

A Primer on the Knowledge Economy

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Foreword

This primer is intended as a brief guide to the Knowledge Economy for people in business and government who need a succinct summary of its major features and implications.

It has been prepared by Professors John Houghton and Peter Sheehan of Victoria University's Centre for Strategic Economic Research (CSES), who have drawn on research undertaken at CSES over the last few years, on the work of the OECD and on a rapidly growing international literature. It aims to provide a synthesis of this body of work in digestible form.

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February 2000

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The Knowledge Economy

[We] are living through a period of profound change and transformation of the shape of society and its underlying economic base ... The nature of production, trade, employment and work in the coming decades will be very different from what it is today.¹



In an agricultural economy land is the key resource. In an industrial economy natural resources, such as coal and iron ore, and labour are the main resources. A knowledge economy is one in which knowledge is the key resource.

... one in which the generation and the exploitation of knowledge has come to play the predominant part in the creation of wealth. It is not simply about pushing back the frontiers of knowledge; it is also about the more effective use and exploitation of all types of knowledge in all manner of economic activity.²

It is not a new idea that knowledge plays an important role in the economy, nor is it a new fact. All economies, however simple, are based on knowledge about how, for example, to farm, to mine and to build; and this use of knowledge has been increasing since the Industrial Revolution. But the degree of incorporation of knowledge and information into economic activity is now so great that it is inducing quite profound structural and qualitative changes in the operation of the economy and transforming the basis of competitive advantage.

The rising knowledge intensity of the world economy and our increasing ability to distribute that knowledge have increased its value to all participants in the economic system. The implications of this are profound, not only for the strategies of firms and for the policies of government but also for the institutions and systems used to regulate economic behaviour.

This primer is intended as a brief guide to the Knowledge Economy for people in business and government who need a succinct summary of its major features and implications. It draws on research undertaken at CSES over the last few years, on the work of the OECD and on a rapidly growing international literature, and aims to provide a synthesis. We address the following questions:

- What is the knowledge economy?
- What is new about the ‘New Economy’?
- What does it mean for Australia?
- What might we do to meet the challenge?

What is the Knowledge Economy ?

*Capitalism is undergoing an epochal transformation from a mass production system where the principal source of value was human labour to a new era of 'innovation-mediated production' where the principal component of value creation, productivity and economic growth is knowledge.*³



The Knowledge Economy is emerging from two defining forces: the rise in *knowledge intensity* of economic activities, and the increasing *globalisation* of economic affairs.

The rise in knowledge intensity is being driven by the combined forces of the information technology revolution and the increasing pace of technological change. Globalisation is being driven by national and international deregulation, and by the IT related communications revolution. However, it is important to note that the term 'Knowledge Economy' refers to the overall economic structure that is emerging, not to any one, or combination of these phenomena.⁴

Increasing knowledge intensity

The last twenty years have seen an explosion in the application of computing and communications technologies in all areas of business and community life. This explosion has been driven by sharp falls in the cost of computing and communications per unit of performance, and by the rapid development of applications relevant to the needs of users. Digitalisation, open systems standards, and the development software and supporting technologies for the application of new computing and communications systems – including scanning and imaging technologies, memory and storage technologies, display systems and copying technologies – are now helping users realise the potential of the IT revolution.

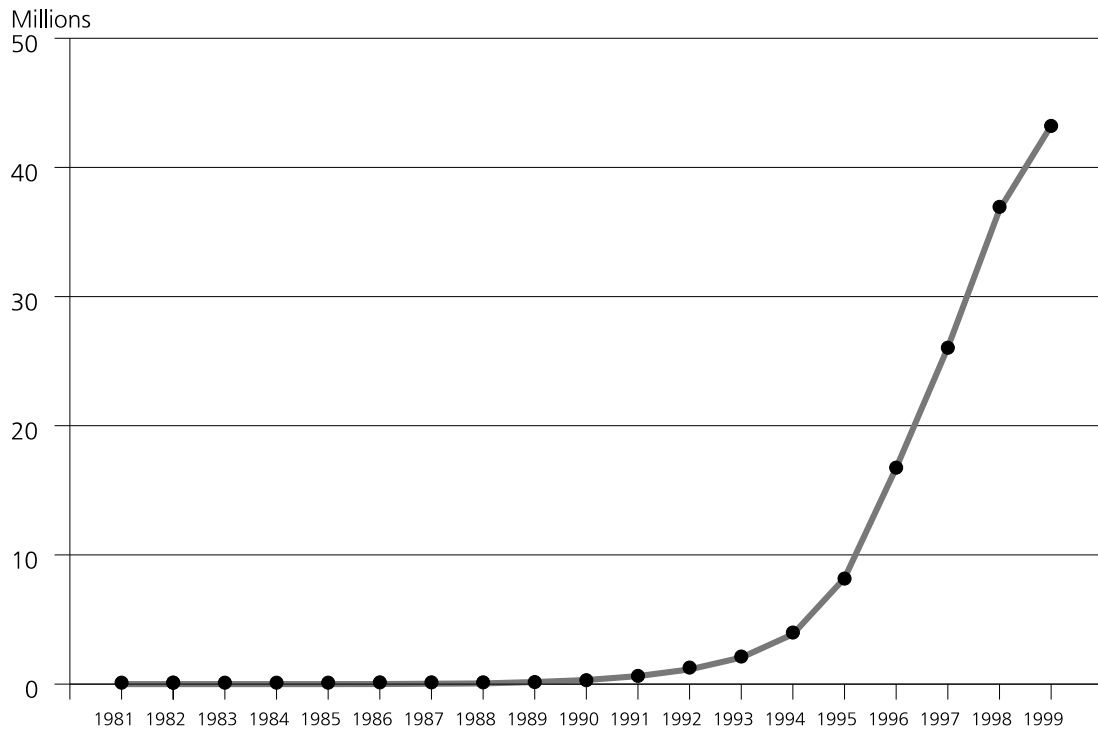
It is in the Internet that these technologies come together, and it is the Internet phenomenon that exemplifies the IT revolution. Over the first decade of its development the Internet remained a specialist research network. By 1989 there were 159,000 Internet hosts worldwide. Now, just 10 years later, there are more than 43 million (Figure 1).

In economic terms, the central feature of the IT revolution is the ability to manipulate, store and transmit large quantities of information at very low cost. An equally important feature of these technologies is their pervasiveness. While most earlier episodes of technical change have centred on particular products or industrial sectors, information technology is generic. It impacts on every element of the economy, on both goods and services; and on every element of the business chain, from research and development to production, marketing and distribution.

Because the marginal cost of manipulating, storing and transmitting information is virtually zero, the application of knowledge to all aspects of the economy is being greatly facilitated, and the knowledge intensity of economic activities greatly increased.

This increasing knowledge intensity involves both the increasing knowledge intensity of individual goods and services, *and* the growing importance of those goods and services in the economy.

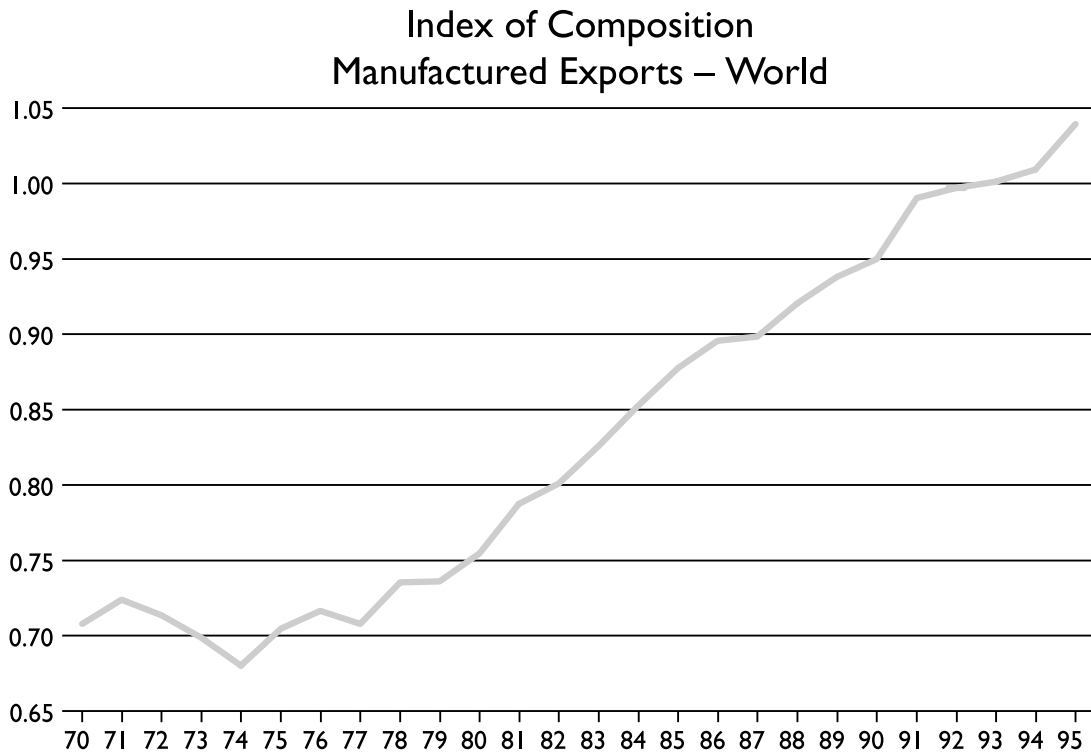
Figure 1: Estimated Number of Internet Hosts, 1981-1999



Source: Network Wizards (<http://www.nw.com>).

Trade data is one area in which these changes can be observed. In both goods and services trade it is the relatively knowledge intensive exports that are growing most rapidly. World exports of high technology products grew by 15 per cent per annum between 1985 and 1995, compared to less than 10 per cent for all other goods. The knowledge intensity of world manufactured exports remained largely unchanged between 1970 and 1977, but since 1977 it has increased steadily and persistently – from an index value of 0.71 in 1977 to 1.04 in 1995 (Figure 2).⁵ United States exports of database and other information services (26.7% pa), engineering, architectural, construction and mining services (16.7% pa), and computer and data processing services (12.6% pa) have all exhibited much higher growth than have exports of other services, manufactures or commodities exports.

Figure 2: Knowledge intensity of manufactured exports, 1970-95



Note: Index of knowledge composition for a country's exports is defined by weighting industry's share of total manufacturing by the average OECD R&D/Production ratio for industry *j* for the period 1987-89, and dividing by the average R&D weight.
Source: Sheehan and Tikhomirova (1998, p. 43).

National economies are showing the benefits of these trends. In the United States the index of knowledge composition for wages is well above that for employment, and the gap between the two has increased since the early 1980s. This implies both higher wages per unit of employment in the more knowledge intensive industries over the period since 1972, and a more rapid growth in wages in knowledge intensive industries (Figure 3).

Globalisation

The other main driver of the emerging knowledge economy is the rapid globalisation of economic activities. While there have been other periods of relative openness in the world economy, the pace and extent of the current phase of globalisation is without precedent.⁶

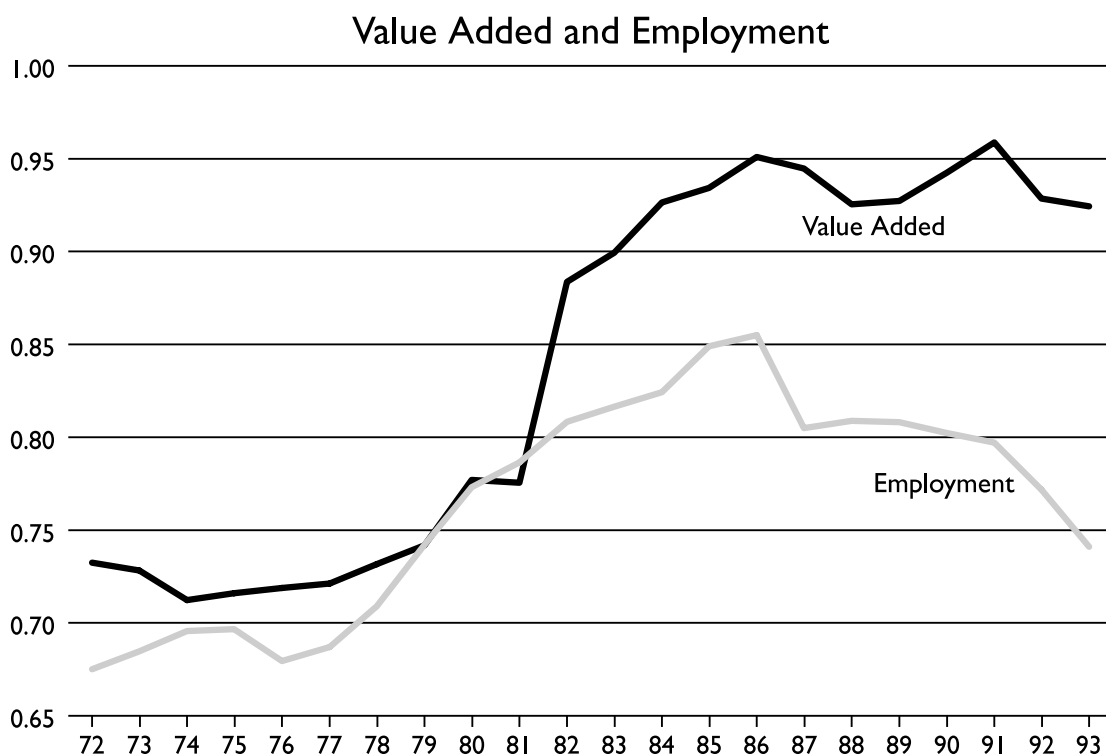
The global communications revolution has been accompanied by a widespread movement to economic deregulation, including:

- the reduction of tariff and non-tariff barriers on trade in both goods and services;

- the floating of currencies and deregulation of financial markets more generally;
- the reduction of barriers to foreign direct investment and other international capital flows, and of barriers to technology transfers; and
- the deregulation of product markets in many countries, particularly in terms of the reduction in the power of national monopolies in areas such as telecommunications, air transport and the finance and insurance industries.

Together these changes have led to rapid globalisation.

Figure 3: Knowledge intensity of value added and employment



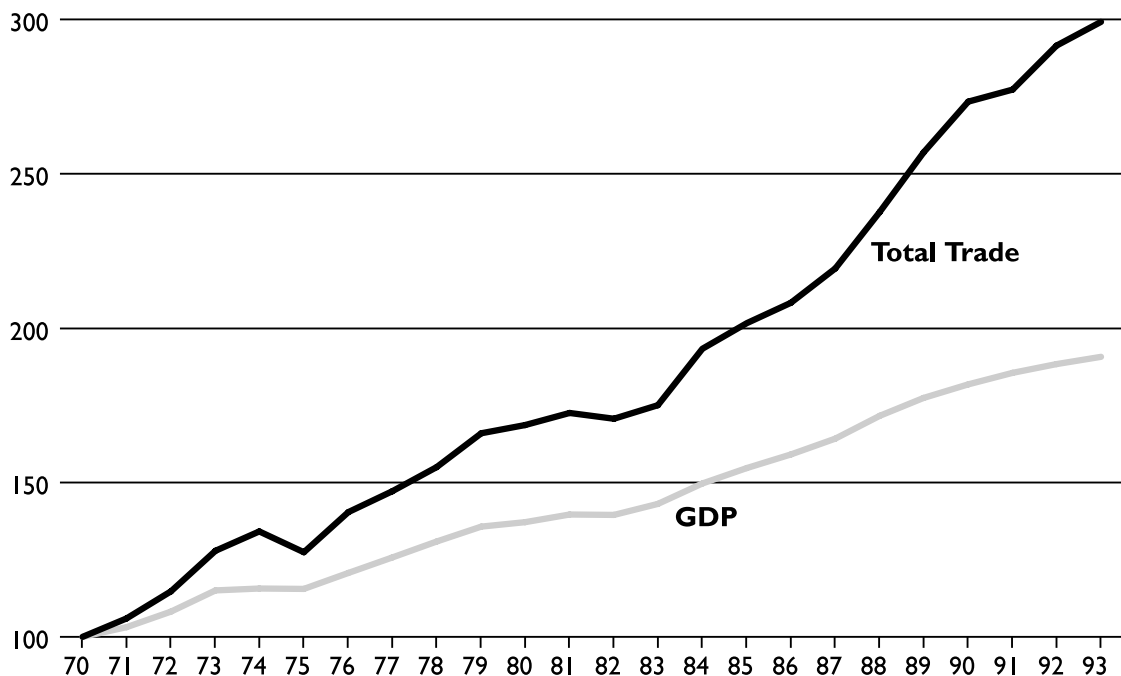
Source: Sheehan and Tikhomirova (1998, p. 48).

The recent phase of globalisation is characterised by rapid increases in the flows of foreign direct investment (FDI), capital transfers other than direct investment, trade flows of goods and services, and technology transfers. But two things stand out. First, FDI and other capital flows have grown more rapidly in recent years than have trade flows – suggesting that the current phase of globalisation is about capital movement rather than trade. Second, these flows of FDI, other capital, trade and technology are becoming increasingly inter-related.

Recent trade and capital flows reveal remarkably rapid globalisation. The volume of world merchandise trade increased by nearly 60 per cent as a proportion of the volume

of world GDP between 1970 and 1993, with about two thirds of the increase occurring after 1983 (Figure 4). More recently, financial flows, technology transfers, information flows and the interpenetration of business activities more generally have become increasingly significant factors.

Figure 4: Trends in the volume of world trade and GDP, 1970-93

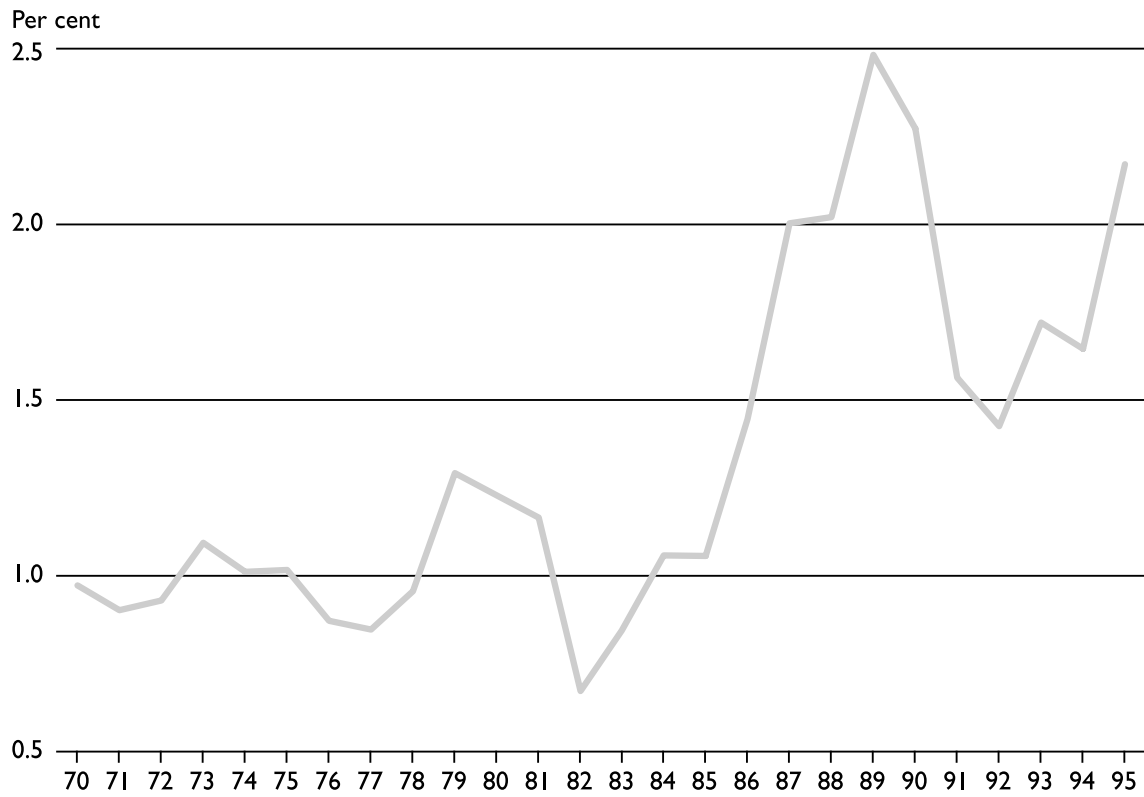


Source: Sheehan and Tikhomirova (1998, p. 55).

The rapid integration of world financial and capital markets since the early 1980s impacts on every element of the financial systems of developed countries, as well as on the systems of an increasing number of developing countries. Financial market integration has witnessed a sharp expansion in net long-term lending to developing countries, a rise of foreign direct investment, and in international bank lending and securities financing, together with the related explosion of derivatives.

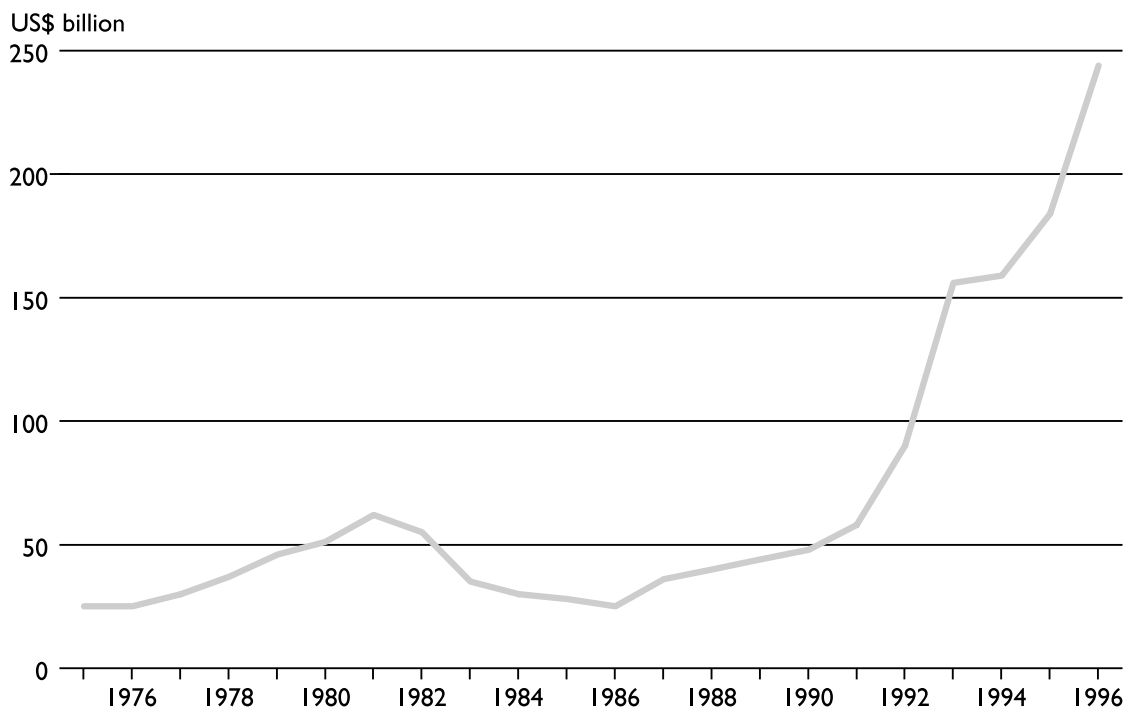
Total flows of FDI from the OECD countries remained broadly constant between 1970 and 1985. But between 1985 and 1990 OECD foreign direct investment flows increased fourfold in absolute terms and more than doubled as a share of GDP. Gross FDI flows from all countries to the USA amounted to US\$365 billion during the 1980s, a more than sixfold increase on the 1970s, and reached US\$210 billion in the first half of the 1990s (Figure 5).

Figure 5: Total FDI shares of GDP, 1970-95 (%)



Source: Sheehan and Tikhomirova (1998, p. 60).

Figure 6: Capital flows to developing countries, 1975-96



Source: Sheehan and Tikhomirova (1998, p. 58).

While capital flows between developed countries have increased greatly, one striking feature of the period from 1990 to 1996 was the sharp increase in the net flow of long-term private capital to developing countries. Between 1984 and 1987 inclusive, net private capital flows to developing countries amounted to less than US\$30 billion per annum. By 1996, they had increased almost tenfold to US\$265 billion. The ratio of net private capital inflow to fixed investment for developing countries in total rose from about 4 per cent in 1990 to about 20 per cent by 1996 (Figure 6).

These forces impact at the firm level, as firms are increasingly required to adopt global strategies to deal with the new realities. Global competition in all major markets between competitors from all major countries, the increasing multinational origin of the inputs to production of both goods and services, the growing intra-industry and indeed intra-product nature of world trade and the interdependent role of the various elements of globalisation are all contributing to a transformation of the global economy.

Box 1: Characteristics of globalisation

The main characteristics of globalisation since the 1980s can be summarised in terms of impacts relating to the emergence of a global system, global competition, the location, organisation and rationalisation of economic activity.

- As economic activity becomes globalised there is an increasing inter-dependence of international flows of goods and services (trade), direct investment, technology and capital transfers.
- No longer does industry face a domestic market protected from international competition.
- Competition is becoming increasingly global and the ability to compete head-to-head in all major markets is essential for success.
- Scale is becoming increasingly important in order to permit firms to roll-out into all major global markets quickly.
- Whether niche or global brand, rapid expansion into major markets now requires outward investment as well as exports.
- Global production is bringing a new global rationalisation of production, coordination, combination and accumulation of assets.
- The comparative advantage of locations increasingly relates to firms' objectives, and is relative to those objectives.
- The globalisation of production and sourcing is leading to increasing specialisation and the facture of chains of production ('filieres') across international boundaries.
- There is substantial national and regional structural adjustment.
- The organisation of economic activity is increasingly flexible, network oriented (including user-producer interactions) and built through clustering.
- The boundary between markets and hierarchies is shifting, the nature and form of integration (vertical and horizontal) is changing and new forms of 'functional integration' are emerging.
- Time is becoming increasingly important for competitiveness, a key aspect of value – essentially a new factor of production.

Box 2: Characteristics of the Knowledge Economy

The emergence of the knowledge economy can be characterised in terms of the increasing role of knowledge as a factor of production and its impact on skills, learning, organisation and innovation.

- There is an enormous increase in the codification of knowledge, which together with networks and the digitalisation of information, is leading to its increasing commodification.
- Increasing codification of knowledge is leading to a shift in the balance of the stock of knowledge – leading to a relative shortage of tacit knowledge.
- Codification is promoting a shift in the organisation and structure of production.
- Information and communication technologies increasingly favour the diffusion of information over re-invention, reducing the investment required for a given quantum of knowledge.
- The increasing rate of accumulation of knowledge stocks is positive for economic growth (raising the speed limit to growth). Knowledge is not necessarily exhausted in consumption.
- Codification is producing a convergence, bridging different areas of competence, reducing knowledge dispersion, and increasing the speed of turnover of the stock of knowledge.
- The innovation system and its ‘knowledge distribution power’ are critically important.
- The increased rate of codification and collection of information are leading to a shift in focus towards tacit (‘handling’) skills.
- Learning is increasingly central for both people and organisations.
- Learning involves both education and learning-by-doing, learning-by-using and learning-by-interacting.
- Learning organisations are increasingly networked organisations.
- Initiative, creativity, problem solving and openness to change are increasingly important skills.
- The transition to a knowledge-based system may make market failure systemic.
- A knowledge-based economy is so fundamentally different from the resource-based system of the last century that conventional economic understanding must be re-examined.

What's New about the New Economy ?

In the 21st century, comparative advantage will become much less a function of natural resource endowments and capital-labour ratios and much more a function of technology and skills. Mother nature and history will play a much smaller role, while human ingenuity will play a much bigger role.⁷



What makes the emergence of the knowledge economy important is that it is, in some significant respects, different from the industrial economy we have known for most of the last 200 years. Those differences include the following.

Information revolution

The IT revolution has intensified the move towards knowledge codification, and increased the share of codified knowledge in the knowledge stock of advanced economies. All knowledge that can be codified and reduced to information can now be transmitted around the world at relatively little cost. Hence, knowledge is acquiring more of the properties of a commodity. Market transactions are facilitated by codification, and the diffusion of knowledge is accelerated.

Codification is also reducing the importance of additional, duplicative investments in acquiring knowledge. It is creating bridges between fields and areas of competence and reducing the 'dispersion' of knowledge. These developments promise an acceleration of the rate of growth of stocks of accessible knowledge, with positive implications for economic growth.

Flexible organisation

Globalisation in the 1950s and 1960s was driven by the global spread and development of Taylorism,⁸ but it is post-Taylorist, flexible forms of organisation that drive and shape globalisation today. Flexible organisations reduce waste and increase the productivity of both labour and capital by integrating 'thinking' and 'doing' at all levels of their operations. In doing so they eliminate many layers of middle management, which are dysfunctional in terms of information flow. Flexible organisations also avoid excessive specialisation and compartmentalisation by defining multi-task job responsibilities (which calls for multi-skilled workers) and by using teamwork and job rotation.⁹

Flexible organisations merge flexibility, high product quality and a degree of customisation, with the speed and low unit costs of mass production. Taylorist producers attained higher levels of productivity than craft producers through *economies of scale* in the production of many standardised products, but flexible producers can attain higher productivity levels than Taylorist producers through *economies of scope* in the production of a diversity of more customised products or services, without sacrificing economies of scale. They do this by more fully utilising the human capabilities of their workers.¹⁰

Knowledge, skills and learning

Information and communication technologies have greatly reduced the cost and increased the capacity of organisations to codify knowledge, process and communicate information. In doing so they have radically altered the ‘balance’ between codified and tacit knowledge in the overall stock of knowledge. In essence, creating a shortage of tacit knowledge. As access to information becomes easier and less expensive, the skills and competencies relating to the selection and efficient use of information become more crucial, and tacit knowledge in the form of the skills needed to handle codified knowledge becomes more important than ever.

Information and communication technology investments are complementary with investment in human resources and skills.¹¹ The skills required of humans will increasingly be those that are complementary with information and communication technology; not those that are substitutes. Whereas machines replaced labour in the industrial era, information technology will be the locus of codified knowledge in the knowledge economy, and work in the knowledge economy will increasingly demand uniquely human (tacit) skills – such as conceptual and inter-personal management and communication skills.¹²

Innovation and knowledge networks

The knowledge economy increasingly relies on the diffusion and use of knowledge, as well as its creation. Hence the success of enterprises, and of national economies as a whole, will become more reliant upon their effectiveness in gathering, absorbing and utilising knowledge, as well as in its creation.

A knowledge economy is, in effect, a hierarchy of networks, driven by the acceleration of the rate of change and the rate of learning, where the opportunity and capability to get access to and join knowledge-intensive and learning-intensive relations determines the socio-economic position of individuals and firms.¹³ Firms must become learning organisations, continuously adapting management, organisation and skills to accommodate new technologies and grasp new opportunities. They will be increasingly joined in networks, where interactive learning involving *creators, producers and users* in experimentation and exchange of information drives innovation.

Learning organisations and innovation systems

In a knowledge economy, firms search for linkages to promote inter-firm interactive learning, and for outside partners and networks to provide complementary assets. These relationships help firms spread the costs and risks associated with innovation, gain access to new research results, acquire key technological components, and share assets in manufacturing, marketing and distribution. As they develop new products and processes, firms determine which activities they will undertake individually, which in collaboration with other firms, which in collaboration with universities or research institutions, and which with the support of government.¹⁴ Innovation is thus the result of numerous interactions between actors and institutions, which together form an innovation system.

Those innovation systems consist of the flows and relationships which exist among industry, government and academia in the development of science and technology. And the interactions within these systems influence the innovative performance of firms and ultimately of the economy. The 'knowledge distribution power' of the system, or its capability to ensure timely access by innovators to relevant stocks of knowledge, is therefore a major determinant of prosperity.¹⁵

Global competition and production

A consequence of deregulation and advances in communication technologies has been a strengthening of world competition, and the emergence of a new form of 'global competition'. Most firms with a dominant position no longer belong to just one leading country. They are multinational or transnational. To compete with their rivals successfully firms must now compete head-to-head in all markets (including their home market), and they must rapidly attain global scale in production and/or rapidly roll out products and services into multiple markets in order to do so. In this new environment, competitiveness depends increasingly on the coordination of, and synergy generated between, a broad range of specialised industrial, financial, technological, commercial, administrative and cultural skills which can be located anywhere around the world.¹⁶

Production is being rationalised globally, with firms combining the factors, features and skills of various locations in the process of competing in global markets. There are three major dimensions of change involved: increasing national (locational) specialisation; increased international 'fracturing' of value chains or chains of production – witnessed in increased intra-industry and intra-firm trade, and greater line-item by line-item trade imbalances; and substantial structural dislocation in local, regional and even national economies, and a consequent need for substantial structural adjustment.

Strategy and location

A number of things have happened since World War II to cause a fundamental re-think of the notion of comparative advantage. It has been shown that during the postwar years exports from the relatively capital rich, labour poor United States were actually more labour intensive than were the United States' import competing products. More recently, intra-industry trade has grown rapidly, as has trade between countries with similar factor endowments. It has, in fact, become increasingly obvious that observable patterns of trade and specialisation do not always fit with the law of comparative advantage. Traditional explanations of international trade and the location of production no longer hold.

Moreover, globalisation is a fundamentally microeconomic phenomenon, driven by the strategies and behaviour of firms. In a global strategy the comparative advantages of each nation, state or location are no longer considered separately. Comparative advantages are determined by a firm's objectives – e.g. low production costs, new markets for standardised or differentiated products, access to new technologies or know-how. Hence, comparative advantages, advantages of location, will vary according to the firm's global strategy.¹⁷ Nations, states and locations need to attend to the development of a coherent set of advantages, and find a niche in the global economy which attracts the type of

economic activity they want to foster. Attending to the generic business environment is necessary, but no longer sufficient.

Clustering in the Knowledge Economy

Networks and geographical clusters of firms are a particularly important feature of the knowledge economy. Firms find it increasingly necessary to work with other firms and institutions in technology-based alliances, because of the rising cost, increasing complexity and widening scope of technology. Many firms are becoming multi-technology corporations locating around centres of excellence in different countries. Despite improved capability for global communication, firms increasingly co-locate because it is the only effective way to share understanding (tacit knowledge).¹⁸

Consequently, skills and life-style are becoming increasingly important locational factors.

As we enter the age of human capital, where firms merely lease knowledge-assets, firms' location decisions will be increasingly based upon quality-of-life factors that are important to attracting and retaining this most vital economic asset. In high-tech services, strict business-cost measures will be less important to growing and sustaining technology clusters ... Locations that are attractive to knowledge assets will play a vital role in determining the economic success of regions.¹⁹

Economics of knowledge

In the knowledge economy there are new ground rules. Knowledge has fundamentally different characteristics from ordinary commodities and these differences have crucial implications for the way a knowledge economy must be organised.²⁰ The whole nature of economic activity, and our understanding of it, is changing.

Unlike physical goods information is non-rival – not destroyed in consumption. Its value in consumption can be enjoyed again and again. Hence, social return on investment in its generation can be multiplied through its diffusion.

Ideas and information exhibit very different characteristics from the goods and services of the industrial economy. For example, much more than is the case with a frozen dinner or a haircut, the social value of ideas and information increases to the degree they can be shared with and used by others. More important, the costs associated with their production are distributed very differently over time. While up front costs associated with the production of traditional goods such as a car or house may not necessarily be high, each item is still costly to produce. The more of these one produces, the more likely one will eventually encounter scarcities that drive up production costs and reduce the size of social returns. In the case of innovation, ideas and information, however, the opposite would seem largely to be the case. While up front development costs can be very high, the reproduction and

transmission costs are low. The more such items are (re)produced, the greater the social return on investment.²¹

Traditional economics is founded on a system which seeks to optimise the efficient allocation of scarce resources, but because of the unique characteristics of information and knowledge the very meaning of scarcity is changing. Indeed, the scarcity defying expansiveness of knowledge is the root of one of its most important defining features. Once knowledge is discovered and made public, there is essentially zero marginal cost to adding more users.²²

Because knowledge does not wear out and people can duplicate it practically without cost, it is a source of supervalue and superproductivity. Knowledge alone can add value to an otherwise closed, zero-sum system of value. It can increase value without diminishing it somewhere else ...²³

...ideas and innovations have extensive externalities, their benefits typically extending well beyond those who first put them forward; and it can be difficult to exclude other potential users of knowledge through intellectual property rights. What is more, there is an inherent 'unknowability' in knowledge: it is like an experience good, which consumers find hard to value unless they have used it.²⁴

Knowledge goods and services are subject to, or part-and-parcel of, almost every form of 'market failure' that traditional approaches to economics have identified. Indeed, there is every sign that in a knowledge-based system market failure will be systemic, and every sign that we need a fundamentally different economic understanding for the knowledge economy.

Systems of creation, production and distribution

The commonly held notion that a knowledge economy is a services economy is dangerously misleading. As information and knowledge add value to basic products manufacturing and services are becoming increasingly integrated into complex chains of *creation, production and distribution*. At the core of the economy are goods producing industries, linked into value chains which see inputs coming from knowledge-based business services and goods related construction and energy industries, and outputs going to goods related distribution service industries.

Industries concerned with the creation, production and distribution of goods (including manufacturing) remain at the heart of the economy. For example, employment in the combined goods producing and good related industries increased by more than 764,000 in Australia between 1985-86 and 1995-96, and still accounts for almost 65 per cent of total employment.²⁵ Our policies must reflect the increasingly complex inter-relation between goods producing and related services activities in the economy and the consequent emergence of complex product systems, and not simplistic interpretations of a structural shift from manufacturing to services.

Convergence or divergence

One disturbing feature of the emerging knowledge economy is increasing evidence that the nations of the world are polarising, rather than converging, in economic terms. Standard neoclassical growth theories suggest that economies subject to market forces should converge in terms of per capita GDP levels, either absolutely or relatively. But the reality is quite different.

Countries appear to be moving towards two peaks or nodes, one at high incomes and one at relatively low incomes. This polarisation of countries into different strata of economic activity and of living standards is becoming both pronounced and persistent.²⁶ What the future will show as the knowledge economy unfolds remains to be seen, but there is little in the recent historical record to assure policy makers that market forces will deliver a continuing process of convergence to US levels. In such a world the consequences of policy failure or inaction can be dramatic.

Divergence and concentration

These same dynamics may cause changes in the industrial structure of knowledge economics. Many contend that increasing inequality can be observed at the international, national, regional, household and personal levels – that the rich are getting rich, while the poor are getting poorer.

Some economists suggest that increasing returns from network economies and learning economies characteristic of knowledge economies will lead to industrial concentration – a world of winner takes all.²⁷ Others contend that the expansion of the knowledge driven economy will create a proliferation of material, firms and activities at all points and at all levels, suggesting that no one can expect to enjoy continued control of markets.

There may be temporary monopolies but they cannot last. And it is misconceived to think that the key lies in being at the point of delivery of the product: the low cost and ease of access to the delivery mechanism mean that the rents are driven down at the delivery level and instead migrate back up the value chain to those with genuinely scarce factors and competitive advantages.²⁸

Whichever proves true, the knowledge economy will see the development of new business models.

What Does it Mean for Australia?

There is now a window of opportunity for improving welfare, and moving along an accelerated path toward sustainable development ... by shifting economies onto a higher performance growth path.²⁹



In considering Australia's position in the emerging knowledge economy, and its ability to deal with a polarising world, it is clear that there are strengths and weaknesses.³⁰

On the positive side, Australia:

- has a strong knowledge base, relative to the size of its population;
- has a range of competitive industries, not only in agriculture and mining but in the service sector and in some niches of manufacturing;
- has already undertaken substantial adjustment, of both industry structure and of economic institutions and attitudes;
- has a record of rapid uptake of new technologies and is in a strong position to embrace the online economy; and
- can benefit from its use of the English language, increasingly the language of the knowledge economy, from its relatively open society and from its position as a stable and growing economy in the Asia-Pacific region.

On the other hand:

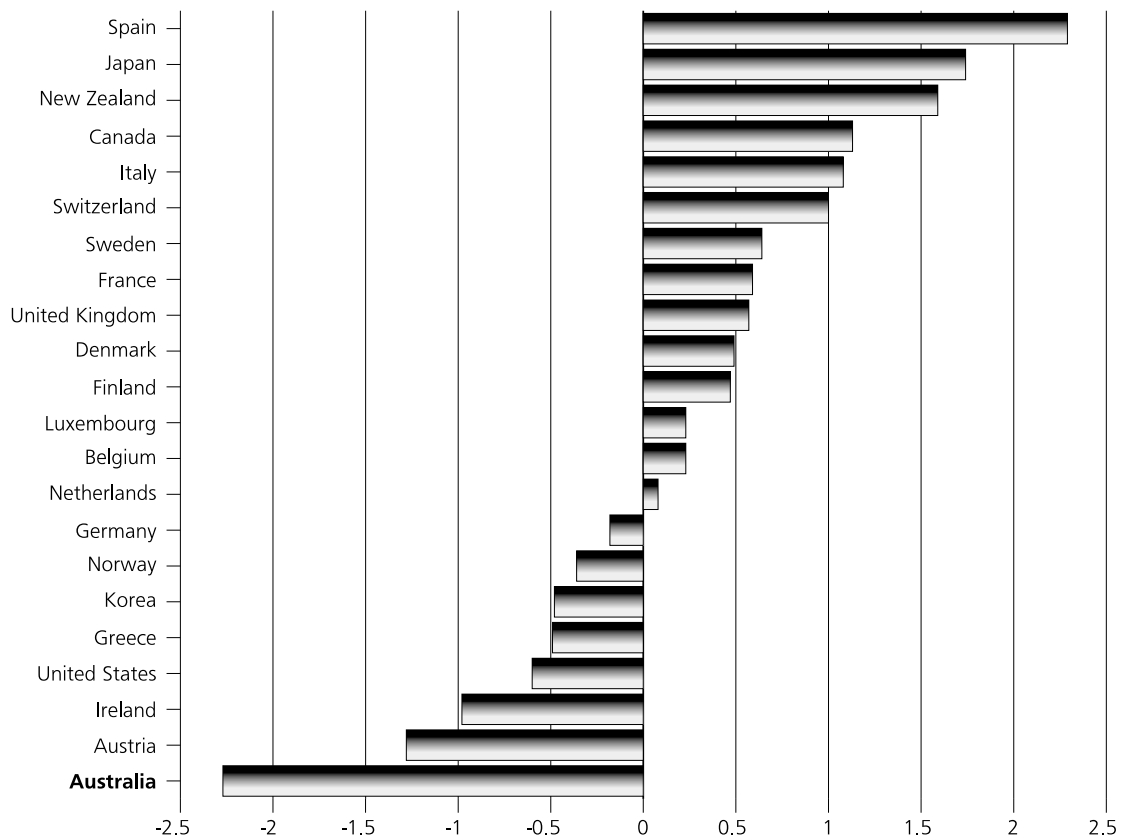
- Australia's rapid adjustment over the past two decades has been at the expense of the maintenance and/or the creation of a competitive firm and industry structure, so that the nation has little productive capacity in large areas of industrial activity;
- many Australian-owned firms are very small, relative to the scale necessary to achieve international competitiveness, and many of the multinational companies operating in Australia are focused on the Australian domestic market rather than on global markets;
- the processes of adjustment in firms and government agencies have largely been through external means – retrenchment, contracting out, downsizing, the use of temporary employees, privatisation and sales of businesses, etc. – with less attention having been given to the retraining and redevelopment of capabilities within firms;
- Australia has failed to attract its share of the large-scale foreign direct investment during the recent period of globalisation – that which has been attracted has too often been focused on the purchase of existing assets, rather than the creation of new productive capacity; and
- as a result, a viable competitive industrial structure, consistent with rapid growth and a return to full employment, is not yet in place.

Many of the changes implemented in Australia over the past quarter century will stand the nation in good stead. Nevertheless, the adjustment costs incurred over this period have been heavy – more so than may have resulted from a more considered

adjustment strategy. And the goal of establishing a competitive industrial structure consistent with rapid economic growth and ‘full employment’ has not yet been achieved.

The fundamental structural problem in Australia’s commodity trade, hence in the economy as a whole, is that Australia’s exports are dominated by primary products, the international demand for which is growing relatively slowly; while Australia’s imports are dominated by elaborately transformed manufactures (ETMs), the demand for which is growing rapidly both in Australia and around the world. Moreover, prices fetched on world markets for natural resource-based products are falling vis-a-vis those fetched by ETMs, hence the things Australia is exporting are earning less and less on world markets, while the things we are importing are costing more and more. As a consequence Australia’s terms of trade have fallen faster and further over the last decade than in any other OECD country – a decline in terms of trade which reduces our standard of living over the long term (Figure 7).

Figure 7: Terms of Trade, average annual percentage change (OECD countries), 1986-96



Source: OECD, 1998, *OECD In Figures: 1997*, OECD, Paris.

Australia cannot rely on natural resource-based products for ever. Even if we believe that endless productivity improvements in agriculture and mining are possible, and that Australia could turn around the decline in standard of living that way, natural resources are finite. The present course is simply not sustainable.

The challenge for Australia is to develop new or expand existing industries in rapidly growing, value-added or knowledge-based manufacturing and services in order to offset the inevitably slower growth of the traditional resources sector.

What Should Be Done to Meet the Challenge?

[T]he sectors that invested more in research and performed more innovative activity are those that employed a larger share of higher skilled workers ... Increased upskilling is thus not merely a consequence of some labour-biased technological shock. Sectoral human capital formation and innovative effort can be read as a mutually reinforcing and cumulative process which can have a lasting effect on industrial performance.³¹



The forces driving the emergence of the knowledge economy are fundamentally reshaping the world economy. This process is proceeding ever more rapidly, and each nation must find its appropriate response to the new economic realities.

When the national challenge is viewed from this historical perspective, and in the light of the magnitude of the economic and social changes under way, it is clear that four broad types of long-term policy response are necessary.

We need to:

- *Drive market-based change* with programs to allow, or to force, the economy to respond to the pressures of global competition and to market forces.
- *Preserve/build a competitive structure for the future* with programs to ensure that the economy retains or develops a strong set of institutions and firms, with a high quality base of human skills and infrastructure, so as to be able to compete in the new economy.
- *Manage the adjustment so as to maximise overall growth* by managing the adjustment process in such a way as to ensure that pressures of adjustment do not constrain the economy to rates of growth below its full potential.
- *Ease the burden of adjustment on individuals, families and regions* with programs to support those within the community on which the costs of adjustment fall especially heavily, and to help them to make the transition to the new environment.

Each of these components is essential to an adequate response to the emerging global knowledge economy.³²

Given the complex dynamics and feedback linkages involved in these things, failure in one respect can have ramifications in another area. For example, opening an economy up rapidly to competitive forces without adequate programs to support domestic firms can denude the economy of long-term competitive capabilities in key industries. If poor macroeconomic management leads to low growth and rising unemployment, or if individuals or communities are severely damaged by structural adjustment without adequate support, community support for market-based reforms may well be damaged. *A long-term, integrated response involving all four elements is essential.*

Outlines of a response

Over and above these general dimensions for policy action, the characteristics of the emerging knowledge economy suggest a number of immediate and quite specific policy implications, including:

- the increasing inter-dependence among trade, investment, technology and capital flows suggests a need for deep integration of policies in these areas;
- because an economy built on knowledge is fundamentally different from one built on natural resources, we require new approaches to understanding;
- innovation, education and learning underpin a knowledge-based economy. This makes them, and organising around them, key foci for economic development policies;
- the transformation from a resource-based to a knowledge-based economy involves substantial structural adjustment and requires explicit transition strategies; and
- the role of governments is different in a globalised economy – transformed from that of governance to that of ‘host’ of economic activities.

The need for policy integration

The increasing inter-dependence of flows of trade, investment, technology and capital which now characterises globalisation creates the need for far greater coordination and integration of policies relating to them. There is a particular need to integrate trade with investment and technology strategies to ensure that they operate in a manner that is mutually reinforcing. There is also a need to achieve a higher level of integration, a ‘deep’ integration, of domestic and international policies more generally.

Facing global competition

Globalisation is changing both the level and nature of competition. Policy development must be based on an understanding of the changing nature of competition, global corporate strategies and enterprise capabilities; and consider market support and support for expansion – including fostering and supporting the further development of supply chain linkages, and facilitating outward direct investment (as well as inward).

Competing on knowledge

Cost competitiveness is a necessary, but no longer sufficient condition for success. Innovation and knowledge are becoming central to creating and sustaining competitive advantage. We must now deal with the impacts of flexible organisation, including the diminished importance of low-skilled labour costs and the increased importance of proximity, networking and cross-cutting forms of organisation. And we must focus business programs towards giving more attention to adding value, rather than simply focusing on cutting costs.

Global investment and production

Globalisation raises a number of investment and locational challenges. The reduction of trade and investment barriers and the global rationalisation of production have changed the motives for location. While there are a number of attributes that are generic to 'attractive' investment locations, globalisation is creating an additional overlay of attributes relating to industry structures, corporate strategies, corporate structures and cultures. Governments will need to continue to focus on creating an attractive business environment, but this alone will not be enough. Just as it is necessary for firms to master production costs *and* flexible manufacturing to enable them to customise products and services for particular customers, so it is becoming increasingly necessary for governments to flexibly customise investment attraction in such a way as to attract the sorts of investments, corporations, asset 'bundles' and cultures that fit with their strategic vision for the economic development of their location.

Shifting the composition of the economy

Policy makers increasingly need to attend to the structure of production in the economy, and to consider policies which seek to pro-actively adjust that structure in pursuit of economic and social development. Policy proposals and interventions should be judged against the criteria of structural impact before implementation to ensure that they contribute positively to shifting the structure of production towards more knowledge intensive activities.³³

Services are increasingly important, and are the locus of much value-adding in the value chain. But, the knowledge economy is not simply a services economy. Our services must be linked intimately with production. With increasing use of integrated computer aided design and manufacturing systems (CAD/CAM), just in time (JIT) and other technologies, and labour and other physical resource costs accounting for an ever smaller proportion of overall costs, the need to integrate research, design, development, manufacturing, distribution and after sales service into seamless chains of creation, production and distribution is likely to increase. We cannot assume that a services economy linked to offshore manufacturing will work. Co-location or deep integration through information and communication technology networks and logistics and distribution networks will increasingly replace arms-length, off-shore, low wage manufacturing. And this has profound implications for investment attraction, structural adjustment, infrastructure development, and skilling.

Flexible organisation

The successful organisation of economic activity is increasingly flexible, network oriented and built through clustering. Translating technological change into productivity gains will increasingly necessitate a range of firm-level organisational changes to increase flexibility – particularly relating to work arrangements, networking, multi-skilling of the labour force and decentralisation. Governments can provide the conditions and enabling infrastructures for these changes through appropriate financial, competition, information and other policies.

Knowledge, education and skills

The trend to new strategies and structures referred to variously as ‘lean production’, the ‘knowledge-based firm’, the ‘high performance organisation’ or the ‘learning organisation’ is altering the internal structure of organisations and placing new emphasis on the use of teams, a high degree of task integration, decentralised decision making, continuous innovation, organisational learning and the blurring of sites of innovation and production.³⁴ This is, in turn, transforming workplaces and placing new demands on workers and management.

Policies will need to focus on the development of human capital, the development and nurturing of an entrepreneurial climate, and the promotion of broad access to skills and competencies – especially the capability to learn. This will include: providing broad-based formal education, establishing incentives for firms and individuals to engage in continuous training and life-long learning, and improving the matching of labour supply and demand. What flexible organisations need most from education systems is not so much investment in the production of skilled but narrowly defined specialists, or a lot of investment in vocational training; but much more investment in the production of people with broad-based problem solving skills and with the social and inter-personal communication skills required for teamwork, along with the skills and attitudes required for flexibility.³⁵

An innovation system

Productivity and growth are increasingly determined by the rate of technical progress and the accumulation of knowledge. Of key importance are networks or systems which can efficiently distribute knowledge and information. Policies relating to science and technology, industry and education will need a new emphasis on the role and importance of innovation systems, the requirement for infrastructures, and incentives which encourage investments in research and training to support those systems.³⁶

Globalisation presents new challenges for science and technology policy. Technology is increasingly looking like an international public good, making national innovation systems appear increasingly porous. In response to globalisation technology policy must shift its focus towards concern for the quality of the workforce, the depth and breadth of new technical knowledge, the culture of entrepreneurship, and the infrastructure for innovation which can make a location attractive for innovation.³⁷

Because of the increasing importance of innovation there is also a greater need for an integrated science and technology policy, which includes full recognition of the shift in focus from invention to diffusion, of the special place of transformative and generic technologies, of embodied technology and the role of imports and investment, of international flows and transfers of technology, and of the need for a deep integration of science policy, investment attraction and focused technology acquisition strategies; and of the importance of chains, clusters and complexes, and integration with regional (locational), supply chain and cluster development strategies. Isolated ‘science’ policy is no longer appropriate.

How we tackle the challenges raised by the emergence of the knowledge economy will be a major determinant of our future prosperity.

Notes

1. Forfas (the policy advisory and coordination board for industrial development, science and technology in Ireland) 1996, *Shaping our Future*, p. 3.
2. DTI, 1998, *Our Competitive Future: Building the Knowledge Driven Economy*, Department of Trade and Industry, London.
3. Richard Florida & Martin Kenney, 1991, 'The New Age of Capitalism', *Futures*, p. 637.
4. This section is derived from Sheehan, P. and Tegart, G. (Eds.) 1998, *Working for the Future: Technology and Employment in the Global Knowledge Economy*, Victoria University Press.
5. See Sheehan, P. and Tegart, G. (Eds.) 1998, *Working for the Future: Technology and Employment in the Global Knowledge Economy*, Victoria University Press, pp. 40-44 for a discussion of the knowledge intensity index of trade.
6. This section is derived from Sheehan, P. and Tegart, G. (Eds.) 1998, *Working for the Future: Technology and Employment in the Global Knowledge Economy*, Victoria University Press.
7. Thurow, L. 1991, 'New Tools, New Rules: Playing to win in the new economic game' *Prism*, p. 101.
8. Taylor, F. 1911, *The Principles of Scientific Management*, Harper, New York: provided the foundational description of the management of mass production systems based on an extensive division of labour and hierarchical control.
9. This section is drawn from Oman C. 1996, *The Policy Challenges of Globalisation and Regionalisation*, Policy Brief No. 11, OECD Development Centre, OECD, Paris, p. 19.
10. Oman C. 1996, *The Policy Challenges of Globalisation and Regionalisation*, Policy Brief No. 11, OECD Development Centre, OECD, Paris, p. 19.
11. Soete, L. 1997, 'Macroeconomic and Structural Policy in the Knowledge-based Economy,' in *Industrial Competitiveness in the Knowledge-based Economy: The New Role of Governments*, OECD, Paris, p. 136.
12. One can think of a knowledge economy production function in which knowledge is the only factor, with codified knowledge replacing capital (equipment) and tacit knowledge replacing labour (knowledge work), but unlike capital and labour, codified knowledge and tacit knowledge are non-substitutable.
13. OECD, 1996, *The Knowledge-Based Economy*, OECD Paris, p. 14; and David, P. and Foray, D. 1995, 'Accessing and Expanding the Science and Technology Knowledge Base,' *STI Review*, No 16, OECD, Paris.
14. OECD, 1996, *The Knowledge-Based Economy*, OECD Paris, p. 16.
15. OECD, 1996, *The Knowledge-Based Economy*, OECD Paris, p. 16; see also OECD, 1997, *National Innovation Systems*, OECD, Paris.
16. Hatzichronoglou, T. 1996, *Globalisation and Competitiveness: Relevant Indicators*, STI Working Paper 1996/5, OECD, Paris, p. 7.
17. This section is drawn from Hatzichronoglou, T. 1996, *Globalisation and Competitiveness: Relevant Indicators*, STI Working Paper 1996/5, OECD, Paris, p. 9.
18. See Cantwell, J. in DTI, 1999, *Economics of the Knowledge Driven Economy*, Conference Proceedings, Department of Trade and Industry, London.
19. DeVol, R.C., 1999, *America's High-Tech Economy: Growth, Development and Risks for Metropolitan Areas*, Milken Institute, Santa Monica, p. 9.
20. DTI, 1999, *Economics of the Knowledge Driven Economy*, Conference Proceedings, Department of Trade and Industry, London, p. 5.
21. Industry Canada 1997, 'Towards a Society Built on Knowledge,' See <http://strategis.ic.gc.ca/SSG/ih01644e.html>
22. DTI, 1999, *Economics of the Knowledge Driven Economy*, Conference Proceedings, Department of Trade and Industry, London, p. 6.
23. Charles Sigismund 1995, 'The New Knowledge Organisation', *SRI International*, p. 11.
24. DTI, 1999, *Economics of the Knowledge Driven Economy*, Conference Proceedings, Department of Trade and Industry, London, p. 6.

25. Houghton, J.W., Pappas, N. and Sheehan, P. 1999, 'New Manufacturing: One Approach to the Knowledge Economy,' *CSES Working Paper 12*, Victoria University. See <http://www.cfses.com>
26. Often referred to a 'twin peaks dynamics' see Sheehan, P. and Tegart, G. (Eds.) 1998, *Working for the Future: Technology and Employment in the Global Knowledge Economy*, Victoria University Press, p100; see also Quah, D., 1996, 'Convergence Empirics Across Economies with (Some) Capital Mobility,' *Journal of Economic Growth*, 1(1) pp. 95-125.
27. See, for example, Arthur, W.B., 1996, 'Increasing Returns and the New World of Business', *Harvard Business Review*, July-August 1996, pp. 100-109.
28. See Kay, J. in DTI, 1999, *Economics of the Knowledge Driven Economy*, Conference Proceedings, Department of Trade and Industry, London.
29. OECD 1997 'Towards a New Global Age', OECD, Paris, p. 11.
30. This section is taken from Sheehan, P. and Tegart, G. (Eds.) 1998, *Working for the Future: Technology and Employment in the Global Knowledge Economy*, Victoria University Press, pp. 101-102.
31. OECD 1996, *Technology and Industrial Performance*, OECD Paris.
32. Sheehan, P. and Tegart, G. (Eds.) 1998, *Working for the Future: Technology and Employment in the Global Knowledge Economy*, Victoria University Press, p. 123.
33. Australian Business Foundation 1997, *The High Road or the Low Road: Alternatives for Australia's future*, Australian Business Foundation, Sydney, p. 113.
34. Branscomb, L. and Florida, R. 1997, 'Challenges to technology policy in a changing world economy', in *Investing in Innovation: Creating a research and innovation policy that works*, MIT Press, p. 11.
35. Oman C. 1996, *The Policy Challenges of Globalisation and Regionalisation*, Policy Brief No. 11, OECD Development Centre, OECD, Paris, p. 37.
36. OECD, 1996, *The Knowledge-Based Economy*, OECD Paris.
37. Branscomb, L. and Florida, R. 1997, 'Challenges to technology policy in a changing world economy', in *Investing in Innovation: Creating a research and innovation policy that works*, MIT Press, p. 13.

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