NATIONS AND SUPRANATIONAL CLUSTERS

International trade, industrial interdependency and knowledge flows

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ABSTRACT

In recent years there has been increasing focus on the concept of national systems of innovation and the knowledge economy. These studies have focused on the nation state as the object of analysis due to localised learning and institutional boundaries. Although any particular country is usually a relatively small producer of the knowledge it utilises, the patterns of use do appear to be heavily influenced by local factors. These lines of research have also led to renewed interest in understanding the dynamics of the clustering of knowledge and production. Such clusters appear to be an important sub-system in industries that are relatively more innovative. Input-output data is becoming an increasingly valuable tool in understanding the networks of production and thus a partial measure of clusters.

Understandably, the international pathways of knowledge have not yet received the same level of attention. While again some partial indicators exist, the situation is more complex, with many of the bits of necessary information not yet readily accessible. One step along the way to understanding the international context better would be to evaluate whether some of the international flows of goods and services constitute trans-boundary or supranational-clusters. To examine this question the paper analyses inter-country industrial linkages between Australia and Japan, primarily for 1990, while also considering the period from the early 1970s. The latest year was determined by the availability of OECD (domestic and import) input-output data along with bilateral trade data, which are combined in an effort to map the linkages. The criteria developed, and the background information on these linkages, draw from recent international literature on industrial clusters and on analysis of Australia's innovation system.

INTRODUCTION

We face an apparent and growing difference in the literature on industrial development as some researchers continue to emphasise the importance and role of the nation and national institutions whilst others dismiss it as increasingly irrelevant.

On the one hand, the innovation literature has not only argued for the importance of knowledge to foster competitiveness but also for the importance of national characteristics for the creation of that knowledge (Lundvall 1992 and Nelson 1993). At the level of the firm, the study of innovation has emphasised the existence and importance of networks and the role of lasting user-supplier relationships. While it is hard to map these relationships extensively, at the macro level they can be viewed through their aggregation into clusters of activity. All the while, however, the focus is *domestic* systems of competitiveness, bounded by national borders that are called national systems of innovation.

On the other hand there is the discussion in the trade literature about international production integration, and flighty capital that moves easily around the world in search of generating high returns. This focus on the division of labour and the movement of manufacturing activities has led many to a conclusion opposite to that of the innovation researchers. For these researchers the patterns of modern trade reveals the weakening of the Nation State and for some even its death (Ohmae 1996). Thus globalisation (Hatzichronoglou 1999 and Yeats 1998) has entered the popular vocabulary to signify not just trade patterns but also increasing foreign ownership of assets and the expansion of the role of international trade rules (WTO etc). This has occurred alongside the observation that the majority of trade exhibits multi-national regional boundaries (triadisation).

So while the innovation literature has had a *tendency* to shy away from trade linkages[1] the 'globalisation' literature appears to have over emphasised the demise of the nation state. Are there approaches that can bridge the best evidence of both perspectives? Naturally there are, but the purpose of this paper is to put

[1] A similar view was also expressed recently in Ernst (2000 p1) "very little empirical or theoretical research has been done on the way globalisation increases the mobility of innovation across national borders…"

forward the idea of 'supranational clusters' not as a total solution, but as a conceptual framework that may fill an apparent current void in the literature. There are basically three reasons for choosing the term 'supranational clusters' to define the economic space of specific production activity. First, the term provides the mental model for considering not just the primary trade linkages but also the secondary linkages that are internal to national economies. Secondly the terminology links with the national systems of innovation analysis that incorporates innovation into national areas of industrial specialisation and clustering (OECD 1999). Finally, at low levels of dollar value many countries trade to a *large* number of countries in *many* industries, but at significant volumes this number of linkages is reduced very dramatically to the point of being highly specific relationships.

Therefore the paper briefly outlines competing approaches to cross border production before detailing what supranational clusters might be described as. As a part of this, the paper assesses what evidence is currently available and what more would be needed to analyse innovative supranational clusters. The empirical component of the paper primarily focuses on the trade linkages between OECD countries for the manufacturing sector. The paper then narrows to analyse the specific case study of Japanese demand for non-ferrous metals, which is one of two key manufacturing export linkages for Australia. However in doing this, the paper attempts to capture one of the dimensions that is critical to the notion of clusters – that of multi-industry interdependency. This type of analysis appears to be lacking from standard trade analysis. Often trade research, even in goods for final consumption, takes the perspective of 'door to door' delivery rather than an interaction between two industrial systems. To examine this, the paper integrates to a limited extent input-output and trade analysis for the industry trade in question. The empirical component of the paper is concluded by briefly pointing to the OECD trade pattern in the non-ferrous metals industry.

TRADE FRAMEWORKS: DIVISION OF LABOUR AND PRODUCTION ACROSS BORDERS

In considering bilateral trade there are many key issues that are important, with four of them stand out. First, the growth of trade and foreign direct investment in the world economy needs to be better

understood. Second, the dynamic driving the growth of some manufacturing shifts to developed in lower cost countries, while some remains in the home country is important. Thirdly, Elam (1997) has suggested that national borders are not total descriptions of reality. Because borders change and national entity in some cases is a somewhat new reality, caution should be exercised in attributing characteristics to 'nations'. Fourthly the growth in regional economic integration through various agreements such as NAFTA and the European Union.

Comparative advantage – the international division of labour

The predominant paradigm for understanding trade is that provided by comparative advantage literature. In this framework countries trade in products where they have a relative advantage. The rise then of intra-industry trade – the export and import of products in the same industry, has been somewhat of a puzzle. However, Fontagne and Freudenberg (1997 p8) have shown that at high levels of data dissagregation intra-industry trade disappears and is replaced by vertical or horizontal product differentiation:

> "Using a dataset embodying data flows of 1 1 European countries facing 10 partners for around 10,000 products, the methodology emphasises that the recent increase in IIT in Europe is entirely due to a trade in vertically differentiated products. To better apprehend the countries' specialisation along the quality ranges, it is assumed that differences in prices reflect quality differences".

The deficiency with this type of analysis seems to be that by placing all the emphasis on the division of labour the use of the imports is not explored.

Cross-border Production Networks

However, there have been a number of approaches that focus more attention on the issue of production integration. For example, the Berkeley Roundtable on the International Economy (BRIE) has done a large amount of research on the operations of international business networks, particularly those in Asia.

> "Cross-National Production Networks, Dieter Ernst has written, are relationships among firms that organise across borders, research and development activities, procurement, distribution, production definition and design, manufacturing and support services in a given industry. What principally

> interests us are the emergence of intricate divisions of labour that become possible when quite heterogeneous mixes of technology capacity and wage costs are woven together. More is at issue than simply labour costs that permit particular components to be built or assembly processes to be conducted at an off-shore production location. Trade and investment, then link together very diverse production functions represented by Japan and Malaysia, for example, to create complementary production arrangements, which neither country would be capable of maintaining independently. Consequently both may be advantaged; and indeed production within the Asian region may be advantaged against producers in other regions. It is the regional division of labour that has recently begun to alter thinking about development policies and corporate strategies" Zysman (1996 p2).

This research points to the integration of the factories of subsidiaries and supplier firms. Their work is a mine of information but though it covers the issue of multiple firms tending towards using the same pathways (clusters), this has not been the focus of their analysis.

The Value of Diamonds

One piece of work which does discuss the clusters issue is Rugman and D'Cruz (1993) in a response to Michael Porter's 'Competitive Advantage of Nations' (1990) analysis suggest that the Porter framework is inadequate for small open economies. Because Porter emphasised the importance of domestic demand, the authors argue the analysis understates (for a limited set of economies) the role of leading international supply connections. The authors develop the idea that as Canada, for example, is strongly linked to the US economy then the USA represents an extension of the Canadian diamond. This is the basis of their double diamond. The effect of combining Canada with the USA is the creation of the North American diamond of business factors.

Though Rugman and D'Cruz analysis in turn leads them to think in terms of triad diamonds, they seem to have not considered that countries may have more than one market. New Zealand, which is one of the countries they discuss briefly, has significant exports to Australia, Japan and the USA: two different segments of the triad, while Australia is often not included in the triad (or at the very least peripheral). Further, while Porter wrote of national diamonds the list of characteristics he proposed (firm strategy,

demand conditions, factor conditions and supplier industries) could be probably contextualised better as *product diamonds* rather than national characteristics of advantage.

It still remains then to find an approach that dissects the trade issue in a way that creates an integrated approach to industry specialisation and interdependency.

Commodity chains and vertical integration

Any discussion of this type needs to consider the contribution of the Global Commodity Chains (GCCs) framework. "What is novel about GCCs is not the spread of economic activity across borders *per se*, but rather the fact that international production and trade are increasingly organised by industrial and commercial firms involved in strategic decision-making and economic networks at the global level" (Gereffi 1998 p40). These chains are particularly envisaged in terms of political economy that takes into account the distinction between developing and developed countries as a central part of the analysis. While the weakness of the framework is that its effectiveness as an approach is more specific than it could be, its strength is a focus on the firm interactions. "The average Japanese automaker's production system, for example, comprises 171 first-tier, 4700 second-tier, and 31600 third-tier subcontractors" (Gereffi p42).

SUPRANATIONAL CLUSTERS

The previous section has shown that most of the approaches to cross border production focus specifically on the development of businesses with international product sourcing. Therefore, apart from individual studies (see for example Hummels etal 1998) this paper argues that there is a requirement for a methodology that examines trade by product channels at levels of economic agglomeration. So as pointed to earlier there are three reasons for conceptualising some trade as being constructed around international clusters. These are the integration of structure and trade, the examination of innovation flows connected with trade, together with an analysis of trade that is primarily from the industry rather than national perspective. However, using the term 'cluster' is currently somewhat problematic because it has been used by a number of authors to give a name to quite different concepts.

Clusters- economic agglomeration: geographic and interdependent industries

According to Verbeek (1999) there is basically one broad division in the clusters literature. The first class of clusters is based on similarity, which includes the analysis of geographic concentrations of industries. The second class focuses on interdependence, chains of production and filieres. While Verbeek's framework provides a clean distinction, it should be pointed out that Porter's (1990) work, which popularised the idea of industrial clustering, seemingly straddles Verbeek's definition. Porter's analysis is based on the combination of areas of specific trade strength blended with interdependence and similarity.

In pursuing the dynamics of trade linkages as possible clusters, the framework that is useful is that of interdependence. A practical methodology for understanding macro interdependencies between countries was adopted in Wyckoff's (1993) work where he analyses industries in OECD countries for their volume of imported intermediate goods content. While Wyckoff provides a general overview of trade and input-output linkage for a number of OECD countries, this paper explores the data on just one system. In general though, it appears valuable to pursue this path because just as understanding the linkages within a domestic economy (ie input-output structural economics) has proven to be a very valuable tool, in the current era it is important to push the analysis to include international trade. The point of focusing on 'supranational clusters' is that the required analysis appears to be manageable.

Innovative clusters, knowledge and production

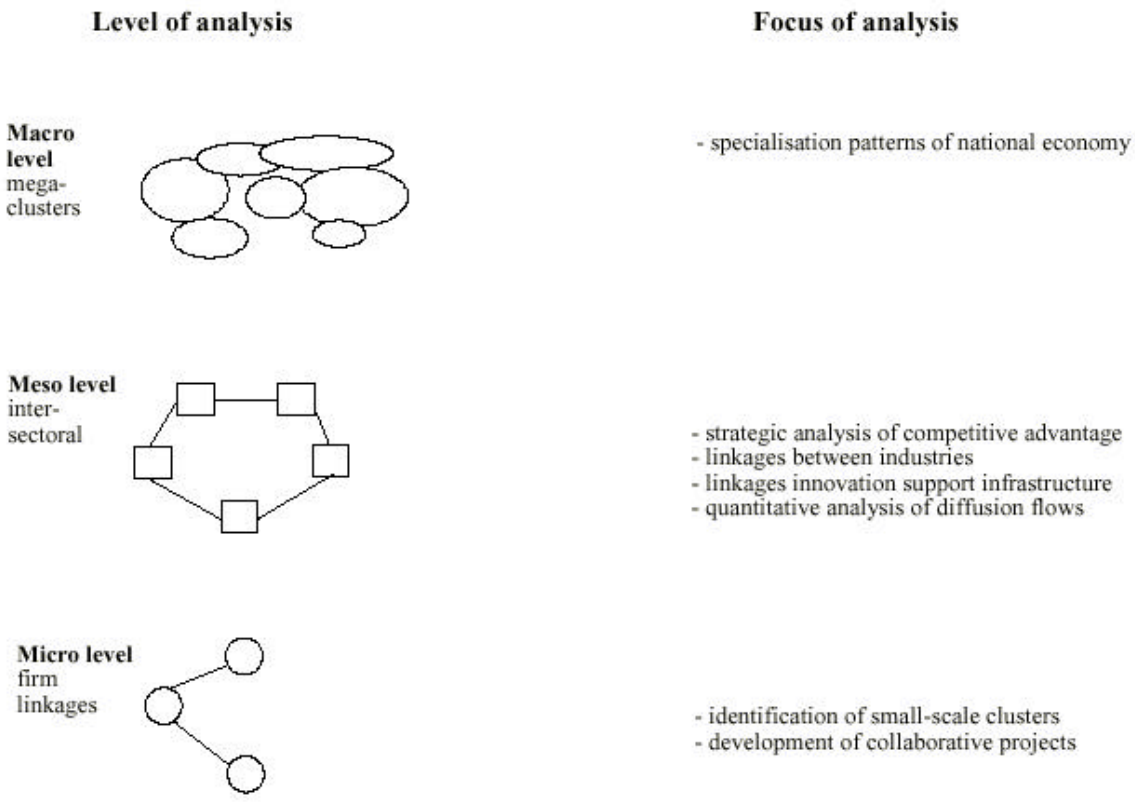
Going beyond mere interdependence to include the degree to which clusters enhance innovation adds several degrees of economic and analytical complexity. Because knowledge often flows along business relationship pathways, clustering is not just economic agglomeration (and thus interdependence linkages), but also the likely hotspots of innovative activity within an economy. The most useful starting point for analysis on innovative clusters are Debresson (1996) and the work of the OECD research program on clusters which began around 1997 and has been conducted as a component of its work on national innovation systems within the Directorate for Science, Technology and Industry (1999).

The national innovation systems approach has emerged from a history of analysis of the patterns of both company and national performance in innovation. The same stream of studies has shown that knowledge

does not travel easily from its source. In turn this has led to studies that reveal that concentrated user-producer interaction and national institutions have been significant for the different patterns of innovation performance. Ernst (2000 p2) writes “this implies that knowledge and innovation do not easily migrate across borders: they do not automatically follow, once production moves. Even while globalization extends its reach beyond trade and finance, giving rise to extensive relocation of production, this may not help to reduce the huge International gaps in knowledge and innovation. For developed countries, the spatial stickiness of innovation may foster attempts to sustain their technological superiority”.

The following diagram is useful because it captures the graduation of research (eg OECD 1999) from the network connections constructed by individual businesses through to clusters (macro - mega clusters) which are in fact statistical representations of business lines of interdependency.

Figure 1: OECD Cluster Categories



Source Drejer 1999 referencing a document by Pim den Hertog

The importance of user-producer relations for innovation (for example Lundvall 1992 and Fagerberg 1992) is that they are long lived demand-supply relationships that facilitate the creation and the pull

through of innovation. Such relations provide a secure environment for the risk of innovating as well as the direct tacit information necessary for improving the performance of a product or process. Debresson for some time has been doing groundbreaking work on furthering the understanding of the connection between user-producer networks to the generation of innovation.

> "As no one organization can possibly keep internally all these dissimilar competencies, but tends to focus on similar competencies, innovation can only be undertaken through the collaboration of different enterprises. Yet the social sciences at the end of this century, except for a tiny part of economic sociology (for instance Burt, 1982, 1992), still only use the individual organization as the sole unit of coordination …This thesis also claims that innovative networks are now central to the understanding of all contemporary economic processes - not just innovation" Debresson (1999 p2).

In essence the transfer of knowledge and thus innovation can be significantly linked with the production networks businesses rely upon. This connection between production and innovation through business networks allows the study of innovation patterns at the cluster level by bringing together knowledge investment and infrastructure (Smith 1997 and Smith 2000) together with production activities and paths of interdependency at levels of aggregation where statistics are readily available.

Amongst many others Marceau (1999) and Hauknes (1999) have discussed clustering at the macro industrial level which is the most suitable for input-output study. At this level a 'map' of interdependency flows can be drawn or charted to reveal the national industry product paths over time. However, as pointed to earlier, the work on innovative clusters has been developed within the 'national' systems of innovation framework. Though it is justifiable to focus on the nation for many reasons, it does, however, have limitations because at the very least, for many countries their important domestic innovative clusters are also their areas of trade specialisation.

Ernst (2000 p9) in fact, argues that the stickiness of knowledge may be breaking down:

> "It is important to emphasize that globalisation should not be reduced to geog raphic dispersion … [and] does not lead to the wonderland of the 'borderless world' where capital, knowledge and

> resources flow freely around the globe … geographic dispersion has been combined with spatial concentration: much of the recent cross-border extension of manufacturing and services has been concentrated on a handful of specialized local clusters".

Ernst then goes on to analyse the "Global Production Network" of a number of high technology industries and the role of leading businesses in these networks together with the role of information technology in breaking down the spatial limitations of knowledge. So in this way we can see that knowledge and production are linked through domestic business networks, industrial clusters and probably *international* business networks. Though the case work has not been done, it is arguable on the basis of this analysis that there may be some transmission of knowledge and innovation through long lasting trade linkages and if so the supranational clusters would be more than just a set of production interdependencies.

Trade linkages

The supranational clusters approach places an analytical emphasis on the structure of trade linkages that exist through time at significant scales. Understanding such dynamics relates to the emerging awareness of the stability of industrial structure that is coming from the national innovation systems literature. For example, Wolff has recently shown that national industrial structure for OECD countries is basically fairly stable when he notes "Most countries retained their specialization over the period from 1970-1993" (p2000 p203). Moreover Laursen (1998) has shown that trade linkages between nations at the industry level are also relatively stable. Taken together this suggests that the whole structure of OECD industrial interaction both nationally and internationally is probably more stable than is generally assumed. It will take some work yet to reveal whether the negative image of this research, that is if the analysis was constructed primarily from the perspective of industries, whether it to would reveal similar stability. However, given this analysis is just the inverse of what has already been done there is no reason to suppose those structure won't also be stable.

But what makes the dynamics of industrial and spatial stability even more puzzling is that it appears to exist at all levels of economic activity. Dodgshon (1998 p100) referring to the work of Pred makes this contribution:

> "looking at the rank order of cities over time, he demonstrates how those with lead advantages during the early phases of the American industrial revolution were still in dominant positions by the 1950s and 1960s. The conclusion he reached was that 'long-term rank stability of large metropolitan complexes … can be most plausibly explained by the tendency of early established major channels of interdependence … to be self-reinforcing' (1977:36-7)".

If stability at this level arises from channels of interdependency then it is an issue to be closely examined wherever structure exhibits stability.

Beyond the different empirical approach, the spin-off benefit of 'supranational clusters' is that it refocusses the mental models away from 'global', 'triad' and 'regional states'. The suggested approach in this paper does not replace these foci but offers a framework that can provide supplementary information.

A methodological framework for supranational clusters

The methodology for exploring supranational clusters is both problematic and requires a large amount of data analysis. The easiest approach to develop empirically is the analysis of trade linkages between countries. This has been done by using the OECD Bilateral Trade Database (1997) to create a matrix of OECD trade both for total manufacturing and for non-ferrous metals, which is a key trade industry for Australia. As will be seen later the resulting charts give an enlightening insight into trade patterns.

The methodology for understanding the intricacies of interdependency for the case study was, as pointed to earlier, based on Wyckoff (1993).

- Country A (primary importer) – input-output intermediate use tables.
- Trade linkages –while it is preferable to exclude trade for final consumption, this was not possible for this paper due to the limitations of the database.
- Country B, C, D etc (exporters) – input –output intermediate use tables.

Integrating data for two, or more countries, requires a large amount of data that is both at the same level of aggregation and synchronised. This paper utilises domestic input-output data[2] and for trade both the OECD imported intermediate goods matrices and the OECD Bilateral Trade Database. Whilst the trade data is highly aggregated it has the advantage of being developed to fit with both the STAN database and the Input-Output Database and it also has excellent coverage for exporting and destination countries. Of course if more data were available there are a number of possible extensions[3] to the analysis presented here.

Finally, while it is not possible to provide direct information on the innovativeness of either the specific supranational cluster study developed or others at present it is possible to have indicators that point to the user-producer relationship dimension of the trade linkage. To develop such indicators requires thinking through the implications of what is already known about knowledge and production. The user-producer relations that matter for innovation tend to be long lived, embodying both elements of trust and mutual benefit. So it appears to be a necessary, though not sufficient criteria for the networks to be channels for innovation, that they are relatively stable compared to being purely market based (more flexible on a price cost basis). The resulting test in the case study therefore considers the stability of the trade relationship. Ultimately it would be important to link macro and corporate data to test this question, but exploring evidence even at this level provides interesting results.

GLOBAL TRADE OVERVIEW

The logical first step in an analysis of supranational clusters is to map global trade for likely linkages. To track down the most likely linkages for further exploration, such a matrix could be produced for all industry groupings of interest, preferably utilising the idea of intermediate trade. This paper starts from the

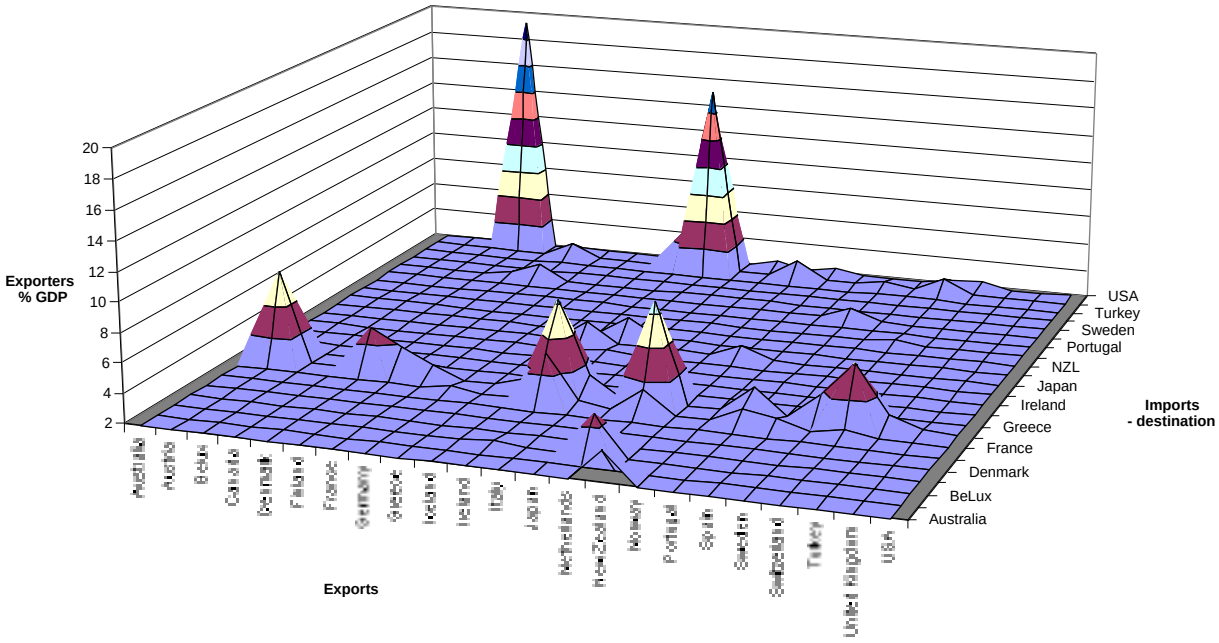
[2] OECD domestic and imported intermediate supply use tables are useful but are aging – the latest data is for 1990.

[3] The Centre d' Etudes Prospectives et d' Informations Internationales has developed a classification of intermediate trade. A step further than this are the data tables constructed by the Institute for Developing Economies (IDE) in Japan which are bilateral Input-Output tables. I have access to some of this data and have begun to work with it. I know of no equvialent data for Europe or North America, although it would be extremely valuable.

perspective of the manufacturing sector as a whole and then focuses on one specific trade relationship that is important for the Australian economy.

Using the OECD Bilateral Trade Database 1997, I have constructed a matrix of OECD trade, for the latest available year (1994) with a threshold in this chart of two percent of GDP, for the *exporting* country. It is useful to start with a high threshold level, in the first instance because it seems that trade linkages rapidly thin towards the two percent level. What emerges in the first chart is probably not surprising, in that Germany, France, the USA and the UK are the major *destination* countries for OECD exports. Australia does not export manufactured products to any country beyond the two percent of GDP threshold.

Figure 2: Industrial countries exports to industrial countries (greater than 2% GDP [1994])



Source Data from OECD Bilateral Trade Database 1997 and IMF GDP data 2000[4].

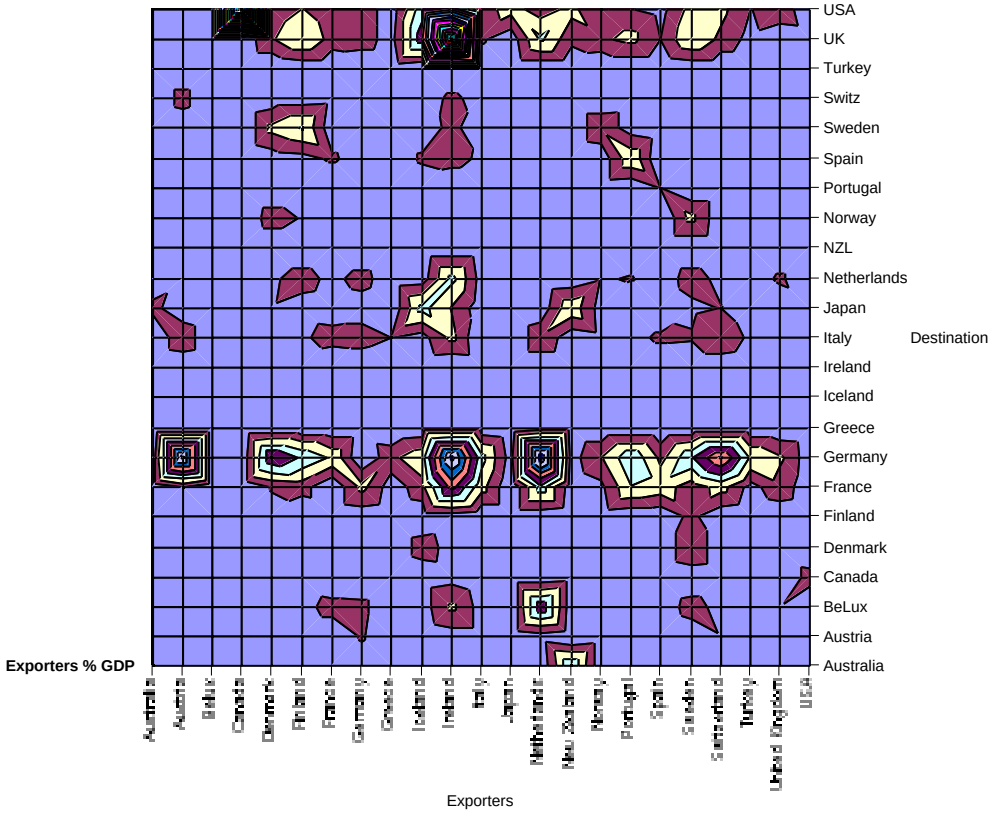
It is quite striking that there are very few linkages that are observable. A lower threshold must be established to capture more trading partners and in particular the export pattern of the Australian economy. Figure 3 maps export direction at levels of trade greater than one percent of GDP. In this chart

[4] The chart is a matrix, though not all the *names* appear on the destination due to software reasons.

there are many more connections, which makes the chart virtually impossible to read if constructed in 3 dimensions. I have therefore changed the orientation of the chart to topographical perspective. In this orientation the different shades and rings signify higher levels of exports. The reader should focus on the grey zones, as these are the areas of trade between one and two percent GDP and therefore the linkages below that are shown in Figure 2. All the other layers and in particular the zones of black which are concentrations greater than the software can cope with are revealed in the earlier figure.

Countries such as Ireland, the Netherlands and Denmark, as small countries are revealed from Figure 3, as worthy of further study due to the number of trade connections. New Zealand a country of only 3 million people manages to have 4 linkages greater than 1% of GDP. Australia (18 million people), on the other hand, has one link – Japan. What is more interesting and perhaps surprisingly is that Japan has only one link – the USA. The remainder of the paper will focus on Australia – Japan trade.

Figure 3: Industrial country export linkages greater than 1% of GDP (1994)



Source Data from OECD Bilateral Trade Database 1997 and IMF GDP data 2000.
Note: The different shadings denote greater concentrations of export linkages. Where these appear black it is because the software cannot depict enough layers – refer to Figure 2 for scale.

AUSTRALIA – JAPAN: INDUSTRY AND TRADE SYSTEMS

While Figure 3 shows that Australia connects in manufacturing industries with Japan, it is necessary to develop a table of Australia trade by country and industry to understand the detail of this trade profile. Appendix Figure A (at the end of the paper) is the chart of that table and reveals that processed food and non-ferrous metals exports are clearly the overwhelming contributors to Australia's overall manufactured trade profile and in particular, trade with Japan. The focus of the rest of the analysis will be on the non-ferrous metals trade with Japan, as it is an industrial ingredient in other industries and it is useful to at least show greater levels of interdependency in the analysis. However, as acknowledged earlier, it is a weaker example for understanding the possible transmission of innovation. Nevertheless the examples does throw up some very interesting material.

Australia's exports

Australia is a resource rich economy that relies heavily on mineral exports. In 1997-98 over AUD$40b were mineral exports while manufacturing, services and agriculture each contributed between $22b & $25b. The minerals are mostly unprocessed commodities such as coal, iron ore. In manufacturing, non-ferrous metals which includes gold, copper, silver, lead, zinc and aluminium as an industry group are together the only metals that Australia value-adds *and* exports to any intensity.

Figure 4 Exports as percentage of production

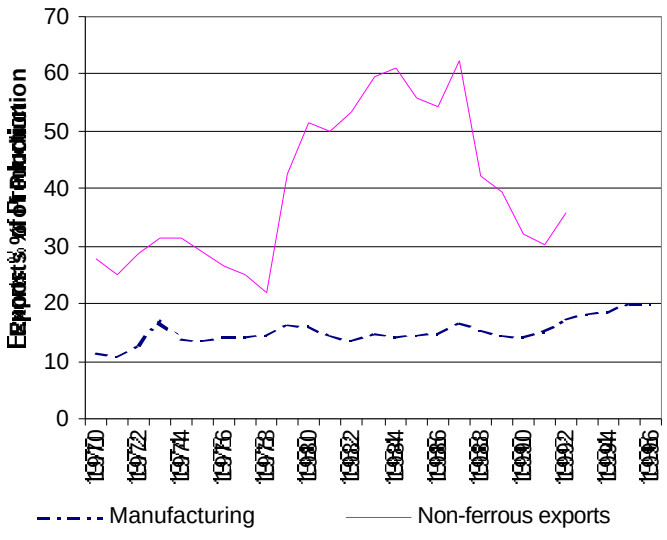
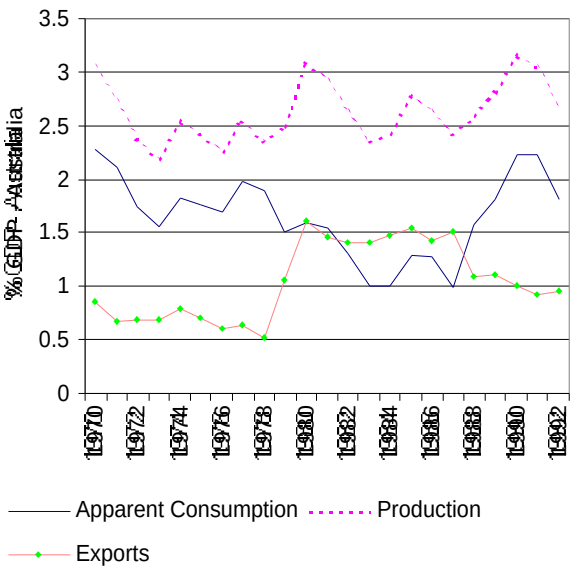


Figure 5 Non-ferrous metals industry



Data Sources: OECD 1998 STAN Database and OECD 1997 ISDB

Figure 4 reveals the export share of production for both non-ferrous metals and the average for manufacturing. The industry has always had a higher export propensity but during much of the 1990s this rose to very high levels. The analysis is extended in Figure 5 to include production, apparent consumption (production – exports + imports) and exports, all as a percentage of GDP.

Taking the three trends together what can be seen is that during the 1970s the non-ferrous metals industry though exporting at greater than the average share of production, was mostly influenced by the domestic market. This changed in the late 1970s with the rapid growth of export markets. However, in the late 1980s the situation reversed with a decline in exports, whilst production and thus apparent consumption basically continued to grow.

Using the OECD I-O database, which is increasingly, unfortunately, out of date, the latest available data for Australia is 1990 (Appendix Figure B). Graphing the matrix as a percentage of GDP we can see that Australia's industrial structure is concentrated in primary resources, low technology industries (food, metals etc) and also services industries. It is clear that the intermediate use of metals apart from those in construction is not particularly strong.

Japan's demand

In terms of the future of Australia's manufacturing exports it is important to understand the use to which Japan puts the imports. Japan is almost the reverse of Australia. Resource poor but with a heavily industrialised structure, Japan trades with a number of economies for the resources it needs. Wyckoff (1993) developed an analysis of the importance various OECD economies place on trade in *intermediate* goods. The table reveals that in non-ferrous metals Japan requires an amount equivalent to 40 percent of its production to be imported[5].

[5] The other economies which appear in the study, excluding the USA (which recorded a similar scale for its highest imported intermediate goods industries), recorded some much larger amounts. Autos in Canada stands out at 4.2.

Table 1. Ranking of intermediate inputs by the ratio of imported to domestic sourcing Japan 1985

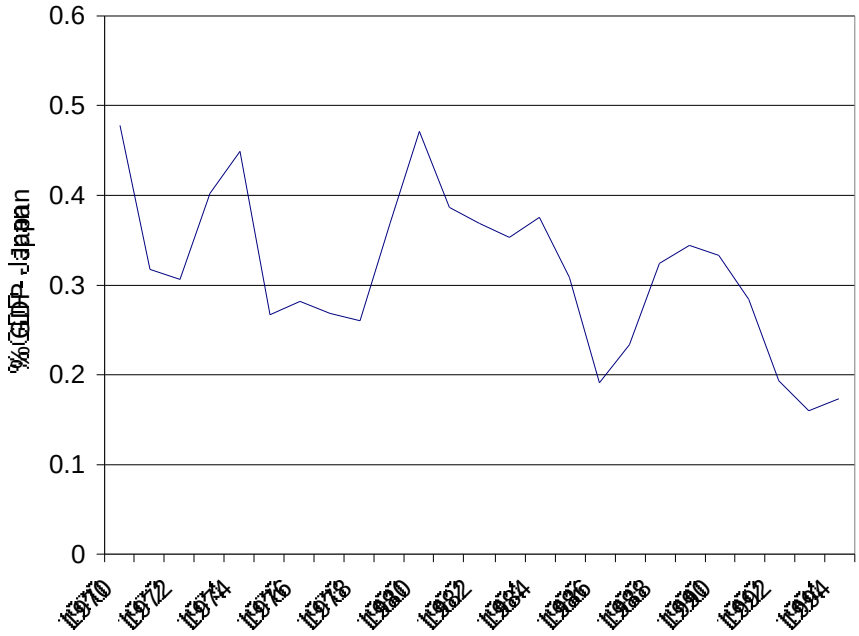
Aerospace 0.6	Non-ferrous 0.4	Computers 0.2	Petroleum refining 0.2	Food drink tobacco 0.1
Wood & furniture 0.1	Textiles, apparel & footwear 0.1	Pharmaceutical 0.1	Chemicals 0.1	Instruments 0.1

Wyckoff 1993

Figure A.3 utilising the imported goods table gives some emphasis to Wyckoff's point. However, Figure A.4 reveals that in terms of *total* trade, non-ferrous metals is not of major significance. Figure 6 is a chart of imports as a percentage of GDP between 1970 and 1994, whilst Figure 7 reveals the country of origin for imports (1970 and 1990).

What is important to note in Figure 6 is the steep rise in imports around 1978 and then the sharp downturn in demand in 1985-87. The rebound in imports following this was rapid but short-lived. If Figures 4 and 5 are taken into account it appears that the increase in demand was the primary trigger for the growth in Australian exports whilst the initial downturn seems to have been the catalyst for Australian industry to refocus on the domestic market. Clearly then it can be argued that there appears to be have been a close relationship between Australian supply and Japanese demand for non-ferrous metals.

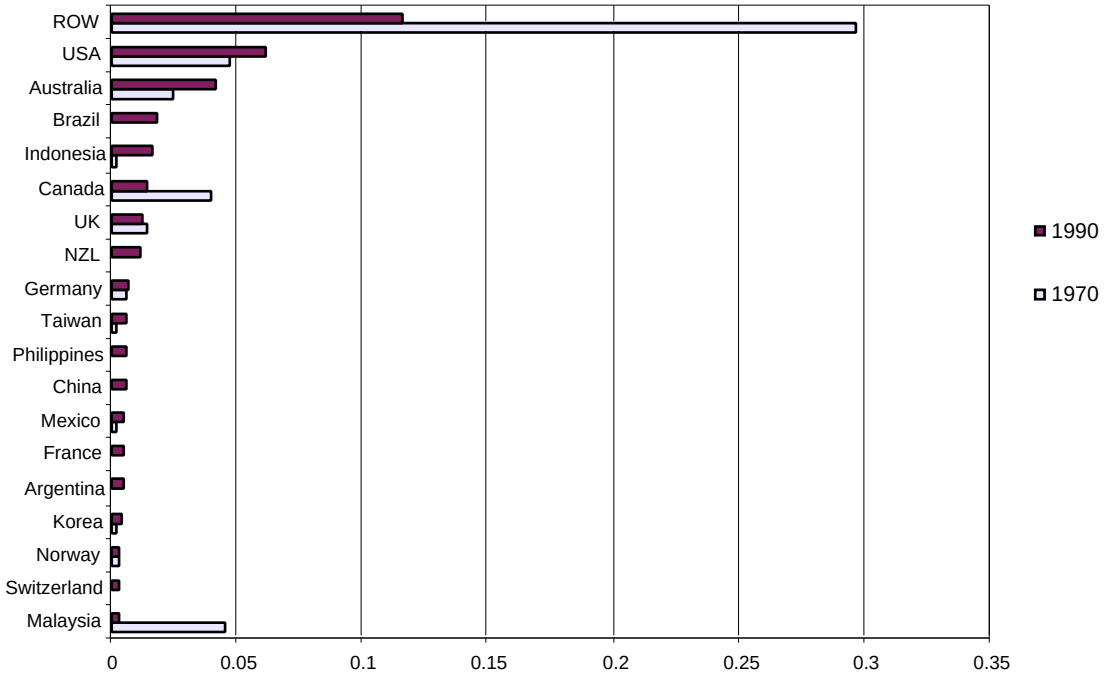
Figure 6: Non-ferrous metals imports – Japan (% GDP 1970 – 1994)



Data Source: OECD 1998 STAN Database

This close tracking of demand has occurred while the significance of Australia as a supplier has grown. It can be seen from Figure 7 that the USA and Australia have been major players since the 1970s but Brazil and Indonesia emerged to join the leading group while Canada and Malaysia have declined.

Figure 7: Non-ferrous imports to Japan by country



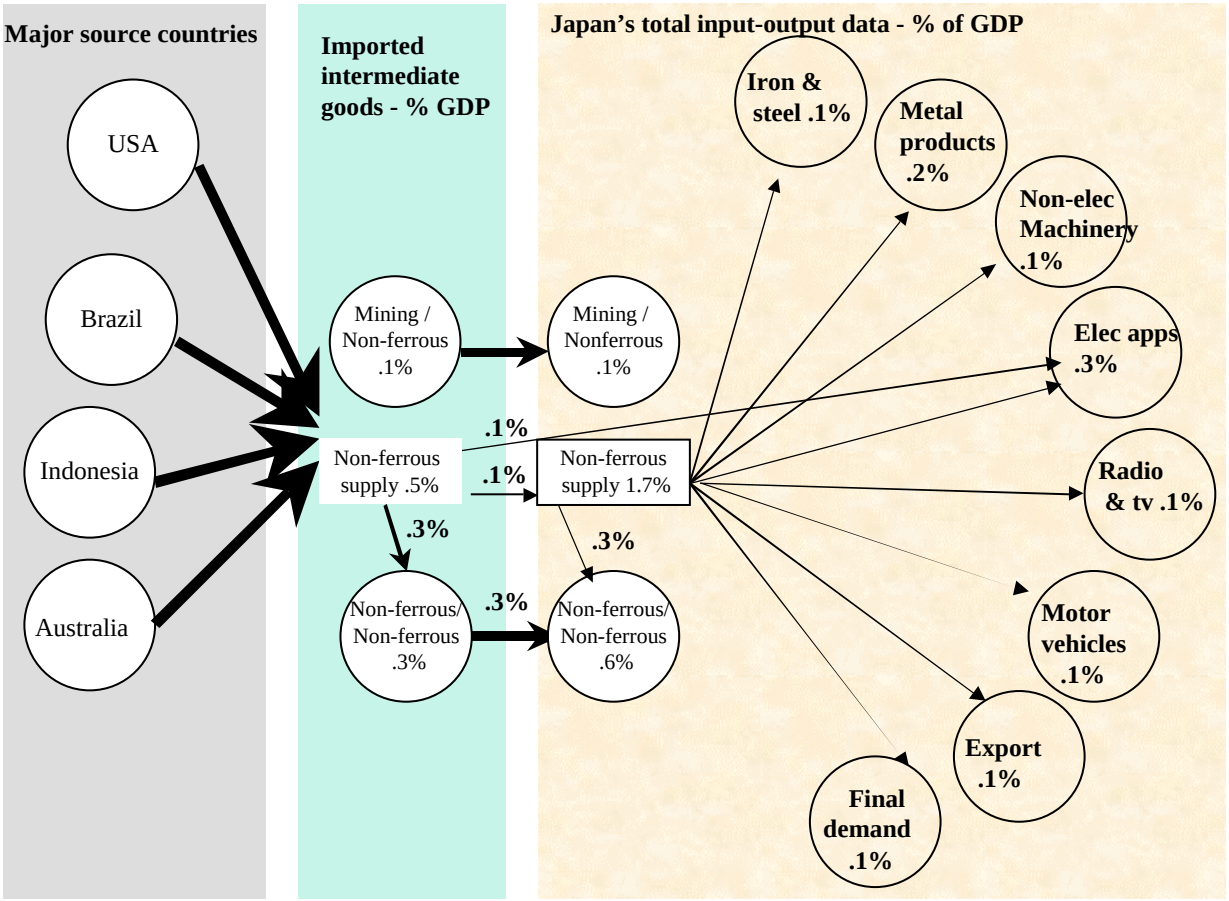
Source: Data from OECD 1997 Bilateral Trade Database and OECD 1997 ISDB.

Figure 8 moves the analysis forward by examining the Japanese data on imported (Appendix Figure C) and total (Appendix Figure E) intermediate (input-output) use of non-ferrous metals. In this schematic diagram of part of the supranational cluster, the use to which some of imports are put becomes clearer. The diagram of the system is divided into three major blocks. The shading on the left indicates the major source countries, the shaded column in the middle provides the available information on imported intermediate goods and then the shaded block on the right depicts the flows of non-ferrous metals within the Japanese economy.

Through this diagram it is possible to see that non-ferrous metals plays an important part in the production processes of a number of industries. The diagram also indicates that apart from the 'electrical appliance industry', which does use directly imported non-ferrous metals, the major proportion of the intermediate goods go to the non-ferrous metals sector itself. This suggests that the imported products are at the more

basic end of the spectrum. The products produced in Japan are spread between a number of end uses including electrical appliances and motor vehicles. The .3 percent of GDP difference between what is produced and what is shown is spread is smaller amounts through the rest of the system.

Figure 8: Supranational cluster



Source: Data from OECD 1996 Input-output database

Though there is evidence for strong user-producer interactions within this set of interdependencies, the last bit of evidence on the source of demand for the imports, in this case points to the probability of only a limited likelihood of innovation and knowledge being transmitted through the system.

Appendix Figure F has been included to show that OECD trade in this industry is quite limited. Primarily, the USA, UK, Japan and Germany are the core destination countries for non-ferrous metal exports from OECD countries as a percentage of their GDP. This emphasises the earlier point that trade at the industry level trade is highly specific both in terms of exporting and importing countries.

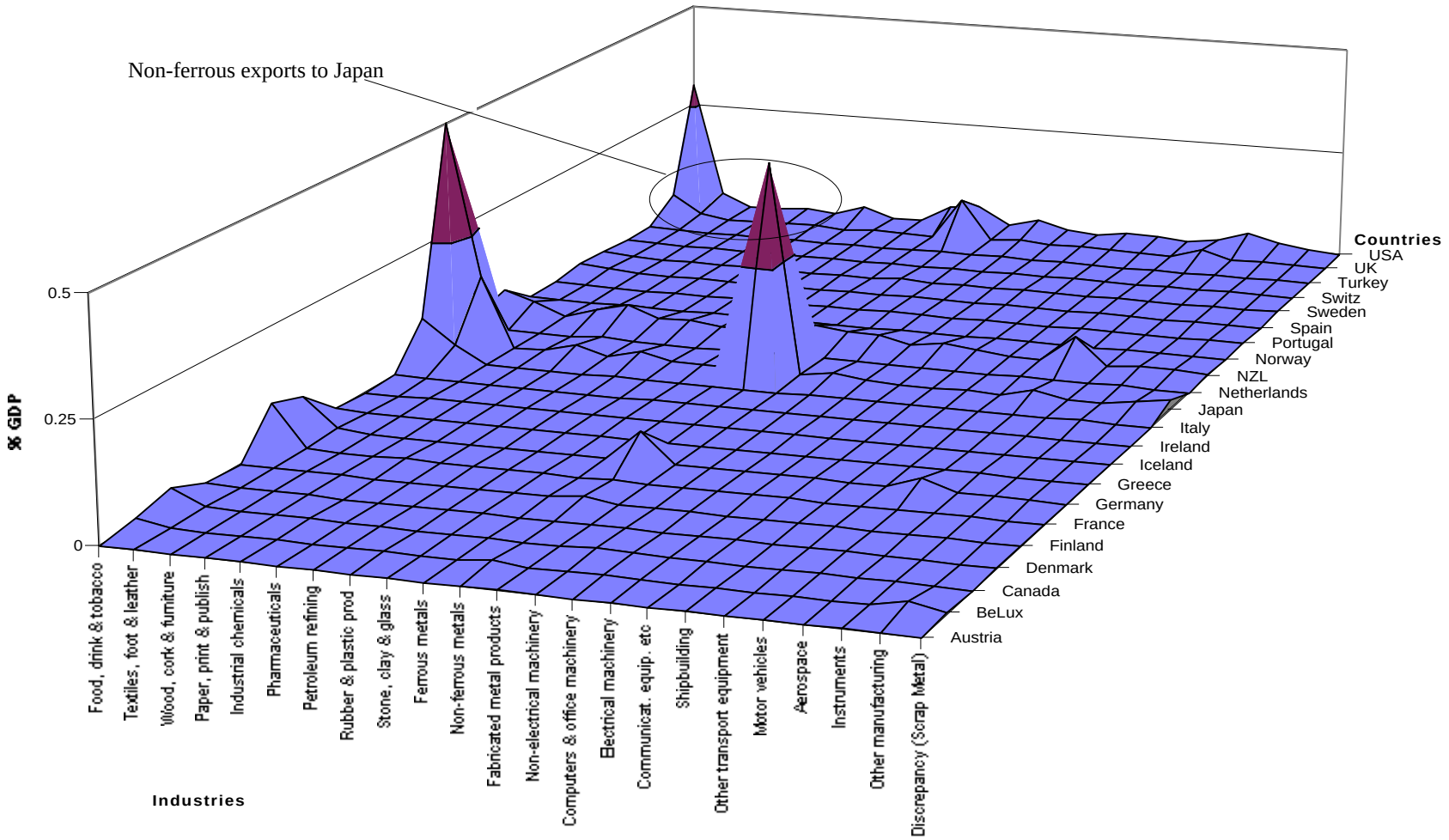
CONCLUDING THOUGHTS

It has been argued in this paper that there are three reasons for considering the use of the analytical framework of supranational clusters for trade analysis. These reasons were: the need for greater consideration of the industrial systems that import intermediate goods (as well as those that produce the exports); the need to assess whether knowledge and innovation are being transmitted across national borders through the channels of interdependency; and then finally the proposal that significant trade linkages between countries are few, specific and long lived.

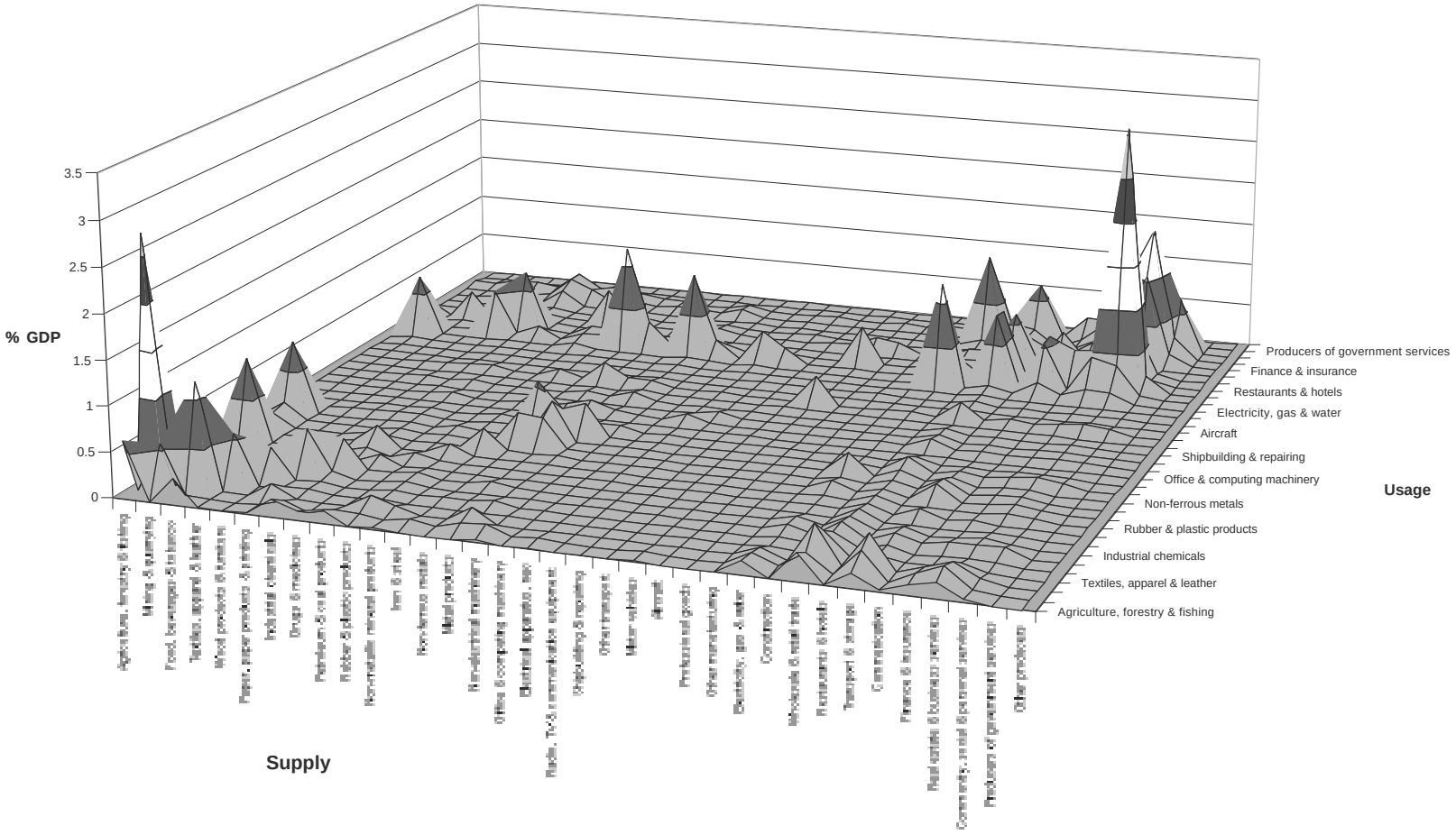
These ideas were tested through the examination of the trade linkage between Australia and Japan. By revealing the end use of at least the intermediate goods component of the trade, the paper has attempted to shown something of the nature of the commodities being traded. The information on the possible innovative nature of the cluster is more shadowy. On the one hand the user-producer connections do appear to exist, which is an important prerequisite, but on the other hand the sophisticated (higher technology industries) industries do not utilise the imports and therefore are unlikely to be channels of knowledge flows. Finally, it has been shown that for this industry the world trade pattern is highly focussed and that is for a basic manufacturing commodity. This is a good indicator that the more advanced products are likely to be even more specialised.

To pursue this framework further would needless to say, require an expanded set of information. The first requirement is for more information on the competitive environment and history of both the supplier and importing countries in terms of both economic and innovation analyses. The second need is to be able to include more information on the company arrangements within the cluster. Within this it would be necessary to develop an understanding of the user-producer relationships within the system to determine the extent to which a distinction could be drawn between production and innovative supranational clusters. This takes us back to the very beginning of the paper – whether the supranational clusters perspective could provide a bridge between the arguments for national innovation systems and globalisation. Though it is not possible to be conclusive on this yet, this paper does point to enough evidence to pursue the idea further. At the very least supranational clusters is a way of tracking webs of international interdependency.

Appendix Figure A: AUSTRALIAN BILATERAL EXPORTS 1990

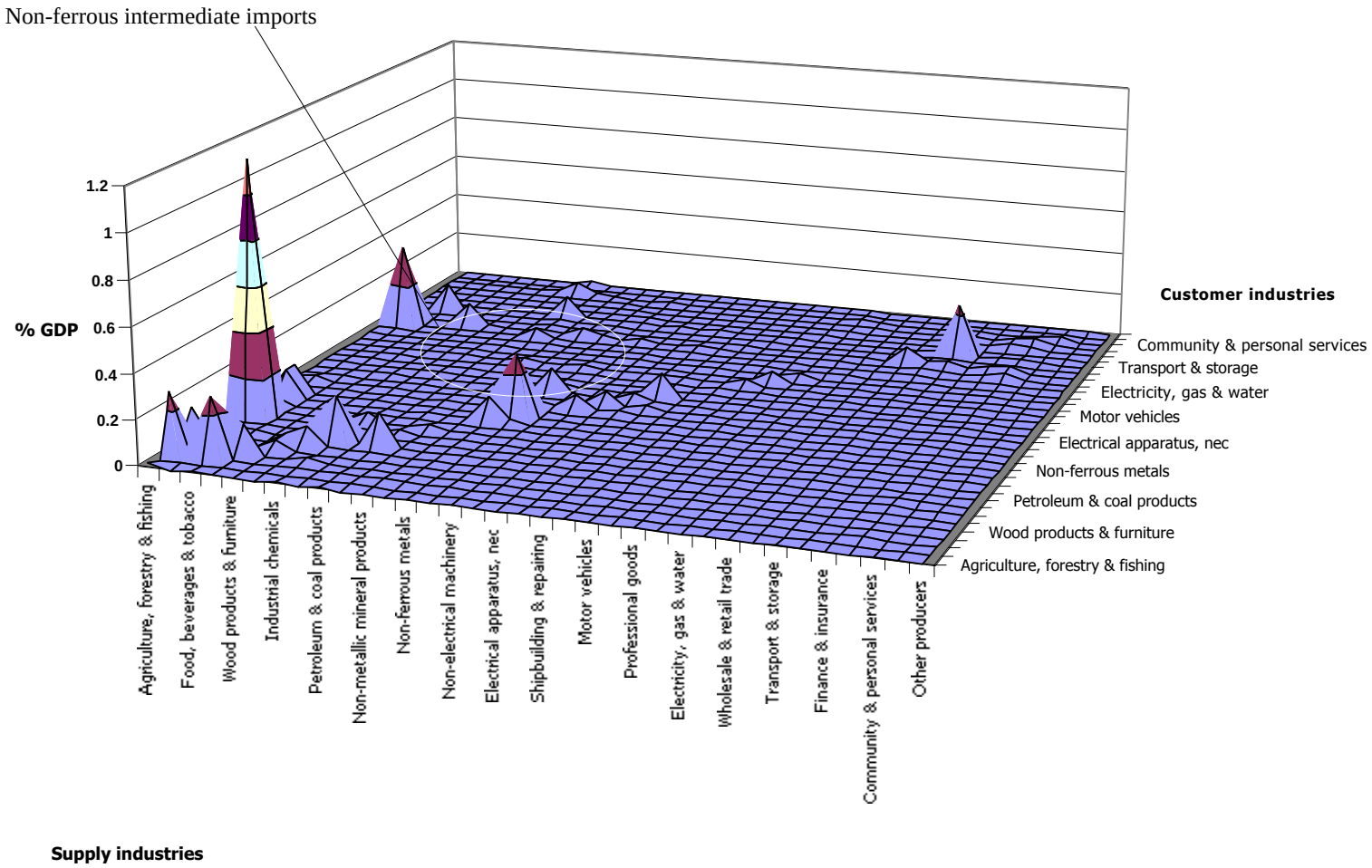


Appendix Figure B: Australia – structure of domestic interactions 1990



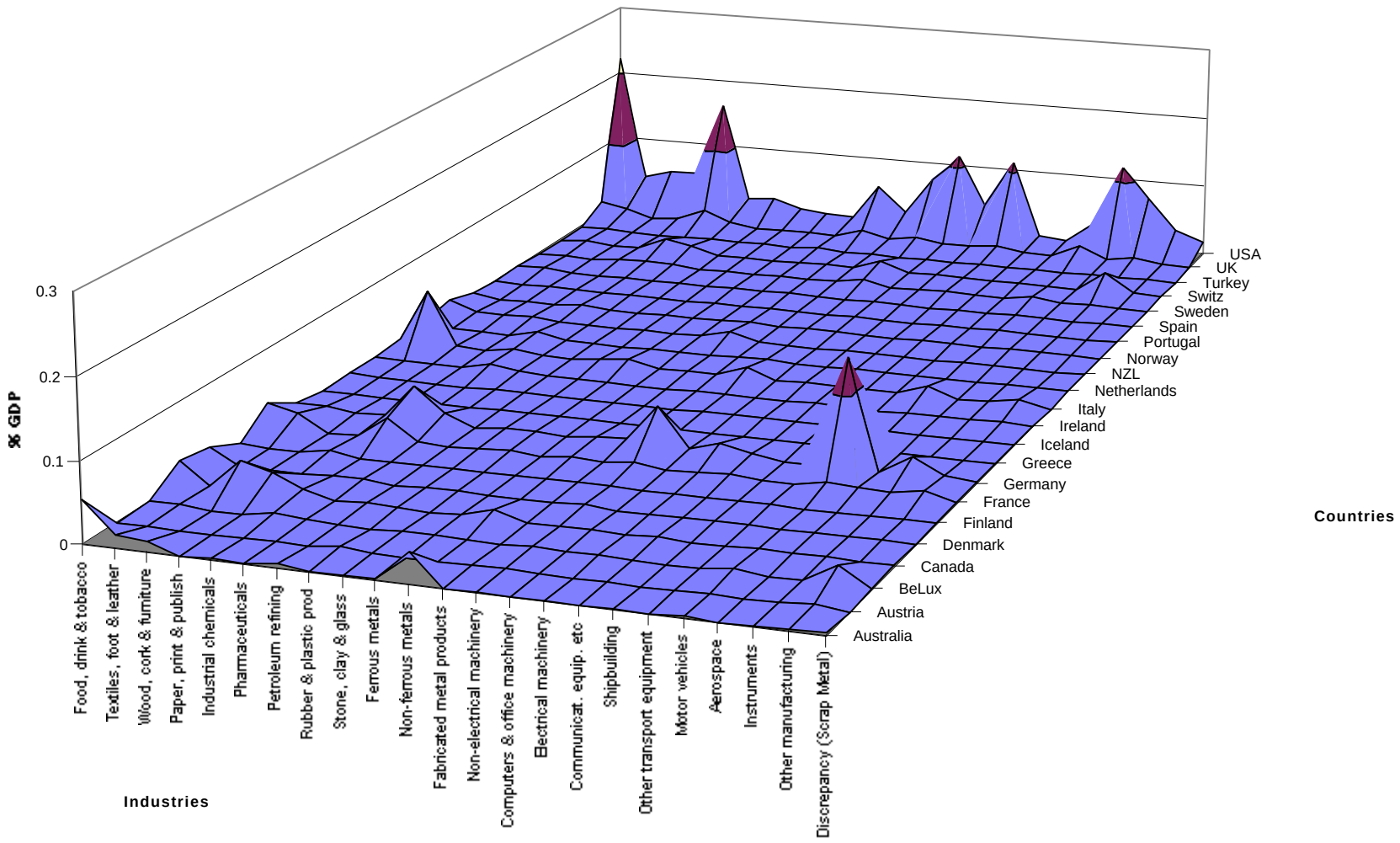
Source: Data from OECD Input-Output Database

Appendix Figure C: Japan – intermediate imports 1990



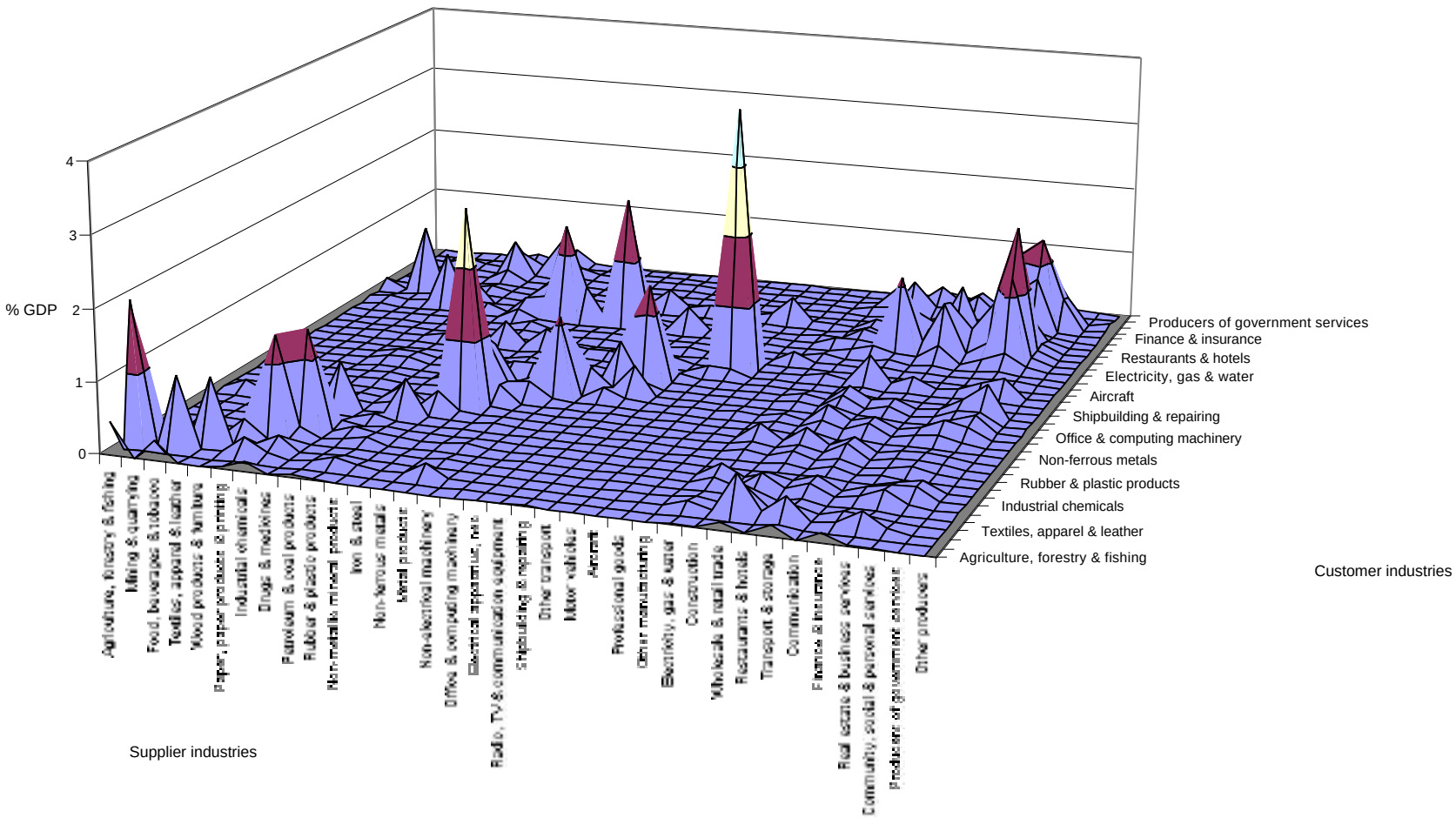
Source: Data from OECD Input-Output Database

Appendix ***Figure D: Japan imports OECD countries 1990***

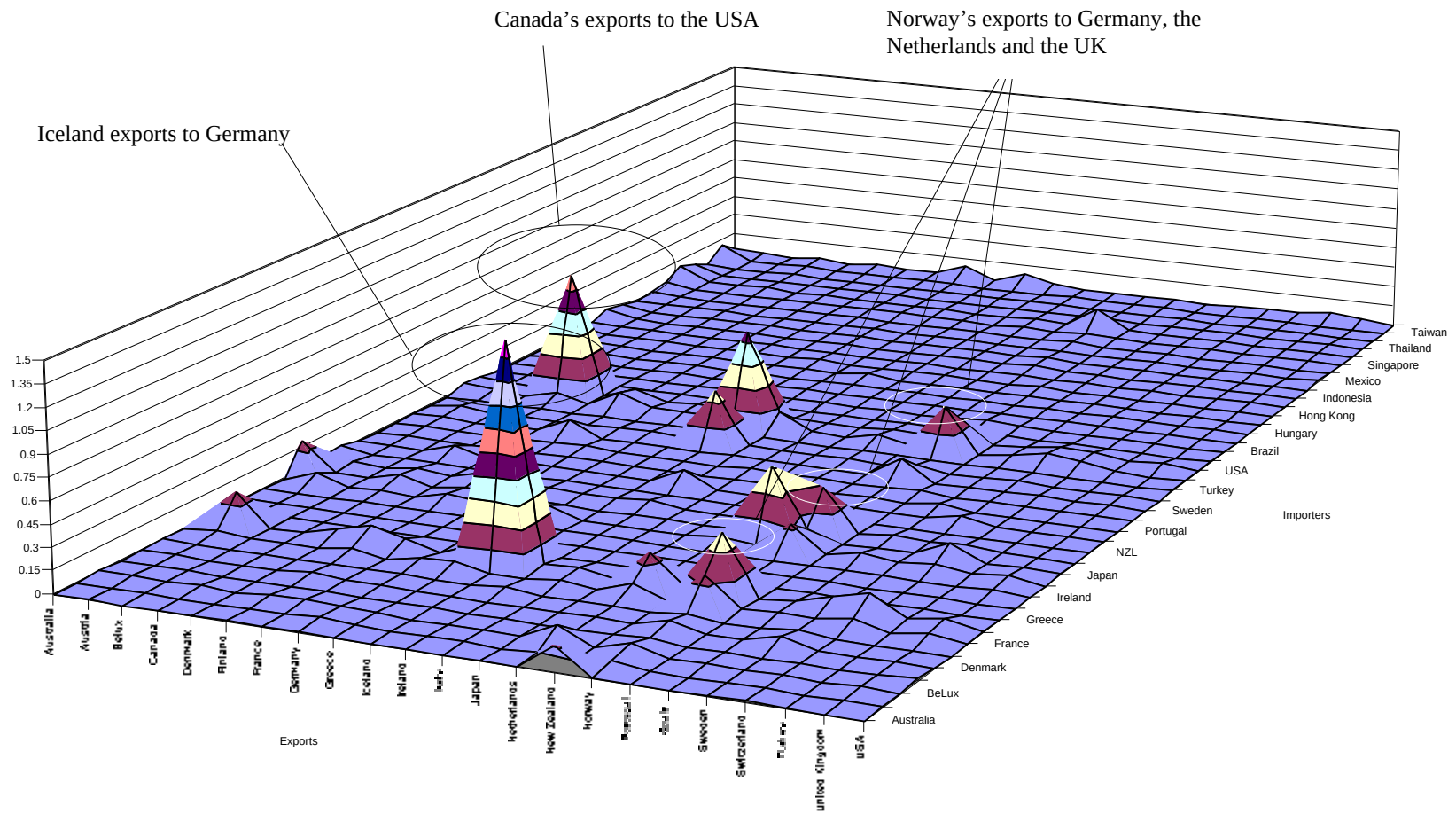


Source: Data from OECD Input-Output Database

Appendix Figure E: Japan – total industrial structure 1990



Appendix Figure F Industrial countries' non ferrous metals trade 1994



Source: Trade data from OECD Bilateral Trade Database 1997 and IMF GDP data. **Note:** Due to the construction of the database it would be preferable to calculate on the basis of imports for this analysis, but this was not possible prior to the conference. The analysis would also be improved by using an OECD or world GDP figure to develop appropriate scales.

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