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Discussion Paper

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Promoting Innovation in the European Union

On the Development of Sound Competition and Industrial Policies

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Introduction

Science, technology, innovation, and competiveness are subjects that concern almost every government in the world. In the current global environment, the capacity of an economy to derive competitive advantages through technical change and innovation is at the core of its ability to sustain economic growth and competitiveness. Policy makers are therefore challenged daily to create policies and programs that allow firms and institutions to innovate and diffuse, adapt, and apply information and knowledge efficiently and effectively.[1] In the European Union (EU), policy makers are under particular pressure to make swift policy changes so that the EU can meet its Lisbon Strategy goal of becoming the most "competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth" by 2010.[2]

1 Luc Soete and Bas ter Weel, Schumpeter and the Knowledge-Based Economy: On Technology and Competition Policy. (Maastricht, The Netherlands: Department of Economics, University of Maastricht and Maastricht Economic Research Institute on Innovation and Technology, 1999).

2 Lisbon Agenda, Lisbon European Council, Presidency Conclusions, March 23-24, 2000, http://www.europarl.europa.eu/summits/lis1_en.htm

In attempting to explain differences in growth performance, economists long focused on analyzing differences in capital and land. But in the new world economy these old concepts have been replaced with new ones – ideas and human creativity (and the ability to apply new concepts to practical uses in an efficient manner) are now widely regarded as the ultimate sources of economic growth. Consequently, economists have started to recognize that knowledge accumulation can be analyzed like the accumulation of any other capital good. One can even apply economic principles to the production and exchange of knowledge.[3]

Moreover, knowledge accumulation can be produced and used in the production of other goods, even in the production of itself.[4] Thus, we can infer that innovation and knowledge are the new main source of wealth of nations, business, and people. And thanks to information and communication technologies, the speed at which knowledge is accumulated and diffused in today's world is faster than ever. This fundamental change has created great opportunities for many countries, and at the same time served as a stumbling block for others. The EU is currently facing difficulties that stem from major shifts in the global economy between the 1970s and 1990s (i.e., Asia's rapid growth).[5] During this period, Europe's productivity growth slowed compared to its competitors, and as a result it experienced losses that were manifested particularly in technologically sophisticated sectors. Accordingly, Europe's ability to restore productivity growth losses, namely in technologically sophisticated sectors, and remain competitive in the global economy has become increasingly difficult.[6]

3 Soete and ter Weel, Schumpeter and the Knowledge-Based Economy, 4.

4 Ibid.

5 Japan and the Asian firms increased their overall market share between 1970 and 1995 by more than five times, from 2.1 to 10.8 percent of the global market. This rapid growth was accompanied by structural change which in turn altered the specialization pattern of these countries. In contrast, both Europe and the U.S. lost overall market shares – these losses were generally visible in high technology sectors, namely in science-based industries.

6 For a long-run perspective on Europe's growth and competitiveness, see Jan Fagerberg, Paolo Guerrieri, and Bart Verspagen, The Economic Challenge for Europe: Adapting to Innovation Based Growth (Cheltenham, England: Elgar Publishing, 1999).

Without an understanding of what shapes innovation processes in Europe, it is very difficult to design policies in this area.[7] Because the production of knowledge does not take the form of physical goods or equipment, it can be difficult to assess and can often be severely underestimated in policy. However, policy makers should be aware that knowledge production "blueprints" can be seen in patents, designs, software programs, and manuscripts, as well as in human beings and in organizations. The difficulty of measuring knowledge production can be tackled by evaluating bibliometric data, research and development (R&D) indicators, patent data, and innovation figures. Measuring the effects of innovation is quite important; some empirical evidence shows that innovation is so significant that innovation in specific firms can have economy-wide effects.[8]

Given the importance of innovation to a knowledge-based economy, it is essential that policy makers give adequate attention to the evaluation, examination, and dissection of the process of knowledge creation for innovation-based policies to be efficient and effective. Due to the economic effects of globalization and the speed at which knowledge is now accumulated and diffused, Europe's policy makers face new challenges – namely, creating policies that restore the dynamism, creativity, and competitiveness that characterized the European economy in earlier periods.[9] These modern policies must be based on innovation and knowledge to be successful. In addition, with 27 Member States, the EU has an intricate system to manage, as not all countries are able to catch up at the same rate or to the same extent.[10] In light of these challenges that face EU policy makers, this paper attempts to address two fundamental questions: What is innovation? And

7 Fagerberg, Guerrieri, and Verspagen, Economic Challenge for Europe, 1-19.

8 Haider Khan, "Building an Innovative Economy Through Managed Creative Destruction: A Theory with Applications to South Korea" (MPRA Paper 7713, University Library of Munich, Germany, 2008).

9 Fagerberg, Guerrieri, and Verspagen, The Economic Challenge for Europe, 228-237.

10 Rajneesh Narula, "Understanding Absorptive Capacities in an 'Innovation Systems' Context: Consequences for Economic and Employment Growth" (Danish Research Unit for Industrial Dynamics, Copenhagen Business School, 2003).

what kind of policy is best suited for the job – one anchored in competition policy or industrial policy?

Evaluation of the EU's economic performance is often couched in short-term analyses. However, innovation and knowledge are strongly linked to long-term growth. Therefore, this paper takes a broader, big-picture approach and explores knowledge creation in a long-run context. A discussion of innovation is provided that includes the basic concepts, characteristics, and dynamics of innovation, as well as a discussion of systems of innovation and several policy concerns regarding innovation. The benefits of a competition structure for innovation will be demonstrated by building on well-known economic growth theories, particularly Schumpeter's theory of creative destruction and radical innovation, as well as Hayek's theory of discovery. The rationale and justification of an industrial policy structure (i.e., market intervention) will also be presented. A short analysis of the EU Lisbon Strategy is provided, as well as a short discussion of the effects of a rigid industrial policy that may hinder innovative efforts. Finally, a short examination of innovation in the European automotive industry is provided.

1. Defining Innovation

There have been significant changes in the role of innovation in economic growth.[11] Information technology in particular has already had a substantial impact on growth, according to the Organization for Economic Cooperation and Development (OECD), and may offer improved performance throughout the economy – even in sectors that have previously experienced slow growth and a low degree of innovation.[12] While the potential for current growth exists, relatively few countries (e.g., the United States in the information technology sector) have been able to reap the benefits of

11 Growth theory based on technological change and R&D has largely been focused on understanding growth in developed countries. Therefore, the observations and information in this paper may not reflect conditions in underdeveloped countries.

developments in innovation. This strongly suggests that the benefits of technological change are conditioned on a range of balancing factors and policies.[13] Before engaging in a deeper discussion, we must first address the basic concept of innovation and draw some general conclusions.

The concepts of *invention* and *innovation* are often confused – understandably so, because they are part of the same process. Schumpeter, perhaps the world's leading theorist on the subject, was the first to make the distinction, and it has generally been incorporated into economic theory since.[14] An invention is the first occurrence of an idea for a new process or product – a thought, sketch, or model for a new or improved device, product, process, or system. As Freeman points out, such inventions may often (not always) be patented, but they do not necessarily lead to technical innovations. An innovation, however, is the first attempt to carry it out in practice.[15] In a sense, an innovation is accomplished when the first commercial transaction is made involving the new product, process, system, or device.[16]

Inventions can take place anywhere (i.e., individually or collectively, privately or publicly), but innovations occur mostly in firms, where an invention becomes an innovation.[17] Transforming an invention into an innovation can depend heavily on several components – namely, knowledge, capability, skills, and resources. Innovation is often seen as the central factor that separates competing firms, regions, and countries in terms of performance. Thus, firms that are able to carry out innovation are likely to prosper at the expense of their less-equipped competitors. In his work,

12 Organization for Economic Cooperation and Development, A New Economy? The Changing Role of Innovation and Information Technology in Growth (Paris: OECD, 2000).

13 Ibid.

14 C. Freeman, "Formal Scientific and Technical Institutions in the National System of Innovation," in B.A. Lundvall, National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning (London: Pinter, 1992), 76.

15 Jan Fagerberg, David C. Mowery, and R. R. Nelson (eds.), The Oxford Handbook of Innovation (Oxford, England: Oxford University Press, 2005).

16 Freeman, "Formal Scientific and Technical Institutions."

17 This is not to say that universities do not play an important role in a knowledge-based economy, but their most important impact seems to stem from factors such as the supply of highly educated and skilled personnel in firms.

Schumpeter conceived of innovation as a three-phase technological change process:

- Invention – the conception of new ideas
- Innovation – a process that involves the development of new ideas into marketable products and processes
- Diffusion – the stage in which the new products and processes are spread across the potential market

Schumpeter's work heavily emphasizes the role of the entrepreneur who innovates (i.e., individual, firm, research facility) and takes what may seem an irrational risk by incorporating new (sometimes radical) ideas into products and processes. Perhaps the most noted contribution of Schumpeter's work is his theory of "creative destruction" – an economic process in which old ideas and structures (products, processes, and organizations) are continually replaced by new industrial activity. Old ideas are destroyed as new ones are created and implemented. Schumpeter suggested that creative destruction is the source of continuous progress and improved living standards. The theory of creative destruction can provide practical and valuable insights into the innovation process, which may be of particular interest to EU policy makers as they form innovation-based policies.

1.1 Characteristics and Dynamics of Innovation

Classical economists long ago realized the value of innovation in terms of its effects on long-term growth. Since Schumpeter, innovation has increasingly been viewed as something much more complex – a multidimensional process that functions as the primary driver of long-term growth. The study of innovation has evolved considerably over the last century, which has created an abundance of academic and empirical research devoted solely to the examination of innovation and its effects on the economy. The following are the most salient features of the scholarly research, which should undoubtedly be of interest to policy makers.

There are several different types of innovation. While technological innovations of the product and process type may reap much attention, organiza-

tional innovations should not be undervalued. Throughout history, some of the most important innovations have been of an organizational nature.[18] Take new distribution systems for example: The system that accompanied the development of mass production in the United States a century ago revolutionized manufacturing worldwide. Likewise, Toyota and other Japanese companies restructured and streamlined the entire value chain in the automotive industry in the period following the end of World War II by incorporating flexible production techniques like the "just-in-time" system.[19] These organizational innovations not only enabled production to be refined, but also allowed for plant flexibility to produce a range of products on the same production lines without driving up indirect costs.[20] The Japanese lean-production innovation enabled Toyota and others to streamline their manufacturing processes and make tremendous profits. Ever since, manufacturers all over the globe have attempted to mimic these production techniques and methods. This example provides clear signs that organizational innovation may be an important impetus to growth in its own right.[21] Beyond the distinction between production and organizational innovation, Freeman and Perez distinguish between incremental innovations (i.e., improvements in existing production or product technologies) and radical innovations (i.e., discontinuous events including the development of a new product or process).[22]

Innovation is pervasive. It flourishes not only in high-tech industries but in other industries as well, including the service sector.[23] Innovation is occur-

18 Jan Fagerberg, What Do We Know About Innovation? Lessons Learned From the TEARI Project (TEARI Project Report No. 1, Centre for Technology, Innovation, and Culture, University of Oslo, 2004). TEARI Project Report No. 1.

19 K. Bruland and D. C. Mowery, "Innovation Through Time" in J. Fagerberg, D.C. Mowery, and R.R. Nelson, The Oxford Handbook of Innovation (Oxford, England: Oxford University Press, 2005).

20 M. H. Best, The New Competition, Institutions of Industrial Restructuring (Cambridge, England: Polity Press, 1990), 143.

21 Fagerberg, What Do We Know About Innovation.

22 C. Freeman and C. Perez, "Structural Crisis of Adjustment: Business Cycles and Investment Behavior" in G. Dosi, et al, Technical Change and Economic Theory (London: Pinter, 1988).

23 F. Malerba, "Sectoral Systems: How and Why Innovation Differs Across Sectors," in Fagerberg, Mowery, and Nelson, The Oxford Handbook of Innovation.

ring in "practically all parts of the economy," not just a subset of high-technology industries.[24] In the EU, innovation surveys and data demonstrate that innovation is widely spread across European industrial sectors.[25]

Innovation processes are cumulative in nature. According to Fagerberg, the bulk of innovation in modern societies consist of relatively small improvements, and these cumulative improvements are likely to be as great as (or greater than) the more "revolutionary" ones.[26] Fagerberg also notes that innovation seems to be the product of a lengthy process that is "intertwined with diffusion and fundamentally shaped by the learning undertaken throughout the process."[27] Sir Isaac Newton's saying about "standing on the shoulders of giants" applies well here, as future innovations depend on the technologies that exist today. Many of the innovations we see today are the result of long processes of gradual improvement and the incorporation of a long series of innovations over time. Therefore, it is important for policy makers to keep in mind that knowledge creation is a long-term investment; while the benefits are vast, they may not be recognizable immediately.

Radical innovation can occur in response to a specific crisis in existing technologies.[28] Take, for example, the replacement of the horse by the automobile at the end of the 19th century. When the limits of horse power were being reached, the internal combustion engine was able to provide the additional "horse power" needed and at the same time reduce the number of horses, which were creating urban congestion.[29] This observation fol-

24 B.A. Lundvall, National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning (London: Pinter, 1992), 8.
25 Luis Navarro, Industrial Policy in the Economic Literature: Recent Theoretical Developments and Implications for EU Policy (Enterprise Directorate-General, European Commission, Enterprise Paper No. 12, 2003).
26 Fagerberg, What Do We Know About Innovation.
27 Ibid, 7.
28 Richard Lipsey and Cliff Bekar, "A Structuralist View of Technical Change and Economic Growth," in T.J. Courchene (ed.), Technology, Information and Public Policy (Kingston, Ontario, Canada: John Deutsch Institute for the Study of Economic Policy, 1995), 9-83.
29 Ibid.

lows Toynbee's well-known theory that challenges (proportionally) create opportunities for responses.[30]

Innovation processes are uncertain and nonlinear. The path of innovation is unpredictable and characterized by a complex feedback mechanism and interactive relations between numerous actors and institutions within the innovation system.[31] Since innovation is a system, rather than a set methodology, there are inherent risks associated with it. In the Schumpeter and Hayek tradition, competition is said to serve as an exploration and invention device that brings about creative destruction – a dynamic that is anything but linear or predictable.

The application of an innovation is typically characterized by positive feedback loops.[32] Success in a technology's application often leads to a desire to improve on its successes, which can give rise to a new set of products and product techniques. Arthur referred to this phenomenon as the "bootstrap effect." He observed that the depth and breadth of a technology's impact grows in proportion to the resources invested in its use, which can lead to acceleration in its rate of diffusion.[33]

Innovation may necessitate structural change. When new technologies are fitted into the structures of their predecessor technologies, they often operate below their full potential.[34] Thus, major structural changes may be warranted to maximize the capacity of the new technology and to maximize efficiency gains.

Technological cooperation is essential. There is strong evidence that interactions between organizations are crucial in learning processes, which are generally the basis for the development of innovations.[35] Edquist suggests

30 Arnold Toynbee, Studies of History: Abridgement of Volumes I-VI (London: Oxford University Press, 1947), 51.
31 Navarro, Industrial Policy.
32 Ibid.
33 B. Arthur, Competing Technologies: An Overview, Technical Change and Economic Theory (London: Pinter, 1988).
34 Lipsey and Bekar, "A Structuralist View of Technical Change."
35 Charles Edquist, "Systems of Innovation – Perspectives and Challenges," in J. Fagerberg, D.C. Mowery, and R.R. Nelson (eds.), The Oxford Handbook of Innovation (Oxford: Oxford University Press, 2004).

that firms "hardly innovate in isolation," but rather in collaboration and interdependence with other organizations (i.e., suppliers, customers, competitors, universities, schools, government ministries). Innovation by means of working within a social network may suggest that further innovation can flourish if the boundaries of organizations and industries can be linked together, especially where problems can be linked together in a creative process that challenges and benefits participants.[36] As Navarro highlights, recent literature places a stronger emphasis on the pro-competitive aspects of knowledge sharing. The concept of "alliance capitalism"[37] used by Dunning relates to the "coexistence of competition, strengthened by globalization and liberalization, with an increasing number of alliances and network relations between competitors."[38]

1.2 Systems of Innovation

Thus far, evidence has been provided to illustrate the characteristics and dynamics of innovation. This section briefly addresses systems of innovation (SI), a branch of study that can help clarify the role that institutions and governments play in innovation and technological progress. SI attempts to analyze the links between the "all important economic, social, political, organizational factors that influence the development, diffusion and use of innovations" from an interdisciplinary perspective.[39]

The initial premise is that institutions, laws, and norms can create "incentives and obstacles" for innovation.[40] A trend is apparent in research that incorporates these ideas into practice, as many research projects have begun with the assertion that it is necessary to get away from viewing innova-

36 Eric von Hippel, Democratizing Innovation (Cambridge, MA: MIT Press, 2005).
37 J. H. Dunning, Alliance Capitalism and Global Business (London: Routledge, 1997).
38 Navarro, Industrial Policy.
39 Charles Edquist, Systems of Innovation: Technology, Institutions, and Organizations (London: Pinter, 1997), 14.
40 Edquist, "Systems of Innovation – Perspectives and Challenges."

tion as a process of mere individual decision making undertaken independently of institutional environments.[41]

Since institutions in large part control the external environment in which firms operate (vs. a firm's internal environment), we can assume the institutional element not only plays an important role in the innovation process, it plays a central role. Institutions wield considerable power as they set the conditions under which firms can achieve innovative success or failure.[42] Although a national system of innovation is often used to identify "the network of institutions in the public and private sectors whose activities and interactions initiate, import and diffuse new technologies,"[43] several authors have emphasized increasing internationalization as an argument against the concept of the national system. This is further supported by recent OECD research that confirms the importance of the international dimension in systems of innovation.[44]

Interactive learning and user-producer interactions also seem to have a vital impact on systems of innovation.[45] Lundvall suggests that the "structure of production" and the "institutional set-up" are the two most critical elements that "jointly define a system of innovation."[46] Policy makers therefore not only bear a special responsibility to formulate policies focused on the economics of knowledge production, but must create strong institutional systems as well.

Fagerberg identifies three types of learning within an SI:

41 Keith Smith, "Innovation as a Systematic Phenomenon: Rethinking the Role of Policy," Enterprise and Innovation Management Studies, (2000), 73-102.

42 It should also be noted that internal factors (i.e., corporate structures, strategies, and decision making) can also have a great effect on determining the success of an innovation. For a more in-depth analysis of firm-level innovation, see Wolfgang Streeck, "The Transformation of Corporate Organization in Europe: An Overview," in Institutions, Innovation, and Growth (Cheltenham, England: Elgar, 2003).

43 C. Freeman, Technology Policy and Economic Performance: Lessons from Japan (London: Pinter, 1987).

44 Organization for Economic Cooperation and Development, Dynamising National Innovation Systems (Paris: OECD, 2002).

45 Lundvall, National Systems of Innovation.

46 Ibid., 10.

- Innovation, which takes place mainly in firms and leads to creation of "structural capital." Since structural capital is an asset controlled by firms, it is a matter of organizational learning.
- Research and Development, which is carried out in universities and public research organizations as well as in firms and leads to publicly available knowledge owned by firms and other organizations, as well as individuals.
- Competence building (i.e., training and education), which occurs in schools and universities as well as in firms and leads to the creation of human capital. Since human capital is controlled by individuals, it is a matter of individual learning.[47]

While these types of learning are distinct from one another, they cannot be expected to be wholly independent from each other. They most probably support and reinforce – or offset – each other.[48] Therefore, it is important to focus on the relations between the three kinds of learning. While SI places much emphasis on the activities, the individual components cannot be neglected. Fagerberg suggests that policy makers should focus on both activities and components to understand and explain innovation processes. The relations between activities and components, as well as the different kinds of components, ought to be addressed.[49]

1.3 Innovation and Policy Considerations

There is no doubt that innovation has great economic effects, and its benefits are universally appreciated. However, much uncertainty exists over which policies provide the most supportive environment for innovation and technological progress.

It has been noted that Schumpeterian economics can serve as a valuable resource in outlining the focus and nature of technology and innovation policy goals. As Schumpeter asserted, the creative destruction process is

47 Edquist, "Systems of Innovation – Perspectives and Challenges," 192.
48 Ibid.
49 Ibid.

occurring at the firm and industry sector level. But we also know from SI studies that the process is heavily influenced by institutions, laws, and norms that are created by the state. Therefore, we can infer that there is a complex interaction between the state policies and market processes that influence the decisions taken by firms. It is within this realm that policy makers should concentrate their efforts. While much research is being done in this area, this paper seeks only to underscore three of the most prominent themes.

Subsidies can reduce incentives to innovate. As European firms tend to experience relatively large rents, inefficient firms generally do not leave the market; as a result, too few new, efficient enterprises are created to replace them. As Alesina points out, the result is "insufficient innovation and no 'creative destruction' by which the natural disappearance of less efficient firms leaves room for more efficient ones." [50] Instead of encouraging creative destruction, European governments tend to heavily subsidize incumbent firms, thinking that these grants will somehow advance innovation. An example of this line of thinking was German Chancellor Angela Merkel's decision to provide 25 million euros in subsidies to existing firms and infrastructure investment, one of her first economic decisions in office.[51]

The regulatory environment is crucial. While sufficient focus should be given to policy making in the area of stimulating innovation, proper attention should also be paid to the factors that can significantly help or hinder innovation in real time. The development or success of an industry (particularly an emerging industry) is faced with a number of problems or uncertainties that government policies can help to address. For instance, failure to create product and technical standards can impede cost improvements. A lack of standard is often caused by product and technology uncertainties that exist, especially in emerging industries.[52] Likewise, industries often face delays in gaining recognition and approval by regulatory agen-

50 Alberto Alesina and Francesco Givazzi, The Future of Europe: Reform and Decline (Cambridge, MA: MIT Press, 2006), 79-100.

51 Ibid.

52 Xiudian Dai, Corporate Strategy, Public Policy and New Technologies: Philips and the European Consumer Electronics Industry, (Oxford: Pergamon, 1996), 24-27.

cies when offering new approaches to needs currently being addressed by other means and subject to regulation.[53]

Dynamic R&D programs are essential. It has been widely established that R&D plays a significant factor in economic growth. But innovation policy discourse tends to focus heavily on how much R&D funding is available and how it should be distributed, rather than on innovation itself. Furthermore, the level of R&D funding explains very little of the economic and competitiveness performance of the economy.[54] Attention should also be placed on the productivity of R&D spending. Since innovation comes from the application of knowledge accumulation, failing to focus on the "innovative output" would be counterproductive. R&D efforts would therefore greatly benefit from more dynamic R&D policies aimed at not only stimulating innovation, but applying it.

2. Governance of Innovation: Competition Policy and Industrial Policy

The EU uses two key methods for governance of innovation – competition policy and industrial policy. Although the EU's internal market was originally designed to function as a market economy, over time, elements of industrial policy (i.e., government interventions due to perceived market failures) have gradually worked their way into the governing treaties of the EU.[55] Competition policy aims to strengthen market forces, to prevent market power and other distortions to competition. Industrial policy, however, attempts to remedy imperfections through government intervention. At the most basic level, competition policy and industrial policy are fundamentally opposed to each other.

53 Ibid.

54 Navarro, "Industrial Policy in the Economic Literature."

55 Legal basis for industrial policy, see: Merger Control Regulation 1989 – promotion of technical progress as an exception; Maastricht Treaty Article 157 ff – fostering better exploitation of the industrial potential of policies of innovation, research, and technological development; Single European Act (SEA) 1987 – regional cohesion policy and research and development; Amsterdam Treaty 1997 – social policy and employment policy.

Creating coherence between the objectives of competition, industrial, and innovation policies is essential for the future and success of the European integration. Without coherence, the evolution of Europe's economic structure may lead to a further weakening of competitiveness.[56] The following is a brief examination of some key elements of competition and industrial policies.

3. Competition Policy

Competition is the core of the market and the permanent driving force in an efficient economy, since competitive forces are what reward successful activities and penalize inefficiency and failure. Although perfect competition does not exist, competition policy attempts to protect competition (not competitors) and guarantees economic freedom. Without a competition policy, the market would be destroyed, as cartels and monopolies would rule.

It can be said that a competitive market is like a democratic society, in the sense that no individual or company is allowed to exercise power over another individual or company.[57] It is therefore critical to protect the fundamental principles of freedom in the marketplace against attempts (by individuals, companies, and/or groups) to extend influence and power over others, either through manipulation of rules or through illegal behavior.

Numerous economists have observed that technological change and productivity growth tend to occur more freely when the government sets a favorable climate for change.[58] In some cases, we can observe firms banning

56 Mario Pianta and Marco Vivarelli, Employment Dynamics and Structural Change in Europe: The Economic Challenge for Europe (Cheltenham, England: Elgar, 1999), 83-103.

57 Johann Eekhoff and Christiane Moch, "Competition Policy in Europe, Competition – the Core of the Market Economy," in Johann Eekhoff (ed.), Competition Policy in Europe (Berlin: Springer-Verlag, 2004).

58 P. Aghion, W. Carlin, and M. Schaffer, "Competition, Innovation and Growth in Transition: Exploring the Interactions Between Policies" (William Davidson Institute Working Paper No. 151, 2002).

together in cooperation on various joint R&D projects.[59] We know from Dunning's work that "alliance capitalism" has become increasingly prevalent. Therefore, policy makers must reinforce competition policies that create an environment where these competitive partnerships are possible.

3.1 Competition Policy and Innovation

Competition presents an interactive process in which actors are rivals, and these rivals create or affect the incentives for innovation. Competition appears to have a substantial impact on how a firm formulates its business strategy, especially with regard to R&D. In 1934, Schumpeter observed that entrepreneurs create technical and financial innovations in the face of competition and falling profits, and these new activities in turn generate economic growth.[60] Empirical data suggests that competition is the main driver behind a firm's decision to spend funds on innovation and knowledge creation. Porter suggested that competition is beneficial for growth because it forces firms to innovate in order to survive,[61] and according to a 2000 OECD report on innovation and information technology growth, "competition matters" in knowledge-based economies, because it drives firms to invest in efficiency-enhancing technologies and innovation.[62] The OECD asserts that firms will invest in innovation if they can expect sufficient returns and if competition forces them to improve performance.[63]

59 A recent example of this approach can be seen in the joint venture between Robert Bosch Corporation and Samsung SDI Co. Ltd. (announced July 2008) to develop, manufacture, and sell lithium-ion batteries – a product with multiple applications, including hybrid and electric drives for vehicles and laptops, mobile phones, and power tools.

60 Joseph Schumpeter, The Theory of Economic Development (Cambridge, MA: Harvard University Press, 1934).

61 Michael Porter, The Competitive Advantage of Nations (New York: Free Press, 1990).

62 Organization for Economic Cooperation and Development, A New Economy? The Changing Role of Innovation and Information Technology in Growth (Paris: OECD, 2000), 73.

63 Ibid. 76.

Recent empirical work[64] suggests a positive correlation between product market competition and productivity growth or "innovativeness" within a firm or industry sector. Competition can also have a positive overall effect on the rate of innovation, because firms may try to innovate in order to escape competition.[65]

3.2 Overview of Economic Growth Theories and Technology Policy

Behind technology lies technological knowledge.[66] We know that we can make new systems, machines, or products that we do not have blueprints for, but we know based on technological knowledge whether we can try to build them or not.[67] Until we attempt to build a new type of automobile, for example, we cannot be certain of its development costs or its running costs. The more our proposed automobile is like the automobiles we've built previously, the more certain we can be regarding its costs. Likewise, the more our proposed automobile is unlike any automobile we've built in the past, the greater the cost uncertainty.[68]

In terms of discovery of new technologies, people are much more productive today than 100 years ago. According to Baumol, "virtually all the economic growth that has occurred since the eighteenth century is ultimately attributable to innovation."[69] Technological change makes an enormous contribution to a society's increased productivity and arises from formal research and development programs and from informal (individual) trial

64 See S. Nickell, "Competition and Corporate Performance," Journal of Political Economy, (1996), 724-246; R. Blundell, R. Griffith, J. Reenen, "Market Shares, Market Value and Innovation in a Panel of British Manufacturing Firms," Review of Economic Studies, (1999), 529-554.

65 Peter Howitt, "Innovation, Competition and Growth: A Schumpeterian Perspective on Canada's Economy," C.D. Howe Institute Commentary, 246 (2007), 6.

66 Thomas J. Courchene, Technology, Innovation and Public Policy (Kingston, Ontario, Canada: John Deutsch Institute for the Study of Economic Policy, 1995), 9-93.

67 Ibid.

68 Ibid.

69 William Baumol, The Free-market Innovation Machine: Analyzing the Growth Miracle of Capitalism (Princeton: Princeton University Press, 2002), 13.

and error. In essence, technological change involves discovering new ways of getting more out of our resources.[70]

Since the time of Adam Smith, economists have attempted to explain why some societies succeed and others fail in producing the goods that make societies healthy and prosperous. Smith argued that when societies adopt rules of market capitalism, their economies grow; when they fail to adopt rules of market capitalism, their economies fail. Several economic models have been developed to explain the factors surrounding growth. The two most recognized mainstream theories are neo-classical theory and the new growth theory.

3.2.1 Neo-Classical Theory

Neo-classical theory (i.e., the Solow-Swan model) was the first economic model to incorporate technological progress as a factor to explain economic growth. It assumes that the key determinant of growth is the capital accumulation as productivity growth results from increases in the amount of capital per worker. In the long run, the model suggests that growth is determined exclusively by the rate of technological change.

Critics (including Schumpeter) have identified the shortcomings of the neo-classical model in great detail. Their concerns lie with the theory's basic assumptions that people have full and perfect information, act perfectly rationally, and are permanently seeking to maximize their satisfaction as consumers and maximize their profits.[71] Economists over time have pointed out that these notions fail to incorporate important aspects of human behavior, as people's choices are not always determined by logical consequences. In addition, the premise that perfect knowledge and perfect competition exist is highly questionable; they are widely accepted as impossible apart from divine intervention.

70 Michael Parkin et al, Economics, 5th ed. (Upper Saddle River, NJ: Pearson Education, 2003), 680-699.

71 Gijs Mom, "Conceptualizing Technical Change: Interaction Between Alternative Artifacts in the Evolution of the Automobile" (paper presented at the Future of In-

3.2.2 New Growth Theory

Romer's new growth theory renewed the study of economic growth by focusing on knowledge investments and "spillovers" and by conceptualizing innovation as a product of a deliberate effort of firms, rather than a pure externality.[72] It seeks to address the shortcomings of the Solow-Swan model by incorporating two concepts: 1) Technological progress is a product of economic activity; and 2) knowledge and technology are characterized by increasing returns, and these returns drive the process of growth.[73] Romer clarified the role of knowledge in the technological process when he wrote:

> Ultimately, all increases in standards of living can be traced to discoveries of more valuable arrangements for the things in the earth's crust and atmosphere.… No amount of savings and investment, no policy of macroeconomic fine tuning, no set of tax and spending incentives can generate sustained economic growth unless it is accompanied by the countless large and small discoveries that are required to create more value from a fixed set of natural resources.[74]

Ideas are non-rival goods – once developed, an idea to build a safer vehicle can be used by a vehicle manufacturer, supplier, etc. Historical experience suggests that as time passes, "one technological change may bring massive gains, to be followed by another that brings smaller gains, to be followed by a shift that brings even larger gains."[75] This can certainly be witnessed in every industry sector, especially where technology is used. The development of sensor technology, for example, can be characterized as a single technological advancement that has brought massive gains, as sensors have been integrated into countless applications and tasks. From heat sensing, to

novation Studies Conference, Eindhoven University of Technology, Eindhoven, The Netherlands, September 2001).

72 Navarro, "Industrial Policy in the Economic Literature."

73 Joseph Cortright, New Growth Theory, Technology and Learning: A Practitioner's Guide (Washington, DC: U.S. Economic Development Administration, 2001).

74 P. M. Romer, "Implementing a National Technology Strategy with Self-Organizing Industry Investment Boards," Brookings Papers on Economic Activity: Microeconomics (Washington, DC: Brookings, 1993), 345.

75 Lipsey and Bekar, "A Structuralist View of Technical Change."

motion detection, to ranging sensors – sensor technology has brought immeasurable gains to products and processes in just about every modern industry. In the automotive industry for instance, sensors contribute to the functioning of numerous systems, including vehicle safety and fuel efficiency,[76] and even to the manufacturing process itself through the use of robotics and high-tech equipment at the plant level. The message here is that there are no known limits to economic growth based on technological change.

New growth theory holds that "the ability to grow the economy by increasing knowledge, rather than labor or capital, creates opportunities for nearly boundless growth."[77] Because ideas are infinitely shareable and reuseable, we can accumulate them without limit. In effect, new growth theory describes the economy as a kind of perpetual motion system in which the economy is constantly being disturbed by technological innovations (where some people lose, and others gain). Some have observed that new growth theory expresses the economy in a kind of competitive Darwinian manner, where survivors succeed in "creating, adopting, and improving new technologies."[78] Policy makers, as a result, can raise growth permanently by increasing the size of investments on R&D or improving the "appropriability conditions" of knowledge.[79]

3.3 Schumpeter – Creative Destruction

This paper has relied heavily on Schumpeter's insights into the innovation process. From Schumpeter's work, we can draw several conclusions that are key to policy debates:

76 Automotive sensors maintain the proper functioning of various technologies, including safety systems like air bags, tire pressure monitoring, and electronic stability control. In the near future, sensor technology is expected to manage driver commutes, help avoid accidents, and provide drivers with increased convenience and comfort.

77 Cortright, New Growth Theory, 2.

78 Howitt, Innovation, Competition and Growth, 1.

79 Navarro, "Industrial Policy in the Economic Literature."

- Increased competition in the market strengthens firms' incentives to innovate
- Competition policy should therefore be strengthened and strictly enforced.
- Patent protection should be a key issue – the more patent rights are extended, the more inventors may be discouraged to inhibit the flow of ideas.[80]
- Universities should continue to develop relationships with firms to ensure that innovative ideas turn into adopted technologies.[81]
- As technological change thrives on competition, a liberal international trade strategy may be beneficial.
- Education systems may need to be strengthened and mobility barriers and labor restrictions may need to be reduced.
- Policy makers should remain aware of the long-run implications of policies, because even a small increase in long-run growth rates implies enormous economic gains.[82]

3.4 Hayek – Competition as a Discovery Procedure

In addition to Schumpeter's innovation concepts, Hayek's theory of competition as a discovery procedure provides evidence from which we can draw several helpful conclusions. Hayek begins with the assumption that like experimentation in science, "competition is foremost a discovery procedure."[83] Competition may not lead to a maximization of measureable results, but as Hayek asserts, under favorable conditions, competition leads to the use of more skill and knowledge than any other known procedure. Ac-

80 Howitt, Innovation, Competition and Growth, 7.
81 Ibid.
82 Ibid.
83 F.A. Hayek, Law, Legislation and Liberty: The Political Order of a Free People (Chicago: University of Chicago Press, 1979), 68-70.

cording to Hayek, competition is of value because it constitutes a discovery procedure which would not be needed if we could predict the future.[84]

While Schumpeter's approach describes the entrepreneur as a creative destroyer, Hayek's approach observes the individual as a creator, adopter and user of knowledge.[85] Although their works differ in several ways, both Schumpeter and Hayek assert that competition is an absolutely necessary precondition for innovation. Although their works do not perfectly conform to one another, a unified Schumpeter-Hayek system provides a complementary platform for generic economic analysis.[86]

4. Industrial Policy

There is often some confusion over the aim and focus of industrial policy. From a broad perspective, industrial policy can be defined as government intervention due to perceived market failures. To this end, governments willingly restrict competition and offer privileged financing or treatment to certain sectors. This approach aims to promote rising industries and global players, foster competitiveness, and provide framework programs for R&D projects. There are two main types of industrial policy – a selective industrial policy favors specific firms, industries, or sectors (i.e., choosing national champions), while a general industrial policy does not discriminate between firms, industries, or sectors.

The industrial policy approach tends to be associated with certain skepticism of the government's ability to fully rectify the market problem, as policy makers pretence of knowledge in an open and competitive environment.[87] In the innovation process, some innovations will succeed and others will fail, but regardless of any circumstances, governments have no way of determining the future. In some cases government intervention

84 Ibid.

85 Kurt Dopfer, "The Origins of Meso Economics: Schumpeter's Legacy" (Papers on Economics and Evolution No. 610, Max Planck Institute of Economics, Jena, Germany), 23-24.

86 Ibid.

leads to "government failure," which can be characterized as a kind of "over-adjustment," and as a result more than offsets the benefits of intervention.[88] This approach is also criticized for wasting public resources, fostering rents, and inciting corruption.

The most common forms of market failures are indivisibilities, externalities, and information problems (i.e., asymmetries). Indivisibilities exist when there are high sunk costs acting as market entry or exit barriers. Indivisibilities are also characterized by economies of scale and economies of scope.

A common justification for the use of industrial policy is the occurrence of an "externality" in knowledge creation.[89] Innovations are said to have high costs because the one who invests the most (e.g., R&D, labor) benefits the least—once an innovation is created and diffused it becomes very easy to copy. This concept is referred to as a "positive externality." Firms are unable to realize all the benefits of their own investment because some of these benefits flow to other firms and sectors. This provides evidence that there may be a role for policy makers to organize publically funded R&D projects, in order to provide incentives for firms to invest in knowledge creation, despite the externalities.

Information asymmetries may also exist (e.g., principal-agent problem). For instance, when one party has better or more information than the other – about the quality of a used car, for example – this can create an imbalance of power in transactions between the buyer and seller, and as a result one side is at a disadvantage relative to the other. Information asymmetries may also present themselves as adverse selection problems, opportunism, or moral hazards. These information imperfections may help to explain why many firms prefer to carry out in-house R&D projects or mutually share resources with competing firms, rather than contract the work out to a third party.[90] Policy makers may therefore be interested in addressing in-

87 F.A. Hayek, "The Pretence of Knowledge" (Nobel Memorial Lecture, (Stockholm, Sweden, December 11, 1974).
88 Navarro, "Industrial Policy in the Economic Literature."
89 Ibid.
90 Soete and ter Weel, Schumpeter and the Knowledge-Based Economy.

formation asymmetry problems in order to establish policies that seek to create an environment where both sides can achieve mutual maximum benefit.

Interestingly, there is a strong tension in treaty documents between competition policy and industrial policy.[91] From its inception, the EU had a pure economic focus and was designed to function as a market economy with competition serving as the cornerstone. Over time however, the EU has become a political actor (as well as a legal actor); political preferences have often led to market intervention as politicians seek to shape economic development.[92]

The current Reform Treaty provides several rationales for market intervention – many of which are problematic from an economic perspective. The Reform Treaty aims to achieve a "highly competitive social market economy,"[93] yet it establishes a principle of a collective welfare state. This goal is incompatible with the original concept of the market economy, where competition is the cornerstone.[94] The Reform Treaty also devalues the notion of competition, by removing it as a general objective of the EU and only referencing in a protocol.[95] Furthermore, the Treaty strengthens the

91 Klaus Bünger, "Competition Policy and Industrial Policy of the EU" (Lecture at the Center for European Integration, Bonn, Germany, December 10, 2007).

92 Legal basis for industrial policy, see: Merger Control Regulation 1989 – promotion of technical progress as an exception; Maastricht Treaty Article 157 ff – fostering better exploitation of the industrial potential of policies of innovation, research, and technological development; Single European Act (SEA) 1987 – regional cohesion policy and research and development; Amsterdam Treaty 1997 – social policy and employment policy.

93 Treaty on European Union, Article 3(3): "The Union shall establish an internal market. It shall work for the sustainable development of Europe based on balanced economic growth and price stability, a highly competitive social market economy, aiming at full employment and social progress, and a high level of protection and improvement of the quality of the environment. It shall promote scientific and technological advance."

94 Klaus Bünger, "The Lisbon Treaty, Change or Failure of Europe – A Critical View to the Lisbon Treaty from an Economic Perspective" (Lecture presented at the conference of the Friedrich Naumann Foundation for Freedom, Brussels, Belgium, June 5, 2008).

95 Bünger, The Lisbon Treaty.

role of industrial policy (e.g., rationale for market intervention),[96] which can lead to increased inefficiency and government failure.

4.1 Market Intervention

Imperfect competition is often the rationale for targeted industrial policy. Brander and Spencer (1983) developed the case for "strategic policy," a trade policy that affects the outcome of strategic interactions between firms in a market that is dominated by a small number of sellers (i.e., oligopolists). They assume that policy makers may foster artificially dominant positions for domestic firms to retain profits within their national borders. Brander and Spencer's analysis shows that subsidies can deter sector investment and production by foreign competitors as a benefit to the domestic economy.

Another common rationale for government intervention is the "infant industry" argument, which argues for protection of newer industries against older ones. The infant industry argument has been subject to a number of well-founded criticisms.[97] While there may be cases in which infant industry protection is legitimate, there are practical problems in creating policies mainly because policy makers lack sufficient industry and trade information. In addition, proponents of infant industry protection argue that policy makers should impose tariffs, quotas, and duty taxes to keep international competitors from damaging the infant industry – strategies that challenge the notions of competition and free trade.

4.2 Industrial Policy Developments in Europe

Since the 1990s, Community institutions have clearly included innovation polices in their documents[98] and several innovation initiatives helped to set

96 Ibid.

97 Narvarro, "Industrial Policy in the Economic Literature."

98 Federica Rossi, "Innovation Policy in the European Union: Instruments and Objectives," working paper, Universita degli Studi di Modena e Reggio Emilia, October 2005.

the stage for current EU innovation policy.[99] Since the formation of the Lisbon Strategy (2000) that sets a goal for the EU to become "the most competitive and dynamic knowledge-based economy," innovation has gained increasing importance in the EU policy framework.[100] In addition, the Lisbon Strategy has provided a new impetus and rationale for industrial policy making in the EU. According to the Commission, the main role of industrial policy is to "provide the right framework conditions for enterprise development and innovation." [101] The Commission also maintains that the role of public authorities is to "act only where needed" and reaffirms its commitment "to avoid return to selective interventionist policies."[102] In theory, the Commission asserts that interventionist policies should be avoided, but in practice it seems to operate quite differently. In 2005, the Commission announced a new approach to strengthen Europe's industrial base. The initiative provided several cross-sectoral policy initiatives (e.g., intellectual property rights, competitiveness, market access, sectoral skills, and industrial research) for 27 industry sectors, handpicked by the Commission. In order to build on EU's industry's existing strengths, the Commission explained that it had "undertaken a detailed screening of the competitiveness of 27 individual sectors… The policy areas chosen… were those particularly important for sectoral productivity growth and international competitiveness."[103]

This new industrial policy strategy is a risky one for Europe and raises several questions and concerns. First, if the main goal for industrial policy is to

99 These included the Green Paper on Innovation (1995), followed by the First Action Plan for Innovation in Europe (1996), which identified policy directions and set goals for the Union to "foster an innovation culture," establish a framework conducive to innovation," and "better articulate research and innovation" in Union documents.

100 Federica Rossi, "Innovation Policy in the European Union: Instruments and Objectives."

101 European Commission, "Implementing the Community Lisbon Program: A Policy Framework to Strengthen EU Manufacturing – Towards a More Integrated Approach for Industrial Policy," COM(2005)474 (Brussels: October 5, 2005).

102 Ibid.

103 European Commission, "A New Industrial Policy: Creating the Conditions for Manufacturing to Thrive" (press release, October 10, 2005).

provide a good framework for development and competition for all sectors, why was only a subset of industry selected? Second, the Commission did not make its selection procedure known. How did it choose these 27 specific industries? Third, if these new policies were to fail, who would have the capability to correct them? With these questions unanswered, a critical observer is likely to presume that the EU's new industrial policy distorts competition, fosters rent-seeking behavior, and lacks a long-term focus

5. Damaging Effects of a Rigid Industrial Policy

Since innovation processes are uncertain and non-linear, they need the proper room to function effectively. As institutions, laws and norms can create incentives and obstacles for innovation, it is essential that government policies be somewhat flexible and adaptable in nature so that innovation can persist.

In 2001, European policy makers seemed confident that Europe would become the leading engine of growth for the global economy. Macroeconomic fundamentals, low inflation levels, and an increasingly robust public finance situation all boded well for future prospects.[104] However, many of these expectations have proved to be much too optimistic, as Europe has been unable to find the right formula for growth. This lack of growth may also be at the core of Europe's competitiveness problem.[105] There is widespread belief that these issues stem from the rigidities of the European market, but policy makers in Europe have devoted a great deal of attention to reforming labor markets and pension systems – reforms that may well be necessary. However, reforms that increase competition may be more effective in achieving Europe's economic goals.

Critics often tout the somewhat negative consequences of competition. Their concerns are that increased competition would result in job losses and thus cause problems in the area of social cohesion. Some theoretical literature maintains that increased competition may have perverse effects on ef-

104 R. Faini, J. Haskel, et al., Contrasting Europe's Decline: Do Product Market Reforms Help? (Cambridge, England: Cambridge University Press, 2006).

ficiency, particularly in areas related to innovation.[106] These concerns may certainly be valid, but the overall consensus of academics and policy makers alike is that the benefits of competition outweigh any costs.[107] This position can be supported by two main arguments. First, as indicated by recent OECD research, well-designed product market reforms can play a key role in boosting productivity.[108] Second, many labor market rigidities are intrinsically linked to market distortions.[109] Inefficient regulations typically generate economic rents that in turn foster additional labor market rigidities.[110] Therefore, when pursuing market reforms, policy makers may find it necessary to facilitate structural changes in labor markets as well.

Since a greater proportion of innovations today are radical rather than elemental, the conditions surrounding successful innovation are as important as ever.[111] There is a fundamental difference between the ability of U.S. companies and European companies to change their organizations fast enough to adapt to new technologies. The slower a firm adapts, the longer it takes for the new technology to raise productivity.[112]

In the 1980s, while U.S. corporations were restructuring, European firms were protected by the state, which provided large subsidies, effectively shielding them from outside competition. In addition, European firms typically were elaborately structured "to allow for lengthy consensus building in decision-making."[113] In Germany, for instance, union representatives made up nearly half of supervisory boards in large German firms – a structure that is perhaps not favorable to organizational change. Volkswagen's shareholders had to bribe union leaders on the supervisory board and pro-

105 Ibid.
106 P. Aghion, N. Bloom, et al., "Competition and Innovation: An Inverted U Relationship," The Quarterly Journal of Economics, 120 (2005), 701-728.
107 Faini, Contrasting Europe's Decline.
108 G. Nicoletti and S. Scarpetta, Regulation, Productivity and Growth: OECD Evidence, OECD Economics Department Working Paper No. 347 (Paris: OECD, 2003).
109 Faini, Contrasting Europe's Decline.
110 Ibid.
111 Alesina and Givazzi, The Future of Europe.
112 Ibid, 66-67.
113 Ibid, 68.

vide them with luxury trips to get their agreement on changes to working rules.[114] In light of these factors, the EU may need to de-politicize industrial policy and restore market competition principles in order to achieve its stated innovation and productivity goals.

5.1 Possible Prevention of Innovation

As Schumpeter's and Hayek's work has illustrated, competition is an "exploration and invention device" that brings about creative destruction. This dynamic is not linear or predictable. If we had perfect information and were certain about the future, competition would not be needed.[115] Since industrial policy eliminates some level of flexibility and competition and politicizes economic activity, it is reasonable to infer that it also hinders the prevention of innovation. As knowledge creation and innovation are widely regarded as the ultimate sources of economic growth, these issues should be of critical importance to policy makers.

5.2 Externalities

When we think of public policy we tend to think in normative terms, that is, about the public interest and public choice. Economists often identify four areas in which market intervention may be needed to achieve economic efficiency: externalities, monopoly, public goods and incomplete social insurance, and the distribution of income and wealth.[116] These rationales for market intervention are particularly common in the EU, since many Member States have long histories of state-owned industries, government subsidies, and social welfare programs. As SI studies demonstrate, innovation is a process not of individual decision making, but one where the structure of production and the institutional set-up are the most critical elements.[117] Therefore, policymakers must weigh the pros and cons of their political decisions against the pros and cons of economic efficiency before intervening into the market.

114 Ibid.
115 Hayek, Law Legislation and Liberty.
116 Courchene, Technology, Information and Public Policy, 447-465.
117 Lundvall, National Systems of Innovation.

6. Case Study: Innovation in the European Automotive Industry

The EU automotive sector is the largest automotive production region in the world, employing about 2 million employees directly and nearly 8 million indirectly.[118] Several million units are produced in Europe annually (16.9 million units in 2002), and in 2002 auto exports accounted for € 66.2 billion. Given these figures, there is no doubt that the success of the European economy rests heavily on the success of Europe's automotive sector.

As the automobile becomes more high-tech, the manufacturing, design, and production becomes more complex for auto manufacturers and suppliers. This reality is balanced with the shared goals of making products quicker, better, cheaper, safer, and cleaner. The automobile has seen drastic changes over its lifetime – it has been transformed from a relatively simple mechanical machine into a highly sophisticated, complex mechanism that depends heavily on electrical and sensor-based platforms and equipment.

Recent environmental and safety considerations are putting increased pressure on automotive manufacturers to produce vehicles that are radically different from previous designs. Several examples of these technological achievements can already be seen on vehicles today; in the area of safety technology – electronic stability control,[119] adaptive speed control, and brake assistance technologies; and in the area of environmental technology – electricity and battery technologies (e.g., hybrid electric vehicles, fuel cell electric vehicles) and alternative fuel sources. Many observers, including the European Commission, forecast further rapid changes in technology for the automotive industry during the next 10 years.

118 European Commission, "Enterprise & Industry – Automotive Industry Sectoral Analysis," http://ec.europa.eu/enterprise/automotive/pagesbackground/sectoral analysis/index.htm

119 The European Commission estimates that electronic stability control (ESC) can reduce car accidents by 20%. http://europa.eu/rapid/pressReleasesAction.do?reference=IP/07/621&format=HTML&aged=1&language=EN&guiLanguage=en

The EU has devoted considerable attention to automotive R&D programs that are ultimately intended to bolster innovation, technological progress, growth, and competitiveness. These programs include the Intelligent Car Initiative, aimed at strengthening European research and policy in the area of information and communication technologies, and the Competitive Automotive Regulatory System for the 21st Century (CARS 21), a public-private high-level working group whose objective is to supply recommendations to the Commission to improve the competitiveness of the European automotive industry.[120] But do these programs and others like them represent all that is needed for the automotive industry to increase its innovation efforts and overall competiveness?

Just two years ago, Günter Verheugen, Vice President of the European Commission responsible for Enterprise and Industry, raised several issues related to the state of Europe's automotive industry.[121] In his remarks, Verheugen said, "We must reinforce our industry's capacity for competition and innovation and this means that we must at last get rid of the obstacles in the path of small and medium-sized enterprises." He also argued for improvements in road safety, trade policy and intellectual property protection which would be taken up by the CARS 21 Group.[122] Although progress has certainly been made, if rapid changes in automotive technology are expected over the next 10 years, policy makers may have more work to do. In promoting innovation, policy makers should be careful to create policies and standards that are forward looking and are technology neutral (as opposed to picking technology winners). However, a technology neutral standard may also in effect require a specific technology – thus, the technical aspects of any policy should be handled thoroughly and with care.[123]

120 For more information on the CARS 21 initiative, see http://ec.europa.eu/enterprise/automotive/pagesbackground/competitiveness/cars21.htm

121 Günter Verheugen, "Sustainability and Competitiveness" (meeting of Vice President Verheugen with the ENVI Committee, Strasbourg, June 12, 2006).

122 Ibid.

123 A technology neutral yet technology specific standard is well exhibited in the California Zero Emissions Vehicles mandate adopted in 1990, which required automobile manufacturers to make at least 2% of their total sales in California as zero emissions vehicles by 1998, 5% in 2001, and 10% in 2003. When the man-

7. Conclusion – Creating Innovation Incentives

Challenges of globalization have forced European firms to evolve by modernizing their manufacturing approaches, working collaboratively in networks, strengthening links between research and innovation, and increasing the value of their products, production, and services.[124] But it is clear that there is much more riding on a firm's success in the knowledge-based economy, beyond its own internal business decisions. The environment in which firms innovate and operate in is crucial to the competitiveness of both the firm, and the economy in which it operates.

Technological change and productivity growth tend to occur more freely when the government sets a favorable climate.[125] In a competitive market, the climate for innovation is quite favorable as competition forces firms to innovate in order to survive,[126] and it drives firms to invest in efficiency-enhancing technologies.[127] In a market driven by industrial policy, innovation may be obstructed due to market rigidities,[128] inefficient regulations and the politicization of the economy. EU policy makers therefore face a challenging task – to create a climate for innovation to prosper in all sectors, while keeping in mind that the role of government is to act as a trustee ensuring that public interest is considered in the development process. [129]

date was adopted, these levels could only be achieved by battery-powered electric vehicles.

124 H. Pero, "ERA: A Challenge for Co-opetition, Towards Knowledge-based Enterprises," in Peter Sachsenmeier and Martein Schottenloher (eds.), Challenges Between Competition and Collaboration: The Future of the European Manufacturing Industry (Berlin: Springer Publishing, 2003).

125 Aghion, Carlin, and Schaffer, Competition, Innovation and Growth in Transition.

126 Porter, Competitive Advantage of Nations.

127 Organization for Economic Cooperation and Development, A New Economy?

128 Faini, Contrasting Europe's Decline.

129 Max Ahman, "Government Policy and Environmental Innovation in the Automobile Sector in Japan," Lund University, Department of Environmental and Energy Systems Studies, Sweden, 2004.

8. Summary - Competition and Industrial Policy: EU Innovation

As this paper has explained, the role of knowledge and innovation has changed during the last quarter century. This realization may now lead to a bit of fresh thinking in policy making to increase economic knowledge-based objectives, without compromising other policies. Evidence has been presented to affirm that the process of innovation is dynamic and relies on a competitive environment to function. In addition, institutions, laws and norms can create incentives and obstacles for innovation. Therefore, it is important for policy makers to address the fundamental conflicts between competition and industrial policy.

This paper has attempted to highlight some of the many challenges facing Europe in terms of technical change and innovation, and economic competitiveness. Although significant institutional policy may need to change, there is no need to reinvent the wheel. Making adjustments to Europe's economy will not be easy, no matter how slight they seem; but if Europe is to restore its knowledge-based economic competitiveness, new approaches to policy will be needed.

Once the economic roots of innovation creation are understood by policy makers, they can help to transform the economy into a highly competitive, knowledge-based, dynamic one. So long as policymakers encourage a policy infrastructure that supports innovation, creative destruction can continue. And as new growth theory exemplifies, "the ability to grow the economy by increasing knowledge, creates opportunities for nearly boundless growth."[130]

130 Cortright, New Growth Theory.

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