Trade Structure, Industrial Structure, and International Business Cycles

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A widely held belief, among economists and policymakers alike, is that countries that are linked through international trade will also share business cycle fluctuations. For this reason, countries proceed slowly and carefully to adopt new arrangements (regional trading arrangements, for example) that are designed to increase trade with a particular group of countries. It is therefore surprising that we lack strong empirical evidence that increased trade, by itself, also increases the extent of business-cycle linkages.[1]

This paper takes a first step on a new line of research that is designed to evaluate the circumstances under which trading relationships between two countries will lead their business cycles to become more synchronized.[2] Our starting point is the observation that most countries have several, even many, trading partners, and that the basket of goods traded with one country may be different from the basket traded with another country. Thus, we use a highly disaggregated dataset that includes information on the industrial structure of each country, as well as detailed information on the industry composition of trade. Our dataset includes information on manufacturing goods, which have been the focus of some past studies, but also includes data on non-manufacturing industries.

In this paper, we examine the extent to which the composition of a country's production and trade differs among its trade partners. For example, does the US export the same bundle of goods to the UK as it does to Japan? If we find high dispersion in a country's export and import bundles with its various trading partners, can this be linked to identifiable country characteristics? These findings will be important for two reasons. First, they enrich our empirical understanding of the nature of trade. Second, they will stand as a guide for further development of economic theories of the international transmission of business cycles.

A. A Snapshot of the Relationship between Production and Trade

This paper analyzes the trade flows and production structure of 164 countries. These data come from a number of sources. Trade flows are based on 4-digit standard international trade classification (SITC) data described in Robert Feenstra, et al. (2002). The data are converted to

2-digit classification (SIC) so that they can be more easily compared to industry data. Production data come from two sources. Disaggregated manufacturing data are from the United Nations Industrial Development Organization (UNIDO) reported at the 4-digit international standard industry classification and converted to 2-digit ISIC level for comparison with trade data. Non-manufacturing trade data were supplied by Werner Antweiler and Daniel Trefler; these data were used in Antweiler and Trefler(2002). These are also reported at the 4-digit ISIC level. A country's land endowment is measured as the quantity of arable land per capita from the World Bank's World Development Indicators. Educational attainment is measured using Robert Barro and Jong-Wha Lee's (1993) average years of schooling in the total population over the age of 15. Real per capita income data are from the Penn World Tables version 5.6. Each country's capital endowment is measured as capital stock per worker from William Easterly and Ross Levine (2001). We use the International Monetary Fund's International Financial Statistics Yearbook (2002) to classify countries as either developing or developed.

To begin, we examine the dispersion in a country's production and trade structure. To do this, we develop indexes of dispersion that are variants of a Herfindahl index. To measure country *i*'s dispersion from the rest of world (ROW) with respect to its production structure, we construct the dispersion index: $dy_i^{row} = \sum_{n=1}^{N} \left(sy_{in} - sy_{row,n} \right)^2$ where s sy_{jn} is output of sector *n* in country *j*, and $sy_{row,n} = \sum_{j \neq i} y_{jn} \div \left(\sum_{n=1}^{N} \sum_{j \neq i} y_{jn} \right)$.

We also want to study the relationship between production dispersion vis-a-vis the rest of the world, and production dispersion vis-a-vis a country's trading partners. Thus, we define indexes that capture the extent to which country *i*'s production structure differs from its export partners and from its import partners. Letting a_{xij} denote the share of total exports of country *i* that go to country *j*, and continuing to let *n* index a particular export good, our measure of country *i*'s dispersion in production relative to her export partners, weighted by export share, is

$dy_i^{export} = \sum_{j=1}^{J} a_{xij} \sum_{n=1}^{N} \left(sy_{in} - sy_{jn} \right)^2$. Our measure of country i's dispersion in production relative to her import partners, weighted by import shares, a_{mij}, is $dy_i^{import} = \sum_{j=1}^{J} a_{mij} \sum_{n=1}^{N} \left(sy_{in} - sy_{jn} \right)^2$.

Finally, we construct indexes of dispersion in exports and imports to measure the extent of dispersion in the structure of a country's exports to its various export partners. As for the production dispersion indexes, we weight each export partner by its contribution to country i's total imports. Thus, our weighted index of export dispersion for country i is $dx_i = \sum_{j=1}^{J} a_{xij} \sum_{n=1}^{N} \left(sx_{in} - sx_{ijn} \right)^2$, where sx_{in} is good n's share of country i's exports, and sx_{ijn} is good n's share of country i's exports to country j. We construct a similar measure the import-share-weighted dispersion of country i's imports from its import partners, j, as $dm_i = \sum_{j=1}^{J} a_{mij} \sum_{n=1}^{N} \left(sm_{in} - sm_{ijn} \right)^2$ where a_{mij} now stands for denote the share of total imports of country i that come from country j.

The relationships among dispersion in production, exports, and imports are shown in Figure 1.[3] Figure 1-A plots a scatter of dy_i^{row} (x-axis) vs. dx_i where each data point is a particular country, i. This figure allows us to address two questions. First, how much does production dispersion differ among different types of countries? Second, how is dispersion in production vs. export partners related to production dispersion vs. the rest of the world?

We find that developed countries (the squares) have low dispersion indexes for both output and exports, and that this does not seem to depend importantly on the developed country's primary net export good. Further, the developed countries tend to be similar both to the rest of the world and to their export partners. Developing countries (the triangles) generally display greater dispersion in production compared both with the rest of the world and with their export partners. Within the group of developing countries, manufactured-goods-exporters have lower dispersion, while commodity and fuel exporters exhibit higher dispersion. Strikingly, *every single country* is more dissimilar in terms of production structure from their export partners than they are from the ROW. This may be interpreted as reflecting the "trade based on comparative

advantage" that is central to traditional trade theory. We note that the gap between "ROW" and export partners widens as production dissimilarity widens, and is especially large for developing countries.

Figure 1-B examines the same questions for import partners. The results are very similar to those for export partners. Industrialized countries show much less dissimilarity from the rest of the world and from their import partners. Developing countries have high dispersion measures, both vs. the rest of the world and for import partners. There are only two countries for which import dissimilarity is less than rest-of-world production dissimilarity: these are Malawi and Bangladesh. Again, these findings seem consistent with a generalized theory of trade based on comparative advantage.

We also compared production dispersion relative to export partners and import partners (see Baxter and Kouparitsas (2003) for more detail). For the industrialized-country commodity exporters, production dispersion relative to export partners is substantially higher than production dispersion relative to import partners. In fact, the positive association between dissimilarity from export partners and dissimilarity from import partners does not appear for these countries. Rather, dispersion relative to import partners is uniformly low for all these countries. For all other groups of countries, there was little difference in production dissimilarity between export and import partners.

We now turn to a closer look at our measure of trade dispersion, which measures the extent to which a country's trade baskets differ among her trading partners. To begin, Figure 2-A examines the relationship between export dispersion and the production dispersion with export partners. For each country, the horizontal axis plots "export dispersion" -- the extent to which a country exports different baskets of goods to her export partners. The vertical axis measures dispersion of a country's production vs. her trading partners. High dispersion means that a country's production structure is very different from that of her export partners. Figure 2-B presents similar information for import dispersion and production dispersion vs. import partners.

Figure 2-A illustrates that there is no link between export dispersion and production dispersion. While industrialized countries (squares) tend to have lower production and export dispersion than developing countries, the general impression from this figure is that one can infer

little about dispersion in export baskets just from looking at differences in production structures. Turning to imports, Figure 2-B shows us that there is no obvious relationship between import dispersion and production dispersion vis-a-vis import partners. Again, these findings suggest that looking at production data for trading partners will tell us little or nothing about the bilateral composition of trade.

B. Factor Endowments, Country Characteristics and Trade Dispersion

Traditional trade theory suggests a strong link between factor endowments, production, and trade. Dispersion in export bundles from one country to its trading partners would be understood as stemming from dispersion in factor endowments among the country's trading partners. Similarly, dispersion in import bundles would be due to dispersion in factor endowments among the country's import partners. The factors we consider are the following: (i) arable land per capita; (ii) capital stock per worker; and (iii) average years of schooling for the population aged 15 and older. In each case, dispersion on the export side is measured as the squared difference between country *i*'s endowment of a factor and the endowment of its export partners, where the contribution of each partner is weighted by that partner's share in country *i*'s total exports. A similar measure is constructed for factor dispersion vs. import partners.

Table 1, columns 2 and 3, presents correlations between factor dispersion and trade dispersion. Considering all countries in the world together, there is no strong evidence that land dispersion is important either for exports or for imports. The other two measures of factor inputs, capital and education, are positively related to trade dispersion, most strongly on the export side. The results are different when we consider just the G-7. For G-7 exports, the relationship between land and exports is strongly positive, while there is a negative relationship between capital and trade and for education and trade. For G-7 imports, we find that each of land, capital, and education dispersion is strongly positively correlated with import dispersion. For all countries taken together however, the correlations are much weaker. The strongest correlation is for education dispersion.

The last three columns of Table 1 show how factor dispersion relates to trade dispersion when we stratify by type of exporter. There is little consistency in these correlations across exporter type. The strongest correlations are again for education, which is positive for all export

categories and for both exports and imports. Capital dispersion is also positively related to trade dispersion for fuel and manufacturing exporters. Land dispersion appears unrelated to trade dispersion for each exporter type.

Because dispersion in the factors may be correlated, we regressed export dispersion on dispersion in land, capital, and education. We also included dummy variables for (a) whether a country is classified as 'developing,' and (b) the country's major export good. The results are shown in Table 2. First, the developing-country dummy variable is positive and strongly significant in all specifications and for both exports and imports. We checked to see whether this was simply a proxy for "country size" – we found that including a measure of real GDP did not change the significance of the developing-country dummy variable. We also found that commodity exporters have significantly larger export dispersion, while fuel exporters have significantly smaller import dispersion. The factor dispersion measures were mostly insignificant. The one exception is the measure of education dispersion, which appears positively correlated with export dispersion in specifications 3 and 4. Finally, we note that the explanatory power of the regressions is higher for exports than for imports. In specification 4, the regression explains 37% of export dispersion and 21% of import dispersion.

C. Summary and Conclusion

This paper analyze the extent to which the composition of a country's production and trade differs among its trade partners. We found that industrialized countries have low dispersion for both output and trade. That is: an industrialized country's production structure tends to be similar to that of the rest of the world, and her export and import baskets are similar among all trading partners. Developing countries, by contrast, show high dispersion in production and trade. When we studied the relationship between export dispersion and the production dispersion (vs. export partners), we failed to find a strong link. Looking at production structures is not sufficient to understand the structure of trade. Finally, we investigated whether dispersion in export and import bundles can be related to dispersion in the factor endowments of trading partners. We found weak evidence that capital and especially education dispersion may help explain trade dispersion. However, the most important determinants of trade dispersion were developing-country status and the major type of export good.

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Footnotes

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1. This is a large and growing literature. The first paper in this literature was by Fabio Canova and Harris Dellas (1993), who found no link. More recently, Jean Imbs (1999) finds that cyclic comovement is explainable by production structure but not trade. A recent review is found in Ayhan Kose, et al., (2002).

2. Our paper shares a micro-trade focus with several related recent contributions, including those by Werner Antweiler and Daniel Trefler (2002), David Hummels, et al. (2001), and Peter Schott (2002).

3. Our related working paper, Marianne Baxter and Michael Kouparitsas (2003), presents results in tabular form for each of our dispersion measures as well as information on additional country characteristics.

Table 1: Correlations between trade and factors

Correlation with dispersion in export partners' :	A. Export Dispersion				
	All countries	G-7	Commodity exporters	Fuel exporters	Manufacturing Exporters
Land	-0.09	0.41	0.06	-0.08	-0.08
Capital	0.25	-0.21	0.10	0.26	0.70
Education	0.35	-0.34	0.40	0.17	0.13

Correlation with dispersion in import partners' :	B. Import Dispersion				
	All countries	G-7	Commodity exporters	Fuel exporters	Manufacturing Exporters
Land	-0.06	0.80	-0.05	0.03	-0.19
Capital	0.09	0.51	-0.02	0.48	0.18
Education	0.19	0.61	0.12	0.63	0.14

Note: all data for 1990.

Table 2

A. dependent variable = weighted export dispersion, 1990

	Specification			
Independent variable	**1**	**2**	**3**	**4**
developing country	**0.11 ****	**0.10 ****	**0.09 ****	**0.09 ****
commodity exporter	**-0.06 ****	**0.06 ****	**0.07 ****	**0.04 ***
fuel exporter	**-0.22 ****	-0.01	0.00	-0.00
Land dispersion	-3.31e-07			-4.29E-07
capital dispersion		1.35E-06		1.45E-06
education dispersion			**1.53e-04 ***	**2.16e-04 ***
adjusted R^2	0.34	0.32	0.35	0.37

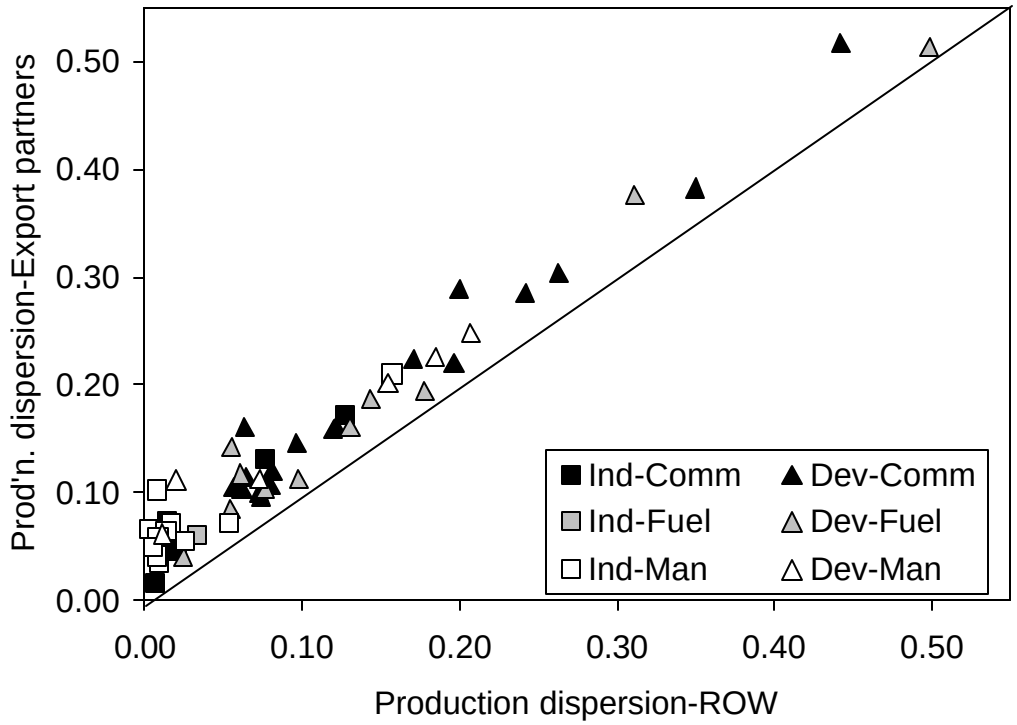
B. dependent variable = weighted import dispersion, 1990

	Specification			
Independent variable	**1**	**2**	**3**	**4**
developing country	**0.06 ****	**0.06 ****	**0.06 ****	**0.06 ****
commodity exporter	-0.00	0.01	-0.00	-0.00
Fuel exporter	**-0.04 ****	**-0.03 ***	**-0.03 ****	**-0.04 ****
land dispersion	-1.68e-07			-2.08e-07
capital dispersion		-7.80e-07		-3.13e-06
education dispersion			2.46e-06	9.18e-05
adjusted R^2	0.18	0.17	0.19	0.21

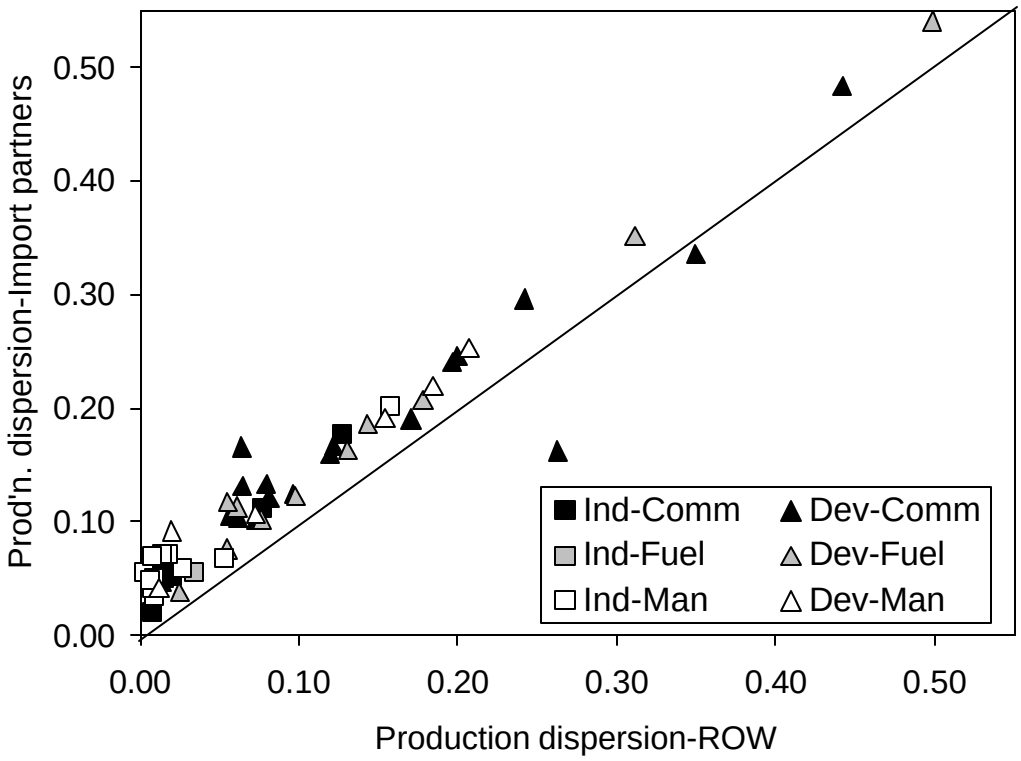
Notes:

1. Coefficient estimates provided in table.
2. The symbol * denotes significance at 10% level
3. The symbol ** denotes significance at 5% level

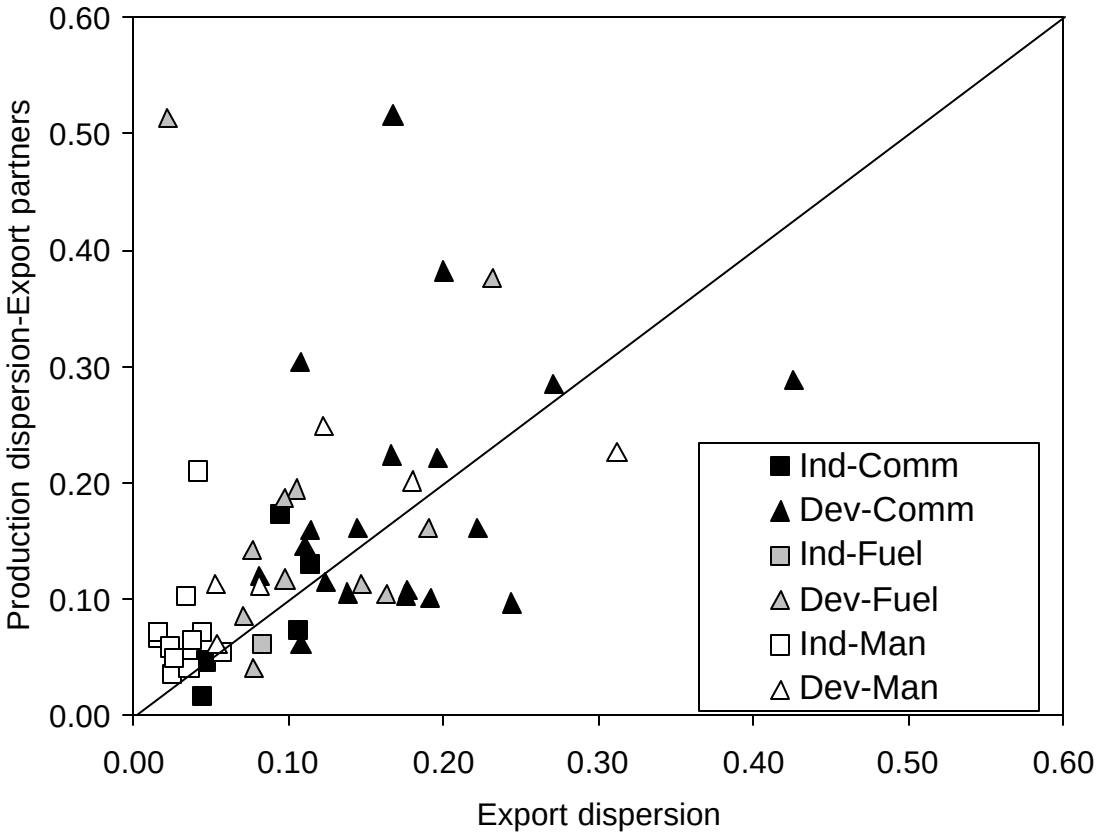
A. Production dispersion:
Rest of World vs. Export partners



B. Production dispersion:
Rest of World vs. Import partners



A. Export dispersion vs. Production dispersion



B. Import dispersion vs. Production dispersion