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The Economics of Isolation and Distance

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This paper explores the economic implications of isolation and remoteness. Evidence on the impact of distance on trade costs and trade flows is reviewed, and the effects of remoteness on real incomes are investigated. Empirical work confirms the predictions of theory, that distance from markets and sources of supply can have a significant negative impact on per capita income. The possible implications of new technologies for these spatial inequalities are discussed. Keywords: Economic isolation, market access, trade costs. JEL classification: F1, R1

A recent programme of research at the Centre for Economic Performance at the London School of Economics addresses the role of geography in determining trade flows, the location of economic activity, and the extent of income differentials between countries.[2] Although not directed especially at the problems faced by small or isolated economies, the central issues researched are the interactions between scale and proximity. There are benefits from being large and from being close to centres of economic activity, and the research seeks to understand these benefits, assess their magnitude, and evaluate the rate at which they fall off with distance from the centre. The purpose of this paper is to draw out some of the implications of this research for small and isolated economies that are deprived of these benefits.

The point of departure is to pose the question, why do isolation and distance matter for economic performance? There are several main considerations. The first is simply that having good access to markets is valuable for firms. The access can derive from two sources: one is proximity to other countries that can

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1. Based on talk prepared for WTO meeting on Small Economies, Geneva, 21/2/02. Corresponding author, A.J. Venables, Dept of Economics, LSE, Houghton Street, London WC2A 2AE.
2. The main analytical work is summarised in Fujita, Krugman and Venables (1999), see also Limao and Venables (2002). Empirical work is summarised in Overman, Redding and Venables (2001), and see also Redding and Venables (2001). This paper is based partly on Venables (2002). The Centre for Economic Performance is funded by the UK Economic and Social Research Council.

bring good access to export markets, and the other is domestic scale, i.e. the extent to which the home market can provide an alternative to exports. Countries that are both remote and small forego both these sources of market access. The second consideration is access to suppliers of intermediate and capital goods. Again, the supply of these goods can be from imports or domestic supply, and remoteness and smallness will have the effect of impeding the supply and raising the prices of these goods. A further penalty may arise if the flow of ideas and technologies is curtailed with distance. Although the determinants of these flows is not well understood, there is a good deal of evidence that proximity to centres of technology matters in both the development and application of R&D and we present some of this evidence below.

These forces can give rise to spatial clustering of economic activity, showing up both at the level of a single industry (eg electronics in Silicon Valley or financial services in London) and at a more aggregate level (the formation of cities and industrial districts). There is evidence – derived from studies of subnational data in both the US and the EU – that productivity levels are higher where economic activity is dense, with causality running from density to productivity.[3] This effect can be a source of benefit for small and densely populated city states – a Singapore or Hong-Kong effect. However, many more countries lack the scale to develop their own clusters of activity, and suffer the costs of remoteness from existing centres.

Although this is not an exhaustive list of the costs of smallness the remainder of the paper will focus on drawing out some of the facts that have been established concerning these forces.[4] We look first (section 2) at the direct effects of distance on economic interactions, particularly the cost of making trades across space. We then turn (section 3) to their implications for per capita income levels. Finally, (section 4), we present a few ideas on the possible effects of new technologies on these relationships.

The direct costs of distance

Distance and economic interactions: However much we hear about globalisation, a startling feature of economic life is how local most economic interactions are, and how sharply they decline with distance. Trade economists have explored this relationship with 'gravity models', in which bilateral trade flows between countries are explained by the economic mass (eg, GDP) of the exporter and importer countries, and 'between-country' variables such as distance, and perhaps also whether they share a common border, language, or membership of a regional integration agreement. Extensive data permits the gravity trade model to be estimated on the bilateral trade flows of one hundred or more countries, and studies find that the elasticity of trade flows with respect to distance is around -0.9 to -1.5. This implies that volumes of trade decline very steeply with distance. Table 1 expresses trade volumes at different distances, relative to their value at 1000km; with a representative value of this elasticity of -1.25, doubling distance more than halves trade flows; by 4000km volumes are down by 82% and by 8000km down by 93%.

Similar methodologies have been used to

3. Ciccone and Hall (1996) for the US, Ciccone (2002) for the EU.
4. Other factors that are important are economies of scale in public sector activities and the commodity concentration of small countries' exports, with the associated high levels of variability of export earnings.

Table 1.
Economic interactions and distance.

(Flows relative to their magnitude at 1000km)

	Trade (θ = -1.25)	Equity flows (θ = -0.85)	FDI (θ = -0.42)	Technology
1000km	1	1	1	1
2000km	0.42	0.55	0.75	0.65
4000km	0.18	0.31	0.56	0.28
8000km	0.07	0.17	0.42	0.05

Sources: see text.

study other sorts of economic interactions and are also reported in Table 1. Portes and Rey (1999) study cross-border equity transactions (using data for 14 countries accounting for around 87% of global equity market capitalisation, 1989–96). Their main measure of country mass is stock market capitalisation, and their baseline specification gives an elasticity of transactions with respect to distance of -0.85. This indicates again how – controlling for the characteristics of the countries – distance matters. Other authors have studied foreign direct investment flows. Data limitations mean that the set of countries is quite small, and the estimated gravity coefficient is smaller, although still highly significant; for example, Di Mauro, (2000) finds an elasticity of FDI flows with respect to distance of -0.42. The effect of distance on technology flows has been studied by Keller (2001) who looks at the dependence of total factor productivity (TFP) on R&D stocks (i.e. cumulated R&D expenditures), for 12 industries in the G-7 countries, 1971–95. The R&D stocks include both the own country stock, and foreign country stocks weighted by distance.[5] Both own and foreign country stocks are significant determinants of each countries' TFP and so too is the distance effect, with R&D stocks in distant economies having much weaker effects on TFP than do R&D stocks in closer economies. The final column in table 1 illustrates his results by computing the spillover effects of R&D in more distant economies relative to an economy 1000km away; the attenuation due to distance is once again dramatic.[6]

In addition, we also know that borders have a major effect in reducing economic interactions. Evidence from Canadian – US trade suggests that even that most innocuous of borders has a huge impact. On average, the exports of Canadian provinces to other Canadian provinces are some twenty times larger than their exports to equivalently situated US states (Helliwell 1997), and

5. Distance weighting according to $\exp(-\theta \text{ distance}_{ij})$)
6. To try and identify the channels through which technical knowledge is transmitted Keller investigates not just distance between countries, but also the volume of trade between them, their bilateral FDI holdings, and their language skills (the share of the population in country *i* that speaks the language of country *j*). Adding these variables renders simple geographical distance insignificant; around two-thirds of the difference in bilateral technology diffusion is accounted for by trade patterns, and one sixth each through FDI and language. However, all these variables are themselves declining with distance.

evidence from urban price movements suggests that the border imposes barriers to arbitrage comparable to 1,700 miles of physical space (Engel and Rogers 1996). Overall then, these facts tell us that geography still matters greatly for economic interaction.

The magnitude of shipping costs:
Underlying the rate of decline of these interactions are a variety of costs. The easiest to measure and observe are freight charges, although other costs of time in transit and information costs are quite possibly more important.

Shipping costs on short or heavily used routes are typically quite low. For the US freight expenditure incurred on imports was only 3.8% of the value of imports; equivalent numbers for, eg, Brazil and Paraguay are 7.3% and 13.3% (Hummels 1999a, from customs data). However, these values incorporate the fact that most trade is with countries that are close, and in goods that have relatively low transport costs. Looking at transport costs unweighted by trade volumes gives much higher numbers. Thus if we take all possible bilateral trade flows for which data is available (some 20,000 combinations of importer and exporter countries) the median cif/fob ratio is 1.28, implying transport and insurance costs amounting to 28% of the value of goods shipped. Looking across commodities, an unweighted average of freight rates is typically 2 to 3 times higher than the trade weighted average rate.

Determinants of shipping costs
Estimates of the determinants of transport costs are given in Hummels (1999b) and Limao and Venables (2001). These studies typically find elasticities of transport costs with respect to distance of between 0.2 and 0.3, meaning that a doubling of the distance over which goods are shipped increases freight costs by around 20%. Sharing a common border substantially reduces transport costs and overland distance is around 7 times more expensive than sea distance.

In addition to the effects of distance and mode of transport, shipping costs are highly route specific, reflecting densities of traffic flow and monopoly power. For example, the cost of shipping a standard container from Baltimore to Durban is $2,500; shipping the 1,600km further to Lusaka costs an additional $2,500, while the 347Km from Durban to Maseru (Lesotho) costs an additional $7,500. (Quotes from the shipping company used by the World Bank, cited in Limao and Venables 2001). Fink, Mattoo and Neagu (2000) study the impact of anti-competitive practises in the shipping industry, and estimate that these raise prices by more than 25%: the break-up of private carrier agreements would, they estimate, save transport costs of $2billion pa on imports to the US alone.

Landlocked countries:
Landlocked countries face severe cost penalties. Research by Limao and Venables (2001) indicates that a representative landlocked country has transport costs approximately 50% greater than does a representative coastal economy. Infrastructure quality (as measured by a composite of index of transport and communications networks) is also important. While this matters for all countries, it is particularly important for landlocked countries, dependent on both their own and their transit countries' infrastructure. Bad infrastructure (at the 75th percentile of the distribution) makes landlocked countries' transport costs a full 75% higher than those a representative coastal economy.

These higher transport costs have a large impact on trade flows. The median landlocked economy (controlling for other factors) has trade flows 60% lower than the median coastal economy. If, in addition, there is poor own infrastructure and transit country infrastructure, then trade is 75% lower than for the median coastal economy.

The costs of time in transit:
Direct shipping costs are only part of the costs of distance. Also important are costs of search, i.e. finding and identifying trading partners and coordinating trades. Time in transit is important, and perhaps increasingly important as firms seek to apply 'just-in-time' management methods. Recent work by Hummels (2000) provides interesting evidence on the magnitude of time costs. He analyses data on some 25 million observations of shipments into the US, some by air and some by sea (imports classified at the 10-digit commodity level, by exporter country, and by district of entry to the US for 25 years). Given data on the costs of each mode and the shipping times from different countries he is able to estimate the implicit value of time saved by using air transport. The numbers are quite large. The cost of an extra day's travel is (from estimates on imports as a whole) around 0.3% of the value shipped. For manufacturing sectors, the number goes up to 0.5%, costs that are around 30 times larger than the interest charge on the value of the goods. One implication of these is that freight costs alone (and the cif/fob ratio) grossly understate the costs of distance. Another is that transport costs have fallen much more through time than suggested by looking at freight charges alone. The share of US imports going by air freight rose from zero to 30% between 1950 to 1998, and containerization approximately doubled the speed of ocean shipping. Together these give a reduction in shipping time of 26 days, equivalent to a shipping cost reduction worth 12–13% of the value of goods traded.

Remoteness and real income

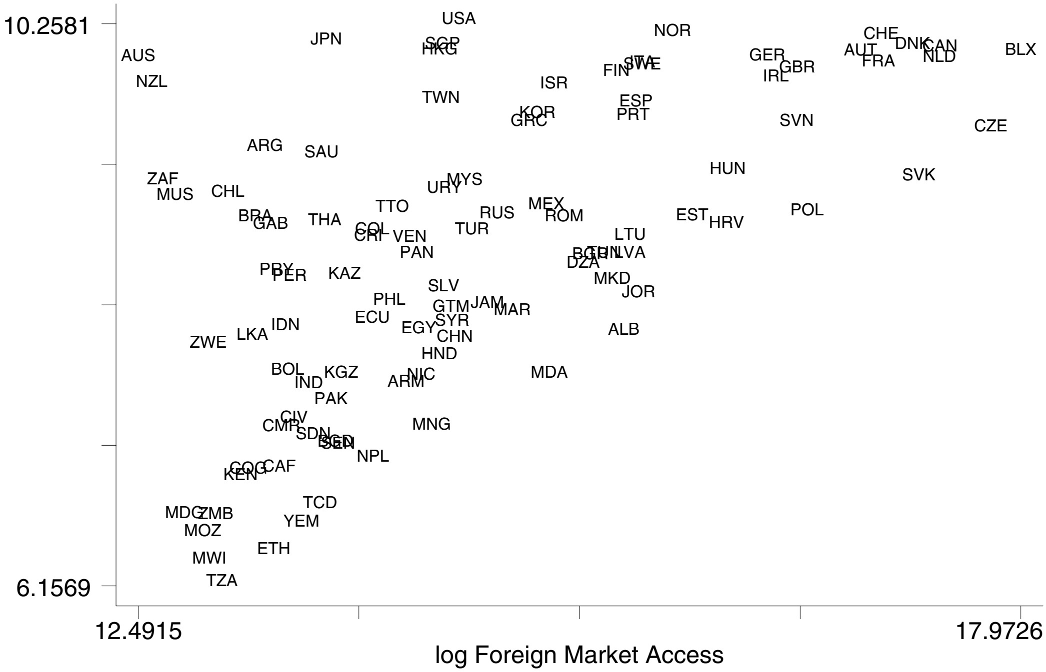
The previous section made the point that distance matters greatly for economic interactions. How does this feed into the distribution of income across countries? A number of mechanisms might be at work, including the effects of investment flows and technology transfers. Here, to illustrate effects, we concentrate just on the way in which trade flows can generate international income gradients between central and peripheral countries.

The effect of distance on factor prices is easily seen through a simple example. Suppose that half of a firm's costs are intermediate goods, and one third labour, the remaining being returns to capital. How does the wage that a firm can afford to pay (while just breaking even) depend on the costs it has to bear on shipping its output to final consumers and importing its intermediate inputs? It turns out that a firm that faces 20% transport costs can only afford to pay labour approximately 20% as much as can a firm that faces zero transport costs. As transport costs rise to 30% the wage the firm can afford to pay drops to 10%, and at 40% transport costs the firm can survive only if it pays its workers nothing. These numbers are based on an example where the cost of capital is the same in the remote country as in the centre. If this cost is higher, then wages in remote countries are depressed even further.

The point of this example is that in remote locations value added gets squeezed in two ways – the firm receives less for its output *and* pays more for imported equipment and intermediate goods. This means that even quite modest transport costs can have quite a dramatic effect on the wage that firms can afford to pay, and suggests that there will be quite steep 'wage gradients' from central to peripheral locations.

Redding and Venables (2001) measure these wage gradients for a sample of 101 coun-

Figure 1.
GDP per capita and FMA

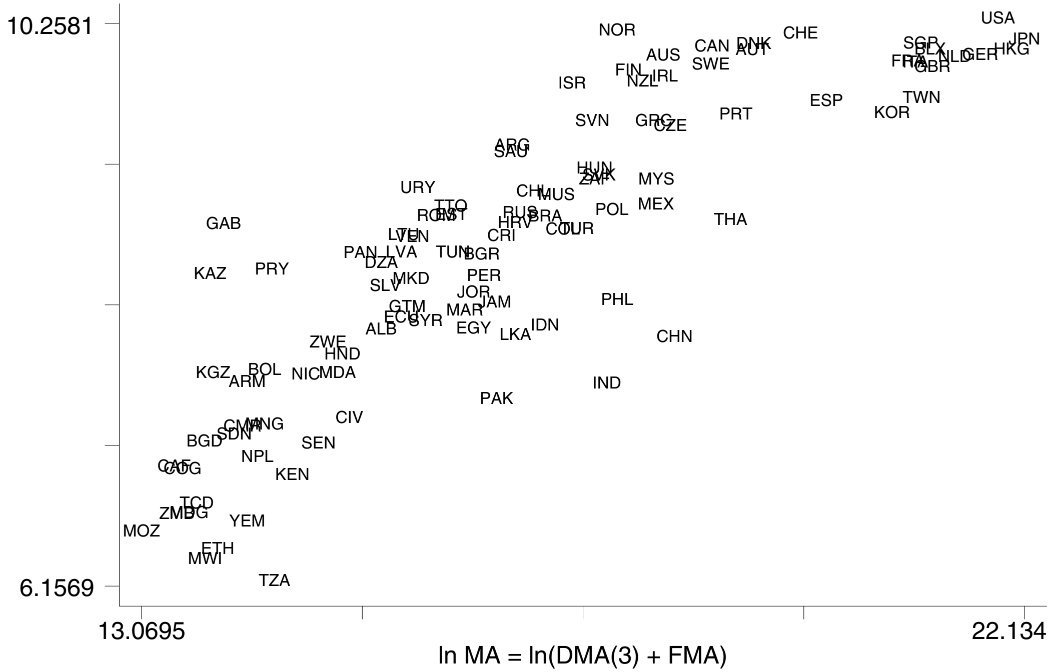


tries.[7] Trade data are used to calculate economically correct measures of 'foreign market access' (FMA). This, like a measure of market potential, aggregates expenditure in different countries, with weights inversely proportional to distance and also depending on whether countries share a common border, are islands or are landlocked.[8] Thus, countries close to large foreign export markets have a high value FMA, while remote countries have low values of this measure.

Figure 1 presents the scatterplot of the relationship between this variable and per capita income (both measured in logs, country codes given in the appendix), illustrating a strong positive relationship between the variables. For example, looking just within Europe, there is evidence of a wage gradient from Belgium/Luxembourg (countries with the best foreign market access) through France, Britain, to Spain, Portugal and Greece. Several other points stand out. One is that a number

7. Wage gradients can be estimated within as well as between countries. Thus for the United States, Hanson (1998) provides evidence that variation in wages across counties is linked to differential access to markets, even after controlling for a variety of other considerations such as levels of human capital and amenities. For Mexico, Hanson (1996, 1997) finds a regional wage gradient centred on Mexico City prior to trade liberalization and the partial breakdown of this regional wage gradient after liberalization as production re-orientated towards the United States
8. The relative importance of these factors is found from econometric estimation of some specifications of a gravity model, see Redding and Venables (2001) for details.

Figure 2.
GDP per capita and MA = DMA(3) + FMA

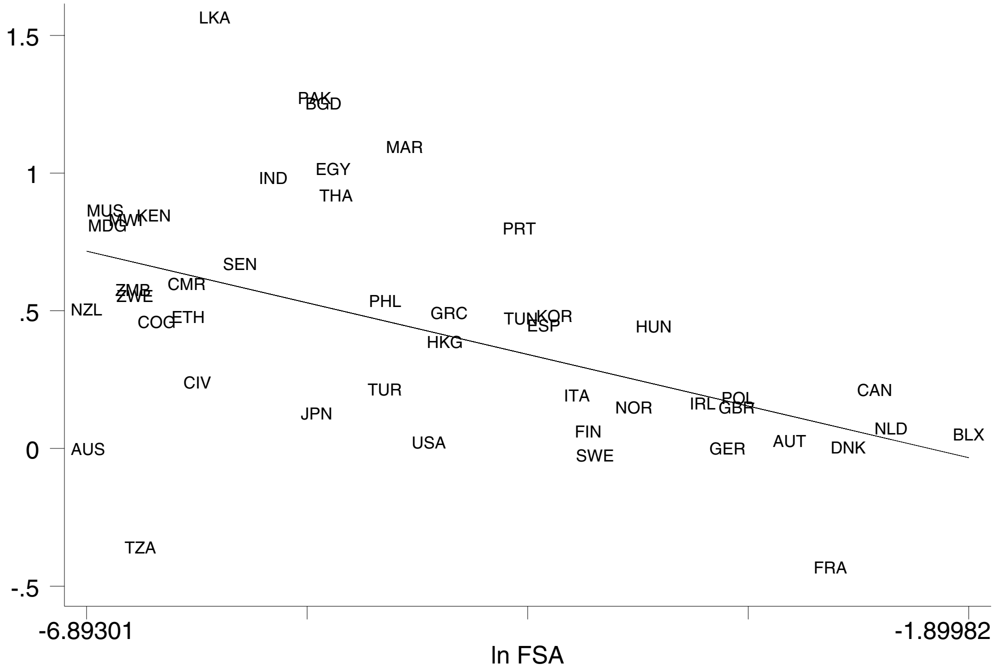


of countries are able to escape the consequence of remoteness from export markets – eg Australia, New Zealand, Japan, USA. However, looking at the bottom right-hand area of the figure, good foreign market access provides a safety net against very low incomes – despite the relatively poor performance of former communist countries.

As noted in the introduction, market access is derived both from proximity to export markets, and from access to a large domestic market. Both proximity and scale matter. The scale effect was absent from figure 1, but is included in figure 2, where the horizontal axis is the sum of foreign market access (FMA) and 'domestic market access' (DMA) a measure of domestic market size adjusted for the area of the country. Combining these effects provides very strong evidence of a wage gradient, indicating the importance of both proximity and scale in determining income levels.

Figures 1 and 2 just give market access (the penalty of being remote from markets) but in addition 'supplier access' matters. One of the mechanisms by which geographical remoteness depresses wages is the high price of imported equipment and intermediate goods in remote locations. Figure 3 presents some direct empirical evidence on the relationship between access to sources of supply and the relative price of these goods. The horizontal axis gives the proper measure of access to foreign suppliers of manufactures (FSA), again derived from trade data, and the vertical axis gives the relative price of machinery and equipment in countries for which data is available. We see a statistically significant negative

Figure 3.
Relative Price of Machinery & Equipment and FSA



relationship, confirming that remote countries have to pay higher prices for these goods, this contributing to the squeeze on the wages that firms in these countries can afford to pay.

Quantifying the effects:
Per capita incomes depend on additional factors, as well as market and supplier access, and Redding and Venables undertake econometric analysis incorporating a set of other variables. These include measures of endowments and of the quality of institutions, which are important determinants of per capita income levels. However, the geographical variables remain highly significant determinants of per capita income levels even once these further variables have been added in.

One way of illustrating the quantitative importance of geography is to undertake a set of hypothetical experiments of the form: suppose we move country 1 to the location of country 2 then, holding other things equal, what would happen to country 1's income? Tables 2 and 3 report the results of a few experiments of this type. Being landlocked and being an island both have a negative effect on real income, and the first column indicates that the penalty from being landlocked is substantial – removing it would raise income by one-quarter.[9] The cost of island status is smaller, costing around 7% of GDP (column 2). Column (3) reports a trade policy experiment: changing countries' trade openness (as measured by the Sachs-Warner (1995) open-

9. The model specification means that the same proportional effect is experienced by all countries.

Table 2.
Percentage change in real income from openess

	Variable			
Country	(1) Access to Coast	(2) Loss of Island Status	(3) Become Open	(4) Distance (Central Europe)
Australia		7.3%		
Sri Lanka		7.3%	20.7%	67.4%
Zimbabwe	24.0%		27.7%	
Paraguay	24.0%		25.3%	79.7%
Hungary	24.0%		26.5%	58.3%

Notes: Actual values for the Sachs and Warner (1995) openness index are 1 in Australia, 0.2321 in Sri Lanka, 0.038 in Hungary, 0.077 in Paraguay, and 0 in Zimbabwe.
Source: Redding and Venables (2000).

ness index) from the 1994 value to the most open possible. This too yields extremely large income gains, of around 25% for countries that were, in 1994, quite economically closed.

Column (4) reports the experiment of moving a country from its present location to that of Hungary, on the edge of the EU. The dramatic increase in FMA brought about by this change means that, for some of the most remote economies in the sample, income increases by nearly 80%.

Common borders are also important for facilitating trade and improving market access, and table 3 quantifies their importance by the hypothetical experiments of closing borders. The effects reported show that smaller countries gain very substantially from access to a large neighbour, as illustrated for Mexico and the Czech Republic. However, two small neighbours, the two African economies, neither of which have large markets nor supplies of manufactures to offer,

Table 3.
Percentage change in real income from border effects

Removal of Common Border	Effect on Per Capita Income	
Germany - Czech Republic	Germany - 0.1%	Czech Republic - 25.7%
U.S. - Mexico	U.S. - 0.5%	Mexico - 27.2%
Zimbabwe-Zambia	Zimbabwe - 0.05%	Zambia - 0.11%

Source: Redding and Venables (2000).

only experience extremely small border effects. An implication of this is that South-South regional integration schemes yield very limited benefits compared to fuller integration into the world economy as a whole.

New technologies: the death of distance?

Technical progress has lead to substantial reductions in trade costs in the last 40 years. Shipping rates and airfreight rates have both fallen, although the decline in these rates ended in the 1960s and 1980s respectively. We have already commented on the cost reductions associated with the speeding up of shipping.

In addition to these changes the development of information and communications technologies (ICT) has made the transmission of digital information virtually free. These technologies bring great benefits to isolated and distant economies, allowing faster and cheaper exchange of information and ideas. However, it is not clear that they overturn all the economic disadvantages of isolation or lead to the 'death of distance' as suggested by some authors (Cairncross 2001). In this section we offer a few remarks about the likely implications of these new technologies for isolated and distant economies.

Weightless inputs and outputs

In some activities inputs and outputs can be digitized – made 'weightless' – and shipped virtually free of charge. These activities can be relocated to lower wage economies, as recent experience indicates. The highly successful Indian software and IT-enabled services sectors had output in 2000 of $8bill with exports of $4bill. IT enabled services – call centres ('customer interaction centres'), medical transcriptions, finance and accounting services – had exports to the US of $0.26bill, predicted to grow to $4bill by 2005 (Economist May 5th 2001). These are substantial size activities, compared to total Indian exports of $45bill in 2000, but are less than 1% of total US imports of around $950billion.[10]

Development of these activities may prove extremely valuable to isolated and distant economies, although a couple of provisos need to be made. First, as activities are codified and digitized, so not only can they be moved costlessly through space, but also they are typically subject to very large productivity increases and price reductions. Thus, the effect of ICT on, say, airline ticketing, has been primarily to replace labour by computer equipment, and only secondarily to allow remaining workers to be employed in India rather than the US or Europe. There is continuing technical progress in these activities so, for example, technology that can capture voice or handwriting will soon make Indian medical transcription obsolete. This suggests that even if more activities become weightless the share of world expenditure and employment attributable to these activities will remain small – perhaps as little as a few percent of world GDP.

The second point is that small economies will face intense competition in attracting these activities, as the experience of India already suggests. There is a sense in which 'weightless' activities are the natural comparative advantage of remote economies since these economies have a comparative disadvantage in transport intensive goods, (Venables and Limao 2002). However, success will require both the telecommunications infrastructure and the skill base to attract investments.

10. For further discussion of the concept of weightlessness and the implications of new information and communication technologies for economic growth, see Quah (1997), (2001).

ICT and the costs of remote management

Recent years have seen the growth of both outsourcing and foreign direct investment (FDI), with the associated development of production networks or production chains. FDI has grown faster than either income or trade. The growth of production networks has been studied by a number of researchers. One way to measure its growth is by looking at trade in components, and Yeats (1998) estimates that 30% of world trade in manufactures is now trade in components rather than final products. Hummels, Ishii and Yi (2001) chart trade flows that cross borders multiple times, as when a country imports a component and then re-exports it embodied in some downstream product. They find that (for 10 OECD countries), the share of imported value added in exports rose by one third between 1970 and 1990, reaching 21% of export value.

Both FDI and outsourcing involve, in somewhat different ways, a fragmentation of the structure of the firm, as production is split into geographically and/or organisationally differerent units. From the international perspective this fragmentation offers the benefits of being able to move particular stages of the production process to the lowest cost locations – labour intensive parts to low wage economies, and so on. However, as well as involving potentially costly shipping of parts and components it also creates formidable management challenges. Product specification and other information has to be transferred, and production schedules and quality standards have to be monitored. Do new technologies reduce the costs of doing this?

To the extent that pertinent information is 'codifiable' the answer is likely to be yes. The use of ICT for business-to-business trade is well documented, although it is reported to often reduce the number of suppliers a firm uses, rather than increase the number. In mass production of standardized products designs can be relatively easily codified; where the production process is routine, daily or hourly production runs can be reported and quality data can be monitored.

However, in many activities the pertinent information cannot be codified so easily. There are two sorts of reasons for this. One is the inherent complexity of the activity. For example, frequent design changes and a process of ongoing product design and improvement (involving both marketing and production engineering) may require a level of interaction that – at present – can only be achieved by face-to-face contact. The second reason is to do with the fact that contracts are incomplete, and people on either side of the contract (or in different positions within a single firm) have their own objectives. It is typically expensive or impossible to ensure that their incentives can be shaped to be compatible with meeting the objectives of the firm. While new technologies may reduce the costs of monitoring, it seems unlikely that these problems of incomplete contracts are amenable to a technological fix.

What evidence is there? On the one hand, there is the fact that in recent years there has been a dramatic increase in the outsourcing of activities to specialist suppliers, suggesting that difficulties in writing contracts and monitoring performance have been reduced. On the other hand, a number of empirical studies point to the continuing importance, despite new technologies, of regular face-to-face contact. Thus, Gaspar and Glaeser (1998) argue that telephones are likely to be complements, not substitutes, for face-to-face contact as they increase the overall amount of business interaction. They suggest that, as a consequence, telephones have historically promoted the development of cities. The evidence on business travel suggests that as electronic communications have increased so too has travel, again indicating the importance of face-to-face contact. Leamer and Storper (2000) draw the distinction between 'conversational' transactions (that can be done at a distance by ICT) and 'handshake' transactions that require face-to-face contact. New technologies allow dispersion of activities that only require 'conversational' transactions, but might also increase the complexity of production and design process, and hence increase the proportion of activities that require 'handshake' communication.

Overall then, it seems that there are some relatively straightforward activities where knowledge can be codified, new technologies will make management from a distance easier, and relocation of the activity to lower wage regions might be expected. But monitoring, control, and information exchange in more complex activities still requires a degree of contact that involves proximity and face-to-face meetings. Perhaps nowhere is this more evident than in design and development of the new technologies themselves.

The speeding up of production:

New technologies provide radical opportunities for speeding up parts of the overall supply process. There are several ways this can occur. One is simply that basic information – product specifications, orders and invoices – can be transmitted and processed more rapidly. Another is that information about uncertain aspects of the supply process can be discovered and transmitted sooner. For example, retailers' electronic stock control can provide manufacturers with real time information about sales and hence about changes in fashion and overall expenditure levels. For intermediate goods, improved stock controls and lean production techniques allow manufacturers to detect and identify defects in supplies more rapidly. These changes pose the interesting question: if some elements of the supply process become quicker, what does this do to the marginal value of time saved (or marginal cost of delay) in other parts of the process? In particular, if one part of the process that takes time is the physical shipment of goods, then will time saving technical changes encourage firms to move production closer to markets, or allow them to move further away?

There are some reasons to think that the effect might encourage firms to move production closer to markets. The new opportunities created for rapid response can be exploited only if all stages of production are fast. The highly successful Spanish clothing chain, Zara (Economist, May 19th 2001) provides an example. It uses real time sales data, can make a new product line in three weeks (compared to the industry average of nine months) and only commits 15% of production at the start of the season (industry average 60%). It also does almost all its manufacturing (starting with basic fabric dyeing through the full manufacturing process) in house in Spain, with most of the sewing done by 400 local cooperatives (compared to the extensive outsourcing of other firms in the industry).[11]

Just-in-time production techniques provide a further example. New technologies have allowed much improved stock control and ordering, and a consequent movement of suppliers towards their customers. In a study of the location of suppliers to the US automobile industry Klier (1999) finds that 70–80% of suppliers are located within one days drive of the assembly plant, although even closer location is limited by the fact that

11. For a formal analysis of the idea that new technologies may encourage firms to move production closer to markets, see Evans and Harrigan (2001).

many suppliers serve several assembly plants. He also finds evidence that the concentration of supplier plants around assembly plants has increased since 1980, a timing that he points out is consistent with the introduction of just-in-time production methods. The leader in the application of just-in-time techniques is Toyota, whose independent suppliers are on average only 59 miles away from its assembly plants, to which they make eight deliveries a day. By contrast, General Motor's suppliers in North America are an average of 427 miles away from the plants they serve and make fewer than two deliveries a day. As a result, Toyota and its suppliers maintain inventories that are one-fourth of General Motor's, when measured as a percentage of sales (Fortune, Dec 8th 1997).

These examples suggest that, at least in some activities, remote economies may become more marginalised as a consequence of new technologies.

Clustering still matters:
Arguments above suggest that new technologies will facilitate the relocation of some activities to lower wage locations. Other activities may become increasingly locked in to established centres. However, for activities that can relocate clustering is likely to be important. Foreign direct investment projects will tend to go to locations where investors can see that other investors are doing well. Firms will want to move to locations where there is a deep pool of skilled labour and a network of local suppliers. These factors may militate against relocation of these activities to small countries.

Overall then, while it is clear that new technologies will bring many benefits, allowing isolated and remote countries closer contact with the outside world, the 'death of distance' view is misplaced. It is far from clear that new technologies will provide a straightforward development strategy for these countries.

Conclusions

Th review of research in this paper is partial in its coverage. For example, we have not discussed the implications of smallness for export concentration and for vulnerability, but instead concentrated on the costs of isolation and distance. These factors choke off economic interactions, mean that potential investors can only pay low wages, and reduce real income. New technologies bring benefits, but need further study. Some activities will become more entrenched in existing centres, others will relocate, and the relocation will likely lead to the formation of new clusters.

What are the policy implications of the preceding analysis? We offer just a few points. The first is that infrastructure improvements are important. Changes that reduce isolation will affect prices in the economy, having non-marginal effects that need to properly evaluated by social cost benefit analysis. These changes do not necessarily require physical investments. Our discussion of the costs of time in transit point to the importance of port, customs and other frontier delays in deterring investments. The example of Intel's investment in Costa Rica is instructive: Intel went ahead with a $300million chip facility only after the government of Costa Rica had guaranteed rapid customs clearance of imports, free of bureaucratic and administrative blockages. Similarly, the discussion of shipping costs pointed to the barriers created by ocean shipping cartels. Competition policy at the international level is needed to break up these cartels.

Second, development strategies need to look carefully at what the comparative advantage of small, distant, and isolated economies really is. Traditional analysis points almost exclusively at factor endowments and factor prices, but additional factors need to be taken into account. In addition to looking to their factor endowments and the factor intensity of industries, remote economies should look to 'transport intensity' of industries. Small economies should look to the importance of scale in different sectors, and not just scale within the individual firm, but scale defined to include the size of viable clusters of firms and pools of skilled labour.

Finally, while geography matters, so too do many other factors, including trade policy, institutions and factor endowments. Restrictive trade policy has the effect, like distance, of making a country more economically remote from the rest of the world. Spatial analysis suggests that clustering is important for many activities, indicating that small initial advantages can translate into large differences in outcomes, as 'cumulative causation' drives the growth of the cluster. This highlights the importance of good initial conditions in the business environment.

Appendix

Table A1: Countries in figures 1 and 2.

1. Albania (ALB)	28. Estonia (EST)	55. Morocco (MAR)	82. Singapore (SGP)
2. Argentina (ARG)	29. Ethiopia (ETH)	56. Moldova (MDA)	83. El Salvador (SLV)
3. Armenia (ARM)	30. Finland (FIN)	57. Madagasc. (MDG)	84. Slovak Rep. (SVK)
4. Australia (AUS)	31. France (FRA)	58. Mexico (MEX)	85. Slovenia (SVN)
5. Austria (AUT)	32. Gabon (GAB)	59. Macedonia (MKD)	86. Sweden (SWE)
6. Bangladesh (BGD)	33. UK (GBR)	60. Mongolia (MNG)	87. Syria (SYR)
7. Bulgaria (BGR)	34. Greece (GRC)	61. Mozambiq. (MOZ)	88. Chad (TCD)
8. Belg./Lux (BLX)	35. Guatemala (GTM)	62. Mauritius (MUS)	89. Thailand (THA)
9. Bolivia (BOL)	36. Hong Kon (HKG)	63. Malawi (MWI)	90. Trinidad/T. (TTO)
10. Brazil (BRA)	37. Honduras (HND)	64. Malaysia (MYS)	91. Tunisia (TUN)
11. C Afr. Rp. (CAF)	38. Croatia (HRV)	65. Nicaragua (NIC)	92. Turkey (TUR)
12. Canada (CAN)	39. Hungary (HUN)	66. Netherlands (NLD)	93. Taiwan (TWN)
13. Switzerl. (CHE),	40. Indonesia (IDN)	67. Norway (NOR)	94. Tanzania (TZA)
14. Chile (CHL)	41. India (IND)	68. Nepal (NPL)	95.Uruguay (URY)
15. China (CHN)	42. Ireland (IRL)	69. New Zeal. (NZL)	96. USA (USA)
16. Cote d'Ivoire (CIV)	43. Israel (ISR)	70. Pakistan (PAK)	97. Venezuela (VEN)
17. Cameroon (CMR)	44. Italy (ITA)	71. Panama (PAN)	98. Yemen (YEM)
18. Congo Rep. (COG)	45. Jamaica (JAM)	72. Peru (PER)	99. South Afr. (ZAF)
19. Colombia (COL)	46. Jordan (JOR)	73. Philippines (PHL)	100. Zambia (ZMB)
20. Costa Rica (CRI)	47. Japan (JPN)	74.Poland (POL)	101. Zimbabwe (ZWE)
21. Czech Rep. (CZE)	48. Kazakhstan (KAZ)	75. Portugal (PRT)	
22. Germany (DEU)	49. Kenya (KEN)	76. Paraguay (PRY)	
23. Denmark (DNK)	50. Kyrgyz Rp. (KGZ)	77. Romania (ROM)	
24. Algeria (DZA)	51. Korea, Rp. (KOR)	78. Russia (RUS)	
25. Ecuador (ECU)	52. Sri Lanka (LKA)	79. Saudi Arab. (SAU)	
26. Egypt (EGY)	53. Lithuania (LTU)	80. Sudan (SDN)	
27. Spain (ESP)	54. Latvia (LVA)	81. Senegal (SEN)	

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