eta}}\frac{\beta r^{1-\eta}}{\beta r^{1-\eta}+(1-\beta)s^{1-\eta}}\frac{1}{r} \tag{86}$$

$$= -(1-\eta)\theta_H^X\theta_K^X\frac{1}{r}\ . \tag{87}$$

Plugging this back in the equation above gives

$$\frac{\partial \theta_H}{\partial r} = \left[-(\sigma-1)\theta_L\theta_K\theta_H^X - (1-\eta)(1-\theta_L)\theta_K^X\theta_H^X\right]\frac{1}{r} \tag{88}$$

$$= \left[-(\sigma-1)\theta_L\theta_K\theta_H^X - (1-\eta)\theta_X\theta_K^X\theta_H^X\right]\frac{1}{r} \tag{89}$$

$$= \left[-(\sigma-1)\theta_L\theta_H^X - (1-\eta)\theta_H^X\right]\frac{\theta_K}{r} \tag{90}$$

$$= \left[-(\sigma-1)\theta_L\theta_H^X - (1-\eta)\left(1-\theta_K^X\right)\right]\frac{\theta_K}{r}\ , \tag{91}$$

so that

$$\frac{\partial \theta_H}{\partial r} r = \left[-(\sigma-1)\,\theta_L \theta_H^X - (1-\eta)\left(1-\theta_K^X\right)\right]\theta_K \ . \tag{92}$$

The first term is similar to the first term in $\partial\theta_K/\partial r$, because it captures substitution between L and X. The second term has the opposite sign and same magnitude in absolute value as for $\partial\theta_K/\partial r$, since it captures substitution between H and K in the opposite direction.

D.2.4 Shares within the capital-skill composite

This was solved above:

$$\frac{\partial \theta_K^X}{\partial r} = \frac{\partial}{\partial r}\frac{\beta r^{1-\eta}}{\beta r^{1-\eta} + (1-\beta)\,s^{1-\eta}} = (1-\eta)\,\theta_K^X \theta_H^X \frac{1}{r} \tag{93}$$

$$\frac{\partial \theta_H^X}{\partial r} = \frac{\partial}{\partial r}\frac{(1-\beta)\,s^{1-\eta}}{\beta r^{1-\eta} + (1-\beta)\,s^{1-\eta}} = -(1-\eta)\,\theta_K^X \theta_H^X \frac{1}{r} \ , \tag{94}$$

so that

$$\frac{\partial \theta_K^X}{\partial r} r = (1-\eta)\,\theta_K^X \theta_H^X \tag{95}$$

$$\frac{\partial \theta_H^X}{\partial r} r = -(1-\eta)\,\theta_K^X \theta_H^X \ . \tag{96}$$

D.2.5 Sum of cost shares

One can verify that

$$\frac{\partial \theta_L}{\partial r} + \frac{\partial \theta_H}{\partial r} + \frac{\partial \theta_K}{\partial r} \tag{97}$$

$$= \left\{ \begin{array}{c} (\sigma-1)\,\theta_L - \left[(\sigma-1)\,\theta_L\left(1-\theta_K^X\right) + (1-\eta)\,(1-\theta_K^X)\right] \\ -\left[(\sigma-1)\,\theta_L\theta_K^X - (1-\eta)\,(1-\theta_K^X)\right] \end{array} \right\} \frac{\theta_K}{r} \tag{98}$$

$$= \left\{(\sigma-1)\,\theta_L - (\sigma-1)\,\theta_L\left(1-\theta_K^X\right) - (\sigma-1)\,\theta_L\theta_K^X\right\}\frac{\theta_K}{r} \tag{99}$$

$$= \left\{(\sigma-1)\,\theta_L - (\sigma-1)\,\theta_L\right\}\frac{\theta_K}{r} \tag{100}$$

$$= 0 \ . \tag{101}$$

And

$$\frac{\partial \theta_K^X}{\partial r} + \frac{\partial \theta_H^X}{\partial r} = 0 \ . \tag{102}$$

D.2.6 Summary of how factor cost shares vary with the price of capital

$$\frac{\partial \theta_L}{\partial r} r = (\sigma - 1)\, \theta_L \theta_K \tag{103}$$

$$\frac{\partial \theta_H}{\partial r} r = -\left[(\sigma - 1)\, \theta_L \theta_H^X + (1 - \eta)\, \theta_H^X\right] \theta_K \tag{104}$$

$$\frac{\partial \theta_K}{\partial r} r = -\left[(\sigma - 1)\, \theta_L \theta_K^X - (1 - \eta)\,(1 - \theta_K^X)\right] \theta_K \tag{105}$$

$$\frac{\partial \theta_K^X}{\partial r} r = (1 - \eta)\, \theta_K^X \theta_H^X \tag{106}$$

$$\frac{\partial \theta_H^X}{\partial r} r = -(1 - \eta)\, \theta_K^X \theta_H^X \ . \tag{107}$$

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Table 1: Payments to Domestic Factors (Forward Linkages), 1995-2007

A. All sectors

	Shares in GDP								Shares in domestic industries' VA		Shares in foreign industries' VA	
	K income from domestic industries (1)	L income from domestic industries (2)	K income from foreign industries (3)	L income from foreign industries (4)	K income (domestic + foreign) (5)	L income (domestic + foreign) (6)	Income from domestic industries (7)	Income from foreign industries (8)	K income (9)	L income (10)	K income (11)	L income (12)
Levels												
VBY 1995	35.01	56.11	3.48	5.40	38.49	61.51	91.12	8.88	38.42	61.58	39.22	60.78
VBY 2007	35.88	52.39	5.06	6.67	40.94	59.06	88.27	11.73	40.65	59.35	43.13	56.87
Changes												
V2007*B1995*Y1995 - VBY 1995	0.95	-0.77	0.11	-0.29	1.06	-1.06	0.18	-0.18	0.97	-0.97	2.07	-2.07
V1995***B2007***Y1995 - VBY 1995	-0.66	-1.53	1.13	1.07	0.47	-0.47	-2.19	2.19	0.21	-0.21	2.41	-2.41
V1995*B1995***Y2007** - VBY 1995	-0.12	-1.65	0.56	1.21	0.44	-0.44	-1.77	1.77	0.62	-0.62	-1.25	1.25
V1995***B2007*Y2007** - VBY 1995	-0.42	-2.71	1.28	1.85	0.86	-0.86	-3.13	3.13	0.89	-0.89	0.47	-0.47
VBY 2007 - VBY 1995	0.87	-3.72	1.57	1.27	2.45	-2.45	-2.84	2.84	2.23	-2.23	3.91	-3.91

B. Manufacturing

	Shares in GDP								Shares in domestic industries' VA		Shares in foreign industries' VA	
	K income from domestic industries (1)	L income from domestic industries (2)	K income from foreign industries (3)	L income from foreign industries (4)	K income (domestic + foreign) (5)	L income (domestic + foreign) (6)	Income from domestic industries (7)	Income from foreign industries (8)	K income (9)	L income (10)	K income (11)	L income (12)
Levels												
VBY 1995	31.84	49.30	6.89	11.96	38.73	61.27	81.14	18.86	39.24	60.76	36.56	63.44
VBY 2007	32.06	41.94	10.70	15.29	42.77	57.23	74.01	25.99	43.33	56.67	41.18	58.82
Changes												
V2007*B1995*Y1995 - VBY 1995	1.15	-1.02	0.36	-0.49	1.51	-1.51	0.13	-0.13	1.35	-1.35	2.17	-2.17
V1995***B2007***Y1995 - VBY 1995	-0.88	-2.49	1.79	1.57	0.92	-0.92	-3.36	3.36	0.57	-0.57	2.53	-2.53
V1995*B1995***Y2007** - VBY 1995	-1.22	-4.12	1.82	3.52	0.60	-0.60	-5.34	5.34	1.16	-1.16	-0.55	0.55
V1995***B1995*Y2007** - VBY 1995	-1.34	-6.00	2.97	4.37	1.63	-1.63	-7.34	7.34	2.08	-2.08	1.09	-1.09
VBY 2007 - VBY 1995	0.22	-7.36	3.81	3.32	4.04	-4.04	-7.13	7.13	4.09	-4.09	4.63	-4.63

Notes. Panel A reports decompositions of changes in factor shares in GDP, while Panel B reports decompositions of changes in factor shares within manufacturing industries’ value added. Columns 1-4 report the shares of income accruing to capital and labor from domestic industries and from foreign industries. All other columns are derived from these. Columns 5 and 6 report the overall capital and domestic shares in value added. The split between domestic and foreign industries is given by different entries within rows in VfBY. The contribution of foreign industries to factor shares is given by the forward concept defined in the text. The contribution of domestic industries is given by the complement of the forward concept. Columns 7 and 8 report the shares in value added arising from all domestic and international sources (forward, as in Figure 3). Columns 9 and 10 report capital and labor shares in payments by domestic final goods industries, while columns 10 and 11 report capital and labor shares in payments by foreign final goods’ industries. The rows labeled "Levels" report levels in 1995 and in 2007. Rows labeled as "Changes" report true and counterfactual changes. All numbers are weighted averages using GDP in 1995 as weights. Source: authors' calculations based on WIOD 2013 release.

Table 2: Payments to Domestic Factors (Forward Linkages), 2007-2014

A. All sectors

	Shares in GDP								Shares in domestic industries' VA		Shares in foreign industries' VA	
	K income from domestic industries (1)	L income from domestic industries (2)	K income from foreign industries (3)	L income from foreign industries (4)	K income (domestic + foreign) (5)	L income (domestic + foreign) (6)	Income from domestic industries (7)	Income from foreign industries (8)	K income (9)	L income (10)	K income (11)	L income (12)
Levels												
VBY 2007	38.17	50.68	5.43	5.71	43.61	56.39	88.85	11.15	42.96	57.04	48.74	51.26
VBY 2014	37.20	51.10	5.33	6.37	42.53	57.47	88.30	11.70	42.13	57.87	45.58	54.42
Changes												
V2014*B2007*Y2007 - VBY 2007	-1.02	1.04	-0.35	0.33	-1.37	1.37	0.02	-0.02	-1.16	1.16	-3.06	3.06
V2007***B2014***Y2007 - VBY 2007	-0.30	-0.06	0.27	0.09	-0.03	0.03	-0.36	0.36	-0.16	0.16	0.84	-0.84
V2007*B2007***Y2014** - VBY 2007	-0.17	-0.81	0.31	0.66	0.15	-0.15	-0.97	0.97	0.29	-0.29	-1.34	1.34
V2007***B2014*Y2014** - VBY 2007	-0.14	-0.46	0.22	0.37	0.08	-0.08	-0.59	0.59	0.13	-0.13	-0.59	0.59
VBY 2014 - VBY 2007	-0.97	0.42	-0.10	0.65	-1.07	1.07	-0.55	0.55	-0.83	0.83	-3.16	3.16

B. Manufacturing

	Shares in GDP								Shares in domestic industries' VA		Shares in foreign industries' VA	
	K income from domestic industries (1)	L income from domestic industries (2)	K income from foreign industries (3)	L income from foreign industries (4)	K income (domestic + foreign) (5)	L income (domestic + foreign) (6)	Income from domestic industries (7)	Income from foreign industries (8)	K income (9)	L income (10)	K income (11)	L income (12)
Levels												
VBY 2007	37.51	39.70	10.89	11.90	48.40	51.60	77.21	22.79	48.58	51.42	47.79	52.21
VBY 2014	35.59	40.03	10.74	13.64	46.33	53.67	75.62	24.38	47.07	52.93	44.06	55.94
Changes												
V2014*B2007*Y2007 - VBY 2007	-1.88	2.01	-1.01	0.88	-2.89	2.89	0.13	-0.13	-2.51	2.51	-4.19	4.19
V2007***B2014***Y2007 - VBY 2007	-0.65	-0.27	0.90	0.02	0.25	-0.25	-0.92	0.92	-0.27	0.27	1.95	-1.95
V2007*B2007***Y2014** - VBY 2007	-0.48	-1.93	0.76	1.65	0.29	-0.29	-2.41	2.41	0.93	-0.93	-1.54	1.54
V2007***B2014*Y2014** - VBY 2007	-0.36	-1.43	0.90	0.90	0.54	-0.54	-1.80	1.80	0.68	-0.68	0.15	-0.15
VBY 2014 - VBY 2007	-1.92	0.33	-0.15	1.74	-2.07	2.07	-1.59	1.59	-1.52	1.52	-3.73	3.73

Notes. Panel A reports decompositions of changes in factor shares in GDP, while Panel B reports decompositions of changes in factor shares within manufacturing industries' value added. Columns 1-4 report the shares of income accruing to capital and labor from domestic industries and from foreign industries. All other columns are derived from these. Columns 5 and 6 report the overall capital and domestic shares in value added. The split between domestic and foreign industries is given by different entries within rows in VfBY. The contribution of foreign industries to factor shares is given by the forward concept defined in the text. The contribution of domestic industries is given by the complement of the forward concept. Columns 7 and 8 report the shares in value added arising from all domestic and international sources (forward, as in Figure 3). Columns 9 and 10 report capital and labor shares in payments by domestic final goods industries, while columns 10 and 11 report capital and labor shares in payments by foreign final goods' industries. The rows labeled "Levels" report levels in 2007 and in 2014. Rows labeled as "Changes" report true and counterfactual changes. All numbers are weighted averages using GDP in 2007 as weights. Source: authors' calculations based on WIOD 2016 release.

Table 3: Payments to Domestic Labor (Forward Linkages), 1995-2007

A. All sectors

	Shares in GDP						Shares in payments to labor (domestic + foreign)		Shares in domestic payments to labor		Shares in foreign payments to labor	
	High skill labor income from domestic industries (1)	Low skill labor income from domestic industries (2)	High skill labor income from foreign industries (3)	Low skill labor income from foreign industries (4)	High skill labor income (domestic + foreign) (5)	Low skill labor income (domestic + foreign) (6)	High skill labor income (7)	Low skill labor income (8)	High skill labor income (9)	Low skill labor income (10)	High skill labor income (11)	Low skill labor income (12)
Levels												
VBY 1995	17.44	38.67	1.40	4.00	18.83	42.68	30.62	69.38	31.08	68.92	25.85	74.15
VBY 2007	20.76	31.63	2.33	4.34	23.09	35.97	39.10	60.90	39.63	60.37	34.90	65.10
Changes												
V2007*B1995*Y1995 - VBY 1995	3.64	-4.42	0.33	-0.62	3.97	-5.03	7.11	-7.11	7.02	-7.02	7.88	-7.88
V1995***B2007***Y1995 - VBY 1995	0.01	-1.54	0.27	0.80	0.27	-0.74	0.68	-0.68	0.88	-0.88	-0.12	0.12
V1995*B1995***Y2007** - VBY 1995	-0.18	-1.46	0.35	0.86	0.17	-0.61	0.50	-0.50	0.60	-0.60	0.59	-0.59
V1995***B2007*Y2007** - VBY 1995	-0.12	-2.59	0.55	1.29	0.43	-1.30	1.15	-1.15	1.35	-1.35	1.06	-1.06
VBY 2007 - VBY 1995	3.33	-7.04	0.93	0.34	4.26	-6.70	8.48	-8.48	8.55	-8.55	9.05	-9.05

B. Manufacturing

	Shares in GDP						Shares in payments to labor (domestic + foreign)		Shares in domestic payments to labor		Shares in foreign payments to labor	
	High skill labor income from domestic industries (1)	Low skill labor income from domestic industries (2)	High skill labor income from foreign industries (3)	Low skill labor income from foreign industries (4)	High skill labor income (domestic + foreign) (5)	Low skill labor income (domestic + foreign) (6)	High skill labor income (7)	Low skill labor income (8)	High skill labor income (9)	Low skill labor income (10)	High skill labor income (11)	Low skill labor income (12)
Levels												
VBY 1995	11.24	38.06	2.70	9.27	13.94	47.33	22.75	77.25	22.80	77.20	22.53	77.47
VBY 2007	12.65	29.29	4.66	10.63	17.31	39.92	30.24	69.76	30.16	69.84	30.48	69.52
Changes												
V2007*B1995*Y1995 - VBY 1995	3.27	-4.29	0.86	-1.35	4.13	-5.64	7.49	-7.49	7.25	-7.25	8.48	-8.48
V1995***B2007***Y1995 - VBY 1995	-0.39	-2.10	0.19	1.38	-0.20	-0.72	0.02	-0.02	0.39	-0.39	-1.21	1.21
V1995*B1995***Y2007** - VBY 1995	-0.89	-3.23	0.90	2.63	0.00	-0.60	0.23	-0.23	0.11	-0.11	0.66	-0.66
V1995***B2007*Y2007** - VBY 1995	-1.21	-4.78	0.99	3.38	-0.22	-1.41	0.25	-0.25	0.36	-0.36	0.04	-0.04
VBY 2007 - VBY 1995	1.41	-8.77	1.96	1.36	3.37	-7.41	7.50	-7.50	7.36	-7.36	7.95	-7.95

Notes. Panel A reports decompositions of changes in factor shares in GDP, while Panel B reports decompositions of changes in factor shares within manufacturing industries' value added. Columns 1-4 report the shares of value added accruing to high skill and low skill labor from domestic demand and from foreign demand. All other columns are derived from these four. Columns 5 and 6 report the overall high skill and low skill labor shares in value added. Columns 7 and 8 report the overall high skill and low skill labor shares in total labor income. Columns 9-12 report high skill and low skill labor shares within domestic payments to labor and within foreign-sourced payments to labor. All numbers are weighted averages using GDP in 1995 as weights. Source: authors' calculations based on WIOD 2013 release.

Table 4: Sources of Compositional Changes in Payments to Labor

A. All sectors

	1995			Δ1995-2007			2007			Δ2007-2014		
	Income from domestic industries (1)	Income from foreign industries (2)	Domestic + foreign (3)	Income from domestic industries (4)	Income from foreign industries (5)	Domestic + foreign (6)	Income from domestic industries (7)	Income from foreign industries (8)	Domestic + foreign (9)	Income from domestic industries (10)	Income from foreign industries (11)	Domestic + foreign (12)
Value chains (B)												
Domestic	55.99	0	55.99	-1.59	0	-1.59	50.54	0	50.54	-0.07	0	-0.07
Bilateral trade	0	4.52	4.52	0	0.42	0.42	0	4.41	4.41	0	0.02	0.02
Complex GVCs	0.12	0.88	1.00	0.05	0.64	0.70	0.14	1.30	1.44	0.01	0.07	0.08
Total	56.11	5.40	61.51	-1.53	1.07	-0.47	50.68	5.71	56.39	-0.06	0.09	0.03
Sources of demand (Y)												
Domestic	52.55	4.48	57.03	-2.45	0.75	-1.71	46.60	4.45	51.04	-0.69	0.66	-0.03
Foreign	3.56	0.92	4.48	0.80	0.46	1.27	4.08	1.27	5.35	-0.12	0.00	-0.12
Total	56.11	5.40	61.51	-1.65	1.21	-0.44	50.68	5.71	56.39	-0.81	0.66	-0.15

B. Manufacturing

	1995			Δ1995-2007			2007			Δ2007-2014		
	Income from domestic industries (1)	Income from foreign industries (2)	Domestic + foreign (3)	Income from domestic industries (4)	Income from foreign industries (5)	Domestic + foreign (6)	Income from domestic industries (7)	Income from foreign industries (8)	Domestic + foreign (9)	Income from domestic industries (10)	Income from foreign industries (11)	Domestic + foreign (12)
Value chains (B)												
Domestic	48.99	0	48.99	-2.64	0	-2.64	39.36	0	39.36	-0.29	0	-0.29
Bilateral trade	0	9.91	9.91	0	0.30	0.30	0	9.18	9.18	0	0.00	0.00
Complex GVCs	0.31	2.06	2.37	0.15	1.27	1.42	0.34	2.72	3.06	0.02	0.02	0.04
Total	49.30	11.96	61.27	-2.49	1.57	-0.92	39.70	11.90	51.60	-0.27	0.02	-0.25
Sources of demand (Y)												
Domestic	39.51	9.61	49.11	-6.43	2.24	-4.19	28.83	8.81	37.65	-1.26	1.59	0.33
Foreign	9.80	2.36	12.15	2.31	1.28	3.59	10.87	3.08	13.95	-0.67	0.05	-0.62
Total	49.30	11.96	61.27	-4.12	3.52	-0.60	39.70	11.90	51.60	-1.93	1.65	-0.29

Notes. Panel A reports decompositions of levels and changes in labor shares in GDP, while Panel B reports decomposition of levels and changes in labor shares within manufacturing industries' value added. The four "Total" rows report in columns 1-3 and 7-9 labor shares in value added that are paid by domestic industries, foreign industries, and overall in the initial year (1995 or 2007); these are the same numbers for the initial year in columns 2, 4 and 6 in Tables 1 and 2. The "Total" rows report in columns 4-6 and 10-12 the changes in the same concepts; these are the same numbers in columns 2, 4 and 6 in Tables 1 and 2 for either changes in B or changes in Y. The rows above the "Total" rows indicate the contributions of sub-components of either B or Y to levels in columns 1-3 and 7-9, and to changes in columns 4-6 and 10-12.
Source: authors' calculations based on WIOD 2013 and WIOD 2016 releases.

Table 5: Quantification of Derivatives of Factor Shares w.r.t. *r*

A. Elasticities of substitution	
Between L and X (σ):	1.6
Between K and H within X (η):	0.6

	B. Factor Shares (θ)						
	L	H	N	K	X	K in X	H in X
1995	0.43	0.19	0.62	0.39	0.57	0.67	0.33
2007	0.36	0.23	0.59	0.41	0.64	0.64	0.36

	C. Half-elasticities with respect to *r*						
	L	H	N	K	X	K in X	H in X
1995	0.099	-0.083	0.016	-0.016	-0.099	0.088	-0.088
2007	0.088	-0.091	-0.003	0.003	-0.088	0.092	-0.092

Notes. Panel A reports elasticities of substitution that are used in the calculations underlying Panel C. Panel B factor shares that used in the calculations underlying Panel C. The factor shares are for the (weighted) average country in the WIOD sample, taken from Tables 1 and 2. Panel C reports the half-elasticities of each factor share with respect to *r* , the user cost of capital, in 1995 and in 2007, according to the formulae in the text. The half-elasticity is the change in the factor share in percent points with respect to a one percent change in r. The quantification uses elasticities reported in Panel A and factor shares that are reported in Panel B.

Table 6: Foreign Direct Investment and Income from Foreign Industries

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable:	Direct bilateral exports of intermediate inputs, V(Bx)Y						Complex global value chains, V(Bg)Y					
Estimator	OLS	OLS	OLS	PPML	PPML	PPML	OLS	OLS	OLS	PPML	PPML	PPML
Log FDI stock	0.066***			0.071**			0.008*			0.023***		
	(0.020)			(0.031)			(0.005)			(0.008)		
Log affiliate sales		0.023***			0.024**			0.003**			0.005*	
		(0.006)			(0.012)			(0.001)			(0.003)	
Log number of affiliates			0.104**			0.093**			0.021**			0.051***
			(0.044)			(0.040)			(0.009)			(0.012)
Log distance	-1.063***	-1.071***	-1.054***	-0.427***	-0.458***	-0.414***	-0.309***	-0.308***	-0.302***	-0.156***	-0.169***	-0.139***
	(0.092)	(0.090)	(0.095)	(0.103)	(0.100)	(0.095)	(0.032)	(0.029)	(0.030)	(0.048)	(0.048)	(0.047)
Common border	0.173	0.167	0.143	0.318***	0.308**	0.296**	-0.216***	-0.216***	-0.220***	-0.237***	-0.246***	-0.252***
	(0.118)	(0.111)	(0.123)	(0.118)	(0.122)	(0.122)	(0.050)	(0.049)	(0.051)	(0.071)	(0.073)	(0.072)
Colonial ties	0.198	0.245*	0.219	0.171	0.183	0.183	-0.042	-0.036	-0.043	0.014	0.029	0.009
	(0.139)	(0.141)	(0.152)	(0.145)	(0.138)	(0.134)	(0.042)	(0.043)	(0.043)	(0.044)	(0.043)	(0.046)
Common language	0.414***	0.432***	0.401***	0.373***	0.389***	0.361***	0.085*	0.086*	0.079	-0.028	-0.025	-0.039
	(0.121)	(0.138)	(0.139)	(0.116)	(0.127)	(0.120)	(0.047)	(0.048)	(0.049)	(0.056)	(0.058)	(0.060)
Free trade agreement	-0.088	-0.088	-0.092	0.780***	0.766**	0.834***	0.018	0.020	0.020	0.071	0.072	0.090
	(0.115)	(0.121)	(0.118)	(0.303)	(0.306)	(0.293)	(0.054)	(0.054)	(0.053)	(0.068)	(0.066)	(0.062)
EU 15	-0.224	-0.202	-0.236	-0.112	-0.159	-0.166	0.003	0.005	-0.003	-0.001	-0.017	-0.014
	(0.190)	(0.194)	(0.188)	(0.208)	(0.229)	(0.216)	(0.053)	(0.052)	(0.053)	(0.117)	(0.117)	(0.109)
EU enlargement exporter to EU 15	0.112	0.122	0.087	0.163	0.134	0.086	0.073	0.075	0.072	0.319***	0.311**	0.293***
	(0.239)	(0.240)	(0.239)	(0.189)	(0.198)	(0.200)	(0.063)	(0.063)	(0.064)	(0.121)	(0.123)	(0.113)
Common currency	-0.069	-0.059	-0.042	-0.145	-0.118	-0.117	-0.031	-0.028	-0.023	0.158***	0.172***	0.171***
	(0.112)	(0.116)	(0.114)	(0.176)	(0.185)	(0.182)	(0.040)	(0.039)	(0.040)	(0.039)	(0.036)	(0.037)
Observations	1,190	1,190	1,190	1,190	1,190	1,190	1,190	1,190	1,190	1,190	1,190	1,190
R-squared	0.890	0.890	0.889	0.950	0.951	0.951	0.989	0.989	0.989	0.980	0.978	0.980
Fixed effects	o & d	o & d	o & d	o & d	o & d	o & d	o & d	o & d	o & d	o & d	o & d	o & d
Clustered standard errors	o & d	o & d	o & d	o & d	o & d	o & d	o & d	o & d	o & d	o & d	o & d	o & d

Notes. The dependent variables are income accruing to factors located in o due to sales of intermediate inputs that are demanded in destination d, either through direct bilateral exports of intermediate inputs [V(Bx)Y], or due to complex GVCs [V(Bg)Y]. All regressions include origin and destination fixed effects. Standard errors in parentheses computed by two-way clustering by origin and destination. *** p<0.01, ** p<0.05, * p<0.1.

APPENDIX TABLES

Table A1: Labor Shares and High Skill Labor Shares, 1995-2007

Country	Labor Shares in GDP			High Skill Labor Shares in GDP			High Skill Labor Shares in Total Labor Compensation			GDP in
	1995	2007	Change	1995	2007	Change	1995	2007	Change	1995
AUS	62.8	60.1	-2.7	14.1	17.9	3.9	22.4	29.8	7.4	352145
AUT	69.7	63.6	-6.0	14.3	18.0	3.7	20.6	28.3	7.7	214795
BEL	67.3	65.6	-1.7	14.1	17.2	3.1	21.0	26.2	5.2	256265
BGR	53.7	50.1	-3.5	8.1	11.1	3.0	15.2	22.2	7.0	12315
BRA	53.1	59.1	6.0	20.1	24.6	4.5	37.8	41.5	3.7	672762
CAN	58.8	57.5	-1.3	14.1	18.1	3.9	24.1	31.5	7.4	547035
CHN	54.7	42.0	-12.6	2.1	5.2	3.1	3.8	12.5	8.6	728005
CYP	62.5	64.4	1.9	28.2	30.7	2.5	45.2	47.7	2.5	8457
CZE	43.6	59.6	16.0	8.6	15.3	6.6	19.8	25.6	5.9	49985
DEU	68.2	62.8	-5.5	22.1	24.1	2.1	32.3	38.5	6.1	2283991
DNK	65.8	69.3	3.5	19.0	25.3	6.2	28.9	36.5	7.6	157483
ESP	65.0	61.2	-3.8	22.9	26.8	3.9	35.2	43.7	8.5	550710
EST	65.0	59.0	-6.0	31.1	25.7	-5.4	47.9	43.6	-4.3	3329
FIN	67.0	62.8	-4.3	25.1	28.3	3.1	37.5	45.1	7.6	114211
FRA	63.6	62.1	-1.6	21.7	25.4	3.8	34.0	41.0	7.0	1405135
GBR	67.3	68.5	1.2	21.9	30.3	8.4	32.6	44.3	11.7	1047517
GRC	50.2	57.4	7.2	14.3	20.8	6.5	28.4	36.3	7.8	119108
HUN	64.3	60.4	-3.9	18.2	23.8	5.6	28.3	39.4	11.1	38823
IDN	50.6	46.4	-4.3	5.8	11.6	5.8	11.5	25.1	13.6	241322
IND	56.6	50.9	-5.7	10.0	13.8	3.8	17.7	27.1	9.4	349731
IRL	62.3	57.1	-5.2	17.6	26.6	9.0	28.3	46.7	18.4	60023
ITA	67.0	64.4	-2.5	10.1	13.8	3.7	15.1	21.3	6.3	1015224
JPN	60.3	56.6	-3.8	17.7	21.7	4.0	29.3	38.3	9.0	5239622
KOR	81.1	72.5	-8.6	36.5	44.3	7.8	45.0	61.1	16.1	481503
LTU	48.7	54.3	5.6	20.3	24.0	3.7	41.7	44.2	2.5	6016
LUX	56.1	50.3	-5.8	14.4	20.0	5.6	25.8	39.8	14.1	18735
LVA	55.8	58.1	2.3	21.1	21.9	0.8	37.7	37.7	0.0	4362
MEX	35.0	32.2	-2.7	9.9	8.0	-1.9	28.3	24.8	-3.5	309604
MLT	57.5	58.2	0.7	12.1	16.6	4.5	21.0	28.5	7.5	3198
NLD	67.3	64.6	-2.7	17.9	25.6	7.6	26.6	39.6	13.0	378721
PRT	65.0	64.9	-0.1	13.5	17.2	3.7	20.7	26.5	5.8	99058
ROU	58.4	62.4	4.0	6.8	10.2	3.4	11.7	16.4	4.7	35878
RUS	58.0	58.9	0.9	11.6	16.0	4.4	19.9	27.1	7.2	315028
SVK	37.4	37.7	0.4	7.6	9.9	2.2	20.4	26.2	5.7	17566
SVN	84.0	69.5	-14.5	22.6	26.0	3.5	26.9	37.4	10.6	17824
SWE	64.8	65.3	0.5	15.8	22.5	6.7	24.4	34.4	10.0	221027
TUR	33.3	37.7	4.4	5.9	10.3	4.5	17.7	27.5	9.8	210799
TWN	65.2	56.5	-8.7	20.3	23.9	3.6	31.1	42.2	11.1	261669
USA	60.2	59.3	-0.9	22.0	26.6	4.6	36.6	44.9	8.3	7421307
Average	59.67	58.03	-1.64	16.40	20.49	4.09	26.98	34.62	7.64	
Weighted average	61.51	59.06	-2.45	18.83	23.09	4.26	30.42	38.65	8.23	

Notes. Weighted averages using GDP in 1995 as weights. Source: authors' calculations based on WIOD 2013 release.

Table A2: Labor Shares and High Skill Labor Shares, 2007-2014

Country	Labor Shares in GDP			High Skill Labor Shares in GDP			High Skill Labor Shares in Total Labor Compensation			GDP in
	2007	2014	Change	2008	2014	Change	2008	2014	Change	2007
AUS	58.1	57.7	-0.4							912442
AUT	57.3	60.9	3.6	15.2	17.7	2.4	29.4	32.8	3.4	345266
BEL	61.8	64.1	2.2							422059
BGR	47.9	63.3	15.5	14.4	19.5	5.1	36.1	41.3	5.2	38093
BRA	48.6	55.1	6.5							1204191
CAN	59.4	58.2	-1.3							1372537
CHE	60.6	65.1	4.5							459284
CHN	45.4	55.1	9.6							3495060
CYP	54.9	54.6	-0.3	25.8	30.0	4.1	50.6	59.1	8.5	21436
CZE	50.4	51.3	0.9	10.7	11.5	0.9	24.0	25.9	1.9	171753
DEU	58.9	62.4	3.5	21.4	18.9	-2.5	39.7	33.5	-6.2	3099194
DNK	65.3	64.5	-0.8	23.8	25.6	1.8	38.7	43.1	4.4	271418
ESP	60.7	58.7	-2.0	23.8	28.5	4.7	43.6	54.7	11.1	1333298
EST	53.8	54.8	1.0	24.3	22.3	-2.0	43.5	42.9	-0.6	19507
FIN	58.5	64.4	5.8	24.8	31.1	6.4	45.9	54.3	8.5	224288
FRA	60.9	65.0	4.1	23.1	27.5	4.4	41.1	47.0	5.8	2394018
GBR	67.1	64.9	-2.3	19.8	24.4	4.5	35.4	44.0	8.6	2664476
GRC	53.6	49.6	-4.0	14.3	18.1	3.7	37.0	48.6	11.7	281318
HRV	70.9	65.9	-5.0	17.0	22.1	5.0	30.5	39.1	8.6	51219
HUN	56.7	53.7	-3.0	21.4	22.1	0.8	41.3	44.9	3.6	119649
IDN	48.3	48.5	0.2							455190
IND	47.6	49.7	2.1							1135324
IRL	53.9	48.8	-5.0	22.4	24.3	1.9	46.1	58.2	12.1	239541
ITA	56.5	58.7	2.2	10.1	9.5	-0.6	23.2	21.6	-1.6	1982454
JPN	58.0	58.3	0.4							4310742
KOR	64.1	63.8	-0.3							1013652
LTU	54.4	48.8	-5.6	24.5	27.4	2.9	50.1	61.9	11.9	35738
LUX	54.9	59.4	4.5	23.9	30.6	6.7	43.9	57.3	13.4	45275
LVA	54.7	53.0	-1.7	21.2	23.0	1.8	39.6	47.7	8.0	27594
MEX	33.6	33.0	-0.7							1003194
MLT	60.6	58.4	-2.2							6910
NLD	59.9	62.1	2.2	21.6	20.5	-1.1	40.2	37.4	-2.8	750373
NOR	50.6	54.1	3.6							356664
POL	49.4	49.8	0.3	15.1	16.5	1.4	34.1	39.0	4.9	375515
PRT	60.6	56.7	-3.9	13.1	18.9	5.9	24.4	37.5	13.1	208568
ROU	45.4	43.5	-1.9	14.4	12.9	-1.5	32.7	34.6	2.0	151950
RUS	56.9	63.2	6.3							1114179
SVK	46.0	48.7	2.7	9.8	10.2	0.4	25.1	24.6	-0.5	69462
SVN	63.2	65.6	2.5	26.9	26.1	-0.8	47.1	45.7	-1.4	42223
SWE	54.0	57.0	3.0	19.3	25.9	6.6	37.2	48.0	10.8	430726
TUR	37.3	37.9	0.6							581365
USA	57.8	56.3	-1.5							14477638
Average	55.2	56.3	1.1	19.3	21.7	2.4	37.7	43.3	5.6	
Weighted average	56.4	57.5	1.1	19.4	21.3	1.9	36.6	39.9	3.3	

Notes. Weighted averages using GDP in 2007 as weights. Source: authors' calculations based on WIOD 2016 release (labor shares) and EU KLEMS 2017 release (high skill labor shares).

Table A3: Forward and Backward Linkages, 1995-2007

Country	Forward Linkages: Foreign Value added Share in GDP			Backward Linkages: Foreign Value Added Share in Domestic Industries VA			GDP in 1995
	1995	2007	Change	1995	2007	Change	
AUS	13.2	15.0	1.8	10.5	10.3	-0.2	352145
AUT	16.0	23.3	7.3	14.9	20.3	5.4	214795
BEL	24.3	26.8	2.5	23.2	26.1	2.8	256265
BGR	15.8	23.2	7.5	21.1	32.0	11.0	12315
BRA	5.2	8.5	3.3	5.1	7.6	2.5	672762
CAN	18.7	18.7	0.0	14.6	13.9	-0.7	547035
CHN	8.7	14.2	5.5	11.2	16.5	5.3	728005
CYP	7.3	10.1	2.8	17.8	17.9	0.1	8457
CZE	22.3	26.2	3.8	23.7	30.0	6.3	49985
DEU	11.0	19.6	8.6	9.2	15.1	5.9	2283991
DNK	13.2	19.2	6.0	13.6	19.8	6.2	157483
ESP	7.7	9.7	2.0	11.0	15.1	4.1	550710
EST	23.3	24.6	1.3	28.7	26.0	-2.8	3329
FIN	20.3	22.7	2.4	14.8	18.7	3.9	114211
FRA	10.2	10.3	0.1	9.7	12.1	2.4	1405135
GBR	13.4	14.5	1.2	12.3	12.3	0.0	1047517
GRC	3.4	8.7	5.4	10.9	15.3	4.4	119108
HUN	16.5	24.8	8.3	22.8	32.3	9.5	38823
IDN	13.5	19.1	5.6	13.1	14.3	1.2	241322
IND	5.8	9.5	3.7	7.9	14.5	6.6	349731
IRL	23.0	31.5	8.5	28.4	32.1	3.7	60023
ITA	9.9	11.4	1.5	11.3	14.4	3.1	1015224
JPN	5.2	9.6	4.4	3.7	8.1	4.4	5239622
KOR	13.4	18.1	4.7	15.3	19.3	4.0	481503
LTU	18.0	20.9	2.9	23.6	21.5	-2.1	6016
LUX	43.1	48.1	5.0	25.0	40.0	15.0	18735
LVA	22.0	17.8	-4.1	20.7	22.1	1.4	4362
MEX	12.1	12.7	0.6	13.2	13.7	0.5	309604
MLT	19.5	28.2	8.6	28.9	30.1	1.2	3198
NLD	21.5	23.3	1.8	20.3	21.8	1.5	378721
PRT	9.4	12.3	2.9	16.5	17.0	0.5	99058
ROU	11.9	14.5	2.6	15.9	19.5	3.7	35878
RUS	19.8	23.1	3.4	7.5	8.0	0.6	315028
SVK	27.0	26.9	0.0	23.4	32.1	8.7	17566
SVN	16.8	22.3	5.5	21.8	26.6	4.8	17824
SWE	18.8	22.8	4.0	15.8	19.4	3.6	221027
TUR	4.5	6.4	1.9	9.4	14.5	5.1	210799
TWN	17.0	28.7	11.7	20.1	22.2	2.1	261669
USA	6.0	6.2	0.2	5.1	7.1	2.1	7421307
Average	15.1	18.8	3.7	15.9	19.5	3.5	
Weighted average	8.9	11.7	2.8	8.1	11.3	3.1	

Notes. Weighted averages using GDP in 1995 as weights. Source: authors' calculations based on WIOD 2013 release.

Table A4: Forward and Backward Linkages, 2007-2014

Country	Forward Linkages: Foreign Value added Share in GDP			Backward Linkages: Foreign Value Added Share in Domestic Industries VA			GDP in 2007
	2007	2014	Change	2007	2014	Change	
AUS	14.0	14.8	0.9	9.6	9.6	0.0	912442
AUT	20.6	21.0	0.4	18.1	19.0	0.9	345266
BEL	24.8	26.1	1.3	22.4	27.4	5.0	422059
BGR	17.7	25.1	7.4	28.4	26.8	-1.6	38093
BRA	7.8	7.5	-0.3	7.8	8.9	1.0	1204191
CAN	17.7	17.9	0.2	13.6	15.0	1.5	1372537
CHE	23.1	21.8	-1.3	17.2	16.6	-0.5	459284
CHN	11.9	9.2	-2.8	15.2	10.5	-4.8	3495060
CYP	18.6	21.1	2.6	17.9	17.3	-0.6	21436
CZE	23.0	26.8	3.8	25.8	29.6	3.8	171753
DEU	17.6	18.2	0.7	13.9	15.0	1.1	3099194
DNK	18.4	18.6	0.2	21.1	21.1	0.0	271418
ESP	9.7	10.5	0.9	14.5	13.2	-1.3	1333298
EST	24.5	29.2	4.7	24.1	27.3	3.2	19507
FIN	19.2	17.7	-1.5	17.3	18.1	0.8	224288
FRA	10.6	11.7	1.1	12.3	13.8	1.6	2394018
GBR	12.9	13.8	0.9	12.2	12.6	0.4	2664476
GRC	9.1	11.6	2.5	13.1	12.6	-0.6	281318
HRV	16.4	20.1	3.7	20.9	19.7	-1.2	51219
HUN	22.1	26.5	4.3	32.0	34.2	2.2	119649
IDN	18.1	14.8	-3.3	13.8	14.3	0.5	455190
IND	10.1	7.3	-2.8	13.9	11.7	-2.3	1135324
IRL	27.7	33.4	5.7	30.0	37.1	7.1	239541
ITA	10.9	11.4	0.5	12.9	12.4	-0.4	1982454
JPN	8.0	7.8	-0.2	8.3	10.3	2.0	4310742
KOR	15.2	19.5	4.3	17.9	20.9	3.0	1013652
LTU	20.0	27.1	7.1	19.5	21.8	2.3	35738
LUX	45.0	45.3	0.3	47.3	51.6	4.3	45275
LVA	17.7	24.0	6.2	20.5	21.2	0.6	27594
MEX	9.7	10.9	1.2	14.1	15.2	1.1	1003194
MLT	26.8	22.9	-3.9	41.2	44.7	3.6	6910
NLD	23.0	31.8	8.9	17.8	22.0	4.1	750373
NOR	31.2	28.2	-3.0	13.2	13.6	0.4	356664
POL	16.2	20.2	3.9	19.3	20.2	0.9	375515
PRT	11.9	15.1	3.2	15.7	16.7	1.0	208568
ROU	14.0	20.2	6.2	17.6	20.5	2.9	151950
RUS	23.8	24.1	0.2	7.7	8.7	1.0	1114179
SVK	23.1	25.8	2.7	31.1	31.8	0.7	69462
SVN	22.2	26.0	3.8	23.6	22.8	-0.7	42223
SWE	20.8	20.0	-0.8	17.5	15.7	-1.8	430726
TUR	10.3	12.3	2.0	14.4	15.4	1.0	581365
USA	5.1	5.9	0.8	6.2	6.4	0.3	14477638
Average	17.9	19.6	1.7	18.6	19.6	1.0	
Weighted average	11.1	11.7	0.6	11.3	11.6	0.4	

Notes. Weighted averages using GDP in 2007 as weights. Source: authors' calculations based on WIOD 2017 release.

Table A5: Payments to Foreign Factors (Backward Linkages), 1995-2007

A. All sectors

	Shares in domestic industries' final demand (VA)								Shares in payments to domestic factors (VA)		Shares in payments to foreign factors (VA)	
	Payments to domestic K (1)	Payments to domestic L (2)	Payments to foreign K (3)	Payments to foreign L (4)	Payments K (domestic + foreign) (5)	Payments L (domestic + foreign) (6)	Payments to domestic factors (7)	Payments to foreign factors (8)	K income (9)	L income (10)	K income (11)	L income (12)
Levels												
VBY 1995	35.28	56.59	3.19	4.95	38.47	61.53	91.87	8.13	38.40	61.60	39.17	60.83
VBY 2007	36.02	52.70	5.09	6.19	41.11	58.89	88.72	11.28	40.60	59.40	45.14	54.86
Changes												
V2007*B1995*Y1995 - VBY 1995	0.94	-0.83	0.10	-0.21	1.03	-1.03	0.11	-0.11	0.97	-0.97	1.74	-1.74
V1995***B2007***Y1995 - VBY 1995	-1.07	-2.35	1.71	1.72	0.63	-0.63	-3.43	3.43	0.27	-0.27	3.16	-3.16
V1995*B1995***Y2007** - VBY 1995	0.59	-0.45	-0.04	-0.10	0.55	-0.55	0.14	-0.14	0.58	-0.58	0.23	-0.23
V1995***B1995*Y2007** - VBY 1995	-0.53	-2.78	1.67	1.63	1.14	-1.14	-3.31	3.31	0.83	-0.83	3.32	-3.32
VBY 2007 - VBY 1995	0.74	-3.88	1.90	1.24	2.64	-2.64	-3.14	3.14	2.20	-2.20	5.96	-5.96

B. Manufacturing

	Shares in domestic industries' final demand (VA)								Shares in payments to domestic factors (VA)		Shares in payments to foreign factors (VA)	
	Payments to domestic K (1)	Payments to domestic L (2)	Payments to foreign K (3)	Payments to foreign L (4)	Payments K (domestic + foreign) (5)	Payments L (domestic + foreign) (6)	Payments to domestic factors (7)	Payments to foreign factors (8)	K income (9)	L income (10)	K income (11)	L income (12)
Levels												
VBY 1995	32.69	51.52	6.11	9.67	38.80	61.20	84.21	15.79	38.82	61.18	38.73	61.27
VBY 2007	32.63	43.98	10.57	12.83	43.20	56.80	76.61	23.39	42.59	57.41	45.17	54.83
Changes												
V2007*B1995*Y1995 - VBY 1995	1.31	-1.39	0.32	-0.24	1.63	-1.63	-0.08	0.08	1.59	-1.59	1.80	-1.80
V1995***B2007***Y1995 - VBY 1995	-1.96	-4.14	3.05	3.05	1.09	-1.09	-6.10	6.10	0.52	-0.52	3.14	-3.14
V1995*B1995***Y2007** - VBY 1995	0.61	-1.35	0.39	0.35	1.00	-1.00	-0.74	0.74	1.07	-1.07	0.61	-0.61
V1995***B1995*Y2007** - VBY 1995	-1.69	-5.73	3.72	3.71	2.02	-2.02	-7.43	7.43	1.55	-1.55	3.62	-3.62
VBY 2007 - VBY 1995	-0.06	-7.54	4.45	3.15	4.39	-4.39	-7.60	7.60	3.77	-3.77	6.44	-6.44

Notes. Panel A reports decompositions of changes in factor shares in aggregate final demand, while Panel B reports decompositions of changes in factor shares within manufacturing industries' final demand. Columns 1-4 report the shares of income derived from final demand accruing to foreign and domestic capital and labor. All other columns are derived from these. Columns 5 and 6 report the overall capital and domestic shares in final demand. The split between domestic and foreign factors is given by different entries within columns in VfBY. The payments to foreign factors are given by the backward concept defined in the text. The payments to domestic factors are given by the complement of the backward concept. Columns 7 and 8 report the shares in final demand paid to all domestic and international factors (backward, as in Figure 3). Columns 9 and 10 report capital and labor shares in payments to domestic factors, while columns 10 and 11 report capital and labor shares in payments to foreign factors. The rows labeled "Levels" report levels in 1995 and in 2007. Rows labeled as "Changes" report true and counterfactual changes. All numbers are weighted averages using GDP in 1995 as weights. Source: authors' calculations based on WIOD 2013 release.

Table A6: Payments to Foreign Factors (Backward Linkages), 2007-2014

A. All sectors

	Shares in domestic industries' final demand (VA)								Shares in payments to		Shares in payments to	
	Payments to domestic K	Payments to domestic L	Payments to foreign K	Payments to foreign L	Payments K (domestic + foreign)	Payments L (domestic + foreign)	Payments to domestic factors	Payments to foreign factors	K income	L income	K income	L income
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Levels												
VBY 2007	38.03	50.71	5.43	5.84	43.45	56.55	88.74	11.26	42.85	57.15	48.17	51.83
VBY 2014	37.12	51.26	5.38	6.24	42.50	57.50	88.38	11.62	42.00	58.00	46.30	53.70
Changes												
V2014*B2007*Y2007 - VBY 2007	0.94	-0.83	0.10	-0.21	-1.32	1.32	0.22	-0.22	-1.17	1.17	-2.37	2.37
V2007***B2014***Y2007 - VBY 2007	-1.07	-2.35	1.71	1.72	0.10	-0.10	-1.08	1.08	-0.02	0.02	0.50	-0.50
V2007*B2007***Y2014** - VBY 2007	0.59	-0.45	-0.04	-0.10	0.14	-0.14	0.44	-0.44	0.17	-0.17	0.08	-0.08
V2007***B2014***Y2014** - VBY 2007	-0.53	-2.78	1.67	1.63	0.22	-0.22	-0.62	0.62	0.14	-0.14	0.54	-0.54
VBY 2014 - VBY 2007	0.74	-3.88	1.90	1.24	-0.95	0.95	-0.35	0.35	-0.85	0.85	-1.87	1.87

B. Manufacturing

	Shares in domestic industries' final demand (VA)								Shares in payments to		Shares in payments to	
	Payments to domestic K	Payments to domestic L	Payments to foreign K	Payments to foreign L	Payments K (domestic + foreign)	Payments L (domestic + foreign)	Payments to domestic factors	Payments to foreign factors	K income	L income	K income	L income
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Levels												
VBY 1995	36.14	40.67	11.26	11.93	47.40	52.60	76.81	23.19	47.05	52.95	48.54	51.46
VBY 2007	34.10	41.41	11.45	13.03	45.56	54.44	75.52	24.48	45.16	54.84	46.77	53.23
Changes												
V2014*B2007*Y2007 - VBY 2007	1.31	-1.39	0.32	-0.24	-2.59	2.59	0.37	-0.37	-2.61	2.61	-2.47	2.47
V2007***B2014***Y2007 - VBY 2007	-1.96	-4.14	3.05	3.05	0.38	-0.38	-1.85	1.85	0.26	-0.26	0.64	-0.64
V2007*B2007***Y2014** - VBY 2007	0.61	-1.35	0.39	0.35	0.28	-0.28	0.21	-0.21	0.31	-0.31	0.18	-0.18
V2007***B2014***Y2014** - VBY 2007	-1.69	-5.73	3.72	3.71	0.64	-0.64	-1.78	1.78	0.58	-0.58	0.73	-0.73
VBY 2014 - VBY 2007	-0.06	-7.54	4.45	3.15	-1.84	1.84	-1.29	1.29	-1.89	1.89	-1.77	1.77

Notes. Panel A reports decompositions of changes in factor shares in aggregate final demand, while Panel B reports decompositions of changes in factor shares within manufacturing industries' final demand. Columns 1-4 report the shares of income derived from final demand accruing to foreign and domestic capital and labor. All other columns are derived from these. Columns 5 and 6 report the overall capital and domestic shares in final demand. The split between domestic and foreign factors is given by different entries within columns in VfBY. The payments to foreign factors are given by the backward concept defined in the text. The payments to domestic factors are given by the complement of the backward concept. Columns 7 and 8 report the shares in final demand paid to all domestic and international factors (backward, as in Figure 3). Columns 9 and 10 report capital and labor shares in payments to domestic factors, while columns 10 and 11 report capital and labor shares in payments to foreign factors. The rows labeled "Levels" report levels in 2007 and in 2014. Rows labeled as "Changes" report true and counterfactual changes. All numbers are weighted averages using GDP in 2007 as weights. Source: authors' calculations based on WIOD 2017 release.

Table A7: Payments to Foreign Labor (Backward Linkages), 1995-2007

A. All sectors

	Shares in domestic industries' final demand (VA)						Shares in payments to labor (domestic + foreign)		Shares in payments to domestic labor (VA)		Shares in payments to foreign labor (VA)	
	Payments to domestic high skill labor (1)	Payments to domestic low skill labor (2)	Payments to foreign high skill labor (3)	Payments to foreign low skill labor (4)	Payments to high skill labor (dometci + foreign) (5)	Payments to low skill labor (dometci + foreign) (6)	High skill labor income (7)	Low skill labor income (8)	High skill labor income (9)	Low skill labor income (10)	High skill labor income (11)	Low skill labor income (12)
Levels												
VBY 1995	17.60	38.99	1.23	3.72	18.82	42.71	30.59	69.41	31.09	68.91	24.82	75.18
VBY 2007	20.88	31.82	1.86	4.33	22.74	36.15	38.61	61.39	39.62	60.38	30.04	69.96
Changes												
V2007*B1995*Y1995 - VBY 1995	3.66	-4.48	0.26	-0.47	3.92	-4.95	7.00	-7.00	7.02	-7.02	6.58	-6.58
V1995*B2007*Y1995 - VBY 1995	-0.38	-1.98	0.36	1.36	-0.02	-0.62	0.29	-0.29	0.66	-0.66	-1.03	1.03
V1995*B1995*Y2007 - VBY 1995	0.23	-0.67	-0.02	-0.08	0.21	-0.76	0.61	-0.61	0.65	-0.65	0.13	-0.13
V1995*B2007*Y2007 - VBY 1995	-0.16	-2.61	0.35	1.28	0.19	-1.33	0.89	-0.89	1.30	-1.30	-0.86	0.86
VBY 2007 - VBY 1995	3.29	-7.17	0.63	0.61	3.92	-6.56	8.02	-8.02	8.53	-8.53	5.22	-5.22

B. Manufacturing

	Shares in domestic industries' final demand (VA)						Shares in payments to labor (domestic + foreign)		Shares in payments to domestic labor (VA)		Shares in payments to foreign labor (VA)	
	Payments to domestic high skill labor (1)	Payments to domestic low skill labor (2)	Payments to foreign high skill labor (3)	Payments to foreign low skill labor (4)	Payments to high skill labor (dometci + foreign) (5)	Payments to low skill labor (dometci + foreign) (6)	High skill labor income (7)	Low skill labor income (8)	High skill labor income (9)	Low skill labor income (10)	High skill labor income (11)	Low skill labor income (12)
Levels												
VBY 1995	12.77	38.75	2.31	7.36	15.08	46.11	24.65	75.35	24.79	75.21	23.89	76.11
VBY 2007	14.37	29.61	3.68	9.15	18.05	38.75	31.78	68.22	32.68	67.32	28.69	71.31
Changes												
V2007*B1995*Y1995 - VBY 1995	3.19	-4.58	0.56	-0.80	3.76	-5.38	6.98	-6.98	7.06	-7.06	6.57	-6.57
V1995*B2007*Y1995 - VBY 1995	-0.76	-3.38	0.58	2.47	-0.18	-0.90	0.14	-0.14	0.56	-0.56	-1.19	1.19
V1995*B1995*Y2007 - VBY 1995	-0.22	-1.13	0.08	0.27	-0.13	-0.86	0.18	-0.18	0.23	-0.23	0.01	-0.01
V1995*B2007*Y2007 - VBY 1995	-1.06	-4.67	0.74	2.97	-0.33	-1.70	0.29	-0.29	0.78	-0.78	-1.13	1.13
VBY 2007 - VBY 1995	1.60	-9.14	1.37	1.78	2.97	-7.36	7.13	-7.13	7.88	-7.88	4.79	-4.79

Notes. Panel A reports decompositions of changes in factor shares in aggregate final demand, while Panel B reports decompositions of changes in factor shares within manufacturing industries' final demand. Columns 1-4 report the shares of final demand paid to domestic and foreign high skill and low skill labor. All other columns are derived from these four. Columns 5 and 6 report the overall shares of payments to high skill and low skill labor shares in final demand. Columns 7 and 8 report the shares of high skill and low skill labor in total labor income paid by final demand. Columns 9 and 10 report the shares of domestic high skill and low skill labor in labor income paid by final demand to domestic labor. Columns 11 and 12 report the shares of foreign high skill and low skill labor in labor income paid by final demand to foreign labor. All numbers are weighted averages using GDP in 1995 as weights. Source: authors' calculations based on WIOD 2013 release.

Table A8: Sources of Compositional Changes in Payments to All Domestic Factors (GDP)

A. All sectors

	1995			Δ1995-2007			2007			Δ2007-2014		
	Income from domestic industries (1)	Income from foreign industries (2)	Domestic + foreign (3)	Income from domestic industries (4)	Income from foreign industries (5)	Domestic + foreign (6)	Income from domestic industries (7)	Income from foreign industries (8)	Domestic + foreign (9)	Income from domestic industries (10)	Income from foreign industries (11)	Domestic + foreign (12)
Value chains (B)												
Domestic	90.92	0	90.92	-2.28	0	-2.28	88.59	0	88.59	-0.38	0	-0.38
Bilateral trade	0	7.43	7.43	0	1.04	1.04	0	8.57	8.57	0	0.18	0.18
Complex GVCs	0.19	1.45	1.64	0.09	1.16	1.25	0.26	2.58	2.84	0.02	0.18	0.20
Total	91.12	8.88	100	-2.19	2.19	0	88.85	11.15	100	-0.36	0.36	0
Sources of demand (Y)												
Domestic	85.56	7.41	92.97	-3.08	1.05	-2.03	81.24	8.74	89.98	-0.63	1.02	0.39
Foreign	5.56	1.48	7.03	1.31	0.72	2.03	7.61	2.41	10.02	-0.34	-0.05	-0.39
Total	91.12	8.88	100	-1.77	1.77	0	88.85	11.15	100	-0.97	0.97	0

B. Manufacturing

	1995			Δ1995-2007			2007			Δ2007-2014		
	Income from domestic industries (1)	Income from foreign industries (2)	Domestic + foreign (3)	Income from domestic industries (4)	Income from foreign industries (5)	Domestic + foreign (6)	Income from domestic industries (7)	Income from foreign industries (8)	Domestic + foreign (9)	Income from domestic industries (10)	Income from foreign industries (11)	Domestic + foreign (12)
Value chains (B)												
Domestic	80.67	0	80.67	-3.59	0	-3.59	76.55	0	76.55	-0.96	0	-0.96
Bilateral trade	0	15.62	15.62	0	1.18	1.18	0	17.54	17.54	0	0.66	0.66
Complex GVCs	0.47	3.24	3.71	0.23	2.19	2.41	0.66	5.25	5.91	0.04	0.26	0.30
Total	81.14	18.86	100	-3.36	3.36	0	77.21	22.79	100	-0.92	0.92	0
Sources of demand (Y)												
Domestic	66.28	15.25	81.53	-9.12	3.38	-5.74	56.74	17.00	73.75	-1.04	2.46	1.43
Foreign	14.86	3.61	18.47	3.78	1.96	5.74	20.47	5.79	26.25	-1.37	-0.06	-1.43
Total	81.14	18.86	100	-5.34	5.34	0	77.21	22.79	100	-2.41	2.41	0

Notes. Panel A reports decompositions of levels and changes in factor payments in GDP, while Panel B reports decomposition of levels and changes in factor payments within manufacturing industries' value added. The four "Total" rows report in columns 1-2 and 7-8 factor payment shares in value added that are paid by domestic industries, foreign industries, and overall in the initial year (1995 or 2007); these are the same numbers for the initial year in columns 7 and 8 in Tables 1 and 2. Columns 3 and 9 are the sums of columns 1-2 and 7-8, respectively. The "Total" rows report in columns 4-6 and 10-12 the changes in the same concepts; these are the same numbers in columns 7 and 8 in Tables 1 and 2 for either changes in B or changes in Y. The rows above the "Total" rows indicate the contributions of sub-components of either B or Y to levels in columns 1-3 and 7-9, and to changes in columns 4-6 and 10-12. Source: authors' calculations based on WIOD 2013 and WIOD 2016 releases.