Manufacturing Employment, Trade and Structural Change*

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Abstract

By using a growth accounting framework I provide quantitative estimates of the impact of international trade on sectoral employment shares, in the presence of structural change. I find that in the USA between 1995 and 2014, international trade accounts for 16 percent of the decline in the goods sector employment share. Across countries, the impact of trade on the goods sector employment share is heterogeneous in sign and magnitudes, and is correlated with comparative advantage in the goods sector. I then introduce a Ricardian model of trade with structural change, to shed light on the comparative advantage mechanism. In the data and in the model, international trade mitigates structural change forces in countries with a comparative advantage in the goods sector, while it magnifies structural change forces in countries with a comparative advantage in the service sector. The framework and results I present suggest that trade policy has a limited role in "bringing the manufacturing jobs back".

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1 Introduction

As can be observed in Figure (1a), the goods sector employment as a share of total employment has fallen in the USA from 16.4% in 1995 to 10.7% in 2014. This had led to political pressure to reverse this trend, as evidenced in claims to "bring the jobs back" via more protectionists policies aimed to reverse the goods sector trade deficit. During this period, the trade integration in both goods and services in the USA has increased significantly, as seen in Figure (2a).

Among economists, however, there seems to be a qualitative agreement: most of the decline in the goods sector employment share is due to structural change, not international trade. Closing the economy, thus, would not increase the goods sector employment share substantially. Furthermore, both the decline in the goods sector employment share and the increasing trade integration are a global phenomena, as Figures (1b) and (2b) suggest.[1]

However, there is no quantitative consensus about the exact impact of international trade on sectoral employment in the presence of structural change. My paper thus attempts to answer two main questions: (i) What is the quantitative impact of international trade on sectorial employment shares?, and (ii) Why is there a different impact of trade on sectorial employment shares across countries? The key goal is in decomposing the total change in sectorial employment share as the sum of a structural change effect and an international trade effect:

$$\text{Change in Sectoral Employment Share} = \text{Structural Change Effect} + \text{International Trade Effect}$$

To tackle this, I develop a growth accounting framework based on a world economy with multiple-sectors and trade in both final and intermediates goods and services. I use data from the World Input Output Database (henceforth WIOD), that traces the flow of goods and services across 35 industries and 40 countries over the period 1995-2014.

I show that in the 1995-2014 period in the USA the trade balance accounts for 16% of the decline in the goods sector employment share.[2] In the manufacturing sector, the trade-balance accounts for 9% of the decline in the employment share. Most of the decline in the goods and manufacturing employment share in the USA is due to structural change (in particular capital biased technological change and the evolving input-output structure).

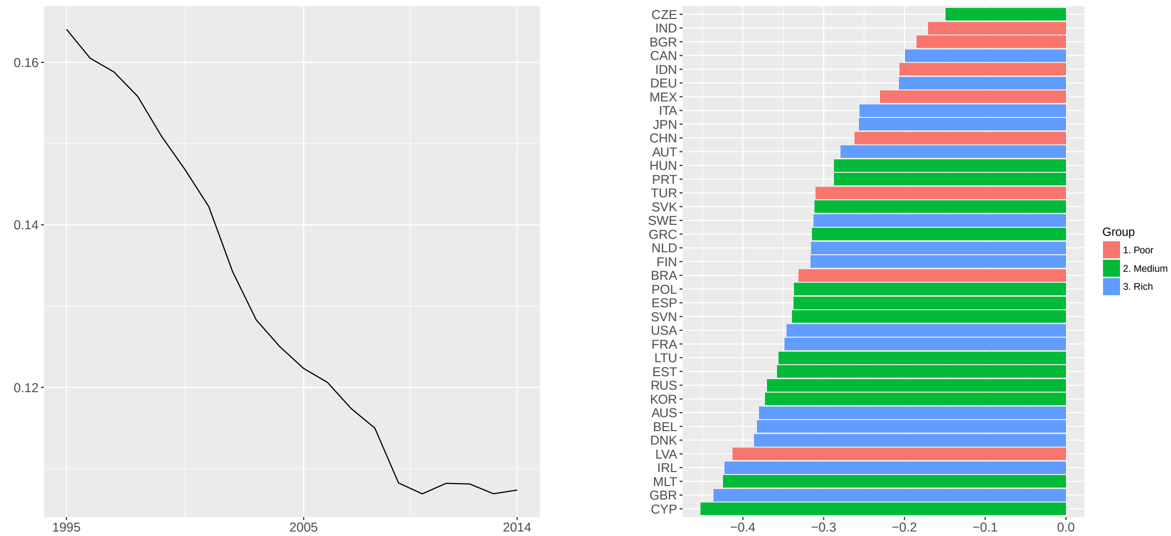
Across countries, the trade balance effect is heterogeneous in sign and magnitudes: it is positive in some

[1] Service trade is on the rise. As can be observed in Figure (2a), service trade has increased in this period more than trade in goods. Service trade is still smaller than trade in goods: in the USA, for instance, services exports are around 30% of goods exports (but this value is increasing over time). See Mattoo et al. [2008] and Francois and Hoekman [2010] for a detailed discussion on service trade.

[2] See Tables (A1) and (A2) for the sector classification and aggregation criteria. I later also present results for the manufacturing sector separately.

Figure 1: Goods Sector Employment Share

(a) USA (b) Percent Change (1995-2014), all countries

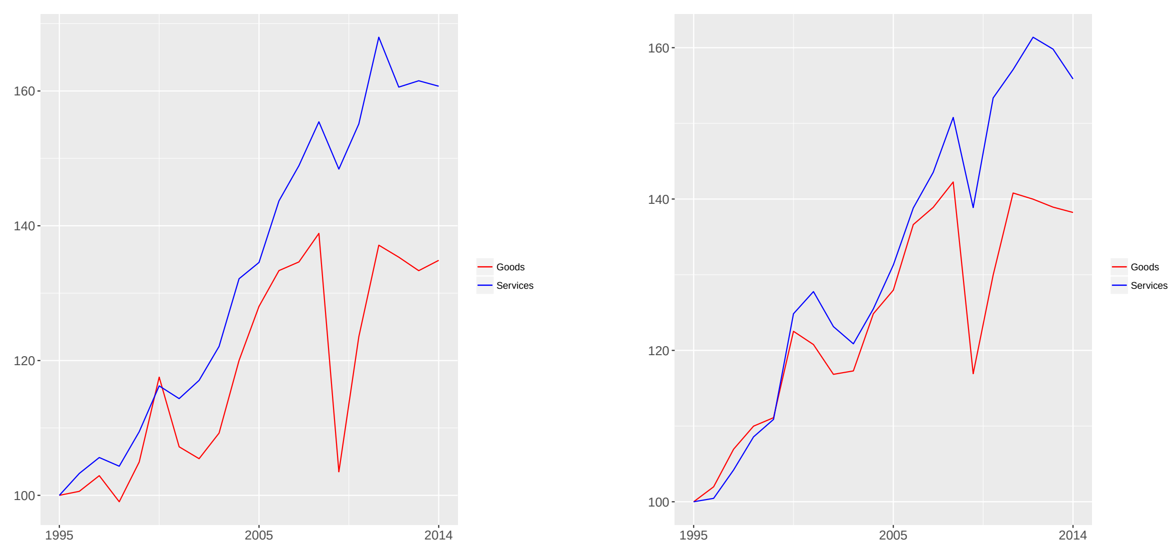


Source: WIOD.

Notes: I classify Agriculture and Manufacturing as goods, and all other sectors as services, as described in Appendix (B.3). I classify countries in three groups according to their level of GDP per capita in 2014. See Appendix (B.1) for more details.

Figure 2: Imports relative to total GDP (1995=100)

(a) USA (b) World



Source: WIOD.

countries (such as the USA and France) and negative in others (such as China and Germany). A positive sign means that international trade tended to reduce the goods sector employment share, while a negative sign means that trade tended to mitigate the decline in the goods sector employment share (the goods sector employment share declines across all countries in the sample between 1995 and 2014).

I then move from the 'what' to the 'why': I show that across countries, the trade balance effect for a given sector is correlated with an empirical measure of comparative advantage for that sector. To shed light on this relationship, I build a theoretical model of structural change with international trade and Ricardian comparative advantage. In the model, the goods sector employment share tends to decline across all countries, due to structural change. However, trade integration "magnifies" structural change forces in countries with a comparative advantage in the services sector and "mitigates" structural change forces in countries with a comparative advantage in the goods sector. The main predictions of the model are thus consistent with the reported empirical patterns.

1.1 Contribution to the Literature

As they develop, economies undergo large sectoral reallocations of output, employment and expenditures. This process is commonly known as "structural change" (Kuznets [1973]; Comin et al. [2015]). Economies also undergo large sectoral reallocations as they open up to international trade (Ricardo [1817]; Feenstra [2003]).

Most of the literature on structural change has been in a closed economy context.[3] Matsuyama [2009] however argues that in order to understand cross-country patterns of structural change one needs a world economy model in which the interdependence across countries is explicitly spelled out. There is now an increasing literature in what can be called "open economy structural change". In particular, some papers also attempt to estimate the (quantitative) impact of trade on sectoral employment shares. My results for the USA are overall consistent with those in Kehoe et al. [2018].[4]

In contrast to most of the literature that tends to focus on one country, I use a large sample of countries in the empirical application. Furthermore, the growth-accounting framework I use is very flexible and allows for several mechanisms that affect the evolution of employment shares. Methodologically, I build on the work by Berlingieri [2013], extending his framework in three key dimensions.[5] First, I allow for

[3] Theories of (closed economy) structural transformation can be classified based on whether they consider mechanisms involving demand or production (Comin et al. [2015]). Demand-side theories emphasize the role of heterogeneity in income elasticities of demand across sectors (Engel's law/non-homotheticity preferences) in driving the observed reallocations accompanying income growth (see Comin et al. [2015] and references therein). Production-side theories, in turn, focus on the differences across sectors in the rates of technological growth (Baumol [1967]; Ngai and Pissarides [2007]), capital intensities (Acemoglu and Guerrieri [2008]) and intermediate-input demand (Berlingieri [2013]).

[4] Other papers that also study the link between international trade and structural change are Uy et al. [2013], Święcki [2017], Cravino and Sotelo [2016], Sposi [2015] and Teignier [2009].

[5] Berlingieri [2013] in turn builds on seminal contributions related to growth accounting with intermediate inputs: Hulten [1978]

international trade. Second, I include capital. Third, I allow for evolving factor income shares. With these modifications, in addition to the demand and input-output mechanisms in Berlingieri [2013], I show that sectoral employment reallocation also depends on the evolution of the sectoral trade balance and on the (sectoral and aggregate) labor intensity.[6] While Berlingieri [2013] focuses on the role of outsourcing and structural change in the USA, I focus on the role of trade and structural change in a large sample of countries. The multi-country production structure and notation I use is similar to the one in Johnson [2014].

To the best of my knowledge my paper is the first to use the 'Price Independent Generalized Linearity' (PIGL) preference structure in an international trade model. The PIGL (a non-homothetic preference) was developed by Muellbauer [1975] and recently used by Boppart [2014] in the context of a closed economy structural change model.[7] The model is linked with data using the revealed comparative advantage index (RCA), following the goods/services application in Barattieri [2014].

The rest of the paper is organized as follows. Section (2) presents the empirical framework and the estimation results. Section (3) links the empirical findings with empirical measures of comparative advantage. Section (4) introduces a theoretical model of structural change with comparative advantage that is consistent with the empirical findings. Section (5) concludes.

2 Empirical Growth Accounting Framework

Consider a multi-period world economy with many countries ($i, j \in \{1, 2, ..., N\}$) and many sectors ($s, s' \in \{1, 2, ..., S\}$). Country i produces output in sector s using capital $K_{it}(s)$, labor $L_{it}(s)$, and composite intermediate input bundle $X_{it}(s)$, which is an aggregate of intermediate inputs produced by different source countries.

I assume that the sector-level production function takes a nested Cobb-Douglas form:

$$Q_{it}(s) = Z_{it}(s) \left[V_{it}(s)\right]^{\beta_{it}(s)} \left[X_{it}(s', s)\right]^{1-\beta_{it}(s)} \tag{1}$$

Where $Z_{it}(s)$ is sector-specific productivity, $V_{it}(s)$ is a composite domestic factor input composed of labor, $L_{it}(s)$, and capital, $K_{it}(s)$:

in the productivity literature and Horvath [1998] in the business-cycle context.

[6] Traditionally, growth accounting frameworks assume constant factor income shares, in line with "Kaldor's Facts". I show however that the labor income share has changed significantly in most countries in the 1995-2014 period. To the best of my knowledge, only Fernald and Neiman [2011] and some references therein discuss some of the implications of changing factor income shares in a growth accounting setting. Also see comments by Brent Neiman on the Fall 2013 Brookings paper by Elsby et al.

[7] Most of the studies in the open economy structural change literature have used Stone-Geary preferences. However, Stone-Geary is well known to have limitations. Stone-Geary is "asymptotically homothetic" (Matsuyama [2016]), which implies that the income elasticity differences across sectors decline with per capita income. This property is not observed in the data (see Comin et al. [2015] and references therein). In this paper I consider a sample with countries at very different stages of development, which makes the PIGL better suited than the Stone-Geary.

$$V_{it}(s) = [L_{it}(s)]^{\alpha_{it}(s)} [K_{it}(s)]^{1-\alpha_{it}(s)} \tag{2}$$

Furthermore, $X_{it}(s',s)$ is a composite of intermediate inputs used by sector s, which is composed of a bundle of $X_{jit}(s',s)$, the quantity of intermediate inputs from sector s' in country j used by sector s in country i:

$$X_{it}(s',s) = \prod_{s'=1}^{S}\prod_{j=1}^{N}\left(X_{jit}(s',s)\right)^{\gamma_{jit}(s',s)} \tag{3}$$

Finally, $\left\{\beta_{it}(s), \alpha_{it}(s), \gamma_{jit}(s)\right\}$ are parameters that govern shares of inputs in gross output, individual factors in value added, and individual inputs in total input use, respectively. Note that labor, capital and intermediate input shares are allowed to differ across sectors, countries, and time. The Cobb-Douglas formulation for the production of gross output is quite common in growth accounting (see Berlingieri [2013]).

In the Appendix (A.1) I show that perfect competition, firm optimization and market clearing imply that the employment share $l_{it}(s) \equiv \frac{L_{it}(s)}{L_{it}}$ in sector s is

$$l_{it}(s) = \frac{\alpha_{it}(s)}{\alpha_{it}}\beta_{it}(s)\left[f_{Nit}(s) + x_{Nit}(s,s') + tb_{iJt}(s)\right] \tag{4}$$

where the new variables introduced are,

1. $\alpha_{it} \equiv \frac{w_t L_{it}}{p_{it} V_{it}}$ is the labor share of income in GDP.
2. $f_{Nit}(s) \equiv \sum_{j=1}^{N} \frac{p_{it}(s) F_{jit}(s)}{p_{it} V_{it}}$ is the domestic absorption of sector s good in country i, as a fraction of GDP.
3. $x_{Nit}(s,s') \equiv \sum_{j=1}^{N}\sum_{s'=1}^{S} \frac{p_{it}(s) X_{jit}(s,s')}{p_{it} V_{it}}$ are the intermediate inputs from sector s used in country i, as a fraction of GDP.
4. $tb_{iJt}(s) \equiv \sum_{j\neq i}^{N} \frac{p_{it}(s) TB_{ijt}(s)}{p_{it} V_{it}}$ is the trade balance of sector s in country i, as a fraction of GDP.[8]

According to this expression, the employment share in sector s in country i increases

1. the more labor-intensive sector s in country i, relative to the economy of country i as a whole,
2. the higher the share of value added in output of sector s in country i,
3. the higher the domestic absorption in the sector s in country i,

[8] The notation can be interpreted as using N to represent the set of all countries, and J for the set of all countries except i.

4. the higher the intermediate inputs from sector s used in country i,

5. the higher the trade balance of country i in sector s.

To get some intuition, consider an economy with no capital ($\alpha_{it} = \alpha_{it}(s) = 1$) and no intermediate inputs ($\beta_{it}(s) = 1$ and $x_{Nit}(s,s') = 0$). Thus, Equation (4) now becomes $l_{it}(s) = f_{Nit}(s) + tb_{iJt}(s)$: the employment share of sector s increases with domestic expenditure in sector s and with the trade balance of sector s. Consider the case of the Goods sector: evidence suggest that the expenditure share of goods decreases with income, so as economies get richer, expenditure in the goods sector falls. This "Engel Curve" mechanism is the main demand-side channel that explains structural change (Comin et al. [2015]).[9] A decline in $f_{Nit}(G)$ then would tend to reduce $l_{it}(G)$. However, there is also the trade-balance channel. The US has experienced an increasing goods sector trade-deficit: $tb_{it}(s)$ is negative and has increased (got more negative) in the 1995-2014 period. Thus, $tb_{iJt}(s)$ would also tend to reduce $l_{it}(G)$. However, it could be the case that either the expenditure channel or trade-balance channel tend to increase the goods sector employment share. Figure (1b) shows that all countries in the sample have experienced declines in the goods sector employment share. Thus, even if one of these components tends to increase the goods sector employment share, in all countries the net result has been negative.

Now consider a version of this framework with capital but still without intermediate inputs. The employment shares becomes $l_{it}(s) = \frac{\alpha_{it}(s)}{\alpha_{it}}\left[f_{Nit}(s) + tb_{iJt}(s)\right]$. Now, the arguments about expenditure and trade-balance from the previous paragraph still hold, but conditional on what is happening to $\alpha_{it}(s)$ and α_{it}. One can interpret $\alpha_{it}(s)$ as the labor-intensity in sector s: it increases with the ratio of labor inputs to capital used in the production process.[10] A decline in this parameter can be interpreted as capital-biased technical change: capital is substituting labor in sector s.

In an economy that also has with intermediate inputs, Equation (4) holds. Here it is important to distinguish between the intermediate inputs used by sector s, and the intermediate inputs from sector s used in the economy. For the former, intermediate inputs have a similar effect that capital does: intermediate inputs can substitute labor, so the higher the share of intermediate inputs in value added (the lower $\beta_{it}(s)$), the lower the employment share in sector s. For the later, as in Berlingieri [2013], the changing nature of the input-output (henceforth I-O) structure of the economy affects sectoral employment: in a model with intermediate inputs, employment shares depend on the input-output I-O structure of the economy through the Leontief inverse matrix. Equation (4) boils down to the one in Berlingieri [2013] for $\alpha_{it} = \alpha_{it}(s) = 1$ and

[9] This channel is most frequently modeled via non-homothetic preferences.

[10] Note that I have assumed perfect competition and hence value added is the sum of labour and capital compensation. In an economy with profits, however, a decline in the labor income share does not necessarily correspond to an increase in the capital income share, since the profit share can be increasing. See Gallacher [2018] for further discussion and evidence on sectoral market power.

a closed economy, $tb_{iJt}(s) = 0$.

All right hand side components of Equation (4) are taken as exogenous.[11] In particular, the expenditure/demand side is not modeled in this section.

2.1 Growth Accounting

Equation (4) can be expressed in percentage-changes terms (see Appendix (A.1.4) for details),

$$\widehat{l_{it}}(s) = \widehat{\alpha_{it}}(s) - \widehat{\alpha_{it}} + \widehat{\beta_{it}}(s) + \frac{f_{Ni\tau}(s)}{y_{i\tau}(s)}\widehat{f_{Nit}}(s) + \frac{x_{Ni\tau}(s,s')}{y_{i\tau}(s)}\widehat{x_{Nit}}(s,s') + \frac{tb_{iJ\tau}(s)}{y_{i\tau}(s)}\widehat{tb_{iJt}}(s) \tag{5}$$

where the hat notation indicates percentage-changes of a variable, $\widehat{l_{it}}(s) = \frac{l_{i\upsilon}(s) - l_{i\tau}(s)}{l_{i\tau}(s)}$ with $\upsilon > \tau$. Period $t = \tau$ represents the initial period and $t = \upsilon$ represents the end period. Note that if $\widehat{l_{it}}(s) = \frac{l_{i\upsilon}(s) - l_{i\tau}(s)}{l_{i\tau}(s)} > 0$, $l_{it}(s)$ is increasing over time, while it is decreasing over time if $\widehat{l_{it}}(s) = \frac{l_{i\upsilon}(s) - l_{i\tau}(s)}{l_{i\tau}(s)} < 0$. Variable $y_{i\tau}(s)$ denotes the fraction of gross output to value added and hence $\frac{tb_{iJ\tau}(s)}{y_{i\tau}(s)}$ is the ratio of the sectorial trade balance to gross output (since value added is diving both numerator and denominator).

Equation (5) says that the evolution of the sectoral employment share over time is given by the sum of the evolution of each of the variable on the right hand side of Equation (4). While the three first variables impact the sectoral employment shares one-to-one, the effect of the latter three variables are dampened by their weight in gross output production.

2.1.1 Decomposition

Re-arranging Equation (5) yields the contribution of each variable to the change in the sectoral employment share. Dividing both sides by $\widehat{l_{it}}(s)$,

$$1 = \underbrace{\frac{\widehat{\alpha_{it}}(s)}{\widehat{l_{it}}(s)} - \frac{\widehat{\alpha_{it}}}{\widehat{l_{it}}(s)} + \frac{\widehat{\beta_{it}}(s)}{\widehat{l_{it}}(s)} + \frac{f_{Nit}(s)}{y_{it}(s)}\frac{\widehat{f_{Nit}}(s)}{\widehat{l_{it}}(s)} + \frac{x_{Nit}(s,s')}{y_{it}(s)}\frac{\widehat{x_{Nit}}(s,s')}{\widehat{l_{it}}(s)}}_{\text{"Structural Change Channel"}} + \underbrace{\frac{tb_{iJt}(s)}{y_{it}(s)}\frac{\widehat{tb_{iJt}}(s)}{\widehat{l_{it}}(s)}}_{\text{"Trade Balance Channel"}} \tag{6}$$

Each element of the right hand side of this equation now indicates how much it contributes to the change in the sectoral employment share. Note that the right hand side elements have been separated into two groups: the "Trade Balance Channel" is the effect that net-exports have on sectoral employment shares, while the "Structural Change Channel" is the effect that the rest of variables have on the sectoral employment shares. In this paper I focus on the trade-balance channel as the main way in which international

[11] As Berlingieri [2013] notes, the approach is close in spirit to the work of Carvalho and Gabaix [2013] who take the change of the Domar weights as given.

trade affects an economy.[12]

As described before, the main focus of the growth accounting exercise is in the last item, $\frac{tb_{iJt}(s)}{y_{it}(s)}\frac{\widehat{tb}_{iJt}(s)}{\widehat{l}_{it}(s)}$, which is the fraction of the change in the employment share that is accounted by the (output-weighted) change in the trade balance.

For ease of exposition, it will be convenient for later to name each of these channels as follows,

$$\begin{aligned}
1 = & \frac{\widehat{\alpha}_{it}(s)}{\widehat{l}_{it}(s)} - \frac{\widehat{\alpha}_{it}}{\widehat{l}_{it}(s)} && \text{"Technical Change Channel"} \\
& + \frac{\widehat{\beta}_{it}(s)}{\widehat{l}_{it}(s)} && \text{"Value Added Share Channel"} \\
& + \frac{f_{Nit}(s)}{y_{it}(s)}\frac{\widehat{f}_{Nit}(s)}{\widehat{l}_{it}(s)} && \text{"Final Demand Channel"} \\
& + \frac{x_{Nit}(s,s')}{y_{it}(s)}\frac{\widehat{x}_{Nit}(s,s')}{\widehat{l}_{it}(s)} && \text{"Input Demand Channel"} \\
& + \frac{tb_{iJt}(s)}{y_{it}(s)}\frac{\widehat{tb}_{iJt}(s)}{\widehat{l}_{it}(s)} && \text{"Trade Balance Channel"}
\end{aligned}$$

where $\widehat{\alpha}_{it}(s) - \widehat{\alpha}_{it}$ can be interpreted as the capital-biased technological change in a given sector, relative to the economy as a whole.

2.2 Empirical Counterpart: Observed and Predicted Sectoral employment share

Denote by $l_{it}(s)$ the observed sectoral employment share and by $l^p_{it}(s)$ the predicted one that corresponds to plugging the appropriate data to Equation (4),

$$l^p_{it}(s) = \frac{\alpha_{it}(s)}{\alpha_{it}}\beta_{it}(s)\left[f_{Nit}(s) + x_{Nit}(s,s') + tb_{iJt}(s)\right] \tag{7}$$

Similarly for the expression in percentage-changes (Equation (5)), we can denote by $\widehat{l}_{it}(s)$ the observed sectoral employment share percent change and by $\widehat{l}^p_{it}(s)$ the predicted one that corresponds to plugging the appropriate variables to Equation (8),

[12]International trade can impact an economy in ways that go beyond the trade balance. For instance, trade integration can alter the factor input prices, thus affecting optimal input demand by firms, ultimately changing $\alpha_{it}(s)$. Trade integration can also affect global value chains, and thus affect $\beta_{it}(s)$. One can imagine more channels in which trade integration affects the items what I have termed the "Structural Change Channel". Studying and incorporating the impact of international trade on the first five components of Equation (4) goes beyond my objective at this stage. Having said this, however, I think that my framework is a reasonable starting point, and in particular $\alpha_{it}(s)$ (which turns out to be one of the most empirically important variables), might indeed be a fully "Structural Change" variable: if international trade impacts $\alpha_{it}(s)$ via prices equally across sectors (which is reasonable to think in competitive markets), and since only the relative evolution of $\alpha_{it}(s)$ impacts the employment share (relative to the aggregate $\alpha_t(s)$), then the only relevant force explaining differences in evolution of $\widehat{\alpha}_{it}(s) - \widehat{\alpha}_{it}$ across sectors is structural change, not international trade.

$$\widehat{l_{it}^{p}}(s) = \widehat{\alpha}_{it}(s) - \widehat{\alpha}_{it} + \widehat{\beta}_{it}(s) + \frac{f_{Ni\tau}(s)}{y_{i\tau}(s)}\widehat{f}_{Nit}(s) + \frac{x_{Ni\tau}(s,s')}{y_{i\tau}(s)}\widehat{x}_{Nit}(s,s') + \frac{tb_{iJ\tau}(s)}{y_{i\tau}(s)}\widehat{tb}_{iJt}(s) \tag{8}$$

If the framework matched the data perfectly well, then $l_{it}(s) = l_{it}^{p}(s)$ and $\widehat{l}_{it}(s) = \widehat{l_{it}^{p}}(s)$. However, one would expect that this would generally not be the case. Let $\widehat{\Gamma}_{it}$ be a measure of framework fitness,

$$\widehat{\Gamma}_{it}(s) \equiv \frac{\widehat{l_{it}^{p}}(s)}{\widehat{l}_{it}(s)} \tag{9}$$

The rest of this section will consist of measuring all right hand side variables of Equations (7) and (8) and applying the decomposition procedure described before.

2.3 Data Source

Data used to conduct the growth accounting exercise is obtained from the World-Input Output Database (WIOD), which is publicly available at www.wiod.org (see Timmer et al. [2015] and references therein for a detailed explanation of its construction). I use both the World Input Output Tables (henceforth WIOT) and the Socio-Economic Accounts (henceforth SEA). WIOT provides bilateral final and intermediate input sectoral country transactions. SEA contains information on industry-level employment, labour compensation, gross output and value added among other variables. I use yearly data for the 1995-2014 period for 37 countries.

I use two main sector classification criteria: (i) Goods/Services (which results I focus on this paper), and (ii) Agriculture/Manufacturing/Services (which results are available in the online appendix). I will study the case of the USA first and then the full sample of countries in WIOD (excluding Luxembourg).[13]

2.4 USA Case

USA, Goods and Service Sectors

Table (1) shows the decomposition results for the USA for the goods and service sectors in the 1995-2014 period. The goods sector decomposition results, reported in the first column, indicate that international trade, via the "Trade Balance Channel", accounts for 16% of the decline in the goods sector employment share. Most of the decline in the goods sector employment share, however, is due to structural change forces: in particular the "Productivity Channel" (50% of the decline) and the "Input Demand Channel" (30% of the decline).

[13] In Appendix (B.3) I describe the aggregation criteria. In Appendix (B.4) I describe the procedure to merge the 2013 and 2016 releases of WIOD.

The second column reports the decomposition results for the service sector. Note that the interpretation of these numbers are conditional on the sign on the denominator: $\widehat{l_{it}}(s)$ is negative in the goods sector and positive in the service sector. A positive sign in Table (1) means that a given channel tends to decrease the employment share in the goods sector, and tends to increase it in the service sector.

The last row of each column indicate the sum of all decomposition channels. They add up to a number close to, but not exactly, 1. This fact is similar to the existence of the growth accounting prediction error, $\widehat{\Gamma}_{it}(s)$, as discussed previously.[14]

Table 1: Growth Accounting Decomposition for $i = USA$, $s = Goods, Services$, 1995-2014 period

	Goods Sector	Service Sector
Technical Change Channel	0.50	0.44
Value Added Share Channel	-0.04	-0.44
Final Demand Channel	0.05	0.33
Input Demand Channel	0.30	0.61
Trade Balance Channel	0.16	0.04
Sum	0.98	0.97

According to these results, 16% of the decline in the goods sector employment share between 1995 and 2014 is due to the increase in the goods sector trade deficit.[15] This corresponds to the fact that the goods sector trade balance as a fraction of sector GDP, $tb_{iJt}(s)$ has also decreased (got more negative): the goods sector trade deficit increased, as seen in the third to last column of Table (2) . This has tended to reduce the goods sector employment share. This is overall consistent for previous estimates for the USA: Kehoe et al. [2018] estimate that the trade balance explains between 11 and 20 percent of the decline in the U.S. goods-sector employment share, having a preferred estimate of 15.1 percent.

In the service sector, the trade balance channel accounted for 4% of the rise in the employment share. This is due to the fact that the service trade surplus increased slightly, thus contributing also slightly to the rise in the service sector employment share.

Table 2: Key Variables for $i = USA$, $s = Goods, Services$, $t = 1995, 2014$

Country	Year	Sector	$l_{it}(s)$	$\alpha_{it}(s)$	α_{it}	$\beta_{it}(s)$	$f_{Nit}(s)$	$x_{Nit}(s,s')$	$tb_{iJt}(s)$	$l^{p}_{it}(s)$	$\Gamma_{it}(s)$
USA	1995	Goods	0.16	0.59	0.60	0.34	0.20	0.35	-0.03	0.18	1.07
USA	2014	Goods	0.11	0.47	0.58	0.34	0.19	0.30	-0.06	0.12	1.12
USA	1995	Services	0.84	0.60	0.60	0.64	0.81	0.46	0.02	0.82	0.99
USA	2014	Services	0.89	0.60	0.58	0.62	0.84	0.51	0.02	0.88	0.98

In order to better understand the forces behind these channels, we can look at the data used in the growth-accounting exercise. Table (2) presents the key variables needed for the decomposition growth

[14] In fact, the sum is equal to $\widehat{\Gamma}_{it}(s)$. In Gallacher [2018] I study the sources of prediction error across countries and the role of market power.

[15] This results is statistically significant. See Appendix (C) for a discussion on a methodology to construct confidence intervals.

accounting exercise presented before in Table (1). Among other things, we can see in the fourth column that the sector employment share, $l_{it}(s)$, declined in the goods sector (and hence rised in the service sector, since $l_{USA,t}(Goods) + l_{USA,t}(Services) = 1$. Columns 5 to 10 show the values of the key variables for the growth-accounting. The last two columns of Table (2) show the predicted employment share and the prediction error, as defined in the previous subsection. These predicted values corresponds to "plugging-in" the data into Equation (7).

Table (3) in turn shows the percentage-change between 1995 and 2014 in the goods and service sector, respectively.[16] The goods sector employment share declined while the service sector one increased, hence the negative and positive values of the fourth column. These changes are accounted by the sum of columns 5 to 10. As before, the last two columns indicate the predicted and prediction error values, which now refer to the percent-changes.

Table 3: Growth Accounting for $i = USA$, $s = Goods, Services$, $\tau = 1995$, $v = 2014$

Country	Period	Sector	$\widehat{l}_{it}(s)$	$\widehat{\alpha}_{it}(s)$	$-\widehat{\alpha}_{it}$	$\widehat{\beta}_{it}(s)$	$\frac{f}{y}\widehat{f}_{Nit}(s)$	$\frac{x}{y}\widehat{x}_{Nit}(s,s')$	$\frac{tb}{y}\widehat{tb}_{iJt}(s)$	$\widehat{l}^{p}_{it}(s)$	$\widehat{\Gamma}_{it}(s)$
USA	1995-2014	Goods	-0.35	-0.21	-0.04	0.01	-0.02	-0.10	-0.06	-0.34	0.98
USA	1995-2014	Services	0.07	-0.01	-0.04	-0.03	0.02	0.04	0.00	0.07	0.97

Dividing the entries of each row in Table (3) by the corresponding percent-change in the sectoral employment share, we get the decomposition results, as seen in Table (4). I report these decomposition results again for transparency, but notice that these are the same results presented before in Table (1). The only difference between these tables, other than the labels, is that the "Productivity Channel" is $\frac{\widehat{\alpha}_{it}(s)-\widehat{\alpha}_{t}(s)}{\widehat{l}_{it}(s)}$, and that in Table (3) I present separately $\frac{\widehat{\alpha}_{it}(s)}{\widehat{l}_{it}(s)}$ and $\frac{\widehat{\alpha}_{t}(s)}{\widehat{l}_{it}(s)}$ (notice that they do add up to the same number).

Table 4: Growth Accounting Decomposition for $i = USA$, $s = Goods, Services$, $\tau = 1995$, $v = 2014$

Country	Period	Sector	$\frac{\widehat{\alpha}_{it}(s)}{\widehat{l}_{it}(s)}$	$-\frac{\widehat{\alpha}_{it}}{\widehat{l}_{it}(s)}$	$\frac{\widehat{\beta}_{it}(s)}{\widehat{l}_{it}(s)}$	$\frac{f}{y}\frac{\widehat{f}_{Nit}(s)}{\widehat{l}_{it}(s)}$	$\frac{x}{y}\frac{\widehat{x}_{Nit}(s,s')}{\widehat{l}_{it}(s)}$	$\frac{tb}{y}\frac{\widehat{tb}_{iJt}(s)}{\widehat{l}_{it}(s)}$	Sum
USA	1995-2014	Goods	0.62	-0.12	-0.04	0.05	0.30	0.16	0.98
USA	1995-2014	Services	-0.16	0.59	-0.44	0.33	0.61	0.04	0.97

With these detailed tables in hand, with can better understand the forces that explain sectoral employment reallocation:

- Recall that the "Productivity Channel" is given by $\frac{\widehat{\alpha}_{it}(s)-\widehat{\alpha}_{t}(s)}{\widehat{l}_{it}(s)}$ and that $\alpha_{it}(s)$ measures the labor intensity in each sector while α_{it} is the labor intensity of the aggregate economy. Empirically, these are the labor compensation share in value added. While both sectors used to be approximately equally labor intensive in 1995, in 2014 the goods sector has become more capital intensive, while the service sector

[16]Note that for space limitation I have modified the notation of variables in fractions: for instance, $\frac{f}{y}\frac{\widehat{f}_{Nit}(s)}{\widehat{l}_{it}(s)}$ instead of $\frac{f_{Nit}(s)}{y_{it}(s)}\frac{\widehat{f}_{Nit}(s)}{\widehat{l}_{it}(s)}$. I will keep this simplified notation for the rest of tables throughout the paper.

has not. The aggregate labor income share decline is a combination of the low increase in the service sector labor income share (the largest sector in the economy) and the large decline in the goods sector labor income share.

- The share of goods sector value added to goods output has increased slightly. In the service sector, on the other hand, it has fallen, indicating that the service sector relies more in intermediate inputs than before and tending to reduce the amount of labor needed in the service sector. Since we know that the service sector employment share increased, this means that other factor is compensating for this decline in $\beta_{it}(s)$ in the service sector.

- The expenditure share in goods -as a fraction of sector GDP- has declined. Although small, this expenditure side contributes to the decline in the goods sector employment share. In the service sector, the expenditure as a fraction of sectoral output has increased.[17]

- In the goods sector, $x_{Nit}(s,s')$, the demand (both domestic and foreign) for intermediate goods produced in the USA -as a fraction of sector GDP- has declined significantly. This is another major force accounting for the decline in the goods sector employment share. In the service sector, however, it has increased, meaning that more services are being demanded as intermediate inputs.

2.5 Full sample Decomposition: Goods Sector

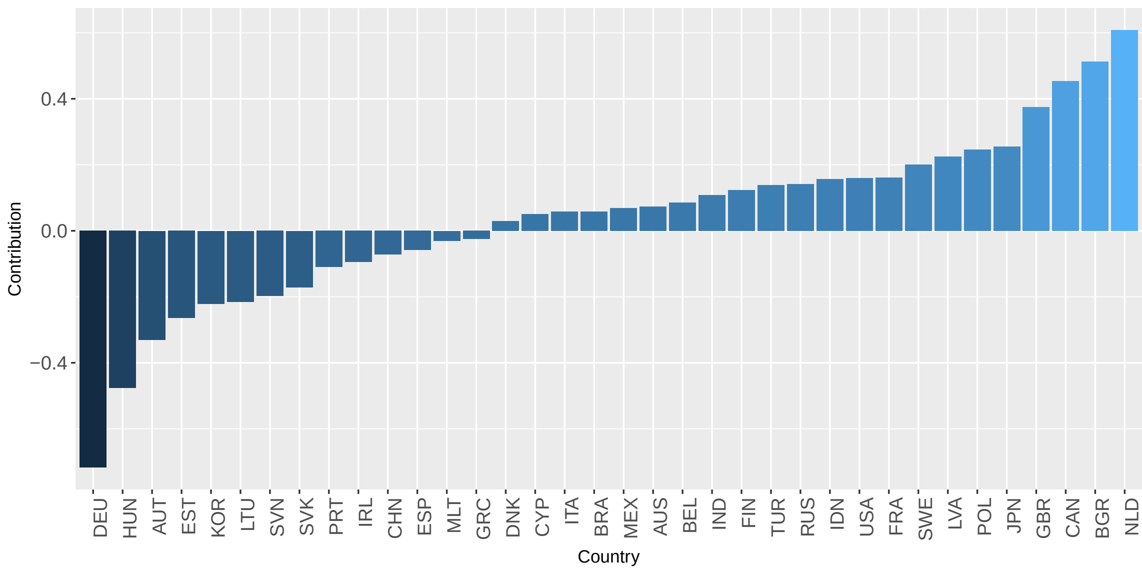
International trade, as shown before, contributed to 16% of the decline in the goods sector employment share in the USA in the 1995-2014 period. What is this number across all countries in the sample? Figure (3) reports the trade balance effect by country, ranked from smallest to largest. The bar length indicates the size of the goods sector trade balance channel for each country. There is considerable heterogeneity in signs and magnitudes of this channel across countries.

How can difference in signs of the trade balance effect be interpreted? One interpretation is the following: if a country has a positive trade balance effect, then international trade magnified the structural change forces, and thus contributed to the decline on the good sector employment share. If a country has a negative trade balance effect, however, then international trade mitigated the structural change forces, and thus tended to make the decline in the goods sector employment share smaller (recall from Figure (1b) that all countries experienced declines in the goods sector employment share).

For instance, the USA, as already described before, has a positive effect: the trade balance accounted for 16% of the decline in the US goods sector employment share. In China, the trade balance accounts for -7%

[17] This is the "Engel Curve" mechanism: note however that both price and quantities affect expenditure shares.

Figure 3: All Countries, Goods Sector Decomposition: Trade Balance Effect, 1995-2014



Source: WIOD.

of the decline. Therefore, in China, the trade balance tended to mitigate the decline in the goods sector trade balance. In conclusion, international trade tends to shrink the goods sector in some countries (USA and others), but tends to expand it in some others (China and others).

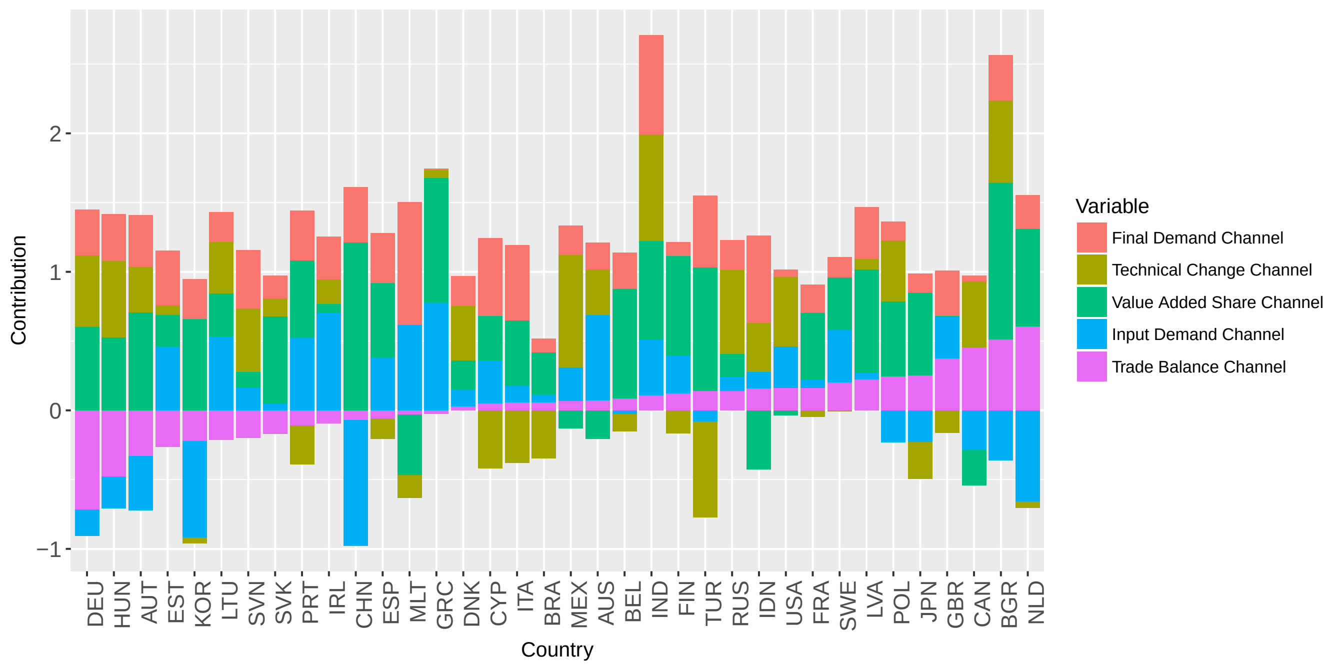
In Figure (4), in turn, we can observe the decomposition estimates for all the growth-accounting components. Countries have been ranked by the trade balance effect, as before.

The expenditure share in goods -as a fraction of sector GDP- has declined in all countries, as can be implied by the always positive value: The Engel-curve type mechanism thus operates in all countries. However the magnitude of this mechanism has been different.

Other mechanisms have had heterogeneous impact on these economies in terms of sign, however (all columns but the third one have both green and red colors).

According to the growth-accounting decomposition framework, all these mechanisms should add up to one, as mentioned before. In some countries they do add up close to one (as the previously analyzed case of USA), which means that the framework closely matches the changes in the sectoral employment share. However, in some countries the framework's prediction power is much weaker. This issue is addressed in Gallacher [2018].

Figure 4: All Countries, Goods Sector Decomposition: 1995-2014



Source: WIOD.

3 Comparative Advantage and the Trade Balance Effect

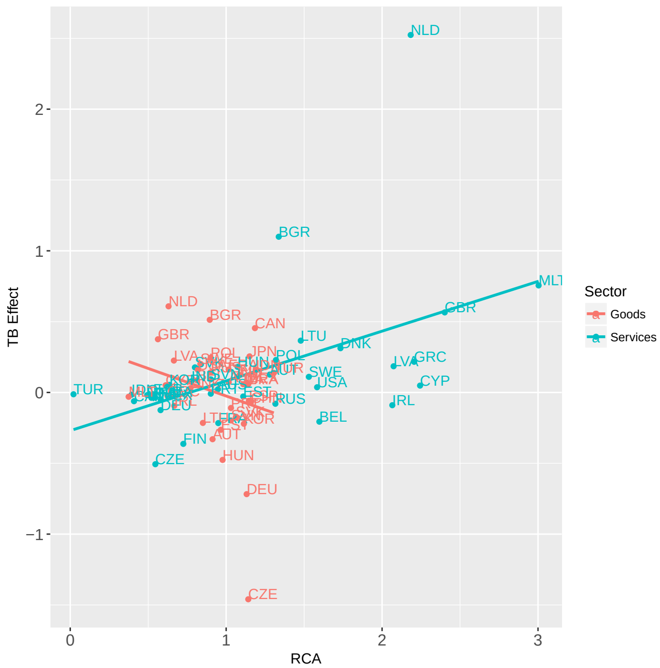
Why is there heterogeneity (in sign and magnitude) in the trade balance channel across countries? A first hypothesis is comparative advantage (Ricardo [1817]): trade integration tends to decrease the goods sector employment share in countries with a comparative advantage in the service sector, while it tends to increase the goods sector employment share in countries with a comparative advantage in the goods sector.

As I later formally show in Section (4), in a Ricardian model with structural change, employment reallocation across sectors is explained by both structural change and international trade. The relevant employment measure that would be correlated with comparative advantage is the change in sectoral employment that is due to international trade. In the context of the framework presented here, this corresponds to the trade balance effect. To test the comparative advantage hypothesis in the presence of structural change, then, we can check the correlation between a comparative advantage measure and the trade balance effect.

3.1 Revealed Comparative Advantage

We need an empirical measure of comparative advantage. I use the Revealed Comparative Advantage (RCA) to proxy for comparative advantage. The RCA, fist introduced by Balassa [1965], is an index of

Figure 5: Goods Sector: Trade Balance Effect and RCA



Source: WIOD.

relative export specialization. It was used in the context of service trade and global imbalances by Barattieri [2014].

Denoting sectors by $\omega = G, S$ ("goods" and "services"), the RCA for the goods sector is

$$RCA_{it}(G) = \frac{\frac{EXP_{it}(G)}{\sum_{\omega} EXP_{it}(\omega)}}{\sum_i \frac{EXP_{it}(G)}{\sum_{\omega} EXP_{it}(\omega)}} \tag{10}$$

where $EXP_{it}(\omega)$ are sector $\omega = \{G, S\}$ exports from country i at time t. If $RCA_{it}(G) > 1$, the country has a revealed comparative advantage in the goods sector, while it has a comparative advantage in the service sector if $RCA_{it}(G) < 1$. In the case of two sectors as I focus on here, $RCA_{it}(G) > 1$ implies $RCA_{it}(S) < 1$. In other words, a country cannot have a comparative advantage in both sectors.

3.2 Correlation

Figure (5) shows the correlation between the trade balance effect for the goods and services sector and the two empirical measures of comparative advantage. As I explain in detail in next section, we would expect the slopes to be negative in the goods sector, and positive in the service sector. This figure thus provides preliminary evidence of the Ricardian comparative advantage force at work.

3.3 Regression Analysis

In order to formally test whether the trade balance effect is related to these measures of comparative advantage, I run the following regression:

$$\frac{tb_{it}(\omega)}{y_{it}(\omega)}\frac{\widehat{tb}_{it}(\omega)}{\widehat{l}_{it}(\omega)} = \delta_0 + \delta_1 RCA_{it}(\omega) + \delta_2 \text{Poor}_{it} + \delta_3 \text{Medium}_{it} + \varepsilon_{it}(\omega) \tag{11}$$

where $RCA_{it}(\omega)$ is the revealed comparative advantage of sector ω. Variables Poor_{it} and Medium_{it} are dummy variables to control for the level of development of the country.

As explained in detail in the next section, according to the comparative advantage hypothesis we would expect $\delta_1 < 0$ for the case of the goods sector and $\delta_1 > 0$ for the case of the service sector.

In Table (5) we can see the results for the Goods sector (first two columns) and Services sectors (last two columns) when using the RCA for the 2014 year. The signs of the coefficients on the revealed comparative advantage measures are as expected. The RCA is statistically significant when controlling for the level of development.

Table 5: Trade Balance Effect (1995-2014) and Revealed Comparative Advantage: 1995-2014 period (RCA 2014)

	Dependent variable:			
	$\frac{tb}{y}\frac{\widehat{tb}_{it}(\omega)}{\widehat{l}_{it}(\omega)}$			
	Goods	Goods	Services	Services
	(1)	(2)	(3)	(4)
$RCA_{it}(\omega)$	−0.389	−0.562**	0.351***	0.390***
	(0.272)	(0.254)	(0.104)	(0.110)
Poor_{it}		0.141		0.177
		(0.143)		(0.199)
Medium_{it}		−0.298**		−0.071
		(0.117)		(0.162)
Constant	0.364	0.610**	−0.270*	−0.327*
	(0.263)	(0.246)	(0.142)	(0.180)
Observations	37	37	37	37
R^2	0.055	0.294	0.245	0.278
Adjusted R^2	0.028	0.230	0.223	0.212
Note:		*p<0.1; **p<0.05; ***p<0.01		

Several robustness checks are done in Appendix (D): Table (A7) reports results for a regression using the 17 year window (which increases the data by a factor of 3), using the RCA for the final year in each sub-period. Table (A8) reports results for a regression using the 17 year window average estimates, distinguishing between countries with statistically significant trade balance effects. Overall, the main conclusion from before hold, in terms of signs of the relationships (some of the alternative specifications are not statistically significant though)

Table (A9) reports results for a regression for the 1995-2014 period using RCA measures of different years: the initial year (1995), end year (2014), and the average 1995-2014.

The signs of the relationships are the same as before. The initial year RCA is not statistically significant though.[18]

Thus, the signs of the coefficients on the RCA supports the conclusion from the Figure (5) and hence the evidence seems to support the Ricardian comparative advantage at work: in the goods sector, the trade balance effect declines with comparative advantage in the goods sector, while in the service sector the trade balance effect increases with comparative advantage in the service sector.

Next I introduce a model to formalize these mechanisms.

4 A Ricardian Model with Structural Change

The model features a perfect competitive environment where countries produce the same goods using different technologies and where labor is the only factor of production. The production side of the model follows the benchmark textbook version of the Ricardian model, as exposed in Allen and Arkolakis [2015]. However, the key difference is in the demand side: preferences are now non-homothetic.

There are two countries, $i = H, F$ ("home" and "foreign") and two sectors, $\omega = G, S$ ("goods" and "services").

Firms: The production technologies in the two countries $i = H, F$ are different for the two sectors $\omega = G, S$ and given by

$$y^i_\omega = Z^i z^i_\omega l^i_\omega \tag{12}$$

where y^i_ω is output, l^i_ω is labor and $Z^i z^i_\omega$ is productivity. Note that productivity is a product of an aggregate term (Z^i) and sector specific term (z^i_ω). Each country is endowed with $\bar{l}^i$ units of labor, where $l^i_G + l^i_S = \bar{l}^i$.

I assume that "home" has a comparative advantage in the production of services.

[18]This reflects the fact that the RCA varied between 1995 and 2014. A way to interpret the fact that only the 2014 measure is statistically significant is that production and export specialization occurs ex-post trade integration. RCA will reflect comparative advantage fuller after trade integration happened. Later measures of RCA would tend to be correlated with trade balances effects more than earlier ones.

$$\frac{z_S^F}{z_G^F} < \frac{z_S^H}{z_G^H} \tag{13}$$

Households: Preferences are specified over the prices of "goods" and "services" $\left(p_G^i, p_S^i\right)$ and the expenditure level of the household e^i. The indirect utility function takes the form

$$V\left(p_G^i, p_S^i, e^i\right) = \frac{1}{\varepsilon}\left[\frac{e^i}{p_S^i}\right]^{\varepsilon} - \frac{v}{\gamma}\left[\frac{p_G^i}{p_S^i}\right]^{\gamma} - \frac{1}{\varepsilon} + \frac{v}{\gamma} \tag{14}$$

where $0 \leq \varepsilon \leq \gamma \leq 1$ and $v \geq 0$. The specified utility function represents a subclass of "price independent generalized linearity" (PIGL) preferences (Boppart [2014]).[19] This preference specification imply "Engel Curves", as can be seen in Figure (A1). See Appendix (A.2) for more properties and the demand function derivations.

4.1 Autarky Equilibrium

An autarky equilibrium is defined here as follows:

Definition 1. An autarky equilibrium is a vector of allocations for consumers $\left(c_\omega^i, i = \{H, F\}, \omega = \{G, S\}\right)$, allocations for the firm $\left(l_\omega^i, i = \{H, F\}, \omega = \{G, S\}\right)$, and prices $\left(w^i, p_\omega^i, i = \{H, F\}, \omega = \{G, S\}\right)$ such that

1. Given prices consumer's allocation maximizes her utility for $i = H, F$.
2. Given prices the allocations of the firms solve the cost minimization problem in $i = H, F$.
3. Markets clear

$$c_\omega^i = y_\omega^i \text{ for } i = \{H, F\}, \omega = \{G, S\}$$

$$\sum_\omega l_\omega^i = \bar{l}^i \text{ for } i = \{H, F\}$$

Proposition 2. *Autarky equilibrium prices* $\left(w^i, p_\omega^i, i = \{H, F\}, \omega = \{G, S\}\right)$ *and employment allocations* $\left(l_\omega^i, i = \{H, F\}, \omega = \{G, S\}\right)$ *are given by*

$$p_G^i Z^i z_G^i = w^i = p_S^i Z^i z_S^i \tag{15}$$

$$\frac{p_G^i}{p_S^i} = \frac{z_S^i}{z_G^i} \tag{16}$$

[19] In general, whenever $\varepsilon \neq 0$, a closed form representation of the direct utility function does not exist (Boppart [2014]).

$$\frac{l_G^i}{\bar{l}^i} = v\left[\frac{z_S^i}{z_G^i}\right]^{\gamma}\left[\frac{1}{Z^i z_S^i \bar{l}^i}\right]^{\varepsilon} \tag{17}$$

$$\frac{l_S^i}{\bar{l}^i} = \left[1 - v\left[\frac{z_S^i}{z_G^i}\right]^{\gamma}\left[\frac{1}{Z^i z_S^i \bar{l}^i}\right]^{\varepsilon}\right] \tag{18}$$

Proof. See Appendix (A.3). □

Given the constant returns to scale production function, relative prices are a function of technology alone (as in the homothetic case) and given by the slope of the (linear) production possibility frontier (PPF), which is $y_G^i = Z^i z_G^i \bar{l}^i - \frac{z_G^i}{z_S^i} y_S^i$. Home's autarky relative price of goods is higher than foreign's (since home has a comparative advantage in services),

$$\frac{p_G^F}{p_S^F} = \frac{z_S^F}{z_G^F} < \frac{z_S^H}{z_G^H} = \frac{p_G^H}{p_S^H}$$

Structural Change The autarky equilibrium allocations provide the intuition to understand the role of economic growth on structural change. The equilibrium equations imply that aggregate productivity increases will create structural change in this economy: the goods sector employment share declines and the service sector employment share rises. This result holds as long as preferences are non-homothetic. The autarky equilibrium thus resembles most of the structural change literature, since it consists of a closed economy equilibrium (Boppart [2014]).

If preferences are instead homothetic, the model boils down to the textbook version of the Ricardian model under autarky, as in Allen and Arkolakis [2015]: sectoral employment shares are constant and equal across countries. There is no structural change under homothetic preferences.

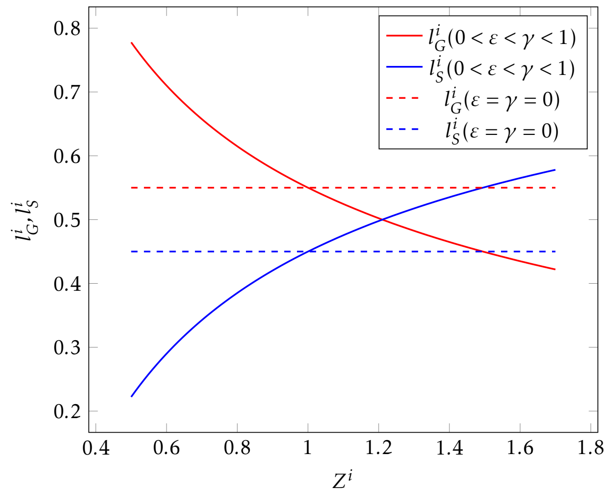
We can formalize this in the following proposition.

Proposition 3. *If preferences are non-homothetic* $(0 < \varepsilon < \gamma < 1)$, *the autarky goods sector employment share declines and the service employment share rises with aggregate productivity gains. If preferences are homothetic* $(\gamma = \varepsilon = 0)$ *the autarky employment shares are constant.*

Proof. Taking partial derivatives of equations (17) and (18) with respect to aggregate productivity yields

$$\frac{\partial\left(\frac{l_G^i}{\bar{l}^i}\right)}{\partial Z^i} = -v\varepsilon\left[\frac{z_S^i}{z_G^i}\right]^{\gamma}\left[\frac{1}{z_S^i \bar{l}^i}\right]^{\varepsilon}\left[\frac{1}{Z^i}\right]^{1+\varepsilon} < 0$$

Figure 6: Employment Shares and Aggregate Productivity



Note: Non-homothetic vs. Homothetic case (dashed). $v = .55$, $\bar{l}^i = 1$.

$$\frac{\partial\left(\frac{l_S^i}{\bar{l}^i}\right)}{\partial Z^i} = v\varepsilon\left[\frac{z_S^i}{z_G^i}\right]^{\gamma}\left[\frac{1}{z_S^i\bar{l}^i}\right]^{\varepsilon}\left[\frac{1}{Z^i}\right]^{1+\varepsilon} > 0$$

Note that for the homothetic case in which $\gamma = \varepsilon = 0$, employment shares are constant and unaffected by economic growth, $\left.\frac{l_G^i}{\bar{l}^i}\right|_{\gamma=\varepsilon=0} = v$ and $\left.\frac{l_S^i}{\bar{l}^i}\right|_{\gamma=\varepsilon=0} = 1-v$. Thus $\left.\frac{\partial\left(\frac{l_G^i}{\bar{l}^i}\right)}{\partial Z^i}\right|_{\gamma=\varepsilon=0} = 0$ and $\left.\frac{\partial\left(\frac{l_S^i}{\bar{l}^i}\right)}{\partial Z^i}\right|_{\gamma=\varepsilon=0} = 0.$

□

The above can be interpreted in terms of a shift of the PPF. An aggregate productivity increase is represented by an increase in the intercept while the slope (and thus relative price) remains unchanged. Given that preferences imply that expansion paths are not linear, then consumption (and hence production and employment) tilts towards services.

This proposition can be seen graphically. Figure (6) shows a numerical example for the employment shares as a function of aggregate productivity. As can be observed, the goods sector employment share decreases with aggregate productivity Z^i (or level of development of the country), while service sector employment share increases with productivity. If preferences are homothetic however, employment shares are constant and unaffected by economic growth, as indicated by the dashed lines.

4.2 Free Trade Equilibrium

Under free trade international prices equalize and relative productivity patterns will determine specialization. As in the benchmark Ricardian model, there can be three possible specialization patters: two where one country specializes and the other diversifies and one where both countries specialize.

Definition 4. A free trade equilibrium is a vector of allocations for consumers $\left(c^i_\omega, i = \{H,F\}, \omega = \{G,S\}\right)$, allocations for the firm $\left(l^i_\omega, i = \{H,F\}, \omega = \{G,S\}\right)$, and prices $\left(w^i, p_\omega, i = \{H,F\}, \omega = \{G,S\}\right)$ such that

1. Given prices consumer's allocation maximizes her utility for $i = H,F$.

2. Given prices the allocations of the firms solve the cost minimization problem in $i = H,F$.

3. Markets clear

$$\sum_i c^i_\omega = \sum_i y^i_\omega \text{ for } \omega = \{G,S\}$$

$$\sum_\omega l^i_\omega = \bar{l^i} \text{ for } i = \{H,F\}$$

Proposition 5. *Under the assumptions stated, at least one country specializes in the free trade equilibrium.*

Proof. If not then the firm's cost minimization would imply $\frac{z^F_S}{z^F_G} = \frac{z^H_S}{z^H_G}$, a contradiction with the comparative advantage assumption. □

In the three different equilibria that can emerge the countries export what they have comparative advantage on (specialization into exporting). Under free trade this relative price has to be in the range:

$$\frac{z^F_S}{z^F_G} \leq \frac{p_G}{p_S} \leq \frac{z^H_S}{z^H_G} \tag{19}$$

In this paper I will focus on the incomplete specialization equilibriums. Note that the complete specialization equilibrium is less relevant for the question I have in mind, since if an economy completely specializes, then after trade there is no further movements of employment shares.

Incomplete Specialization Equilibrium Next I describe the two incomplete specialization cases.

Proposition 6. *Home diversifies: in the free trade equilibrium where home diversifies, the equilibrium goods sector employment shares* $\left(l^G_\omega, i = \{H,F\}\right)$ *are given by*

$$\frac{l^H_G}{\bar{l^H}} = v\left[\frac{z^H_S}{z^H_G}\right]^\gamma \left[\frac{1}{Z^H z^H_S \bar{l^H}}\right]^\varepsilon + \frac{z^F_G}{z^H_G}\frac{Z^F}{Z^H}\frac{\bar{l^F}}{\bar{l^H}}\left(\left[\frac{z^H_G}{z^H_S}\frac{1}{Z^F z^F_G \bar{l^F}}\right]^\varepsilon - 1\right) \tag{20}$$

$$\frac{l^F_G}{\bar{l^F}} = 1 \tag{21}$$

Proof. See Appendix (A.4). □

Proposition 7. *Foreign diversifies: in the free trade equilibrium where foreign diversifies, the equilibrium goods sector employment shares* $\left(l_{\omega}^{G}, i = \{H, F\}\right)$ *are given by*

$$\frac{l_G^H}{l^{\bar{H}}} = 0 \tag{22}$$

$$\frac{l_G^F}{l^{\bar{F}}} = v\left[\frac{z_S^F}{z_G^F}\right]^{\gamma}\left[\frac{1}{Z^F z_S^F l^{\bar{F}}}\right]^{\varepsilon} + v\left[\frac{z_S^F}{z_G^F}\right]^{\gamma}\left[\frac{1}{Z^H z_S^H l^{\bar{H}}}\right]^{\varepsilon}\frac{Z^H z_S^H}{Z^F z_S^F}\frac{l^{\bar{H}}}{l^{\bar{F}}} \tag{23}$$

Proof. See Appendix (A.5). □

Trade Liberalization Now that both incomplete specialization equilibria are solved for, we can study the impact of trade integration on employment shares. I will focus on the goods sector employment share of the country that diversifies.

Proposition 8. *Holding productivity constant, trade integration increases the employment share of the sector in which the country has a comparative advantage.*

Proof. See Appendix (A.6). □

Thus, as in the benchmark comparative advantage model, countries export what they have a comparative advantage on and hence reallocate resources towards that sector. The good sector employment share in home declines while it increases in foreign.[20] These equations also imply a link between the magnitude of the reallocation of employment and the magnitude of comparative advantage.

4.2.1 Economic Growth under Free Trade

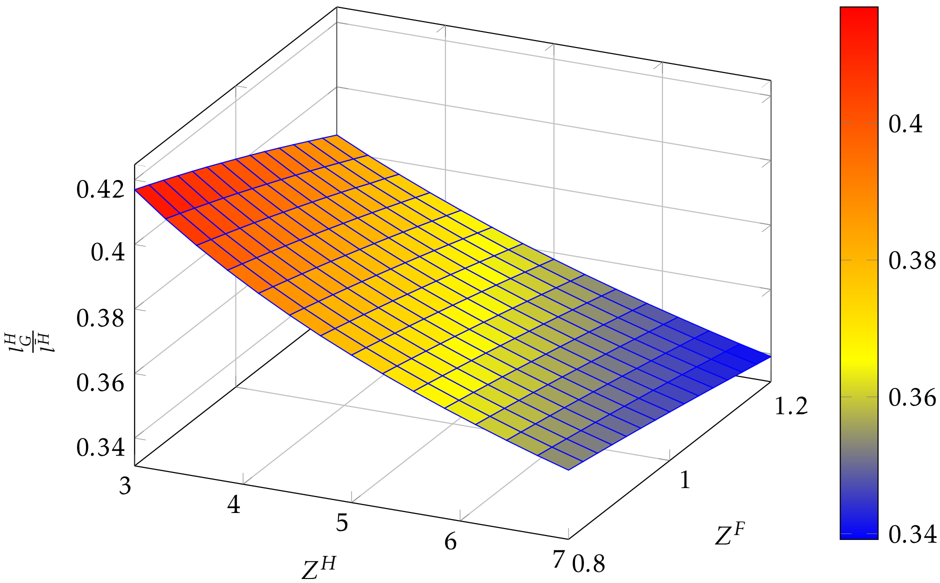
The previous results where conditional on aggregate productivity. Within the free trade equilibria, however, we can also analyze the effect of economic growth on the goods sector employment shares.

While under the autarky equilibrium only domestic aggregate productivity affected the goods sector employment shares, in the free trade equilibria aggregate productivity of both countries affect the goods sector employment share.[21] In other words, the autarky goods sector employment share -Equation (17)- is a function of Z^i but not Z^j, while the free trade goods sector employment shares in the country that

[20] Note that these relationships hold as well in the country that specializes, in which case all employment reallocates to the sector in which the country has a comparative advantage.

[21] Recall that I focus on the country that diversifies. In the country that specializes all employment is reallocated to the sector in which the country has a comparative advantage, and thus the goods sector employment share is one, constant, and independent of aggregate productivity

Figure 7: Home: Goods Sector Employment Share and Aggregate Productivity



Note: numerical example for given parameter values consistent with the model assumptions.

diversifies -Equation (20) for home and Equation (20) for foreign- depend on aggregate productivity of both countries, Z^G and Z^F. In Figures (7) and (8) we can observe the employment share in each country as a function of aggregate productivity in home and foreign.

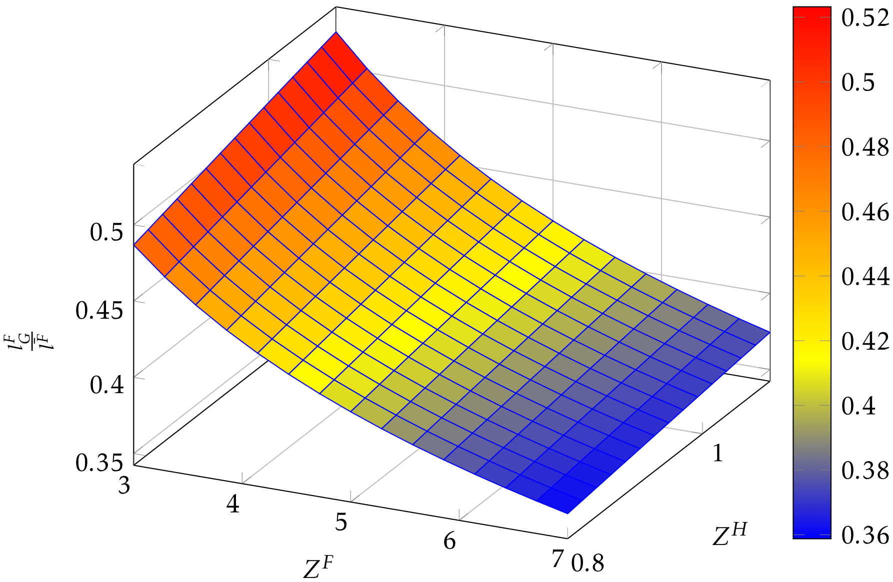
The goods sector employment share in home (foreign) declines with home (foreign) aggregate productivity, conditional on foreign's (home's) aggregate productivity. The sign of this relationship is in line with the autarky case. Interestingly, however, the impact of the other country's growth on employment share is asymmetric between countries: foreign growth causes the home goods sector employment share to shrink will home growth causes the foreign goods sector employment share to rise.

4.3 Trade Liberalization and Economic Growth

Trade liberalization decreases the goods sector employment share in home and increases it in foreign, conditional on productivity (Proposition (8). As shown in Figure (9): in home, the autarky goods sector employment share is always above the free trade one. The opposite is true in foreign: the autarky goods sector employment share is always below the free trade one, as seen in Figure (10).

Trade liberalization implies that the goods sector employment share moves (or "jumps") between surfaces: from the red to the blue one. Economic growth implies that the goods sector employment share moves within a surface. When both trade liberalization and economic growth happen, the goods sector employment share moves both between and within surfaces.

Figure 8: Foreign: Goods Sector Employment Share and Aggregate Productivity



Note: numerical example for given parameter values consistent with the model assumptions.

With this theoretical apparatus we can now disentangle how much of the change in the goods sector employment share is due to either trade or technological progress. This is done in the next subsection.

4.4 Decomposition

Consider a two period economy, $t = 1, 2$.

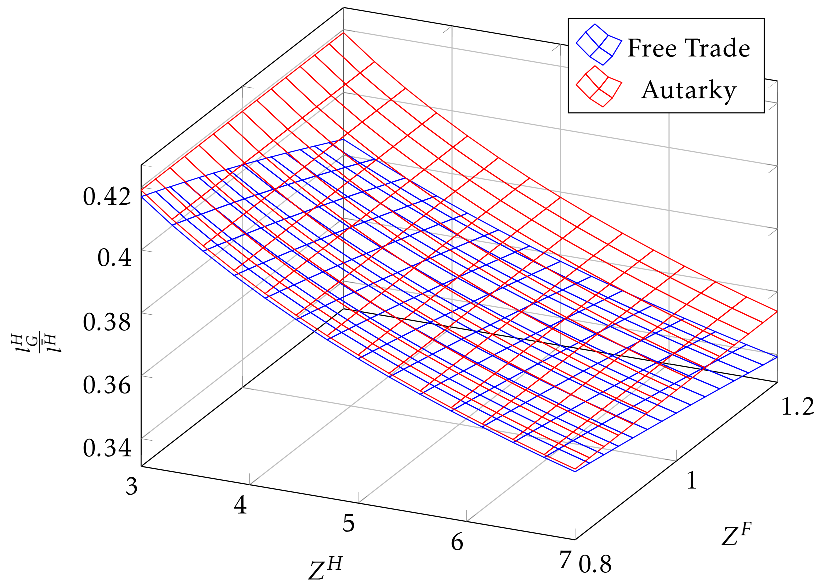
- In $t = 1$ the economies are in autarky and productivity is low (Z_1^i).
- In $t = 2$ the economies are in free trade and productivity is high ($Z_2^i > Z_1^i$).

Given the results in the previous sub-sections, we can anticipate that between $t = 1$ and $t = 2$ employment shares will change. How much of the change in employment shares is due to international trade and how much is it due to economic growth (higher aggregate productivity)?

In order to decompose these effects, we need to consider counterfactuals: In particular, how much would employment shares be in $t = 2$ had the economy not opened to trade (Counterfactual 1)? Alternatively, how much would employment shares be in $t = 2$ had productivity not changed (Counterfactual 2)? We can summarize this in the following table:

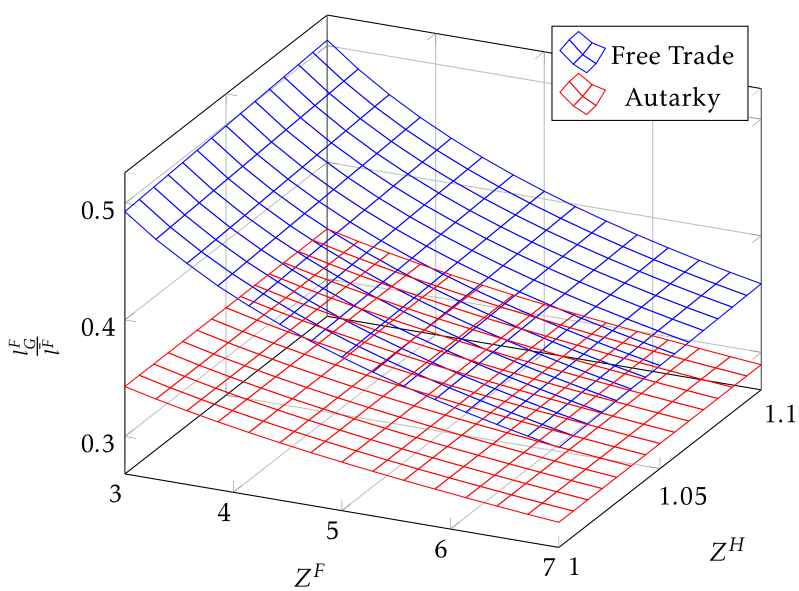
	Z_1^i	Z_2^i
Autarky	Start	Counterfactual 1
Free Trade	Counterfactual 2	End

Figure 9: Home: Goods Sector Employment Share and Aggregate Productivity



Note: numerical example for given parameter values consistent with the model assumptions.

Figure 10: Foreign: Goods Sector Employment Share and Aggregate Productivity



Note: numerical example for given parameter values consistent with the model assumptions.

Note that the goods sector employment share in home will unambiguously fall: trade and growth move the goods sector employment share in same direction. In foreign however, it is not clear what happens to employment shares: on one hand, trade induces a reallocation to the goods sector, on the other, economic growth induces a reallocation to the service sector.

Note that we have already calculated the change from "Start" to Counterfactual 1 in Proposition (3): under autarky, goods sector employment share declines with productivity. Also, we have already calculated the change from "Start" to Counterfactual 2 in Proposition (8): holding productivity constant, trade integration increases the employment share of the sector in which the country has a comparative advantage. We have also calculated the change between Counterfactual 1 and "End", since Proposition (8) was conditional on a level of aggregate productivity, Z^i.

We still need to compare the total effect, the change between "Start" and "End". In the next proposition I do this and show that this total change is the sum of two effects:

Proposition 9. *The total change in employment shares is the sum of a "Structural Change" effect and an "International Trade" effect, and the closed form expressions for the total change are*

$$\triangle\frac{l_G^H}{\bar{l^H}} = \underbrace{v\left[\frac{z_S^H}{z_G^H}\right]^{\gamma}\left[\frac{1}{z_S^H\bar{l^H}}\right]^{\varepsilon}\left(\left[\frac{1}{Z_2^H}\right]^{\varepsilon}-\left[\frac{1}{Z_1^H}\right]^{\varepsilon}\right)}_{\text{"Structural Change Effect"}}+\underbrace{\frac{z_G^F}{z_G^H}\frac{Z_2^F}{Z_2^H}\frac{\bar{l^F}}{\bar{l^H}}\left(v\left[\frac{z_S^H}{z_G^H}\right]^{\gamma}\left[\frac{z_G^H}{z_S^H}\frac{1}{Z_2^F z_G^F\bar{l^F}}\right]^{\varepsilon}-1\right)}_{\text{"International Trade Effect"}} \tag{24}$$

$$\triangle\frac{l_G^F}{\bar{l^F}} = \underbrace{v\left[\frac{z_S^F}{z_G^F}\right]^{\gamma}\left[\frac{1}{z_S^F\bar{l^F}}\right]^{\varepsilon}\left(\left[\frac{1}{Z_2^F}\right]^{\varepsilon}-\left[\frac{1}{Z_1^F}\right]^{\varepsilon}\right)}_{\text{"Structural Change Effect"}}+\underbrace{v\left[\frac{z_S^F}{z_G^F}\right]^{\gamma}\left[\frac{1}{Z_2^H z_S^H\bar{l^H}}\right]^{\varepsilon}\frac{Z_2^H z_S^H}{Z_2^F z_S^F}\frac{\bar{l^H}}{\bar{l^F}}}_{\text{"International Trade Effect"}} \tag{25}$$

Proof. See Appendix (A.7). □

Proposition 10. *The total effect is always negative in home while it is negative in foreign only if the increase in productivity is high enough.*

Proof. The total change in home is negative (since both terms are negative; see Propositions (3) and (8)).

The total change in foreign is negative if

$$v\left[\frac{z_S^F}{z_G^F}\right]^{\gamma}\left[\frac{1}{Z_2^H z_S^H\bar{l^H}}\right]^{\varepsilon}\frac{Z_2^H z_S^H}{Z_2^F z_S^F}\frac{\bar{l^H}}{\bar{l^F}}+v\left[\frac{z_S^F}{z_G^F}\right]^{\gamma}\left[\frac{1}{z_S^F\bar{l^F}}\right]^{\varepsilon}\left(\left[\frac{1}{Z_2^F}\right]^{\varepsilon}-\left[\frac{1}{Z_1^F}\right]^{\varepsilon}\right)<0$$

Let $Z_2^F = g^F Z_1^F$ and rearrange,

$$\left(1+\left[\frac{Z_2^H z_S^H\bar{l^H}}{Z_2^F z_S^F\bar{l^F}}\right]^{1-\varepsilon}\right)^{-\frac{1}{\varepsilon}}-1<g^F-1$$

which holds if the growth rate of productivity $(\theta - 1)$ is larger than threshold $\tilde{\theta} = \left(1 + \left[\frac{Z^H z_S^H \bar{l^H}}{Z_{high}^F z_S^F \bar{l^F}}\right]^{1-\varepsilon}\right)^{-\frac{1}{\varepsilon}}$. $\square$

These results are quite intuitive. As shown in Proposition (3), aggregate productivity increases results in employment shares decline in all countries. As economies open up to trade, employment shares decline only in countries with a comparative advantage in the goods sector, and increase in countries with a comparative advantage in the service sector, as proved in Proposition (8). When both productivity increase and trade integration occur, the total effect is unambiguously negative in countries with a comparative advantage in the service sector. However, the employment shares decline in countries with a comparative advantage in goods only if the increase in productivity is large enough to compensate the "International Trade Effect".

4.5 The Model and the Data

The main predictions of the model are consistent with the empirical patterns reported in Section (3): If the Ricardian comparative advantage forces hold, countries with a comparative advantage in the goods sector would experience negative trade-balance effects in the goods sector. Trade integration makes countries that are relatively better at producing goods to specialize in the goods sector. Countries with a comparative advantage in the service sector would experience positive trade-balance effects in the goods sector, since trade integration tends to shrink the goods sector employment share in these countries.

Recall that since the goods sector employment share declines over time, a negative trade balance effect means that the trade-balance tended to increase its goods sector employment share (or it tended to "mitigate" the decline), while a positive trade balance effect means that the trade balance tended to decrease its goods sector employment share (or it tended to "magnify" the decline).

These signs are the opposite in the case of the service sector, since the service sector employment share increases over time: countries with a comparative advantage in the service sector would experience positive trade-balance effects in the service sector: trade integration makes countries that are relatively better at producing services to specialize in the service sector. Countries with a comparative advantage in the goods sector would experience negative trade-balance effects in the service sector, since trade integration tends to shrink the service sector employment share in these countries.

In conclusion, according to the model we would expect the trade-balance effect in the goods sector to be negatively associated with comparative advantage in the goods sector, and the trade-balance effect in the service sector to be positively associated with comparative advantage in the service sector. This is what is observed in the data, as Section (3) describes.

5 Conclusion

In this paper I have developed a growth accounting framework to study structural change in a globalized context. I estimated the impact of international trade on sectoral employment in 35 countries for the 1995-2014 period. I also provided evidence of the comparative advantage force at work and introduced a model of international trade with structural change that is consistent with it. The model abstracted from empirically relevant mechanisms, for instance input-output linkages. A richer model would allow to tackle an array of new questions: trade costs estimation, counterfactual exercises, etc. A dynamic extension could then tackle business cycle questions.

The framework and estimates presented in this paper have policy implications. Attempts to increase the manufacturing employment share via protectionism should take into account that most of the decline in the manufacturing sector employment share is due to factors that go beyond international trade. In addition, the theoretical results indicate that the impact of protectionism on sectorial employment reallocation is only temporary: in the long run, structural change forces will keep shrinking the goods sector employment share over time, independently of the trade policy. Trade policy, hence, is quite limited at "bringing the manufacturing jobs back".

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A Proofs and Derivations

A.1 Growth Accounting Derivation

A.1.1 Conditional Factor Demand

Using (2) and (3) in (1),

$$Q_{it}(s) = Z_{it}(s)\left[[L_{it}(s)]^{\alpha_{it}(s)}[K_{it}(s)]^{1-\alpha_{it}(s)}\right]^{\beta_{it}(s)}\left[\prod_{s'=1}^{S}\prod_{j=1}^{N}\left(X_{jit}(s',s)\right)^{\gamma_{jit}(s',s)}\right]^{1-\beta_{it}(s)} \tag{26}$$

Output is produced under conditions of perfect competition. A representative firm in country i, sector s takes the prices for its output and inputs as given, and the firm rents capital, hires labor and demands intermediate inputs to solve:

$$\max\; p_{it}(s)Q_{it}(s) - w_t L_{it}(s) - r_t K_{it}(s) - \sum_{j=1}^{N}\sum_{s'=1}^{S} p_{jt}(s')X_{jit}(s',s)$$

s.t.

$$L_{it}(s)\geq 0, K_{it}(s)\geq 0, X_{jit}(s',s)\geq 0,$$

where $p_{it}(s)$ denotes the price of output, w_{it} is the wage, r_{it} is the rental rate of capital, and the production function for $Q_{it}(s)$ is given above by (26). The optimality conditions are given by:

$$p_{it}(s)\alpha_{it}(s)\beta_{it}(s)\frac{Q_{it}(s)}{L_{it}(s)} = w_t$$

$$p_{it}(s)[1-\alpha_{it}(s)]\beta_{it}(s)\frac{Q_{it}(s)}{K_{it}(s)} = r_t$$

$$p_{it}(s)\gamma_{jit}(s',s)[1-\beta_{it}(s)]\frac{Q_{it}(s)}{X_{jit}(s',s)} = p_{jt}(s')$$

The conditional factor demands are

$$L_{it}(s) = p_{it}(s)\alpha_{it}(s)\beta_{it}(s)\frac{Q_{it}(s)}{w_t} \tag{27}$$

$$K_{it}(s) = p_{it}(s)[1-\alpha_{it}(s)]\beta_{it}(s)\frac{Q_{it}(s)}{r_t} \tag{28}$$

$$X_{jit}(s',s) = p_{it}(s)\,\gamma_{jit}(s',s)\,[1-\beta_{it}(s)]\,\frac{Q_{it}(s)}{p_{jt}(s')} \tag{29}$$

Conditional demand for labor in sector s (Equation (27)) will help pin-down the sectoral employment share, and will be a key part of the analysis that follows. Note that equation (29) is the conditional input demand that sector s in country i demands from sector s' in country j.

A.1.2 Market Clearing

Sectoral output is used as an intermediate input in production and is also consumed directly as a final product. Denote final shipments from country i to country j in sector s at time t as $F_{ijt}(s)$. Gross output of sector s in country i then equals final product shipments plus shipments used as intermediates:

$$Q_{it}(s) = \sum_{j=1}^{N} F_{ijt}(s) + \sum_{j=1}^{N}\sum_{s'=1}^{S} X_{ijt}(s,s') \tag{30}$$

Note that $\sum_j F_{ijt}(s)$ is the world aggregate final demand for products shipped from sector s in country i. In turn, $\sum_j \sum_{s'=1}^{S} X_{ijt}(s,s')$ is the world demand for intermediate inputs shipped from sector s in country i. Equation (30) represents the world-input output matrix (a system of $N \times S$ equations).

Note that world demand includes country i's own demand. Re-writing condition (30),

$$Q_{it}(s) = F_{iit}(s) + \sum_{s'=1}^{S} X_{iit}(s,s') + \sum_{j\neq i}^{N} F_{ijt}(s) + \sum_{j\neq i}^{N}\sum_{s'=1}^{S} X_{ijt}(s,s') \tag{31}$$

where $F_{iit}(s) + \sum_{s'=1}^{S} X_{iit}(s,s')$ is output from country i in sector s that is consumed domestically, either as a final product or intermediate input. In turn, $\sum_{j\neq i} F_{ijt}(s) + \sum_{j\neq i}\sum_{s'=1}^{S} X_{ijt}(s,s')$ are exports from country i in sector s, which are composed of final product as well as intermediate input shipments.

We can express Equation (31) in terms of the (sectoral) trade balance. For this, add and subtract $\sum_{j\neq i}^{N} F_{jit}(s)$ (sector s final imports in country i) and $\sum_{j\neq i}^{N}\sum_{s'=1}^{S} X_{jit}(s,s')$ (sector s intermediate input imports in country i):[22]

[22] It is crucial to be clear with the subscripts to avoid getting confused between variables. For instance, $\sum_{j=1}^{N} F_{ijt}(s) \neq \sum_{j=1}^{N} F_{jit}(s) \neq \sum_{j\neq i}^{N} F_{ijt}(s) \neq \sum_{j\neq i}^{N} F_{jit}$.

$$
\begin{aligned}
Q_{it}(s) = {} & F_{iit}(s) + \sum_{j\neq i}^{N} F_{jit}(s) \\
& + \sum_{s'=1}^{S} X_{iit}(s,s') + \sum_{j\neq i}^{N} \sum_{s'=1}^{S} X_{jit}(s,s') \\
& + \sum_{j\neq i}^{N} \left(F_{ijt}(s) + \sum_{s'=1}^{S} X_{ijt}(s,s') - F_{jit}(s) - \sum_{s'=1}^{S} X_{jit}(s,s') \right)
\end{aligned} \tag{32}
$$

Denote line 1 of Equation (32), the total final demand in country i for sector s products (both domestic and imported), as:

$$
\sum_{j=1}^{N} F_{jit}(s) \equiv F_{iit}(s) + \sum_{j\neq i}^{N} F_{jit}(s) \tag{33}
$$

Denote line 2 of Equation (32), the total intermediate inputs from sector s used in country i (both domestic and imported inputs; used by all sectors), as:

$$
\sum_{j=1}^{N} \sum_{s'=1}^{S} X_{jit}(s',s) \equiv \sum_{s'=1}^{S} X_{iit}(s,s') + \sum_{j\neq i}^{N} \sum_{s'=1}^{S} X_{jit}(s,s') \tag{34}
$$

Denote line 3 of Equation (32), the sectoral trade balance of country i sector s, as:

$$
TB_{iJt}(s) \equiv \sum_{j\neq i}^{N} \left(\underbrace{F_{ijt}(s) + \sum_{s'=1}^{S} X_{ijt}(s,s')}_{\text{Shipments from } i \text{ to } j} - \underbrace{\left[F_{jit}(s) + \sum_{s'=1}^{S} X_{jit}(s,s') \right]}_{\text{Shipments from } j \text{ to } i} \right) \tag{35}
$$

Note that the term in parenthesis in Equation (35) is the bilateral trade balance, and thus the aggregate trade balance is the sum of bilateral ones, $TB_{iJt}(s) = \sum_{j\neq i}^{N} TB_{ijt}(s)$. Using Equations (33), (34) and (35) in (32) we get,

$$
Q_{it}(s) = \sum_{j=1}^{N} F_{jit}(s) + \sum_{j=1}^{N} \sum_{s'=1}^{S} X_{jit}(s,s') + \sum_{j\neq i}^{N} TB_{ijt}(s) \tag{36}
$$

Output from sector s in country i is thus equal to the sum of the total final expenditure in country i in sector s, the total intermediates from sector s used in country i, and the sectoral trade balance in country i, sector s. This alternative way of expressing market clearing condition (30) will be helpful next.

A.1.3 Sectoral Labor (Re-)Allocation

The employment share $l_{it}(s) \equiv \frac{L_{it}(s)}{L_{it}}$ of each sector can be written as follows:

$$
\begin{aligned}
l_{it}(s) &\equiv \frac{L_{it}(s)}{L_{it}} \\
&= \frac{\alpha_{it}(s)\beta_{it}(s)}{L_{it}w_t} p_{it}(s) Q_{it}(s) \\
&= \frac{\alpha_{it}(s)\beta_{it}(s)}{L_{it}w_t} \left[p_{it}(s) \sum_{j=1}^{N} F_{jit}(s) + p_{it}(s) \sum_{j=1}^{N} \sum_{s'=1}^{S} X_{jit}(s',s) + p_{it}(s) \sum_{j \neq i}^{N} TB_{ijt}(s) \right]
\end{aligned}
$$

Where line two has used conditional demand for labor (27) and line three has used the alternative way of expressing the market clearing condition (36).

This expression relates sectoral employment shares to final consumption, intermediate input demand, trade balance, and key parameters. Re-express by multiplying and dividing by nominal value-added in country i, $(p_{it}V_{it})$.

$$
l_{it}(s) = \alpha_{it}(s)\beta_{it}(s) \frac{p_{it}V_{it}}{L_{it}w_t} \left[\frac{p_{it}(s) \sum_{j=1}^{N} F_{jit}(s)}{p_{it}V_{it}} + \frac{p_{it}(s) \sum_{j=1}^{N} \sum_{s'=1}^{S} X_{jit}(s',s)}{p_{it}V_{it}} + \frac{p_{it}(s) \sum_{j \neq i}^{N} TB_{ijt}(s)}{p_{it}V_{it}} \right]
$$

A.1.4 Percent-Changes

Taking logs to (4):

$$
\log[l_{it}(s)] = \log[\alpha_{it}(s)] - \log[\alpha_{it}] + \log[\beta_{it}(s)] + \log\left[f_{Nit}(s) + x_{Nit}(s,s') + tb_{iJt}(s)\right] \tag{37}
$$

Expressing gross output in terms of value added, $y_{it}(s) \equiv \frac{Q_{it}(s)}{V_{it}(s)}$, then from market clearing condition (36) we get that the last term in brackets of Equation (37) equals $y_{it}(s) = f_{it}(s) + x_{it}(s,s') + tb_{it}(s)$. Differentiating Equation (37) with respect to time then yields Equation (6).

A.2 Demand Functions under PIGL Preferences

The PIGL includes familiar homothetic preferences as special cases. I will use this property as comparison with benchmark homothetic models. In particular, for $\gamma = \varepsilon = 0$, we obtain Cobb-Douglas preferences. Applying Roy's identity to the indirect utility function (14) gives the Marshallian (partial equilibrium) demand functions:

$$c_G^i = -\frac{\frac{\partial V}{\partial p_G^i}}{\frac{\partial V}{\partial e^i}} = -\frac{-v\left[\frac{p_G^i}{p_S^i}\right]^\gamma \frac{1}{p_G^i}}{\left[\frac{e^i}{p_S^i}\right]^\varepsilon \frac{1}{e^i}}$$

$$c_S^i = -\frac{\frac{\partial V}{\partial p_S^i}}{\frac{\partial V}{\partial e^i}} = -\frac{-\frac{1}{p_S^i}\left[\left[\frac{e^i}{p_S^i}\right]^\varepsilon - v\left[\frac{p_G^i}{p_S^i}\right]^\gamma\right]}{\left[\frac{e^i}{p_S^i}\right]^\varepsilon \frac{1}{e^i}}$$

Rearranging yields:

$$c_G^i = v\left[\frac{p_G^i}{p_S^i}\right]^\gamma \left[\frac{p_S^i}{e^i}\right]^\varepsilon \frac{e^i}{p_G^i} \tag{38}$$

and

$$c_S^i = \frac{e^i}{p_S^i}\left[1 - v\left[\frac{p_G^i}{p_S^i}\right]^\gamma \left[\frac{p_S^i}{e^i}\right]^\varepsilon\right] \tag{39}$$

With $\varepsilon > 0$, the expenditure elasticity of demand is positive, but strictly smaller than unity for goods and larger than unity for services. This means that goods are necessities whereas services are a luxury. These demand functions imply Engel curves: the demand for both goods and services increases with income, but goods demand do so at a decreasing rate while the demand for service does so at an increasing rate. Figure (A1) plots the consumption functions. With $\varepsilon = \gamma = 0$, we have homothetic preferences (expenditure elasticities of both sectors are equal to unity). Sign and magnitude of relative price changes on the expenditure shares are controlled by the elasticity of substitution across sectors, which is below one

Note that $c_s^i > 0$ if $\left[\frac{e^i}{p_S^i}\right]^\varepsilon - v\left[\frac{p_G^i}{p_S^i}\right]^\gamma > 0$, or,

$$\left[e^i\right]^\varepsilon > v\left[p_S^i\right]^\varepsilon \left[\frac{p_G^i}{p_S^i}\right]^\gamma \tag{40}$$

which I assume that holds throughout the paper

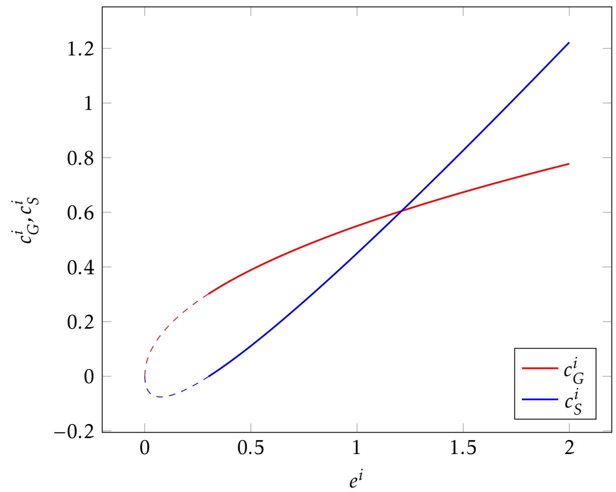
Throughout this paper I assume a representative household in each country.[23] In general equilibrium, the representative household splits its labor endowment between the goods and service sector.

A.3 Proof of Proposition (2)

Firm's profits are $\pi^i = p_\omega^i Z^i z_\omega^i l_\omega^i - w^i l_\omega^i$. First order conditions for profit maximization imply that optimal employment is reached when the value of marginal productivity is equal to marginal cost, $p_\omega^i Z^i z_\omega^i = w^i$. This holds for both sectors, thus equations (15) and (16) hold in equilibrium.

[23] Within country inequality is beyond the scope of this paper. I leave it for future research

Figure A1: Demand functions ("Engel Curves")



Note: $\varepsilon > 0$. As indicated by the dashed sections, preferences are only well defined if the expenditure exceeds threshold (40).

Note that expenditure is in equilibrium equal to income, $e^i = w\bar{l^i}$ and since wages are pinned down by equation (15) then expenditure in equilibrium becomes

$$e^i = p^i_G Z^i z^i_G \bar{l^i} = p^i_S Z^i z^i_S \bar{l^i}$$

which implies that $\frac{p^i_S}{e^i} = \frac{1}{Z^i z^i_S \bar{l^i}}$ and $\frac{e^i}{p^i_G} = Z^i z^i_G \bar{l^i}$. Plugging these conditions and relative prices (16) into equations (38) and (39) yields the demand functions,

$$c^i_G = v \left[\frac{z^i_S}{z^i_G}\right]^{\gamma} \left[\frac{1}{Z^i z^i_S \bar{l^i}}\right]^{\varepsilon} Z^i z^i_G \bar{l^i} \tag{41}$$

$$c^i_S = Z^i z^i_S \bar{l^i} \left[1 - v \left[\frac{z^i_S}{z^i_G}\right]^{\gamma} \left[\frac{1}{Z^i z^i_S \bar{l^i}}\right]^{\varepsilon}\right] \tag{42}$$

We can solve for the rest of equilibrium allocations. Using the goods market clearing condition, $c^i_\omega = y^i_\omega$ for $\omega = 1, 2$ together with the consumption and the production functions allows to solve for sectoral employment equations shares (17) and (18).

A.4 Proof of Proposition (6)

Since home diversifies then it sets prices, so

$$\frac{p_G}{p_S} = \frac{z_S^H}{z_G^H} \tag{43}$$

and since it produces both sectors, then firms optimization imply,

$$p_G Z^H z_G^H = w^H = p_S Z^H z_S^H \tag{44}$$

Since foreign only produces goods, then in equilibrium,

$$w^F = p_G Z^F z_G^F \tag{45}$$

In order to get consumption allocations, plug equilibrium relative prices into demand functions (38) and (39):

$$c_G^H = v\left[\frac{z_S^H}{z_G^H}\right]^{\gamma}\left[\frac{p_S}{e^H}\right]^{\varepsilon}\frac{e^H}{p_G}$$

$$c_S^H = \frac{e^H}{p_S}\left[1 - v\left[\frac{z_S^H}{z_G^H}\right]^{\gamma}\left[\frac{p_S}{e^H}\right]^{\varepsilon}\right]$$

$$c_G^F = v\left[\frac{z_S^H}{z_G^H}\right]^{\gamma}\left[\frac{p_S}{e^F}\right]^{\varepsilon}\frac{e^F}{p_G}$$

$$c_S^F = \frac{e^F}{p_S}\left[1 - v\left[\frac{z_S^H}{z_G^H}\right]^{\gamma}\left[\frac{p_S}{e^F}\right]^{\varepsilon}\right]$$

Using equilibrium expenditure relationships ($e^H = w^H \bar{l^H} = p_G Z^H z_G^H \bar{l^H} = p_S Z^H z_S^H \bar{l^H}$ and $e^F = w^F \bar{l^F} = p_G Z^F z_G^F \bar{l^F}$) together with relative price $\frac{p_G}{p_S} = \frac{z_S^H}{z_G^H}$, then the following relationships hold,

$$\frac{p_S}{e^H} = \frac{1}{Z^H z_S^H \bar{l^H}}$$

$$\frac{e^H}{p_G} = Z^H z_G^H \bar{l^H}$$

$$\frac{p_S}{e^F} = \frac{p_s}{p_G Z^F z_G^F \bar{l^F}} = \frac{z_G^H}{z_S^H}\frac{1}{Z^F z_G^F \bar{l^F}}$$

$$\frac{e^F}{p_G} = \frac{p_G Z^F z_G^F l^{\bar{F}}}{p_G} = Z^F z_G^F l^{\bar{F}}$$

and plugging in these four equations yield equilibrium consumptions,

$$c_G^H = v\left[\frac{z_S^H}{z_G^H}\right]^\gamma \left[\frac{1}{Z^H z_S^H l^{\bar{H}}}\right]^\varepsilon Z^H z_G^H l^{\bar{H}} \tag{46}$$

$$c_S^H = Z^H z_S^H l^{\bar{H}} \left[1 - v\left[\frac{z_S^H}{z_G^H}\right]^\gamma \left[\frac{1}{Z^H z_S^H l^{\bar{H}}}\right]^\varepsilon\right] \tag{47}$$

$$c_G^F = v\left[\frac{z_S^H}{z_G^H}\right]^\gamma \left[\frac{z_G^H}{z_S^H}\frac{1}{Z^F z_G^F l^{\bar{F}}}\right]^\varepsilon Z^F z_G^F l^{\bar{F}} \tag{48}$$

$$c_S^F = \frac{z_S^H}{z_G^H} Z^F z_G^F l^{\bar{F}} \left[1 - v\left[\frac{z_S^H}{z_G^H}\right]^\gamma \left[\frac{z_G^H}{z_S^H}\frac{1}{Z^F z_G^F l^{\bar{F}}}\right]^\varepsilon\right] \tag{49}$$

For employment shares in home, using the world service sector market clearing condition,

$$y_S^H + y_S^F = c_S^H + c_S^F$$

and the fact that foreign completely specialized in goods ($y_S^F = 0$), then using production functions and equilibrium demand,

$$Z^H z_S^H l_S^H = Z^H z_S^H l^{\bar{H}} \left[1 - v\left[\frac{z_S^H}{z_G^H}\right]^\gamma \left[\frac{1}{Z^H z_S^H l^{\bar{H}}}\right]^\varepsilon\right] + \frac{z_S^H}{z_G^H} Z^F z_G^F l^{\bar{F}} \left[1 - v\left[\frac{z_S^H}{z_G^H}\right]^\gamma \left[\frac{z_G^H}{z_S^H}\frac{1}{Z^F z_G^F l^{\bar{F}}}\right]^\varepsilon\right]$$

Rearranging,

$$Z^H z_S^H l_S^H = Z^H z_S^H l^{\bar{H}} - Z^H z_S^H l^{\bar{H}} v\left[\frac{z_S^H}{z_G^H}\right]^\gamma \left[\frac{1}{Z^H z_S^H l^{\bar{H}}}\right]^\varepsilon + \frac{z_S^H}{z_G^H} Z^F z_G^F l^{\bar{F}} - \frac{z_S^H}{z_G^H} Z^F z_G^F l^{\bar{F}} v\left[\frac{z_S^H}{z_G^H}\right]^\gamma \left[\frac{z_G^H}{z_S^H}\frac{1}{Z^F z_G^F l^{\bar{F}}}\right]^\varepsilon$$

Solving for home's service sector employment share,

$$\frac{l_S^H}{l^{\bar{H}}} = 1 - v\left[\frac{z_S^H}{z_G^H}\right]^\gamma \left[\frac{1}{Z^H z_S^H l^{\bar{H}}}\right]^\varepsilon + \frac{z_G^F}{z_G^H}\frac{Z^F}{Z^H}\frac{l^{\bar{F}}}{l^{\bar{H}}} - \frac{z_G^F}{z_G^H}\frac{Z^F}{Z^H}\frac{l^{\bar{F}}}{l^{\bar{H}}} v\left[\frac{z_S^H}{z_G^H}\right]^\gamma \left[\frac{z_G^H}{z_S^H}\frac{1}{Z^F z_G^F l^{\bar{F}}}\right]^\varepsilon$$

Rearranging,

$$\frac{l_S^H}{l^{\bar{H}}} = 1 + \frac{z_G^F}{z_G^H}\frac{Z^F}{Z^H}\frac{l^{\bar{F}}}{l^{\bar{H}}} - v\left[\frac{z_S^H}{z_G^H}\right]^{\gamma}\left(\left[\frac{1}{Z^H z_S^H l^{\bar{H}}}\right]^{\varepsilon} + \frac{z_G^F}{z_G^H}\frac{Z^F}{Z^H}\frac{l^{\bar{F}}}{l^{\bar{H}}}\left[\frac{z_G^H}{z_S^H}\frac{1}{Z^F z_G^F l^{\bar{F}}}\right]^{\varepsilon}\right)$$

Thus,

$$\frac{l_S^H}{l^{\bar{H}}} = 1 + \frac{z_G^F}{z_G^H}\frac{Z^F}{Z^H}\frac{l^{\bar{F}}}{l^{\bar{H}}} - v\left[\frac{z_S^H}{z_G^H}\right]^{\gamma}\left(\left[\frac{1}{Z^H z_S^H l^{\bar{H}}}\right]^{\varepsilon} + \frac{z_G^F}{z_G^H}\frac{Z^F}{Z^H}\frac{l^{\bar{F}}}{l^{\bar{H}}}\left[\frac{z_G^H}{z_S^H}\frac{1}{Z^F z_G^F l^{\bar{F}}}\right]^{\varepsilon}\right) \tag{50}$$

Home's goods sector employment share is $\frac{l_G^H}{l^{\bar{H}}} = 1 - \frac{l_S^H}{l^{\bar{H}}}$, so equation (20) follows.

The foreign case is trivial, since it is completely specialized in goods sector ($l_G^F = l^{\bar{F}}$ and $l_S^F = 0$). Thus equation (21) and the following equation hold,

$$\frac{l_S^F}{l^{\bar{F}}} = 0 \tag{51}$$

A.5 Proof of Proposition (7)

Since foreign diversifies, it sets prices

$$\frac{p_G}{p_S} = \frac{z_S^F}{z_G^F} \tag{52}$$

Foreign firms optimization implies

$$w^F = p_G Z^F z_G^F = p_S Z^F z_S^F \tag{53}$$

Home only produces services so in equilibrium

$$w^H = p_S Z^H z_S^H \tag{54}$$

In order to get consumption allocations, plug equilibrium relative prices into demand functions (38) and (39):

$$c_G^H = v\left[\frac{z_S^F}{z_G^F}\right]^{\gamma}\left[\frac{p_S}{e^H}\right]^{\varepsilon}\frac{e^H}{p_G}$$

$$c_S^H = \frac{e^H}{p_S}\left[1 - v\left[\frac{z_S^F}{z_G^F}\right]^{\gamma}\left[\frac{p_S}{e^H}\right]^{\varepsilon}\right]$$

$$c_G^F = v\left[\frac{z_S^F}{z_G^F}\right]^{\gamma}\left[\frac{p_S}{e^F}\right]^{\varepsilon}\frac{e^F}{p_G}$$

$$c_S^F = \frac{e^F}{p_S}\left[1 - v\left[\frac{z_S^F}{z_G^F}\right]^{\gamma}\left[\frac{p_S}{e^F}\right]^{\varepsilon}\right]$$

Using equilibrium expenditure relationships ($e^H = w^H l^{\bar{H}} = p_S Z^H z_S^H l^{\bar{H}}$ and $e^F = l^{\bar{F}} w^F = p_G Z^F z_G^F l^{\bar{F}} = p_S Z^F z_S^F l^{\bar{F}}$) and relative prices $\frac{p_G}{p_S} = \frac{z_S^F}{z_G^F}$, then the following relationships hold,

$$\frac{p_S}{e^H} = \frac{p_S}{p_S Z^H z_S^H l^{\bar{H}}} = \frac{1}{Z^H z_S^H l^{\bar{H}}}$$

$$\frac{e^H}{p_G} = \frac{p_S Z^H z_S^H l^{\bar{H}}}{p_G} = \frac{z_G^F}{z_S^F} Z^H z_S^H l^{\bar{H}}$$

$$\frac{p_S}{e^F} = \frac{p_S}{p_S Z^F z_S^F l^{\bar{F}}} = \frac{1}{Z^F z_S^F l^{\bar{F}}}$$

$$\frac{e^F}{p_G} = \frac{p_S Z^F z_S^F l^{\bar{F}}}{p_G} = Z^F z_G^F l^{\bar{F}}$$

Plugging in these four equations yield equilibrium consumptions,

$$c_G^H = v\left[\frac{z_S^F}{z_G^F}\right]^{\gamma}\left[\frac{1}{Z^H z_S^H l^{\bar{H}}}\right]^{\varepsilon} \frac{z_G^F}{z_S^F} Z^H z_S^H l^{\bar{H}} \tag{55}$$

$$c_S^H = Z^H z_S^H l^{\bar{H}}\left[1 - v\left[\frac{z_S^F}{z_G^F}\right]^{\gamma}\left[\frac{1}{Z^H z_S^H l^{\bar{H}}}\right]^{\varepsilon}\right] \tag{56}$$

$$c_G^F = v\left[\frac{z_S^F}{z_G^F}\right]^{\gamma}\left[\frac{1}{Z^F z_S^F l^{\bar{F}}}\right]^{\varepsilon} Z^F z_G^F l^{\bar{F}} \tag{57}$$

$$c_S^F = Z^F z_S^F l^{\bar{F}}\left[1 - v\left[\frac{z_S^F}{z_G^F}\right]^{\gamma}\left[\frac{1}{Z^F z_S^F l^{\bar{F}}}\right]^{\varepsilon}\right] \tag{58}$$

Using the world goods sector market clearing condition,

$$y_G^H + y_G^F = c_G^H + c_G^F$$

Using the fact that home completely specializes ($y_G^H = 0$) and using the production functions and equilibrium demand,

$$Z^F z_G^F l_G^F = v\left[\frac{z_S^F}{z_G^F}\right]^\gamma \left[\frac{1}{Z^H z_S^H \bar{l^H}}\right]^\varepsilon \frac{z_G^F}{z_S^F} Z^H z_S^H \bar{l^H} + v\left[\frac{z_S^F}{z_G^F}\right]^\gamma \left[\frac{1}{Z^F z_S^F \bar{l^F}}\right]^\varepsilon Z^F z_G^F \bar{l^F}$$

Rearranging,

$$\frac{l_G^F}{\bar{l^F}} = v\left[\frac{z_S^F}{z_G^F}\right]^\gamma \left[\frac{1}{Z^H z_S^H \bar{l^H}}\right]^\varepsilon \frac{z_S^H}{z_S^F}\frac{Z^H}{Z^F}\frac{\bar{l^H}}{\bar{l^F}} + v\left[\frac{z_S^F}{z_G^F}\right]^\gamma \left[\frac{1}{Z^F z_S^F \bar{l^F}}\right]^\varepsilon$$

Rearraging yields (23). The foreign services employment share is then

$$\frac{l_S^F}{\bar{l^F}} = 1 - v\left[\frac{z_S^F}{z_G^F}\right]^\gamma \left(\left[\frac{1}{Z^H z_S^H \bar{l^H}}\right]^\varepsilon \frac{Z^H z_S^H}{Z^F z_S^F}\frac{\bar{l^H}}{\bar{l^F}} + \left[\frac{1}{Z^F z_S^F \bar{l^F}}\right]^\varepsilon\right) \tag{59}$$

The home case is trivial, since it is completely specialized in service sector,

$$\frac{l_S^H}{\bar{l^H}} = 1 \tag{60}$$

Thus equation (22) holds as well.

A.6 Proof of Proposition (8)

Denote by $\triangle\frac{l_G^i}{\bar{l^i}}$ the change in the goods sector employment share between autarky and free trade.

In the equilibrium where home diversifies, this is equal to the difference between Equation (20) and (17):

$$\triangle\frac{l_G^H}{\bar{l^H}} = \frac{Z^F z_G^F \bar{l^F}}{Z^H z_G^H \bar{l^H}}\left(v\left[\frac{z_S^H}{z_G^H}\right]^\gamma \left[\frac{z_G^H}{z_S^H}\frac{1}{Z^F z_G^F \bar{l^F}}\right]^\varepsilon - 1\right) < 0 \tag{61}$$

which is negative since $v\left[\frac{z_S^H}{z_G^H}\right]^\gamma \left[\frac{z_G^H}{z_S^H}\frac{1}{Z^F z_G^F}\right]^\varepsilon < 1$, or $v\left[\frac{z_G^H}{z_S^H}\right]^\varepsilon \left[\frac{z_S^H}{z_G^H}\right]^\gamma < \left[Z^F z_G^F\right]^\varepsilon$ which is the threshold (40) mentioned before. Notice that both coincide since $\frac{e^F}{p_G} = Z^F z_G^F$ and $\frac{p_G}{p_S} = \frac{z_S^H}{z_G^H}$, hence $v\left[\frac{p_S}{p_G}\right]^\varepsilon \left[\frac{p_G}{p_S}\right]^\gamma < \left[Z^F z_G^F\right]^\varepsilon$, or $v\left[p_S\right]^\varepsilon \left[\frac{p_G}{p_S}\right]^\gamma < \left[p_G Z^F z_G^F\right]^\varepsilon$. Thus the foreign countries threshold is the relevant one here.

In the equilibrium where foreign diversifies, the change in the goods sector employment share is equal to the difference between Equation (23) and (17):

$$\triangle\frac{l_G^F}{\bar{l^F}} = v\left[\frac{z_S^F}{z_G^F}\right]^\gamma \left[\frac{1}{Z^H z_S^H \bar{l^H}}\right]^\varepsilon \frac{Z^H z_S^H}{Z^F z_S^F}\frac{\bar{l^H}}{\bar{l^F}} > 0 \tag{62}$$

Which is positive.

A.7 Proof of Proposition (9)

Denote time-varying variables as $x_{\omega,t}^{i}$ where $t = 1, 2, C1, C2$,where $t = 1$ denotes the "Start” period, $t = 2$ denotes the "End” period, $t = C1$ denotes "Counterfactual 1" and $t = C2$ denotes "Counterfactual 2". As before, $i = H, F$ and $\omega = G, S$.

A.7.1 Home

Let’s start by analyzing home. The goods sector employment share in different scenarios are:

Start is

$$\frac{l_{G,1}^{H}}{l^{\bar{H}}} = v\left[\frac{z_{S}^{H}}{z_{G}^{H}}\right]^{\gamma}\left[\frac{1}{Z_{1}^{H} z_{S}^{H} l^{\bar{H}}}\right]^{\varepsilon}$$

Counterfactual 1 is

$$\frac{l_{G,C1}^{H}}{l^{\bar{H}}} = v\left[\frac{z_{S}^{H}}{z_{G}^{H}}\right]^{\gamma}\left[\frac{1}{Z_{2}^{H} z_{S}^{H} l^{\bar{H}}}\right]^{\varepsilon}$$

Counterfactual 2 is

$$\frac{l_{G,C2}^{H}}{l^{\bar{H}}} = v\left[\frac{z_{S}^{H}}{z_{G}^{H}}\right]^{\gamma}\left(\left[\frac{1}{Z_{1}^{H} z_{S}^{H} l^{\bar{H}}}\right]^{\varepsilon} + \frac{z_{G}^{F}}{z_{G}^{H}}\frac{Z_{1}^{F}}{Z_{1}^{H}}\frac{l^{\bar{F}}}{l^{\bar{H}}}\left[\frac{z_{G}^{H}}{z_{S}^{H}}\frac{1}{Z_{1}^{F} z_{G}^{F} l^{\bar{F}}}\right]^{\varepsilon}\right) - \frac{z_{G}^{F}}{z_{G}^{H}}\frac{Z_{1}^{F}}{Z_{1}^{H}}\frac{l^{\bar{F}}}{l^{\bar{H}}}$$

End is

$$\frac{l_{G,2}^{H}}{l^{\bar{H}}} = v\left[\frac{z_{S}^{H}}{z_{G}^{H}}\right]^{\gamma}\left(\left[\frac{1}{Z_{2}^{H} z_{S}^{H} l^{\bar{H}}}\right]^{\varepsilon} + \frac{z_{G}^{F}}{z_{G}^{H}}\frac{Z_{2}^{F}}{Z_{2}^{H}}\frac{l^{\bar{F}}}{l^{\bar{H}}}\left[\frac{z_{G}^{H}}{z_{S}^{H}}\frac{1}{Z_{2}^{F} z_{G}^{F} l^{\bar{F}}}\right]^{\varepsilon}\right) - \frac{z_{G}^{F}}{z_{G}^{H}}\frac{Z_{2}^{F}}{Z_{2}^{H}}\frac{l^{\bar{F}}}{l^{\bar{H}}}$$

The change between Start and Counterfactual 1:

$$\begin{aligned}
\triangle\frac{l_{G,1C1}^{H}}{l^{\bar{H}}} &= \frac{l_{G,C1}^{H}}{l^{\bar{H}}} - \frac{l_{G,1}^{H}}{l^{\bar{H}}} \\
&= v\left[\frac{z_{S}^{H}}{z_{G}^{H}}\right]^{\gamma}\left[\frac{1}{Z_{2}^{H} z_{S}^{H} l^{\bar{H}}}\right]^{\varepsilon} - v\left[\frac{z_{S}^{H}}{z_{G}^{H}}\right]^{\gamma}\left[\frac{1}{Z_{1}^{H} z_{S}^{H} l^{\bar{H}}}\right]^{\varepsilon} \\
&= v\left[\frac{z_{S}^{H}}{z_{G}^{H}}\right]^{\gamma}\left[\frac{1}{z_{S}^{H} l^{\bar{H}}}\right]^{\varepsilon}\left(\left[\frac{1}{Z_{2}^{H}}\right]^{\varepsilon} - \left[\frac{1}{Z_{1}^{H}}\right]^{\varepsilon}\right)
\end{aligned}$$

The change between Counterfactual 1 and End:

$$
\begin{aligned}
\triangle\frac{l^H_{G,C12}}{\bar{l^H}} &= \frac{l^H_{G,2}}{\bar{l^H}} - \frac{l^H_{G,C1}}{\bar{l^H}} \\
&= v\left[\frac{z^H_S}{z^H_G}\right]^{\gamma}\left(\left[\frac{1}{Z^H_2 z^H_S \bar{l^H}}\right]^{\varepsilon} + \frac{z^F_G}{z^H_G}\frac{Z^F_2}{Z^H_2}\frac{\bar{l^F}}{\bar{l^H}}\left[\frac{z^H_G}{z^H_S}\frac{1}{Z^F_2 z^F_G \bar{l^F}}\right]^{\varepsilon}\right) - \frac{z^F_G}{z^H_G}\frac{Z^F_2}{Z^H_2}\frac{\bar{l^F}}{\bar{l^H}} - v\left[\frac{z^H_S}{z^H_G}\right]^{\gamma}\left[\frac{1}{Z^H_2 z^H_S \bar{l^H}}\right]^{\varepsilon} \\
&= \frac{z^F_G}{z^H_G}\frac{Z^F_2}{Z^H_2}\frac{\bar{l^F}}{\bar{l^H}}\left(v\left[\frac{z^H_S}{z^H_G}\right]^{\gamma}\left[\frac{z^H_G}{z^H_S}\frac{1}{Z^F_2 z^F_G \bar{l^F}}\right]^{\varepsilon} - 1\right)
\end{aligned}
$$

The change between Start and End is, denoted by T (Total Effect), is

$$
\begin{aligned}
\triangle\frac{l^H_{G,T}}{\bar{l^H}} &= \frac{l^H_{G,2}}{\bar{l^H}} - \frac{l^H_{G,1}}{\bar{l^H}} \\
&= v\left[\frac{z^H_S}{z^H_G}\right]^{\gamma}\left(\left[\frac{1}{Z^H_2 z^H_S \bar{l^H}}\right]^{\varepsilon} + \frac{z^F_G}{z^H_G}\frac{Z^F_2}{Z^H_2}\frac{\bar{l^F}}{\bar{l^H}}\left[\frac{z^H_G}{z^H_S}\frac{1}{Z^F_2 z^F_G \bar{l^F}}\right]^{\varepsilon}\right) - \frac{z^F_G}{z^H_G}\frac{Z^F_2}{Z^H_2}\frac{\bar{l^F}}{\bar{l^H}} - v\left[\frac{z^H_S}{z^H_G}\right]^{\gamma}\left[\frac{1}{Z^H_1 z^H_S \bar{l^H}}\right]^{\varepsilon} \\
&= v\left[\frac{z^H_S}{z^H_G}\right]^{\gamma}\left[\frac{1}{Z^H_2 z^H_S \bar{l^H}}\right]^{\varepsilon} + v\left[\frac{z^H_S}{z^H_G}\right]^{\gamma}\frac{z^F_G}{z^H_G}\frac{Z^F_2}{Z^H_2}\frac{\bar{l^F}}{\bar{l^H}}\left[\frac{z^H_G}{z^H_S}\frac{1}{Z^F_2 z^F_G \bar{l^F}}\right]^{\varepsilon} - \frac{z^F_G}{z^H_G}\frac{Z^F_2}{Z^H_2}\frac{\bar{l^F}}{\bar{l^H}} - v\left[\frac{z^H_S}{z^H_G}\right]^{\gamma}\left[\frac{1}{Z^H_1 z^H_S \bar{l^H}}\right]^{\varepsilon} \\
&= v\left[\frac{z^H_S}{z^H_G}\right]^{\gamma}\left[\frac{1}{z^H_S \bar{l^H}}\right]^{\varepsilon}\left(\left[\frac{1}{Z^H_2}\right]^{\varepsilon} - \left[\frac{1}{Z^H_1}\right]^{\varepsilon}\right) + \frac{z^F_G}{z^H_G}\frac{Z^F_2}{Z^H_2}\frac{\bar{l^F}}{\bar{l^H}}\left[v\left[\frac{z^H_S}{z^H_G}\right]^{\gamma}\left[\frac{z^H_G}{z^H_S}\frac{1}{Z^F_2 z^F_G \bar{l^F}}\right]^{\varepsilon} - 1\right]
\end{aligned}
$$

Note that this is the sum of the change between Start and Counterfactual 1 and change between Counterfactual 1 and End. Thus, the total effect can be interpreted as the sum of a "structural change" effect and an "international trade" effects.

$$
\triangle\frac{l^H_{G,T}}{\bar{l^H}} = \underbrace{v\left[\frac{z^H_S}{z^H_G}\right]^{\gamma}\left[\frac{1}{z^H_S \bar{l^H}}\right]^{\varepsilon}\left(\left[\frac{1}{Z^H_2}\right]^{\varepsilon} - \left[\frac{1}{Z^H_1}\right]^{\varepsilon}\right)}_{\text{"Structural Change Effect"}} + \underbrace{\frac{z^F_G}{z^H_G}\frac{Z^F_2}{Z^H_2}\frac{\bar{l^F}}{\bar{l^H}}\left(v\left[\frac{z^H_S}{z^H_G}\right]^{\gamma}\left[\frac{z^H_G}{z^H_S}\frac{1}{Z^F_2 z^F_G \bar{l^F}}\right]^{\varepsilon} - 1\right)}_{\text{"International Trade Effect"}}
$$

A.7.2 Foreign

Start is

$$
\frac{l^F_{G,1}}{\bar{l^F}} = v\left[\frac{z^F_S}{z^F_G}\right]^{\gamma}\left[\frac{1}{Z^F_2 z^F_S \bar{l^F}}\right]^{\varepsilon}
$$

Counterfactual 1 is

$$
\frac{l^F_{G,C1}}{\bar{l^F}} = v\left[\frac{z^F_S}{z^F_G}\right]^{\gamma}\left[\frac{1}{Z^F_2 z^F_S \bar{l^F}}\right]^{\varepsilon}
$$

Counterfactual 2 is

$$\frac{l^F_{G,C2}}{l^{\bar{F}}} = v\left[\frac{z^F_S}{z^F_G}\right]^{\gamma}\left(\left[\frac{1}{Z^H_1 z^H_S l^{\bar{H}}}\right]^{\varepsilon}\frac{Z^H_1 z^H_S}{Z^F_1 z^F_S}\frac{l^{\bar{H}}}{l^{\bar{F}}} + \left[\frac{1}{Z^F_1 z^F_S l^{\bar{F}}}\right]^{\varepsilon}\right)$$

End is

$$\frac{l^F_{G,2}}{l^{\bar{F}}} = v\left[\frac{z^F_S}{z^F_G}\right]^{\gamma}\left(\left[\frac{1}{Z^H_2 z^H_S l^{\bar{H}}}\right]^{\varepsilon}\frac{Z^H_2 z^H_S}{Z^F_2 z^F_S}\frac{l^{\bar{H}}}{l^{\bar{F}}} + \left[\frac{1}{Z^F_2 z^F_S l^{\bar{F}}}\right]^{\varepsilon}\right)$$

The change between Start and Counterfactual 1 is

$$\begin{aligned}
\triangle\frac{l^F_{G,1C1}}{l^{\bar{F}}} &= \frac{l^F_{G,C1}}{l^{\bar{F}}} - \frac{l^F_{G,1}}{l^{\bar{F}}} \\
&= v\left[\frac{z^F_S}{z^F_G}\right]^{\gamma}\left[\frac{1}{Z^F_2 z^F_S l^{\bar{F}}}\right]^{\varepsilon} - v\left[\frac{z^F_S}{z^F_G}\right]^{\gamma}\left[\frac{1}{Z^F_1 z^F_S l^{\bar{F}}}\right]^{\varepsilon} \\
&= v\left[\frac{z^F_S}{z^F_G}\right]^{\gamma}\left[\frac{1}{z^F_S l^{\bar{F}}}\right]^{\varepsilon}\left(\left[\frac{1}{Z^F_2}\right]^{\varepsilon} - \left[\frac{1}{Z^F_1}\right]^{\varepsilon}\right)
\end{aligned}$$

The change between Counterfactual 1 and End is

$$\begin{aligned}
\triangle\frac{l^F_{G,C12}}{l^{\bar{F}}} &= \frac{l^F_{G,2}}{l^{\bar{F}}} - \frac{l^F_{G,C1}}{l^{\bar{F}}} \\
&= v\left[\frac{z^F_S}{z^F_G}\right]^{\gamma}\left(\left[\frac{1}{Z^H_2 z^H_S l^{\bar{H}}}\right]^{\varepsilon}\frac{Z^H_2 z^H_S}{Z^F_2 z^F_S}\frac{l^{\bar{H}}}{l^{\bar{F}}} + \left[\frac{1}{Z^F_2 z^F_S l^{\bar{F}}}\right]^{\varepsilon}\right) - v\left[\frac{z^F_S}{z^F_G}\right]^{\gamma}\left[\frac{1}{Z^F_2 z^F_S l^{\bar{F}}}\right]^{\varepsilon} \\
&= v\left[\frac{z^F_S}{z^F_G}\right]^{\gamma}\left[\frac{1}{Z^H_2 z^H_S l^{\bar{H}}}\right]^{\varepsilon}\frac{Z^H_2 z^H_S}{Z^F_2 z^F_S}\frac{l^{\bar{H}}}{l^{\bar{F}}}
\end{aligned}$$

The change between Start and End is

$$\begin{aligned}
\triangle\frac{l^F_{G,T}}{l^{\bar{F}}} &= \frac{l^F_{G,2}}{l^{\bar{F}}} - \frac{l^F_{G,1}}{l^{\bar{F}}} \\
&= v\left[\frac{z^F_S}{z^F_G}\right]^{\gamma}\left(\left[\frac{1}{Z^H_2 z^H_S l^{\bar{H}}}\right]^{\varepsilon}\frac{Z^H_2 z^H_S}{Z^F_2 z^F_S}\frac{l^{\bar{H}}}{l^{\bar{F}}} + \left[\frac{1}{Z^F_2 z^F_S l^{\bar{F}}}\right]^{\varepsilon}\right) - v\left[\frac{z^F_S}{z^F_G}\right]^{\gamma}\left[\frac{1}{Z^F_1 z^F_S l^{\bar{F}}}\right]^{\varepsilon} \\
&= v\left[\frac{z^F_S}{z^F_G}\right]^{\gamma}\left[\frac{1}{Z^H_2 z^H_S l^{\bar{H}}}\right]^{\varepsilon}\frac{Z^H_2 z^H_S}{Z^F_2 z^F_S}\frac{l^{\bar{H}}}{l^{\bar{F}}} + v\left[\frac{z^F_S}{z^F_G}\right]^{\gamma}\left[\frac{1}{Z^F_2 z^F_S l^{\bar{F}}}\right]^{\varepsilon} - v\left[\frac{z^F_S}{z^F_G}\right]^{\gamma}\left[\frac{1}{Z^F_1 z^F_S l^{\bar{F}}}\right]^{\varepsilon} \\
&= v\left[\frac{z^F_S}{z^F_G}\right]^{\gamma}\left[\frac{1}{Z^H_2 z^H_S l^{\bar{H}}}\right]^{\varepsilon}\frac{Z^H_2 z^H_S}{Z^F_2 z^F_S}\frac{l^{\bar{H}}}{l^{\bar{F}}} + v\left[\frac{z^F_S}{z^F_G}\right]^{\gamma}\left[\frac{1}{z^F_S l^{\bar{F}}}\right]^{\varepsilon}\left(\left[\frac{1}{Z^F_2}\right]^{\varepsilon} - \left[\frac{1}{Z^F_1}\right]^{\varepsilon}\right)
\end{aligned}$$

Similar as before,

$$\triangle\frac{l_{G,T}^{F}}{\bar{l^F}}=\underbrace{v\left[\frac{z_S^F}{z_G^F}\right]^{\gamma}\left[\frac{1}{z_S^F\bar{l^F}}\right]^{\varepsilon}\left(\left[\frac{1}{Z_2^F}\right]^{\varepsilon}-\left[\frac{1}{Z_1^F}\right]^{\varepsilon}\right)}_{\text{Structural Change Effect}}+\underbrace{v\left[\frac{z_S^F}{z_G^F}\right]^{\gamma}\left[\frac{1}{Z_2^H z_S^H\bar{l^H}}\right]^{\varepsilon}\frac{Z_2^H z_S^H}{Z_2^F z_S^F}\frac{\bar{l^H}}{\bar{l^F}}}_{\text{International Trade Effect}}$$

Foreign

Rewrite SC effect in equation (25) as,

$$\begin{aligned}SC^F&=v\left[\frac{z_S^F}{z_G^F}\right]^{\gamma}\left[\frac{1}{z_S^F\bar{l^F}}\right]^{\varepsilon}\left(\left[\frac{1}{g^F Z_1^F}\right]^{\varepsilon}-\left[\frac{1}{Z_1^F}\right]^{\varepsilon}\right)\\&=v\left[\frac{z_S^F}{z_G^F}\right]^{\gamma}\left[\frac{1}{z_S^F\bar{l^F}}\right]^{\varepsilon}\left[\frac{1}{Z_1^F}\right]^{\varepsilon}\left(g^{F-\varepsilon}-1\right)\end{aligned}$$

Similarly, the SC effect is negative, and the larger g^F, the larger the absolute value of the SC effect,

$$\frac{\partial SC^F}{\partial g^F}=-\varepsilon v\left[\frac{z_S^F}{z_G^F}\right]^{\gamma}\left[\frac{1}{z_S^F\bar{l^F}}\right]^{\varepsilon}\left[\frac{1}{Z_1^F}\right]^{\varepsilon}\left(g^F\right)^{-\varepsilon-1}<0$$

B Data Source

B.1 Countries classification by GDP per Capita

Throughout the paper I classify countries according to their PPP GDP per capita in 2014 as "Poor" (below $25,000), "Medium" (between $25,000 and $35,000) or "Rich" (above $35,000).

This threshold divides the sample into:

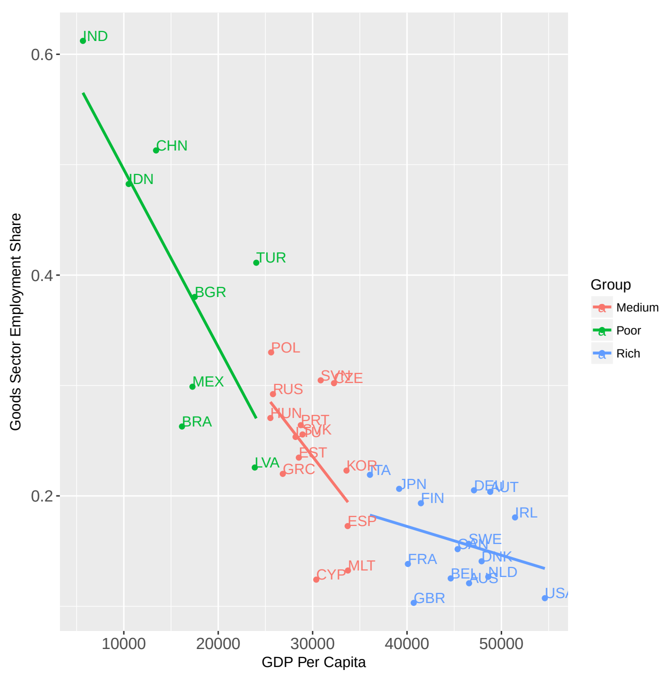
1. 15 "Rich" countries: AUS, AUT, BEL, CAN, DEU, DNK, FIN, FRA, GBR, IRL, ITA, JPN, NLD, SWE, USA.

2. 14 "Medium" countries: CYP, CZE, ESP, EST, GRC, HUN, KOR, LTU, LVA, MLT, POL, PRT, RUS, SVK, SVN

3. 8 "Poor" countries: BGR, BRA, CHN, IDN, IND, MEX, TUR

In Figure (A2) we can see the relationship between goods sector employment share and GDP per capita in 2014, and the difference in terms of development in these two groups.

Figure A2: Goods Sector Employment Share and GDP per Capita, 2014.



Source: WIOD.

B.2 Service Trade Data

The World Trade Organization (WTO) defines in its General Agreement on Trade in Services (GATS), services trade to span the following four modes of supply:

- Mode 1 - Cross-border: services supplied from the territory of one country into the territory of another,
- Mode 2 - Consumption abroad: services supplied in the territory of a nation to the consumers of another,
- Mode 3 - Commercial presence: services supplied through any type of business or professional establishment of one country in the territory of another (i.e. FDI), and
- Mode 4 - Presence of natural persons: services supplied by nationals of a country in the territory of another.

As described in Dietzenbacher et al. [2013], in the data set collected for the WIOD, only data on cross-border services trade in the GATS mode 1 has been used: "The WIOTs are constructed on a territorial basis meaning that they include all activities that take place on the territory of the country, either by residents or non-residents, so mode 3 and 4 are not considered as part of imports and exports. Mode 2 activities are already covered by the items 'purchases of non-residents on domestic territory' and 'foreign purchases of residents' in the national SUTs and are not split further by the country of supply...There is ample space for further improvements in the measurement of services trade. The WIOD database for trade in services should be seen in this light as the best currently available approximation to a comprehensive picture of global trade flows in Mode 1 services."

The service trade flows used throughout my paper are thus in Mode 1 only.

B.3 Aggregation

I use both the 2013 and 2016 releases of WIOD. The different releases of WIOD differ in coverage of years, countries and sectors:

- The 2013 release of WIOD covers 40 countries for the period from 1995 to 2011. Data for 35 sectors are classified according to the International Standard Industrial Classification revision 3 (ISIC Rev. 3).
- The 2016 release of WIOD covers 43 countries for the period from 2000 to 2014. Data for 56 sectors are classified according to the International Standard Industrial Classification revision 4 (ISIC Rev. 4).

Throughout the paper, I focus on two aggregation criteria:

1. Goods sector: for the 2013 release of WIOD, I classify sectors 1 to 16 as Goods (following Kehoe et al. [2018]). I classify the rest as Services.[24] I follow the same criteria for the 2016 release of WIOD, so I classify sectors 1 to 22 as Goods and 23 to 56 as Services.
2. Manufacturing sector: for the 2013 release of WIOD, I classify sectors 1 to 3 as Agriculture, 4 to 16 as Manufacturing and 17 to 35 as Services (following Uy et al. [2013]).[25]. I follow the same criteria for the 2016 release of WIOD, so I classify sectors 1 to 5 as Agriculture, 6 to 22 as Manufacturing, and 23 to 56 as Services.

Table (A1) and (A2) summarizes this sector classification for the 2013 and 2016 releases of WIOD, respectively.

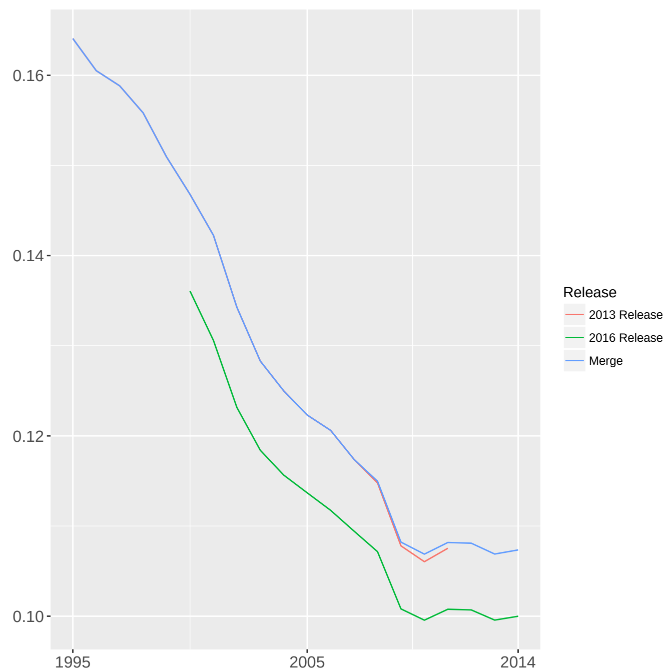
[24]Different from Kehoe et al. [2018], I include Construction as a Service while they take Construction as a third sector. See their online appendix at http://users.econ.umn.edu/ tkehoe/publications.html

[25]Uy et al. [2013] use sources different from WIOD. The classification criteria they follow (which I apply to the WIOD sectors) is: "Unless otherwise noted, the sectors are defined by the International Standard Industrial Classification, revision 3 (ISIC III) definitions: Agriculture corresponds to ISIC divisions 1-5 (agriculture, forestry, hunting, and fishing), 10-14 (mining and quarry), 15-16 (food, beverages and tobacco-FBT); Manufacturing corresponds to divisions 17-37 (total manufacturing less FBT); Services corresponds to divisions 40-99 (utilities, construction, wholesale and retail trade, transport, government, financial, professional, and personal services such as education, health care, and real estate services)." See their online appendix at https://www.sciencedirect.com/science/article/pii/S030439321300086X

B.4 WIOD 2013 and 2016 releases merge

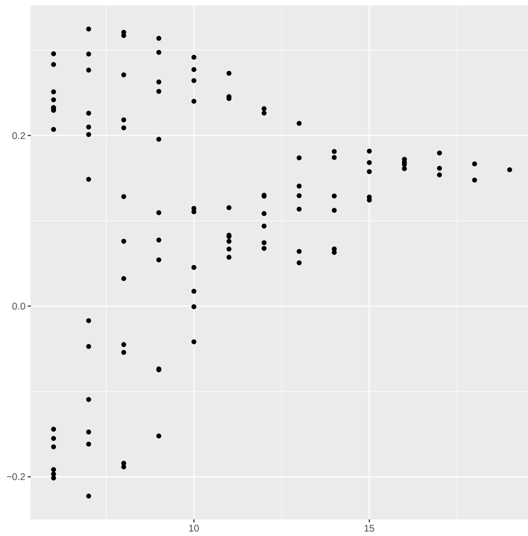
Since the sectors in the 2013 and 2016 releases of WIOD are different, I merge as follows: for each release, I aggregate by the sector classification described in the previous paragraph. I then merge by using 1995-2007 data from the 2013 release and 2008-2014 data from the 2016 release. Merging the databases is not straightforward since there are discrepancies between them. For example, Figure (A3) shows the discrepancy in the employment share in the goods sector in USA. These discrepancies seem to be mostly on the level of variables, and less so in growth rates. Given these this, I merge by using the 2013 release data until 2007, and then use the growth rates implied by the 2014 release to construct the remaining years until 2014. In other words, I shift the 2016 release data to match the level of the variables in 2007 given by the 2013 release values.

Figure A3: WIOD 2013 and 2016 Comparison example: Goods Sector Employment Share in the USA

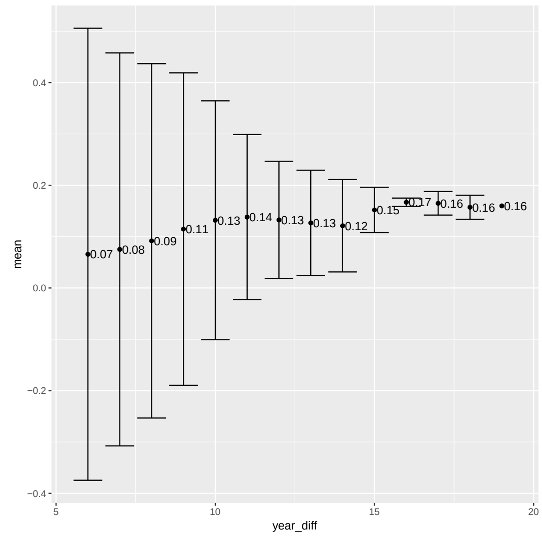


Source: WIOD.

Figure A4: USA Goods Sector, Trade Balance Effect: Window lengths, point estimates and 95% confidence intervals



(a) Trade Balance Effect



(b) Confidence Intervals

Source: WIOD.

C Confidence Intervals

Estimates in Table (4) correspond the the single observation using the difference between the years 1995 and 2014. However, one would like to have a confidence interval for these estimations. A description follows on how to construct such intervals.

The growth accounting exercise could be repeated for any given two pairs of years in which the initial year is smaller than the end year ($\tau < \nu$). The possible year-pair combinations between 1995 and 2014 is then $\binom{20}{2} = \frac{20!}{(20-2)!2!} = 190$, per country. In practice, I drop window lengths smaller than 5 years to avoid business-cycle led dynamics, which shrink the data to 105.

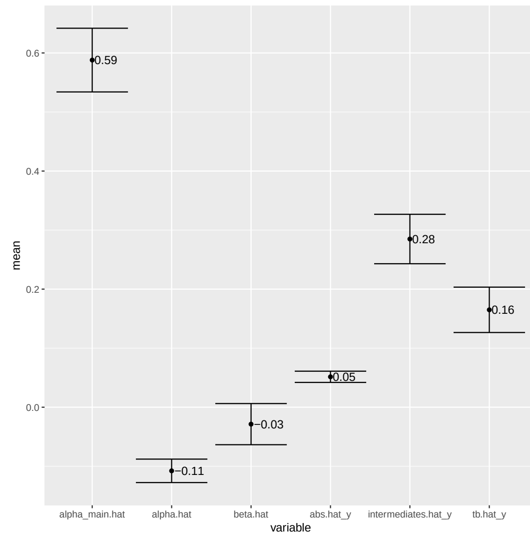
In this set there are window periods of different lengths. A given length implies a given amount of observations: the larger the window, the lower the amount of observations. Given a window length and these observations, a confidence intervals can be computed, defined as $\bar{x} \pm t^* \frac{s}{\sqrt{n}}$, where $\bar{x}$ is the average, s is the standard deviation and t^* is the critical value of Student's t distribution, for a given significance level and $n-1$ degrees of freedom.

In Figure (A4a) we can observe the observed trade balance effects in the USA. The horizontal axis represent the length of the window. In Figure (A4b) we can observe the corresponding point estimates and 95% confidence intervals for each window length.

These confidence intervals can be repeated for each element in the decomposition excersice. In Figure

(A5) we can observe the 95% confidence intervals for the decomposition estimate in the USA, corresponding to a 17 year window ($n = 3$). As can be observed, all components are statistically different from zero, except for $\frac{\widehat{\alpha}_{it}}{\widehat{l}_{it}(s)}$ and $\frac{\widehat{\beta}_{it}(s)}{\widehat{l}_{it}(s)}$. The point estimates are overall similar with respect to the the full 1995-2014 estimates.

Figure A5: USA, Goods Sector Decomposition: 95% Confidence Intervals (17 year window length, $n = 3$).



Source: WIOD

D Tables

Table A1: Sectors in WIOD 2013 Release

	Sector	Classification 1	Classification 2
1	Agriculture, Hunting, Forestry and Fishing	Goods	Agriculture
2	Mining and Quarrying	Goods	Agriculture
3	Food, Beverages and Tobacco	Goods	Agriculture
4	Textiles and Textile Products	Goods	Manufacturing
5	Leather, Leather and Footwear	Goods	Manufacturing
6	Wood and Products of Wood and Cork	Goods	Manufacturing
7	Pulp, Paper, Paper , Printing and Publishing	Goods	Manufacturing
8	Coke, Refined Petroleum and Nuclear Fuel	Goods	Manufacturing
9	Chemicals and Chemical Products	Goods	Manufacturing
10	Rubber and Plastics	Goods	Manufacturing
11	Other Non-Metallic Mineral	Goods	Manufacturing
12	Basic Metals and Fabricated Metal	Goods	Manufacturing
13	Machinery, Nec	Goods	Manufacturing
14	Electrical and Optical Equipment	Goods	Manufacturing
15	Transport Equipment	Goods	Manufacturing
16	Manufacturing, Nec; Recycling	Goods	Manufacturing
17	Electricity, Gas and Water Supply	Services	Services
18	Construction	Services	Services
19	Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	Services	Services
20	Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	Services	Services
21	Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	Services	Services
22	Hotels and Restaurants	Services	Services
23	Inland Transport	Services	Services
24	Water Transport	Services	Services
25	Air Transport	Services	Services
26	Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	Services	Services
27	Post and Telecommunications	Services	Services
28	Financial Intermediation	Services	Services
29	Real Estate Activities	Services	Services
30	Renting of M and Eq and Other Business Activities	Services	Services
31	Public Admin and Defence; Compulsory Social Security	Services	Services
32	Education	Services	Services
33	Health and Social Work	Services	Services
34	Other Community, Social and Personal Services	Services	Services
35	Private Households with Employed Persons	Services	Services

Table A2: Sectors in WIOD 2016 Release

	Sector	Classification 1	Classification 2
1	Crop and animal production, hunting and related se...	Goods	Agriculture
2	Forestry and logging	Goods	Agriculture
3	Fishing and aquaculture	Goods	Agriculture
4	Mining and quarrying	Goods	Agriculture
5	Manufacture of food products, beverages and tobacc...	Goods	Agriculture
6	Manufacture of textiles, wearing apparel and leath...	Goods	Manufacturing
7	Manufacture of wood and of products of wood and co...	Goods	Manufacturing
8	Manufacture of paper and paper products	Goods	Manufacturing
9	Printing and reproduction of recorded media	Goods	Manufacturing
10	Manufacture of coke and refined petroleum products...	Goods	Manufacturing
11	Manufacture of chemicals and chemical products	Goods	Manufacturing
12	Manufacture of basic pharmaceutical products and p...	Goods	Manufacturing
13	Manufacture of rubber and plastic products	Goods	Manufacturing
14	Manufacture of other non-metallic mineral products...	Goods	Manufacturing
15	Manufacture of basic metals	Goods	Manufacturing
16	Manufacture of fabricated metal products, except m...	Goods	Manufacturing
17	Manufacture of computer, electronic and optical pr...	Goods	Manufacturing
18	Manufacture of electrical equipment	Goods	Manufacturing
19	Manufacture of machinery and equipment n.e.c.	Goods	Manufacturing
20	Manufacture of motor vehicles, trailers and semi-t...	Goods	Manufacturing
21	Manufacture of other transport equipment	Goods	Manufacturing
22	Manufacture of furniture; other manufacturing	Goods	Manufacturing
23	Repair and installation of machinery and equipment...	Services	Services
24	Electricity, gas, steam and air conditioning suppl...	Services	Services
25	Water collection, treatment and supply	Services	Services
26	Sewerage; waste collection, treatment and disposal...	Services	Services
27	Construction	Services	Services
28	Wholesale and retail trade and repair of motor veh...	Services	Services
29	Wholesale trade, except of motor vehicles and moto...	Services	Services
30	Retail trade, except of motor vehicles and motorcy...	Services	Services
31	Land transport and transport via pipelines	Services	Services
32	Water transport	Services	Services
33	Air transport	Services	Services
34	Warehousing and support activities for transportat...	Services	Services
35	Postal and courier activities	Services	Services
36	Accommodation and food service activities	Services	Services
37	Publishing activities	Services	Services
38	Motion picture, video and television programme pro...	Services	Services
39	Telecommunications	Services	Services
40	Computer programming, consultancy and related acti...	Services	Services
41	Financial service activities, except insurance and...	Services	Services
42	Insurance, reinsurance and pension funding, except...	Services	Services
43	Activities auxiliary to financial services and ins...	Services	Services
44	Real estate activities	Services	Services
45	Legal and accounting activities; activities of hea...	Services	Services
46	Architectural and engineering activities; technica...	Services	Services
47	Scientific research and development	Services	Services
48	Advertising and market research	Services	Services
49	Other professional, scientific and technical activ...	Services	Services
50	Administrative and support service activities	Services	Services
51	Public administration and defence; compulsory soci...	Services	Services
52	Education	Services	Services
53	Human health and social work activities	Services	Services
54	Other service activities	Services	Services
55	Activities of households as employers; undifferent...	Services	Services
56	Activities of extraterritorial organizations and b...	Services	Services

Table A3: Growth Accounting Decomposition for s =Goods, $\tau = 1995$, $v = 2014$ for all Countries

Country	Period	Sector	$\frac{\widehat{\alpha}_{it}(s)}{\widehat{l}_{it}(s)}$	$-\frac{\widehat{\alpha}_{it}}{\widehat{l}_{it}(s)}$	$\frac{\widehat{\beta}_{it}(s)}{\widehat{l}_{it}(s)}$	$\frac{f}{y}\frac{\widehat{f}_{Nit}(s)}{\widehat{l}_{it}(s)}$	$\frac{x}{y}\frac{\widehat{x}_{Nit}(s,s')}{\widehat{l}_{it}(s)}$	$\frac{tb}{y}\frac{\widehat{tb}_{iJt}(s)}{\widehat{l}_{it}(s)}$	Sum
AUS	1995-2014	Goods	0.46	-0.13	-0.20	0.19	0.62	0.07	1.01
AUT	1995-2014	Goods	0.44	-0.11	0.71	0.37	-0.39	-0.33	0.69
BEL	1995-2014	Goods	-0.15	0.02	0.79	0.26	-0.03	0.09	0.98
BGR	1995-2014	Goods	-0.70	1.30	1.13	0.33	-0.36	0.51	2.20
BRA	1995-2014	Goods	-1.15	0.80	0.30	0.10	0.06	0.06	0.17
CAN	1995-2014	Goods	0.69	-0.22	-0.26	0.04	-0.28	0.45	0.43
CHN	1995-2014	Goods	0.29	-0.29	1.21	0.40	-0.90	-0.07	0.63
CYP	1995-2014	Goods	-0.47	0.06	0.32	0.56	0.31	0.05	0.82
CZE	1995-2014	Goods	-1.46	2.62	1.31	0.70	-0.70	-1.46	1.01
DEU	1995-2014	Goods	0.65	-0.13	0.60	0.33	-0.19	-0.72	0.55
DNK	1995-2014	Goods	0.29	0.10	0.21	0.22	0.12	0.03	0.97
ESP	1995-2014	Goods	0.12	-0.27	0.54	0.36	0.38	-0.06	1.07
EST	1995-2014	Goods	0.28	-0.21	0.23	0.40	0.46	-0.26	0.89
FIN	1995-2014	Goods	-0.24	0.08	0.72	0.10	0.27	0.12	1.05
FRA	1995-2014	Goods	-0.16	0.11	0.48	0.20	0.06	0.16	0.86
GBR	1995-2014	Goods	-0.12	-0.04	0.01	0.33	0.30	0.38	0.85
GRC	1995-2014	Goods	-0.13	0.19	0.90	0.01	0.78	-0.03	1.72
HUN	1995-2014	Goods	0.93	-0.38	0.53	0.34	-0.23	-0.48	0.71
IDN	1995-2014	Goods	0.74	-0.38	-0.43	0.63	0.12	0.16	0.84
IND	1995-2014	Goods	1.10	-0.34	0.72	0.72	0.40	0.11	2.71
IRL	1995-2014	Goods	0.57	-0.40	0.07	0.31	0.70	-0.09	1.16
ITA	1995-2014	Goods	-0.38	0.00	0.48	0.54	0.12	0.06	0.82
JPN	1995-2014	Goods	-0.04	-0.22	0.59	0.14	-0.23	0.25	0.49
KOR	1995-2014	Goods	0.23	-0.28	0.66	0.29	-0.70	-0.22	-0.01
LTU	1995-2014	Goods	0.38	-0.00	0.31	0.22	0.54	-0.21	1.22
LVA	1995-2014	Goods	0.06	0.02	0.74	0.37	0.05	0.23	1.47
MEX	1995-2014	Goods	1.25	-0.43	-0.13	0.21	0.24	0.07	1.20
MLT	1995-2014	Goods	-0.10	-0.06	-0.44	0.89	0.62	-0.03	0.87
NLD	1995-2014	Goods	-0.03	-0.01	0.70	0.24	-0.66	0.61	0.85
POL	1995-2014	Goods	1.76	-1.31	0.54	0.13	-0.23	0.25	1.13
PRT	1995-2014	Goods	-0.05	-0.23	0.55	0.36	0.53	-0.11	1.05
RUS	1995-2014	Goods	0.29	0.32	0.17	0.22	0.10	0.14	1.23
SVK	1995-2014	Goods	-0.09	0.22	0.63	0.16	0.05	-0.17	0.80
SVN	1995-2014	Goods	0.88	-0.42	0.11	0.42	0.16	-0.20	0.96
SWE	1995-2014	Goods	-0.20	0.19	0.38	0.15	0.38	0.20	1.10
TUR	1995-2014	Goods	-1.18	0.48	0.90	0.52	-0.08	0.14	0.78
USA	1995-2014	Goods	0.62	-0.12	-0.04	0.05	0.30	0.16	0.98

Table A4: Summary Statistics: Full Panel, All years, Goods Sector, Decomposition

$\frac{\widehat{\alpha}_{it}(s)}{\widehat{l}_{it}(s)}$	$-\frac{\widehat{\alpha}_{it}}{\widehat{l}_{it}(s)}$	$\frac{\widehat{\beta}_{it}(s)}{\widehat{l}_{it}(s)}$	$\frac{f}{y}\frac{\widehat{f}_{Nit}(s)}{\widehat{l}_{it}(s)}$	$\frac{x}{y}\frac{\widehat{x}_{Nit}(s,s')}{\widehat{l}_{it}(s)}$	$\frac{tb}{y}\frac{\widehat{tb}_{iJt}(s)}{\widehat{l}_{it}(s)}$	Sum
Min. : -Inf	Min. : -Inf	Min. : -Inf	Min. : -Inf	Min. : -Inf	Min. : -Inf	Min. :-1.2e+13
1st Qu.:-1.373	1st Qu.:-0.656	1st Qu.:-0.58	1st Qu.:-0.42	1st Qu.:-1.07	1st Qu.:-0.621	1st Qu.: 0.0e+00
Median : 0.019	Median :-0.016	Median : 0.29	Median : 0.15	Median : 0.13	Median : 0.067	Median : 1.0e+00
Mean : NaN	Mean : NaN	Mean : NaN	Mean : NaN	Mean : NaN	Mean : NaN	Mean :-1.7e+10
3rd Qu.: 1.462	3rd Qu.: 0.620	3rd Qu.: 1.33	3rd Qu.: 0.71	3rd Qu.: 1.20	3rd Qu.: 0.717	3rd Qu.: 1.0e+00
Max. : Inf	Max. : Inf	Max. : Inf	Max. : Inf	Max. : Inf	Max. : Inf	Max. : 1.9e+02
						NA's :4

Table A5: Growth Accounting Decomposition for s =Manufacturing, τ = 1995, υ = 2014 for countries with increase in manufacturing employment share

Country	Period	Sector	$\frac{\widehat{\alpha}_{it}(s)}{\widehat{l}_{it}(s)}$	$-\frac{\widehat{\alpha}_{it}}{\widehat{l}_{it}(s)}$	$\frac{\widehat{\beta}_{it}(s)}{\widehat{l}_{it}(s)}$	$\frac{f}{y}\frac{\widehat{f}_{Nit}(s)}{\widehat{l}_{it}(s)}$	$\frac{x}{y}\frac{\widehat{x}_{Nit}(s,s')}{\widehat{l}_{it}(s)}$	$\frac{tb}{y}\frac{\widehat{tb}_{iJt}(s)}{\widehat{l}_{it}(s)}$	Sum
CHN	1995-2014	Manufacturing	-0.18	0.20	-1.18	-0.12	1.19	0.23	0.14
IDN	1995-2014	Manufacturing	-0.02	0.67	0.51	-1.33	-2.26	-0.49	-2.92
IND	1995-2014	Manufacturing	-0.15	0.10	-0.18	-0.16	-0.10	0.04	-0.46
TUR	1995-2014	Manufacturing	3.26	-0.47	-1.11	-0.41	0.06	-0.15	1.19

Table A6: Growth Accounting Decomposition for s =Manufacturing, τ = 1995, υ = 2014 for countries with decrease in manufacturing employment share

Country	Period	Sector	$\frac{\widehat{\alpha}_{it}(s)}{\widehat{l}_{it}(s)}$	$-\frac{\widehat{\alpha}_{it}}{\widehat{l}_{it}(s)}$	$\frac{\widehat{\beta}_{it}(s)}{\widehat{l}_{it}(s)}$	$\frac{f}{y}\frac{\widehat{f}_{Nit}(s)}{\widehat{l}_{it}(s)}$	$\frac{x}{y}\frac{\widehat{x}_{Nit}(s,s')}{\widehat{l}_{it}(s)}$	$\frac{tb}{y}\frac{\widehat{tb}_{iJt}(s)}{\widehat{l}_{it}(s)}$	Sum
AUS	1995-2014	Manufacturing	-0.05	-0.10	0.27	0.16	0.70	0.30	1.27
AUT	1995-2014	Manufacturing	0.32	-0.09	1.01	0.38	-0.68	-0.68	0.27
BEL	1995-2014	Manufacturing	-0.07	0.04	0.80	0.16	0.00	0.07	0.99
BGR	1995-2014	Manufacturing	1.70	1.43	1.50	-0.61	-1.79	0.80	3.03
BRA	1995-2014	Manufacturing	-4.42	2.29	1.48	0.05	0.25	0.75	0.40
CAN	1995-2014	Manufacturing	-0.64	-0.23	1.04	0.03	-0.09	0.97	1.08
CYP	1995-2014	Manufacturing	-0.14	0.04	-0.01	0.72	0.41	-0.22	0.80
CZE	1995-2014	Manufacturing	-9.15	18.79	9.59	4.56	-12.41	-15.42	-4.05
DEU	1995-2014	Manufacturing	0.76	-0.15	0.60	0.26	-0.26	-0.96	0.25
DNK	1995-2014	Manufacturing	0.30	0.07	0.29	0.18	0.11	-0.04	0.90
ESP	1995-2014	Manufacturing	0.15	-0.28	0.52	0.24	0.53	-0.13	1.02
EST	1995-2014	Manufacturing	0.11	-0.44	0.87	0.74	0.41	-1.39	0.29
FIN	1995-2014	Manufacturing	-0.59	0.27	0.99	-0.00	0.21	-0.01	0.87
FRA	1995-2014	Manufacturing	-0.11	0.10	0.43	0.19	0.02	0.13	0.75
GBR	1995-2014	Manufacturing	-0.13	-0.05	0.05	0.24	0.33	0.36	0.80
GRC	1995-2014	Manufacturing	0.36	0.14	1.07	-0.01	0.70	-0.24	2.01
HUN	1995-2014	Manufacturing	4.69	-1.91	2.78	0.71	-4.26	-3.73	-1.71
IRL	1995-2014	Manufacturing	0.41	-0.37	-0.09	0.27	0.68	-0.06	0.85
ITA	1995-2014	Manufacturing	-0.58	0.05	0.51	0.56	0.23	-0.04	0.73
JPN	1995-2014	Manufacturing	-0.13	-0.14	0.75	0.14	-0.09	-0.05	0.48
KOR	1995-2014	Manufacturing	-0.11	-0.34	0.76	0.27	-0.92	-0.62	-0.97
LTU	1995-2014	Manufacturing	1.81	-0.10	0.76	-0.11	0.44	-1.57	1.22
LVA	1995-2014	Manufacturing	0.26	-0.01	0.86	0.16	-0.27	0.44	1.43
MEX	1995-2014	Manufacturing	1.82	-0.73	-0.10	0.26	0.21	0.35	1.81
MLT	1995-2014	Manufacturing	-0.04	-0.04	-0.63	0.87	0.63	0.04	0.84
NLD	1995-2014	Manufacturing	-0.23	0.03	0.98	0.21	-0.73	0.66	0.92
POL	1995-2014	Manufacturing	7.37	-12.05	5.79	-1.62	-5.41	2.64	-3.28
PRT	1995-2014	Manufacturing	0.22	-0.19	0.40	0.26	0.48	-0.16	1.01
RUS	1995-2014	Manufacturing	0.20	0.42	0.55	-0.13	-0.49	0.41	0.97
SVK	1995-2014	Manufacturing	-0.94	0.58	1.83	0.01	-0.86	-0.58	0.05
SVN	1995-2014	Manufacturing	0.78	-0.46	0.06	0.37	0.01	-0.23	0.54
SWE	1995-2014	Manufacturing	-0.23	0.24	0.40	0.02	0.41	0.18	1.03
USA	1995-2014	Manufacturing	0.44	-0.12	0.08	0.09	0.44	0.09	1.02

Table A7: Trade Balance Effect and Revealed Comparative Advantage, 17 year window

	Dependent variable:			
	$\frac{tb}{y}\frac{\widehat{tb}_{it}(s)}{\widehat{l}_{it}(s)}$			
	Goods	Goods	Services	Services
	(1)	(2)	(3)	(4)
$RCA_{it}(s)$	-0.421^{***}	-0.636^{***}	0.332^{***}	0.362^{***}
	(0.151)	(0.134)	(0.059)	(0.062)
$\text{Poor}_{it}(s)$		0.161^{**}		0.131
		(0.074)		(0.110)
$\text{Medium}_{it}(s)$		-0.315^{***}		-0.047
		(0.061)		(0.090)
Constant	0.399^{***}	0.686^{***}	-0.259^{***}	-0.305^{***}
	(0.146)	(0.130)	(0.080)	(0.100)
Observations	111	111	111	111
R^2	0.067	0.352	0.226	0.244
Adjusted R^2	0.058	0.334	0.219	0.222
Note:				*p<0.1; **p<0.05; ***p<0.01

Table A8: Trade Balance Effect and Revealed Comparative Advantage (trade balance effects :17 year window averages, significant vs non-significant esimates)

	Dependent variable:			
	$\frac{tb}{y}\frac{\widehat{tb}_{it}(s)}{\widehat{l}_{it}(s)}$			
	Goods	Goods	Services	Services
	(1)	(2)	(3)	(4)
$RCA_{it}(s)$	-0.694^{**}	-0.792	0.295^{**}	0.252^{*}
	(0.298)	(0.793)	(0.129)	(0.127)
$\text{Poor}_{it}(s)$	0.110	0.165	0.019	0.228
	(0.128)	(0.226)	(0.190)	(0.230)
$\text{Medium}_{it}(s)$	-0.357^{***}	-0.680^{**}	-0.108	-0.029
	(0.110)	(0.243)	(0.164)	(0.249)
Constant	0.777^{**}	0.885	-0.170	-0.303
	(0.299)	(0.806)	(0.179)	(0.221)
Observations	37	17	37	13
R^2	0.337	0.457	0.139	0.357
Adjusted R^2	0.277	0.331	0.060	0.143
Note:				*p<0.1; **p<0.05; ***p<0.01

Table A9: Trade Balance Effect and Revealed Comparative Advantage: 1995-2014 period (different years RCA)

	Dependent variable:					
	$\frac{tb}{y}\ \frac{\widehat{tb}_{it}(s)}{\widehat{l}_{it}(s)}$					
	Goods	Goods	Goods	Services	Services	Services
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{Poor}_{it}(s)$	0.053	0.141	0.102	−0.019	0.177	0.085
	(0.147)	(0.143)	(0.144)	(0.218)	(0.199)	(0.205)
$\text{Medium}_{it}(s)$	-0.329^{**}	-0.298^{**}	-0.333^{***}	−0.178	−0.071	−0.166
	(0.136)	(0.117)	(0.122)	(0.202)	(0.162)	(0.175)
$RCA_{i1995}(s)$	−0.288			0.238		
	(0.464)			(0.170)		
$RCA_{i2014}(s)$		-0.562^{**}			0.390^{***}	
		(0.254)			(0.110)	
$RCA_{iAverage}(s)$			-0.632^{*}			0.417^{***}
			(0.360)			(0.147)
Constant	0.386	0.610^{**}	0.703^{*}	−0.061	-0.327^{*}	−0.298
	(0.475)	(0.246)	(0.356)	(0.209)	(0.180)	(0.203)
Observations	37	37	37	37	37	37
R^2	0.199	0.294	0.259	0.060	0.278	0.199
Adjusted R^2	0.126	0.230	0.191	−0.026	0.212	0.127
Note:						*p<0.1; **p<0.05; ***p<0.01