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 in 1995–2014, while taking into account international trade based on value added concepts. Declines in labor shares accelerate in 2001–2007, concurrently with global value chain (GVC) integration, after which there is no trend for both. We develop a gravity-based instrument and find that the acceleration in the decline in labor shares is caused by increased intensity of intermediate input exporting. The integration of China into GVCs has a disproportionally large effect. Declines in labor shares are shouldered mostly by less skilled workers in fabrication functions. Relatively capital abundant countries integrate more into forward GVCs linkages, which is associated with greater upstreamness within GVCs and increases in capital intensity. Forward GVC integration is associated with international vertical integration of both upstream input production and of downstream assembly.

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 both caught the attention of academics and generated concern of policy makers. Apart from having important implications for economic modeling, the interest in declining labor shares stems from 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 paid to labor implies that income inequality among people rises. This is particularly acute given relatively weak productivity growth in recent times.[3]

In this paper we argue that the acceleration in the decline in labor shares that took place in 2001–2007 is strongly associated with a concurrent intensification of forward global value chain (GVC) integration, in particular with China. Figure 1 illustrates that while declines in labor shares started in the 1980s, this evolution accelerated markedly in 2001–2007, when GVC integration accelerated as well. Both labor shares and forward GVC integration level-off after 2007.[4]

Significant increases in international integration imply that studying the evolution of factor shares from a closed economy perspective—as does most of this literature—is bound to miss some of the underlying mechanisms. And while there is a large literature that studies labor market effects of trade integration, recent work illustrates that standard gross trade sales statistics can be misleading, and that this has become particularly acute since China joined the World Trade Organization in 2001 and its subsequent increase of global production sharing.[5] While Freeman (1995) asked

[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), and up to date 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.

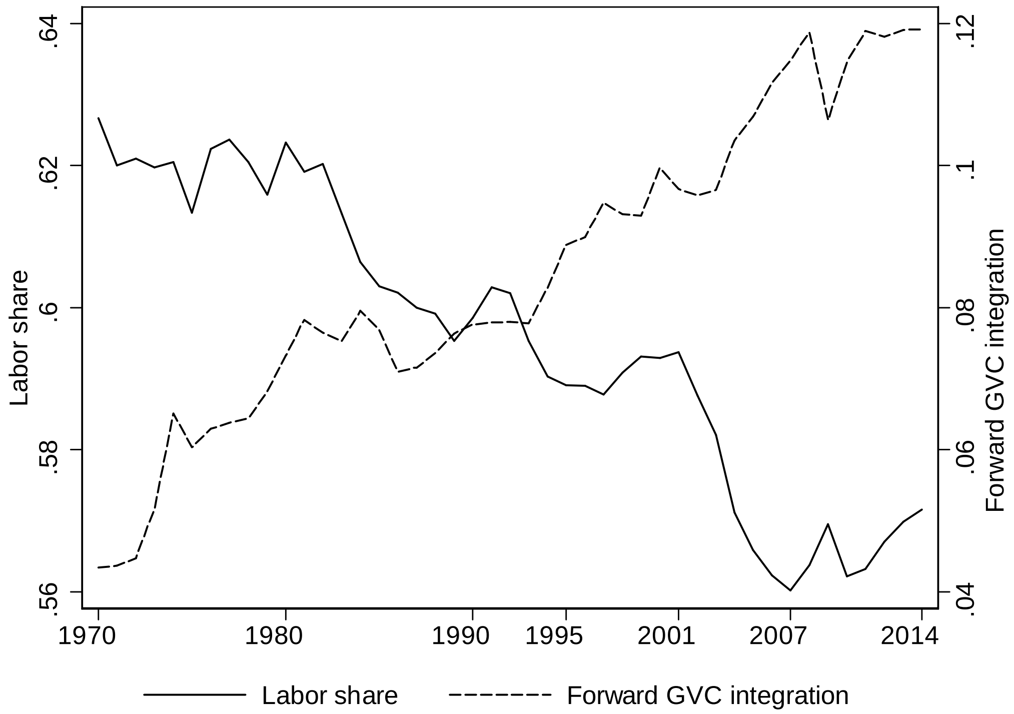
[3] An additional concern relates to how income inequality affects overall growth and political economy; see, e.g., Persson and Tabellini (1994), Alesina and Rodrik (1994), Alesina and Perotti (1996), and more recently Ostry and Berg (2011).

[4] In Appendix A, Figure A1, we show that different concepts of the labor share in the Penn World Tables exhibit very similar trajectories, in particular the 2001–2007 acceleration in the decline in labor shares and the change in trajectory after 2007. Gutiérrez and Piton (2019) argue that after adjusting for (netting out) the housing sector, labor shares did not decline during 1970–2015 in a set of advanced economies plus China, India, and Russia—except in the US and Canada. However, we do find in their data that labor shares declined in 2001–2007—both using their "adjusted corporate sector" and "adjusted business sector" series—in similar magnitudes to our data.

[5] Trefler and Zhu (2010) show that taking into account intermediate inputs helps aligning factor content of trade predictions of the Heckscher-Ohlin model with the data. Ito, Rotunno, and Vézina (2017) show that predictions of Heckscher-Ohlin trade theory hold much better when using value added trade data versus gross trade values. Timmer, Miroudot, and de Vries (2018) show that revealed comparative advantage indices based on gross trade statistics deviate significantly from those based on and trade in value added, which are more sensible. Jakubik and Stolzenburg (2018) use data on trade in value added to revisit the estimates in Autor, Dorn, and Hanson (2013) of the effect of imports from China on local labor markets in the U.S.—and find significantly weaker effects. Using gross instead of value added export data is also one of the the conceptual flaws underlying the so-called Leontief (1953) paradox. See Johnson (2014) for a portrait of differences between gross trade and value added trade flows, as well as several implications. Koopman, Wang, and Wei (2012) and Kee and Tang (2016) demonstrate the consequences of

"Are your wages set in Beijing?", the deepening of production sharing across international borders requires a different data approach in order to answer such questions.[6]

Figure 1. Labor Shares and Forward GVC Participation



Notes. The displayed series are year fixed effects from a regression of either labor shares or forward GVC integration on year fixed effects and country fixed effects, weighted by real GDP. Forward GVC Participation is exports of intermediate inputs in value added terms as a share of GDP. The sample for labor shares includes 39 countries that correspond to the WIOD 2013 release sample of countries, and the year fixed effects are adjusted by the weighted (by GDP) average in 1995. The labor share series encompasses compensation of employees and labor income of self-employed; the latter is based on part of mixed income. For China the labor share includes only compensation of employees. Source: Penn World Tables mark 9.1; see Feenstra, Inklaar, and Timmer (2015) for documentation on labor shares. The sample for forward GVC integration in 1995–2014 includes 39 countries that correspond to the WIOD 2013 release sample of countries. Data for 1995–2007 are from WIOD 2013 release. Data for 2007–2014 are from WIOD 2016 release, and the year fixed effects are adjusted by the weighted (by GDP) average in 2007 from the WIOD 2013 release. Data for 1970–1995 are from Johnson and Noguera (2012), and the year fixed effects are adjusted by the weighted (by GDP) average in 1995 from the WIOD 2013 release. Compared to the sample of 39 countries, the sample from Johnson and Noguera (2012) excludes Bulgaria, Cyprus, Czech Rep., Estonia, Lithuania, Luxembourg, Latvia, Malta, Russian Federation, Slovakia, Slovenia, Taiwan; these countries account for 2.8% of GDP of the 39 countries in the WIOD sample.

Our first contribution is to study the timing and mechanisms that govern the relationship between labor shares and globalization using data from the World Input-Output Database (WIOD)

the rise of China for mis-representation of gross trade data. Johnson (2018) provides a recent survey of these issues.

[6] 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."

in 1995–2014. This allows us to account for international integration in value added terms, the same concept in which labor shares are measured. We find that increases in forward foreign GVC integration—i.e., exports of intermediate inputs for use in foreign downstream activities—lowers labor shares. Other dimensions of globalization (exports and imports of final goods and imports of inputs) do not affect labor shares significantly.

We estimate that the declines of labor shares are driven by forward GVC deepening only in 2001–2007, coinciding with China's accession to the WTO in 2001, and that China's integration into GVCs during this period in particular has a particularly large effect. The relationship between GVCs and labor shares disappears after 2007, when China's integration into GVCs slows down, along with that of the rest of the world (Figure 1). Indeed, Chor, Manova, and Yu (2020) find that the upstreamness of imports by Chinese firms stops increasing after 2007.

In order to make causal inference we develop an instrument based on a structural gravity relationship; this is our second contribution. The main threat to identification in our regressions is if supply shocks increase an industry's exports and at the same time affect its labor share—for example, biased technological change, differential declines in the rental rate of capital, or changes in imported input costs. Structural gravity attributes variation in exports to variation in source country supply factors, destination country factors (which are determined by all source countries, in addition to the specific destination), and bilateral trade barriers. We estimate these source and destination factors and construct an instrument that is orthogonal to supply factors, and thus includes only the demand-driven part of GVC integration. The internal validity of our regression results is bolstered by saturating them with fixed effects. Since the regressions are panels of long differences, adding fixed effects absorbs trends, and renders identification very demanding.

We then ask whether differences in factor endowments can help interpret the results. Sposi, Yi, and Zhang (2020) extend the model of Antràs and De Gortari (2020) to include Heckscher-Ohlin forces that operate within value chains. They assume that upstream stages of production are more capital intensive (which we document, especially in GVCs). When splitting the geographical location of different stages of production is possible, declines in trade barriers cause relocation of relatively capital-intensive upstream stages to relatively capital abundant countries. We find evidence that is consistent with this prediction: relative capital abundance predicts both the capital intensity and the volume of exports of intermediate inputs, and these associations strengthen over time. Applying the insight of Feenstra and Hanson (1997), these mechanisms can raise labor shares everywhere if tasks or inputs that are relatively labor un-intensive within capital-abundant countries are offshored to labor-abundant countries, in which they are relatively labor intensive. Related to this, we show that increases in the upstreamness of production are associated with reductions in labor shares, and that only the foreign-driven part of upstreamness accounts for this relationship.

We then show that forward GVC-driven reductions in labor shares are shouldered mostly by labor in fabrication tasks, and to a lesser extent by management and marketing. In contrast, it is not driven by reductions in payments to labor engaged in research and development (R&D). This is consistent with the idea that selling final goods requires more interaction with consumers and more management control of production processes compared to producing intermediate inputs further up the value chain. It is also consistent with some degree of technology transfer that is involved in forward GVC integration, as argued by Baldwin (2016).

Finally, we examine briefly the roles of offshoring of assembly and multinational enterprises (MNEs). We find that offshoring of assembly of hitherto exported final goods, while contributing to the patterns we uncover, is not the main mechanism driving the results. Greater intensity of exports of intermediate inputs lowers labor shares, whether or not is it done for the purpose of this kind of offshoring. We find that MNEs are associated with forward GVC integration both in offshoring downward assembly, as well as in offshoring upstream input production.

Before turning to positioning our work within the literature, we wish to stress an under-emphasized fact: more than the entire drop in overall labor shares and cross-country variation therein is shouldered by unskilled labor. Labor shares decline on average 2.5 percent points in 1995–2007, with significant variation across countries summarized by a coefficient of variation of -1.37 (using GDP in 1995 as weights). In contrast, the share of *skilled* labor in GDP concurrently increased by 4.25 percent points with a much smaller coefficient of variation of 0.36 (data from EU KLEMS). Consistent with this, we find that most of the GVC-induced declines in labor shares are shouldered by labor in fabrication tasks, which is less skilled than labor engaged in management, marketing and R&D. Our finding of a negative association between GVC integration and labor shares while skilled labor shares increase is reminiscent of, *inter alia*, Richardson (1995) and especially Wood (1995). Consistent with this, Timmer, Los, Stehrer, and de Vries (2013) find that the rise of GVCs is associated with a shift towards skilled labor employment within total employment in 1995–2008.

The rest of the paper is organized as follows. We position our work in the relevant literature in Section 2. Section 3 describes the data and methodology. Section 4 describes changes in factor shares and in GVC integration. In Section 5 we investigate the role of GVC deepening in explaining declines in labor shares, as well as several mechanisms. We offer concluding remarks in Section 6.

2 Relationship to the literature

Our paper contributes to a large body of work that studies the determinants of labor shares. Since most countries have experienced declines in labor shares, it is plausible that the cause is common to all. One such common trend is globalization. While most previous research focuses on the United States and other developed economies, e.g., Blanchard (1997), Elsby, Hobijn, and Şahin (2013), Rognlie (2016), and pays little attention to international economic integration—Harrison (2005) studies the evolution of labor shares in a panel of countries, including less developed ones, and investigates, *inter alia*, the role of trade openness (aggregate gross imports + exports divided by GDP). Elsby, Hobijn, and Şahin (2013) suggest that offshoring may have contributed to the decline of the labor share in the United States, but do not study this beyond simple correlations. Böckerman and Maliranta (2012) and Panon (2020) study the role of exporters in accounting for the evolution of labor shares in Finnish and French manufacturing, respectively. Weinberger and Leblebicioglu (2018) study the effect of capital goods import liberalization in India, and find that this actually increased firm-level labor shares, probably by increasing quality of capital equipment while lowering its effective price. Compared to these papers, we stress the role of GVC integration and exporting of intermediate inputs, using value added trade data.

The closest paper to ours is chapter 3 in International Monetary Fund (2017). In contrast to our work, that paper does not distinguish the impact of forward from backward GVC integration (it aggregates them) on labor shares, and does not control for other forms of trade, e.g., in final goods in regression analysis. In addition, we identify causal effects by distinguishing the period in which GVC integration accelerated, and we use gravity-based instruments in order to overcome bias due to confounding factors. We also study the mechanisms underlying the relationship between GVCs and labor shares in greater detail.[7] As discussed above, we find support for an Heckscher-Ohlin mechanism that operates within value chains, as suggested in the model of Sposi, Yi, and Zhang (2020).

Another common trend, that has been proposed as an explanation for declines in labor shares by Karabarbounis and Neiman (2014), is the widespread decline in the price of investment. This may have caused a shift in expenditures towards capital if the elasticity of substitution between capital and labor were greater than unity, as Karabarbounis and Neiman (2014) estimate.[8] Indeed, they

[7]Another difference is that International Monetary Fund (2017) mix several datasets that are based on different methodologies, whereas we rely on the WIOD for both labor shares and GVC measures.

[8]Harrigan, Reshef, and Toubal (2021) find an elasticity between labor, capital and materials greater than 1 using French administrative firm-level data. 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. This explanation can also capture embodied technological change (computers, robots, etc.), as argued in Martinez (2018). See also Graetz and Michaels (2018).

document that in countries and industries where the decline in investment goods' prices were deeper, labor shares dropped more. However, Glover and Short (2020) demonstrate how the estimator of the elasticity of substitution in Karabarbounis and Neiman (2014) is biased upwards; using a corrected estimator, they estimate an elasticity comfortably below unity. Oberfield and Raval (2014), using different econometric methodology, also estimate that the elasticity of substitution between labor and capital is less than unity.[9] Results in Bergholt, Furlanetto, and Faccioli-Maffei (forthcoming) also point toward strong capital-labor complementarity in US data. These findings weaken the argument on the importance of the decline in the price of investment in contributing to the decline in the labor share. We control for declines in the price of investment in our regressions, and find no evidence for this mechanism in our data.[10]

Variation in labor shares may also be related to endogenous directed technological change as proposed by 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. Bergholt, Furlanetto, and Faccioli-Maffei (forthcoming) find an important role for automation in US data. Bentolila and Saint-Paul (2003) study variations in labor shares in OECD countries and show how they are linked to technological change, prices of imported materials and labor market frictions. Grossman, Helpman, Oberfield, and Sampson (2017) show that in a growth model with endogenous human capital accumulation, the decline in productivity growth can lead to declines in labor shares. More generally, biased technological progress can explain both variation in exporting and in labor shares, as we show below. In our analysis we develop a gravity model-based instrument that helps identifying the role of forward GVC integration separately from domestic technological change and changes in prices of inputs, *inter alia* imported intermediate inputs.[11]

Recent work studies the evolution of the labor share at the firm or establishment level, usually in manufacturing. Kyyrä and Maliranta (2008) and Autor, Dorn, Katz, Patterson, and Van Reenen (2020) consider the role of firm size distribution and increases in market share concentration in ac-

[9]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).

[10]In a previous version of this paper we showed that in the presence of capital-skill complementarity the relationship between the price of investment or the rental rate of capital and labor shares may not even be monotone.

[11]Declines in labor shares have 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)), to dynamics in real estate values (Gutiérrez and Piton (2019)), and to fertility and immigration (d'Albis, Boubtane, and Coulibaly (2021)). Bengtsson, Rubolino, and Waldenström (2020) study the institutional determinants of the long run evolution of labor shares in a closed economy context. For business cycle properties of the labor share see McAdam and Willman (2013), Young (2004) and Mućk, McAdam, and Growiec (2018).

counting for changes in labor shares, while Kehrig and Vincent (2021) assigns a much smaller role for changes in concentration in US manufacturing establishments, and Mertens (2019) attributes most of the decline in the labor share in German manufacturing to production process transformation, rather than firm concentration. Stansbury and Summers (2020) argue that declines in rent sharing with labor, due to declines in "labor power", can help explain both the decline in labor shares and the decline in the NAIRU in the United States. Brooks, Kaboski, Li, and Qian (2019) argue that employers' monopsony power in China and India lowers labor shares there, and that this effect has declined over time. Our sample covers mostly developed, mid-income and transition economies, but also important developing and emerging economies (e.g., India and China), and we perform our analysis both at the industry and country levels.

3 Data and methodology

The main source of data is the World Input-Output Database (WIOD). We outline the main features here and relegate other details to the Appendix B. We use the WIOD 2013 release to compute statistics over the pre-2008 financial crisis period of 1995–2007. Along with detailed Input-Output tables for 40 countries and 35 industries (of which 14 are in manufacturing, ISIC rev. 3), the 2013 release also provides Socio-Economic Accounts with data on employment, labor compensation and capital stocks, all by country and industry. WIOD 2013 uses the 1993 System of National Accounts (SNA). We also use the more recent 2016 WIOD release, covering 43 countries and 56 industries (of which 14 are in manufacturing, ISIC rev. 4) to compute statistics for 2007–2014. WIOD 2016 uses the 2008 SNA.[12] In both datasets the labor share includes compensation of employees and labor income of self-employed (part of "mixed income").[13] The labor shares from the WIOD data exhibit virtually identical trends at the country level as those from the Penn World Tables used to construct Figure 1. In Appendix A, Figure A1, we show that different concepts of the labor share exhibit very similar trajectories, in particular the 2001–2007 acceleration in the decline in labor shares and the change in trajectory after 2007.

Changes in the System of National Accounts preclude merging data from the two WIOD releases. However, for comparability of within-sample trends we reclassify WIOD 2016 release data to conform with the 2013 release in two dimensions. First, we allocate countries that appear in the 2016 release but not in the 2013 release to the "Rest of World" (ROW) category. Second, since

[12] 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.

[13] WIOD 2013 release reports data until 2011, but the incidence of missing values for labor shares in the Socio-Economic Accounts increases significantly after 2009. This is not an issue in WIOD 2016. In both datasets and in all years, the input-output matrices do not have missing values.

the sectors in the 2016 release are more disaggregate, we aggregate them to the same level of the 2013 release.[14] The correlation across the two WIOD releases in 2007 for labor shares and forward GVC integration is over 0.85, and the trends in the overlapping years (2000-2011) are remarkably similar.[15] We drop Poland from the analysis because it is an extreme outlier in 1995, and thus creates unreasonable variation over time for that country.

3.1 Forward GVC integration

We measure forward GVC integration as payments to domestic factors that are generated by downstream foreign industries. This is driven by more than just direct exports of intermediate inputs and services to businesses, as it takes into account the entire network of GVCs, where value can "travel" across several borders (e.g., purchases from buyers of my output, etc.).[16]

We rely on the well-known methodology of Leontief (1936), applied to an international setting. 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 $X = AX + Y$, where X is the vector of gross outputs, AX is intermediate demand and Y is final consumption, or demand for final goods; A is the matrix of technical coefficients.[17] Rearranging leads to $X = (I - A)^{-1}Y = BY$, where $B = (I - A)^{-1}$ is the Leontief (inverse) matrix, which takes into account the indirect production linkages across industries. The matrix B summarizes all value chains, be they domestic or global.[18] It is useful to define Y as a diagonal matrix, with the corresponding values on the diagonal and zeros elsewhere, implying that X is a matrix as well.

By pre-multiplying gross output terms (in US dollars) by a diagonal matrix of value added to gross output ratios (intensities) one obtains $VX = VBY$. 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.[19]

Each element of the VBY matrix contains all payments to factors that are employed in sector i in origin country o that contribute to the production of sector j in destination country d: $(vby)_{ij}^{od}$. Then

[14] The sectoral reclassification is important for comparability of changes over time across the two WIOD releases because the increase in the number of industries in WIOD 2016 is due to splitting industries into relatively upstream and relatively downstream industries.

[15] Table A1 and Table A2 in the appendix report country-level labor shares and skilled labor shares in 1995, 2007 and 2014.

[16] See Hummels, Ishii, and Yi (2001) and Yi (2003) on the increasing importance of vertical specialization and integration in world trade.

[17] A typical entry of the A matrix a_{ij}^{od} indicates the value of input from industry i located in country o that is needed to produce one dollar worth of good j in country d.

[18] 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.

[19] 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 added terms).

$\sum_{d\neq o}\sum_j (vby)_{ij}^{od}$ summarizes payments to primary factors employed in country o in industry i due to exports (in value added terms) of intermediate inputs. We define forward foreign GVC integration for an industry i in country o as the share of exports of intermediate inputs in value added terms in value added: $forward_i^o = \sum_{d\neq o}\sum_j (vby)_{ij}^{od} / \sum_d \sum_j (vby)_{ij}^{od}$. The equivalent concept at the country level is $forward^o = \sum_{d\neq o}(vby)^{od}/GDP^o$, where $vby^{od} = \sum_i \sum_j (vby)_{ij}^{od}$ and $GDP^o = \sum_d (vby)^{od}$.[20] This follows the GVC income approach, which is theoretically consistent.[21]

Figure 1 illustrates that the weighted average $forward$ increases by 2.84 percent points in 1995–2007. All but one country (Latvia) in our sample exhibit increases in this period, to varying degrees. Figure 1 also illustrates that $forward$ leveled off after 2007, which is a consequence of much more modest increases in some countries, and some reductions in others.[22]

3.2 Upstreamness

Forward GVC integration manifests in a concurrent increase in "upstreamness", defined as the average number of production stages between production in a particular industry in a given country and final good demand, across all possible value chains (domestic and global). Antràs and Chor (2018) use the following measure of upstreamness

$$U_i^r = 1 \times \frac{Y_i^r}{X_i^r} + 2 \times \frac{\sum_s \sum_j a_{ij}^{rs} Y_j^s}{X_i^r} + 3 \times \frac{\sum_s \sum_j \sum_t \sum_k a_{ij}^{rs} a_{jk}^{st} Y_k^t}{X_i^r} + ... \, , \qquad (1)$$

where, as above, Y is final demand, X denotes gross output, and a_{ij}^{rs} are technical coefficients, denoting the amount of output of industry i located in country r that is required to produce one unit of output of industry j located in country s. Miller and Temurshoev (2017) show that (1) is equal to the row-sum of the inverse Ghosh (1958) matrix G (which is related to the Leontief inverse

[20] Table A3 and Table A4 in the appendix report country-level forward GVC integration in 1995, 2007 and 2014. An alternative view of GVC deepening is backward linkages, which imply payments to foreign factors by domestic industries though supply of intermediate inputs and services. Since the world is a closed economy (and this is taken into account in the WIOD data), the global (and, therefore, average) forward and backward linkages are the same, although within each country there can be differences between the two. We discuss backward linkages in Appendix C.

[21] Johnson (2018) reviews different input-output approaches to study trade in value added. There are two complementary methodologies that describe how value added is traded, either from the consumption or the production perspective. The production perspective allocates the value added in a given location (and industry) of production to final goods production via global value chains of intermediate inputs. Since this traces the income generated by production of final goods to primary factors thought intermediate input flows it is also named "GVC income" decomposition (Timmer, Los, Stehrer, and de Vries (2013)). Johnson (2018) acknowledges that by measuring the domestic and foreign content of domestic production, GVC income is conceptually closely tied to the literature on offshoring and trade in tasks. The third approach to trade in value added focuses on the decomposition of gross exports. Johnson (2018) argues that the theoretical motivations for a gross export decomposition are “unclear” and that some bilateral export decompositions may also generate inconsistencies, e.g., Koopman, Wang, and Wei (2014). For these reasons, the analysis presented in this paper builds on the GVC income approach.

[22] The slowdown in forward GVC deepening is consistent with Timmer, Los, Stehrer, and de Vries (2016), who rely on the same data. On the manifestation of the "so-called" trade collapse from 2008 on value added trade see Bems, Johnson, and Yi (2011) and Nagengast and Stehrer (2016).

B matrix), $U = G\iota$, where ι is a column vector of ones.[23] This is useful, because it permits to easily separate the part of upstreamness that is accounted for by domestic linkages and foreign ones:

$$U = U^D + U^F \ . \tag{2}$$

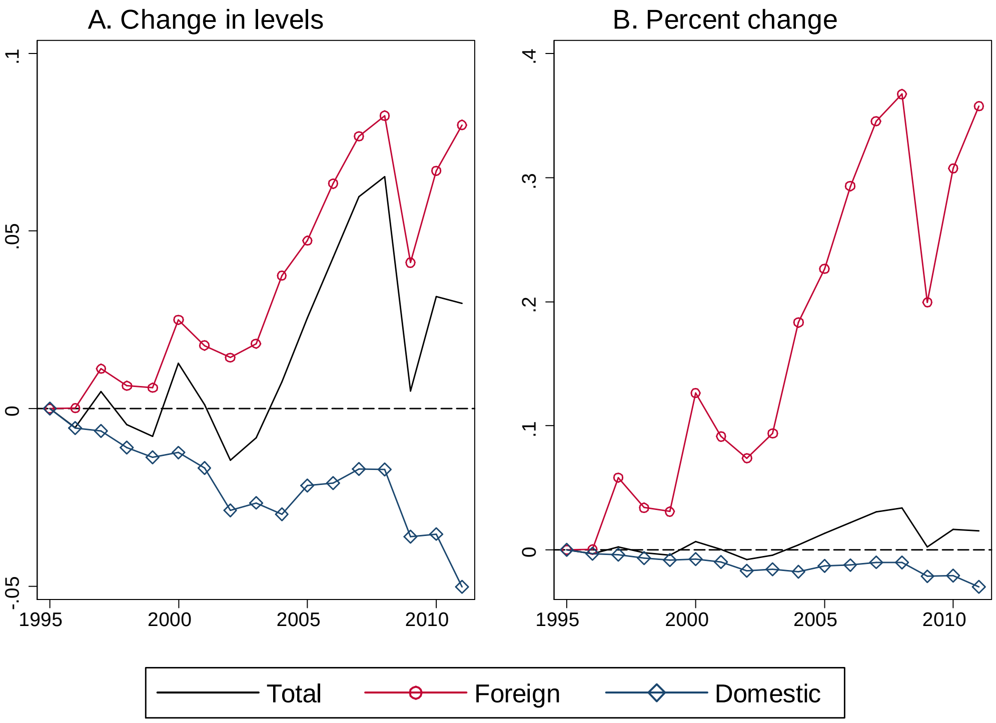
Here $U^D = G^D\iota$, where G^D is a block-diagonal matrix using only domestic demand. The foreign part is $U^D = [G - G^D] = G^F\iota$.

In Figure 2 we illustrate that global upstreamness increases, as in Antràs and Chor (2018), that the increase in U is entirely driven by U^F, as in Miller and Temurshoev (2017), and in addition, that most of this takes place in 2001–2007.

Antràs, Chor, Fally, and Hillberry (2012) show that upstreamness is negatively correlated with labor shares in a cross section of U.S. manufacturing industries. We replicate this finding using the WIOD data in Section 5.6 below, which is an assumption in the model of Sposi, Yi, and Zhang (2020). We also show that this correlation holds within industries over time: industries that increase their upstreamness—and in particular foreign-driven upstreamness—exhibit declining labor shares. This is consistent with the mechanism in Sposi, Yi, and Zhang (2020), where in response to a reduction in the cost of geographical production fragmentation, the relatively capital abundant country specializes in more upstream and capital intensive steps in the value chain.

[23] The "inverse Ghosh" matrix G relates changes in gross output across industries to changes in primary factor use in a particular industry, where primary factor use is value added: $X = G'V$. It is related to the Leontief inverse matrix B by the following formula $XGX^{-1} = B$. See chapter 12 in Miller and Blair (2009) for more details.

Figure 2. Upstreamness and its components



Notes. The displayed series are year fixed effects from a regression of either country-level upstreamness (U_{ct}), its domestic (U_{ct}^D) and foreign (U_{ct}^F) components, or their natural logarithms ($\ln U_{ct}$, $\ln U_{ct}^D$, $\ln U_{ct}^F$) on year fixed effects and country fixed effects, weighted by real GDP in 1995. Country-level upstreamness indices are computed as the weighted average of industry values from (2) (using value added as weights), and $U_{ct} = U_{ct}^D + U_{ct}^F$. The sample includes 39 countries that correspond to the WIOD 2013 release, which is also the source of the data.

4 Accounting for sources of change in labor shares

4.1 Composition versus within-industry intensities

We split value added into labor and capital payments, as follows $V_L BY + V_K BY = VBY$, where V_f are diagonal matrices of factor shares in output.[24] Computing factor shares is straightforward. We split factor payments into the part that arises from payments by domestic final goods producers, and payments by foreign final goods producers. The domestic contribution is the block-diagonal part of $V_f BY$. The contribution of foreign industries is the off-block-diagonal part of $V_f BY$, and is akin to numerator of $forward$ defined above, differentiated by factor f.

We decompose changes in factor shares into changes in within-industry intensities where factors are located V_f, and industry composition, determined by demands for final goods in destination markets Y and the network of GVCs B. The change in $V_f BY$ (indeed, of any three conformable matrices) from period 1 to period 2 can be written as

$$\begin{aligned} V_{f2}B_2Y_2 - V_{f1}B_1Y_1 &= \Delta\left(V_f BY\right) \\ &= (\Delta V_f)B_1Y_1 + V_{f1}(\Delta B)Y_1 + V_{f1}B_1(\Delta Y) \\ &\quad +V_{f1}(\Delta B)(\Delta Y) + (\Delta V_f)B_1(\Delta Y) + (\Delta V_f)(\Delta B)Y_1 \\ &\quad +(\Delta V_f)(\Delta B)(\Delta Y)\ . \end{aligned} \tag{3}$$

where Δ denotes the element-by-element change operator.[25] While other decompositions of changes exist, (3) 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). Considering changes in BY together 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.

Before turning to the results of the decomposition we wish to flag an important caveat to analyzing changes in $V_f BY$: factor shares in any industry in any country are invariant to the using industries, or to whether the using industry is domestic or foreign. It is well-known that within industries exporters are more capital and skill intensive; this may bias our analysis of the role of GVC integration in the evolution of labor shares.[26]

Table 1 reports the results of the decomposition of factor shares using (3) for 1995–2007. Panel A

[24] See, also Timmer, Erumban, Los, Stehrer, and de Vries (2014).
[25] See Appendix D for proof.
[26] See, e.g., Bernard, Jensen, Redding, and Schott (2007) and Harrigan and Reshef (2015). Another caveat is that we do not make allowances for capital depreciation. International Monetary Fund (2017) demonstrate that although affecting levels, adjusting for this hardly alters trends in factor shares.

reports this for the entire economy, while Panel B focuses on manufacturing industries, which follow similar patterns but in greater magnitudes.[27] 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. Column 5 reports the overall labor share in GDP. Column 6 reports the share in GDP arising from all international sources (this is the $forward$ concept, displayed in Figure 1). Columns 7 and 8 report labor shares in payments by domestic and foreign industries, respectively. All numbers are weighted averages across countries using GDP in 1995 as weights.

Table 1 reveals several facts. First, on average, the increase of 2.45 percent points in capital shares is driven both by domestic industries (0.87 pp), and even more so by payments from foreign industries (1.57 pp). In manufacturing industries the increase of 4.04 percent points in capital shares is almost entirely driven by payments from foreign industries (3.81 pp). The overall 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 (similarly, in manufacturing). Thus, the decline in labor shares is associated with a shift towards foreign sources of income (2.84 pp overall, and 7.13 pp in manufacturing).

Changes in industry composition account for a large part of the decline of labor shares. 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 ($V_{2007}B_{1995}Y_{1995} - VBY_{1995}$).[28] Changes in industry 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 change. In manufacturing the split is 37 percent for within-industry changes and 40 percent for composition.[29]

Both within industry changes in factor intensities and changes in industry composition account

[27] Although all factors in Panel B are employed in manufacturing, services industries, both domestic or foreign, can also be a source of income for manufacturing.

[28] Within-industry changes can be significantly driven by 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). Virtually all firm level evidence indicates that exporting firms are significantly more capital and skill intensive (see, for example, Bernard, Jensen, Redding, and Schott (2007) for the U.S., Harrigan and Reshef (2015) in Chile). Therefore, variations in firm composition due to trade liberalization can also lower labor shares within-industries. See also Kehrig and Vincent (2021) for an establishment-level anatomy of the decline in the labor share with in U.S. manufacturing.

[29] Karabarbounis and Neiman (2014) and International Monetary Fund (2017) find a smaller role for industry composition. 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, because it does not take into account changes in composition due to sourcing decisions. The second reason for differences in results is variation in data sources, measurement, and level of aggregation. International Monetary Fund (2017) use only 10 industries, which mechanically causes more variation to occur within industries compared to our data, which include 35 industries. 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.

for the evolution of labor shares. This informs the empirical investigation in Section 5, and leads us to study determinants of changes of labor shares both at the industry and at the national levels.[30]

4.2 Complex GVCs and foreign sources of demand

We study the relative importance of foreign value chains captured in B, and of foreign demand for final goods Y. We start by decomposing B using Stone's additive decomposition (see Appendix E for details):

$$B = I + (B^d - I) + B^x + B^g \ . \tag{4}$$

Here I captures the direct effect of demand, while the other components capture indirect linkages: $B^d - I$ captures the effect of all strictly *domestic* input-output linkages, B^x captures *bilateral exports* of intermediate inputs that cross borders only once, and B^g captures *complex global value chains* that cross borders more than once, including "return loops".[31] Equation (4) allows us to write

$$V_f(\Delta B)Y = V_f(\Delta B^d)Y + V_f(\Delta B^x)Y + V_f(\Delta B^g)Y \ . \tag{5}$$

Final goods production can be written as

$$Y = Y^d + Y^f \ , \tag{6}$$

where Y^d is *domestic* demand by the country producing the final goods and Y^f is *foreign* demand for final goods. Both Y^d and Y^f include demand for domestically-produced goods and for imports. Using (6) we can write

$$V_f B(\Delta Y) = V_f B(\Delta Y^d) + V_f B(\Delta Y^f) \ , \tag{7}$$

which allocates demands to production via B and then to factor payments via V_f.

Table 2 displays the results of the analysis for labor shares ($V_f = V_L$) in 1995–2007 for the entire economy level and separately for manufacturing. The four "Total" rows in columns 1–3 report labor shares in GDP that are paid by domestic industries, foreign industries, and overall in 1995; these are the same numbers in columns 2, 4 and 5 in Table 1. The "Total" rows in columns 4–6 report the changes in the same concepts. The rows above the "Total" rows indicate the contributions of sub-components of either B or Y to their levels and changes in the corresponding columns.

We start with the Stone decomposition of B in levels. Overall, most payments to labor in 1995

[30] We performed the same analysis for factor shares in 2007–2014 (Table A5 in the appendix). The main differences are that labor shares increase by 1 percent points, on average, in contrast to the decline in 1995–2007, and that within-industry changes account for more than all of the increase in labor shares in this period, while composition accounts for small reductions (in the same direction as in 1995–2007).

[31] 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.

are generated due to domestic linkages (91% for all industries and 80% in manufacturing). Almost all of labor payments originating in domestic industries occurs via to domestic linkages (B^d), while most of the demand from foreign industries occurs due to bilateral trade linkages (B^x) (roughly 84%). Complex GVCs (B^g) originate mostly from foreign industries; return loop value chains are much less important. These findings are consistent with Miroudot and Nordstrom (2015).

The novel findings are the contributions to changes, using (5). Column (6) of Table 1 implies that increasing complexity in how world demand for final goods is met by production (recall that Y is held constant) accounts for part of the decline in labor shares. The the decline in labor shares in 1995–2007 that is due to ΔB is driven by a reduction in income from domestic industries (ΔB^d) that is not fully counterbalanced by both exports of intermediates (ΔB^x) and by more complex GVCs (ΔB^g). Complex GVCs account for more than 60% of this shift; in manufacturing the corresponding figure is more than 81%.

Turning to the breakdown of Y, we see that domestic demand (Y^d) accounts for the lion's share of labor payments in 1995 (93% overall and 80% in manufacturing), although this declines by 2007 (91% overall and 74% in manufacturing). Changes in foreign demand (ΔY^f) in 1995–2007 increase labor payments both through domestic and foreign industries; the latter is due to how domestic labor participates in GVCs supplying foreign industries. Interestingly, changes in domestic demand (ΔY^d) reduce labor payments through domestic industries, while concurrently contributing to an increase in labor payments due to domestic demand for foreign final goods. The latter is due to domestic industries supplying labor intensive inputs to foreign industries. The changes in manufacturing are larger, and overall in the same direction as the entire economy.

Table 2 delivers two messages. The first is that shifts towards more complex GVCs account for an important part of the decline in labor shares. The second is that the greater reliance on foreign sources of income demand, including how domestic demand for final goods is supplied by foreign production, contribute to lower labor shares.[32]

5 Explaining changes in labor shares

In this section we study the role of forward GVC integration and juxtapose it with other explanations. We start with fitting the following industry-by-country regression in a panel of changes

$$\begin{aligned} \Delta LS_{ic,t} \quad &= \quad \beta_1 \Delta FWD_{ic,t} + \beta_2 \Delta BACK_{ic,t} + \beta_3 \Delta EXP_{ic,t} + \beta_4 \Delta IMP_{ic,t} \\ &\quad + \beta_5 \Delta \ln q_{c,t} + \text{fixed effects} + \varepsilon_{ic,t} \ , \end{aligned} \tag{8}$$

[32] We performed the same analysis in 2007–2014 (Table A6 in the appendix). The main difference is that in manufacturing changes in both domestic (ΔB^d) and foreign linkages (ΔB^x and ΔB^g) contribute to declines in labor shares. In addition, changes in foreign demand in 2007–2014 account for small declines in labor shares, not increases as in 1995–2007.

where ΔLS_{ic} is the change in labor share in industry i located in country c. The first four variables on the right hand side of (8) capture dimensions of globalization: $FWD_{ic} = forward_{ic}/VA_{ic}$ is the share of exports of intermediate inputs in value added, i.e., forward foreign GVC intensity (the industry-country equivalent of the country-level variable examined in Section 3.1); $BACK_{ic} = foreign\_inputs_{ic}/inputs_{ic}$ is the share of imported inputs in total input purchases, i.e., backward foreign GVC intensity; $EXP_{ic} = y_{ic}^{-c}/VA_{ic}$ is export intensity of final goods in value added (y_{ic}^{-c} is final demand for industry i in country c from other countries $-c$); and $IMP_{ic} = y_{i,-c}^{c}/absorption_{i,c}$ is import intensity of final goods in total absorption ($y_{i,-c}^{c}$ is demand of country c for final goods i produced in other countries $-c$; and $absorption_{i,c}$ is given by local production plus imports minus exports of final good i in country c: $y_{i,c} + y_{i,-c}^{c} - y_{i,c}^{-c}$). Finally, q_c is the relative price of capital equipment investment (only country-level variation).[33] [34]

We estimate versions of (8) for manufacturing industries and then for all strictly private sector industries in 1995–2014.[35] While we expect GVC deepening to affect manufacturing, GVCs should affect services and other non-traded sectors through input linkages. We split the sample into three periods: 1995–2001, 2001–2007 and 2007–2014. The split is determined by the timing of changes in the rate of decline of the labor share, which are evident in Figure 1. In the Appendix G we present a procedure that identifies 2001 as a natural split for the 1995–2007 sub-sample. The second split is mandated by the fact that cover the period before 2007 and the period after 2007 with different releases of the WIOD (see discussion in Section 3).

We report regressions with increasingly demanding combinations of fixed effects that absorb time, country and industry trends in labour shares. Our most demanding specifications of (8) include country-industry fixed effects (with and without time fixed effects), which absorb any trends within these units, e.g., within industry and country trends in use of housing (Gutiérrez and Piton (2019)). We estimate (8) by weighted least squares (WLS) with VA_{ic} in 1995 as weights (choosing different years for weights changes little the results) in order to give greater importance to larger industries (Solon, Haider, and Wooldridge (2015)). We report robust standard errors

[33] The data for q 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). See Appendix F for more details.

[34] In order try to address the relationship between firm market share concentration and labor shares highlighted in Autor, Dorn, Katz, Patterson, and Van Reenen (2020) we experimented with adding to (8) the log of the number of firms at the country-by-industry level using data from UNIDO's INDSTAT 2019 edition database (we harmonize the 2-digit ISIC rev. 3 industry definition In INDSTAT to match the WIOD 2013 classification). This variable is very weakly correlated with labor shares and adding it does not alter the other coefficients. This is clearly an imperfect indicator of concentration, but we could not find other sources to compute industry concentration for so many industries and countries from 1995. For example, Orbis would allow us to do so only from 2004 and only for publicly available firms.

[35] The private sector excludes the following industries: "Public Admin and Defence; Compulsory Social Security", "Education", "Health and Social Work", "Other Community, Social and Personal Services", "Private Households with Employed Persons".

clustered by country and by industry (two-way clusters), to accommodate the fact that q_c varies only by country (Moulton (1990)), and to account for any cross-country correlations in the errors across industries (Cameron, Gelbach, and Miller (2011)).

5.1 Baseline WLS estimates

Table 3 presents the baseline results. We start with specifications without any fixed effects, and then increase the saturation of the model up to inducing country-industry and period fixed effects. Overall, only the coefficient to ΔFWD is statistically significant across all specifications. Moreover, the magnitude is stable across specifications, which considerably alleviates concerns for endogeneity caused by omitted variables. The coefficient to $\Delta BACK$ is negative, but not precisely estimated and is smaller than that to ΔFWD, implying a more limited role for offshoring in reductions in labor shares.

The largest effect for manufacturing industries is found in the most demanding specification in column 7; it implies that a one percent faster increase in forward foreign GVC integration is associated with 0.43 percent point faster decline the labor share. Perhaps not surprisingly, the effect is smaller when considering all private sector industries, at 0.28. These are economically large effects. A manufacturing industry in a given country at the third quartile of ΔFWD sees its labor share drop by 2 percent points more than an industry at the first quartile, which is a fifth of the inter-quartile range for ΔLS (10 percent points). The equivalent computation for all private sector industries gives about half as much explanatory power.[36]

5.2 Baseline W2SLS estimates

The results above imply a strong relationship between increases in forward GVC integration and declines in labor shares. Here we address concerns for causal interpretation of this relationship. While WLS may be biased due to omitted variables despite the high saturation of fixed effects, the main concern for endogeneity arises from unobserved biased technological change, or from differential reductions in the rental rate of capital. To make this concrete, suppose that the value added production function in a given industry is

$$Y = \left[\alpha \left(\Omega_K K\right)^{\rho} + \left(1-\alpha\right)\left(\Omega_L L\right)^{\rho}\right]^{1/\rho}, \quad \rho \leq 1,$$

where Ω_K and Ω_L capture capital and labor augmenting technological change, respectively. Then cost minimization in competitive factor markets implies that the labor share can be written as

$$LS = 1 - \alpha^{\sigma}\left(\Omega_K / r\right)^{\sigma-1}, \tag{9}$$

[36] See descriptive statistics in Table A7. We make sure that our results are not driven by outliers. In unreported results we drop the top and bottom 1% observations of ΔFWD; these yield virtually identical results.

where r is the rental rate of capital and $\sigma = 1/(1-\rho)$ is the elasticity of substitution between capital and labor. An increase in Ω_K (or reduction in r) will make the industry more competitive and it will export more, and at the same time have a direct effect on LS unless $\sigma = 1$ (similarly, Ω_L). We do not take a stand on whether σ is above or below unity, which implies a different direction of bias for the estimator of (8). Bias would similarly arise in the context of a gross output production function if intermediate inputs are not equally complementary to capital and labor, and their price declines due to, e.g., importing.

In order to deal with such concerns we construct an instrument based on structural gravity. Denote intermediate input sales of some industry i in year t originating from country c and sold in destination country d by $X_{cd}^{i,t} = \sum_j (vby)_{ij,t}^{cd}$, where $d = c$ implies domestic sales. In what immediately follows, we suppress the industry and time indices to ease notation, denoting by X_{cd} the generic $X_{cd}^{i,t}$. Let X_{cd} follow a gravity relationship along the lines of Eaton and Kortum (2002),

$$\begin{aligned} \ln X_{cd} &= -\theta \ln \tau_{cd} + \ln T_c - \theta \ln w_c + \ln X_d - \ln \Phi_d \\ &= \ln \tau_{cd}^{-\theta} + \underbrace{\ln T_c w_c^{-\theta}}_{\gamma_c} + \underbrace{\ln X_d - \ln \left[T_c w_c^{-\theta} \tau_{cd}^{-\theta} + \sum_{j \neq c} T_j \left(w_j \tau_{jd} \right)^{-\theta} \right]}_{\delta_d = \ln X_d - \ln \Phi_d}, \end{aligned} \tag{10}$$

where $\Phi_d = \sum_{j=1}^{N} T_j \left(w_j \tau_{jd} \right)^{-\theta} = T_c \left(w_c \tau_{cd} \right)^{-\theta} + \sum_{j \neq c} T_j \left(w_j \tau_{jd} \right)^{-\theta}$, and N is the number of countries. T_c is productivity in country c; w_c is the cost of production, including labor, capital and intermediate inputs; θ is the trade elasticity; $X_d = \sum_c X_{cd}$ is total expenditures in destination d; and τ_{cd} denotes bilateral trade barriers (all for some industry i in time t).[37] The instrument shuts down country c-variation in T_c and w_c in (10), both directly and within Φ_d, in order to avoid the potential supply-side relationship between exports and labor shares due to technological change, as illustrated in discussion around equation (9). Since w_c includes the cost of intermediate inputs, this approach also purges the instrument from the effects of offshoring.

The instrument is constructed as follows. We estimate $\widehat{\gamma}_c$ and $\widehat{\delta}_d$ in (10) by PPML and obtain $\widehat{\ln \tau_{cd}^{-\theta}}$ as a residual (all up to some normalization, which is inconsequential). Denote by $\widetilde{\gamma}$ the straight average of $\widehat{\gamma}_c$, which allows us to write $\widetilde{Tw^{-\theta}} = e^{\widetilde{\gamma}}$. We replace γ_c and $T_c w_c^{-\theta}$ by $\widetilde{\gamma}$ and $\widetilde{Tw^{-\theta}}$ in (10), including in the expression for Φ_d, respectively, and compute $\widetilde{X}_{cd}$; see Appendix H for complete details. We repeat this for each industry i and year $t \in \{1995, 2001, 2007, 2014\}$,

[37] Here τ_{cd} is a complex function of bilateral tariffs and the world input-output structure. This is of no consequence here, since it does not matter how τ_{cd} arises, as long as it is bilateral. This becomes clear in the implementation described in Appendix H. Although the gravity relationship (10) in Eaton and Kortum (2002) is articulated in gross trade terms, it is easy to incorporate industry i and year t-specific value added shares. These will be absorbed in the γ_c terms.

giving us $\widetilde{X}_{cd}^{i,t}$.[38] The instrument for $\Delta FWD_{ic,t}$ is thus

$$\Delta Z_{ic,t} = \ln \sum_{d \neq c} \widetilde{X}_{cd}^{i,t} - \ln \sum_{d \neq c} \widetilde{X}_{cd}^{i,t-1} \tag{11}$$

The instrument isolates the demand-driven part of $\Delta FWD_{ic,t}$ and is orthogonal to supply shocks that may be directly correlated with labor shares.

Table 4 reports the results of estimating (8) by weighted 2SLS (W2SLS), using (11) as an instrument. We report here only the results using the most saturated model, and relegate results of specifications with fewer fixed effects to Table A8 in the appendix, as they deliver a similar message. In columns 1 and 4 we repeat the baseline WLS results from Table 3, column 7. Columns 2 and 5 reports the W2SLS estimates, including first stage statistics, and columns 3 and 6 report the first stage regressions. The W2SLS estimates of the coefficients to ΔFWD are negative and larger than the WLS estimates in absolute value, especially in manufacturing industries. This is consistent with upward bias in the WLS estimates in Table 3. This can arise from three reasons. First, classic measurement error would bias the estimator of the coefficient to ΔFWD towards zero. Second, measurement error in value added alone would bias the estimator of the coefficient to ΔFWD towards 1 (it is in the denominator of both ΔFWD and ΔLS). Third, unmeasured capital-augmenting technological change (an increase in Ω_K) would tend to increase the labor share if the elasticity of substitution between capital and labor is smaller than 1, while boosting exports.[39]

We experimented with two alternative instruments. First, we used the first difference (not in logs) of $\widetilde{FWD}_{cd}^{i,t} = \sum_{d \neq c} \widetilde{X}_{cd}^{i,t} / \sum_{d} \widetilde{X}_{cd}^{i,t}$, where the denominator is predicted value added. While results are qualitatively similar, this resulted in much weaker first stage statistics, especially when we included non-manufacturing industries. We also experimented with constructing the instrument using only direct sales of intermediate inputs in (10), i.e., $X_{cd}^{i,t} = \sum_j (vay)_{ij,t}^{cd}$ (using direct input requirements A). For manufacturing industries, this yielded a strong instrument and very similar results to using (11). But when we added all other non-manufacturing industries the instrument proved to be weak, because there are virtually no direct exports of intermediate inputs of non-manufacturing industries.

Finally, we consider potential violations of the exclusion restriction for the instrument (11). Structural gravity allows w_c in (10) to depend on all other countries in general equilibrium, through imported inputs; our methodology purges the instrument from this source of variation. However, the same mechanism implies that w_j for $j \neq c$ may depend on T_c. This imperfection will have only minimal effects on the estimator as long as the instrument is strong, because country c is only one

[38] We compute $\widetilde{X}_{cd}^{i,2007}$ twice: once using WIOD 2013 release, to be consistent with $\widetilde{X}_{cd}^{i,2001}$, and a second time using WIOD 2016 release, to be consistent with $\widetilde{X}_{cd}^{i,2014}$.

[39] $\partial LS/\partial \Omega_K = -(\sigma-1)\,\alpha^{\sigma}\,(\Omega_K/r)^{\sigma-1}/\Omega_K \lesseqgtr 0$ if $\sigma \gtreqless 1$.

supplier among all other countries, including, in particular, the domestic (j) suppliers.

In order to asses the importance of potential violations of the exclusion restriction, we applied the "Local-to-Zero" (LTZ) approximation of Conley, Hansen, and Rossi (2012). We use this methodology to compute confidence intervals for ΔFWD that take into account uncertainty about the validity of the exclusion restriction for ΔZ. We first estimate by WLS a version of (8) that includes the instrument (11), and we store the standard error of the coefficient to the instrument, $\widehat{\gamma}$, denoted $\widehat{\sigma}_{\widehat{\gamma}}$. We then use the LTZ approximation to construct confidence intervals for the W2SLS coefficient to ΔFWD using different multiples of $\widehat{\sigma}_{\widehat{\gamma}}$—1, 10, 25 and 50—and two distribution functions for γ—normal and uniform. The confidence intervals do not include zero until we get to 50 times $\widehat{\sigma}_{\widehat{\gamma}}$. This indicates that even if the instrument is not strictly exogenous, it is strong enough to justify small violations of the exclusion restriction, and is thus useful for inference.[40]

5.3 The role of China

After establishing that the negative relationship between labor shares and forward GVC integration is causal in Table 4 we turn to the role of China in driving them. We show that the effect of forward GVC integration on reductions in labor shares is concentrated in 2001–2007, the period starting with China's accession to the WTO, in which its integration into GVCs accelerated, and in which the decline in labor shares accelerates (Figure 1). Moreover, we find particularly strong effects when China is on the importing side.

We report the results in Table 5, using the most saturated model; results from specifications with fewer fixed effects deliver the same message.[41] In columns 1 and 6 we repeat the baseline WLS results from Table 3, column 7. In columns 2 and 7 we interact ΔFWD with period fixed effects and find that the effect is present only in 2001–2007. In columns 3 and 8 we split ΔFWD into the part which is imported by China and another part that is imported by the rest of the world (RoW). The coefficient to ΔFWD to China is large and precisely estimated, while the coefficient to ΔFWD to RoW is smaller and not statistically significant at conventional levels of significance. In columns 4 and 9 we interact ΔFWD to China and to RoW with period fixed effects. In manufacturing we find that the effect of both ΔFWD to China and to RoW are precisely estimated only in 2001–2007. The results are similar when we add all other private sector industries, with the only difference being that we also estimate an equally strong effect of China in 1995–2001.

[40] See Section III.C in Conley, Hansen, and Rossi (2012) for a discussion of this last point and of the LTZ approximation in general. Results for the WLS estimates of (8) that include the instrument (11), as well as the confidence intervals that use the LTZ approximation are reported in the appendix in Table A10 and Table A11, respectively.

[41] These results are available upon request.

5.4 Country-level regressions

The decompositions results in Table 1 imply that both within-industry changes and change in industry composition account for reductions in labor shares, and in equal measure. In order to take into account both margins, we estimate (8) at the country level.

We report the results in Table 6. Columns 1–4 report WLS estimates of (8) using value added in 1995 as weights, with different configurations of fixed effects. We report robust standard errors clustered by country. Overall, the results resemble those in Table 4, and the coefficients are larger for both manufacturing and for the entire economy. While the estimates are precise in all specifications in columns 1–4 in manufacturing, including both country and period fixed effects reduces precision for the entire economy, although the point estimate changes little.

In addition, we estimate (8) by W2SLS using the same instrument (11) aggregated up to manufacturing or the entire economy, reported in Table 6 in column 5, with first stage regressions reported in column 6. We report only the specification with country fixed effects. Different configurations of fixed effects yield similar results, and are reported in Table A9 in the appendix, but as with WLS, using both country and period fixed effects for the entire economy yields an imprecisely estimated coefficient to ΔFWD—but not in manufacturing. As with the W2SLS regressions at the country-industry panel, the instrument is not weak and the estimated coefficient to ΔFWD is larger compared to WLS. We discuss above in Section 5.2 potential explanations for this larger effect.[42]

In unreported regressions we estimate that for manufacturing the effect of ΔFWD is concentrated in 2001–2007, with a greater effect for ΔFWD when China is the importer—similar to the results discussed in Section 5.3 and reported in Table 5 (and with larger coefficients). However, when estimating the same specifications for the entire economy, the coefficients to ΔFWD across periods and destinations are much less precisely estimated.

Overall, the results at the country level corroborate those at the country-industry level.

5.5 The role of endowments

In this section we ask whether the patterns of forward GVC integration are associated with relative factor abundance (RKA). If relatively upstream production is more capital intensive (we corroborate this in Section 5.6), then Heckscher-Ohlin logic would imply that as trade barriers decline and GVCs rise, upstream activities should be attracted to relatively capital abundant countries. These countries should, therefore, export more intermediate inputs that are relatively capital intensive to

[42] Different specifications of the instrument, discussed above in Section 5.2, yield similar results, although they prove to be significantly weaker instruments when aplied to the entire economy, compared to manufacturing.

less capital abundant countries, where labor-intensive downstream stages take place. This is the mechanism underlying the model in Sposi, Yi, and Zhang (2020).

In order to explore these ideas empirically we start by estimating the following regression

$$\frac{(V_K BY)_{od} - (V_L BY)_{od}}{GDP^o} = \beta \cdot RKA_{od} + \gamma' gravity_{od} + \alpha_o + \alpha_d + \varepsilon_{od} \ , \tag{12}$$

where $V_K BY_{od}$ is income accruing to capital installed in origin country o that originates from supplying intermediate inputs for final goods production in destination country d, and similarly for labor income in $V_L BY_{od}$. The dependent variable expresses the capital intensity (in value added terms) of intermediate input exports from o to d. We define relative capital abundance as

$$RKA_{od} = \ln\left(\frac{E_o^K}{E_o^K + E_d^K}\right) - \ln\left(\frac{E_o^L}{E_o^L + E_d^L}\right) \ ,$$

where E_i^f are expenditures on factor $f \in \{K, L\}$ in country $i \in \{o, d\}$. The coefficient of interest is β, and given the discussion above, we expect a positive relationship. We control for standard bilateral control variables in $gravity_{od}$: log distance, and indicators for a common border, colonial ties, common language, free trade agreements, and common currency.[43] We also include in (12) origin and destination fixed effects to control for overall attractiveness of o for capital intensive production, and overall tendency of d to produce final goods with capital intensive inputs structure (the source of income flowing from d to o). The results in Table 5 indicate that the effects of forward GVC integration are present only in 2001–2007, so we study these effects only in that period. We estimate (12) by OLS in two cross sections, in 2001 and in 2007. We report robust two-way clustered standard errors at the country o and country d level.

We report the results in columns 1 and 2 of Table 7. We find that greater RKA is associated with greater capital intensity of exports of intermediate inputs from o to d, and that this association has strengthened a bit from 2001 to 2007. Since we include both source and destination fixed effects, this result is not driven by overall abundances *per se*.

We now turn to discuss the volume of these exports. We estimate gravity regressions

$$VBY_{od} = \exp\{\beta \cdot RKA_{od} + \gamma' gravity_{od} + \alpha_o + \alpha_d\} + \varepsilon_{od} \ , \tag{13}$$

where VBY_{od} is the value added of exports of intermediate inputs from origin country o used in destination country d for final good production. The other variables are as in (12). We estimate (13) by PPML, and report robust two-way clustered standard errors at the country o and country d level.

We see in columns 3 and 4 of Table 7 that greater RKA is strongly associated with greater

[43] Data from the CEPII gravity dataset.

exports of intermediate goods, and that this association, too, has strengthened from 2001 to 2007. We interpret this strengthening of the effect of RKA on both the volume and the capital intensity of forward GVC integration as a consequence of reductions in barriers to the geographical spread of GVCs, in line with the predictions in Sposi, Yi, and Zhang (2020).

Finally, we investigate whether the effect of RKA is different for direct exports, VB^xY_{od}, compared to indirect exports of intermediate inputs, VB^gY_{od}, where $VBY_{od} = VB^xY_{od} + VB^gY_{od}$ for $o \neq d$ (see (4) above). We see in columns 5 and 6 of Table 7 a stronger association of RKA with direct exports of intermediate goods, VB^xY_{od}, which is reasonable given the bilateral nature of RKA_{od} (and, similarly, stronger effects of distance and common language), versus the more complex and indirect GVCs involved in VB^gY_{od}.[44]

Overall, the results in Table 7 imply that the pattern of expansion of forward GVC integration is responsive to factor endowments. Relatively capital abundant countries tend to integrate forward, increasing the capital intensity of their exports of intermediate inputs, which contributes to lower labor shares.

5.6 Changes in positioning within GVCs: upstreamness

Industries and countries that increased the intensity of supplying intermediate inputs to foreign industries have seen their labor share decline. This is consistent with the idea that production that is more upstream, i.e. farther away from final goods production or final assembly is less labor intensive. It is also the key assumption in Sposi, Yi, and Zhang (2020). Here we investigate this assumption.

We fit two sets of regressions using data in 2001–2007, the period in which the relationship between forward GVC integration and labor shares is strongest. First we fit country by industry by year panel regressions. Then we fit cross section long difference regressions of changes from 2001 to 2007. The dependent variable is labor shares and the explanatory variables are either upstreamness (1) or its domestic and foreign components (2) (in levels or in changes). We also control for downstreamness, which is computed in an analogous way as upstreamness, except that it pertains to distance from the first stage of production. This control is important since, as Antràs and Chor (2018) demonstrate, upstreamness and downstreamness are positively correlated, and together they indicate the overall position of an industry within its average value chain. We use different sets of fixed effects (FEs) in the panel regressions in order to illustrate different sources of variation. We report robust standard errors clustered both by country and by industry.

[44] We also see that membership in the same free trade agreement and sharing a common currency increases VB^gY_{od} but not VB^xY_{od}. This may be associated with the fact that these integration tools are multilateral in nature, fostering a greater "pool" of countries through which intermediate inputs can flow at low costs. The negative association of common border with VB^gY_{od} is mechanical, since VB^gY_{od} necessarily passes through third countries.

We report the results in Table 8. We start with manufacturing industries. Column 1, with only year fixed effects, demonstrates that upstreamness (U) is associated with lower labor shares in the cross section—but this is not precisely estimated. This is consistent with Antràs, Chor, Fally, and Hillberry (2012), who document a similar negative correlation in a cross section of U.S. manufacturing industries. Since we control for downstreamness, this implies that length (or fragmentation) of value chains *per se* is not strongly associated with labor shares. In columns 2 and 3 we find that this association is stronger over time within countries and industries. In column 4 we find that the domestic component of upstreamness (U^D) is associated with lower labor shares in the cross section. In contrast, in columns 5 and 6 we see that increases in the foreign component of upstreamness (U^F) are associated with decreases in labor shares over time, not changes in the domestic component. These results are corroborated in columns 7 and 8 using long differences, where we see that the association between upstreamness and declines in labor shares is driven by the foreign component. When we turn to the results for all private sector industries we find similar patterns. The only substantive difference is that we find a significant positive association between increases domestic upstreamness and changes in labor shares in column 8.

Overall, the results show that increases in upstreamness that are driven by exports of intermediate inputs to foreign industries are negatively associated with labor shares. As industries re-position farther away from final good production and assembly, they require less labor and more capital.

5.7 Changes in functional specialization

In this section we ask what types of labor tasks account for the declines in labor shares documented above. We draw on data from Timmer, Miroudot, and de Vries (2018), that allows splitting labor income into four categories of "functional specialization": management (MGT), research and development ($R\&D$), fabrication (FAB), and marketing (MKT). This allows us to write

$$\Delta LS_{ic} = \Delta MGT_{ic} + \Delta R\&D_{ic} + \Delta FAB_{ic} + \Delta MKT_{ic} \ .$$

Inspection of the occupational classifications that underlie the four functions reveals that they are particularly meaningful in manufacturing, but less so in non-manufacturing industries. For example, outside of manufacturing the marketing category is very heterogeneous, resembling a residual of the other, more consistently defined functions.

As above, we focus on the period in which the association between labor shares and forward GVC integration is strongest. Thus, we fit the following long difference regressions in 2001–2007, both in manufacturing and in all private sector industries:

$$\Delta FUNCTION_{ic} = \beta^D \Delta U^D_{ic} + \beta^F \Delta U^F_{ic} + \delta \Delta D_{ic} + \text{fixed effects} + \varepsilon_{ic} \ , \tag{14}$$

and

$$\begin{aligned} \Delta FUNCTION_{ic} &= \gamma_1 \Delta FWD_{ic} + \gamma_2 \Delta OFF_{ic} + \gamma_3 \Delta EXP_{ic} + \gamma_4 \Delta IMP_{ic} \\ &\quad + \kappa_1 \Delta \ln q_c + \text{fixed effects} + \varepsilon_{ic} \ , \end{aligned} \tag{15}$$

where $FUNCTION \in \{MGT, R\&D, FAB, MKT\}$, D_{ic} is the measure of downstreamness in industry i and country c. We weigh regressions by value added in 2001 and cluster standard errors by country and by industry. In order to ease the exposition of (15), we report only estimates of γ_1; other coefficients are not precisely or robustly estimated, and imply much weaker effects.[45] We estimate (14) and (15) with no fixed effects, country effects and industry effects; results using both country and industry fixed effects are not precisely estimated, which is not surprising given the very demanding specification (only one cross section of changes). Since all variables are in changes, the coefficients are comparable across all specifications.

We report the results in Table 9. Across all specifications, we find that ΔU^F and ΔFWD are negatively associated with ΔMGT, ΔMKT and—to a much greater extent—with ΔFAB. One reason for the larger effect on fabrication tasks is that increases in upstreamness and GVC integration are driven by offshoring of assembly. Expenditure on management, design, marketing and post-sales services also decline as we move up the value chain, away from final good production. Our interpretation of this is that selling final goods requires more interaction with consumers and more management control of production processes compared to producing intermediate inputs further up the value chain. More generally, as Baldwin (2016) argues, moving production stages within a value chain across borders requires moving some management and marketing together with fabrication tasks, because GVC integration involves technology transfer to where production activities are relocated.[46] In contrast, we do not find any effect of forward GVC integration on the share of labor expenditures in R&D. This is what we would expect to find if forward GVC integration is associated with multinationals offshoring assembly, where parents perform almost all of the R&D for the multinational, a pattern that is well documented by several sources.[47]

A corollary of these findings is that R&D becomes more intensive *within* labor in industries that

[45] Full results are available in Table A12 in the appendix.

[46] Indeed, this technology transfer has been hailed by many economists as one of the largest benefits of GVC integration for less developed countries. The point here is that this technology transfer cannot be achieved without some transfer of management and marketing tasks.

[47] For example, about 80% of R&D expenditures by U.S. multinationals in 2014 was performed by parents located in the U.S.; see National Sciences Board (2018), Chapter 4.

integrate forward into foreign GVCs. Interestingly, when estimating (14) in the sample with all private sector industries (but not in manufacturing) we find a positive association between changes in downstreamness ΔD with $\Delta R\&D$. Together with the results on upstreamness, this implies that R&D becomes more intensive in industries that increase the overall length of the value chains they participate in. However, the association of downstreamness with R&D is not strong enough to increase labor shares significantly, as seen in Table 8.[48]

Overall, forward GVC integration and greater upstreamness are associated with declines in labor shares because they require less expenditure on fabrication, management and marketing labor activities.

5.8 Offshoring of assembly of exports of final goods

We start by asking whether the effect of an increase in the export intensity of intermediate inputs is due to offshoring of assembly of final goods that would have otherwise been exported. Offshoring of assembly of final goods that would have been consumed domestically is controlled for by ΔIMP. The first stage regressions in Table 4 do not reveal any correlation between ΔIMP and ΔFWD.

We compute a modified version of ΔFWD, denoted ΔFWD^*, in which we subtract exports of final goods from value added in the denominator of FWD. Offshoring of assembly may increase the numerator of FWD if domestic inputs are shipped to foreign assembly sites. At the same time, it may reduce the denominator if it causes fewer exports of final (assembled) goods. If offshoring of labor-intensive assembly of hitherto exported final goods is an important mechanism, then ΔFWD^* should have a smaller effect on the reduction in labor shares. The results in columns 5 and 10 of Table 5 imply that, compared to the baseline results for ΔFWD in columns 1 and 6, there is a slightly weaker association ΔFWD^* with labor shares in manufacturing, but a slightly stronger association in all private sector industries.[49] The coefficient to ΔEXP (changes in exports of final goods intensity) increases dramatically in columns 5 and 10. This is because the numerator is precisely the part that is deducted from the denominator of ΔFWD^*.

In unreported regressions we tried to detect a different effect of ΔFWD^* through two channels: value added bilateral exports of intermediate inputs that cross borders only once and are absorbed in the direct destination country—versus when it is embodied in exports of the destination country, i.e. complex GVCs that cross borders more than once. Due to the high collinearity, we could not

[48] We also estimated (15) by W2SLS using the instrument (11). Within manufacturing industries we find similar results to those in Table 8, except that the coefficients are generally larger; as in Table 4, the instrument is strong. However, the results are much less precise in the sample of all private sector industries. These results are available upon request.

[49] We drop the top and bottom 1 percent of observations in order to eliminate very extreme outliers, which are driven by observations in which exports of final goods is most of value added, leading to unrealistic values for the modified ΔFWD.

separately identify these effects. In our data 75 percent of ΔFWD^* accrues to value that crosses borders only once, on average.[50]

We conclude that offshoring of assembly of final goods exports is one mechanism through which forward GVC integration lowers labor shares, although probably not the most important one.

5.9 Multinationals and cross-border capital ownership

Given their importance in the world economy, we now study the role of multinational enterprises (MNEs) in forward GVC integration.[51] By exploiting the bilateral and directional nature of GVC integration and cross-border ownership we can shed light on the nature of this relationship.

We estimate the following gravity equation in a cross section in 2007:

$$VBY_{od} = \exp\left\{\beta \cdot \text{arcsinh}(affiliates_{od}) + \delta \cdot \text{arcsinh}(affiliates_{do}) + \gamma' gravity_{od} + \alpha_o + \alpha_d\right\} + \varepsilon_{od}\ , \tag{16}$$

where VBY_{od} is income accruing to primary factors in country o due to exports of intermediate inputs for final goods production in country d. Here $affiliates_{od}$ is the number of affiliates located in o with parents in (owned by) d; $affiliates_{do}$ is the number of affiliates located in d with parents in (owned by) o; and $\text{arcsinh}(x) = \ln[x + (1+x^2)^{1/2})]$ is the inverse hyperbolic sine transformation, which approximates the logarithmic function but allows for zeros (other functional forms, e.g., $\ln(1+x)$, yield similar results). Thus, β captures the degree to which exports of intermediate inputs are associated with foreign-owned upstream input production; and δ captures the degree to which exports of intermediate inputs are associated with foreign-owned downstream assembly activity. The data on affiliates are averages in 1996–2001, and taken from Ramondo, Rodríguez-Clare, and Tintelnot (2015). Using other measures of cross-border ownership intensities such as FDI stocks and affiliate sales yield, qualitatively, the same results.[52] The variables in $gravity_{od}$ are described in the previous section, and we include origin and destination fixed effects to control for unobserved factors that may determine overall attractiveness of a location for input or final good production, and overall MNE prowess. We estimate (16) by PPML, and report robust two-way clustered standard errors at the country o and country d level.

We report the results in Table 10. In columns 1–3 we see that cross-border MNE activity in both directions is associated with exports of intermediate inputs, and the difference in the strength of the

[50] While the increase in the share of value added that crosses borders more than once within total trade is often portrayed as the hallmark of GVC integration (e.g., Antràs (2021)), it is not as important as a share of production value added.

[51] In 2016 MNEs accounted for about a third of global GDP, two thirds of global exports and 40% of imports of intermediate inputs; see Cadestin, De Backer, Desnoyers-James, Miroudot, Ye, and Rigo (2018).

[52] These results are available upon request. Many of the the observations on cross-border ownership are imputed ("extrapolated"), as described in the data appendix of Ramondo, Rodríguez-Clare, and Tintelnot (2015). After merging the data on affiliates to our data we are left with 1122 observations, where we lose information on five of the 39 countries in our sample: Cyprus, Estonia, Latvia, Malta, Taiwan ($1122 = 34 \times 33$, compared to $1482 = 39 \times 38$).

association is small. This implies that both types of vertical international integration play a role in fostering forward GVC integration: offshoring of upstream input production and of downstream assembly. This dovetails with our results in Table 5, where we did not find significant differences for the effect of forward GVC integration on labor shares once we excluded assembly offshoring.

We also investigate whether the these associations are different for direct exports, VB^xY_{od}, compared to indirect exports of intermediate inputs, VB^gY_{od}, where $VBY_{od} = VB^xY_{od} + VB^gY_{od}$ for $o \neq d$ (see (4) above). We see in columns 4–6 and 7–9 of Table 10 a stronger association with direct exports of intermediate goods, VB^xY_{od}, which is reasonable given the bilateral nature the cross-border ownership indicators (other gravity variables has similar correlations as in Table 9).[53]

6 Concluding remarks

In this paper we studied the evolution of labor shares in a sample of 39 countries, both developed and less developed, in 1995–2014. Our main message is that deepening of forward foreign GVC integration caused declines in labor shares, especially in 2001–2007, after China's accession to the WTO and until the trade collapse of 2008. This is driven by increases in exporting—in value added terms—of intermediate inputs which tend to be more capital intensive. It manifests in an increase in industry upstreamness, and in a shift away from fabrication, as well as marketing and management labor activities. The increase in foreign forward GVC integration and in upstreamness all but halt after 2007, when labor shares cease to decline, on average. Since skilled labor shares increase while the overall labor share declines, this implies that unskilled labor shoulders the decreases in payments to labor, which is consistent with the greater drop in fabrication compared to other labor activities. We show that the rise in forward GVC integration is associated with differences in relative capital abundances, and with cross-border MNE presence.

Our findings have important implications. First, 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), our findings on the effect of globalization on lowering labor shares raise concerns about the costs of further economic integration. Second, our findings on MNE activity imply that studying the effects of globalization on income distribution through the evolution of labor shares should take into account a national product approach, rather than rely solely on domestic production approach. This is because MNEs own (most of) the capital installed in their foreign affiliates, and thus a large part of the income flows due to GVC integration do not accrue where production takes place, but to the owners of capital involved in production.

One important caveat of our study is that we do not identify the underlying forces that drive

[53] The results are robust to dropping Ireland and the aggregated Belgium+Luxemburg, which are the only tax havens in our data according to Hines Jr and Rice (1994).

globalization (for example, reductions in man-made trade barriers, or technological forces). Nevertheless, whatever the underlying causal forces, we demonstrate that they operate through forward foreign GVC integration. In addition, since we do not observe firms, we cannot study whether GVC deepening accounts for declines in labor shares by changing the composition of firms—along the lines Harrigan and Reshef (2015), Autor, Dorn, Katz, Patterson, and Van Reenen (2020) and De Loecker and Eeckhout (2018)—or by changes within firms. Understanding the role of firms in GVC integration and changes in labor shares is an important task for future research.

Appendix

A Labor share concepts in the Penn World Tables

The Penn World Tables report five different concepts of labor shares. Here we list them, and we denote their labels in Figure A1 in brackets:

1. Compensation of employees [**Employees**].
2. Compensation of employees + all income of self employed (mixed income) [**Employees + All mixed income**].
3. Compensation of employees + labor income of self employed (mixed income), computed by assuming that self-employed workers use labor and capital in the same proportion as the rest of the economy [**Employees + Self empl (K/L)**].
4. Compensation of employees + labor income of self employed (mixed income), computed by using the aggregate average wage of self-employed [**Employees + Self empl (avg wage)**].
5. Compensation of employees + value added in agriculture, assuming that all value added in agriculture is labor compensation (on average, it is 90%). This correction is useful for developing countries, where about half of self-employed workers are in agriculture [**Employees + Self empl (agric)**].

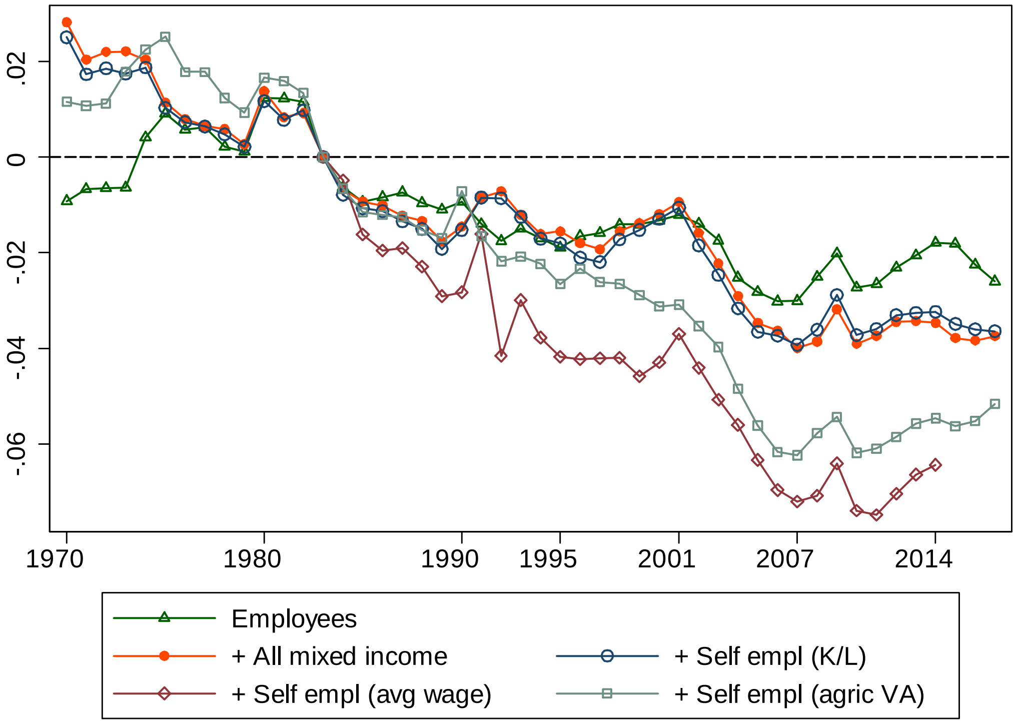
See Feenstra, Inklaar, and Timmer (2015) and their online appendix for fuller details. See also Mućk, McAdam, and Growiec (2018) for an overview of different measures of the labor share.

In Figure A1 we report year fixed effects from regressions of each labor share concept on year fixed effects and country fixed effects, weighted by real GDP. We use data from Penn World Tables 9.1 on all labor shares concepts, dropping all observations that are extrapolated (extrapolated values are set to the first or last observed value, so they have no content for the evolution of labor shares). The year fixed effects are adjusted be equal to zero in 1983, the first year in which the fourth concept is available. The sample includes 39 countries that correspond to the WIOD 2013 release sample of countries.

Figure A1 demonstrates that all measures of the labor share exhibit similar trends, especially the acceleration in the decline in 2001–2007. Mućk, McAdam, and Growiec (2018) also show that for the United States, all measures of the labor share exhibit common trends from 2001 and on. This is important for us, because 2001 is the year after which the association of labor shares declines with forward foreign GVC deepening is strongest.

In Figure 1 all countries' labor shares are the Employees + Self empl (K/L) series, except for China (compensation of employees) and India and Indonesia (compensation of employees + value added in agriculture).

Figure A1. Different Labor Share Concepts in the Penn World Tables



B WIOD data and computations

B.1 Data structure

The 2013 release of the World Input-Output database (WIOD) 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 WIOD 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. WIOD 2013 uses the 1993 System of National Accounts (SNA), while WIOD 2016 uses the 2008 SNA, which renders merging the two impossible.

One major caveat in using these data arises from the proportionality assumptions in constructing 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. For example, this means that the WIOD data do not allow the value added intensity in gross output to depend on the use of output (downstream industries or consumption, domestic or foreign). de Gortari (2017) demonstrates that the latter can have significant quantitative implications for measures of economic integration between the U.S. and Mexico. In contrast, Puzzello (2012) finds that similar proportionality assumptions lead to small bias in factor content of trade.

Figure A2 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 A2: Schematic Outline of a World Input-Output Table

		A						Y			
		S		R		T					
Cty	**Ind**	1	2	1	2	1	2	S	R	T	X
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 A2 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 A2 (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.

B.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 A2.

The elements of the diagonal matrix of final goods demand Y are obtained by a row-wise summation of the "Y-area" in Figure A2 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 A2 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 three countries and two industries is

$$\begin{aligned}
&VBY \\
&= \begin{bmatrix} v_1^s & 0 & 0 & 0 & 0 & 0 \\ 0 & v_2^s & 0 & 0 & 0 & 0 \\ 0 & 0 & v_1^r & 0 & 0 & 0 \\ 0 & 0 & 0 & v_2^r & 0 & 0 \\ 0 & 0 & 0 & 0 & v_1^t & 0 \\ 0 & 0 & 0 & 0 & 0 & v_2^t \end{bmatrix}
\begin{bmatrix} b_{11}^{ss} & b_{12}^{ss} & b_{11}^{sr} & b_{12}^{sr} & b_{11}^{st} & b_{12}^{st} \\ b_{21}^{ss} & b_{22}^{ss} & b_{21}^{sr} & b_{22}^{sr} & b_{21}^{st} & b_{22}^{st} \\ b_{11}^{rs} & b_{12}^{rs} & b_{11}^{rr} & b_{12}^{rr} & b_{11}^{rt} & b_{12}^{rt} \\ b_{21}^{rs} & b_{22}^{rs} & b_{21}^{rr} & b_{22}^{rr} & b_{21}^{rt} & b_{22}^{rt} \\ b_{11}^{ts} & b_{12}^{ts} & b_{11}^{tr} & b_{12}^{tr} & b_{11}^{tt} & b_{12}^{tt} \\ b_{21}^{ts} & b_{22}^{ts} & b_{21}^{tr} & b_{22}^{tr} & b_{21}^{tt} & b_{22}^{tt} \end{bmatrix}
\begin{bmatrix} y_1^s & 0 & 0 & 0 & 0 & 0 \\ 0 & y_2^s & 0 & 0 & 0 & 0 \\ 0 & 0 & y_1^r & 0 & 0 & 0 \\ 0 & 0 & 0 & y_2^r & 0 & 0 \\ 0 & 0 & 0 & 0 & y_1^t & 0 \\ 0 & 0 & 0 & 0 & 0 & y_2^t \end{bmatrix} \\
&= \begin{bmatrix} v_1^s b_{11}^{ss} y_1^s & v_1^s b_{12}^{ss} y_2^s & v_1^s b_{11}^{sr} y_1^r & v_1^s b_{12}^{sr} y_2^r & v_1^s b_{11}^{st} y_1^t & v_1^s b_{12}^{st} y_2^t \\ v_2^s b_{21}^{ss} y_1^s & v_2^s b_{22}^{ss} y_2^s & v_2^s b_{21}^{sr} y_1^r & v_2^s b_{22}^{sr} y_2^r & v_2^s b_{21}^{st} y_1^t & v_2^s b_{22}^{st} y_2^t \\ v_1^r b_{11}^{rs} y_1^s & v_1^r b_{12}^{rs} y_2^s & v_1^r b_{11}^{rr} y_1^r & v_1^r b_{12}^{rs} y_2^r & v_1^r b_{11}^{rt} y_1^t & v_1^r b_{12}^{rt} y_2^t \\ v_2^r b_{21}^{rs} y_1^s & v_2^r b_{22}^{rs} y_2^s & v_2^r b_{21}^{rr} y_1^r & v_2^r b_{22}^{rr} y_2^r & v_2^r b_{21}^{rt} y_1^t & v_2^r b_{22}^{rt} y_2^t \\ v_1^t b_{11}^{ts} y_1^s & v_1^t b_{12}^{ts} y_2^s & v_1^t b_{11}^{tr} y_1^r & v_1^t b_{12}^{ts} y_2^r & v_1^t b_{11}^{tt} y_1^t & v_1^t b_{12}^{tt} y_2^t \\ v_2^t b_{21}^{ts} y_1^s & v_2^t b_{22}^{ts} y_2^s & v_2^t b_{21}^{tr} y_1^r & v_2^t b_{22}^{rr} y_2^r & v_2^t b_{21}^{tt} y_1^t & v_2^t b_{22}^{tt} y_2^t \end{bmatrix} \ . \qquad (17)
\end{aligned}$$

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 production of final goods (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 production of final goods in industry 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.

B.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:

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

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

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:

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

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 $v_1^s b_{11}^{sr} y_1^r$, $v_1^s b_{12}^{sr} y_2^r$, $v_1^s b_{11}^{st} y_1^t$ and $v_1^s b_{12}^{st} y_2^t$. The denominator in this case is equal to value added of industry 1 in country s, va_1^s.

B.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.

C Backward GVC integration

Each element of the VBY matrix contains all payments to factors that are employed in sector i in origin country o that contribute to the production of sector j in destination country d: $(vby)_{ij}^{od}$. Then $\sum_{o \neq d} \sum_i (vby)_{ij}^{od}$ summarizes payments to foreign primary factors due to imports (in value added terms) of intermediate inputs used in industry j located in country d. Define backward foreign GVC integration for an industry j in country d as the share of imports of intermediate inputs in value added terms in input use: $backward_j^d = \sum_{o \neq d} \sum_i (vby)_{ij}^{od} / \sum_o \sum_i (vby)_{ij}^{od}$. The equivalent concept at the country level is $backward^d = \sum_{o \neq d} \sum_i \sum_j (vby)_{ij}^{od} / \sum_o \sum_i \sum_j (vby)_{ij}^{od}$. Table A3 and Table A4 in the appendix report country-level backward GVC integration using WIOD 2013 and WIOD 2016, respectively, in 1995, 2007 and 2014.

The global trend in backward GVC integration is similar to that of forward GVC integration (exhibited in Figure 1), because the numerators use the same global trade in inputs in value added terms. However, forward and backward differ at the country and industry level, due to differences across industries and countries in the tendency to import inputs or to export inputs from and to other industries, respectively.

D Proof of decomposition equation (3)

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

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

Applying the same algebra in (18) to $X = (BY)$ and plugging this back into (18) yields (3).

E 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 $\widetilde{A}X$

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

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 $X = M_3M_2M_1Y$ in (21) and arrives at:

$$X = IY + \underbrace{(M_1 - I)}_{\widetilde{M}_1} Y + \underbrace{(M_2 - I)\,M_1}_{\widetilde{M}_2} Y + \underbrace{(M_3 - I)\,M_2M_1}_{\widetilde{M}_3} Y \tag{22}$$

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

$$\begin{aligned} B &= M_1M_2M_3 \\ &= M_2M_1 + M_1M_2M_3 - M_2M_1 \\ &= M_2M_1 + (M_3 - I)\,M_2M_1 \\ &= M_1 + M_2M_1 - M_1 + (M_3 - I)\,M_2M_1 \\ &= M_1 + (M_2 - I)\,M_1 + (M_3 - I)\,M_2M_1 \\ &= I + (M_1 - I) + (M_2 - I)\,M_1 + (M_3 - I)\,M_2M_1 \end{aligned}$$

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 $A_{ij} A_{jk} A_{kl} A_{lm} \ldots$, where $i \neq j$, $j \neq k$, $k \neq l$, $l \neq m \ldots$, 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 $\widetilde{M}_1$.

In the main text equation (4) reads

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

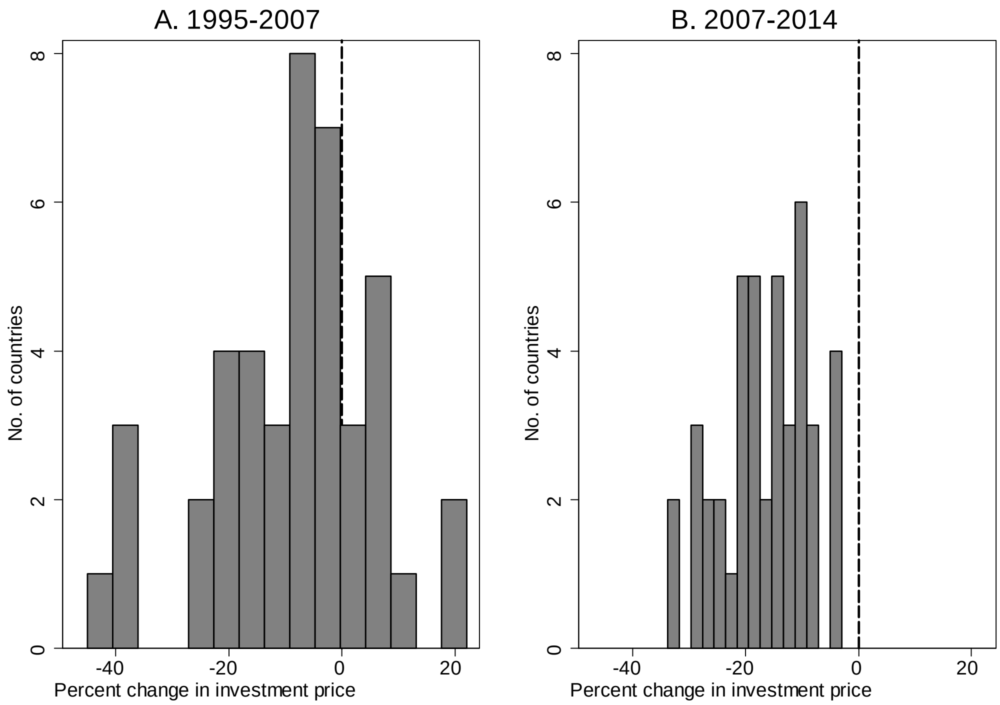
Here I captures the direct effect of demand on output. Next, $B^d - I$ captures output that is induced by all strictly *domestic* indirect linkages. To see this, note that $B^d = (I - A^d)^{-1}$, To see this, note that $B^d = (I - A^d)^{-1}$, where A^d is the matrix of block diagonal elements from A, 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 international 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.

F Price of investment in capital equipment

We use data 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).

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 (from PWT data). This means that $P_{ct}^{inv}/P_{ct}^{con}$ is the relative price of investment in terms of that of the United States' ratio in PPP. 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 ($P_{USA,t}^{pce}$) (the latter from BEA data). In the regressions we use log differences in the resulting $q_{ct} = (P_{ct}^{inv}/P_{ct}^{con})/(P_{USA,t}^{inv}/P_{USA,t}^{con}) \cdot (P_{USA,t}^{pfi}/P_{USA,t}^{pce})$.

The weighted average decline in q_c 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.



G Identifying 2001 as the split year in 1995–2007

We identify 2001 as a natural split for the 1995–2007 sub-sample. We estimate a series of regressions of the type

$$\begin{aligned}\Delta_{1995-\tau}LS_{ic} &= \gamma_1\Delta_{1995-\tau}FWD_{ic} \\ &+\gamma_2\Delta_{1995-\tau}BACK_{ic}+\gamma_3\Delta_{1995-\tau}EXP_{ic}+\gamma_4\Delta_{1995-\tau}IMP_{ic} \\ &+\kappa_1\Delta_{1995-\tau}\ln q_c+\text{fixed effects}+\varepsilon_{ic} \qquad (23)\end{aligned}$$

and

$$\begin{aligned}\Delta_{\tau-2007}LS_{ic} &= \gamma_1\Delta_{\tau-2007}FWD_{ic} \\ &+\gamma_2\Delta_{\tau-2007}BACK_{ic}+\gamma_3\Delta_{\tau-2007}EXP_{ic}+\gamma_4\Delta_{\tau-2007}IMP_{ic} \\ &+\kappa_1\Delta_{\tau-2007}\ln q_c+\text{fixed effects}+\varepsilon_{ic}\ , \qquad (24)\end{aligned}$$

where $\Delta_{1995-\tau}$ denotes changes from 1995 to year τ, and $\Delta_{\tau-2007}$ denotes changes from year τ to 2007, for $\tau = 1996, 1997, ...2006$. The results (available upon request) imply that the coefficient to FWD is small and imprecisely estimated in (23) unless $\tau > 2001$; the coefficient to FWD is large and precisely estimated in (24) when $\tau \geq 2001$. Regressions like (23) and (24) using data aggregated to the country level deliver a similar message.

H Gravity instrument construction

Let X_{cd} follow a gravity relationship along the lines of Eaton and Kortum (2002),

$$\begin{aligned} \ln X_{cd} &= -\theta \ln \tau_{cd} + \ln T_c - \theta \ln w_c + \ln X_d - \ln \Phi_d \\ &= \ln \tau_{cd}^{-\theta} + \underbrace{\ln T_c + \ln w_c^{-\theta}}_{\gamma_c} + \underbrace{\ln X_d - \ln \left[T_c w_c^{-\theta} \tau_{cd}^{-\theta} + \sum_{j \neq c} T_j \left(w_j \tau_{jd} \right)^{-\theta} \right]}_{\delta_d = \ln X_d - \ln \Phi_d}, \end{aligned} \tag{25}$$

where $\Phi_d = \sum_{j=1} T_j \left(w_j \tau_{jd} \right)^{-\theta} = T_c \left(w_c \tau_{cd} \right)^{-\theta} + \sum_{j \neq c} T_j \left(w_j \tau_{jd} \right)^{-\theta}$. T_c is productivity in country c; w_c is the cost of production, including labor, capital and—importantly—intermediate inputs; θ is the trade elasticity; $X_d = \sum_c X_{cd}$ is total expenditures destination d; and τ_{cd} denote bilateral trade barriers (all for industry i in time t).

We estimate $\widehat{\gamma}_c$ and $\widehat{\delta}_d$ by PPML and obtain $\widehat{\ln \tau_{cd}^{-\theta}}$ as a residual—all up to some normalization, which is inconsequential. Denote by $\widetilde{\gamma}$ the straight average

$$\widetilde{\gamma} = \frac{1}{N} \sum_{j=1}^{N} \widehat{\gamma}_c,$$

which allows us to write

$$\widetilde{Tw^{-\theta}} = e^{\widetilde{\gamma}}$$

We proceed as follows.

1. Since X_d is observable, we obtain

$$\ln \widehat{\Phi}_d = \ln X_d - \widehat{\delta}_d \tag{26}$$

   and therefore

$$\widehat{\Phi}_d = e^{\ln X_d - \widehat{\delta}_d} = X_d e^{-\widehat{\delta}_d} = X_d / e^{\widehat{\delta}_d} \tag{27}$$

2. Compute

$$\widehat{T_c w_c^{-\theta}} \cdot \widehat{\tau_{cd}^{-\theta}} = e^{\widehat{\gamma}_c + \widehat{\ln \tau_{cd}^{-\theta}}} \tag{28}$$

3. Compute

$$\begin{aligned} \widetilde{\Phi}_{d,-c} &= \widehat{\Phi}_d - \widehat{T_c w_c^{-\theta}} \cdot \widehat{\tau_{cd}^{-\theta}} + \widetilde{Tw^{-\theta}} \cdot \widehat{\tau_{cd}^{-\theta}} && (29) \\ &= \widehat{\Phi}_d - \widehat{T_c w_c^{-\theta}} \cdot \widehat{\tau_{cd}^{-\theta}} + e^{\widetilde{\gamma}} \cdot \widehat{\tau_{cd}^{-\theta}} && (30) \end{aligned}$$

4. Use $\widetilde{\Phi}_d$ to generate

$$\widetilde{\delta}_{d,-c} = \ln X_d - \ln \widetilde{\Phi}_{d,-c} \tag{31}$$

5. Compute

$$\ln \widetilde{X}_{cd} = \widehat{\ln \tau_{cd}^{-\theta}} + \widetilde{\gamma} + \widetilde{\delta}_{d,-c} = \widehat{\ln \tau_{cd}^{-\theta}} + \widetilde{\gamma} + \ln X_d - \ln \widetilde{\Phi}_{d,-c} \tag{32}$$

   and therefore

$$\widetilde{X}_{cd} = \exp \left\{ \widehat{\ln \tau_{cd}^{-\theta}} + \widetilde{\gamma} + \widetilde{\delta}_{d,-c} \right\}. \tag{33}$$

We use (33) to construct the instrument as described in the main text.

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Table 1: Decomposition of Changes in Labor Shares in GDP and in Manufacturing Value Added, 1995-2007

A. All sectors, percent GDP

	K income from domestic industries (1)	L income from domestic industries (2)	K income from foreign industries (3)	L income from foreign industries (4)	L income (domestic + foreign) (5)	Income from foreign industries (6)
Levels						
VfBY 1995	35.01	56.11	3.48	5.40	61.51	8.88
VfBY 2007	35.88	52.39	5.06	6.67	59.06	11.73
Changes						
Vf2007*B1995*Y1995 - VfBY 1995	0.95	-0.77	0.11	-0.29	-1.06	-0.18
Vf1995***B2007***Y1995 - VfBY 1995	-0.66	-1.53	1.13	1.07	-0.47	2.19
Vf1995*B1995***Y2007** - VfBY 1995	-0.12	-1.65	0.56	1.21	-0.44	1.77
Vf1995***B2007*Y2007** - VfBY 1995	-0.42	-2.71	1.28	1.85	-0.86	3.13
VfBY 2007 - VfBY 1995	0.87	-3.72	1.57	1.27	-2.45	2.84

B. Manufacturing industries, percent in value added

	K income from domestic industries (1)	L income from domestic industries (2)	K income from foreign industries (3)	L income from foreign industries (4)	L income (domestic + foreign) (5)	Income from foreign industries (6)
Levels						
VBY 1995	31.84	49.30	6.89	11.96	61.27	18.86
VBY 2007	32.06	41.94	10.70	15.29	57.23	25.99
Changes						
Vf2007*B1995*Y1995 - VfBY 1995	1.15	-1.02	0.36	-0.49	-1.51	-0.13
Vf1995***B2007***Y1995 - VfBY 1995	-0.88	-2.49	1.79	1.57	-0.92	3.36
Vf1995*B1995***Y2007** - VfBY 1995	-1.22	-4.12	1.82	3.52	-0.60	5.34
Vf1995***B2007*Y2007** - VfBY 1995	-1.34	-6.00	2.97	4.37	-1.63	7.34
VfBY 2007 - VfBY 1995	0.22	-7.36	3.81	3.32	-4.04	7.13

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. Column 5 reports the overall labor share (columns 2 + 4). Column 6 reports the share of income accruing from serving foreign industries. 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. 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: Sources of Compositional Changes in Payments to Labor

A. All sectors

	1995, Percent in GDP			Δ1995-2007		
	Income from domestic industries	Income from foreign industries	Domestic + foreign	Income from domestic industries	Income from foreign industries	Domestic + foreign
	(1)	(2)	(3)	(4)	(5)	(6)
Value chains						
Domestic (Bd)	55.99	0	55.99	-1.59	0	-1.59
Bilateral trade (Bx)	0	4.52	4.52	0	0.42	0.42
Complex GVCs (Bg)	0.12	0.88	1.00	0.05	0.64	0.70
Total (B)	56.11	5.40	61.51	-1.53	1.07	-0.47
Sources of demand						
Domestic (Yd)	52.55	4.48	57.03	-2.45	0.75	-1.71
Foreign (Yf)	3.56	0.92	4.48	0.80	0.46	1.27
Total (Y)	56.11	5.40	61.51	-1.65	1.21	-0.44

B. Manufacturing

	1995, Percent in GDP			Δ1995-2007		
	Income from domestic industries	Income from foreign industries	Domestic + foreign	Income from domestic industries	Income from foreign industries	Domestic + foreign
	(1)	(2)	(3)	(4)	(5)	(6)
Value chains						
Domestic (Bd)	48.99	0	48.99	-2.64	0	-2.64
Bilateral trade (Bx)	0	9.91	9.91	0	0.30	0.30
Complex GVCs (Bg)	0.31	2.06	2.37	0.15	1.27	1.42
Total (B)	49.30	11.96	61.27	-2.49	1.57	-0.92
Sources of demand						
Domestic (Yd)	39.51	9.61	49.11	-6.43	2.24	-4.19
Foreign (Yf)	9.80	2.36	12.15	2.31	1.28	3.59
Total (Y)	49.30	11.96	61.27	-4.12	3.52	-0.60

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 in columns 1-3 report labor shares in GDP that are paid by domestic industries, foreign industries, and overall in 1995; these are the same numbers in columns 2, 4 and 5 in Table 1. The "Total" rows in columns 4-6 report the changes in the same concepts. The rows above the "Total" rows indicate the contributions of sub-components of either B or Y to levels in columns 1-3 or to changes in columns 4-6. All numbers are weighted averages using GDP in 1995 as weights. Source: authors' calculations based on WIOD 2013 release.

Table 3. Changes in Labor Shares and Forward GVC Integration in 1995-2014

	Dependent variable: Δ labor share						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. Manufacturing industries							
Δ forward intensity	-0.276**	-0.224*	-0.313**	-0.321**	-0.365**	-0.296***	-0.429***
	(0.118)	(0.105)	(0.110)	(0.123)	(0.123)	(0.053)	(0.080)
Δ backward intensity	-0.159	-0.137	-0.228	-0.179	-0.259	-0.217	-0.287
	(0.179)	(0.171)	(0.198)	(0.190)	(0.225)	(0.206)	(0.298)
Δ exports of final goods intensity	0.031	0.049	0.066	0.077	0.115	0.130*	0.135
	(0.090)	(0.068)	(0.063)	(0.096)	(0.087)	(0.067)	(0.096)
Δ imports of final goods intensity	0.015	0.015	0.013	0.013	0.012	0.013	0.022
	(0.015)	(0.013)	(0.013)	(0.015)	(0.012)	(0.010)	(0.013)
Δ log relative price of investment	-0.006	0.006	-0.017	-0.006	-0.017	0.002	0.012
	(0.050)	(0.057)	(0.061)	(0.051)	(0.061)	(0.075)	(0.075)
Fixed effects	-	Per	Cty	Ind	Cty, Ind	Cty, Ind, Per	Cty-Ind, Per
Observations	1,532	1,532	1,532	1,532	1,532	1,532	1,522
R-squared	0.026	0.079	0.117	0.044	0.135	0.185	0.301
B. Private sector industries							
Δ forward intensity	-0.167***	-0.134***	-0.201**	-0.192**	-0.230**	-0.192**	-0.283**
	(0.060)	(0.047)	(0.089)	(0.082)	(0.098)	(0.073)	(0.107)
Δ backward intensity	-0.132	-0.097	-0.163	-0.122	-0.145	-0.104	-0.153
	(0.113)	(0.096)	(0.140)	(0.136)	(0.158)	(0.133)	(0.149)
Δ exports of final goods intensity	0.070	0.058	0.065	0.093	0.090	0.079	0.126
	(0.094)	(0.083)	(0.097)	(0.118)	(0.119)	(0.104)	(0.129)
Δ imports of final goods intensity	0.011	0.011	0.010	0.010	0.008	0.009	0.013*
	(0.008)	(0.007)	(0.007)	(0.006)	(0.006)	(0.005)	(0.007)
Δ log relative price of investment	-0.008	0.001	-0.002	-0.008	-0.001	0.013	0.019
	(0.027)	(0.033)	(0.033)	(0.027)	(0.032)	(0.043)	(0.044)
Fixed effects	-	Per	Cty	Ind	Cty, Ind	Cty, Ind, Per	Cty-Ind, Per
Observations	3,270	3,270	3,270	3,270	3,270	3,270	3,241
R-squared	0.010	0.041	0.049	0.047	0.086	0.116	0.310

Notes. The dependent variable is changes in country-industry specific labor shares in three periods: 1995-2001, 2001-2007, 2007-2014. Δ forward is the change in intermediate inputs exports intensity in value added (forward GVC integration), Δ backward is the change in importing of intermediate inputs intensity in total input purchases, Δ exports of final goods is the change in export intensity of final goods in value added, and Δ imports of final goods is the change in import intensity of final goods in domestic absorption. Δ log relative price of investment is the country-level log change in investment prices. All regressions are weighted by value added in 1995 as weights. A constant is always included but not reported. Robust standard errors in parentheses are computed by two-way clustering by country and by industry. *** p<0.01, ** p<0.05, * p<0.1.

Table 4. Changes in Labor Shares and Forward GVC Integration in 1995-2014: W2SLS

	Dependent variable: Δ labor share					
	(1)	(2)	(3)	(4)	(5)	(6)
	Manufacturing industries			Private sector industries		
	WLS	W2SLS	1st stage	WLS	W2SLS	1st stage
Δ forward intensity	-0.429***	-0.685***		-0.283**	-0.305**	
	(0.080)	(0.115)		(0.107)	(0.145)	
Δ backward intensity	-0.287	-0.399	-0.292***	-0.153	-0.160	-0.194***
	(0.298)	(0.306)	(0.082)	(0.149)	(0.153)	(0.055)
Δ exports of final goods intensity	0.135	0.188	0.072	0.126	0.132	0.135*
	(0.096)	(0.109)	(0.050)	(0.129)	(0.139)	(0.068)
Δ imports of final goods intensity	0.022	0.024*	0.006	0.013*	0.013*	0.006
	(0.013)	(0.013)	(0.004)	(0.007)	(0.007)	(0.003)
Δ log relative price of investment	0.012	0.029	0.022	0.019	0.020	-0.001
	(0.075)	(0.074)	(0.017)	(0.044)	(0.043)	(0.014)
Δ Z			0.124***			0.080***
			(0.026)			(0.017)
Fixed effects: Cty-Ind, Period	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1522	1,522	1,522	3,241	3,241	3,241
R-squared	0.301		0.744	0.310		0.651
Kleibergen-Paap F statistic		23.29			21.53	

Notes. The dependent variable is changes in country-industry specific labor shares in three periods: 1995-2001, 2001-2007, 2007-2014. Δ forward is the change in intermediate inputs exports intensity in value added (forward GVC integration). The instrument Δ Z is constructed by eliminating home-country and industry sources of variation from Δ forward in a gravity relationship; see text for complete details. Δ backward is the change in importing of intermediate inputs intensity in total input purchases, Δ exports of final goods is the change in export intensity of final goods in value added, and Δ imports of final goods is the change in import intensity of final goods in domestic absorption. Δ log relative price of investment is the country-level log change in investment prices. All regressions are weighted by value added in 1995 as weights. A constant is always included but not reported. Robust standard errors in parentheses are computed by two-way clustering by country and by industry. *** p<0.01, ** p<0.05, * p<0.1.

Table 5. Changes in Labor Shares and Forward GVC Integration in 1995-2014: period splits, China and assembly offshoring

	Dependent variable: Δ labor share									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Manufacturing industries					Private sector industries				
Δ forward intensity	-0.429***					-0.283**				
	(0.080)					(0.107)				
1995-2001		-0.160					-0.152			
		(0.247)					(0.239)			
2001-2007		-1.038***					-0.815***			
		(0.271)					(0.232)			
2007-2014		0.479					0.181			
		(0.391)					(0.183)			
Δ forward intensity to China			-1.582**					-1.266**		
			(0.698)					(0.551)		
1995-2001				-0.616					-1.625***	
				(0.442)					(0.454)	
2001-2007				-1.744**					-1.624***	
				(0.679)					(0.490)	
2007-2014				2.154					0.568	
				(1.519)					(0.447)	
Δ forward intensity to RoW			-0.220					-0.183		
			(0.196)					(0.114)		
1995-2001				-0.082					-0.055	
				(0.279)					(0.235)	
2001-2007				-0.769***					-0.649***	
				(0.234)					(0.177)	
2007-2014				0.310					0.087	
				(0.338)					(0.155)	
Δ forward intensity, net of assembly offshoring					-0.379***					-0.308***
					(0.051)					(0.094)
Δ backward intensity	-0.287	-0.201	-0.276	-0.200	-0.305	-0.153	-0.112	-0.156	-0.123	-0.180
	(0.298)	(0.301)	(0.312)	(0.286)	(0.317)	(0.149)	(0.162)	(0.153)	(0.166)	(0.148)
Δ exports of final goods intensity	0.135	0.017	0.074	-0.016	0.381***	0.126	0.029	0.088	0.038	0.347**
	(0.096)	(0.046)	(0.091)	(0.069)	(0.084)	(0.129)	(0.099)	(0.124)	(0.106)	(0.160)
Δ imports of final goods intensity	0.022	0.019*	0.022*	0.017	0.027*	0.013*	0.012**	0.012*	0.012**	0.015*
	(0.013)	(0.010)	(0.012)	(0.010)	(0.015)	(0.007)	(0.006)	(0.007)	(0.006)	(0.008)
Δ log relative price of investment	0.012	0.006	0.012	0.009	0.009	0.019	0.022	0.017	0.020	0.021
	(0.075)	(0.066)	(0.073)	(0.068)	(0.072)	(0.044)	(0.042)	(0.043)	(0.041)	(0.044)
Fixed effects: Cty-Ind, Period	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,522	1,522	1,522	1,522	1,483	3,241	3,241	3,241	3,241	3,160
R-squared	0.301	0.395	0.323	0.412	0.313	0.310	0.346	0.319	0.354	0.320

Notes. The dependent variable is changes in country-industry specific labor shares in three periods: 1995-2001, 2001-2007, 2007-2014. Δ forward is the change in intermediate inputs exports intensity in value added (forward GVC integration). In columns 2 and 7 we split Δ forward by period; in columns 3 and 8 we split by shipments to China and the Rest of the World (RoW); and in columns 4 and 9 we split by both period and destination of shipments (China, RoW). In columns 5 and 10 Δ forward net of assembly offshoring is the change in intermediate inputs exports intensity in value added that excludes exports of final goods; we drop the bottom and top percentiles of this variable to avoid extreme outliers that are driven by deducting exports of final goods from value added in the denominator. Δ backward is the change in offshoring of intermediate inputs intensity in total input purchases, Δ exports of final goods is the change in export intensity of final goods in value added, and Δ imports of final goods is the change in import intensity of final goods in domestic absorption. Δ log relative price of investment is the country-level log change in investment prices. All regressions are weighted by value added in 1995 as weights. A constant is always included but not reported. Robust standard errors in parentheses are computed by two-way clustering by country and by industry. *** p<0.01, ** p<0.05, * p<0.1.

Table 6. Changes in Labor Shares and Forward GVC Integration in 1995-2014: Country level regressions

	Dependent variable: Δ labor share					
	(1)	(2)	(3)	(4)	(5)	(6)
A. Manufacturing industries						
	WLS				W2SLS	1st stage
Δ forward intensity	-0.652***	-0.560***	-0.802***	-0.679**	-1.245***	
	(0.193)	(0.202)	(0.261)	(0.314)	(0.278)	
Δ backward intensity	-0.541	-0.595	-0.562	-0.616	-0.466	-0.213
	(0.538)	(0.440)	(0.624)	(0.610)	(0.688)	(0.308)
Δ exports of final goods intensity	-0.085	-0.055	-0.171	-0.122	-0.070	0.324
	(0.455)	(0.453)	(0.490)	(0.522)	(0.572)	(0.250)
Δ imports of final goods intensity	0.357	0.395*	0.268	0.378*	0.287	0.068
	(0.246)	(0.223)	(0.246)	(0.196)	(0.238)	(0.100)
Δ log relative price of investment	-0.014	0.013	0.005	0.042	0.009	0.023
	(0.054)	(0.063)	(0.071)	(0.079)	(0.075)	(0.020)
Δ Z						0.049***
						(0.008)
Fixed effects	-	Per	Cty	Cty, Per	Cty	Cty
Observations	117	117	117	117	117	117
R-squared	0.208	0.319	0.448	0.546		0.729
Kleibergen-Paap F statistic					42.69	
B. Private sector industries						
	WLS				W2SLS	1st stage
Δ forward intensity	-0.449**	-0.372*	-0.498*	-0.387	-1.037*	
	(0.179)	(0.184)	(0.264)	(0.249)	(0.565)	
Δ backward intensity	0.024	-0.052	0.120	0.047	0.259	-0.019
	(0.252)	(0.284)	(0.412)	(0.410)	(0.377)	(0.157)
Δ exports of final goods intensity	-0.591	-0.649	-0.975*	-1.019**	-0.545	0.752***
	(0.389)	(0.393)	(0.543)	(0.487)	(0.650)	(0.241)
Δ imports of final goods intensity	0.117	0.329	-0.175	0.099	-0.110	0.216
	(0.324)	(0.329)	(0.351)	(0.306)	(0.383)	(0.233)
Δ log relative price of investment	0.011	0.020	0.038	0.044	0.042	0.013
	(0.024)	(0.033)	(0.032)	(0.041)	(0.032)	(0.013)
Δ Z						0.022***
						(0.004)
Fixed effects	-	Per	Cty	Cty, Per	Cty	Cty
Observations	117	117	117	117	117	117
R-squared	0.169	0.262	0.396	0.471		0.687
Kleibergen-Paap F statistic					25.99	

Notes. The dependent variable is changes in country-level labor shares in three periods: 1995-2001, 2001-2007, 2007-2014. Δ forward is the change in intermediate inputs exports intensity in value added (forward GVC integration). The instrument Δ Z is constructed by eliminating home-country and industry sources of variation from Δ forward in a based on a gravity relationship; see text for complete details. Δ backward is the change in importing of intermediate inputs intensity in total input purchases, Δ exports of final goods is the change in export intensity of final goods in GDP, and Δ imports of final goods is the change in import intensity of final goods in domestic absorption. Δ log relative price of investment is the country-level log change in investment prices. All regressions are weighted by value added in 1995 as weights. A constant is always included but not reported. Robust standard errors in parentheses are clustered by country. *** p<0.01, ** p<0.05, * p<0.1.

Table 7. Factor endowments and forward GVC integration

	(1)	(2)	(3)	(4)	(5)	(6)
Estimator:	OLS	OLS	PPML	PPML	PPML	PPML
Dependent variable:	(VKBY-VLBY)/GDP, 2001	(VKBY-VLBY)/GDP, 2007	VBY, 2001	VBY, 2007	V(Bx)Y, 2007	V(Bg)Y, 2007
Relative capital abundance in 2001	0.268**		0.522**			
	(0.113)		(0.229)			
Relative capital abundance in 2007		0.317**		0.863***	1.067***	0.293***
		(0.149)		(0.208)	(0.287)	(0.101)
Log distance	0.017	0.015	-0.484***	-0.526***	-0.635***	-0.175***
	(0.022)	(0.018)	(0.071)	(0.061)	(0.075)	(0.032)
Common border	-0.093	-0.023	0.155	0.143	0.190	-0.302***
	(0.057)	(0.073)	(0.108)	(0.107)	(0.124)	(0.070)
Colonial ties	-0.011	-0.045	0.174	0.153	0.213	0.018
	(0.057)	(0.060)	(0.115)	(0.107)	(0.135)	(0.032)
Common language	0.038	0.053	0.242**	0.315***	0.399**	0.016
	(0.067)	(0.070)	(0.117)	(0.116)	(0.157)	(0.038)
Free trade agreement	0.017	0.080*	0.259	0.099	0.084	0.127***
	(0.024)	(0.043)	(0.163)	(0.121)	(0.151)	(0.047)
Common currency	-0.032	-0.056*	0.084	0.044	0.077	0.198***
	(0.029)	(0.028)	(0.137)	(0.145)	(0.187)	(0.065)

Notes. The dependent variables in all columns pertain to (value added) income accruing to primary factors located in origin country o due to exports of intermediate inputs that are part of GVCs that end in final good production in destination country d. In columns 1-2 it is income accruing to capital located in o minus income accruing to labor in o, as a share of GDP in o; in columns 3-4 it is the total income flow of this type; in column 5 it is income due to direct bilateral exports of intermediate inputs [V(Bx)Y]; in column 6 it is income due to flows that pass through at least one other country, not o and not d, i.e., complex GVCs [V(Bg)Y]. Income flows calculated from WIOD 2013. Relative capital abundance of o relative to d is described in the text. All regressions estimated on 1,482 observations (=39*38, where 39 is the number of countries in our sample), and include origin and destination fixed effects. Robust standard errors in parentheses are computed by two-way clustering by origin and by destination. *** p<0.01, ** p<0.05, * p<0.1.

Table 8. Upstreamness and Labor Shares, 2001-2007

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Manufacturing industries								
	Dependent variable: labor share						Dependent variable: Δ labor share	
Upstreamness	-0.041	-0.136	-0.125*				-0.128*	
	(0.047)	(0.081)	(0.069)				(0.064)	
	[-0.132]	[-0.438]	[-0.402]				[-0.210]	
Domestic				-0.085**	-0.020	-0.028		0.036
				(0.038)	(0.042)	(0.049)		(0.041)
				[-0.217]	[-0.052]	[-0.071]		[0.055]
Foreign				0.059	-0.240***	-0.232***		-0.227***
				(0.065)	(0.060)	(0.064)		(0.043)
				[0.141]	[-0.575]	[-0.555]		[-0.347]
Downstreamness	-0.109	-0.007	0.042	-0.091	0.029	0.035	-0.035	-0.059
	(0.100)	(0.083)	(0.089)	(0.089)	(0.070)	(0.078)	(0.078)	(0.065)
	[-0.153]	[-0.010]	[0.058]	[-0.126]	[0.041]	[0.049]	[-0.046]	[-0.077]
Fixed effects	Year	Cty X Ind	Cty X Ind, Yr	Year	Cty X Ind	Cty X Ind, Yr	-	-
Observations	3,727	3,725	3,725	3,727	3,725	3,725	530	530
R-squared	0.069	0.952	0.954	0.130	0.956	0.956	0.081	0.182
B. Private sector industries								
	Dependent variable: labor share						Dependent variable: Δ labor share	
Upstreamness	0.012	-0.037	-0.024				-0.002	
	(0.082)	(0.056)	(0.053)				(0.054)	
	[0.033]	[-0.100]	[-0.066]				[-0.003]	
Domestic				0.019	0.050**	0.040		0.105***
				(0.096)	(0.023)	(0.027)		(0.021)
				[0.040]	[0.107]	[0.086]		[0.151]
Foreign				-0.005	-0.205***	-0.168***		-0.193***
				(0.075)	(0.038)	(0.045)		(0.031)
				[-0.009]	[-0.416]	[-0.341]		[-0.264]
Downstreamness	0.169	0.005	0.064	0.172	0.038	0.067	0.020	0.018
	(0.128)	(0.061)	(0.059)	(0.133)	(0.056)	(0.052)	(0.064)	(0.049)
	[0.309]	[0.010]	[0.117]	[0.314]	[0.070]	[0.123]	[0.028]	[0.026]
Fixed effects	Year	Cty X Ind	Cty X Ind, Yr	Year	Cty X Ind	Cty X Ind, Yr	-	-
Observations	7,926	7,922	7,922	7,926	7,922	7,922	1,117	1,117
R-squared	0.089	0.985	0.986	0.090	0.986	0.986	0.001	0.106

Notes. Dependent variable is always the labor share. Columns (1)-(6) report country by industry by year panel regressions in 2001-2007. Coulmns (7)-(8) report long difference regressions, where the dependent and explanatory variables are changes between 2001 and 2007. The explanatory variables are upstreamness and its domestic and foreign components, with variation that is commensurate with the dependent variable. All regressions estimated by weighted least squares with value added in 2001 as weights. Robust standard errors in parentheses are computed by two-way clustering by country and by industry. *** p<0.01, ** p<0.05, * p<0.1. Standardized, "beta" coefficients reported in brackets.

Table 9. Functional Specialization, Upstreamness and Forward Foreign GVC Integration, 2001-2007

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
A. Manufacturing												
Dependent variable:	Δ MGT	Δ R&D	Δ FAB	Δ MAR	Δ MGT	Δ R&D	Δ FAB	Δ MAR	Δ MGT	Δ R&D	Δ FAB	Δ MAR
Δ upstreamness, foreign	-0.043***	-0.009	-0.140***	-0.035***	-0.042**	0.006	-0.112***	-0.020**	-0.038***	-0.018	-0.143**	-0.029**
	(0.014)	(0.015)	(0.038)	(0.010)	(0.016)	(0.017)	(0.035)	(0.008)	(0.009)	(0.015)	(0.057)	(0.012)
Δ upstreamness, domestic	0.003	-0.006	0.029	0.010	0.009	0.004	-0.029	-0.002	-0.003	-0.010	0.026	0.013
	(0.010)	(0.014)	(0.029)	(0.010)	(0.011)	(0.013)	(0.029)	(0.010)	(0.009)	(0.013)	(0.037)	(0.014)
Δ downstreamness	-0.040*	0.016	-0.000	-0.034**	-0.041	0.009	0.041	-0.024	-0.011*	0.027***	0.026	-0.027
	(0.022)	(0.014)	(0.043)	(0.015)	(0.025)	(0.017)	(0.045)	(0.017)	(0.006)	(0.008)	(0.054)	(0.028)
Δ forward intensity	-0.167***	-0.019	-0.398***	-0.141***	-0.181**	-0.007	-0.256***	-0.102***	-0.091***	-0.018	-0.368*	-0.093*
	(0.049)	(0.047)	(0.101)	(0.038)	(0.066)	(0.058)	(0.071)	(0.029)	(0.026)	(0.032)	(0.194)	(0.045)
Fixed effects	-	-	-	-	Ind	Ind	Ind	Ind	Cty	Cty	Cty	Cty
B. All industries												
Dependent variable:	Δ MGT	Δ R&D	Δ FAB	Δ MAR	Δ MGT	Δ R&D	Δ FAB	Δ MAR	Δ MGT	Δ R&D	Δ FAB	Δ MAR
Δ upstreamness, foreign	-0.057***	0.003	-0.098***	-0.041*	-0.061***	0.012	-0.043*	-0.049	-0.035***	-0.009	-0.111**	-0.030*
	(0.018)	(0.010)	(0.029)	(0.023)	(0.022)	(0.017)	(0.021)	(0.030)	(0.012)	(0.011)	(0.043)	(0.015)
Δ upstreamness, domestic	-0.001	-0.002	0.079**	0.028*	-0.002	0.001	0.044	0.017	0.014	-0.003	0.085**	0.054***
	(0.012)	(0.005)	(0.031)	(0.016)	(0.017)	(0.006)	(0.039)	(0.014)	(0.011)	(0.004)	(0.040)	(0.015)
Δ downstreamness	0.013	0.021***	-0.052	0.037	0.008	0.010**	-0.013	0.045	0.027*	0.025***	-0.049	0.050*
	(0.015)	(0.004)	(0.034)	(0.026)	(0.021)	(0.005)	(0.029)	(0.034)	(0.015)	(0.007)	(0.030)	(0.028)
Δ forward intensity	-0.147***	0.014	-0.296***	-0.106**	-0.156***	0.015	-0.134***	-0.116*	-0.075***	0.001	-0.386***	-0.108***
	(0.040)	(0.034)	(0.088)	(0.042)	(0.048)	(0.038)	(0.043)	(0.061)	(0.014)	(0.028)	(0.127)	(0.028)
Fixed effects	-	-	-	-	Ind	Ind	Ind	Ind	Cty	Cty	Cty	Cty

Notes. The dependent variables are changes in labor income shares in value added of four categories of "functional specialization": management (MGT), R&D, fabrication (FAB), and marketing (MKT). Overall labor shares are the sum of shares over these four categories. Changes for all variables are computed for 2001-2007. The first three lines in each panel reoprt coefficients from regressions where foreign and domestic upstreamness are included, as well as downstreamness. The fourth line reports the coefficient to Δ forward, the change in intermediate inputs export and GVC intensity, from regressions where the other explanatory variables are the change in offshoring of intermediate inputs intensity in total input purchases (Δ offshoring), the change in export intensity of final goods in value added (Δ exports of final goods), the change in import intensity of final goods in total absorption (Δ imports of final goods), and the country-level log change in investment prices (Δ log relative price of investment). Regressions estimated by weighted least squares with value added in 2001 as weights. Robust standard errors in parentheses are computed by two-way clustering by country and by industry. *** p<0.01, ** p<0.05, * p<0.1.

Table 10. Multinationals and forward GVC integration

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Forward GVC integration			Direct bilateral exports of intermediate inputs			Complex global value chains		
Dependent variable:	VBY(o,d) = V(Bx)Y(o,d) + V[Bg]Y(o,d)			V(Bx)Y(o,d)			V(Bg)Y(o,d)		
arcsinh no. of affiliates in o with parents in d	0.125***		0.099***	0.161***		0.127***	0.043***		0.035**
	(0.028)		(0.024)	(0.037)		(0.031)	(0.015)		(0.014)
arcsinh no. of affiliates in d with parents in o		0.135***	0.112***		0.172***	0.141***		0.049***	0.043***
		(0.038)	(0.038)		(0.050)	(0.050)		(0.015)	(0.014)
Log distance	-0.423***	-0.407***	-0.357***	-0.500***	-0.482***	-0.419***	-0.142***	-0.133***	-0.115***
	(0.062)	(0.062)	(0.057)	(0.075)	(0.077)	(0.071)	(0.035)	(0.032)	(0.033)
Common border	0.195*	0.213**	0.206**	0.257**	0.277**	0.267**	-0.274***	-0.264***	-0.267***
	(0.106)	(0.092)	(0.091)	(0.123)	(0.108)	(0.108)	(0.070)	(0.063)	(0.063)
Colonial ties	0.077	0.082	0.041	0.111	0.119	0.068	0.016	0.016	0.000
	(0.104)	(0.098)	(0.100)	(0.128)	(0.119)	(0.124)	(0.036)	(0.037)	(0.033)
Common language	0.244**	0.237**	0.208**	0.309*	0.301**	0.263*	-0.008	-0.011	-0.021
	(0.117)	(0.108)	(0.106)	(0.158)	(0.147)	(0.144)	(0.044)	(0.042)	(0.041)
Free trade agreement	0.227*	0.231*	0.242**	0.246	0.252	0.270*	0.184***	0.185***	0.184***
	(0.126)	(0.125)	(0.119)	(0.155)	(0.154)	(0.148)	(0.054)	(0.055)	(0.050)
Common currency	-0.015	-0.013	-0.023	-0.001	0.001	-0.014	0.160**	0.159**	0.159**
	(0.148)	(0.139)	(0.139)	(0.190)	(0.179)	(0.179)	(0.067)	(0.065)	(0.065)

Notes. The dependent variables are all (value added) income accruing to primary factors located in origin country o due to exports of intermediate inputs that are part of GVCs that end in final good production in destination country d. In columns 1-3 it is the total income flow of this type; in columns 4-6 it is income due to direct bilateral exports of intermediate inputs [V(Bx)Y]; in columns 7-9 it is income due to flows that pass through at least one other country, not o and not d, i.e., complex GVCs [V(Bg)Y]. Income flows calculated from WIOD 2013 release in 2007. The number of affiliates are averages in 1996-2001 from Ramondo, Rodriguez-Clare and Tintelnot (2015), and other variables from the CEPII gravity dataset. The arcsinh(x) = ln[x + (1+x^2)^0.5] is the inverse hyperbolic sine function that approximates , All regressions are estimated on 1122 observations (=34*33, where 34 is the number of countries in this sample after merging the data on the number of affiliates) using PPML, and include origin and destination fixed effects. Robust standard errors in parentheses are computed by two-way clustering by origin and by destination. *** p<0.01, ** p<0.05, * p<0.1.

APPENDIX TABLES

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

	Labor Shares in GDP			High Skill Labor Shares in GDP		
Country	1995	2007	Change	1995	2007	Change
AUS	62.8	60.1	-2.7	14.1	17.9	3.9
AUT	69.7	63.6	-6.0	14.3	18.0	3.7
BEL	67.3	65.6	-1.7	14.1	17.2	3.1
BGR	53.7	50.1	-3.5	8.1	11.1	3.0
BRA	53.1	59.1	6.0	20.1	24.6	4.5
CAN	58.8	57.5	-1.3	14.1	18.1	3.9
CHN	54.7	42.0	-12.6	2.1	5.2	3.1
CYP	62.5	64.4	1.9	28.2	30.7	2.5
CZE	43.6	59.6	16.0	8.6	15.3	6.6
DEU	68.2	62.8	-5.5	22.1	24.1	2.1
DNK	65.8	69.3	3.5	19.0	25.3	6.2
ESP	65.0	61.2	-3.8	22.9	26.8	3.9
EST	65.0	59.0	-6.0	31.1	25.7	-5.4
FIN	67.0	62.8	-4.3	25.1	28.3	3.1
FRA	63.6	62.1	-1.6	21.7	25.4	3.8
GBR	67.3	68.5	1.2	21.9	30.3	8.4
GRC	50.2	57.4	7.2	14.3	20.8	6.5
HUN	64.3	60.4	-3.9	18.2	23.8	5.6
IDN	50.6	46.4	-4.3	5.8	11.6	5.8
IND	56.6	50.9	-5.7	10.0	13.8	3.8
IRL	62.3	57.1	-5.2	17.6	26.6	9.0
ITA	67.0	64.4	-2.5	10.1	13.8	3.7
JPN	60.3	56.6	-3.8	17.7	21.7	4.0
KOR	81.1	72.5	-8.6	36.5	44.3	7.8
LTU	48.7	54.3	5.6	20.3	24.0	3.7
LUX	56.1	50.3	-5.8	14.4	20.0	5.6
LVA	55.8	58.1	2.3	21.1	21.9	0.8
MEX	35.0	32.2	-2.7	9.9	8.0	-1.9
MLT	57.5	58.2	0.7	12.1	16.6	4.5
NLD	67.3	64.6	-2.7	17.9	25.6	7.6
PRT	65.0	64.9	-0.1	13.5	17.2	3.7
ROU	58.4	62.4	4.0	6.8	10.2	3.4
RUS	58.0	58.9	0.9	11.6	16.0	4.4
SVK	37.4	37.7	0.4	7.6	9.9	2.2
SVN	84.0	69.5	-14.5	22.6	26.0	3.5
SWE	64.8	65.3	0.5	15.8	22.5	6.7
TUR	33.3	37.7	4.4	5.9	10.3	4.5
TWN	65.2	56.5	-8.7	20.3	23.9	3.6
USA	60.2	59.3	-0.9	22.0	26.6	4.6
Average	59.67	58.03	-1.64	16.40	20.49	4.09
Weighted average	61.51	59.06	-2.45	18.83	23.09	4.26

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

	Labor Shares in GDP			High Skill Labor Shares in GDP		
Country	2007	2014	Change	2008	2014	Change
AUS	58.1	57.7	-0.4			
AUT	57.3	60.9	3.6	15.2	17.7	2.4
BEL	61.8	64.1	2.2			
BGR	47.9	63.3	15.5	14.4	19.5	5.1
BRA	48.6	55.1	6.5			
CAN	59.4	58.2	-1.3			
CHN	45.4	55.1	9.6			
CYP	54.9	54.6	-0.3	25.8	30.0	4.1
CZE	50.4	51.3	0.9	10.7	11.5	0.9
DEU	58.9	62.4	3.5	21.4	18.9	-2.5
DNK	65.3	64.5	-0.8	23.8	25.6	1.8
ESP	60.7	58.7	-2.0	23.8	28.5	4.7
EST	53.8	54.8	1.0	24.3	22.3	-2.0
FIN	58.5	64.4	5.8	24.8	31.1	6.4
FRA	60.9	65.0	4.1	23.1	27.5	4.4
GBR	67.1	64.9	-2.3	19.8	24.4	4.5
GRC	53.6	49.6	-4.0	14.3	18.1	3.7
HUN	56.7	53.7	-3.0	21.4	22.1	0.8
IDN	48.3	48.5	0.2			
IND	47.6	49.7	2.1			
IRL	53.9	48.8	-5.0	22.4	24.3	1.9
ITA	56.5	58.7	2.2	10.1	9.5	-0.6
JPN	58.0	58.3	0.4			
KOR	64.1	63.8	-0.3			
LTU	54.4	48.8	-5.6	24.5	27.4	2.9
LUX	54.9	59.4	4.5	23.9	30.6	6.7
LVA	54.7	53.0	-1.7	21.2	23.0	1.8
MEX	33.6	33.0	-0.7			
MLT	60.6	58.4	-2.2			
NLD	59.9	62.1	2.2	21.6	20.5	-1.1
POL	49.4	49.8	0.3	15.1	16.5	1.4
PRT	60.6	56.7	-3.9	13.1	18.9	5.9
ROU	45.4	43.5	-1.9	14.4	12.9	-1.5
RUS	56.9	63.2	6.3			
SVK	46.0	48.7	2.7	9.8	10.2	0.4
SVN	63.2	65.6	2.5	26.9	26.1	-0.8
SWE	54.0	57.0	3.0	19.3	25.9	6.6
TUR	37.3	37.9	0.6			
USA	57.8	56.3	-1.5			
Average	54.8	55.9	1.1	19.4	21.7	2.3
Weighted average	56.4	57.4	1.0	19.4	21.3	1.9

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		
	1995	2007	Change	1995	2007	Change
AUS	13.2	15.0	1.8	10.5	10.3	-0.2
AUT	16.0	23.3	7.3	14.9	20.3	5.4
BEL	24.3	26.8	2.5	23.2	26.1	2.8
BGR	15.8	23.2	7.5	21.1	32.0	11.0
BRA	5.2	8.5	3.3	5.1	7.6	2.5
CAN	18.7	18.7	0.0	14.6	13.9	-0.7
CHN	8.7	14.2	5.5	11.2	16.5	5.3
CYP	7.3	10.1	2.8	17.8	17.9	0.1
CZE	22.3	26.2	3.8	23.7	30.0	6.3
DEU	11.0	19.6	8.6	9.2	15.1	5.9
DNK	13.2	19.2	6.0	13.6	19.8	6.2
ESP	7.7	9.7	2.0	11.0	15.1	4.1
EST	23.3	24.6	1.3	28.7	26.0	-2.8
FIN	20.3	22.7	2.4	14.8	18.7	3.9
FRA	10.2	10.3	0.1	9.7	12.1	2.4
GBR	13.4	14.5	1.2	12.3	12.3	0.0
GRC	3.4	8.7	5.4	10.9	15.3	4.4
HUN	16.5	24.8	8.3	22.8	32.3	9.5
IDN	13.5	19.1	5.6	13.1	14.3	1.2
IND	5.8	9.5	3.7	7.9	14.5	6.6
IRL	23.0	31.5	8.5	28.4	32.1	3.7
ITA	9.9	11.4	1.5	11.3	14.4	3.1
JPN	5.2	9.6	4.4	3.7	8.1	4.4
KOR	13.4	18.1	4.7	15.3	19.3	4.0
LTU	18.0	20.9	2.9	23.6	21.5	-2.1
LUX	43.1	48.1	5.0	25.0	40.0	15.0
LVA	22.0	17.8	-4.1	20.7	22.1	1.4
MEX	12.1	12.7	0.6	13.2	13.7	0.5
MLT	19.5	28.2	8.6	28.9	30.1	1.2
NLD	21.5	23.3	1.8	20.3	21.8	1.5
PRT	9.4	12.3	2.9	16.5	17.0	0.5
ROU	11.9	14.5	2.6	15.9	19.5	3.7
RUS	19.8	23.1	3.4	7.5	8.0	0.6
SVK	27.0	26.9	0.0	23.4	32.1	8.7
SVN	16.8	22.3	5.5	21.8	26.6	4.8
SWE	18.8	22.8	4.0	15.8	19.4	3.6
TUR	4.5	6.4	1.9	9.4	14.5	5.1
TWN	17.0	28.7	11.7	20.1	22.2	2.1
USA	6.0	6.2	0.2	5.1	7.1	2.1
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	2014	Change	2007	2014	Change	2007
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
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
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
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	17.4	19.3	1.9	18.7	19.8	1.1	
Weighted average	10.9	11.5	0.6	11.2	11.5	0.4	

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

Table A5: Decomposition of Changes in Labor Shares in GDP and in Manufacturing Value Added, 2007-2014

A. All sectors, percent in GDP

	K income from domestic industries	L income from domestic industries	K income from foreign industries	L income from foreign industries	L income (domestic + foreign)	Income from foreign industries
	(1)	(2)	(3)	(4)	(5)	(6)
Levels						
VBY 2007	38.4	50.7	5.3	5.7	56.38	10.96
VBY 2014	37.4	51.1	5.2	6.3	57.41	11.56
Changes						
V2014*B2007*Y2007 - VBY 2007	-1.04	1.03	-0.29	0.30	1.33	0.01
V2007***B2014***Y2007 - VBY 2007	-0.26	-0.08	0.28	0.06	-0.02	0.34
V2007*B2007***Y2014** - VBY 2007	-0.19	-0.84	0.34	0.68	-0.16	1.03
V2007***B2014*****Y2014** - VBY 2007	-0.11	-0.50	0.25	0.35	-0.15	0.60
VBY 2014 - VBY 2007	-1.01	0.41	-0.02	0.62	1.03	0.60

B. Manufacturing inductries, percent in value added

	K income from domestic industries	L income from domestic industries	K income from foreign industries	L income from foreign industries	L income (domestic + foreign)	Income from foreign industries
	(1)	(2)	(3)	(4)	(5)	(6)
Levels						
VBY 2007	37.5	39.4	11.0	12.1	51.51	23.07
VBY 2014	35.5	39.6	11.0	13.9	53.52	24.84
Changes						
V2014*B2007*Y2007 - VBY 2007	-1.87	1.84	-0.84	0.87	2.71	0.03
V2007***B2014***Y2007 - VBY 2007	-0.64	-0.16	0.87	-0.08	-0.24	0.79
V2007*B2007***Y2014** - VBY 2007	-0.59	-2.01	0.82	1.78	-0.23	2.61
V2007***B2014*****Y2014** - VBY 2007	-0.42	-1.38	0.89	0.90	-0.48	1.80
VBY 2014 - VBY 2007	-2.03	0.25	0.01	1.76	2.01	1.77

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. Column 5 reports the overall labor share (columns 2 + 4). Column 6 reports the share of income accruing from serving foreign industries. 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. 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 A6: Sources of Compositional Changes in Payments to Labor

A. All sectors

	2007, Percent in GDP			Δ2007-2014		
	Income from domestic industries	Income from foreign industries	Domestic + foreign	Income from domestic industries	Income from foreign industries	Domestic + foreign
	(1)	(2)	(3)	(4)	(5)	(6)
Value chains						
Domestic (Bd)	50.54	0	50.54	-0.09	0	-0.09
Bilateral trade (Bx)	0	4.43	4.43	0	0.01	0.01
Complex GVCs (Bg)	0.14	1.27	1.41	0.01	0.05	0.06
Total (B)	50.68	5.71	56.38	-0.08	0.06	-0.02
Sources of demand						
Domestic (Yd)	46.60	4.46	51.06	-0.71	0.69	-0.02
Foreign (Yf)	4.08	1.24	5.32	-0.13	-0.01	-0.14
Total (Y)	50.68	5.71	56.38	-0.84	0.68	-0.16

B. Manufacturing

	2007, Percent in GDP			Δ2007-2014		
	Income from domestic industries	Income from foreign industries	Domestic + foreign	Income from domestic industries	Income from foreign industries	Domestic + foreign
	(1)	(2)	(3)	(4)	(5)	(6)
Value chains						
Domestic (Bd)	39.04	0	39.04	-0.17	0	-0.17
Bilateral trade (Bx)	0	9.34	9.34	0	-0.06	-0.06
Complex GVCs (Bg)	0.35	2.78	3.13	0.01	-0.02	-0.01
Total (B)	39.39	12.12	51.51	-0.16	-0.08	-0.24
Sources of demand						
Domestic (Yd)	28.63	9.02	37.65	-1.27	1.74	0.47
Foreign (Yf)	10.76	3.09	13.86	-0.74	0.04	-0.70
Total (Y)	39.39	12.12	51.51	-2.01	1.78	-0.23

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 in columns 1-3 report labor shares in GDP that are paid by domestic industries, foreign industries, and overall in 2007; these are the same numbers in columns 2, 4 and 5 in Table A5. The "Total" rows in columns 4-6 report the changes in the same concepts. The rows above the "Total" rows indicate the contributions of sub-components of either B or Y to levels in columns 1-3 or to changes in columns 4-6. Source: authors' calculations based on WIOD 2013 release.

Table A7. Descriptive statistics, 1995-2014

	mean	Std.Err.	p25	p50	p75	IQR
A. Manufacturing industries (N = 1532)						
Δ labor share	0.001	0.084	-0.052	-0.002	0.049	0.100
Δ forward intensity	0.031	0.048	0.002	0.025	0.050	0.048
- to China	0.010	0.016	0.001	0.005	0.013	0.012
- to RoW	0.021	0.041	0.001	0.017	0.040	0.039
- net of assembly offshoring	0.044	0.069	0.006	0.032	0.078	0.071
- absorbed in destination	0.032	0.053	0.002	0.022	0.063	0.062
- re-exported	0.012	0.023	0.001	0.009	0.022	0.021
Δ backward intensity	0.011	0.026	-0.001	0.008	0.020	0.021
Δ exports of final goods intensity	0.009	0.041	-0.001	0.004	0.018	0.019
Δ imports of final goods intensity	0.046	0.234	0.006	0.036	0.085	0.080
Δ log relative price of investment	-0.067	0.143	-0.158	-0.072	0.004	0.163
B. All private sector industries (N = 3270)						
Δ labor share	0.000	0.070	-0.033	-0.001	0.035	0.068
Δ forward intensity	0.016	0.038	-0.001	0.007	0.026	0.027
- to China	0.005	0.010	0.000	0.002	0.005	0.005
- to RoW	0.011	0.034	-0.002	0.004	0.019	0.021
- net of assembly offshoring	0.020	0.048	-0.001	0.009	0.029	0.030
- absorbed in destination	0.014	0.038	-0.001	0.005	0.021	0.022
- re-exported	0.005	0.014	0.000	0.002	0.008	0.008
Δ backward intensity	0.011	0.023	0.000	0.008	0.020	0.020
Δ exports of final goods intensity	0.003	0.023	0.000	0.000	0.004	0.004
Δ imports of final goods intensity	0.015	0.179	0.000	0.001	0.014	0.014
Δ log relative price of investment	-0.064	0.139	-0.116	-0.080	0.004	0.120
C. Manufacturing (N = 117)						
Δ labor share	-0.006	0.057	-0.052	-0.005	0.031	0.082
Δ forward intensity	0.031	0.035	0.014	0.027	0.049	0.036
Δ backward intensity	0.012	0.015	0.008	0.013	0.023	0.015
Δ exports of final goods intensity	0.009	0.024	0.003	0.009	0.015	0.012
Δ imports of final goods intensity	0.047	0.045	0.032	0.051	0.073	0.041
Δ log relative price of investment	-0.067	0.143	-0.158	-0.072	0.004	0.163
D. Entire economy (N = 117)						
Δ labor share	-0.006	0.028	-0.021	-0.013	0.012	0.033
Δ forward intensity	0.012	0.020	0.002	0.008	0.014	0.013
Δ backward intensity	0.012	0.014	0.004	0.012	0.023	0.020
Δ exports of final goods intensity	0.002	0.010	-0.002	0.001	0.008	0.010
Δ imports of final goods intensity	0.006	0.012	-0.005	0.007	0.012	0.016
Δ log relative price of investment	-0.064	0.139	-0.116	-0.080	0.004	0.120

Notes. Statistics are for changes in country-industry specific variables (panels A and B) or in country specific variables (panels C and D), in three periods: 1995-2001, 2001-2007, 2007-2014. Δ labor shares is the change in labor compensation ratio in value added. Δ forward is the change in intermediate inputs exports intensity in value added (forward GVC integration). Δ forward net of assembly offshoring is the change in intermediate inputs exports intensity in value added that excludes exports of final goods. Δ forward absorbed in destination is the part of Δ forward net of assembly offshoring value added that cross borders only once and is absorbed in the direct destination country. Δ forward re-exported is the part of Δ forward net of assembly offshoring value added that is embodied in exports of the destination country, i.e. complex GVCs that cross borders more than once. Δ backward is the change in importing of intermediate inputs intensity in total input purchases, Δ exports of final goods is the change in export intensity of final goods in value added, and Δ imports of final goods is the change in import intensity of final goods in domestic absorption. Δ log relative price of investment is the country-level log change in investment prices. IQR = p75-p25 is the inter-quartoile range.

Table A8. Changes in Labor Shares and Forward GVC Integration in 1995-2014, W2SLS

	Dependent variable: Δ labor share													
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
A. Manufacturing industries														
	W2SLS	1st stage	W2SLS	1st stage	W2SLS	1st stage	W2SLS	1st stage	W2SLS	1st stage	W2SLS	1st stage	W2SLS	1st stage
Δ forward intensity	-0.857***		-0.439***		-1.001**		-0.913***		-1.054**		-0.601***		-0.685***	
	(0.266)		(0.139)		(0.337)		(0.289)		(0.351)		(0.108)		(0.115)	
Δ backward intensity	-0.348	-0.385***	-0.222	-0.337***	-0.474	-0.389***	-0.402	-0.403***	-0.531	-0.404***	-0.355	-0.288***	-0.399	-0.292***
	(0.239)	(0.084)	(0.171)	(0.084)	(0.273)	(0.074)	(0.269)	(0.092)	(0.310)	(0.077)	(0.209)	(0.078)	(0.306)	(0.082)
Δ exports of final goods intensity	0.120	0.135***	0.088	0.097**	0.133	0.081	0.199*	0.169***	0.212*	0.110*	0.180**	0.048	0.188	0.072
	(0.103)	(0.044)	(0.082)	(0.039)	(0.090)	(0.056)	(0.108)	(0.049)	(0.112)	(0.055)	(0.079)	(0.042)	(0.109)	(0.050)
Δ imports of final goods intensity	0.022	0.011	0.018	0.010	0.017	0.007	0.019	0.010	0.015	0.005	0.015	0.005	0.024*	0.006
	(0.020)	(0.007)	(0.014)	(0.006)	(0.016)	(0.006)	(0.019)	(0.006)	(0.014)	(0.005)	(0.011)	(0.004)	(0.013)	(0.004)
Δ log relative price of investment	0.019	0.056***	0.023	0.030*	0.002	0.047**	0.016	0.053***	0.001	0.046**	0.023	0.021	0.029	0.022
	(0.054)	(0.018)	(0.057)	(0.014)	(0.065)	(0.021)	(0.055)	(0.017)	(0.065)	(0.021)	(0.073)	(0.016)	(0.074)	(0.017)
Δ Z		0.057***		0.126***		0.052***		0.056***		0.051***		0.128***		0.124***
		(0.007)		(0.023)		(0.007)		(0.007)		(0.006)		(0.024)		(0.026)
Fixed effects	-	-	Per	Per	Cty	Cty	Ind	Ind	Cty, Ind	Cty, Ind	Cty, Ind, Per	Cty, Ind, Per	Cty-Ind, Per	Cty-Ind, Per
Observations	1,532	1,532	1,532	1,532	1,532	1,532	1,532	1,532	1,532	1,532	1,532	1,532	1,532	1,532
R-squared		0.347		0.534		0.459		0.410		0.513		0.667		0.744
Kleibergen-Paap F statistic	60.12		30.87		61.11		65.66		68.10		29.05		23.29	
B. All private sector industries														
	W2SLS	1st stage	W2SLS	1st stage	W2SLS	1st stage	W2SLS	1st stage	W2SLS	1st stage	W2SLS	1st stage	W2SLS	1st stage
Δ forward intensity	-0.624***		-0.098		-0.712***		-0.678***		-0.767***		-0.245		-0.305**	
	(0.068)		(0.178)		(0.115)		(0.130)		(0.152)		(0.156)		(0.145)	
Δ backward intensity	-0.272***	-0.348***	-0.084	-0.271***	-0.347**	-0.382***	-0.261*	-0.331***	-0.329**	-0.367***	-0.125	-0.251***	-0.160	-0.194***
	(0.102)	(0.073)	(0.119)	(0.079)	(0.131)	(0.074)	(0.131)	(0.068)	(0.156)	(0.067)	(0.154)	(0.057)	(0.153)	(0.055)
Δ exports of final goods intensity	0.221*	0.299***	0.046	0.234***	0.220*	0.279***	0.242	0.264***	0.241	0.246***	0.095	0.158**	0.132	0.135*
	(0.121)	(0.072)	(0.122)	(0.064)	(0.128)	(0.067)	(0.151)	(0.078)	(0.153)	(0.075)	(0.122)	(0.059)	(0.139)	(0.068)
Δ imports of final goods intensity	0.017	0.013	0.011	0.013	0.015	0.011	0.014	0.008	0.012	0.006	0.009	0.006	0.013*	0.006
	(0.012)	(0.009)	(0.007)	(0.009)	(0.012)	(0.008)	(0.010)	(0.006)	(0.009)	(0.005)	(0.005)	(0.004)	(0.007)	(0.003)
Δ log relative price of investment	0.006	0.032**	-0.001	0.004	0.013	0.033**	0.007	0.034**	0.014	0.033**	0.016	0.003	0.020	-0.001
	(0.028)	(0.012)	(0.034)	(0.012)	(0.034)	(0.013)	(0.029)	(0.012)	(0.035)	(0.013)	(0.042)	(0.012)	(0.043)	(0.014)
Δ Z		0.033***		0.071***		0.030***		0.034***		0.031***		0.076***		0.080***
		(0.005)		(0.012)		(0.005)		(0.005)		(0.005)		(0.016)		(0.017)
Fixed effects	-	-	Per	Per	Cty	Cty	Ind	Ind	Cty, Ind	Cty, Ind	Cty, Ind, Per	Cty, Ind, Per	Cty-Ind, Per	Cty-Ind, Per
Observations	3,270	3,270	3,270	3,270	3,270	3,270	3,270	3,270	3,270	3,270	3,270	3,270	3,241	3,241
R-squared		0.249		0.357		0.321		0.359		0.421		0.529		0.651
Kleibergen-Paap F statistic	41.38		32.91		40.78		37.77		38		23.44		21.53	

Notes. The dependent variable is changes in country-industry specific labor shares in three periods: 1995-2001, 2001-2007, 2007-2014. Δ forward is the change in intermediate inputs exports intensity in value added (forward GVC integration). The instrument Δ Z is constructed by eliminating home-country and industry sources of variation from Δ forward in a gravity relationship; see text for complete details. Δ backward is the change in importing of intermediate inputs intensity in total input purchases, Δ exports of final goods is the change in export intensity of final goods in value added, and Δ imports of final goods is the change in import intensity of final goods in domestic absorption. Δ log relative price of investment is the country-level log change in investment prices. All regressions are weighted by value added in 1995 as weights. A constant is always included but not reported. Robust standard errors in parentheses are computed by two-way clustering by country and by industry. *** p<0.01, ** p<0.05, * p<0.1.

Table A9. Changes in Labor Shares and Forward GVC Integration in 1995-2014: Country level regressions, W2SLS

	Dependent variable: Δ labor share							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Manufacturing industries								
	W2SLS	1st stage	W2SLS	1st stage	W2SLS	1st stage	W2SLS	1st stage
Δ forward intensity	-1.070***		-0.541*		-1.245***		-0.834*	
	(0.246)		(0.316)		(0.278)		(0.414)	
Δ backward intensity	-0.566	-0.458	-0.586	-0.513**	-0.466	-0.213	-0.655	-0.190
	(0.587)	(0.345)	(0.486)	(0.222)	(0.688)	(0.308)	(0.622)	(0.146)
Δ exports of final goods intensity	0.077	0.471**	-0.068	0.124	-0.070	0.324	-0.034	-0.228
	(0.486)	(0.216)	(0.518)	(0.204)	(0.572)	(0.250)	(0.576)	(0.150)
Δ imports of final goods intensity	0.422*	0.144**	0.392*	0.186***	0.287	0.068	0.390*	0.195***
	(0.244)	(0.065)	(0.223)	(0.045)	(0.238)	(0.100)	(0.194)	(0.043)
Δ log relative price of investment	-0.010	0.022	0.012	-0.002	0.009	0.023	0.051	-0.005
	(0.053)	(0.020)	(0.065)	(0.013)	(0.075)	(0.020)	(0.082)	(0.013)
Δ Z		0.055***		0.167***		0.049***		0.190***
		(0.007)		(0.021)		(0.008)		(0.015)
Fixed effects	-	-	Per	Per	Cty	Cty	Cty, Per	Cty, Per
Observations	117	117	117	117	117	117	117	117
R-squared		0.557		0.774		0.729		0.905
Kleibergen-Paap F statistic	60.61		65.86		42.69		161.9	
B. All industries								
	W2SLS	1st stage	W2SLS	1st stage	W2SLS	1st stage	W2SLS	1st stage
Δ forward intensity	-0.968**		-0.489*		-1.037*		-0.461	
	(0.440)		(0.277)		(0.565)		(0.440)	
Δ backward intensity	0.048	-0.206	-0.077	-0.312**	0.259	-0.019	0.043	-0.103
	(0.223)	(0.133)	(0.283)	(0.125)	(0.377)	(0.157)	(0.411)	(0.124)
Δ exports of final goods intensity	-0.185	0.735***	-0.538	0.199	-0.545	0.752***	-0.944	0.064
	(0.478)	(0.248)	(0.414)	(0.267)	(0.650)	(0.241)	(0.595)	(0.236)
Δ imports of final goods intensity	0.288	0.370*	0.382	0.529***	-0.110	0.216	0.121	0.567***
	(0.353)	(0.189)	(0.365)	(0.150)	(0.383)	(0.233)	(0.353)	(0.148)
Δ log relative price of investment	0.011	0.006	0.023	-0.015	0.042	0.013	0.046	-0.016
	(0.024)	(0.011)	(0.032)	(0.011)	(0.032)	(0.013)	(0.040)	(0.012)
Δ Z		0.024***		0.088***		0.022***		0.096***
		(0.004)		(0.016)		(0.004)		(0.015)
FEs	-	-	Per	Per	Cty	Cty	Cty, Per	Cty, Per
Observations	117	117	117	117	117	117	117	117
R-squared		0.536		0.714		0.687		0.846
Kleibergen-Paap F statistic	36.87		30.32		25.99		42.77	

Notes. The dependent variable is changes in country-level labor shares in three periods: 1995-2001, 2001-2007, 2007-2014. Δ forward is the change in intermediate inputs exports intensity in value added (forward GVC integration). The instrument Δ Z is constructed by eliminating home-country and industry sources of variation from Δ forward in a based on a gravity relationship; see text for complete details. Δ backward is the change in importing of intermediate inputs intensity in total input purchases, Δ exports of final goods is the change in export intensity of final goods in GDP, and Δ imports of final goods is the change in import intensity of final goods in domestic absorption. Δ log relative price of investment is the country-level log change in investment prices. All regressions are weighted by value added in 1995 as weights. A constant is always included but not reported. Robust standard errors in parentheses are clustered by country. *** p<0.01, ** p<0.05, * p<0.1.

Table A10. "Structural equation" used for the "local to zero" approximation of Conley, Hansen and Rossi (2012)

	Dependent variable: Δ labor share	
	Manufacturing industries	Private sector industries
	WLS	WLS
Δ forward intensity	-0.172	-0.271*
	(0.140)	(0.159)
Δ backward intensity	-0.249	-0.153
	(0.320)	(0.147)
Δ exports of final goods intensity	0.151	0.128
	(0.100)	(0.130)
Δ imports of final goods intensity	0.021	0.013*
	(0.013)	(0.007)
Δ log relative price of investment	0.018	0.020
	(0.073)	(0.043)
ΔZ	-0.064**	-0.003
	(0.025)	(0.019)
Fixed effects: Cty-Ind, Period	Yes	Yes
Observations	1522	3,241
R-squared	0.312	0.310

Notes. The dependent variable is changes in country-industry specific labor shares in three periods: 1995-2001, 2001-2007, 2007-2014. Δ forward is the change in intermediate inputs exports intensity in value added (forward GVC integration). ΔZ is the instrument, here added to the second stage equation, constructed by eliminating home-country and industry sources of variation from Δ forward in a gravity relationship; see text for complete details. Δ backward is the change in importing of intermediate inputs intensity in total input purchases, Δ exports of final goods is the change in export intensity of final goods in value added, and Δ imports of final goods is the change in import intensity of final goods in domestic absorption. Δ log relative price of investment is the country-level log change in investment prices. All regressions are weighted by value added in 1995 as weights. A constant is always included but not reported. Robust standard errors in parentheses are computed by two-way clustering by country and by industry. *** p<0.01, ** p<0.05, * p<0.1.