Innovation and the economy

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ABSTRACT Unemployment has remained at relatively high levels across most European countries for a generation now. There have been a number of suggested explanations for this, with correspondingly different policy implications. Two of the major hypotheses relate, first, to the impact on the European economies from increased international competition, and ‘globalisation’ more generally, and, secondly, to the effects of new technology and innovation. The effects of both globalisation and technology on growth and employment in Europe have been researched over the past two years through an EU-funded project, the results of which, relating in particular to innovation, are reported in this Special Issue of the International Review of Applied Economics. (The results relating to globalisation were reported in a Special Issue of the Journal of Interdisciplinary Economics, Volume 13.) It is clear from the empirical work reported that the effects of technological innovation have been mixed. There is no doubt that some innovation has had a negative effect on employment, without the compensatingly positive effects that new technology usually brings in its wake. However, in high technology manufacturing sectors there is scope for boosting both productivity and employment. But this requires an appropriate policy environment, conducive to increased investment in capital, R&D and the workforce itself.

1. The Innovation Challenge to Economic Research

This special issue of the International Review of Applied Economics addresses the widely felt need by economists to establish a link between innovation, economic performance and employment, which is grounded in theory and carefully investigated through empirical studies.\(^1\) This is in the context of Europe having experienced relatively high unemployment for over 25 years.\(^2\)

Few economists would object to the notion that knowledge is at the root of economic growth. A substantial part of this knowledge takes the form of technologies associated with economic and social activities, such as the production and use of goods and services. For firms, the possession (and sometimes ownership)
of a particular knowledge (often embodied in machinery, always present in its workers) is a precondition for carrying out production. Thus:

Innovation – the invention and application of new technologies, products and production processes – is a key driver of productivity growth. Innovation has accounted for around two-thirds of UK economic growth in the post-World War II period. Furthermore, a majority of the UK’s productivity gap with the US can be accounted for by differences in the level of innovation. (HM Treasury and Department of Trade and Industry, 2001, p. 23)

The present form of capitalism in advanced countries has often been referred to as a ‘knowledge-based economy’ and the growing importance of developing and enhancing such knowledge in people has led to concepts such as the ‘learning economy’ (Archibugi & Lundvall, 2001).

Mainstream economic analysis has made substantial efforts to pay attention to such developments. The new growth theory has started to conceptualise innovation as an endogenous process and variables accounting for technology, learning and education appear with increasing frequency in models used for empirical tests. However, the paradox is that the fundamentally disequilibrating nature of technological change introduced by particular firms is usually treated in a context that still assumes general equilibrium of markets and undifferentiated economic agents.³

The neo-Schumpeterian and evolutionary approaches to economic change have offered, in the last two decades in particular, a solid alternative for investigating the nature and impact of technology. The cornerstones of this approach have included the concept of techno-economic paradigms, linking waves of technological changes to economic and social structures and to institutional settings (Freeman et al., 1982; Freeman & Soete, 1987, 1994); an evolutionary view of microeconomic change characterised by processes of diversity generation (through innovation) and selection (in the marketplace) (Nelson & Winter, 1982); and a link to macro-economic theories of structural change, cumulative growth, and institutional regulation (Dosi et al., 1988).

Much of this line of analysis puts at the centre of its research the concept of innovation, which is the deliberate activity by firms and institutions to introduce new goods and services and new ways of producing, distributing and using them. A major problem with innovation has long been the impossibility of measuring it in the same way as other economic variables. Scholars have had to use ‘partial’ measures, such as R&D and patenting, in order to describe the rate and direction of technological change. However, these measures account for some inputs only (expenditures for research) or for some outputs only (that recorded by patents) of a much wider and more complex innovation process. This inadequacy is strikingly evident when innovation in services is considered: in contrast to their rapid pace of diffusion, only around a quarter of the R&D performed in the business sector is carried out in service industries, and the share of patents obtained by services is below 15%.⁴

Moreover, the traditional technological indicators were associated with a rather simplified ‘linear’ view of the innovation process, leading from research inputs to innovation (and patenting) outputs and to market performance. A more sophisticated ‘chain-linked’ model has provided a suitable alternative for grasping the systemic nature of the innovation process, increasingly made of a complex web of
linkages and knowledge flows between firms and the wider institutional context in which they operate. The concept of ‘national systems of innovation’ has also asserted itself as an essential part of the picture for studying country patterns and the links between technological change, economic structures and institutions in particular countries:

In recent years, considerable progress has been made in understanding the factors that underlie productivity and income gaps between nations and regions. In particular, the growing literature on national systems of innovation has highlighted the positive relationship between innovation and economic performance. The systems approach views the ability of an economic system to innovate as one of the key determinants of economic performance.

Here, innovation is defined broadly to include new products and processes, new forms of organisation, new markets and the development of new skills and human capital. Factors affecting an economic system’s ability to innovate include: its industrial structure; its financial system; the system of education and training; industrial relations; R&D and technology provision; the strength of the science base; the system of technology transfer and the institutional environment – particularly the relationships between industry, the science base and government. (Michie & Oughton, 2001a, pp. 165–166)

1.1. The Community Innovation Survey

Many of the conceptual and data constraints that have long forced innovation into a ‘black box’, which is off-limits for economic research, are now disappearing. New theories are filling the gaps between the understanding of technological change and the functioning of economies; data shortages are replaced by opportunities. For the first time, a large data set on innovation is becoming available for a large number of countries with extensive information on the characteristics, objectives, nature, quality, expenditure and economic impact of the innovative activities carried out by firms. This is the result of the decision by Eurostat and the European Commission to adopt innovation surveys as a systematic source of information on technological activities in firms. The data collected by the Community Innovation Survey referring to the years 1994–96 (CIS 2) can now be linked to the previously used technology variables and to standard economic indicators.

As new opportunities for research are opened up, new questions can be asked. The ones addressed in the articles of this Special Issue can be summarised as follows.

1.2. Research Issues

A new theoretical challenge questions the idea of the homogeneous nature of innovation carried out in firms. The theories of the neo-Schumpeterian and the evolutionary approaches, as well as the rich evidence of innovation surveys, now suggest that different models of innovative activities are present, and characterise particular sectors or national economies. An obvious cleavage to be expected is the one between innovation strategies aiming at either product or process innovation. But more refined typologies are also clearly emerging.
A second challenge questions the idea that innovation has an automatically positive impact on economic performance. Again, careful theorising, and now also empirical studies, has suggested that different innovation strategies, which characterise particular sectors, may have diverse effects on economic growth and employment patterns, and on the associated developments in international investment and production.

A third challenge is to integrate the new view of innovation in macroeconomic relations within the complex interaction of demand and supply, the web of substitution and compensation effects, and the turning points in structural change and distribution patterns.

Finally, cutting across all the above issues, there is the need to address, in parallel, questions at the level of firms, industries and the aggregate economy. The ability to provide a coherent picture of change at all these levels of analysis remains a challenge for both theory and empirical studies.

2. Models of Techno-economic Change

The need to understand the variety of innovations, the diversity of their possible effects and their complex links to macroeconomic issues is made more urgent by the current emergence in advanced economies of the new techno-economic paradigm based on Information and Communication Technologies (ICTs). The questions for theory and empirical research lead in this context to a set of policy options of great importance to European economies.

The radical change in the nature and trajectories of innovations produced by the new techno-economic paradigm is at the core of the latest, short-lived fashion in economic studies and policy, namely the infatuation with the ‘new economy’ (OECD, 2001). Economic developments during 2001 in the US and the world economy proved that the widespread expectations of continuing rises in stock prices, in the rates of growth of GDP and productivity, and of an ‘end of business cycles’, to be massively exaggerated. The flop of the ‘new economy’, however, does not mean that change stops. Rather, it is likely to follow the more complex, long term route of diffusion of a new techno-economic paradigm shown by the history of the emergence of new pervasive ‘technological systems’ with large potential for change. Sustained and sustainable growth can be expected only once the mismatches between the new technologies and the old economic and social structures and institutions are overcome, in a two-way adjustment of the latter to the requirements of new technologies, and of re-orienting innovation and adapting it to social needs and economic demands.

From our perspective, the most important implication is the possibility of different models of innovation, depending on the constraints posed by existing economic structures, on the competencies available, and on the specific strategies pursued by firms and governments. In a very simplified way, four possible innovation models can emerge, relevant for both analysis and policy.

(1) ICT focused. In this model, innovative efforts are concentrated on the activities based on ICTs and on their applications. The technological opportunities of ICTs are the driving force of growth, although operating from a rather narrow base of technological and economic activities. The ability to extend their impact and applications across a wide range of economic activities is a key test for success.
2.3. The Link with Structural Change and Economic Performance

In periods of changing techno-economic paradigms, the inherited economic structure of a country and its ability to undergo wide-ranging structural change are crucial factors shaping its growth prospects. The strains of change on national economies are higher, the greater is the extension of traditional industries facing restructuring or decline. Growth opportunities are higher in countries where new
fast growing sectors, in both manufacturing and services, are more important. The sectoral structure of economies is therefore an important factor that can help explain differences in national economic performances. Its weight is emphasised by the process of globalisation that exacerbates competition and makes more evident the relative advantages associated with ‘structural’ competitiveness and the disadvantages associated with traditional industries.

2.4. The Need for New Demand

A major mismatch is now found between the high potential of new ICT-based products, offering more various and ‘personalised’ goods and services, and the lack of an emergence of new large markets with strong demand. The modest dynamics of aggregate demand in Europe and the lack of growth in wages in the context of growing social polarisation have all contributed to delaying the emergence of new markets in many countries. Moreover, many of the ICT-based goods and services require new learning processes in consumption and a need for social innovations (particularly in the use of time) required to ‘match’ the opportunities of technological change.

The variety of these factors, the differences in innovation models and the distinct strategies that can be pursued by firms and governments suggest that no automatic link can be expected between innovation and growth performances in the context of the current changes in technologies and economic structure. Far from being a deterministic process, the economic and employment outcomes of specific models of technological change are the result of social processes, where institutions, government policies and social relations play a major role, alongside the developments in technology and the strategies of firms. The challenge for economic research on innovation is to develop a more solid understanding of these issues, relationships and contexts, advancing at the same time theory and empirical research.

3. Investigating Innovation, Economic Performance and Employment

The articles selected for this special issue on *Innovation, economic performance and employment* focus in various ways upon these issues. Moving from a set of common starting points – broadly outlined above – they investigate the key research issues summarised below, using a variety of methodologies and levels of analysis.

3.1. Sectoral, Aggregate and Firm-level Analyses

The articles address all the levels of analysis required in this field. The first three papers cover the whole of European manufacturing industries, using a sectoral breakdown for a large number of countries. They provide background on the general picture regarding the links between technology and productivity (Corley, Michie & Oughton), on the diversity of innovation patterns in Europe (Nascia & Perani), and on the employment impact of specific strategies, namely product or process innovation (Antonucci & Pianta).

The following paper (Evangelista & Savona, using Italian data) introduces a much needed extension to the case of service industries addressing – in parallel to the paper by Antonucci & Pianta – the issue of employment effects, highlighting similarities and differences with manufacturing in terms of innovation and its impact on jobs.
Another country case study, on Swedish manufacturing industries (Hommen & Sellenthin) investigates the variety of innovative strategies pursued.

Moving ‘up’ from the sectoral to the aggregate level, the next paper (Castellacci) addresses the macroeconomic performances of advanced countries. The final two papers move ‘down’ to the firm level, and use large samples of Italian firms in order to study the skill bias of technological change (Piva & Vivarelli) and the link between technology and international production (Castellani). The key research questions that are addressed, and the findings of this volume can be summarised as follows.

3.2. The Variety of Innovation Strategies

The articles by Nascia & Perani, and by Hommen & Sellenthin, address the complexity of innovative activities and the diversity of the strategies associated with them. Firms introduce innovations that differ regarding their typology (product, process); the sources used (internal, external); the inputs employed (R&D, design, investment, and so on); and the objectives pursued (reduce costs, enlarge markets, and so on).

Nascia & Perani provide a useful overview of the results of the CIS 2, providing basic information on the characteristics of innovation in manufacturing industries in all European countries. These are clustered in three major classes: the industries dominated by product innovators focusing on markets, the group of process innovators focusing on costs, and sectors emerging as ‘general innovators’, which combine both strategies in order to advance on all aspects. Within European industries, some innovation dimensions appear to be the result of specificities of national innovation systems, while others are common features of sectors across all countries, as shown by an analysis of variance. Finally, regarding the economic impact of innovation – as described by the share of sales of the industry due to product innovations – the total expenditure for innovation, the R&D component, and the cooperation with universities are all found to be important factors.

The article by Hommen & Sellenthin concentrates on manufacturing industries in Sweden; it presents a typology based on clustering, points out ‘offensive’ and ‘defensive’ strategies associated with innovation, emphasises the importance of product innovation, and finally draws out the policy conclusions in terms of focusing and targeting policy.

3.3. The Impact of Innovation on Economic Performance

The article by Corley, Michie & Oughton and the one by Castellacci address the effects that technological factors have on economic performance and productivity, in particular on OECD countries in the 1990s. The former paper tests the effects on labour productivity of investment in physical capital, R&D and human capital, using a cross-sectoral study of manufacturing industries. The generally positive impact of all three factors is qualified by allowing for the relevance of country-specific factors and also for the specificities of high and low-tech industries. It is clear that there is scope for boosting both productivity and employment in the high-tech sectors, and that to do so, investment is required across all three categories, of fixed capital, R&D and human capital.⁶

The article by Castellacci develops a model for the aggregate economy combining the technology-gap approach with the Kaldorian idea of cumulative
causation; from this, a variety of outcomes are expected, as technological catching up is a necessary but not sufficient condition for convergence in productivity growth. An analysis of growth in OECD countries in the 1990s leads to the identification of different country groupings, from the technological leaders to their close competitors, to the distant followers.

3.4. The Impact of Innovation on the Quantity and Quality of Employment

The articles by Antonucci & Pianta and Evangelista & Savona address the controversial issue of the impact of new technologies on jobs. Both use CIS 2 data at the sectoral level, associated with economic and employment variables. The former covers manufacturing industries in eight European countries; the latter covers service industries in Italy only. Antonucci & Pianta develop a model where employment is affected by demand dynamics, labour costs and innovation variables associated with strategies of technological or price competitiveness. The empirical findings show that European industries, in the context of the modest aggregate growth of the 1990s, were dominated by the latter strategy, associated with process innovations, leading often to a generally negative effect on jobs.

A study of service industries in Italy is undertaken in the paper by Evangelista & Savona, in which an overview is given of the problems and findings on innovation in services, and the impact that this innovation has had on jobs in the 1990s is tested. Again, an overall negative effect is found, concentrated among the largest firms, on low skilled workers, on capital intensive and finance-related sectors, and where the impact of ICTs has been most widespread. Smaller firms and technology-oriented activities show, on the other hand, net employment gains.

However, the quantitative impact of technological change is not the only aspect relevant here. The quality of employment is at the centre of a growing literature on the skill bias of technological change. The article by Piva & Vivarelli surveys the topic, showing a general upskilling trend over the past few decades. They find this for both the US and Europe. Going on to investigate a sample of Italian manufacturing firms, they find that organisational innovation appears to be the most important factor related to this upskilling, while technology and foreign direct investment appear to play only a secondary role.

3.5. The Link between Technology and International Production

Finally, the paper by Castellani explores the link between foreign investment and the technological trajectories of multinational corporations. A large body of literature has argued that the presence of foreign subsidiaries is expected to strengthen the productivity of multinational firms in their home base. Using a large sample of Italian manufacturing firms, total factor productivity in the 1990s is found to be positively associated with the creation of foreign affiliates, especially when these are located in advanced economies such as the US.

4. Stylised Facts and Policy Implications

A detailed discussion of the policy implications of these findings is beyond the scope of this Special Issue. However, certain implications do emerge with surprising consistency from the papers contained in this volume and also from other recent work investigating similar problems, including Vivarelli & Pianta (2000), Fagerberg
et al. (1999), and Petit & Soete (2001). These stylised facts, regarding the impact that innovation has on economic performance and employment, which emerge from this empirical research can be summarised as follows.

(1) Technological unemployment cannot be neglected as a possible outcome of current technological change, especially in Europe. There is no automatic mechanism ensuring that a national economy is able to compensate fully for innovation-related job losses.

(2) Aggregate demand and macroeconomic conditions play a key role in creating the conditions for a positive impact of technological change not only on employment levels, but also on income distribution and other consequences of economic change.

(3) Labour market conditions obviously play a role, as do country specific institutions and social relations. However, there is little evidence that either wage levels or ‘rigidities’ can explain by themselves much of the employment change that has occurred in Europe; on the contrary, structural factors remain crucial.

(4) The sectoral structure of the economy is important. The sources of job creation and destruction are specific for individual manufacturing and service industries and such structural factors are important determinants of countries’ employment performances. This is particularly important as the activities based on ICTs and characterising the ‘new economy’ are highly concentrated in just a few countries.

(5) The type of innovation is important, with different effects resulting from alternative strategies. Product innovation generally has a potentially positive employment impact, while a negative one is found for process innovation. The overall effect of the technological change recorded in European manufacturing industry in the 1990s has generally been a labour-saving one.

(6) The role of services and ICTs is crucial. New services and ICT-based activities have a positive impact on growth and jobs, while in other services labour-saving new processes dominate, at least from the limited evidence available for selected countries.

(7) The skill bias effect is relevant. Within the trend towards a quantitative reduction of manufacturing jobs in Europe, an upskilling process is evident. Blue collar and low-skilled jobs have fallen rapidly, while higher skilled jobs have been created, although with a highly uneven pattern across countries, industries and firms.

(8) International production is associated with innovation and productivity growth. As innovation has an increasingly international reach, a two-way link between foreign investment and technological and output performance can be found in multinational firms.

4.1. Conclusion

Two key principles for policy emerge from such evidence (see also Vivarelli & Pianta, 2000): the first is the need for targeting industries with the greater potential for growth and employment, and for specific actions directed at the needs of individual industries; and second is the need for a strong coherence between industrial, technology, learning and macroeconomic policies.

Policies need to address not just the achievement of productivity gains made possible by new technologies, but also the pattern of distribution of such gains. In
the summary and conclusions from their own empirical work, and their surveys of existing data sources, Wilkinson & Lapido argue along similar lines, stressing the importance of maintaining and enhancing cooperative relations at work, both within the workplace and between firms:

The contrasting experiences of Britain, Germany, the USA and Japan should make us reassess the claim that the need to negotiate technical change slows down the development process. This might be true from the perspective of the distributive interests of the large corporations, but only at great cost to a large proportion of the workforce and many customers. And what the overall costs and benefits are judged to be will depend upon the relative weights attached to the different interests and the extent to which the assessor subscribes to the view that what is good for the corporation is necessarily good for the system. In any case, in evaluating the longer-term effects, the risk of destroying co-operative and trusting inter- and intra-firm relations and those in the wider society would need to be added to the cost side of the balance sheet . . .

As we enter the twenty-first century, the policies pursued by our governments need to be adaptive to the challenges of the new technological, organisational and market forms spawned by the pressure of scientific discovery and intensified competition. Past experience suggests that the success of these policies, and their impact on the speed and direction of technical change, will depend on the extent to which our regulatory frameworks and codes of practice succeed in restricting the over-exploitation of bargaining advantage. (Wilkinson & Ladipo, 2001, pp. 183–184)

Over the past few decades, innovation has mainly benefited firms and consumers in the form of higher profits and lower prices, in a context of increasing pressure on firms from increasing international competition and from investors demanding high financial returns. Workers have seen job losses, frequent reductions in real wages, increased insecurity, increased work intensification, and often increased working time. The result has been an increasingly uneven distribution of incomes, made worse by the reduction of resources available for social redistribution through the tax system. If we want to reap the benefits promised by the new technologies, it is vital that these negative trends be reversed through the pursuit of a new generation of policies.

Notes
1. The articles in this Special Issue are the outcome of a major, Europe-wide research project on ‘Assessing the impact of technology and globalisation: the effects on growth and employment’ (AITEG, contract HPSE-CT-1999–00043) funded by the European Commission’s Fifth Framework Programme, with co-funding from the British Academy (Grant number SG-32283). The articles selected for inclusion in this Special Issue focus, in particular, on the technology and innovation aspects of that research. Those that focused more on the globalisation aspects of growth and employment were published in a Special Issue of the Journal of Interdisciplinary Economics (Volume 13, Numbers 1–3, April 2002). We are grateful for editorial advice on this Special Issue of the International Review of Applied Economics from Professor Peter Swann.
2. EU unemployment increased from 7.7% in September 2001 to 7.8% in both October and November 2001 and is forecast to increase further in the course of 2002 (European Commission, 2002).
3. For a brief overview of the key contributions to the economic literature on innovation, see Swann (2001).
4. For a discussion of the various possible measures of, and proxies for, innovation, see Michie (1998). This is the introductory essay for a Special Issue of the International Journal of the Economics of Business on 'The Internationalisation of the Innovation Process'. It also therefore discusses the relationship between technological innovation on the one hand, and the continued importance of national systems of innovation on the other.
5. For detailed discussion of the implications of technological innovation for globalisation, and of globalisation for technological innovation, see the various contributors to Archibugi & Michie (1996) and Archibugi et al. (1999). For a recent review of 'globalisation' theories, see Hirst (2001).
6. On the UK in particular, Nickell & Van Reenen (2000) find a weakness not just in high tech areas but also in absorbing best-practice techniques and methods more widely, due to a weakness in technological innovation with comparatively low and falling levels of R&D and patenting.
8. The EU's Regional Innovation Strategies initiative thus 'represents an important development in industrial policy in that it provides a vehicle for catalysing innovation in lagging regions and co-ordinating innovation policy with industrial policy' (Michie & Oughton, 2001a, p. 169).
9. Our AITEG research programme focused on corporate, industrial and macro policies rather than employee co-operation within the workplace. However, related research projects have confirmed the importance of progressive human resource practices for encouraging innovation and good corporate and organisational outcomes; see for example Michie & Oughton (2001b) and Michie & Sheehan-Quinn (2001).
10. See Burchell et al. (2002) for a discussion of the international evidence, as well as for evidence from their own surveys of job insecurity and work intensification.

References


