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Is employment globalizing?

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ABSTRACT

While work within many industries increasingly involves competition and cooperation with workers in other countries, we show that national labor markets have not necessarily globalized very fast. This is because the most globally intertwined industries have tended to shed workers to less globally connected industries, creating a de-globalizing, between-industry countertrend. We characterize between- and within-industry trends in three measures of labor market globalization over timespans of 16-50 years in 40-68 countries. We also clarify which policy debates each measure is most relevant to. While our results strongly support this globalization within-industries, deglobalization between-industries story, they also underscore how few empirically defensible conclusions can be drawn about trends in some dimensions of labor market globalization. The idea that nations' labor markets have globalized dramatically in recent decades, and that this calls for economy-wide overhaul of policies and institutions, rests on rather little empirical evidence.

1. Introduction

This paper deals with two ubiquitous subjects in public discourse: employment and globalization. With within-country inequality generally rising (Atkinson, 2015; Bourguignon, 2017), there is widespread recognition of the need to develop high-quality jobs (World Bank, 2013). Discussions of how to do this usually turn to strategies for leveraging opportunities abroad and surviving foreign competition. These strategies involve many policy instruments, including exchange rate interventions, stimulus programs, education reforms and relaxing labor regulations. Deliberations about them are often shaped by the perception that national labor markets today are more interconnected than they were before the 1990s: in other words, that they are more "global". The questions are - what does it mean for employment to globalize, and has this happened? This paper addresses these questions by providing the best possible estimates of three measures of labor market globalization covering timespans of 14-50 years in 40-68 countries.

By labor market globalization, we simply mean an increase in some measure designed to capture the extent to which some aspect of workers' employment is influenced by forces originating in foreign countries. Previous estimates of national labor market globalization are of broadly two types: back of the envelope estimates that must, for mechanical reasons, rise whenever trade flows rise or trade barriers come down (Freeman, 2009; Harrigan and Balaban, 1999, pp 15-16; Jaumotte and Tytell, 2008); and bottom-up studies of changes in the numbers and types of workers exposed to global markets in different ways over time (Blinder, 2009; Blinder and Krueger, 2013; Bohn et al., 2019; Ebenstein et al., 2014; Jensen, 2011; Jensen et al., 2005). Our work belongs to this second tradition.[1]

Our three measures of labor market globalization are *export induced labor demand* (EILD), the fraction of a country's labor demand that exists to meet demand for its exports; the *tradable em-*

[1] Our work connects to literature on the factor content of trade (Foster-McGregor and Stehrer, 2013; Trefler and Zhu, 2010), but is different in its objectives. That literature seeks to explain trade patterns to test trade theory and inform trade policy. Our goal is to better understand the evolving composition of employment and its implications for other social and economic policies – taking trade patterns and policies as given.

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ployment share, the fraction of workers engaged in producing internationally tradable goods and services; and *trade-linked employment*, which measures the fraction of labor either located in a tradable industry or involved in producing services that are required by these tradable industries.[2] We argue that these measures are each relevant to a different type of institutional or policy discussion (i) international coordination of stimulus policy is more important if EILD is high; (ii) the net benefits of currency devaluations during an international payments crisis increase with tradable employment levels; and (iii) the case for pro-competitive reforms to human capital policy and labor regulation strengthens if a lot of employment is trade-linked.

Our key finding is that the evidence that each of these measures has increased for most countries is quite weak. Several countries saw declining EILD, and most saw declines in the share of employment that is in industries whose output it is technologically feasible to trade across national borders. Even where EILD increased it usually increased very little. In the case of other measures and countries, we show that it is often impossible to say, using the available data and even heroic assumptions, whether they have increased or decreased. All of this suggests that in many cases, calls for sweeping changes to exchange rate and stimulus policies, education systems and labor regulations in response to ostensibly globalizing labor markets are proceeding in advance of the evidence.

These results may be surprising given that most of our analysis concerns a period during which the EU expanded from 12 to 27 members, China emerged as a manufacturing power, most developing countries continued to liberalize trade, and the WTO, NAFTA and MERCOSUR were launched. To explain why the trend was not a monotonic shift towards more globalized labor markets, we apply a simple between-within sector decomposition framework to each of our measures. The results show that even as each measure trended up within most industries,[3] this was accompanied by employment shifts from more to less globalized industries. These deglobalizing between-industry shifts are predicted by theory. Economists since Adam Smith (1776) have known that the international division of labor driving within-industry globalization dramatically increases output per worker in the industries experiencing it. Where demand for output does not keep pace, the most globalized industries can therefore shed workers, who find work in other, less globalized industries (Feenstra and Hong, 2010).[4] The downwards trend in agricultural employment in developing economies further depresses tradable and trade-linked employment.

The remainder of this paper is structured as follows. Section 2 defines and distinguishes our three measures of interconnection. Section 3 characterizes the trends and levels of our measures of globalization within and between industries, and reflects carefully on the sources of ambiguity in these estimates. The first three subsections also lay bare exactly what can and cannot be known about them given the data available. The section ends by characterizing some large economies' experiences with respect to employment globalization. Section 4 points to directions for future research and underscores the consequences of empirical uncertainty regarding labor market globalization. Appendices 1–4 are referenced in the text and provide technical details.

2. Definitions, distinctions, and relationships

Table 1 defines, distinguishes, and motivates our three measures of interconnectivity.

2.1. Definitions and motivations

Our first measure is the fraction of a country's labor hours demanded to produce exports (henceforth, the *Export-induced Labor Demand* or EILD share). It captures all labor demand created by foreign entities buying products exported by the home country. This includes some labor demanded from workers in non-tradable industries, such as the labor demanded from a truck driver who transports a tennis racket from a factory to a port for export, as well as labor demanded from the financiers, salespeople, and lawyers who made the export deal possible. It also includes the labor demanded from the factory workers to produce the tennis rackets, and from domestic workers to produce and transport the intermediate goods that went into it. EILD is imputed from the sales of final and intermediate goods recorded in the input–output tables, and the unit labor requirements of each industry. An increase in EILD can have implications for macroeconomic management, insofar as it would render countries more susceptible to free-riding on other countries' stimulus policies. It therefore should strengthen the argument for internationally coordinating macroeconomic policy, especially in response to multi-country recessions (e.g., Blanchard, 2008; Cwik and Wieland, 2011; Lagarde, 2016; and comments by various governments around the 2009 G20 meetings; Prasad and Sorkin, 2009).

Second, one might consider the share of workers employed in industries producing tradable goods or services. We shall refer to this figure as the *tradable employment share*. This is a concept utilized widely in trade theory, wherein a good or service is more tradable if the elasticity of substitution between varieties produced at home and abroad is large, and if the transaction and transportation costs of a resident of another country consuming it are low, given the policies in place at the time. The simplest trade models consider polar cases: perfect substitutes, wherein the prices of tradable products relative to each other are determined in world markets (with zero transport costs), and the no substitutes case in which the relative prices of non-tradables are determined by the relative production costs in local markets.[5,6] Conceptually, an industry producing a tradable product is a tradable industry, and the

[2] Other labor market interconnections are examined elsewhere. For example, international migration has grown relative to the populations of receiving, but not sending, countries (Czaika and Haas, 2014). We also do not consider labor footprints, the amount of foreign labor involved in producing a home country's consumption basket (Bohn et al., 2019).

[3] Previous studies describe globalizing within-industry trends in detail, showing that workers within particular industries increasingly have competitors, collaborators, and customers abroad. (Curtin, 2016; Curtin and Vanderhoef, 2015; Dedrick et al., 2010; Deyo, 2016; Gereffi et al., 2010; Timmer et al., 2014).

[4] For example, in the deindustrializing United States, 98% of net employment creation between 1990 and 2008 occurred in non-tradable services (Spence and Hlatshwayo 2011). There is also evidence that the global spread of manufacturing knowhow is reducing individual countries' capacity to sustain high manufacturing employment shares. (Rodrik 2016, Felipe et al., 2019).

[5] Several services lie between these polar cases, and some trade economists treat most goods as tradable but for high trade costs that it might be possible to reduce (Miroudot et al., 2013). Like previous studies particularly concerned with employment (Blinder, 2006, 2009; Blinder and Krueger, 2013; Jensen, 2011; Jensen et al., 2005) we assign workers to binary categories. Nevertheless, acknowledging how much the tradability of services varies across settings (Gervais and Jensen, 2019), we apply bounds analysis to study tradable employment rather than providing point estimates.

[6] Only Mode 1 and 2 tradable services (respectively, services delivered from the home country to buyers abroad, and services provided to nationals of a foreign country temporarily in the home country) meet this definition of tradability. If service providers need to establish a commercial presence in the consumer's country (Mode 3), or to visit that country (Mode 4), this suggests a very low elasticity of substitution between services produced in the consumer's country and those produced abroad, or that mode 1 and 2 trade costs that are very high. Mode 1 tradability of services is closely related to Blinder and Krueger's (2013) notion of offshorability, although they categorize occupations producing such services while we categorize industries. Occupational classifications have changed frequently in most countries, precluding analysis of changing offshorability of the occupational mix over time.

Table 1
Distinguishing three notions of internationally interconnected labor markets.

	Export-Induced Labor Demand	Tradable Employment	Trade-linked Employment
(1) This is a feature of...	Tasks	Workers	Workers
(2) What/who is included?	Tasks undertaken to produce products for sale to foreigners	Workers producing tradables (goods and services that could be produced or sold in other countries).	Workers producing tradables... plus... .. workers employed in industries that produce non-tradable services used in production by tradable industries.
(3) For example:	• Labor demanded from racket factory workers to make those rackets that are exported; • Labor demanded from truckers to transport these rackets to port.	• Workers in tennis racket or shoe factories	• Workers in tennis racket or shoe factories Those truckers who serve these factories
(4) What is not included?	Tasks undertaken to serve domestic markets	Workers producing non-tradables.	Those workers producing services that are neither tradable nor auxiliary to the production of tradables.
(5) For example:	• Labor demanded from factory workers to produce shoes and those rackets that are sold domestically; • Labor demanded from truckers to transport shoes or tennis rackets to local markets. • Labor demanded from truckers to help local people move house.	• All truck drivers	• Those truck drivers who specialize in serving local consumers (e.g., moving companies)
(6) This measure is relevant for discussions about...	... the importance of coordinating stimulus policy internationally.	... the welfare effects of exchange rate policies.	... the importance of pro-competitive human resource policies.

workers employed in it add to the country's tradable employment share. Tradable industries include those that compete in overseas markets and those that are import-competing. Tradable employment shares are estimated from labor force surveys, by counting the workers whose primary jobs are in industries whose outputs are deemed to be tradable.

The employment share of tradable industries is relevant for a government considering the implications of a currency devaluation to adjust to a balance of payments crisis. The welfare effects of a devaluation depend upon this fraction because it is workers producing tradables that could see demand for their labor increase as a result of a devaluation. [7] For workers producing non-tradables, the key impact of devaluation is to increase the cost of living by lifting tradable goods prices relative to wages (Frieden, 2014; Obstfeld et al., 1996).

Our third measure is the fraction of workers who are *trade-linked*. We define a worker to be trade-linked if his/her contribution to production, per dollar spent on their wages, has bearing on the country's trade competitiveness. We developed this measure to shed light on how relevant arguments for general pro-competitive education and labor relations policies might be, given the composition of employment.[8] While academic economists have been circumspect about when and why such changes are required, governments, industry bodies and policy commentators can be quite quick to invoke a globalized labor market as justification.[9]

As this measure is not a mainstay in the literature, it is useful to motivate it with reference to a hypothetical economy that produces only three products/services: shoes, which it produces for domestic consumption and which face competition from imports; tennis rackets, some of which it exports; and trucking services, which are sold both to domestic consumers (to move house) as well as to shoe and racket factories. Clearly (holding exchange rates and other factor prices constant), the economy's competitiveness in shoes depends on the productivity and pay of both, the workers in shoe factories, and the truckers who transport raw inputs to shoe factories and domestically-produced shoes to market. If their pay increases, or their productivity falls, then, other things equal, shoe imports should rise and employment related to shoe production should decline. Similarly, the country's competitiveness in tennis rackets depends upon the productivity and pay of workers in racket factories and of those of the truckers who keep them supplied and drive their finished products to domestic markets and to ports. All of these workers are therefore trade-linked.

In principle, it might be possible to estimate levels and trends in trade-linked employment with the aid of the input–output tables. However, as we shall show, the assumptions needed to do this are numerous, often implausible, and untested. This suggests that globalization-motivated demands for sweeping adjustments to human resource policies reflect little more than guesswork.

2.2. Distinctions and relationships

The first five rows of Table 1 summarize the differences and relationships between the three measures.

First, the three measures are attributes of different entities (Table 1, row 1). Tradability is an attribute of products, industries and workers, and tradable employment is measured in numbers of workers. Conversely, only a task can be considered export induced; a worker cannot, as a given worker will supply labor to

[7] A real devaluation will have this effect if the Bickerdike-Robinson-Metzler condition holds (Dornbusch, 1975).

[8] Calls to reform education in pursuit of competitiveness usually involve a shift in emphasis towards vocational and STEM education, while pro-competitive labor regulation reforms imply a more employer-friendly regulatory stance (e.g., The Economist, 2014).

[9] Consider two examples of the links between such policies and labor market globalization narratives. First, the "Skill India" and the "Make in India" campaigns have been the two pillars of the Indian government's employment policies, promoting vocational education, and more employer-friendly labor regulations. The Prime Minister launched them during his 2014 Independence Day speech, in which he invoked the presumably huge numbers of Indian workers who must "be in a position to face their counterparts in any corner of the world". Also, see the series of reports in the US, beginning with National Academies of Science Engineering and Health (2007), invoking Friedman's (2005) "Flat Earth" metaphor for a newly global labor market to appeal for a massive government focus on STEM education.

meet demand in export markets at certain times, but not at others (e.g., a truck driver drives tennis rackets to port for export, and then returns carrying imported shoes to meet domestic demand). Trade-linked employment is a hybrid concept that combines counting workers and using the input–output tables. Although a given worker will sometimes undertake tasks that are trade-linked and other times undertake tasks that are not (e.g., a truck driver may transport personal belongings one day and shoes the next), trade-linked employment is an idea developed to shed light on policies that influence human capital accumulation and labor regulations. Training is embodied in workers, and labor regulations apply to workers. Trade-linked employment is therefore most usefully treated as a feature of workers, not tasks. It cannot be a feature of an industry, because some workers in service industries upstream from tradable industries do not sell services to the tradable industry (e.g., some workers in the trucking industry move household furniture and do not interact with shoe and racket factories).

Second, the set of workers producing tradables is a subset of those who are trade-linked (Table 1, rows 2 and 3). Every worker in a shoe or a tennis-racket factory produces tradables. All these workers, by definition, are trade-linked, but so are those truckers who facilitate shoe and racket production. Those truckers do not produce a tradable service, because trucking services must be provided in the country where they are consumed, with the result that the price of trucking services varies enormously around the world.[10,11]

Finally, although trade-linked employment is a feature of workers, and export-induced labor demand is a feature of tasks, the two phenomena are nested in a different way. Any task that is performed to meet export demand must be performed by a worker who is, by definition, trade-linked. After all, the fact that a trucker sometimes carries tennis rackets to port suffices to make him/her trade-linked. A key logical result follows: so long as trade-linked workers put in as much time at work as non-trade-linked workers, the share of all person-hours spent working on export-induced tasks must be smaller than the share of all workers who are trade-linked.

To reiterate: the three concepts are distinct. Two of them are features of workers and one of tasks, and the share of workers who are trade-linked will be larger than both the fraction of workers who produce tradables, and (usually) the fraction of labor demand that is induced by exports.

3. Results

3.1. Export-induced labor demand

We estimate EILD by combining each country's National Input–Output Table (NIOT) with industrial employment shares from the Socio-Economic Accounts (WIOD). Both databases are sourced from the 2014 World Input–Output database, covering 1995-2011 (Timmer et al., 2015).[12] We make these estimates separately for each country and year. We estimate EILD for 35 industries in each economy, as the gross sales required from that industry to meet demand for the country's exports, multiplied by the average labor requirement per unit of sales for the industry. Dividing export-linked labor demand in industry i ($l_{x,i}$) by the industry's total labor demand (l_i) yields the share of labor demand in the industry that is export induced (λ_i). The equations involved are presented in Appendix 1. If we denote aggregate (i.e., economy wide) labor demand by $l \equiv \sum_i l_i$ and total export-linked labor demand by $l_x \equiv \sum_i l_{x,i}$, then the aggregate export-induced labor demand share (henceforth, EILD) is simply $\lambda \equiv l_x/l$.[13]

3.1.1. Description

Fig. 1 graphs EILD in 1995 and 2011 for the 40 European Union (EU) and non-EU WIOD countries. The average share of labor demand that is export-linked, when countries are weighted by population, rose from 13.5% to 16%. The population-unweighted EILD also rose, but from 22.5% to 25.1%, reflecting the higher levels of integration of the less populous EU countries at the start of this period. Several countries saw EILD decrease.

Table 2 provides descriptive regressions of EILD, separately for 1995 and 2011. The RHS variables include a dummy variable for EU membership - to test for the importance of this globalizing institution; the logarithms of population and GDP - to examine whether labor demand is less export-linked in countries with larger domestic markets; and the logarithm of GDP per capita – to see whether richer countries' more sophisticated export mixes (Hausmann et al., 2014) drive EILD up more than their higher wages drive it down.[14] The results confirm the statistical importance of EU membership and domestic market size, and the ambiguous effects of per capita income. They also suggest that the importance of EU membership for EILD has grown over time.

3.1.2. Decomposition

Next, to understand why EILD did not increase faster, we analyze the contributions of within- and between-industry changes to shifts in EILD, for each country. Denote each industry's share of national labor demand by α_i. National EILD is then the employment-weighted average of the EILD shares within industries:

$$\lambda \equiv \frac{l_x}{l} \equiv \sum_i \frac{l_{x,i}}{l} \equiv \sum_i \frac{l_i}{l}\frac{l_{x,i}}{l_i} \equiv \sum_i \alpha_i \lambda_i \quad (1)$$

The change in EILD over a time interval can then be decomposed as:

$$\Delta\lambda \equiv \sum_i \alpha_i \Delta\lambda_i + \sum_i \lambda_i \Delta\alpha_i \quad (2)$$

[10] Rights to engage in cabotage – transportation of goods or passengers from point to point within a country of which one is not a citizen – do make some trucking services tradable. However, most nations prohibit cabotage. EU members are exceptional in permitting cabotage in aviation, shipping, and road transport. A few other exceptions involve bilateral treaties, such as those between Australia and New Zealand. However, even NAFTA's transportation provisions, if fully implemented, would not have granted any cabotage rights.

[11] The distinction between trade-linked and tradable employment parallels a distinction well-accepted in the measurement of "tradable" value-added. For example, Bohn et al. (2018) distinguish the value added in those services that are directly tradable from the value added of domestic services industries that is embodied in traded manufactured goods.

[12] We restrict our analysis to the 2014 release for two reasons. Unlike the most recent WIOD, the 2014 release includes data going back to 1995, and the 1990s were a period of rapid trade expansion. Also, less of the data in this database would be subject to the global trade slow-down in the wake of the 2008-9 Global Financial Crisis (Timmer et al., 2016). Given that our results might be seen as skeptical of the globalization-everywhere view, it is important that the results are, if anything, biased in favor of that perspective. Including the 1990s serves that purpose.

[13] Measures similar to EILD have been analyzed for the US and China (Bohn et al., 2019; Los et al., 2015). These studies adopt a "global" input-output framework that uses disaggregated information on how much each country-industry pair in a home country exports to every other country-industry pair in the world to satisfy final demand originating outside the home country. We use a slightly simplified national input-output framework in which all final or intermediate goods sales to all foreign countries are treated as national exports. We therefore count labor used to produce intermediate goods exports that are subsequently reimported in our calculations. This labor would not be attributed to foreign final demand in the global I-O framework. This appears empirically unimportant. Bohn et al. (2019)'s figures indicate that US "exports of domestic labor" declined from 7.3% of employment in 1995 to 7.1% in 2008. Our estimates similarly show that EILD fell from 8.0% to 7.9% of employment between 1995 and 2011. Likewise, Los et al. (2015) estimate that exports added 31.2 million new jobs between 1995 and 2009 in China, which is only a little low compared with the 37.1 million between 1995 and 2011 that we estimate.

[14] We use purchasing-power parity (PPP) corrected estimates for GDP, but not for per capita GDP. The reason is that the purchasing power considerations that drive the size hypothesis require PPP corrections, while the competitiveness considerations that drive EILD's possible relationships with GDP per capita do not.

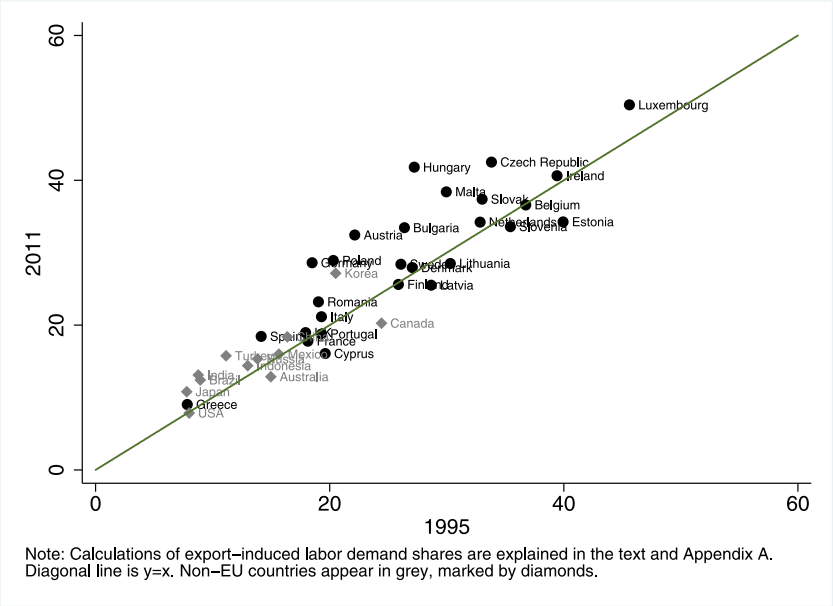


Fig. 1. Percentages of labor demand that were export induced.

Table 2
The correlates of export-induced labor demand.

	(1)	(2)	(3)	(4)	(5)	(6)
A. Results in 1995						
EU member dummy	12.85***				3.73	3.76
	(2.260)				(2.602)	(2.665)
Population (in logs)		−3.90***			-3.43***	
		(0.633)			(0.829)	
GDP, PPP-corrected, (in logs)			−4.00***			−3.39***
			(0.611)			(0.808)
Per capita GDP (in logs)				2.14	−0.74	1.59
				(1.348)	(0.795)	(0.979)
Constant	13.62***	87.75***	127.06***	2.02	84.48***	93.44***
	(1.470)	(11.001)	(16.432)	(12.547)	(16.790)	(18.603)
Observations	39	39	39	39	39	39
R-squared	0.370	0.571	0.519	0.055	0.591	0.589
B. Results in 2011						
EU member dummy	14.00***				6.72*	7.24**
	(2.332)				(3.327)	(3.359)
Population (in logs)		−3.64***			−2.63***	
		(0.666)			(0.953)	
GDP, PPP-corrected, (in logs)			−3.84***			−2.49**
			(0.746)			(0.974)
Per capita GDP (in logs)				3.01*	−0.65	0.86
				(1.710)	(1.160)	(1.346)
Constant	15.36***	86.30***	128.85***	−4.99	71.08***	78.71***
	(1.408)	(11.744)	(20.807)	(16.582)	(20.382)	(24.608)
Observations	39	39	39	39	39	39
R-squared	0.380	0.445	0.400	0.064	0.489	0.474

Source: Authors.
EU = European Union, GDP = gross domestic product, PPP = public–private partnership.
Notes: Dependent variable is the percentage (0–100) of labor demand that is export induced. Robust standard errors in parentheses.
* p<0.10
** p<0.05
*** p<0.01.

where α_i and λ_i are the averages of the start and end values.The first summation captures the effect of increasing export dependence *within industries.* These arise when the fraction of demand for an industry's output (and therefore labor) that originates in other countries grows. The second summation will be positive when workers shift from low EILD to high EILD industries, and vice versa. If output per worker grows faster in higher EILD industries, while demand does not grow sufficiently faster in higher-EILD industries, labor shifts to lower EILD industries and this *between-industry* contribution to globalization will be negative.

Fig. 2 presents the results of this decomposition. Countries appear in descending order by the change in their EILD shares between 1995 and 2011. While labor demand became more export-induced in 28 countries (Hungary–Mexico), it became less export induced in 12 (US–Estonia). Moreover, EILD increased fairly slowly in many of the 28 countries in which it rose—to pick two arbitrary cutoffs, EILD increased by less than 3 percentage points in 11 of

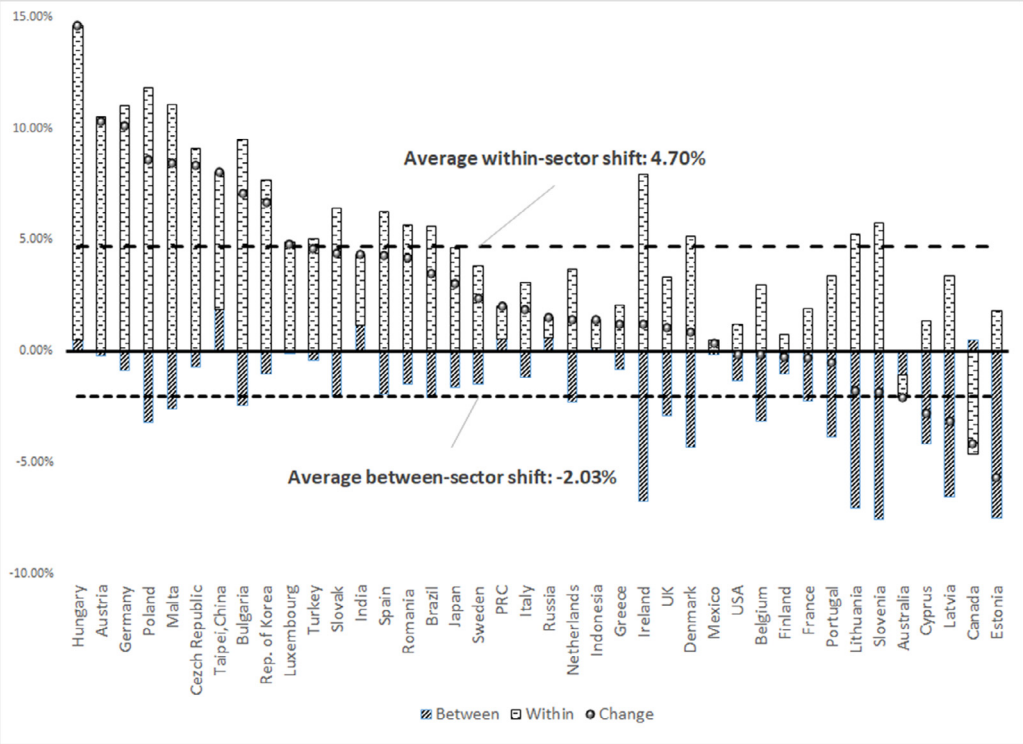


Fig. 2. Decomposing the changes in Export-Linked Labor Demand, 1995-2011.

these 28 countries; and by less than 5 percentage points in 19 of the 28.

The decomposition in Fig. 2 accounts for weak growth in EILD. All but two large commodity-dependent countries (Australia and Canada) saw significant internationalization of supply chains *within* industries.[15] Averaging across countries, had there been no reallocation of labor between industries, EILD would have increased by 4.7 percentage points in the (population unweighted) average country. At 20.7% of the average EILD in 1995, this is a substantial increase in interconnectedness. However, this globalization within industries was counterbalanced by a deglobalizing between-industry trend as employment in high-EILD industries shrank. This between-industry shift on average reduced EILD by 2 percentage points in the (population-unweighted) average country, although its magnitude is lower in lower-income countries.

Table 3 and Fig. 3, respectively, break down the within- and between-industry shifts. Table 3 shows that averaging across countries, manufacturing, mining and miscellaneous business services registered the largest increases in EILD, followed by wholesale and retail trade, and air and water transportation. Employment in finance, hotels and restaurants did not become rapidly more export induced. Agricultural employment only became slightly more export dependent, as the share of agricultural production that gets exported from most countries stagnated (Anderson, 2010). Most other services registered very small increases in EILD.

Fig. 3 decomposes the between-industry trend for Eastern European, higher- and lower-income economies (each considered as an aggregated group). The bars show changes in industries' employment shares arranged by their average EILD level across all WIOD countries, with the industrial sectors (manufacturing, and those services auxiliary to it) naturally falling on the right of the dashed vertical line. Eastern Europe deindustrialized in employment terms as Soviet era supply chains disintegrated, while high-income economies did so partly in response to growing competition from lower-wage countries (Felipe et al., 2019). With agricultural employment declining in both groups and services employment growing to compensate, employment in these countries shifted from high-EILD to low-EILD industries. In the three low- and middle-income WIOD countries (India, China and Indonesia), on the other hand, a much larger shift out of agriculture resulted not only in services employment growth, but also in some employment growth in high-EILD manufacturing. As a result, between-sector shifts reduced EILD more strongly in Eastern European and higher-income countries than in the lower-income countries (see Fig. 2).

The above results clearly indicate that industry specialists associated with manufacturing industries are correct to report that *their industries* are growing rapidly more reliant on exports for job creation. However, they equally clearly show that labor demand has gradually shifted from more to less export-linked industries as countries have deindustrialized, moved workers out of agriculture, and shifted into services. Indeed, Fig. 4, which graphs the data in Table 3, provides compelling descriptive evidence consistent with increased participation in global supply chains causing labor redundancy. It shows that (excluding agriculture), those industries with the largest increases in EILD shed the most workers.

The decomposition analysis helps explain three features of EILD changes. First, it shows why they are so small. The between-industry shifts reduced the rate at which export dependence grew, on average by 2.03 percentage points, counteracting the average 4.7% within-industry shift (Fig. 2), and resulting in aggregate EILD shifts of around 2.6% (from 22.5% to 25.1%, as described above). Second, it shows why all the countries experiencing declines in EILD (Mexico-Estonia in Fig. 2) are advanced economies. Globalization has spread manufacturing capabilities around the world, leading to deindustrialization (Felipe and Mehta, 2016; Haraguchi et al., 2017) within countries and a more negative between-shift in

[15] Detailed analysis of our results indicates that EILD fell in Australia because agriculture became more focused on meeting domestic demand. In Canada it did so because several manufacturing subsectors' reliance on export demand fell, possibly because Canada's oil boom triggered Dutch Disease (Beine et al., 2012).

Table 3
Changes in EILD and employment by industry, 1995-2011.

		Δ(EILD)	Δ(α)
Primary Sectors			
	Agriculture, Hunting, Forestry and Fishing	2.8%	-14.9%
	Mining and Quarrying	5.4%	-0.4%
Non-Manufacutring Industry			
	Construction	0.3%	2.7%
	Electricity, Gas and Water Supply	3.8%	0.0%
Manufacturing			
	Food, Beverages and Tobacco	4.5%	-0.2%
	Textiles and Textile Products	0.1%	0.6%
	Leather, Leather and Footwear	-1.7%	0.2%
	Wood and Products of Wood and Cork	-0.8%	0.3%
	Other Non-Metallic Mineral	-4.1%	-0.4%
	Basic Metals and Fabricated Metal	8.4%	-0.2%
	Chemicals and Chemical Products	11.1%	-0.1%
	Rubber and Plastics	9.5%	0.4%
	Coke, Refined Petroleum and Nuclear Fuel	10.5%	0.0%
	Electrical and Optical Equipment	10.5%	0.5%
	Pulp, Paper, Paper, Printing and Publishing	3.5%	0.1%
	Transport Equipment	12.7%	0.0%
	Manufacturing, Nec; Recycling	23.3%	0.1%
	Machinery, Nec	10.2%	-0.2%
Transport & Communications			
	Air Transport	3.7%	0.0%
	Water Transport	3.4%	0.0%
	Inland Transport	3.6%	0.4%
	Other Supporting and Aux. Transp. Act.; Travel Agencies	-2.7%	0.2%
	Post and Telecommunications	-0.1%	0.1%
Business services			
	Financial Intermediation	2.8%	0.0%
	Real Estate Activities	0.6%	0.5%
	Renting of M&Eq and Other Business Activities	6.8%	3.0%
Trading			
	Retail Trade, excl. automotives; Repair of HH Goods	3.2%	0.9%
	Wholesale and Commission Trade, excl. automotives	4.1%	0.4%
	Sale, Maintenance and Repair of Automotive; Fuel Sales	2.5%	0.2%
Other services			
	Hotels and Restaurants	1.4%	1.1%
	Education	0.5%	0.4%
	Health and Social Work	0.3%	1.5%
	Other Community, Social and Personal Services	-3.3%	3.3%
	Private Households with Employed Persons	2.8%	0.6%
	Public Admin and Defence; Compulsory Social Security	0.3%	0.4%

Δ(EILD) and Δ(α) are the unweighted averages across 40 WIOD countries of, respectively, the change in the share of that industry's labor demand that is export-induced, and the change in its share of national labor demand.

richer countries (Fig. 3). Third, it explains why the only advanced economies in which EILD increased significantly (Austria; Germany; Taiwan; and the Republic of Korea) are those that have successfully pursued industrial policies to retain manufacturing jobs (Chang, 2002; Parker, 2000). These countries' EILD levels grew as manufacturing supply chains became more international because they were able to retain larger manufacturing employment shares than other equally advanced economies.

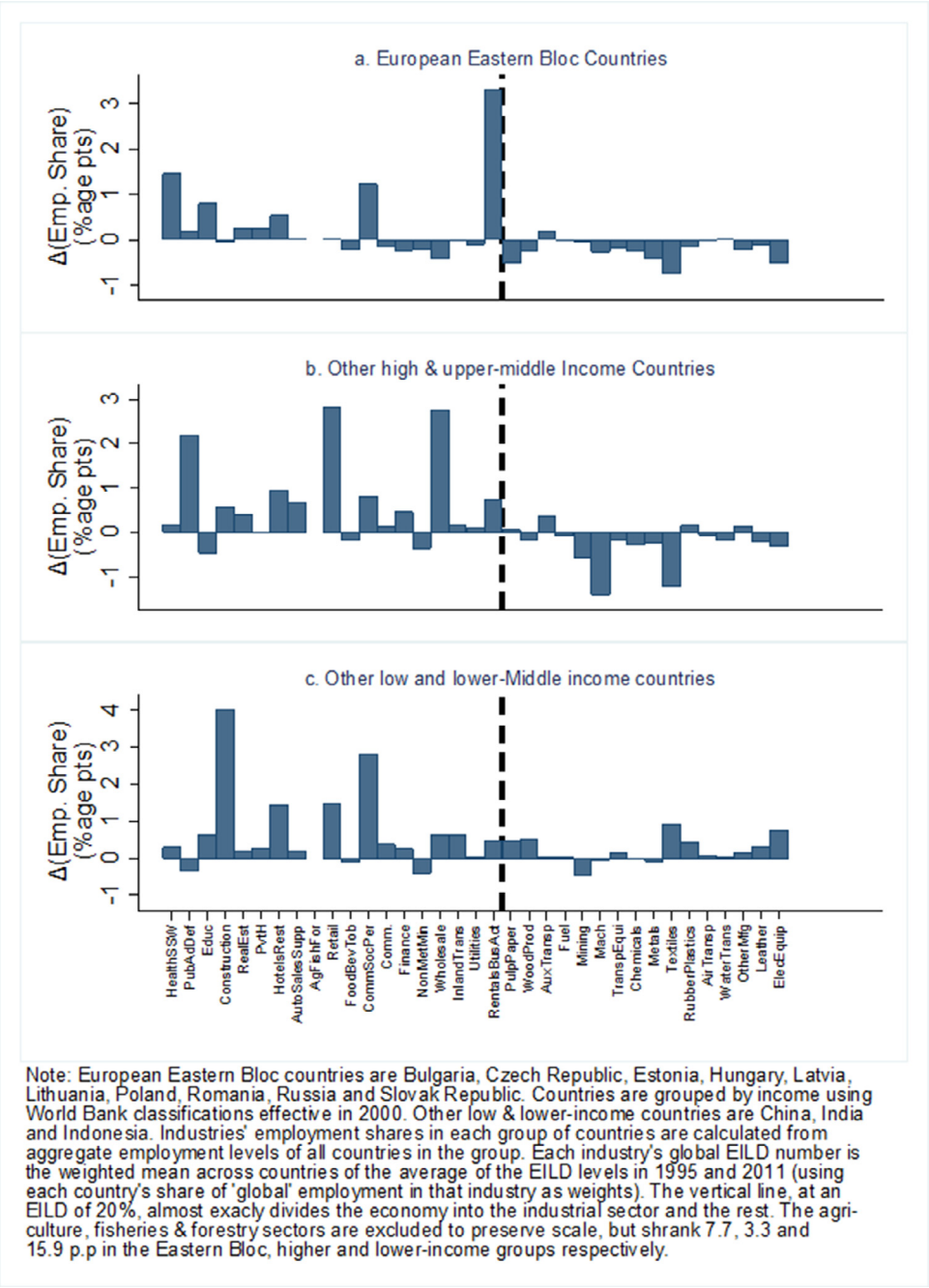
3.2. Tradable employment

It is more difficult to characterize trends in tradable employment than in EILD. This section explains why, and uses a decomposition similar to (2) to put bounds on the level and trend in tradable employment.

To proceed, we note that there are many products that are *intrinsically tradable*, but have sometimes been rendered *de facto* non-tradable by government policies. For example, it has been technologically feasible to ship cars across borders for several decades, but import restrictions have often rendered them *de-facto* non-tradable. Export restrictions have done likewise for grain. To put this formally, let λ^I and λ^D represent the shares all workers producing products that are intrinsically and de-facto tradable, respectively. Their within-industry analogues are λ_i^I and λ_i^D. Obviously, products are only *de-facto* tradable if they are intrinsically tradable, so that $\lambda^I \geq \lambda^D$ and $\lambda_i^I \geq \lambda_i^D,\ \forall i$. Let $\theta \equiv (\lambda^I - \lambda^D)$ and $\theta_i \equiv (\lambda_i^I - \lambda_i^D)$ be the fractions of all and within-industry employment that are intrinsically tradable, but rendered de-facto non-tradable by policy. For brevity, we refer to these as the (aggregate or within-industry) *policy wedges*. It is then obvious that: $\lambda^D \equiv \lambda^I - \theta \equiv \sum_i \alpha_i \lambda_i^I - \theta$, leading to the decomposition:

$$\Delta\lambda^D \equiv \Delta\lambda^I - \Delta\theta \equiv \overbrace{\sum_i \lambda_i^I \Delta\alpha_i}^{(A)} + \overbrace{\sum_i \alpha_i \Delta\lambda_i^I}^{(B)} - \Delta\theta \tag{3}$$

The first identity breaks the change in de-facto tradable employment into the difference between the changes in intrinsically tradable employment and in the policy wedge. The second identity breaks the shift in intrinsically tradable employment into between- and within-industry components. The between-industry component, *A*, is negative whenever employment shifts towards industries with less intrinsically tradable employment (e.g., farmers become security guards). Component *B* captures the effects of technological changes that lead to a growing share of an industry's workers producing intrinsically tradable goods and services (e.g., internet-based communications put more accountants in competition with foreign workers, so $\Delta\lambda_i^I > 0$ in the accounting indus-



Note: European Eastern Bloc countries are Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Russia and Slovak Republic. Countries are grouped by income using World Bank classifications effective in 2000. Other low & lower-income countries are China, India and Indonesia. Industries' employment shares in each group of countries are calculated from aggregate employment levels of all countries in the group. Each industry's global EILD number is the weighted mean across countries of the average of the EILD levels in 1995 and 2011 (using each country's share of 'global' employment in that industry as weights). The vertical line, at an EILD of 20%, almost exacly divides the economy into the industrial sector and the rest. The agriculture, fisheries & forestry sectors are excluded to preserve scale, but shrank 7.7, 3.3 and 15.9 p.p in the Eastern Bloc, higher and lower-income groups respectively.

Fig. 3. Changes in Industries' employment shares, 1995-2011 (industries arranged from lowest to highest global EILD).

try). Because no point estimates are available for λ_i^I, λ_i^D, θ, or their changes over time, we turn to bounds analyses. The next subsection characterizes the between-industry and total shifts in intrinsically tradable employment (A and $A+B$, respectively), while the subsequent subsection decomposes $\Delta\theta$ conceptually into between- and within-industry components and reviews existing studies to suggest signs for each.

3.2.1. Intrinsically tradable employment: A and B

To characterize the levels and trends of intrinsically tradable employment one requires knowledge of the λ_i^Is. This is unavailable since we do not know which workers within industries produce which products, and which of those products are intrinsically tradable. We derive a lower bound for λ^I by counting only employment in goods industries as intrinsically tradable ($\lambda_i^I = 100\%$), and all services as intrinsically non-tradable ($\lambda_i^I = 0\%$). This underestimates the level of tradable employment at any moment in time, because some services are intrinsically tradable. Our upper bound draws on Jensen and Kletzer's (2005) work on the spatial clustering of services establishments in the US. Jensen and Kletzer argue that domestically non-tradable services must be geographically scattered to remain close to customers, while domestically tradable services can exploit the agglomeration economies and economies of scale that come from clustering far from the final consumer. This permits them to explore the tradability of a highly disaggregated set of subindustries using the 2000 Decennial Census of Population Public Use Micro Sample (IPUMS files). These geographic concentration tradability measures have been accepted in the literature (Mian and Sufi, 2014). We map these estimates onto 1-digit industries contained in the ILO and the GGDC datasets, and the 35

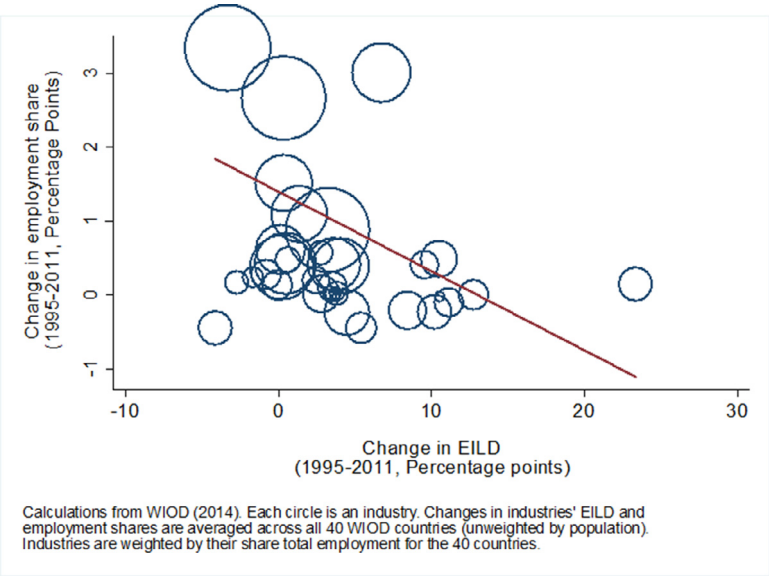


Fig. 4. Increasingly export dependent sectors shed jobs (excluding agriculture).

industries in the 2014 WIOD release to obtain upper bound estimates of λ_i^I in services.

Our assumption that this yields an upper bound for λ^I is justified as follows. First, following the logic of New Trade Theory (Krugman, 1991), industries are more likely to be clustered within the US than they are to be tradable across international borders. This is because transportation, regulatory, informational, logistical and customs costs are generally lower within the US than across international borders.[16] Second, most industries that the internet rendered tradable (e.g., call centers, logistics) were already being delivered across US state lines in 2000. Third, Jensen et al.'s (2005) methodology has been criticized for potentially misidentifying industries that are merely urban as tradable (Blinder, 2009). This possibility actually works to our advantage when using their estimates to derive upper bounds on tradability. Fourth, outsourcing of service tasks from manufacturing to domestic services firms likely had progressed further in the US by 2003 than in most other countries, especially developing countries.[17] And fifth, the services outsourced from manufacturing cluster geographically around manufacturing firms (Kakaomerlioglu and Carlsson, 1999), so that those services subsectors hosting the jobs are likely to be classified as tradable in our upper bound.

For maximum country coverage, we carefully cleaned the longest available set of ILO data (LABORSTA), yielding usable employment series for 68 countries, covering about 73% of the world's population from 1970 until 2008. Cleaning procedures appear in Appendix 2. For more temporal coverage, we use the GGDC's 10-sector database, which contains data for 43 countries over variable periods spanning 1947–2013. Results using GGDC data are fully consistent with those reported here, and appear in Appendix 3. To ensure that our results using ILO, GGDC and WIOD data use estimates of services tradability that are in principle compatible, we make our estimates of tradable employment first for the 35 WIOD industries and then aggregate them up to the 1-digit ISIC classification used by the ILO and GGDC.[18] Appendix 4 provides upper bound estimates of the fractions of employment in each WIOD industry and each 1-digit ISIC industry that are assumed to be tradable for our upper bound estimates.

Fig. 5 illustrates our approach using ILO data. In 1970, an estimated 65.5% of South Korea's employed labor force worked in goods-producing industries, and no more than 68.4% worked in industries producing either goods, or services that would be considered tradable in the US by the year 2000. These figures fell to 24% and 38.3% by 2008. Thus, we arrive at two estimates of between-industry shifts in intrinsically tradable employment ($A \equiv \sum_i \lambda_i^I \Delta\alpha_i$): -41.5% (= 24% - 65.5%) and -30.1%. A more disaggregated examination of Korea's employment trends reveals why these lines slope down. Employment shifted out of agriculture, only sometimes into manufacturing, with the rest moving into ser-

[16] Tourism could be an exception. For example, more tourism employment may be tradable to small island economies than was tradable across US state lines. To deal with this we use a generous upper bound assumption that 50% of all hotel and restaurant workers produce tradable services. Medical tourism is not likely to cause problems due to its low employment share. We regard medical tourism across the US-Mexico border as a "crucial case" (Eckstein, 1975): wage differences are higher relative to transport costs across this border than they are across almost any other, implying that if medical tourism constitutes a major share of employment anywhere, it is mostly likely do so in Mexico. Using raw data on 3.7 million Mexican workers from the 2015 census (IPUMS-I, 2019), we find that only 1.9% of workers were employed in private healthcare industries. Given that the vast majority of Mexican medical personnel serve Mexican patients, this suggests that medical tourism, even in this most likely case, has an extremely small share of national employment.

[17] The extent of domestic outsourcing is notoriously difficult to compare across countries (e.g., see Kakaomerlioglu and Carlsson, 1999, Table 1). However, the view that outsourcing of manufacturing activity to service firms was most advanced by the turn of the century in liberal market economies like the US is standard in work on the varieties of capitalism (Soskice and Hall, 2001), US labor relations (Brown et al., 2009), and firm strategy (Berger, 2005). Similarly, Baumol at al. (2003), document rapid downsizing in US manufacturing and upsizing in non-manufacturing starting in 1987, and link this to the US's exceptionally rapid political and institutional shift to the right.

[18] We drew on Spence and Hlatshwayo (2011) to create our upper bound estimates. Their Appendix II provides estimates of tradability based on Jensen and Kletzer's estimates of tradability by 2-digit 2000 census codes. Wherever the Spence and Hlatswayo sectors map cleanly onto the 35-sector classification used in the WIOD data, we used their estimates of tradability. For the remaining WIOD sectors, we constructed a many-to-one mapping to them from the US census sectors, categorized all employment in each census sector in which Jensen and Kletzer (2005) report medium or high geographic concentration as tradable, and gave each WIOD sector a tradability score equal to the employment-weighted average of the tradability score of its constituent census sectors (using employment-weights from the 2000 UC census). We then aggregated up from the WIOD to the 1-digit codes using US employment data from the WIOD.

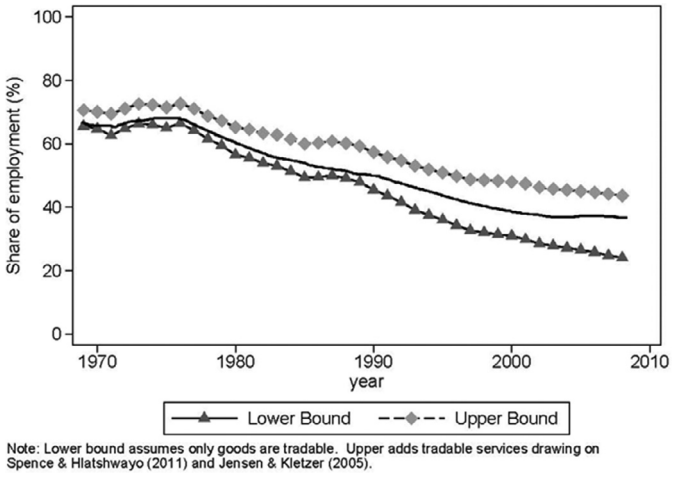


Fig. 5. Intrinsically tradable employment in South Korea.

vices and construction. All agricultural and manufacturing production is intrinsically tradable, but some services are not.

The bounds analysis also permits us to sign the total trend in intrinsically tradable employment ($A + B$). The difference between the lower and upper bound is an estimate of the maximum amount of employment in intrinsically tradable services. As technology has rendered services more tradable, the (unobserved) true intrinsically tradable employment share, sandwiched between our bounds, should move from close to our lower bound estimate in 1970 towards our upper bound estimate by 2008. Fig. 5 includes an artist's rendition of that line. As the initial lower bound exceeds the final upper bound, this line must generally slope downward, confirming that intrinsically tradable employment fell, i.e., that $A + B < 0$.

Fig. 5 is helpful in two other respects. First, it demonstrates something that we will show holds in every OECD country—namely, the upper bound estimates of intrinsically tradable employment fall to between 15% and 45% (depending on the country) by the late 2000s. Thus, *de-facto* tradable employment could not have exceeded these levels.

Second, it shows that employment in intrinsically tradable *services* might have risen quite dramatically, especially at early stages of development. The maximum possible employment in intrinsically tradable services, estimated by the gap between our upper and lower bounds, expanded from 2.9% (=68.4%–65.5%) in 1970 to 14.3% by 2008 in the Republic of Korea. This is why the possibility that intrinsically tradable employment has risen must be taken seriously: tradable services could have grown faster in employment terms than agriculture and manufacturing have shrunk.

To summarize what our bounds analysis tells us about trends in each country, we first estimate separately the slopes of their lower- and upper-bound lines. We then classify countries by whether they globalized, deglobalized, or fall into an ambiguous category. We conclude that a country "deglobalized" in terms of the intrinsic tradability of employment only if two conditions are met: (i) the slopes of both the upper and lower bound series are negative and statistically significant at the 5% significance level (i.e., $A<0$ for both estimates); and (ii) the earliest lower bound estimate is higher than the eventual upper bound estimate (i.e., $A + B < 0$). We deem countries for which the initial upper bound is lower than the subsequent lower bound to have "globalized" in terms of intrinsically tradable employment. The rest are "ambiguous." The stronger (weaker) requirements to conclude that a country deglobalized (globalized) protect against incorrectly rejecting the theory that labor markets have globalized.

Table 4 provides results for 68 countries based on ILO data over the years available. The countries are arranged by region, and the regions are arranged in rough descending order by per capita income. The results reveal a general cross-sectional relationship with levels of development. Intrinsically tradable employment is generally much larger in less developed economies, given their higher agricultural employment shares.

Economic development is also associated with less intrinsically tradable employment *over time*. The lower and upper bound estimates shrank in almost every country. Thirty-nine countries, capturing 80.1% of the population represented, deglobalized in the period for which we have data. The remaining 29 countries, which are on average less populous, fall in the ambiguous category. Eighteen of these 29 countries are either advanced or island economies, with the low initial agricultural and manufacturing employment levels that come respectively with higher wages or physical distance. Seven others among these 29, many of them former Communist Bloc countries, have employment time series that may be too short to discern a structural trend given the width of the bounds (Azerbaijan, Hungary, Kyrgyzstan, Mongolia and Russia; plus Bangladesh and Nicaragua). The remaining countries in the ambiguous category experienced relatively limited exit from agriculture during the period for which their employment data exist (Chile, Cuba, Myanmar, and Botswana).[19] No country globalized in terms of intrinsically tradable employment.

Finally, focusing on the richest economies (found by working up the table from Korea, skipping Turkey), we see that the share of employment in intrinsically tradable industries by the end of our series lies in the 15%–45% range.

3.2.2. Policy wedges

The policy wedges between intrinsically and *de-facto* tradable employment (the θ_is) cannot be estimated using available data. While it is tempting to conclude that widespread trade liberalization shrinks the aggregate policy wedge, this is a within-industry phenomenon. The effect of between-industry employment shifts must be considered also.[20] Specifically, it can be shown in now familiar fashion that:

$$-\Delta\theta \equiv \overbrace{-\sum_i \theta_i^I \Delta\alpha_i}^{(C)} + \overbrace{-\sum_i \alpha_i \Delta\theta_i^I}^{(D)} \tag{4}$$

It is well known that tariff and non-tariff barriers on goods trade have been reduced significantly since the 1980s (Anderson and Van Wincoop, 2004). Policy barriers to (mode 1 and 2) trade in services have not been tracked for long, but appear to remain high while falling slowly (Nordås, 2016; OECD, 2019).[21] The fact that barriers have been reduced in goods and probably in services suggests that policy changes within industries have boosted tradable employment (i.e., $D>0$). It is more difficult to sign C, as

[19] Despite our procedures for cleaning ILO, Botswana's data remain suspect, with intrinsically tradable employment declining from the high 60% range to the high 30% range between 1985 and the mid-1990s, and then rising back up to 40%–50% by 2008.

[20] This discussion assumes, for the sake of clearly discussing other sources of ambiguity, that policy changes rendering more of an industry's output tradable also make more of its labor tradable.

[21] The cleanest available data on policy barriers to services come from the STRI, which indicates that the barriers to mode 1 and 2 services trade usually involve licensing and other prudential restrictions (Grosso et al., 2015), most of which change slowly, but a few of which have been liberalized (OECD, 2019). Other studies impute from trade data that *overall* barriers to services trade (including both technological and policy barriers) have fallen (Anderson et al., 2018), but that they have fallen more slowly in services than in goods (Miroudot et al., 2013). However, as these imputed shifts cannot be attributed to declining policy barriers alone, this is evidence only that B+D>0, not that D>0.

Table 4
Lower and upper bound estimates of the share of employment that is intrinsically tradable.

		Easliest observation			Latest observation			Lower Bound Slope		Upper Bound Slope		
Region	Country	Year	Lower Bound	Upper Bound	Year	Lower Bound	Upper Bound	Coeff.	P-Value	Coeff.	P-Value	Category
Western European and Others												
	Australia	1980	27.6%	43.9%	2008	14.8%	36.4%	**-0.005**	(0.000)	**-0.003**	(0.000)	Ambiguous
	Austria	1983	38.7%	52.7%	2008	22.8%	43.3%	**-0.007**	(0.000)	**-0.004**	(0.000)	Ambiguous
	Belgium	1970	38.0%	51.2%	2008	18.3%	39.2%	**-0.005**	(0.000)	**-0.003**	(0.000)	Ambiguous
	Canada	1987	22.5%	41.8%	2008	15.8%	38.4%	**-0.002**	(0.000)	**-0.001**	(0.005)	Ambiguous
	Cyprus	1976	44.6%	56.4%	1995	26.4%	44.0%	**-0.009**	(0.000)	**-0.006**	(0.000)	Ambiguous
	Denmark	1972	34.8%	49.0%	2008	17.8%	37.8%	**-0.004**	(0.000)	**-0.002**	(0.000)	Ambiguous
	Finland	1989	30.3%	48.1%	2008	21.8%	42.7%	**-0.004**	(0.000)	**-0.003**	(0.000)	Ambiguous
	France	1969	42.2%	54.5%	2008	18.1%	38.6%	**-0.006**	(0.000)	**-0.004**	(0.000)	Ambiguous
	Greece	1981	50.5%	62.9%	2008	23.5%	36.6%	**-0.011**	(0.000)	**-0.009**	(0.000)	Ambiguous
	Iceland	1991	27.5%	43.2%	2008	16.2%	35.3%	**-0.007**	(0.000)	**-0.004**	(0.000)	Ambiguous
	Ireland	1969	49.1%	59.4%	2008	18.7%	39.3%	**-0.008**	(0.000)	**-0.005**	(0.000)	Ambiguous
	Italy	1977	43.6%	54.3%	2008	24.5%	44.7%	**-0.006**	(0.000)	**-0.002**	(0.000)	Ambiguous
	Luxembourg	1970	42.5%	56.1%	2006	10.7%	42.1%	**-0.010**	(0.000)	**-0.004**	(0.000)	Ambiguous
	Netherlands	1969	34.8%	49.1%	2008	14.3%	36.2%	**-0.005**	(0.000)	**-0.003**	(0.000)	Ambiguous
	New Zealand	1986	31.6%	47.0%	2008	19.8%	39.7%	**-0.005**	(0.000)	**-0.003**	(0.000)	Ambiguous
	Norway	1972	36.6%	49.0%	2008	15.8%	34.6%	**-0.006**	(0.000)	**-0.004**	(0.000)	Ambiguous
	Portugal	1974	60.8%	68.1%	2008	29.4%	44.8%	**-0.009**	(0.000)	**-0.007**	(0.000)	Ambiguous
	San Marino	1978	43.2%	49.8%	2008	29.4%	49.2%	**-0.005**	(0.000)	**-0.002**	(0.005)	Ambiguous
	Spain	1969	58.1%	66.0%	2008	19.7%	39.9%	**-0.010**	(0.000)	**-0.007**	(0.000)	Ambiguous
	Sweden	1969	39.2%	53.1%	2008	16.7%	38.5%	**-0.005**	(0.000)	**-0.003**	(0.000)	Ambiguous
	Switzerland	1969	46.5%	58.1%	2008	19.9%	41.8%	**-0.008**	(0.000)	**-0.005**	(0.000)	Ambiguous
	Turkey	1988	62.8%	69.7%	2004	51.9%	61.9%	**-0.008**	(0.000)	**-0.005**	(0.000)	Ambiguous
	United Kingdom	1969	39.8%	53.3%	2008	13.9%	37.1%	**-0.007**	(0.000)	**-0.004**	(0.000)	Ambiguous
	United States	1969	32.7%	45.8%	2002	16.2%	34.6%	**-0.005**	(0.000)	**-0.003**	(0.000)	Ambiguous
Asia's High Income Economies												
	Hong Kong	1978	46.0%	57.3%	2008	5.7%	31.3%	**-0.015**	0.000	**-0.010**	0.000	Deglobalized
	Japan	1976	38.1%	50.8%	2008	22.6%	42.6%	**-0.005**	0.000	**-0.003**	0.000	Ambiguous
	South Korea	1969	65.6%	70.6%	2008	24.1%	43.7%	**-0.012**	0.000	**-0.008**	0.000	Deglobalized
Latin America & Caribbean												
	Bolivia	1976	62.4%	67.5%	2007	48.7%	58.8%	**-0.004**	0.000	**-0.002**	0.000	Deglobalized
	Brazil	1970	55.8%	62.8%	2010	26.5%	40.8%	**-0.006**	0.000	**-0.004**	0.000	Deglobalized
	Chile	1975	41.5%	51.3%	2008	26.0%	42.6%	**-0.003**	0.000	**-0.001**	0.007	Ambiguous
	Costa Rica	1987	45.6%	54.7%	2008	24.7%	42.1%	**-0.010**	0.000	**-0.006**	0.000	Deglobalized
	Cuba	1995	40.0%	47.9%	2008	30.1%	40.0%	**-0.008**	0.000	**-0.006**	0.000	Ambiguous
	El Salvador	1975	58.1%	64.4%	2007	34.9%	37.6%	**-0.008**	0.000	**-0.009**	0.000	Deglobalized
	Haiti	1969	80.3%	83.2%	1990	73.1%	77.4%	**-0.005**	0.000	**-0.004**	0.000	Deglobalized
	Honduras	1970	74.3%	78.4%	2007	49.7%	59.4%	**-0.008**	0.000	**-0.006**	0.000	Deglobalized
	Jamaica	1992	39.2%	50.2%	2008	25.7%	40.4%	**-0.008**	0.000	**-0.006**	0.000	Ambiguous
	Mexico	1960	51.0%	59.4%	2010	29.0%	43.4%	**-0.005**	0.000	**-0.003**	0.000	Deglobalized
	Nicaragua	1990	48.8%	56.1%	2006	43.3%	54.0%	**-0.003**	0.039	-0.001	0.271	Ambiguous
	Panama	1969	47.4%	55.0%	2008	22.7%	38.6%	**-0.006**	0.000	**-0.004**	0.000	Deglobalized
	Puerto Rico	1969	30.8%	40.6%	2008	12.0%	23.8%	**-0.004**	0.000	**-0.004**	0.000	Deglobalized
	Trinidad and Tobago	1969	41.5%	49.3%	2008	16.6%	32.0%	**-0.006**	0.000	**-0.004**	0.000	Deglobalized
	Venezuela	1975	36.6%	47.6%	2008	21.3%	36.1%	**-0.005**	0.000	**-0.004**	0.000	Deglobalized
Smallest Island Nations												
	Bahamas	1973	16.1%	34.0%	1993	9.6%	29.3%	**-0.002**	0.022	**-0.002**	0.084	Ambiguous
	Barbados	1976	25.9%	38.2%	2004	9.1%	22.7%	**-0.006**	0.000	**-0.006**	0.000	Deglobalized
	Montserrat	1975	21.6%	31.9%	1991	12.4%	26.8%	**-0.003**	0.009	**-0.002**	0.008	Ambiguous
	Netherlands Antilles	1989	10.6%	28.7%	2008	8.2%	32.1%	**-0.002**	0.000	0.001	0.082	Ambiguous
East and Southeast Asia												
	China	1982	87.2%	89.1%	2010	66.4%	73.2%	**-0.007**	0.002	**-0.006**	0.003	Deglobalized
	Indonesia	1976	72.7%	76.9%	2008	53.6%	62.7%	**-0.005**	0.000	**-0.004**	0.000	Deglobalized
	Malaysia	1980	54.2%	60.8%	2008	32.7%	47.3%	**-0.006**	0.000	**-0.004**	0.000	Deglobalized
	Myanmar	1978	75.4%	83.2%	1998	72.4%	78.2%	0.000	0.493	**-0.002**	0.000	Ambiguous
	Philippines	1977	62.4%	69.1%	2008	44.3%	56.4%	**-0.007**	0.000	**-0.005**	0.000	Deglobalized
	Thailand	1971	82.1%	84.8%	2008	56.4%	65.2%	**-0.007**	0.000	**-0.005**	0.000	Deglobalized
Former Communist Bloc												
	Azerbaijan	1991	44.1%	50.7%	2008	44.4%	54.8%	0.002	0.207	**0.004**	0.013	Ambiguous
	Estonia	1989	48.3%	60.9%	2008	25.9%	44.6%	**-0.011**	0.000	**-0.008**	0.000	Deglobalized
	Hungary	1992	27.1%	42.2%	2008	22.7%	41.6%	**-0.002**	0.000	0.000	0.796	Ambiguous
	Kyrgyzstan	1986	49.9%	57.2%	2008	42.8%	52.9%	0.000	0.979	0.001	0.605	Ambiguous
	Moldova	1981	59.7%	65.4%	2008	42.3%	52.9%	**-0.004**	0.000	**-0.002**	0.010	Deglobalized
	Mongolia	1994	10.2%	18.0%	2008	9.0%	19.2%	**-0.001**	0.000	0.001	0.075	Ambiguous
	Poland	1981	59.5%	69.4%	2008	35.9%	47.8%	**-0.010**	0.000	**-0.007**	0.000	Deglobalized
	Romania	1969	73.1%	77.5%	2008	50.5%	61.8%	**-0.004**	0.000	**-0.003**	0.000	Deglobalized
	Russia	1990	42.4%	49.4%	2008	27.0%	43.0%	**-0.008**	0.000	**-0.003**	0.000	Ambiguous

Table 4
(Continued)

Region	Country	Easliest observation			Latest observation			Lower Bound Slope		Upper Bound Slope		
		Year	Lower Bound	Upper Bound	Year	Lower Bound	Upper Bound	Coeff.	P-Value	Coeff.	P-Value	Category
Middle East & North Africa												
	Egypt	1970	66.5%	71.6%	2008	43.2%	52.7%	**-0.007**	0.000	**-0.006**	0.000	Deglobalized
	Israel	1969	33.6%	45.7%	2008	17.0%	38.7%	**-0.004**	0.000	**-0.002**	0.000	Ambiguous
	Syria	1970	62.9%	68.3%	2007	35.5%	45.6%	**-0.010**	0.000	**-0.008**	0.000	Deglobalized
South Asia												
	Bangladesh	1984	67.8%	73.0%	2005	59.2%	68.5%	-0.004	0.211	-0.002	0.322	Ambiguous
	India	1983	75.9%	80.0%	2011	62.0%	68.1%	**-0.004**	0.004	**-0.004**	0.011	Deglobalized
	Pakistan	1973	70.2%	75.7%	2008	57.8%	65.4%	**-0.004**	0.000	**-0.004**	0.000	Deglobalized
Sub-Saharan Africa												
	Botswana	1985	64.4%	68.3%	2006	39.2%	50.6%	**-0.014**	0.068	-0.011	0.119	Ambiguous

Note: Lower bounds assume all goods sectors except construction are tradable. Upper bounds are calculated from 1-digit ILO employment shares and tradability assumptions presented in Appendix 4. Deglobalizing countries are those with negative, significant (p<=0.05) linear time trends on both bounds and initial lower bounds that exceed subsequent upper bounds.

this requires comparisons of the estimated impact of those restrictions on employment across industries. Miroudot et al. (2013), use a gravity model of bilateral trade flows by industry to estimate services trade costs that are 2-3 times larger than those in goods, and argue that much of these costs arise due to regulatory barriers to services trade. This in turn implies that the observed employment shifts from goods to services industries could have increased the average policy wedge (i.e., that $C<0$).

Unfortunately, it is difficult to assess this possibility empirically. Imputation of the cost of barriers to trade in a product (i.e. a good or service) relies on assumptions regarding the elasticity of substitution between versions of the product produced in different countries (Chen and Novy, 2011), and not all of the imputed costs are necessarily attributable to policy barriers (Novy, 2013). We therefore assert only that such a countervailing, between-industry trend is suggested on prior evidence, and that observing trade liberalization within industries is insufficient to conclude that the policy wedges between intrinsic and de-facto tradable employment shrank.

3.2.3. *Employment in* de facto *tradable industries*

Our approach disciplines what can be said about *de facto* tradable employment. Together, identities (3) and (4) discipline speculation on its trend, and noting that $\lambda_i^I \geq \lambda_i^D, \ \forall i$ disciplines speculation on its level.

With respect to levels, our results clearly imply that by the end of our period of analysis, no more than 30-45% of employment in advanced economies was *de facto* tradable (Table 4, subsequent upper bound). This upper limit is much lower in the rich countries, where there is much less agricultural employment.

Finally, we cannot sign the past trend in *de-facto* tradable employment because while both technological change and trade liberalization probably globalized employment within industries (i.e., B>0, D >0), employment continues to shift rapidly into services, which are less intrinsically tradable ($A<0$) and possibly more protected (C may be negative as well). Lacking evidence to measure C and D, we conjecture that the latter deglobalizing trend dominated for large developing countries moving rapidly out of agriculture, because $A+B$ is large and negative, and C could be negative as well.

3.3. Trade-linked employment

Increases in trade-linked employment are implicitly cited as justification for generalized, pro-competitive shifts in labor relations and education policy. Here we demonstrate why trade-linked employment is so difficult to *measure*, and therefore that trends in trade-linked employment are highly uncertain. We also show that these trends are difficult to *predict* because changes within industries are counteracted by employment shifts between industries.

Trade-linked employment includes two components: tradable employment and upstream employment producing non-tradable services for sale to tradable industries. As seen in Section 3.B., tradable employment is difficult to estimate because there are no point estimates of how much labor in each industry in each country is intrinsically tradable, and we do not know how much intrinsically-tradable employment is *de facto* tradable. We therefore assume the same bounds on intrinsically tradable employment as in Section 3.C, and work with the knowledge that *de-facto* tradable employment is less than that. Then, we use input-output tables to estimate the number of upstream workers required to supply these tradable industries under each bounding scenario.

Estimating that second component of trade-linked employment is also difficult. This is because input-output datasets do not record industries' employment and output levels separately by destination industry (e.g., how much transportation labor facilitated tradable factory production). Even if this problem could be solved, translating the resulting estimates into education policy or general labor regulation recommendations would be very difficult because the input-output tables would still only tell us how many person-days of labor this activity required, not how many people are implicated in providing them. This matters because one educates workers, not person-days of labor, and labor regulations are also often targeted at people not tasks. To obtain estimates despite these problems, we are forced to make two untestable assumptions: that output per worker in each services industry is the same whether the service in question is sold to a tradable industry or not; and that each worker in non-tradable services specializes completely either in activities auxiliary to producing tradables, or in activities not auxiliary to tradables (i.e., these workers do not divide their time between these activities).[22] Appendix 1 details these calculations.

Fig. 6 displays the upper and lower bounds for the intrinsically trade-linked employment shares for 40 WIOD countries in 1995 and 2011. The Figure on the left plots the 2011 upper bound against the 1995 lower bound, seeking unambiguous evidence of a decline in intrinsically trade-linked employment. Only 4 countries provide it. India and China are large developing countries still moving out of agriculture, Romania's supply chains have had to adjust to a post-Soviet industrial landscape (several other countries close

[22] Taking the other extreme view - that every non-tradable worker spends some of their time producing for tradable sectors – obviates the entire discussion: so that 100% of workers are intrinsically trade-linked, by assumption. We have found no data or literature on this.

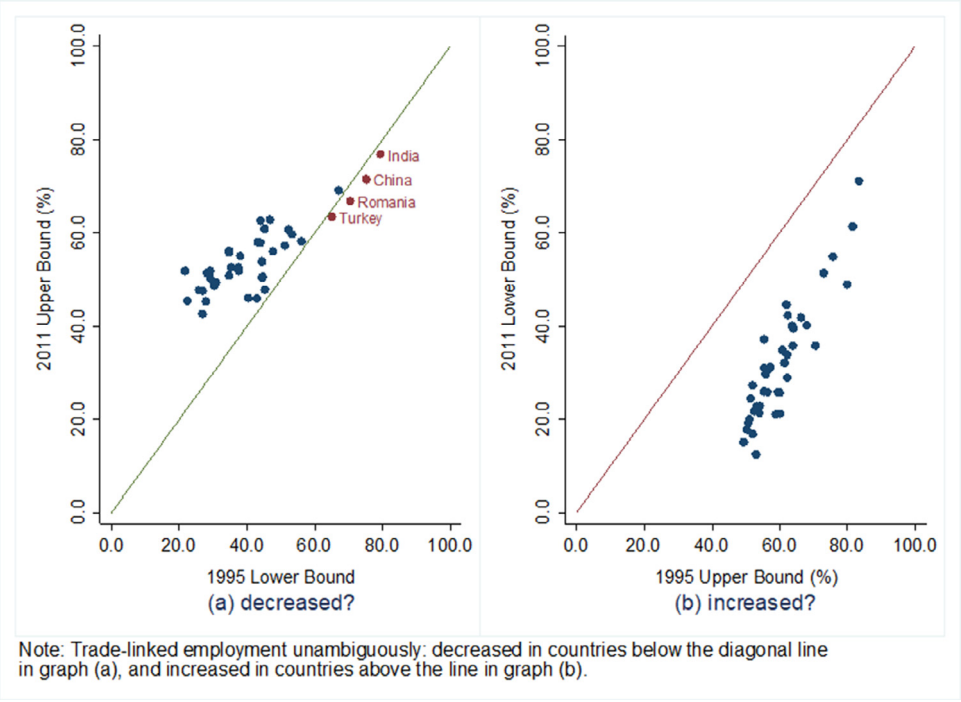


Fig. 6. Any evidence that trade-linked employment unambiguously.

to the line are also former Soviet Republics), and Turkey deindustrialized during the period. The right-hand side of Fig. 6 plots the 2011 lower bound against the 1995 upper bound, seeking cases in which trade-linked employment increased unambiguously. There are none. Intrinsically trade-linked employment therefore fell unambiguously in 4 countries, and its trajectory cannot be discerned in another 36.

Table 5 lists the bounds of intrinsically trade-linked employment in 1995 and 2011. Countries are ordered by the 2011 upper bound. Excluding the 4 countries just discussed, the difference between lower and upper bounds in either year ranges from 13%–45%. This wide range is a result of uncertainty over the percentage of services employment that is tradable. In combination with small changes in the upper and lower bound estimates over time, this uncertainty makes it impossible to confirm increases or decreases in intrinsically trade-linked employment.

Table 5 also shows that large, low-income economies were much more trade-linked, especially in 1995 than small high-income countries. This reflects the lower employment shares of agriculture and manufacturing in richer countries. Trade-linked employment shares therefore had less room to fall in richer countries, and indeed the four countries that saw declining intrinsically tradable employment are not rich.

The trade-linked employment shares in Fig. 6 may provide reasonable bounds, in richer economies, for the number of workers whose education would matter for competitiveness. But these figures are not directly relevant for policy makers in low-income countries where vocational training is typically considered for students in secondary education—which excludes many of those who become farmers; and the labor protections that governments are considering trimming do not apply to agriculture either. To examine whether globalization changed the case for such policy moves, Fig. 7 therefore re-estimates intrinsically trade-linked employment after removing agricultural workers from the numerator and the denominator. This shifts all countries into the ambiguous category.

Unfortunately, even this inconclusive bounds analysis underestimates the difficulty of discerning useful trends in trade-linked employment because *de facto* tradability is not known, so trends in the de facto trade-linked employment share are not knowable. Observers proposing sweeping reforms to labor and education policies as a response to globalization implicitly claim to know more about the employment landscape than is knowable given the data available.

As with our other measures, this ambiguity in trends in trade-linked employment owes to a tension between industries each becoming more interconnected globally, and the most globally connected industries shedding workers. Fig. 8 displays, for each country, the number of jobs in upstream non-tradables generated by backwards linkages per job in tradables. These are calculated separately for 1995 and 2011, at upper and lower bound estimates for intrinsically tradable employment shares within services. The number of backward-linked non-tradable jobs per job in tradables increased in all but a handful of labeled, post-industrial countries. Thus, non-tradable employment became more tightly bound with employment in tradable industries, even as the intrinsically tradable industries generating these backwards linkages mostly shrank (see Section 3B).

3.4. A Composite view for some large economies

We have so far analyzed tradable employment using ILO and GGDC data, and export-induced labor demand and trade-linked employment using WIOD data. These choices enabled us to expand the range of countries and years for which we could estimate tradable employment. To obtain a composite view, and thereby make useful structural comparisons between countries, Table 6 presents the levels of each of the three measures using WIOD data for 1995 and 2011 for a dozen countries. Countries are arranged roughly in order of per capita GDP in 2011.

Inspection of Table 6 illustrates two propositions from section II: (intrinsically) trade-linked employment exceeds (intrinsically) tradable employment at either the upper or lower bound; and, the upper bound estimates of trade-linked employment always exceed the EILD.

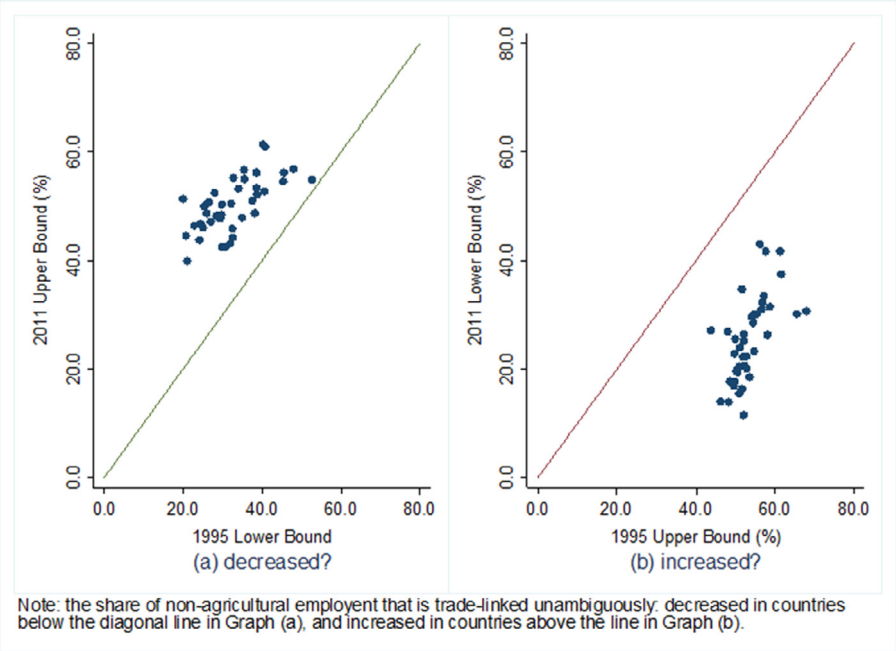


Fig. 7. Any evidence that trade-linked employment, excluding agriculture, unambiguously.

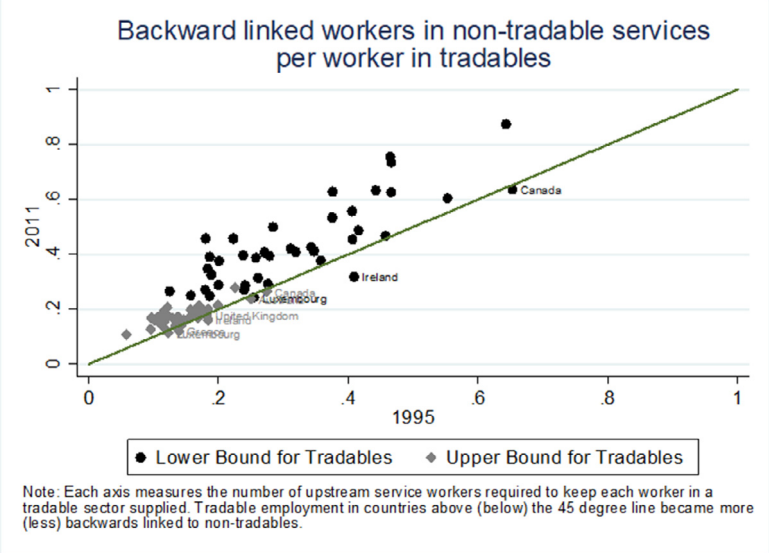


Fig. 8. Backward linkages from tradables into non-tradable industries thickened.

We discern a crude clustering of countries in the table – one that is imperfectly correlated with income.

(i) *Diverse developing countries* – India and China. Intrinsically tradable and trade-linked employment declined as labor moved rapidly out of agriculture and into non-tradable, inward-looking, services. However, these countries did open up to trade, so that export-induced labor demand rose modestly, and linkages between non-tradable and tradable industries thickened.

(ii) *Commodity-dependent developing countries* – Brazil and Indonesia. Primary sector employment declined more slowly in these countries than in the above group. There is also more employment in potentially tradable service industries, as is clear from the large gap between upper and lower bounds on tradable and trade-linked employment. Trends in tradable and trade-linked employment are therefore ambiguous during this period (though, as we saw in section III.B, trends in intrinsically tradable employment were negative over longer time spans).

(iii) *Persistent Manufacturing Economies* - Germany, Taiwan, South Korea, and to an extent, Japan. These countries had the highest levels of trade-linked employment among the advanced economies by 2011. They are also advanced economies in which EILD is growing fast. Within this group, Japan has a very low but steadily rising EILD, which may reflect its already high level of offshored manufacturing production by 1995, and its movement upstream into the management of international supply chains in the years since.

(iv) *Service Economies* - United Kingdom, France, and the US - having already transitioned from agriculture and manufacturing into services, have the lowest tradable and trade-linked employment shares in the sample. Changes in the EILD have also been small or negative.

Table 5
Intrinsically trade-linked employment - upper & lower bounds.

	1995			2011				1995			2011		
country	Lower Bound	Upper Bound	Spread	Lower Bound	Upper Bound	Spread	country	Lower Bound	Upper Bound	Spread	Lower Bound	Upper Bound	Spread
Cyprus	26.9	50.3	23.4	17.7	42.6	24.9	Spain	35.3	56.4	21.1	25.9	52.6	26.7
Australia	27.9	51.2	23.3	20	45.2	25.2	Portugal	44.4	61.3	16.9	32	53.9	21.9
USA	22.4	49.4	27.0	15	45.3	30.3	Italy	37.9	57.2	19.3	31.2	55	23.8
Latvia	43	60.2	17.2	21.1	45.8	24.7	Austria	34.7	56.6	21.9	30.4	55.7	25.3
Ireland	40.4	58.9	18.5	21	45.9	24.9	Brazil	47.7	63.8	16.1	35.8	55.9	20.1
Malta	26.8	50.7	23.9	19.1	47.4	28.3	Germany	34.7	55.3	20.6	31	56.1	25.1
UK	25.9	51.9	26.0	16.9	47.6	30.7	Russia	51.2	62.4	11.2	42.3	57.2	14.9
Lithuania	45.2	60.1	14.9	25.7	47.7	22.0	Slovakia	44	62.3	18.3	33.8	57.8	24.0
Denmark	30.2	52.4	22.2	21.7	48.5	26.8	Korea	43.2	60.7	17.5	34.8	58	23.2
Sweden	30.8	51.5	20.7	24.4	49.3	24.9	Poland	56.1	68	11.9	40.1	58.1	18.0
France	29.3	53.2	23.9	22.7	50.2	27.5	Slovenia	53.1	70.4	17.3	35.7	59.7	24.0
Mexico	44.3	55.3	11.0	37.1	50.4	13.3	Bulgaria	52.3	66.4	14.1	41.8	60.7	18.9
Estonia	44.5	62.3	17.8	28.9	50.5	21.6	Hungary	45	63.6	18.6	40	60.9	20.9
Japan	34.8	55.4	20.6	26	50.8	24.8	Czech	44.1	63.9	19.8	39.4	62.6	23.2
Netherlands	28.2	54.2	26.0	22.9	51.4	28.5	Taiwan	46.7	62	15.3	44.6	62.8	18.2
Belgium	28.4	54	25.6	21.3	51.5	30.2	Turkey	65.1	73	7.9	51.3	63.5	12.2
Greece	37.7	59.5	21.8	25.8	51.8	26.0	Romania	70.5	80	9.5	48.8	66.7	17.9
Canada	29.2	52	22.8	27.3	51.8	24.5	Indonesia	67.2	75.8	8.6	54.9	69.1	14.2
Luxembourg	21.6	53	31.4	12.4	51.9	39.5	China	75.1	81.5	6.4	61.4	71.5	10.1
Finland	37.5	55.8	18.3	29.6	52.6	23.0	India	79.4	83.5	4.1	71.1	76.9	5.8

Table 6
Tradable employment, trade linked employment and export-induced labor demand for a common set of countries and years.

Country Name	Per Capita GDP (2011$)	Share of employment in tradables					Trade Linked Employment					Export-Induced Labor Demand		
		1995		2011		Conclusion of bounds analysis	1995		2011		Conclusion of bounds analysis			
		Lower bound	Upper Bound	Lower bound	Upper Bound		Lower bound	Upper Bound	Lower bound	Upper Bound		1995	2011	Change
India	4,636	73.8	78.5	63.9	70.4	Fell	79.4	83.5	71.1	76.9	Fell	8.8	13.1	4.3
China	10,384	69.4	76.1	53.9	63.7	Fell	75.1	81.5	61.4	71.5	Fell	16.4	18.4	2.0
Indonesia	8,838	60.8	70.4	49.2	63.5	Ambiguous	67.2	75.8	54.9	69.1	Ambiguous	13.0	14.4	1.4
Brazil	14,973	39.3	54.9	26.4	45.9	Ambiguous	47.7	63.8	35.8	55.9	Ambiguous	8.9	12.4	3.5
Mexico	15,923	38.8	50.3	31.2	45.3	Ambiguous	44.3	55.3	37.1	50.4	Ambiguous	15.7	16.0	0.3
Korea	31,229	35.5	54.7	25.0	50.0	Ambiguous	43.2	60.7	34.8	58.0	Ambiguous	20.5	27.2	6.6
Japan	35,775	27.7	48.3	19.6	43.5	Ambiguous	34.8	55.4	26.0	50.8	Ambiguous	7.8	10.8	3.0
Germany	42,693	25.8	47.8	19.7	47.1	Ambiguous	34.7	55.3	31.0	56.1	Ambiguous	18.5	28.6	10.1
Taiwan		36.5	53.8	32.6	54.1	Ambiguous	46.7	62.0	44.6	62.8	Ambiguous	31.7	39.7	8.0
United Kingdom	36,456	18.3	44.1	12.0	40.5	Ambiguous	25.9	51.9	16.9	47.6	Ambiguous	17.9	19.0	1.0
France	37,457	21.2	45.6	14.0	42.4	Ambiguous	29.3	53.2	22.7	50.2	Ambiguous	18.1	17.8	-0.3
USA	49,791	16.4	43.4	10.8	39.7	Ambiguous	22.4	49.4	15.0	45.3	Ambiguous	8.0	7.9	-0.1

Note: All calculations use WIOD and NIOT data. Calculations are explained in Appendix 1.

(v) Mexico: With substantial amounts of export-oriented manufacturing employment near its Northern border and employment trends more typical of a developing economy further south, Mexico illustrates the limits of applying a national lens to study this issue.

To summarize: results from sections 3A-D demonstrate that the transition of national economies out of agriculture into services, now the most common development path, creates a deglobalizing structural undercurrent, while expanding global trade works in the opposite direction within industries. It is those economies that are most successful in supporting manufacturing that are best able to project labor outwards into other countries. In other countries, labor market globalization is experienced as a thickening of inter-sector and international trade flows that displaces some workers from tradable industries, and does not necessarily or dramatically render the workplace writ large more connected to workers and consumers in other countries.

4. Conclusions

We have examined the much-extended idea that labor markets have globalized – i.e., that national labor markets have become more interconnected. We have studied three different dimensions of labor market interconnections, clarified their relationship to one another, and argued that each dimension is relevant to a different sphere of economic analysis. Our analysis covers 40-63 countries, accounting for up to 82% of the world's population, over anywhere between 13 years and four decades.

We have shown that more globalized industries tended to shed workers, creating a de-globalizing between-industry trend that has counteracted increasingly globalized employment within industries. As a consequence, the aggregate trends provide little support for the narrative that most *national* labor markets are increasingly interconnected in most respects. Rather, globalization is a *within-sector* phenomenon. This between-sector de-globalization is unrelated to and pre-dates deglobalization due to the post-2008 slowdown in trade volumes (e.g., Timmer et al., 2016).

Here, we consider the implications of our findings with respect to each measure for policy debates and future employment scenarios.

EILD has not grown fast or everywhere, and indeed has shrunk in some countries, as labor has shifted into less export-dependent industries. These divergent experiences suggest that employment-related incentives to free ride on other economies' stimulus policies have been unevenly distributed, and have become more so. Only a few still-industrial economies in Europe, along with Taiwan and South Korea, had strong and growing employment-related incentives to free-ride on other countries' stimulus efforts. These incentives remained much weaker in many large economies, including the USA, China, India, Brazil and Japan.

Trends in tradable employment are harder to peg. Employment in intrinsically tradable industries fell unambiguously in most countries, capturing most of the developing world's workers, and increased unambiguously in none. The removal of trade restrictions may nevertheless have permitted the share of workers producing *de facto* tradable products to increase in the past. But there are few remaining restrictions on goods trade (Anderson and Van Wincoop, 2004) and restrictions on mode 1 and 2 services trade are persistent (Miroudot et al., 2013; OECD, 2019), so trends in *de facto* and intrinsically tradable employment are likely to be similar in the future. If so, any increased tradability of employment will have to come from technological changes that render more services intrinsically tradable. However, technological changes often generate labor redundancy, making their net effects on tradable employment difficult to predict (Blinder, 2006).[23] Predictions that tradable employment will grow robustly in future must contend with this arithmetic. Our educated guess is therefore that for the foreseeable future, no more than 45% of any country's labor force, and in many cases, much less, will produce goods and services that are internationally tradable. This urges attention to safety nets when using currency devaluations as an adjustment strategy, as there is not reliable evidence that the fraction of workers who might gain in the short run from such a policy has grown.

We also clarified what it would take to ascertain whether the share of workers whose pay and productivity matter for international competitiveness has grown or shrunk. Again, defying the globalization-everywhere narrative, but in a different way, we find that even with multiple heroic assumptions, it is impossible to ascertain whether this trade-linked employment share has increased or decreased in most countries. This suggests that arguments for *across-the-board* changes in labor and education policy are not empirically grounded. It may be more sensible to treat these as sector-specific policies, as we do see linkages thickening within particular industries. Governments pursuing job creation can vary labor regulations across industries according to their price elasticities of labor demand, and market mechanisms can be used to uncover who and how many would benefit most from vocational training.

Policy-makers must therefore think carefully about policy proposals that are forged in response to ostensibly globalized labor markets. They should understand what dimension of interconnection is salient to each policy decision, measure it carefully in their labor force, and then proceed in a fashion that takes the limits of what they know seriously. Governments should adjust policies affecting those sectors of the economy that have clearly globalized, but be careful about extending those policies to sectors that have not. Adjusting policy in response to labor market globalization requires a scalpel, not a broom.

Author statement

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Appendix 1. Estimation of export-induced and trade-linked labor demand

Z is the matrix recording sales in nominal value terms from 35 producing industries (in rows) to 35 destination industries (in

[23] Consider the recent explosion of online retailing. In the US, for example, e-retailing firms themselves hire fewer workers than traditional retailing (Cowen, 2011, 2013). Moreover, most jobs in industries auxiliary to online retailing are obviously place-based (i.e., non-tradable), counted within the transportation and warehousing sector, whose employment in the US has grown since the 2000s, while employment in the retail sector remained flat (Spence and Hlatshwayo, 2011, Fig. 6).

columns). Final sales by industries to satisfy final demand from 6 sources (domestic households; the government; nonprofits; firms - for, separately, capital investment and inventory accumulation purposes; and exports to the rest of the world) are recorded in the 35 × 6 matrix, **F**, partitioned according to $\mathbf{F} = (\mathbf{f_1},\ldots,\mathbf{f_5},\mathbf{x})$, where **x** is the 35 × 1 vector of exports by industry. Gross sales by industry are recorded in vector **y** (35 × 1). $\hat{\mathbf{y}}^{-1}$is a 35 × 35 diagonal matrix in which the reciprocals of the elements of **y** form the diagonal. Employment by industry is **l**(35 × 1), which is partitioned into our 16 goods and 19 services industries: $\mathbf{l} = [\mathbf{l_G}|\mathbf{l_S}]$. Leontief production functions are assumed in each industry, and the utilization of labor and intermediate inputs by each industry is assumed not to depend upon where the output is sold. The following calculations are then standard.

The matrix of Leontief technical coefficients $\mathbf{A} = [a_{ij}; i = 1\ldots35, j = 1\ldots35\ ]$ is recovered by: $\mathbf{A} = \mathbf{Z}\hat{\mathbf{y}}^{-1}$. Gross output is related to intermediate and final demand by: $\mathbf{y} = \mathbf{Zu_{35}} + \mathbf{Fu_6y}$, where $\mathbf{u_n}$ is an nx1 vector of ones. Putting these expressions together yields $\mathbf{y} = (\mathbf{I} - \mathbf{A})^{-1}(\mathbf{f}_1 + \ldots + \mathbf{f}_5 + \mathbf{x})$. The 35 × 1 vector containing outputs of each industry linked to demand for exports is then $\mathbf{y_x} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{x} = [y_{x,i}; i = 1\ldots35]$. The amounts of export-linked employment in each industry are $\mathbf{l_x} = [l_i * y_{x,i}/y_i;\ \ i = 1\ldots35]$. Total export linked employment in the economy is $\mathbf{l_x}'\mathbf{u_{35}}$. The estimated fraction of each industry's gross production that is export linked is $\hat{\mathbf{y}}^{-1}\mathbf{y_x}$. This vector also serves as our estimate of the fraction of each industry's employment that is export linked. For convenience, we label these fractionsλ_1, ..λ_{35}. The share of all employment economy wide that is export linked is given by $\lambda = (\mathbf{l_x}'\mathbf{u_{35}})/(\mathbf{l}'\mathbf{u_{35}})$.

Our bounds for intrinsically trade-linked employment are calculated as follows: Define a 35 × 1 vector capturing the fractions of activities within each of our goods and services industry that are tradable: $\boldsymbol{\tau} = [\boldsymbol{\tau_G}|\boldsymbol{\tau_S}]$. Both bounds assume goods are intrinsically tradable ($\boldsymbol{\tau_G} = \mathbf{u}_{16}$). The lower bound assumes no services are tradable ($\boldsymbol{\tau_S} = 0$) while the upper bound estimates of services tradability are derived, as before, from the geographic clustering of US industries (see Appendix 4). In either case, total trade-linked employment is calculated as $\mathbf{u}_{35}{}'(\boldsymbol{\tau} \odot \mathbf{l} + \mathbf{b})$, where ⊙ denotes element-wise multiplication of vectors, and each of the 35 elements of **b** is given by $b_i = \tau_i y_i \sum_{j=1}^{35}(1 - \tau_j)a_{ji}/\lambda_j$. The $\boldsymbol{\tau}\odot\mathbf{l}$ term is simply direct employment in tradable industries. The **b** vector is employment in non-tradable activities that exists to supply auxiliary services to tradables: $\tau_i y_i$ is the amount of activity in industry i that is tradable, a_{ji}/λ_j is the labor demanded in industry j to make possible a unit of activity in industry i, and $(1 - \tau_j)$ is a correction to ensure that only non-tradable employment in industry j gets added to the indirect effects. This procedure only captures first order backwards linkages – a trucker who transports tradable products is considered trade-linked; the mechanic who maintains his/her truck is not. This is a second order concern, as even with this assumption the over-time trends are ambiguous.

Appendix 2. International labour organization data cleaning procedures

We began with the full LABORSTA database, which contains information on the numbers of employed persons over time for 174 countries. In any given country and year, these data can include competing series of estimates from more than one source, and the sources may use different industrial classifications.

We culled and cleaned this dataset as follows. We first kept observations collected according to the International Standard Industrial Classification (ISIC) revisions 2, 3, or 4, and dropped those collected according to ISIC Revision 1. We then dropped series that exclude major sections of the workforce (e.g., rural residents, agricultural workers). In those instances where employment levels in some industries were missing, but could be inferred from total employment and employment in other industries (e.g., Spain was missing only agricultural employment in 1978 but provided data on total employment), we filled in the blanks and checked to see whether this yielded discontinuities in the series. Where discontinuities were observed, the series was dropped. Where the information needed to fill in the holes was unavailable (e.g. the series based on Costa Rica's labor force survey has no estimates for mining, utilities or finance between 1976 and 1978 and was dropped) we dropped those years, but not the entire series.

After these adjustments, some countries still had multiple series. For these countries, we combined the series. When two series were available with overlapping years we opted to use the longest available series for those years, and use the data from the remaining years from the shorter series. If two series overlapped temporally and had the same length, we chose the one in ISIC revision 2. If series did not overlap, we spliced them together and checked the total employment series visually for breaks. If the temporal gap between the two series exceeded three years, such a test was not possible. We then checked the resulting total employment series visually to ensure that there were no breaks or anomalies. Once the longer series were assembled, we mapped all non-ISIC Revision 2 data to ISIC revision 2. Finally, we restricted attention to the 67 countries for which the graphically consistent series spanned at least 20 years.

For the People's Republic of China (PRC) we use Census data from 1982, 1990, 1995, 2000, 2005 and 2010. Data from the PRC's Yearbooks are considered less reliable, particularly in their handling of migrant workers (Li and Gibson, 2013) and don't cover the rural industry post-2003.

We have produced graphs of the upper and lower bound estimates of intrinsically tradable employment separately for all countries, and found only one country, Botswana, in which these series appear to display sudden jumps.

Appendix 3. Intrinsically tradable employment estimates from Groningen growth and development centre data

As noted the ILO data are somewhat limited in their temporal coverage. The GGDC's 10 Sector Database provides longer series on employment shares, typically back to the 1960s, and in some cases to the 1950s, and ending between 2010 and 2012. While it only includes data on 42 countries, several of these are not in our ILO dataset, including eleven countries in Sub-Saharan Africa.

These data reconfirm a decline in employment in intrinsically tradable industries. In 39 out of 42 countries, the initial lower-bound is higher than the subsequent upper bound. This includes several countries that fell in the ambiguous category using ILO data: The three exceptions are Singapore, Nigeria and Zambia. In Singapore, the lower bound estimate declines over time and the upper bound estimate increases, leaving it in the ambiguous category. In Nigeria, intrinsically tradable employment declined from over 80% in 160 to around 50% in 1982 before climbing back up to over 70% by 2010. This V-shape was driven entirely by a dramatic rebound in agriculture's share of employment. Zambia is the only country in either dataset in which our bounds reveal evidence of an increase in intrinsically tradable employment, which rose from around 70% to around 80%, driven again by agricultural expansion. However, as noted in previous studies (McMillan et al., 2014), the increase in agricultural employment in these two countries is exceptional.

Appendix 4. Assumed level of intrinsic tradability of WIOD and 1 digit ISIC industries

WIOD CODE	DESCRIPTION	Upper Bound (EU countries)	Upper Bound (non-EU countries)	How we got this value	1 Digit	Upper Bound
AtB	Agriculture, Hunting, Forestry and Fishing	100.00%	100.00%	Goods are tradable	Agriculture	100.00%
C	Mining and Quarrying	100.00%	100.00%	Goods are tradable	Mining	100.00%
15t16	Food, Beverages and Tobacco	100.00%	100.00%	Goods are tradable	Manufacturing	100.00%
17t18	Textiles and Textile Products	100.00%	100.00%	Goods are tradable		
19	Leather, Leather and Footwear	100.00%	100.00%	Goods are tradable		
20	Wood and Products of Wood and Cork	100.00%	100.00%	Goods are tradable		
21t22	Pulp, Paper, Paper, Printing and Publishing	100.00%	100.00%	Goods are tradable		
23	Coke, Refined Petroleum and Nuclear Fuel	100.00%	100.00%	Goods are tradable		
24	Chemicals and Chemical Products	100.00%	100.00%	Goods are tradable		
25	Rubber and Plastics	100.00%	100.00%	Goods are tradable		
26	Other Non-Metallic Mineral	100.00%	100.00%	Goods are tradable		
27t28	Basic Metals and Fabricated Metal	100.00%	100.00%	Goods are tradable		
29	Machinery, Nec	100.00%	100.00%	Goods are tradable		
30t33	Electrical and Optical Equipment	100.00%	100.00%	Goods are tradable		
34t35	Transport Equipment	100.00%	100.00%	Goods are tradable		
36t37	Manufacturing, Nec; Recycling	100.00%	100.00%	Goods are tradable		
E	Electricity, Gas and Water Supply	19.15%	19.15%	Jensen & Kletzer, Table 4	Utilities	19.15%
F	Construction	0.00%	0.00%	Spence & Hlatshwayo, Appendix II	Construction	0.00%
50	Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	0.00%	0.00%	By assumption	Commerce	22.09%
51	Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	0.00%	0.00%	Spence & Hlatshwayo, Appendix II		
52	Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	14.82%	14.82%	Spence & Hlatshwayo, Appendix II		
H	Hotels and Restaurants	50.00%	50.00%	By assumption		
60	Inland Transport	100.00%	0.00%	By assumption	Transportation & Communications	45.83%
61	Water Transport	100.00%	100.00%	By assumption		
62	Air Transport	100.00%	100.00%	By assumption		
63	Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	27.12%	27.12%	Aggregated using employment data and Jensen & Kletzer 2006, Table 2		
64	Post and Telecommunications	72.58%	72.58%	Aggregated using employment data and Jensen & Kletzer 2006, Table 2		
J	Financial Intermediation	67.46%	67.46%	Aggregated using employment data and Jensen & Kletzer 2006, Table 2	FIRE	72.61%
70	Real Estate Activities	0.00%	0.00%	Spence & Hlatshwayo		
71t74	Renting of M&Eq and Other Business Activities	81.03%	81.03%	Aggregated using employment data and Jensen & Kletzer 2006, Table 2		
L	Public Admin and Defence; Compulsory Social Security	0.00%	0.00%	Spence & Hlatshwayo, Appendix II	Other	5.43%
M	Education	1.14%	1.14%	Aggregated using employment data and Jensen & Kletzer 2006, table 2		
N	Health and Social Work	2.14%	2.14%	Aggregated using employment data and Jensen & Kletzer 2006, Table 2		
O	Other Community, Social and Personal Services	27.11%	27.11%	Aggregated using employment data and Jensen & Kletzer 2006, table 2		
P	Private Households with Employed Persons	0.00%	0.00%	Aggregated using employment data and Jensen & Kletzer 2006, Table 2		

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