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BACKGROUND PAPER

**AN ACCOUNT OF GLOBAL
INTRAINDUSTRY TRADE, 1962–2006**

MARIUS BRULHART

Département d'économétrie et économie politique

HEC Lausanne

University of Lausanne

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Marius Brülhart[#]

Département d'économétrie et économie politique

HEC Lausanne

University of Lausanne

1015 Lausanne

Switzerland

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Abstract

This paper provides a comprehensive description of intra-industry trade patterns and trends, using data on more than 39 million bilateral trade flows. In 2006, 27 percent of global trade was intra-industry if measured at the finest (5-digit) level of statistical aggregation, and 44 percent if measured at a coarser (3-digit) level of statistical aggregation. The observed steady growth in global intra-industry trade since the early 1960s suggests a process of world-wide structural convergence: economies are becoming more similar over time in terms of their sectoral compositions. In particular since the 1990s, this trend appears to be driven to a significant extent by the international fragmentation of vertical production chains. Intra-industry trade is a high-income and middle-income country phenomenon: African trade remains overwhelmingly of the inter-industry type. Moreover, the observed increase in intra-industry trade was not accompanied by a comparable increase in *marginal* intra-industry trade, suggesting that trade-induced adjustment pressures remain potentially important.

<All figures and tables at end>

JEL classification: F1

Keywords: intra-industry trade, marginal intra-industry trade

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[#] Email: Marius.Brulhart@unil.ch. Also affiliated with the Centre for Economic Policy Research (CEPR).

1. Introduction

Merchandise trade is by far the best documented aspect of international economic relations. Trade data therefore offer a rich source of information on patterns and shifts in the allocation of economic activity around the globe.

In this paper I describe global merchandise trade flows through the lens of intra-industry trade (IIT) indices, which quantify the extent to which bilateral imports and exports are matched within sectors. A simple description of IIT patterns is of interest for two main purposes: as a gauge of the sectoral similarity of different national economies, and as a proxy for the intensity of factor-market adjustment pains associated with trade expansion.

It is easy to see how IIT can serve as an indicator of economic similarity: for two countries to be able to export goods of a particular sector to each other, they both need to produce this good.¹ Given the relative paucity of internationally comparable and sectorally disaggregated production and employment data, trade-based measures can provide uniquely comprehensive (though indirect) evidence on international specialization patterns.

The link between IIT and adjustment is similarly intuitive. If tighter international trade integration leaves the sectoral composition of national economies broadly intact by fostering the two-way exchange of different “varieties” of the same type of good, then labor and capital does not have to be reallocated from declining import-competing sectors to expanding export sectors, but simply between different product lines within a given sector. It is primarily due to this “smooth-adjustment hypothesis” that the original discovery of high IIT levels among liberalizing European countries in the late 1960s generated enormous interest among policy-oriented

¹ The link between export values and production values is provided by export propensities, which can vary considerably across sectors and destinations. Hence, trade values are a noisy measure of underlying production values. Trade and production specialisation may even diverge. Epifani (2005), for example, develops a trade model within which increasing inter-industry specialisation in production coincides with rising IIT. The present study relies on the premise that such configurations are the exception, not the rule. Moreover, actual trade data occasionally (and erroneously) report goods that merely transit a country (typically one that hosts an important port) as exports. In this case, trade flows also do not reflect production patterns. Work by Amiti and Venables (2002) and by Venables, Rice and Steward (2003) supports the interpretation of IIT that motivates this study. Venables *et al.* (2003), for example, conclude that their results “provide strong support for the view that the spatial pattern of IIT is merely reflecting the spatial distribution of country characteristics” (p. 2) and that “close countries do a lot of IIT because they have similar economic structures” (Abstract).

economists and that IIT continues to be used as a diagnostic tool in impact assessments of trade reforms.²

The paper is organized as follows. Section 2 presents the IIT measures employed and the data on which they are computed. In Section 3, I provide a snapshot of global IIT patterns in 2006, the last year for which I have data; and in Section 4 I take a longer view by describing the evolution of IIT over the full sample period 1962-2006. The evolution of the main cross-country determinants of IIT, based on annual regression estimates, is described in Section 5. Section 6 reports measures of marginal IIT, which are more closely related to structural adjustment than the standard IIT indices. Section 7 concludes.

2. Measurement and Data

The Grubel-Lloyd Index

IIT is commonly understood as coterminous with the index proposed by Grubel and Lloyd (1975), which expresses IIT as a share of total bilateral trade in a particular industry i :

$$GL_{cd,i} = 1 - \frac{|X_{cd,i} - M_{cd,i}|}{(X_{cd,i} + M_{cd,i})}, \quad (1)$$

where $X_{cd,i}$ and $M_{cd,i}$ refer to country c 's exports and imports respectively, to/from country d over one particular year (time subscripts are implied). This measure takes values between zero and one and increases in the share of IIT.

GL indices can be aggregated across N industries, as a trade-weighted (rather than simple arithmetic) average of the industry indices:

² The proposition that IIT entails lower adjustment costs than inter-industry trade has originally been articulated by Balassa (1966) and further developed in the influential monographs on IIT by Grubel and Lloyd (1975) and Greenaway and Milner (1986). For a survey, see Brühlhart (1999).

$$GL_{cd} = \sum_{i=1}^N w_{cd,i} GL_{cd,i} = \sum_{i=1}^N \left(\frac{X_{cd,i} + M_{cd,i}}{\sum_{i=1}^N (X_{cd,i} + M_{cd,i})} \right) GL_{cd,i} = 1 - \frac{\sum_{i=1}^N |X_{cd,i} - M_{cd,i}|}{\sum_{i=1}^N (X_{cd,i} + M_{cd,i})}.$$

Equivalent to this definition is the following expression:

$$GL_{cd} = \frac{\sum_{i=1}^N 2 * (\min X_{cd,i}, M_{cd,i})}{\sum_{i=1}^N (X_{cd,i} + M_{cd,i})}, \quad (2)$$

which is easily summed to give a country's total bilateral IIT across all trade partners:

$$GL_c = \sum_{d=1}^{D_c} \left(\frac{\sum_{i=1}^N 2 * (\min X_{cd,i}, M_{cd,i})}{\sum_{i=1}^N (X_{cd,i} + M_{cd,i})} \right), \quad (3)$$

where D_c is country c 's number of trading partners. This can be further aggregated across countries, for a measure of IIT by group of countries C (which could mean the entire world economy):

$$GL_{countrygroup} = \sum_{c=1}^C \sum_{d=1}^{D_c} \left(\frac{\sum_{i=1}^N 2 * (\min X_{cd,i}, M_{cd,i})}{\sum_{i=1}^N (X_{cd,i} + M_{cd,i})} \right), \quad (4)$$

where C delineates the group of countries considered.³

Three variants of the index in (4) will be distinguished. First, for IIT *within* a particular country group C (say, among all low-income countries), $D_c \subseteq C \forall c$. Conversely, for IIT *between* country groups (say, between low-income and high-income countries), $D_c \not\subseteq C \forall c$. Finally, country group

³ I let C symbolize both the number of countries in a particular group and the particular group (set) itself.

C 's total IIT (say, IIT of low-income countries with all their trading partners) obtains when $D_c \subseteq \{C, C'\} \forall c$, where C' denotes the complement to C (i.e. all trading nations that are not part of the group C).

Note that all these indices are computed for pairs of countries. It would be simple to aggregate a country's trade flows across all (or a subset) of that country's trade partners to obtain a measure of "multilateral IIT". However, most of the interest in IIT measures stems from the observation of simultaneous imports and exports between a given pair of countries, and this definition of IIT also serves best to identify similarity of trade compositions among country pairs. I therefore use bilateral IIT measures as the basis for all the results reported in this paper.⁴

The GL index is highly intuitive and has found near-universal acceptance. Two additional measurement issues nonetheless merit discussion.

Categorical aggregation. The definition of an "industry" is probably the most contentious issue in applied IIT research. Grubel and Lloyd (1975, p. 86) defined IIT as "trade in differentiated products which are close substitutes". Over time, it has become generally accepted that the relevant criterion is substitutability in production (rather than in consumption), since this is the aspect of industries that (a) maps trade flows to production patterns and (b) lies at the heart of the link between IIT and factor-market adjustment.⁵ Whilst statistical product classifications are inevitably imperfect in this respect, they are nevertheless largely guided by the correct criterion, i.e. an effort to group together goods with similar input requirements.⁶ This still leaves open the question about the most appropriate level of statistical aggregation for the calculation of IIT indices. Whilst many empirical studies use data at the 3-digit level, this choice is mostly motivated by expediency rather than any *a priori* reason for favoring that level of aggregation. I opt for a narrower definition in this paper, by working mainly with 5-digit sectors and thus

⁴ Through this bilateral definition, our IIT indices are conservative measures of the international fragmentation of production (also referred to as outward processing), as they will not capture sequential production chains that encompass more than two countries (see e.g. Hummels, Ishii and Yi, 2001).

⁵ Furthermore, it is this definition of IIT that distinguishes it from comparative-advantage based trade and that provided the impetus for economic theorists to develop the "new trade theory" (see Helpman and Krugman, 1985, for a comprehensive statement).

⁶ In the list of five similarity criteria used by the experts in charge of the third revision of the Standard International Trade Classification (SITC), an earlier version of which my calculations are based on, the first principle was "the nature of the merchandise and the materials used in its production", while "the uses of the product" only ranks third (United Nations, 1986, p. viii). Evidence in favour of reasonable homogeneity of statistical sectors in terms of factor requirements has been found by Elliott, Greenaway and Hine (2000).

Country	MIIT 1962-1975	MIIT 1975-1990	MIIT 1990-2006	MIIT average	% of total tr. change, 1962-1975	% of total tr. change, 1975-1990	% of total tr. change, 1990-2006	% of total tr. change, average
Sri Lanka	0.008	0.061	0.028	0.032	0.012	0.015	0.018	0.015
Jordan	0.013	0.050	0.041	0.035	0.003	0.011	0.030	0.015
Bulgaria	0.106	0.066	0.255	0.142	0.006	0.005	0.031	0.014
Cote d'Ivoire	0.015	0.007	0.012	0.012	0.027	0.008	0.006	0.014
Cyprus	0.057	0.071	0.136	0.088	0.003	0.012	0.023	0.013
Guatemala	0.015	0.065	0.094	0.058	0.007	0.009	0.021	0.013
Jamaica	0.086	0.115	0.077	0.093	0.015	0.009	0.008	0.011
Bahrain	0.032	0.029	0.055	0.039	0.005	0.012	0.015	0.011
Bangladesh	n.a.	0.026	0.014	0.020	0.000	0.007	0.024	0.010
Ghana	0.034	0.013	0.027	0.025	0.021	0.004	0.005	0.010
Lebanon	0.016	0.012	0.028	0.019	0.015	0.008	0.006	0.010
Iceland	0.032	0.035	0.065	0.044	0.008	0.010	0.011	0.010
Angola	0.008	0.002	0.001	0.004	0.006	0.007	0.015	0.009
Cameroon	0.012	0.026	0.007	0.015	0.011	0.007	0.007	0.009
Bolivia	0.010	0.009	0.034	0.018	0.015	0.005	0.005	0.008
Uruguay	0.043	0.108	0.113	0.088	0.007	0.008	0.010	0.008
Dominican Republic	0.045	0.012	0.031	0.030	0.009	0.008	0.008	0.008
Malta	0.115	0.405	0.300	0.273	0.004	0.009	0.011	0.008
Kenya	0.031	0.027	0.016	0.025	0.007	0.007	0.008	0.007
Congo, Dem. Rep.	0.014	0.009	0.005	0.009	0.016	0.005	0.001	0.007
Liberia	0.018	0.027	0.015	0.020	0.009	0.007	0.004	0.007
Senegal	0.019	0.059	0.047	0.042	0.010	0.006	0.004	0.007
Vietnam	n.a.	0.024	0.049	0.036	0.000	0.001	0.018	0.006
El Salvador	0.023	0.067	0.095	0.062	0.005	0.004	0.010	0.006
Honduras	0.030	0.038	0.067	0.045	0.003	0.004	0.011	0.006
Paraguay	0.028	0.013	0.039	0.027	0.004	0.005	0.008	0.006
Brunei	0.016	0.013	0.008	0.012	0.002	0.007	0.007	0.005
Mauritius	0.014	0.067	0.070	0.051	0.001	0.008	0.006	0.005
Cuba	0.009	0.009	0.012	0.010	0.007	0.004	0.003	0.005
Sudan	0.012	0.012	0.012	0.012	0.007	0.002	0.005	0.005
Special Categories	0.130	0.076	0.040	0.082	0.006	0.005	0.001	0.004
Gabon	0.006	0.003	0.004	0.005	0.007	0.003	0.002	0.004
Macao	0.000	0.136	0.099	0.078	0.000	0.004	0.008	0.004
Nicaragua	0.015	0.041	0.043	0.033	0.004	0.002	0.004	0.004
Madagascar	0.014	0.030	0.021	0.022	0.005	0.002	0.003	0.003
Myanmar	0.008	0.010	0.012	0.010	0.005	0.001	0.002	0.003
Bahamas, The	0.043	0.015	0.019	0.026	0.003	0.002	0.003	0.003
Papua New Guinea	0.007	0.015	0.006	0.009	0.001	0.003	0.003	0.002
Mozambique	0.010	0.009	0.005	0.008	0.003	0.001	0.003	0.002
Ethiopia(includes Eritrea)	0.011	0.020	n.a.	0.016	0.003	0.003	0.000	0.002
Congo, Rep.	0.007	0.004	0.002	0.004	0.002	0.002	0.002	0.002
Zambia	n.a.	0.007	0.003	0.005	0.000	0.003	0.003	0.002
Guadeloupe	0.053	0.027	n.a.	0.040	0.001	0.003	n.a.	0.002
New Caledonia	0.002	0.004	0.021	0.009	0.003	0.001	0.001	0.002
Togo	0.009	0.012	0.004	0.008	0.003	0.001	0.001	0.002
Fiji	0.006	0.044	0.057	0.036	0.000	0.002	0.002	0.002
Bunkers	0.020	0.001	0.000	0.007	0.003	0.001	0.000	0.002
Martinique	0.066	0.030	n.a.	0.048	0.000	0.003	n.a.	0.002
Tanzania	n.a.	0.013	0.011	0.012	0.000	0.002	0.003	0.002
Barbados	0.104	0.095	0.050	0.083	0.001	0.002	0.002	0.001
Reunion	0.024	0.017	n.a.	0.020	0.001	0.003	0.000	0.001
Zimbabwe	n.a.	0.056	0.017	0.036	0.000	0.000	0.004	0.001
Guyana	0.026	0.025	0.022	0.025	0.002	0.001	0.000	0.001
Afghanistan	0.012	0.011	0.009	0.011	0.002	0.000	0.000	0.001
Korea, Dem. Rep.	0.003	0.027	0.028	0.019	0.000	0.001	0.002	0.001
Suriname	0.110	0.016	0.026	0.051	0.002	0.001	0.000	0.001
Mali	0.049	0.018	0.008	0.025	0.001	0.001	0.001	0.001
Bermuda	0.018	0.022	0.004	0.015	0.000	0.001	0.002	0.001
Haiti	0.055	0.034	0.040	0.043	0.001	0.001	0.001	0.001
Malawi	n.a.	0.006	0.020	0.013	0.000	0.002	0.001	0.001
Benin	0.002	0.004	0.001	0.002	0.001	0.000	0.001	0.001
Nepal	0.019	0.028	0.036	0.027	0.000	0.001	0.001	0.001
Burkina Faso	0.005	0.004	0.003	0.004	0.001	0.000	0.000	0.001
Sierra Leone	0.007	0.005	0.016	0.009	0.001	0.000	0.000	0.001
Guinea	0.001	0.006	0.005	0.004	0.000	0.001	0.001	0.001
Uganda	0.003	0.004	0.009	0.005	0.000	0.000	0.001	0.001
French Polynesia	0.015	0.014	0.020	0.016	0.000	0.001	0.001	0.000
Albania	0.027	0.031	0.249	0.102	0.000	0.000	0.001	0.000
Mauritania	0.000	0.002	0.009	0.004	0.000	0.000	0.000	0.000
Yemen Democratic	0.003	0.014	n.a.	0.009	0.001	0.001	0.000	0.000
Faeroe Islands	n.a.	0.040	0.053	0.046	0.000	0.000	0.001	0.000
Niger	0.012	0.005	0.009	0.008	0.001	0.000	0.000	0.000
St. Lucia	n.a.	0.090	0.058	0.074	0.000	0.001	0.000	0.000
Seychelles	n.a.	0.021	0.088	0.054	0.000	0.000	0.001	0.000

Country	MIIT 1962-1975	MIIT 1975-1990	MIIT 1990-2006	MIIT average	% of total tr. change, 1962-1975	% of total tr. change, 1975-1990	% of total tr. change, 1990-2006	% of total tr. change, average
Yemen	0.001	0.004	0.013	0.006	0.000	0.000	0.001	0.000
Andorra	n.a.	0.041	0.040	0.041	n.a.	0.000	0.000	0.000
Central African Republic	0.004	0.003	0.008	0.005	0.001	0.000	0.000	0.000
Chad	0.010	0.003	0.007	0.007	0.001	0.000	0.000	0.000
Cambodia	0.007	0.001	0.002	0.004	0.000	0.000	0.001	0.000
Somalia	0.005	0.004	0.010	0.006	0.001	0.000	0.000	0.000
French Guiana	0.001	0.025	n.a.	0.013	0.000	0.001	0.000	0.000
Belize	0.000	0.048	0.028	0.025	0.000	0.000	0.000	0.000
Djibouti	0.004	0.015	0.006	0.008	0.000	0.000	0.000	0.000
Mongolia	0.000	0.021	0.014	0.012	0.000	0.000	0.001	0.000
Greenland	n.a.	0.014	0.012	0.013	0.000	0.000	0.000	0.000
Cayman Islands	n.a.	0.009	0.004	0.006	0.000	0.000	0.000	0.000
Lao PDR	0.001	0.039	0.010	0.017	0.000	0.000	0.000	0.000
Gibraltar	0.001	0.040	0.009	0.017	0.000	0.000	0.000	0.000
Aruba	n.a.	n.a.	0.008	0.008	0.000	0.000	0.000	0.000
Us Msc.Pac.I	0.005	0.009	n.a.	0.007	0.000	0.000	0.000	0.000
Gambia, The	0.002	0.008	0.006	0.005	0.000	0.000	0.000	0.000
Maldives	n.a.	0.029	0.008	0.019	0.000	0.000	0.000	0.000
Burundi	0.004	0.010	0.010	0.008	0.000	0.000	0.000	0.000
Antigua and Barbuda	n.a.	0.015	0.003	0.009	0.000	0.000	0.000	0.000
Vanuatu	0.001	0.004	0.010	0.005	0.000	0.000	0.000	0.000
Cape Verde	0.000	0.008	0.030	0.013	0.000	0.000	0.000	0.000
St. Vincent and the Grenadines	n.a.	0.037	0.015	0.026	0.000	0.000	0.000	0.000
Rwanda	n.a.	0.004	0.004	0.004	0.000	0.000	0.000	0.000
Equatorial Guinea	0.001	0.010	0.007	0.006	0.000	0.000	0.000	0.000
Samoa	0.005	0.037	0.027	0.023	0.000	0.000	0.000	0.000
Free Zones	0.001	0.000	0.001	0.001	0.000	0.000	0.000	0.000
Fm Panama Cz	0.002	n.a.	n.a.	0.002	0.000	0.000	0.000	0.000
Guinea-Bissau	0.009	0.016	0.008	0.011	0.000	0.000	0.000	0.000
Dominica	n.a.	0.017	0.035	0.026	0.000	0.000	0.000	0.000
Solomon Islands	n.a.	0.010	0.006	0.008	0.000	0.000	0.000	0.000
Grenada	n.a.	0.046	0.021	0.033	0.000	0.000	0.000	0.000
St. Kitts and Nevis	n.a.	n.a.	0.155	0.155	0.000	0.000	0.000	0.000
British Virgin Islands	n.a.	0.026	0.028	0.027	0.000	0.000	0.000	0.000
Tonga	n.a.	0.020	0.010	0.015	0.000	0.000	0.000	0.000
Comoros	0.000	0.004	0.002	0.002	0.000	0.000	0.000	0.000
Saint Pierre and Miquelon	0.000	0.008	0.003	0.004	0.000	0.000	0.000	0.000
Montserrat	n.a.	0.006	0.025	0.015	0.000	0.000	0.000	0.000
Turks and Caicos Isl.	n.a.	0.108	0.003	0.055	0.000	0.000	0.000	0.000
Kiribati	n.a.	0.004	0.012	0.008	0.000	0.000	0.000	0.000
Bhutan	n.a.	0.008	0.022	0.015	0.000	0.000	0.000	0.000
Falkland Island	n.a.	0.157	0.012	0.084	0.000	0.000	0.000	0.000
Sao Tome and Principe	n.a.	0.009	0.025	0.017	0.000	0.000	0.000	0.000
Cook Islands	n.a.	0.002	0.011	0.007	0.000	0.000	0.000	0.000
Nauru	n.a.	0.000	0.000	0.000	0.000	0.000	0.000	0.000
East Timor	0.003	0.000	0.000	0.001	0.000	0.000	0.000	0.000
Anguila	n.a.	n.a.	0.007	0.007	0.000	0.000	0.000	0.000
Saint Helena	n.a.	0.031	0.005	0.018	0.000	0.000	0.000	0.000
Wallis and Futura Isl.	n.a.	0.000	0.004	0.002	0.000	0.000	0.000	0.000
Christmas Island	n.a.	0.000	0.005	0.003	0.000	0.000	0.000	0.000
Norfolk Island	n.a.	0.007	0.008	0.007	0.000	0.000	0.000	0.000
Cocos (Keeling) Islands	n.a.	0.018	0.046	0.032	0.000	0.000	0.000	0.000
Tuvalu	n.a.	n.a.	0.007	0.007	0.000	0.000	0.000	0.000
Neutral Zone	n.a.	0.000	n.a.	0.000	0.000	0.000	0.000	0.000
Niue	n.a.	0.040	0.030	0.035	0.000	0.000	0.000	0.000
Tokelau	n.a.	n.a.	0.023	0.023	0.000	0.000	0.000	0.000
British Indian Ocean Ter.	n.a.	0.003	0.000	0.001	0.000	0.000	0.000	0.000
Fr. So. Ant. Tr	n.a.	n.a.	0.000	0.000	0.000	0.000	0.000	0.000
Pitcairn	n.a.	0.000	0.006	0.003	0.000	0.000	0.000	0.000
Western Sahara	n.a.	n.a.	0.000	0.000	0.000	0.000	0.000	0.000
Unweighted average	0.061	0.080	0.087	0.072	0.498	0.493	0.508	0.501

Appendix Table 1: Countries Included in the “Long Coverage” Data Set
(by World Bank income group)

Low income and lower middle income:

Bolivia, Brazil, Colombia, Ecuador, Egypt, Guatemala, Honduras, Indonesia, India, Jordan, Morocco, Nicaragua, Pakistan, Peru, Philippines, Paraguay, El Salvador, Thailand, Tunisia

Upper middle income:

Argentina, Barbados, Chile, Costa Rica, Hungary, Mexico, Malaysia, Panama, Turkey, Venezuela

High-Income:

Australia, Austria, Belgium, Canada, Switzerland, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Hong Kong, Ireland, Iceland, Israel, Italy, Japan, Korea, Malta, Netherlands, Norway, New Zealand, Portugal, Singapore, Sweden, United States