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An industrial policy for Europe?

From concepts to action

European Investment Bank

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Preface

Sauli Niinistö
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Industrial policy is certainly among the policy areas where practical implementation has a longer and broader track record than economic analysis. Public sector intervention to promote the competitiveness of the domestic economy, certain sectors, or individual firms is, arguably, as old as economic policy making. While economic arguments have long been used to both justify and contest the meaningfulness of industrial policy action, industrial policy analysis has never developed into a field of study in its own right.

To take stock of the wide array of economic arguments for and against active industrial policies and to put them into proper perspective, the companion edition (Volume 11, Number 1) to this edition of the *EIB Papers* (Volume 11, Number 2) addresses issues such as the history of industrial policy in Europe, the more recent experience with de-industrialisation, mainstream and alternative justifications for industrial policy action, and pros and cons of coordinating industrial policies among countries.

This edition extends the discussion in two distinct ways. For one thing, it considers the conflicts and complementarities between industrial and other policies, especially competition policy. Any industrial policy action is likely to impact other areas of economic policy, possibly compromising their ability to reach their goals. Thus, it is key to understand clearly the broader repercussions – costs and benefits alike – of industrial policies. For another, this edition considers the evidence of the effectiveness and efficiency of industrial policies. In doing so, it looks not only at the impact of different types of industrial policies in Europe but also at broader lessons that can be learned from the long, broad, and arguably successful Asian experience with industrial policy.

Against this background, we should get a step closer to responding to the question posed in the title of the *EIB Papers*: "An industrial policy for Europe?". I am convinced that the perspectives on industrial policy as well as its conceptual and empirical analyses contained in this volume of the *EIB Papers* will make a noticeable contribution to our understanding of industrial policy. This should be useful for a wide audience, but especially for policy makers in the Member States of the European Union – old and new alike.

An industrial policy for Europe?

From concepts to action

The *2006 EIB Conference on Economics and Finance* – held at EIB headquarters in Luxembourg on January 19 – examined industrial policy, with a special focus on the European context. Presentations covered some conceptual issues, investigating – among other things – the history of industrial policy and its theoretical underpinnings according to different schools of thought, as well as lessons from real-world experiences with different types of industrial policy.

Speakers included:

Ha-Joon CHANG,
of the University of Cambridge, UK

Elie COHEN,
of the Centre National de la Recherche Scientifique, France

Olivier DEBANDE,
of the EIB

Charles EDQUIST,
of Lund University, Sweden

James FOREMAN-PECK,
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Jordi GUAL,
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ABSTRACT

Considering industrial policy from the perspective of other economic policies, this paper seeks to identify the sources and consequences of conflicts between industrial, competition, trade, and fiscal policies. *The goals of industrial policy, even when economically justified in isolation, are in certain circumstances in an intrinsic conflict with especially competition and trade policy goals. Industrial policy also lacks its own independent instruments, and fiscal policy instruments are frequently used and often economically optimal to implement industrial policy, which can create a policy conflict even when the goals themselves are independent. For these reasons, the cost of industrial policy is often the sacrifice of some other policy goal. This interdependence narrows the scope for economically sensible industrial policy.*

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No policy is an island – on the interaction between industrial and other policies

There's nothing remarkable about it. All one has to do is hit the right keys at the right time and the instrument plays itself.
Johann Sebastian Bach

1. Introduction

Timo Välilä

Industrial policy action is economically justified under certain circumstances, as reviewed by Cohen (this volume). Focussing on the neoclassical case for industrial policy, a number of market failures can justifiably prompt the public sector to intervene in the process of allocating resources among economic activities or sectors. In other words, the presence and identification of market failures is a necessary condition for industrial policy action to be economically sensible.

If industrial policy were implemented in isolation, addressing a market failure would also be a sufficient condition for the policy intervention to be welfare enhancing. However, industrial policy is seldom, if ever, implemented without any repercussions on other areas of economic policy. Therefore, an assessment of how much scope there is for economically sensible industrial policy has to account for the wider costs and benefits that an industrial policy intervention has by affecting other policies and their goals.

To draw a musical parallel, Bach spoke about how to play the organ in the quote above. The organ is a solo instrument, and with a talent like Bach's, there is presumably little else to worry about, apart from hitting the right keys at the right time. If industrial policy could be played solo, it would suffice for the policy maker to design and implement the intervention right, and there would be applause at the end, at least by the economists in the audience. However, when surrounded by an orchestra of strings, woodwinds, brass, and percussion, even a technically faultless and aesthetically pleasing solo organ performance can be completely out of place, and the audience would be better off if the organist left his keys alone and let the audience enjoy an organ-free symphony.

Thus, this paper will focus on industrial policy as part of an orchestra of economic policies. To set the stage, Section 2 recapitulates the most important goals of industrial policy that have an economic justification to them. These goals are then contrasted against the goals of other policies in Section 3, with the aim of identifying the circumstances where industrial policy is compatible with other policies and where there is a conflict. The focus shifts from goals to instruments in Section 4, where the aim is to map out the possible and the optimal instruments of industrial policy and to see how the choice of policy instruments affects the compatibility of different policy areas. At the end of this exercise, we hope to have gained a more nuanced and more comprehensive idea of just how much scope for economically sensible industrial policy there is.

2. Industrial policy nailed down

Industrial policy differs from most other areas of economic policy in several important respects. First, as opposed to, e.g., monetary, fiscal, trade, or competition policies, industrial policy does not have an established and permanent institutional framework. There is in general no public agency devoted to industrial policy, nor is there a legal framework for industrial policy[1]. Second, and again in contrast with

1 National legislation or international treaties (such as the Treaty of Rome) may well (and do, in fact) contain a negative list of prohibited industrial policy measures, but this is different from there being a positive legal framework, such as a central bank law in the case of monetary policy, that outlines the competencies of the agencies involved in executing that particular policy.

most other areas of economic policy, industrial policy does not have a well-identified and universally recognised set of goals to achieve. Industrial policy has goals, such as innovation support or protection of sectors in decline, but those goals change over time and from country to country. And finally, as elaborated in Section 4 in greater detail, industrial policy does not possess a clearly identifiable tool kit of policy instruments that would be devoted exclusively to achieving the goals of industrial policy.

Consequently, it has proven difficult to define industrial policy unambiguously. In the broadest sense, Caves (1987) defines industrial policy to encompass public sector intervention aimed at changing the distribution of resources between economic sectors and activities. This could, in principle, encompass 'vertical' policy measures targeting individual firms or sectors as well as 'horizontal' policy measures focussing on specific economic activities, such as innovation. While it is indeed customary to include both horizontal and vertical policy measures in industrial policy, some authors – such as Chang (this volume) – emphasise vertical policy measures in their definition of industrial policy, whereas others – such as Edquist (this volume) – only focus on horizontal measures, notably innovation support.

Against this background, it is hardly surprising that the quest for a rock-solid definition of industrial policy is often abandoned in favour of a looser delineation of the concept or even in favour of outright agnosticism, as exemplified by Geroski (1989):

> "'Industrial policy' is the label that has come to be used to describe a wide-ranging, ill-assorted collection of micro-based supply-side initiatives which are designed to improve market performance in a variety of occasionally mutually inconsistent ways."

Even in the absence of a definition, industrial policy has been recognised as a policy area in its own right.

Even in the absence of a universally agreed definition, industrial policy has nevertheless been recognised as a distinct area of economic policy in its own right, so there has to be a way to characterise it, if not define it. To nail down industrial policy by characterising it, this section focuses on distinct types of industrial policies, each with a distinct set of policy goals. To be clear, the goals considered are limited to those that have a clear economic justification, i.e., where intervention by the public sector makes the economy better off by alleviating the markets' failure to allocate economic resources in an optimal way for the economy as a whole. Goals often associated with industrial policy but that do not address a market failure and therefore have no economic justification – such as supporting sectors with high value-added or promising future growth potential – are not considered.

2.1 Types and goals of industrial policy

The goals of industrial policy with a (neoclassical) economic justification have been examined by Cohen (this volume). This section presents such goals from a slightly different perspective to allow an explicit comparison of the goals of industrial policy with those of other policy areas in subsequent sections. To link this theoretical discussion more closely with practical policy making, this section concludes by raising some key difficulties in designing industrial policy measures.

The classification of industrial policy goals to be presented here and followed subsequently is based on the taxonomy introduced by Caves (1987) and Gual (1995a, b). They identify three distinct types of industrial policies aimed at enhancing economic efficiency: horizontal (e.g., innovation support extended regardless of economic sector to address knowledge externalities); vertical (e.g., strategic trade policy support to a certain industry or firm to capture rents); and structural change (e.g., temporary support of a declining industry to prevent too abrupt adjustment to changes in technology or comparative advantage). In addition to enhancing economic efficiency, industrial policy can also aim at improving equity (e.g., support to uncompetitive sectors or firms on grounds of social or regional income distribution, rather than economic efficiency). Each of these four types is discussed in detail below.

2.1.1 Horizontal industrial policy

Horizontal industrial policy is non-selective.

'Horizontal' in the context of industrial policy denotes the absence of selectivity in terms of the individual firms or sectors supported. In other words, horizontal industrial policy support concerns a wide range of firms and sectors.[2] In the broadest sense, as employed by European Commission (2005), horizontal industrial policy encompasses the broad framework conditions under which the entire enterprise sector operates, including macroeconomic stability, rule of law, protection of property rights, absence of administrative barriers and red tape, good public sector governance, and so on. More narrowly, horizontal industrial policy refers to measures targeting economic activities that are common to many sectors and firms and that are plagued by market failures, notably the presence of spill-over effects in the production process.

The most common example of horizontal industrial policy targeting a specific economic activity is innovation support. Knowledge is a public good (i.e., it can be shared among an unlimited number of consumers), and its creation is associated with positive externalities (i.e., one firm's investment in it can benefit other firms too). Private companies, left to themselves, would invest too little in innovation because they would choose a level that would maximise their private profits, thus ignoring the wider spill-over benefits to the economy as a whole. This being the case, public innovation support would be warranted to account for spillovers – provided the public support does not discriminate between sectors or firms and hence does not create distortions.

As illustrated by the case of Finland (see Toivanen in this volume), public innovation support can be extended using a wide range of fiscal policy instruments. Such fiscal support aims at encouraging the early stages of the innovation process, especially underlying research and the subsequent development of commercially viable products.

In addition to supporting research and development of new knowledge and products, the public sector has traditionally offered temporary protection of intellectual property rights embodied in products that are ready to enter the market. The granting of patents to inventors (and copyrights to artists) entails a granting of a temporary monopoly to the inventor, so as to allow him to appropriate the benefits and monopoly profits associated with his invention. These monopoly profits would improve his incentive to innovate, thus benefiting society as a whole. Of course, the success of a system of intellectual property rights depends on finding the right balance between temporary protection and subsequent competition.

While common in all industrial countries, the patent system has been criticised as unnecessary or even harmful. An inventor will enjoy temporary, if short-lived, market power and monopoly profits even without patent protection, which should provide sufficient and cost-effective incentives to innovate, especially compared to the burdensome machinery that patent approval and administration necessitates. Worse, the excess monopoly profits offered by patent protection can lead to overinvestment in innovation, as firms compete against one another in patent races. And, perhaps most fundamentally, the establishment of market power to spur innovation appears to contradict

2 The distinction between *ex ante* availability of support and *ex post* distribution of support can be important. It is sometimes argued that there is no such thing as horizontal support, because no support can reach all sectors and firms but is bound to be selective to some extent (see Gual and Chang, this volume). This argument relates to the distribution of support actually extended by the public sector. However, one may use instead as a criterion for the horizontality of support the eligibility of firms in different sectors to apply for public support. As an example, as discussed by Toivanen (this volume), the extension of innovation support in Norway was based on the authorities' discretion, while that in Finland remains based on unsolicited applications. The former can hardly be characterised as horizontal, while the latter can, based on its general availability, despite the fact that not all sectors and firms end up receiving it.

squarely the observation that more competitive economies tend to be richer and grow faster, as observed by Aghion and Howitt (2005).

2.1.2 Vertical industrial policy

Spatial externalities and rent shifting have been used as justifications for selective industrial policies.

In contrast to the non-selective horizontal industrial policy, vertical industrial policy targets support to a specific sector or an individual firm. Three different economic justifications for such selectivity are reviewed below. They include spatial externalities; rent shifting by means of strategic trade policy from foreign competitors with market power to a domestic producer; and rent shifting by means of a domestic merger to a domestic producer.

The first case of economically justifiable vertical support to be considered here concerns spatial externalities, consider – following Krugman (1993) and Baldwin *et al*. (2003) – a sector that is characterised by economies of scale in production and by market size effects. Economies of scale imply that each producer wants to concentrate production geographically, preferably where there are few other competitors. To minimise transportation costs, producers would locate where demand is largest. But the demand is largest where the majority of producers locate. The relative strength of agglomeration and dispersion forces will determine the geographical distribution of production in the economy. From the perspective of economic efficiency, agglomeration is desirable in sectors where positive spatial externalities are important. However, agglomeration is not desirable if it gives rise to excessive negative externalities, such as congestion.

Based on such spatial externalities – which are distinctly different from the technological externalities discussed in connection with public innovation support – Krugman (1993) argues the case for industrial policy support of selected industries such as semiconductors, software, and scientific instruments. The task for industrial policy in this case is to encourage agglomeration in sectors where geographical proximity increases demand and production without, however, giving rise to too much congestion or other negative externalities. Without public support, firms' location decisions would not account for the positive spillovers of proximity on other firms' demand and production, resulting in too little agglomeration. With public support of agglomeration, the market size effects can be captured, resulting in higher allocative efficiency in the economy. Moreover, vertical industrial policy facilitating sectoral specialisation based on spatial externalities can, as interpreted by Martin and Sunley (1996), help create national comparative advantage and thus influence international specialisation and trade.

While spatial externalities constitute a reasonably uncontroversial case for industrial policy intervention, at least conceptually if not in practice (see section 2.2), the same is not true for rent shifting by means of strategic trade policy, to which we now turn. The goal of vertical support in the form of strategic trade policy is to capture excess profits of foreign producers in a market with imperfect competition, and thereby raise domestic income at the expense of other countries. Originally developed by Brander and Spencer (1983, 1985), the strategic trade policy literature considers a sector with economies of scale as a starting point, with only foreign producers in the market.[3] The presence of scale economies is accompanied by market power and excess profits for the incumbent foreign producers, as they deter potential new entrants by threatening to undercut them (for example, by deliberately maintaining excess capacity) whenever they attempt to enter the market, which makes entry seem unprofitable at the outset.

3 The reasoning would also apply to economies of scope; that is, to efficiency gains from increasing the scope of product variety, marketing, and distribution. For brevity, the concept of economies of scale (or scale economies) is used henceforth to denote economies of scale and scope.

To shift some of the excess profits to the home economy, the home government commits to support a domestic rival (a 'national champion') to the incumbent foreign producers. The role of public support is to lend credibility to the new entrant and to signal that he has staying power in the market even if the incumbents launch a temporary price war. The entry of the domestic producer increases competition in the market, which reduces excess profits and benefits consumers worldwide. Moreover, to the extent that excess profits still remain, they will in part be shifted to the home economy. If the gain to the home economy is larger than the subsidy extended by the government, the home economy will be better off with such public intervention than without.

Strategic trade policy is controversial on several accounts.

This type of strategic policy is controversial on several accounts. First, the global welfare implications of such rent shifting are unclear. As already pointed out, it entails domestic gain at the expense of other countries, so the assessment of the desirability of rent shifting depends on one's viewpoint and cannot be made objectively. Similarly, while the increased competition benefits consumers worldwide, it will reduce the global producer surplus by reducing producers' profits, leaving thus the net effect undetermined and dependent on how one values consumers' gain in relation to producers' loss. Second, to be beneficial to the home economy the public subsidy must be calibrated so that it is large enough to make the domestic producer's entry credible, but it should be small enough in relation to the gross gain to the domestic economy from the rent shifting. As elaborated in Section 2.2, such calibration can only be done in the unlikely event where the policy maker possesses very detailed knowledge about the market structure, incumbent's behaviour, production costs, and so on. Finally, even when strategic trade policy succeeds in its mission in the static setting described above, its efficacy is less clear in a more dynamic setting. Strategic trade policy by one country may well prompt counteraction by other countries, and the resulting subsidy war can make everyone worse off compared to the initial situation with no public support to the domestic entrant.

A classical example of rent shifting that has received ample attention from economists concerns state aid to the aircraft industry. There are only a handful of big airplane producers worldwide, and the limited competition implies the presence of excess profits, or rents, in the market for airplanes. In an attempt to capture some of those rents, European governments have supported Airbus to become a major producer alongside Boeing and McDonnell Douglas. This vertical support to Airbus is analysed in detail in Box 1.

As a final goal of vertical industrial policy, let us consider rent shifting from a foreign producer by means of a merger of domestic producers. Consider, as above, a sector characterised by imperfect competition internationally and the presence of excess profits. In contrast to the Airbus example above, assume now that there are two domestic producers, in addition to a foreign firm. Also, let us relax the assumption about scale economies for the time being to show that the results can be obtained even if production technology exhibits constant returns to scale. In this set-up, the two domestic firms would have no obvious incentive to merge. On the contrary, a merger between them may be objectionable to the home competition authority, as it results in a dominant domestic market position for the merged firm.

Huck and Konrad (2001) demonstrate that industrial policy can be used to raise national income in this set-up. By supporting the merger, thereby creating a 'national champion', and by subsequently subsidising the merged firm to strengthen its competitiveness *vis-à-vis* the foreign producer, the home government can contribute to rent shifting that benefits domestic producers and the home economy. As in the case of strategic trade policy discussed earlier, this gain comes at the expense of foreign firms and the foreign economy. Also as above, the industrial policy intervention – merger combined with public subsidies – is economically sensible, for the home economy at least, if its cost falls short of the benefit (rents shifted home).

Box 1. Causes and consequences of industrial policy support to Airbus

The aircraft industry is characterised by significant economies of scale, as the development of a new aircraft model requires large up-front investment long before actual production can start. As a consequence of this large fixed cost, the average cost of producing an aircraft declines only slowly with the number of aircraft produced. The presence of scale economies means that only a limited number of producers can be profitable. This, in turn, gives rise to market power and rents. Producers gain at the expense of consumers, and the economy as a whole is worse off because the quantity of production and consumption is suboptimally small.

In the 1980s, Airbus entered the competition for the market for medium-range medium-body aircraft that was dominated by Boeing (McDonnell-Douglas, a third major producer, chose not to compete in this particular market segment). By supporting Airbus to compete against Boeing by granting it 'launch aid' to develop a medium-range medium-body aircraft, European governments wished to shift some of the rents enjoyed by Boeing to Europe.

For such public 'launch aid' to be economically justifiable, it should have addressed a market failure, in this case Boeing's market power. To this end, public support may have been necessary for the credibility of Airbus's presence in the market. Without such support, the argument goes, Boeing could have threatened with a temporary price war, making the market look too unattractive for Airbus to enter in the first place. In addition to securing Airbus' entry and a shift of part of Boeing's rents to Europe, the rents themselves should have fallen as a result of increased competition, thus benefiting consumers. In addition, European economies should have benefited from spillovers emanating from Airbus' R&D investment. However, the loss of market share by Boeing would have made it less efficient in the long run.

Seabright and Neven (1995) sought to quantify the various effects of such launch aid to Airbus. They concluded that entry by Airbus did indeed benefit Europe by shifting some of Boeing's profits there, and that it benefited consumers worldwide by increasing competition in the market. This gain by consumers was, however, quantitatively smaller than the loss of overall producers' profits due to increased competition and a reduction in cost efficiency at Boeing. The latter was a result of an increase in variable costs following from a decline in the scale of production, and not so much related to fixed costs (production capacity), which for Boeing was a sunk cost.

The results of Seabright and Neven cast also some light on firms' entry decisions. By deterring McDonnell-Douglas from entering the medium-range medium-body aircraft segment, the entry by Airbus facilitated its entry into the long-range segment, where Boeing had also become less competitive due to loss of scale economies. Thus, the entry by Airbus hurt Boeing across the board, but allowed McDonnell-Douglas to enter another market segment.

The parallels between strategic trade policy and strategic merger policy can be drawn even further. Consider the example used above with Airbus and Boeing, but account now explicitly for the presence of the third player in the market, McDonnell-Douglas. From the US perspective, the merger of Boeing and McDonnell-Douglas, in response to the entry and public support of Airbus in Europe, can constitute an effective retaliation strategy. While the merger, that took place in 1997, has given rise to only a little analysis in the literature, it is nevertheless a vivid example of strategic merger policy, as shown by Huck and Konrad (2001).

Finally, to make the parallel between the two cases complete, let us consider how introducing economies of scale affects the consequences of a strategic merger. With scale economies, the domestic firms have a stronger incentive to merge to start with. If this incentive is strong enough, the merger will take place even in the absence of public subsidies. Moreover, the merger might be less objectionable to the competition authority, provided the gains in productive efficiency from the merger outweigh the loss in competition and allocative efficiency.

However, as pointed out by Neven *et al*. (1993), the trade-off between allocative and productive efficiency is not entirely straightforward, as market power can also have the opposite effect and raise, not reduce, production costs. This may happen because firms are prepared to incur costs to obtain market power and excess profits. Such costs may take the form of advertising, investment in excess capacity, or lobbying to gain protection through quotas or licences – to name but a few examples. Alternatively, market power may be associated with declining productive efficiency if managers and workers of a firm seek to extract some of the excess profits from the firm's owners, thereby inflating production costs. This is especially the case, as the absence of product market competition and benchmarks complicates the owners' monitoring of the firm's managers and workers.

2.1.3 Industrial policy to support structural change

It was mentioned in the opening paragraphs of this section that industrial policy is often associated with influencing the sectoral structure of the economy. Indeed, both horizontal and vertical industrial policies discussed above would imply an allocation of resources among sectors that is different from the free market outcome. In both cases, industrial policy seeks to alleviate some market failure (knowledge or spatial externalities; market power), and doing so will imply a sectoral redistribution of resources.

Industrial policy can induce or resist structural change.

However, industrial policy can also play a more direct role in facilitating structural change in the economy. That role can be change inducing in character, whereby public intervention seeks to alleviate market failures that slow down or prevent the development of new 'sunrise' sectors. Or it can be change resisting in character, whereby public intervention seeks to prevent market failures from resulting in too disruptive an exit of declining sectors. Both cases are considered in turn below.

Perhaps the best-known argument in favour of public intervention to support sunrise sectors is based on the idea that they need protection in the early stages of their life cycle so as to become large and strong enough to withstand competition by established foreign firms. This 'infant industry' argument – which can be traced back to Alexander Hamilton and Friedrich List of the 18th and 19th centuries, respectively – is taken to justify the protection of an emerging manufacturing sector where it constitutes a potential comparative advantage for the country in question. A more recent version of the infant industry argument, articulated initially by Bardhan (1971) and extended by Young (1991), focuses more explicitly on the role that public sector protection can play in enhancing economic efficiency. The argument has it that young firms gain in efficiency as they 'learn-by-doing' and need protection early on to reach a level of efficiency that allows them to compete internationally.

Apart from learning effects, failures in financial markets and education have been suggested as justifications for industrial policy targeting sunrise sectors by, among others, Begg *et al*. (2002). Start-ups may be denied finance or only get it at excessive cost because of their inherent riskiness and informational asymmetries between them and investors. By improving start-ups' access to finance, public loan guarantees or seed capital can promote the emergence of new viable sectors. Education may also fail to support the emergence of new production, as skills necessary for new production will only be demanded if the production is there, but there will be no production without the skills. By providing relevant training, the public sector can similarly promote the emergence of new sectors.

The distinction between this type of industrial policy and innovation support discussed in Section 2.1.1 is somewhat blurred. After all, in both cases industrial policy targets primarily young sectors and firms, and it is not entirely obvious whether structural change is the goal or a consequence of industrial policy action. However, innovation support has traditionally been treated as a separate subject in its own right, if only for the reason that it is more tractable both theoretically and empirically than other types of support to sunrise sectors.

Leaping then from the beginning to the end of firms' life cycle, industrial policy support to declining sectors that has potential to improve economic efficiency concerns situations where market failures hamper the adjustment of industries or firms to technological change or to change in comparative advantage. As explained by Gual (1995a, b), such market failures may include capital specificity – productive capital accumulated by existing firms is not readily usable for the production of other, more profitable goods – or rigidities in labour market adjustment. In the presence of such rigidities in capital and labour markets simultaneously, the private sector response to changes in technology or comparative advantage may be too abrupt, and the economy may be better off with the government coordinating the pace of change in the capital and labour markets. Such coordination may be achieved through temporary subsidies or trade protection, for example.

In the case of sunset sectors, industrial policy support aims thus to offset the impact of a failure (rigidity) in the markets for inputs. This is clearly only the second-best policy response to such market failures, the first-best response being the removal of the failures (rigidities) that cause the inefficiency in the first place. However, first-best solutions in cases like this are often unattainable.

In concluding the examination of the types of industrial policies aimed at improving economic efficiency, suffice it to emphasise that the second-best character of industrial policy action is not limited to the case of sunset industries. Removing any of the market failures discussed earlier in connection with horizontal, vertical, or structural adjustment-related industrial policy would be the efficiency-maximising course of action. In the absence of that option in most cases, the best industrial policy can do from the perspective of economic efficiency is to resort to second-best measures, such as mergers that reduce competition or temporary protection of industries in decline.

2.1.4 Industrial policy to support equity objectives

Socially desirable income distribution may, too, be an industrial policy objective.

Having covered three types of industrial policies to promote economic efficiency, it is now time to consider industrial policy with equity objectives. In the broadest sense, industrial policy support may target inherently unviable sectors or firms to obtain a socially desirable distribution of income among individuals or geographical regions. The assessment of the efficacy of industrial policy in achieving equity objectives is less straightforward than in the case of efficiency objectives and, as a consequence, less attention has been devoted to this topic in the literature.

It was concluded earlier that the presence of spatial externalities necessitates agglomeration from the perspective of economic efficiency. From an equity perspective, however, agglomeration may not be desirable. As discussed in Baldwin *et al*. (2003), market outcomes in terms of firm location are determined by the geographical distribution of purchasing power. Whenever the distribution of purchasing power differs significantly from the distribution of population, there will be too much agglomeration to the richer regions. By subsidising relocation to relatively poorer locations, industrial policy can enhance equity, albeit at the cost of efficiency.

Clearly, equity-oriented industrial policy support is prevalent in practice. When assessing the merits and failures of industrial policy – be it theoretically or empirically – it is important to distinguish between

industrial policy that aims to boost efficiency and industrial policy that serves equity objectives. Gual (2000) considers industrial policy support (state aid) in the EU to steel, shipbuilding, and coal sectors as being extended solely on equity grounds. Aid to railways and regional aid may have both equity and efficiency objectives. Support of innovation, SMEs, and external trade objectives, in turn, may be justified on efficiency grounds.

2.2 Difficulties in executing industrial policy

The conclusion of this section so far has been that it is possible to identify economically legitimate goals for industrial policy and that it is possible to identify the types of industrial policies that can serve to achieve these goals. This is, however, still a long way from demonstrating that industrial policy is welfare enhancing. Establishing that intervention can be beneficial is just a necessary, but not sufficient, condition for industrial policy to enhance welfare. Sufficiency requires that the benefit from intervention exceeds its cost, which – in this case – come in two forms. First, intervention is not without risks, which can eat up the benefits if they materialise. Second, intervention involves opportunity cost, to be discussed in subsequent sections, that may also outweigh the benefits.

The risks involved in executing industrial policy are not different in nature from the risks involved in executing other types of economic policies, but they are arguably greater in magnitude. Public intervention to alleviate a market failure, or to serve an equity objective, always risks evoking a government failure that makes the situation worse than before the intervention. Such government failures can arise because of policy makers' self-interest; electoral pressures; capture by special industrial interest groups; or incomplete information about individuals' preferences and behaviour.

That industrial policy is especially prone to political cycles and capture by vested interests is hardly surprising. A rich political-economy literature suggests, as reviewed by Neven and Röller (2000), that the risk of political capture is particularly high in sharply partisan political systems; at times of weak governments; and in the absence of transparency, which makes it easier to redistribute resources without scrutiny and sanctioning by the public at large. But even at times of consensual, strong, and transparent governments industrial policy is prone to capture because industrial lobbies are among the most focused, best organised and hence most powerful in any economy.

Industrial policy intervention can result in a government failure or negative effects in a dynamic setting.

Another possibly important source of government failure in the case of industrial policy is the gap between necessary and available information. To calibrate an industrial policy intervention – say, a strategic trade policy subsidy – the policy maker would need to possess detailed knowledge about production costs, future demand, market structure, and rivals' response to the support in order to assess with any degree of precision how large the subsidy should be to achieve its goal. In other words, the policy maker would need to possess at least as much information about the market in question as any private firm operating in the market. This is a tall order, especially given the agency problems traditionally attributed to the relationship between policy makers and firms, be they public or private.

Apart from the risk of government failure, some types of industrial policies are subject to the risk that their impact is much less favourable in a dynamic setting than in a static one, which has been the focus of most of the analysis so far. It was mentioned in passing above that mergers to promote productive efficiency and strategic trade policy are both associated with static gains and dynamic losses. In the case of mergers, it was argued that the resulting market power may have a negative impact on productive efficiency, thus offsetting the benefit from the merger. In the case of strategic trade policy, retaliation by foreign countries may ignite a subsidy or tariff war that can leave everyone worse off.

All in all, the dynamic risks and, in particular, the risk of government failure have potential to inflict high costs on industrial policy intervention. In addition, as alluded to above, industrial policy action involves opportunity costs, as pursuing industrial policy goals can necessitate the abandoning of other economic policy goals. Such opportunity cost is the topic of the remainder of this paper.

3. Goal conflicts between industrial and other policies

To recast the discussion above in a somewhat different light, one possible way to see the current undertaking is in terms of a cost-benefit analysis of industrial policy intervention. In Section 2 the main focus was on the benefit side, and a number of market failures to allocate resources efficiently or equitably were identified as economically justifiable grounds for industrial policy intervention. Yet, the section concluded with remarks about the risks associated with such intervention – risks that can cause direct costs, thereby reducing the net gain from the intervention. In the present section and next, the focus will shift to indirect costs of industrial policy in terms of what has to be foregone to achieve the goal of an industrial policy action. Once all costs, both direct and indirect, have been identified, it is possible to specify, if not quantify, the cost-benefit analysis facing the policy maker contemplating industrial policy action. In other words, it is possible to formulate sufficient conditions for industrial policy to enhance economic welfare.

Even when sensible in isolation, industrial policy may be costly if it means missing other policy goals.

In order to consider the indirect, or opportunity, costs of industrial policy, it is necessary to broaden the perspective and consider industrial policy from the viewpoint of other areas of economic policy, instead of just considering it in isolation, as was done in Section 2. The issue at hand is to examine the trade-offs between industrial and other economic policies. Even when industrial policy is economically sensible in isolation, it may conflict with other policies, thus raising the question of whether the achievement of industrial policy goals is worth missing other goals.

The two areas that will be the focus of this section are competition and international trade policies. These two areas of economic policy are subjected to special scrutiny here because they are most closely linked with industrial policy, as should be clear from the characterisation of industrial policy in Section 2. The goals of industrial policy articulated there will be assessed below from the perspective of the goals of these two policies, with a view to examining when the pursuit of industrial policy goals is compatible with them and when there is a conflict between industrial policy and competition and trade policies, respectively. When a conflict between the goals is identified, the opportunity cost of undertaking industrial policy action becomes obvious.

Before embarking on the analysis, it is perhaps worthwhile giving the discussion a more practical spin and linking the concepts with reality by means of a concrete example. In essence, the issue of policy trade-offs can be illustrated by considering industrial policy support to domestic textile producers in Europe facing competition from low-wage countries that will render the sector unviable over the medium term. To avoid excessively abrupt adjustment in the form of wholesale plant closures and mass layoffs, the public sector may choose to support the domestic textile industry temporarily, either by extending subsidies or by erecting protective trade barriers against foreign competitors. The benefit of such support can be a more efficient adjustment process, with gradual redeployment of labour and capital to more profitable uses.

However, as discussed earlier, the support is subject to the risk of political capture. It is also difficult to calibrate: should the subsidy amount to €10 million, €100 million, or €1 billion? Should it be extended during 1 year, 5 years, or 10 years? The support may also prompt retaliation by other countries, thereby increasing its costs. Finally, to converge to the topic of this section, the support may distort domestic

competition among textile producers if it is extended selectively, and it may also distort foreign trade by raising trade barriers or by giving domestic producers an artificial competitive advantage *vis-à-vis* foreign ones. Both these distortions compromise allocative efficiency in the domestic economy and raise the question whether the gain in terms of a smoother adjustment process is greater in magnitude than the direct cost of such intervention and the partial loss of free domestic competition and free international trade. This and next sections will deal with exactly that trade-off.

3.1 Goals of industrial and competition policies

3.1.1 Normative view of competition policy

The discussion of industrial policy goals in Section 2 suggested, at least implicitly, that industrial policy action will have repercussions on competition and competition policy. Such repercussions are made explicit below, with the aim of assessing the various goals of industrial policy from the perspective of the goals of competition policy.

As a starting point, let us articulate the goals of competition policy. In so doing, we focus on competition policy from a normative perspective, considering what competition policy should aim at in order to enhance welfare. Moreover, the only concern for the time being is domestic competition, so the economy is assumed to be a closed one. The international dimension of competition will be analysed in connection with trade policy below.

The welfare costs of market power are well articulated in the economic literature and well known in a positive sense (see, e.g., Tirole 1988). In an imperfectly competitive market, firms set prices above marginal costs of production, thereby maximising their profits but inflicting a social loss, as the quantity produced and sold falls short of what would be the case under marginal cost pricing. That is, imperfect competition is associated with lower allocative efficiency than perfect competition, because there will be consumers willing to pay the marginal cost, or more, who will walk out of the market exchange empty-handed. The loss in consumer welfare constitutes a deadweight loss from imperfect competition.

Consequently, to avoid such social loss, the normative goal of competition policy is to 'promote and protect competition' (European Commission 2004). In practice, it involves antitrust regulation and control; merger control; state aid control; and liberalising potentially competitive markets.

The promotion and protection of competition maximises welfare, with some exceptions.

The promotion and protection of competition is a rule of thumb for maximising welfare, with some exceptions. First, as mentioned in connection with innovation support, temporary market power (patent) may enhance welfare if it helps address the market failure arising from knowledge externalities. Second, as alluded to in connection with vertical industrial policy, it may not be possible to introduce perfect competition and marginal cost pricing due to economies of scale. In this case, the second-best solution is to allow the increase in market power as long as the gain in productive efficiency from the larger scale of production exceeds the loss in allocative efficiency from reduced competition. However, as also mentioned above, the emerging market power may in itself lead to lower productive efficiency in a dynamic setting.

Another case where it is not clear that free competition can maximise social welfare concerns markets with spatial product differentiation. In this case, there is a trade-off between providing the widest possible product variety to all consumers and the cost of supplying a wide variety of goods to the geographically spread-out consumers. Theoretically, as elaborated by Tirole (1988), it is not clear that free competition between producers will result in higher social welfare in terms of consumed product variety than a regulated market.

3.1.2 Compatibility of industrial and competition policy goals

Having thus concluded that competition policy should aim at promoting competition, except when there are sufficiently large gains to reap from economies of scale or when product variety is an issue, let us now consider the compatibility of the goals of industrial policy with competition policy goals. In what is to come, the presentation follows the structure introduced in Section 2, starting with horizontal industrial policy and ending with industrial policy supporting equity objectives.

Truly horizontal support does not conflict with competition policy.

Consider horizontal innovation support to, say, domestic car manufacturers to help them develop hybrid engines. Under what circumstances is such support compatible with the goals of competition policy? If the support only aims to alleviate market failures arising from knowledge externalities, and if it is truly horizontal in character, that is, available to all domestic car producers, then it does not distort competition and hence does not conflict with competition policy. Conversely, any selectivity in extending such support will distort competition and conflict with competition policy goals.

Fast forwarding to vertical industrial policy, and starting with the case of spatial externalities, policies to encourage agglomeration and competition policy are likely to be compatible if product variety is not of concern. Agglomeration is likely to be associated with more competition, not less, as geographical dispersion is conducive to local monopoly power, which clustering eliminates, at least to some extent. While it could also be argued that agglomeration makes collusion and cartels between firms easier, this risk is likely small compared to the expected benefit from increased competition. However, if product variety is a concern, then the support of agglomeration may actually reduce welfare by reducing the supply of variety in the periphery, as production is concentrated in the core and not all products will be shipped to the periphery due to transportation costs.

Strategic trade policy, in turn, cannot be unambiguously assessed from the perspective of competition policy. From the perspective of domestic competition, subsidies to a 'national champion' do not make any difference when the firm is a 'natural' monopolist anyway. Of course, in the presence of other domestic producers – actual or potential – such subsidies to a selected firm would be distortionary and conflict with the goals of competition policy.

As regards strategic mergers, there is a clear conflict between industrial and competition policies if the production technology is characterised by constant return to scale. In this case, the merger results in less (domestic) competition, with no gains in productive efficiency. Support for the merger to achieve the industrial policy goal (rent shifting) would be at odds with optimal competition policy.

In the presence of economies of scale, on the other hand, the criterion for the compatibility of industrial and competition policy has already been spelled out. A horizontal merger of two domestic car manufacturers, as an example, is unambiguously welfare enhancing and compatible with competition policy if it results in higher productive efficiency (for example, because the combined production costs of the two firms fall as a result of reaping scale economies in product development) such that the gain exceeds the loss in allocative efficiency possibly resulting from reduced competition in the domestic car market.[4] Conversely, if industrial policy promotes a merger where the gain in productive efficiency falls short of the loss in competition and allocative efficiency, there is a conflict between industrial and competition policies.

4 A merger can also lead to an increase, instead of a decrease, in allocative efficiency. If the merger results in more, not less competition, the cost reduction due to scale economies can be passed on to consumers, the economic deadweight loss would diminish, and allocative efficiency would increase. This could be the case in a market comprising originally two large and many small firms, where the small firms are allowed to merge into, say, two new large firms.

Finally, industrial policies to support structural change or equity objectives is compatible with the goals of competition policy if they are non-selective in character. Temporary public subsidies to smooth out the winding down of the domestic textile or mining industry do not distort domestic competition if they are available to all firms in those sectors. Also, if the industry only comprises a 'natural' monopolist, industrial policy support to that monopolist on grounds of structural change or equity would not distort domestic competition.

To sum up, all types of industrial policies have conflict potential with the goals of competition policy. This conflict potential does not materialise, however, in the case of truly horizontal innovation support; vertical strategic trade policy support to a domestic 'natural' monopolist; strategic merger policy support if the gains in productive efficiency exceed the possible loss in allocative efficiency; and support of structural change or equity objectives to the whole sector or to a 'natural' monopolist. In contrast, the conflict is always present in strategic merger support in the absence of scale economies and in any industrial policy support that targets specific firms in a potentially competitive sector.

3.2 Goals of industrial and trade policies

3.2.1 Normative view of trade policy

Broadly speaking, trade policy involves the use of economic policy instruments to influence the pattern of trade of a country with the rest of the world. Policy instruments mobilised to this end include taxes, subsidies, quotas, other non-tariff barriers, trade-related foreign investment measures (such as local factor content requirements), preferential financing arrangements (such as export credit subsidies), or national procurement policies (Gual 1995a).

Any use of the policy instruments mentioned above changes the allocation of resources from what free trade would imply. However, as with free domestic competition, the case for free international trade is well articulated and well known. Intervention to restrict free international trade will, as a rule, reduce economic efficiency and cause the economy to forego 'dynamic' gains from scale economies and incentives to innovate.

As with free competition, there are exceptions to the rule that free trade is optimal.

Again as with free competition, there are exceptions to the rule where the economy is better off restricting international trade. First, a large country able to affect prices in international trade may benefit from imposing an import tariff. If the import tariff leads to a reduction in the price of imports, the country experiences a gain in its terms of trade. If this gain is larger than the cost of the tariff in terms of distorting production and consumption, free trade is not optimal. This result may not hold, however, in a dynamic setting, as other countries may retaliate against the tariff, and the ensuing tariff war may make all countries worse off than free trade.

A second exception to the rule concerns failures in domestic input markets. As discussed, e.g., in Krugman and Obstfeld (1994) and Gual (1995a, b), tariff protection may be the second-best response to rigidities in the labour and capital markets, especially at times of structural change, as discussed in Section 2.1.3. While conceptually well articulated, this argument for trade protection has been of particular concern because of the difficulty in identifying the market failure and in designing an appropriate policy response to it. Besides, it is not obvious why trade policy should be optimal to mitigate domestic input market failures: is a tariff really the only available instrument to address, say, urban unemployment?

Third, economies of scale at the level of an industry, as opposed to a firm, can also justify tariff protection. Such external economies imply that the larger the sector in a country is, the more cost effectively it can

produce. As a rule, competition will drive all production to the country where production (per unit) is cheapest. However, historical accident may have located production elsewhere to start with, and because of the external economies, it will not relocate easily. As an example, Krugman and Obstfeld (1994) consider watch production, which has historically clustered in Switzerland, remaining strong to-date, although it would clearly be cheaper in numerous low-wage countries. Rather than importing expensive watches from Switzerland, such low-wage countries could be better off imposing an import tariff so as to promote local watch production, thus supplying their domestic markets more cheaply.

Finally, as already discussed extensively, strategic trade policy considerations may also suggest the optimality of trade protection. However, such protection is controversial, especially as its optimality is local, and as its global impact may even be negative.

3.2.2 Compatibility of industrial and trade policy goals

Having thus assessed international trade policy normatively, it is possible to contrast the goals of industrial policy with optimal trade policy. Again, the exposition follows Section 2, starting with horizontal industrial policy and ending with industrial policy in support of equity objectives.

Horizontal industrial policy, such as innovation support, does not distort free international trade, provided it just addresses the domestic market failure related to knowledge externalities. All countries are equally entitled to such policy, so no distortion to trade arises.

The same goes for vertical agglomeration support: no trade distortion is caused if policy just addresses spatial externalities.

Strategic trade policy, in turn, was already found to be controversial, as it can both increase and distort trade. Support to Airbus is a case in point: as a result of its entry, international competition and trade increased. However, especially from its competitors' perspective, increased trade came about as a result of policy intervention that induced a distortion by subsidising a producer who was arguably unviable without the public support.

Strategic merger policy will distort trade whenever there are no scale economies, as public support would give the merged firms an undue competitive advantage. In the presence of scale economies, and assuming that public support is needed to induce the merger, it can also be argued that trade is being distorted. The merger is again policy driven, and the public support will give the merged firm an undue competitive advantage.

Industrial policy to support structural change may be compatible with trade policy, but trade policy may be sub-optimal to that end.

Industrial policy in support of structural change may be compatible with trade policy goals, but trade policy may still not be the optimal instruments to extend such support. Sunrise sectors characterised by learning effects and external economies (sector-wide scale economies) may be justifiably protected from international competition on a temporary basis. Similarly, tariff protection may be justified for sunset industries to allow them to exit smoothly. However, as discussed by Caves (1987) and Gual (1995a, b), it is questionable in both cases whether trade policy is the best available instrument; instead, domestic subsidies may fare better at avoiding undesired side effects, such as consumption distortions.

Finally, industrial policy in support of equity objectives always distorts foreign trade by giving domestic producers an undue competitive advantage. In the absence of a market failure, industrial policy support would compromise allocative efficiency by supporting too high domestic production. Such support may, however, still be rational if the equity gain exceeds the efficiency loss.

To conclude, industrial policy goals are compatible with the goals of trade policy in the case of non-selective (horizontal) innovation support; vertical support aimed at addressing spatial externalities; and support of structural change. In the last case, trade policy may not be in conflict with industrial policy, but trade policy may also not be the optimal way to achieve the goals of industrial policy. In contrast, there is a direct conflict between industrial and trade policies in the case of strategic mergers and equity-based support. Finally, strategic trade policy can both increase and distort trade.

3.3 Summary and further issues

The above survey of the goals of industrial policy from the perspective of competition and trade policies, respectively, suggests that there is significant conflict potential between these policies. The only cases where the goals of industrial policy seem fully compatible with competition and trade policies include truly horizontal (innovation) support to address domestic externalities and temporary support to an entire declining industry to ensure smooth exit. However, in both these cases the caveat concerning the difficulty of identifying the underlying market failure and of designing and calibrating the support action applies.

Industrial policy should be pursued only when gains from it exceed its cost.

On the other hand, industrial policy goals that always conflict with competition or trade policy goals include support to selected firms in a potentially competitive sector; strategic mergers in the absence of scale economies; and measures in support of equity objectives. In these cases, the pursuit of the industrial policy goal automatically implies the sacrifice of either free domestic competition or free international trade. This trade-off should determine the policy choice: if the gain from achieving the goal of industrial policy (e.g., higher productive efficiency and rent shifting through a strategic merger) exceeds the cost (loss of domestic competition and allocative efficiency, possibly foreign retaliation), then the industrial policy goal should receive priority. In the opposite case it should be abandoned.

Similar reasoning applies for the remainder of industrial policy goals, which are sometimes compatible with other policies, sometimes not. Agglomeration support; strategic trade policy to shift rents; and temporary protection of sunrise sectors while they are moving along their learning curve all involve a trade-off with other policies. If the circumstances are such that one of these goals brings more benefit than it costs in terms of missing other goals, industrial policy should take precedent over other policies. And *vice versa*.

The trade-offs involved in industrial policy in terms of competition and trade policies have now been articulated. But there are obviously yet other areas of economic policy that experience repercussions from industrial policy actions. The repercussions may be less direct or less strong than in the cases examined above, but they exist and should therefore be accounted for when contemplating the economic impact of carrying out industrial policy.

While not even attempting to present an exhaustive list of such other policies, let us conclude this section by focussing on fiscal policy, which has already featured indirectly above as a source of public subsidies. While it is obvious that a link between industrial and fiscal policies exists, it is more difficult to examine for two reasons. First, it is difficult to articulate the goals of fiscal policy unambiguously. They include goals related to macroeconomic and cyclical management; longer-term policy sustainability; and equity, but their relative importance varies over time and across countries. Second, it is eminently feasible to use fiscal policy instruments, such as subsidies, to achieve industrial policy goals, while using other fiscal policy instruments, such as other expenditure or taxes, to make sure that fiscal policy goals (budget deficit or public debt targets; income redistribution) are nevertheless achieved. This feature of fiscal policy is not shared by competition and trade policies.

For these reasons, one cannot present a straightforward comparison of the goal compatibility between industrial and fiscal policies. Nevertheless, as will become clear below, it is still possible to say something about the desirability of industrial policy action from the perspective of fiscal policy.

4. Instruments of industrial policy

Policy instruments, too, create interaction between industrial and other policies.

When characterising industrial policy in Section 2 and when examining the goal conflicts between industrial and other policies in Section 3, the application of industrial policy has been cast in generic terms, with broad terms like 'support' and 'protection' used to denote industrial policy action. While this approach enabled us to examine the conflicts between policy goals, it is not enough to expose the full extent of interaction between industrial and other policies.

To that end, it is necessary to lift the veil of generic terms and study what exactly is meant by 'support' or 'protection'. Put differently, the focus is shifted from what industrial policy aims to achieve to how exactly the goals are being pursued. This, in turn, can be examined by considering the instruments that are used to extend industrial policy 'support' or 'protection'.

The issue of instruments has already been implicit in the discussion so far. It has been possible to read between the lines that horizontal support could be extended by means of budgetary innovation subsidies or tax breaks; that vertical strategic trade policy support could be extended by means of budgetary production, investment, or export subsidies; or that industrial policy to support sectors in decline could take the form of budgetary production subsidies or import tariff protection, to name but a few examples.

The purpose of this section is to present a more explicit and systematic analysis of the instruments of industrial policy. The issue at hand will be approached from two different perspectives. First, the array of possible instruments that could conceivably be used in industrial policy is mapped. Second, the question which possible instruments are optimal from an economic perspective is tackled. This approach, as will become clear, is helpful in elaborating how the choice of instrument to pursue an industrial policy goal will affect the trade-offs between different policy areas discussed above.

4.1 Possible instruments

Leaving the issue of economic optimality aside for the time being, let us simply consider which economic policy instruments could, in principle, be used to extend industrial policy 'support' or 'protection'. It is, obviously, impossible to come up with an exhaustive list of instruments; after all, virtually any economic policy instrument can support innovation directly or indirectly, or be geared to protect a specific sector or firm. Thus, rather than aiming at exhaustiveness, the discussion below seeks to achieve the lesser goal of comprehensiveness, trying to cover the most important instruments for executing different types of industrial policies.

Starting with innovation support, it can be extended by a multitude of instruments, most of which are fiscal in character. Budgetary innovation or research and development (R&D) subsidies; loan guarantees; subsidised loans; as well as tax breaks promoting innovation and R&D are the most obvious examples. However, as discussed by Toivanen (this volume), a number of other instruments can be used, too, including government-run research centres, business support agencies, and even public venture capital funds. The common feature of all these forms of innovation support is that they rely on fiscal policy instruments – be they direct budgetary subsidies, indirect budgetary subsidies through government agencies, or tax policy instruments.

Agglomeration support can also be extended by means of direct budgetary subsidies; loan guarantees; soft loans; or tax breaks for relocating firms. In addition, regional policy instruments, such as construction of economic infrastructure (traffic and energy networks, educational and health care facilities, and so on) can promote agglomeration. Again, the key instruments are fiscal.

Strategic trade policy to shift rents to the home economy, in turn, can be effected using fiscal instruments – such as production, investment, or export subsidies to the domestic producer – and trade policy instruments. In the case of aircraft production, the latter could involve high import tariffs (or quotas) on foreign-made aircraft; low import tariffs on raw materials and intermediate inputs used by the domestic producer; or preferential financing arrangements in favour of domestic production.

Strategic merger policy would involve competition policy instruments (merger control), combined with budgetary subsidies (production-, investment-, or export-based) or tax breaks.

Finally, industrial policy in support of structural change or equity objectives can use any of the instruments mentioned above. Most notably, budgetary subsidies, tax breaks, and tariff (or quota or other non-tariff barrier) protection against foreign competition can help achieve the goals of these types of industrial policies.

Industrial policy instruments can be broadly classified into fiscal and structural instruments.

This brief overview suggests two broad categories of possible industrial policy instruments: fiscal policy and structural policy instruments. The latter include trade and competition policy instruments, such as tariffs and non-tariff barriers to trade, as well as merger control, but also instruments from a number of policy areas not explicitly mentioned above. Examples include education policies; labour market policies; regulation of financial markets and foreign capital flows, and so on.

While it is difficult to be more precise about the character, magnitude, and impact of structural policy instruments used to achieve industrial policy goals, it is easy – relatively speaking – to identify and quantify different fiscal policy instruments used to the same end. Data on state aid in EU member countries compiled by the Directorate-General Competition of the European Commission[5] enables a brief detour to reality, to verify exactly which fiscal policy instruments are being used to extend industrial policy support in the form of state aid. The data are summarised in Table 1.

Budgetary grants are the most frequently used state aid instrument, accounting for about one-half of state aid extended Union-wide, but with significant cross-country variation. In some countries, such as Austria, Denmark, and Luxembourg, grants are almost the sole instrument used, while in others, notably the Czech Republic, Lithuania, and Portugal they account for only 10 percent or less of total state aid.

Tax exemptions are another major instrument, accounting for one-third of state aid extended Union-wide. Again, in some countries, such as Cyprus, Portugal, or the Slovak Republic, this is the main instrument, while it is not used at all in others (Austria, Estonia, Luxembourg).

The other state aid instruments – including equity participations, soft loans, tax deferrals, and government guarantees – are less important at the aggregate level, but nevertheless frequently used in selected countries. Most notably, guarantees are the dominant instrument in the Czech Republic; tax deferrals are a significant instrument in Italy and the Netherlands; as are soft loans in France, Malta, Spain, and the United Kingdom; and equity participations to some extent in Poland and the Slovak Republic.

5 Available at http://europa.eu.int/comm/competition/index_en.html

Table 1. Share of each aid instrument in total aid to manufacturing and services (in %), 2001-2003

	Grants	Tax exemptions	Equity participations	Soft loans	Tax deferrals	Guarantees
EU-25	48.1	32.3	1.3	5.0	3.1	10.2
Belgium	88.6	3.4	0.1	6.1	0.6	1.2
Czech Rep.	10.6	3.0	3.9	0.7	0.0	81.8
Denmark	92.0	8.0	0.0	0.0	0.0	0.0
Germany	40.3	39.3	1.9	1.2	0.0	17.4
Estonia	78.0	0.0	0.0	0.4	0.0	21.6
Greece	66.4	33.6	0.0	0.0	0.0	0.0
Spain	59.9	29.2	0.3	10.6	0.0	0.0
France	51.6	30.6	0.1	15.3	0.1	2.3
Ireland	38.9	58.6	1.3	0.2	0.9	0.1
Italy	66.9	9.7	0.7	3.9	18.7	0.1
Cyprus	24.2	71.6	0.0	0.0	0.0	4.2
Latvia	16.8	69.0	2.6	7.9	0.0	3.7
Lithuania	8.3	81.1	3.0	1.9	5.8	0.0
Luxembourg	95.8	0.0	0.0	4.2	0.0	0.0
Hungary	34.4	63.7	0.5	0.1	0.0	1.3
Malta	20.0	47.8	0.0	20.9	5.7	5.6
Netherlands	61.4	11.6	0.0	3.3	13.3	10.3
Austria	92.6	0.0	0.0	6.6	0.0	0.8
Poland	14.8	58.3	8.1	5.1	5.2	8.6
Portugal	8.3	83.3	0.1	6.7	1.6	0.0
Slovenia	59.7	31.1	1.1	4.7	0.0	3.4
Slovak Rep.	15.0	76.6	6.8	0.0	0.0	1.5
Finland	66.3	27.4	1.0	5.3	0.0	0.0
Sweden	33.7	63.4	0.6	2.2	0.0	0.1
United Kingdom	55.6	32.4	1.2	10.8	0.0	0.0

Source: European Commission, DG-Competition.

The simple exercise of listing possible instruments of industrial policy serves two purposes. First, it is a starting point for analysing which instruments are optimal, to be elaborated below. Second, it highlights an important feature of industrial policy – alluded to in passing in Section 2 – namely that industrial policy does not have its own, independent set of instruments, but that it has to resort to instruments of other areas of economic policy to achieve its goals.

The 'Tinbergen rule' says that the number of independent policy instruments must match that of policy goals.

This dependence of industrial policy on the instruments of other policy areas brings us back to a classic analysis of goals and instruments in economic policy making by Tinbergen (1955, 1956). The key insight in Tinbergen's work – the so-called 'Tinbergen rule' – is that the number of policy instruments that are independent of one another must at least match the number of policy goals for the latter to be attainable. In other words, if economic policy aims to achieve, say, two goals (low inflation and protection of domestic textile production), it is imperative to have two independent instruments (money supply and import tariffs) for both goals to be achievable simultaneously.

The challenge arising from the lack of independent instruments of industrial policy is thus clear: as the achievement of any industrial policy goal necessitates the employment of a policy instrument that is there to primarily serve another area of economic policy, the policy maker may have to choose whether to employ the instrument to achieve the industrial policy goal or some other goal. Thus, budgetary subsidies may support innovation but be incompatible with fiscal consolidation, *ceteris paribus*. Tariff protection of a declining sector may smooth structural adjustment but be incompatible with free international trade. In both cases, the policy maker has to choose the instrument in question to be used to achieve one goal and abandon the other one.

Lacking its own instruments, industrial policy needs to borrow them from other policy areas.

The examples above are clear-cut insofar as the two goals are indeed in conflict with one another. In this case, it is obvious that using one instrument will imply that at most one of the two goals can be achieved. Thus, a goal conflict along the lines discussed in Section 3 is a sufficient condition for the Tinbergen rule to be violated.

If the two goals are complementary then, obviously, there is no problem and the Tinbergen rule is not violated. This is the case with strategic mergers that boost productive efficiency so much that competition is worth sacrificing, or whenever an industrial policy goal can be achieved by fiscal instruments at a time when fiscal expansion is desirable.

In addition to the clear cases of goal conflict and goal complementarity, it is possible that the goals are genuinely independent of one another. It can be argued that there is no inherent conflict between innovation support and fiscal consolidation. If there were an instrument to support innovation that had no impact on the fiscal stance, both goals could be achieved simultaneously. If, however, fiscal instruments (subsidies, tax breaks) are used to support innovation, a trade-off situation arises, as industrial policy would be associated with fiscal expansion, all other things equal, which would be in conflict with the fiscal policy goal of consolidation.

To sum up, three different situations can be distinguished. First, whenever there is an inherent conflict between policy goals (e.g., protection of a domestic sector *versus* free international trade), the Tinbergen rule is violated, and the policy maker will have to choose whether to use an instrument (tariffs) to achieve the industrial policy goal or another goal. Second, whenever the policy goals are complementary (rent shifting through a strategic merger in the presence of scale economies and enhancement of productive efficiency), one instrument (merger) suffices to meet both. Third, whenever the goals are inherently independent (innovation support and fiscal consolidation), the use of an instrument from one policy area (e.g., budgetary subsidies) to achieve the industrial policy goal will violate the Tinbergen rule, and again the policy maker will have to choose whether to use the instrument to achieve the industrial policy goal or the other goal.

4.2 Optimal instruments

Above, the choice of instrument to achieve an industrial policy goal was regarded from the perspective of the interaction between industrial and other policies. While that discussion completes the consideration of the interaction between industrial and other policies, it is opportune to conclude by asking which instrument is economically optimal to achieve the various industrial policy goals. Another way of thinking about the optimality analysis is to take the decision to pursue an industrial policy goal as given – either because it is compatible with other policy goals or because it is considered more valuable than other goals that may need to be sacrificed in the process – and to find the least distortionary instrument to achieve the goal.

The issue of instrument optimality has not been addressed systematically in the literature. There is some generic literature concerning the choice of instruments to address specific market failures, as exemplified below, and there are some rather specific contributions, also reviewed below, addressing the choice of instruments in a certain set-up, with little general applicability.

Subsidies tend to be optimal to target positive production externalities.

In way of generic analysis of instrument optimality, a situation characterised by the presence of externalities is well articulated.[6] The instruments available to address them include budgetary subsidies; taxes (or tax breaks); government regulation; and the establishment of ownership rights allowing the taxation of gainers and compensation of losers.[7] In the case of a positive production externality – such as knowledge spillovers or agglomeration externalities – a subsidy directly targeting the market failure is generally the most efficient (least distortionary) instrument. By reducing the private marginal cost of knowledge production, a subsidy will increase the amount produced towards the social optimum. A tax break, while indirectly encouraging higher knowledge production, does not directly affect its private marginal production cost and is therefore likely to be less effective and less efficient.[8] Regulation, in turn, will not affect production costs or prices at all, and by requiring a certain level of research and development spending, for example, it would bypass the price mechanism as a source of economic information and implicitly assume any type of research and development spending in the required amount to be welfare maximising.

The establishment of ownership rights, in turn, is difficult in general because of high transaction costs and significant information requirements. However, as discussed in Section 2, a widely used shortcut to this end is the patent system, which grants its holder full property rights for a limited period, only to rescind them thereafter.

High transaction costs and significant information requirements plague the use of other policy instruments to address externalities, too (see Toivanen, this volume, for instance). After all, when trying to remedy an externality, the policy maker should always know the associated private and social costs and benefits in order to set the correct size of the subsidy, magnitude of the tax break, or regulatory limit on some activity. In effect, all this relates to the issue of how difficult it is to design and calibrate an industrial policy intervention, discussed in Section 2.2.

The use of a tariff as yet another instrument to encourage innovation is considered in Caves (1987). He concludes that a tariff cannot be the optimal instrument to encourage innovation, because tariff protection of a sector that underinvests in innovation (with a view to raising its profitability) would induce excessive entry by otherwise unviable firms and, moreover, it would create incentives for matching or imitating innovations, rather than original innovations. Besides, a tariff will cause a consumption distortion as it alters the domestic price relative to the international price; a subsidy would avoid distorting consumption.

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6 See any intermediate or advance textbook on microeconomics or public economics, such as Stiglitz (1988) or Mas-Colell *et al.* (1995).

7 According to the so-called Coase Theorem, the presence of unambiguous property rights can alleviate market failures due to externalities. Specifically, any externality can in principle be internalised through appropriate price setting and transfers whereby those causing negative externalities, for example, compensate those suffering economic loss due to them. For such internalisation to be possible, however, property rights must be clear enough to allow the assignment and payment of the appropriate amount of compensation.

8 The tax break will leave the cost of undertaking innovation unchanged, while it reduces the overall production costs. Thus, while it creates an incentive to spend on innovation, that incentive will not act directly to equate private cost, social cost, and the benefits of innovation. Therefore, it is less likely than a direct innovation subsidy to be effective and efficient.

Turning to strategic trade and merger policies, aimed at shifting rents in imperfectly competitive markets to the home economy, a number of studies compare the use of tariffs and budgetary subsidies. As observed by Caves (1987) and Gual (1995a, b), an import tariff is the optimal instrument to extract rents from a foreign producer who is a monopolist before the entry of a domestic rival. The tariff is to make the foreign monopolist price at marginal cost. Enter the domestic rival, and the optimal policy instrument becomes a subsidy (production or export subsidy) to him if the two firms compete in quantities (Cournot behaviour) and a tax (export tariff) if they compete in prices (Bertrand behaviour; see Eaton and Grossman 1985). In both cases, the policy maker uses the instrument to expand the domestic producer's market share.[9]

Leahy and Neary (2001) consider the optimality of an investment subsidy in the strategic trade policy context. In the general case, the sign of the subsidy (positive or negative, i.e., subsidy or tax) depends on whether the two competitors' investments are 'friendly' in the sense that investment by one firm raises the other's profits, and on whether the investments are 'strategic substitutes' in the sense that one firm's investment raises the marginal profitability of the other firm's investment. In short, the general case is characterised by ambiguity, and no robust case for an investment subsidy can be made.

However, Leahy and Neary show that an investment subsidy is unambiguously optimal in certain circumstances. They include a situation where firms are symmetric and compete in quantities and investment reduces production costs (e.g., investment in research and development). Moreover, an investment subsidy is optimal when firms are symmetric and compete in prices and investment is market expanding (e.g., investment in marketing efforts) rather than cost reducing.

Industrial policy to support structural change is most often effected through subsidies on production factors. It would, obviously, be first-best to remove the rigidities in factor markets that prevent an efficient adjustment process, but if this is not possible, a subsidy tends to be preferable to tariff protection, as the latter induces a greater distortion by altering domestic prices relative to international prices. Rigidity in real wages, for example, would call for a (temporary) labour subsidy in the sector concerned, rather than tariff protection of the sector.

Finally, industrial policy in support of equity objectives can be extended by means of tariffs or subsidies, both causing similar distortions. A tariff on rival imports or a (production) subsidy to home producers will cause an efficiency loss, as domestic producers and consumers face distorted prices and hence make distorted production and consumption decisions. In the case of a large country, or a non-competitive sector, there is also a terms-of-trade gain, which can offset the efficiency loss, at least in part.

In sum, as far as the optimal instrument to execute industrial policy goes, it has been argued that a budgetary production subsidy is best to address knowledge or agglomeration externalities; to alleviate factor rigidities that hamper structural adjustment; and to seek rent shifting in an oligopolistic sector characterised by quantity competition. Price competition in similar circumstances would argue for an export tax (tariff). As regards investment subsidies, a subsidy to cost-reducing investment would seem warranted in quantity competition, while a subsidy to a market-expanding investment would be more efficient in the case of price competition.

Budgetary subsidies are often optimal instruments to execute industrial policy.

9 While the use of a subsidy to boost domestic production and exports is clear, the use of a tax in price competition deserves an explanation. A tax (or an export tariff) on the domestic producer will reduce his pre-tax product price, which will allow him to undercut the foreign producer and thereby gain market share.

4.3 Summary

To deepen the analysis of the interaction between industrial and other economic policies, this section has considered the set of policy instruments that can and should be used to implement industrial policy. Most importantly, it was discovered that the lack of 'own' instruments, and the associated need to 'borrow' instruments of other policy areas to achieve industrial policy goals, could create a conflict between industrial and other policies even when the policy goals are independent of one another.

Instrument dependence can create conflicts between industrial and other policies.

In other words, this instrument dependence of industrial policy opens up another possible avenue for conflict with other policies. The case of outright goal conflicts was covered in Section 3, where it was concluded that in the case of a goal conflict, the cost of pursuing industrial policy is the inability to achieve the rival goal simultaneously. But even when the goals of industrial and another policy are not linked in any way, as was seen in this section, the use of other (fiscal, trade, or competition policy) instruments to achieve industrial policy goals can lead to a situation where the policy maker will have to abandon another policy goal (fiscal consolidation; free trade; or free competition) if he chooses to pursue an industrial policy goal.

So under what circumstances is this additional channel of conflict likely to be operative? It was observed that fiscal policy instruments are frequently both possible and economically optimal to pursue an industrial policy goal. Consequently, the use of subsidies and tax breaks – which are indeed the most frequently used instruments to extend state aid in EU countries – creates friction between industrial and fiscal policies whenever the optimal fiscal policy involves budgetary contraction. Arguably, this has been the case in most old member states of the EU for the past decades, so there has been a structural conflict between fiscal and industrial policies.

But could one not make the same argument concerning any government spending; after all, is there not a similar perpetual conflict between, say, education spending and fiscal consolidation?

The issue facing the policy maker contemplating industrial policy or any other action is one of productivity of public expenditure. In a world where economic efficiency guides the policy maker's action, the latter would prioritise spending so that the most productive expenditure are undertaken, while observing the budget constraint (short- and long-term fiscal targets). In this imaginary world, innovation subsidies; labour subsidies to smooth structural adjustment; and production or investment subsidies to capture rents would only be extended if they were not only productive (i.e., enhance social welfare) but also more productive than those expenditure that need to be curtailed so as to observe the budget constraint.

Thus, while there is an inherent conflict between fiscal spending to implement industrial policy and observing budget constraints, it is still possible to achieve both goals, provided the industrial policy spending is sufficiently productive. This result addresses the question of the compatibility of industrial and fiscal policies, which was left open at the end of Section 3. Having thus completed the circle that started with goal conflicts, passed through the choice of policy instruments, only to end up back at goal conflicts, it is high time to conclude.

5. Conclusions

When considered in its proper context, industrial policy appears somewhat more complicated than organ playing, at least by the standards of Johann Sebastian Bach quoted at the beginning of this paper. In addition to just hitting the right keys at the right time – which was sufficient for Bach's

masterly command of the instrument – the policy maker contemplating industrial policy action will also need to consider how it fits together with all the other instruments playing simultaneously. Even when industrial policy would seem fine in a solo context, it might be a real misfit as just another part of a bigger orchestra.

In this paper, two different sources of dissonance between industrial and other policies have been identified. First, the goals of industrial policy may conflict with those of especially domestic competition and international trade policies. Industrial policy, even when economically justified, has an element of 'favouritism' to it, with certain economic activities (innovation, agglomeration) or certain economic sectors or firms (domestic producers in internationally imperfectly competitive sectors; sunrise or sunset sectors; or socially weak and vulnerable sectors) receiving public sector support and protection. As is intuitively clear, such favouritism squares poorly with the general goals of free domestic and international competition. There are situations where industrial policy is compatible with competition and trade policies, as reviewed in Section 3, but in other situations there is an inherent conflict between the policies, meaning that the policy maker will ultimately have to choose whether to pursue industrial policy goals while sacrificing free competition or trade, or *vice versa*.

Conflicts related to both policy goals and instruments create trade-offs between industrial and other policies, forcing policy makers to prioritise.

The second possible source of dissonance between industrial and other policies, it was discovered, is the fact that industrial policy does not have its own set of independent policy instruments. While this is not so much of an issue for competition or trade policies – after all, their goals are always either compatible or in conflict with those of industrial policy, no matter what – the issue of instrument dependence is an issue in the context of fiscal policy. Given the multitude of goals fiscal policy has, it is not straightforward to identify the circumstances where they conflict with industrial policy goals. That there is significant interaction between fiscal and industrial policies is however clear, as fiscal policy instruments are not only frequently used to implement industrial policy, but they are also in many cases optimal from an economic perspective.

Thus, the use of fiscal instruments to achieve two sets of goals creates interdependence between the policies, even when the policy goals *per se* were independent (such as the fiscal stance and innovation support). This interdependence is sometimes problem free (combining fiscal expansion with innovation subsidies), sometimes not. But the interdependence always means that there is a trade-off between fiscal spending for industrial policy and other purposes: given a certain fiscal deficit target, €100 million in industrial policy support is €100 million taken away from other spending. For industrial policy support through the budget to be economically sensible, it has to be more productive than the spending it crowds out. Again, the policy maker faces a choice: either he pursues an industrial policy goal while foregoing other goals, or *vice versa*.

While it is not directly novel to point out that there are trade-offs in economic policy making, it is important to articulate them clearly, especially in the case of industrial policy. First, the goal conflicts between industrial and other policies are there by the nature of the policies, so they are more fundamental in character than the sporadic conflicts between, say, monetary and fiscal policies. Second, instrument dependence as a source of conflict especially between fiscal and industrial policies is not obvious at first sight, but it confronts the policy maker with equally difficult choices as a goal conflict.

And, as a concluding thought, even when industrial policy would seem to play well together with other policies, it is still awfully difficult to get it right. Hitting the right keys at the right time is not as easy for a policy maker as playing the organ was for Bach.

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ABSTRACT

Competition policy has seen quite significant changes over the past years. *With the reform of Merger Control and the application of Article 81 (agreements) an 'effects-based, economic approach' was formally introduced by the Commission. Two other areas of competition policy are under discussion, namely state aid control and the application of Article 82 (abuse of a dominant position). It will be one of the key questions whether and to what extent an 'economic approach' should be followed here too. Some issues of competition policy with regard to industrial policy will be analysed in view of this changes. As the 'economic approach' is based on neoclassical market form analysis and welfare economics, I will try to make these approaches more comprehensive before I point to some problems which occur if the 'theory' were to be applied in real cases.*

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Competition policy at war with industrial policy?

1. What is 'industrial policy'?

Andreas Strohm

'Industrial policy' is a somewhat complicated word. There is no consensus on what it means and some commentators strongly believe that there should be no such thing at all: for some, industrial policy is key to the future, for others it only harms the market process. In the view of the European Commission this policy forms a key part of the commitment to focus on growth and jobs. Success will be of paramount importance here, not only for the survival of social security systems but also for society as a whole. During a period of approximately 150 years, economic policies in countries like Germany and France mainly focussed on how growing welfare was to be distributed – today the question seems rather to be how sufficient welfare can be created.

There are several challenges. Globalisation has happened and nobody is able to turn back the clock again. Costs are reduced and flexibility is constantly increased by global production networks. In particular, the Asian emerging market economies are today taking their place and fully participating in global markets. An increasing internationalisation offers enormous opportunities, but naturally also intensified competition for the EU as a location for investment, production and R&D spending. Of course, the path to globalisation is not easy. There is a need for sometimes difficult adjustment that we must help to overcome and manage. However, on the whole, globalisation can and should bring strong benefits for Europe: the EU is the biggest trading bloc in the world and we have most to lose from any rise in protectionism.

Secondly, the nature of manufacturing production continues to change profoundly. Fast technological changes are taking place across the globe. In many industries, traditional manufacturing methods of mass production are being replaced by more adaptable production runs, using intelligent and multi-task production equipment. Global production networks are putting a premium on reducing costs and increasing flexibility.

In spite of these challenges, we should be confident about EU manufacturing industry's place in the world and its future. Commission analyses show that EU industry has not by and large performed as badly as often presumed. The majority of individual EU manufacturing sectors have performed well in comparison with their counterparts in other industrialised economies.

Important EU manufacturing sectors like pharmaceuticals, mechanical engineering, chemicals and motor vehicles sectors have a substantial revealed comparative advantage and record trade surpluses against the rest of the world.

Nevertheless, the industrial structure of the EU economy as a whole makes it less than ideally positioned to face the ongoing globalisation process. Three observations are worth making. First, there is clearly a productivity growth differential between the EU and other industrialised economies, particularly the United States. To some extent this is due to an industrial composition effect: the ICT producing sector is one of the growth engines of the US economy; in comparison to Europe, its share in the whole economy is bigger as well as its growth. Second, another factor is that EU trade is overall still concentrated in sectors with medium-high technologies and low to intermediate skilled labour. That makes us vulnerable in the competition with Asia, notably China, and other emerging countries. Third, there is also increasing international competition for R&D spending. There is evidence that the EU is not competitive enough as a location for research.

The United States and Japan are attracting more international R&D expenditure than the EU, whilst there is evidence that countries such as China and India are becoming important locations for new R&D investments. The United States has also been more successful than the EU in attracting researchers and highly skilled staff. These trends are a matter of considerable concern in so far as they lead to a loss of R&D investment and researchers from the EU.

The challenge for industry is to be able to maintain and further improve their performance in the future in the face of further technological breakthroughs and continued internationalisation. The challenge for policy makers is to give a clear and coherent response by making substantial improvements to the general environment in which European industry operates.

Industrial policy contains various fields of action and not just 'one'. The Commission has analysed 27 manufacturing sectors in detail, identifying in each of them their strengths and weaknesses and the priority challenges. The initiatives will be different, depending on the priority issues for the sector.

In defining its industrial policy, the Commission has not identified a conflict with competition policy. Without any doubt, rivalry on the home market creates strong incentives for innovation. In the case of low performance of a company, it is more difficult to explain it with mysterious reasons since the conditions on that market are the same for all companies. The elimination of competition would reduce the pressure for the remaining companies to adapt to new challenges and changes. Economies of scale are not the only thing. The strength of local competitors is a key factor for developing competitive advantages.

2. Merger policy

2.1 The issue of 'predictability'

Effective competition on European markets is widely seen as enhancing the international competitiveness of Europe's industries, but a number of specific competition policy issues are surrounded by controversy.

Notwithstanding the widely shared view that effective competition on the European markets is key to international competitiveness of the industry, there are enough particular issues of competition policy on which commentators have disagreed. One prominent field is, not surprisingly, the Commission's merger policy.

Some commentators expressed the view that merger policy shall most importantly be 'predictable'. As markets become increasingly turbulent, the predictability of the framework established and implemented by politics was crucial. The European Round Table of Industrialists stated in 2003 that a system of rules whose interpretation is perceived as unsystematic or erratic was almost as bad as not having rules at all and suggested to make European merger control more predictable (Voigt and Schmidt 2003).

Other commentators however had the opposite view. They felt that the Commission's application of the merger regulation was very rigidly orientated on legal criteria and did not give enough leeway to integrate welfare considerations in the assessment of mergers.

The legal test was changed in 2004 within the reform of the merger regulation. Before it was adopted, statements showed a split between opposing camps. There was initial broad agreement that merger control should ensure adequate consideration of 'non-coordinated effects' in oligopoly

cases below the market dominance threshold.[1] The point of contention was whether such consideration necessitated a revision of the legal test – in order to ensure legal certainty.

According to the arguments of the supporters of the so-called substantial-lessening-of-competition (SLC) test, this criterion took into account the post merger competition consequences for the market as a whole, unlike the market-dominance test, which dealt with just the market position of the merging companies. Thus, only the implementation of the SLC test would be able to offer legal certainty regarding non-coordinated effects in an oligopoly. Expanding the conditions of market dominance to encompass all cases relevant to competition policy was seen by these parties as an unacceptable alternative.

Interestingly enough, the supporters of a maintenance of the existing market-dominance test also claimed arguments of legal certainty. The evolution of the market-dominance concept through Commission decisions and court rulings had validated it as an effective and flexible regulatory instrument. Initially market-share focussed, the criterion had become applicable to all merger cases posing possible risks to competition. Changing the existing legal test would have the effect of loosing existing case law and raise the problem of legal certainty.

The compromise that resulted in the Council was essentially a rewording of Article 2 (3) of the EC Merger Regulation, through which the secondary limb – the 'significant impediment to effective competition' – became the central and sole basis upon which to assess a merger. The creation or strengthening of a dominant position on the other hand is now only one possible (although the most important) instance of a significant impediment to effective competition. The new provision was aimed to achieve more legal clarity regarding how to handle the unilateral effects of oligopolies. On the other hand, market dominance remained the most important factor in significant impediments to competition, as the Commission made expressively clear in its guidelines for horizontal mergers. By maintaining the original wording, the goal was to preserve the applicability of the wide-ranging legal basis built through rulings by the European Court of Justice on market dominance issues.

The 'significant impediment to effective competition' criterion has become the central basis for the Commission's assessment of mergers, with 'market dominance' remaining the most important factor in assessing impediments to competition.

2.2 Assessment of 'economic effects'

The introduction of the new primary criterion of 'significant impediment to effective competition' was not a matter of implementing a particular economic concept. The economic applicability depends on the procedures of the entire regulatory process. Most importantly, it depends on 'economic thinking'. The study of the Round Table of Industrialists has analysed some of the developments in the so-called 'new industrial organisation'. Although the study finds models in this tradition very convincing, it points out that the application in the real world of merger cases is "often confronted with the fact that the results of the models are very sensitive on specific assumptions made." (Voigt and Schmidt 2003, p.157)

Has the Commission taken a wrong approach in the Horizontal Merger Guidelines[2]?

In economic theory, there is no shortage of attempts to clarify the relationship between competition and market power. The approaches show that the question of how to define market power very

1 Non-coordinated effects ('unilateral effects') refer to effects on competition solely due to the fact that the competitive pressure exercised by the merging parties on each other disappears as a result of the merger. This term does not include factors pertaining to a merger-created environment that facilitates coordinated behaviour.

2 European Commission (2004).

often depends on the concept of competition underlying the analysis. The Lerner Index for evaluating market power, for example, is based on a model of total competition. The condition for efficient allocation, by which all exchange profit is exhausted and the price corresponds equally to the cost margin, has to be seen in economic terms as applying not only to one market but to all markets simultaneously. Other concepts are based on a dynamic competition model and attempt to optimise the intensity of competition within a framework of previously defined competition functions. An increase in market concentration does not automatically mean an increase in unwanted market power, but may result in an increase in competition intensity. The examples above illustrate that a generally valid definition of market power remains elusive. Similarly, the related question of what exactly is meant by 'competition' remains – from the viewpoint of Karl Popper's initial criticism of essentialism – an unanswerable question.

The horizontal merger guidelines of the Commission aimed at preventing mergers capable of denying consumers the advantages of effective competition.

The guidelines describe the goal of merger control as the prevention of mergers capable of denying consumers the advantages of effective competition – meaning in particular low prices, high-quality products, broad selection, and innovation. The central criterion looks at the market power of the merged company, meaning whether or not such power is noticeably increased by the merger. Market power means in this context the capacity of one or more companies to raise prices in the interest of increasing profit or to limit the availability, selection or quality of goods, or to restrict innovation or otherwise influence the parameters of competition (European Commission 2004, Recital 8). This goal of safeguarding effective competition by limiting market power is based on the economic principle that competition leads to greater efficiency and economic viability for companies, therefore being ultimately beneficial to the common good.

The guidelines define not only the general goal of merger control but also the welfare standard. Defining the process as aimed at the goal of consumer welfare was a key decision determining the specific economic orientation of competition analysis (de la Mano 2002). The choice of welfare standard has consequences for the entire evaluation of mergers, particularly considering the significance of 'cognisability of efficiencies' as a core element of the clearance process. The welfare-related approach is fundamentally based on competition not existing for its own sake, but as a tool to achieve a higher level of welfare.

In contrast to the structural approach of German merger regulation, which justifies the interference of regulators on the basis of abstractly defined anticompetitive market structures and behaviours,[3] the concept of consumer welfare is bound to the specific effects of a particular merger. The aim is to better orient rulings on the specific economic effects (for the consumer) expected from a merger. Conceptually, this differs from the concept evident in the guidelines as well as in the model of unfettered competition. It is guided primarily by market results that are evaluated according to the criteria of consumer benefit or consumer welfare. This means, first and foremost, prices.

The application of quantitative methods and simulation models in merger control is seen, particularly in Germany, in a sceptical light and linked to fundamental questions about the possibilities of reaching accurate conclusions in economics (Strohm 2004). This debate has a long tradition. From the point of view of von Hayek (1969), whose position is particularly highly regarded in Germany, the limits that result from 'constitutional lack of knowledge' regarding the ability to make exact forecasts about market developments are 'insurmountable'. As a result, gearing economic policy towards specific goals (such as consumer welfare) will not necessarily lead to desired results.

Some developments of the 'new empirical industrial organisation' initially seem to confirm this view, since it is difficult to imagine that the models developed in such a way could be integrated

3 Also see *Bundeskartellamt, Arbeitskreis Kartellrecht, Diskussionsbeiträge* (2004).

into a merger–control process. But the question of whether it is possible to differentiate, in terms of validity, between two competing theoretical models on the basis of empirically observed data – the problem of identification, in other words – is as old as the social sciences themselves. Contemporary industrial economics provides methods of both a theoretical and empirical nature, which have not only changed our understanding of reality but have offered new, previously unimagined, possibilities of identification. The methods subsequently applied to test theoretical models range from descriptive statistics of relevant market forms, natural experiments and correlative analyses to complex econometric procedures or simulations. These methods are principally complementary. The key question in a case-by-case approach is whether it is possible to gain qualitatively reliable data about the relevant market parameters – such as prices, sales, or costs – within the framework of competition analysis. Only in this way will the resulting consequences in the context of competition analysis be sufficiently robust and able to withstand scrutiny in a court of law (see Röller *et al*. 2004, for instance).

Since competition analysis has to satisfy a very specific demand – namely market analysis based on short-term data, solid factual basis, and resistance to manipulation – simple techniques, such as natural experiments, are often better suited than very complex methods. Natural experiments examine historical events towards identifying the relationship between two specific variables. For instance, a departure of a company from the market provides observable data on the relationship between the number of competitors and the level of prices (provided other important factors remain constant). Like the quality of econometric calculations and statements in general, the value of natural experiments depends on the availability of data. This data must be as comparable as possible and lie within a specific time period. The merger-control process does not always allow for an optimal situation, since the time in which a ruling has to be reached is strictly limited by the EC Merger Regulation (ECMR from here on). In addition, participants cannot be asked to submit to a disproportionately strenuous examination process.[4]

The merger-control process does not always allow for an optimal situation, since the deadline for reaching a ruling is strictly limited by the EC Merger Regulation.

However, the willingness to apply new methods does not mean that the limits of their use are ignored. The effects of innovation, improvements in quality, or the vertical effects of mergers are more difficult to document – in terms of empirical verification – with quantitative methods. A specialised theoretical or empirical analysis can therefore not replace the case-by-case comparative analysis of specific factors. Simulation models have also proven inadequate to fully explain possible behavioural changes resulting from a merger – such as the shift of companies to a cooperative strategy. Empirical analyses can at the most provide answers to specific problems, but this information may nevertheless be decisive in the overall review process.[5]

2.3 Efficiencies in merger control

The idea of including efficiency perspectives in merger analysis reflects the assumption that while efficiencies can impede competition, they may also have economic advantages. For example, the study of the European Round Table of Industrialists claims the integration of transaction cost efficiencies in the assessment of vertical mergers since – under the conditions set out in transaction cost theory – "the prohibition of mergers would be detrimental to overall efficiency." (Voigt and Schmidt 2003, p.30)

How does the Commission asses efficiencies? Is there space for improvements?

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4 *Bundeskartellamt, Arbeitskreis Kartellrecht, Diskussionsbeiträge* (2004, p.6).

5 *Bundeskartellamt, Arbeitskreis Kartellrecht, Diskussionsbeiträge* (2004, p.7).

2.3.1 The 'theory' of efficiencies

The question of whether efficiencies shall be a valid standard for merger control hinges to a large extent on whether there is adequate knowledge, notably whether it is actually possible to precisely gauge the effects of the merger and whether, in the context of the specific welfare standard, they can be comparatively evaluated. A comparative evaluation is necessary if the goal is to facilitate the approval of mergers that may have a negative effect on competition, which may however be offset by positive welfare effects. This poses specific conditions regarding the content of the evaluation in question. The Williamson trade-off, which forms the theoretical basis for efficiency analysis within economic theory, provides a good illustration of the idea that a decision based on the proposed criteria can only be reached when the opposing effects, namely allocative inefficiencies (welfare losses through monopolisation) and productive efficiency (welfare gains through cost savings) of the merger in question can be precisely determined. We will come back to this point later.

Economists usually suggest that competition policy should be based on the effects a decision may have on welfare as a whole.

Economists usually suggest to base competition policy generally on the effects a decision may have on the welfare as a whole, or 'total welfare' (Schmidtchen 2004). In relationship to merger control, as illustrated in the Williamson model (see Schwalbe 2004, for instance), this means that a merger could be approved according to the welfare standard if the sum of producer and consumer benefit is positive. In a simplified form, the total welfare standard includes cases in which the price rises after the merger (the consequent lowering of consumer benefit being compensated by the efficiency gain to the producer in the form of an increase in producer benefit).

The decision which welfare standard shall apply cannot be reached through welfare theory itself, but must be decided normatively. Practically, this means that the decision is a political one.

However, *de lege lata*, it is not possible to choose a welfare standard entirely on a theoretical model. In the literature on this subject, the core assumption is that European merger-control law is "based on the narrower welfare standard that conforms to the consumer interest." (Montag 2004, p. 95). The use of the term 'welfare standard' in this context can easily lead to misunderstandings because (as stated in Article 2 ECMR, the basis for appraisal being 'the consumer interest') it equates the proper standard with a familiar term from welfare economics. However, some commentators have reached the conclusion that the analysis of mergers may rest solely on the quantitative analysis of prices.

The welfare-theory approach basically starts with the assumption that competition is not an end in itself, but an instrument for increasing welfare. It follows that mergers should be judged individually and to a greater degree on the basis of their actual economic effects, which is why merger-control reform is often said to be striving for a 'more economic approach'.

There is a fundamental difference between this focus on actual effects and the structural approach currently underlying German competition law - which formed a kind of blueprint for the EC Merger Regulation at the time when it was created. In the classical structural approach, no explicit prognoses are laid out regarding the changes in price or quantities resulting from a merger. The sole test is whether the merger allows the new company manoeuvrability to raise prices.

In hindsight, these differences harbour a key consequence for efficiencies as evaluation criteria: within the structural approach, there is no possibility for efficiencies to play a role, since the structural criteria sets an upper limit above which efficiencies cannot be taken into account. If, however, the analysis is based on actual welfare effects, possible efficiency gains must always be a part of any analysis, since they may always have the effect of increasing welfare.

Another difference to the structural approach is the relevant timeframe. Proponents of the structural approach start with the assumption that due to the loss of competition, a company dominating the market as a result of a merger will gradually lose in the medium term the impetus to strive for efficiency gains and pass the benefit on to the consumer (Böge 2004). Structural market changes should therefore not be judged according to short-term profit. They should be evaluated with the view of whether competition maintains its long-term function as a welfare-boosting impetus for rivalry in the marketplace following the merger or whether a serious and lasting impediment to this process will emerge as a result of market dominance. Welfare analysis, on the other hand, is based on projected short-term welfare effects. To the extent that a valid consumer standard exists, the theoretical studies on this subject focus on projected prices. The logical result of this would be that a merger can only be approved if it does not result in higher prices (within a yet undetermined timeframe) independent from the change of the market structure (Röller *et al.* 2001). This is based on price-theory models remaining comparatively static, meaning that all conditions remain constant, therefore reflecting a timeframe of zero.

Theoretically, efficiency standards can be integrated into merger regulation in various ways, including as 'efficiency defence' and, alternatively, as an integrated part of the competition analysis itself (integrated approach).

Theoretically, efficiency standards can be integrated into merger regulation in various ways.

An efficiency defence entails a trade-off, meaning the appraisers have the option of approving a merger even if it has been determined that doing so will impede competition. In contrast to the integrated approach, the procedure is twofold: the appraisers will weigh any advantages of the efficiency gain against the previously determined disadvantages to competition. In the Williamson trade-off, the comparison is between the projected efficiency gains (cost cuts) and the merger–related anti-competitive effects (allocative inefficiencies). The main principle of an efficiency defence is a 'rule of reason', which may entail entirely different standards[6] – one reason why this concept has been accused of resulting from corporate lobbying (Schürgas 2002). From the viewpoint of welfare theory, however, it is necessary (and possible) to tie the decision to welfare criteria – such as that total welfare must increase from the achievable efficiencies (Schmidtchen 2004).

Within the integrated approach, efficiency is a factor of competition analysis itself. In other words, efficiencies are an additional element influencing the appraisal of a merger. In this alternate approach, achievable efficiencies of a merger cannot be weighed against its impediments to competition, efficiencies are seen as a factor which might help to solve the competition problem itself. In most of the theoretical studies as well as in suggested merger simulation models this is nothing other than a price reduction achieved by a gain in efficiency (see also de la Mano 2002).

The decision to use an integrated approach, provided it is carried through, results in the efficiency analysis providing the blueprint for a partial price-theory analysis. This is evident primarily in the question of which efficiency categories are admissible as cognisable efficiencies and which are not:

- Efficiency advantages enjoyed by consumers in other markets (such as in the form of new products) cannot be taken into account since they do not contribute to solving the competition problem within the relevant market. This condition is based on cost-benefit analysis, which examines solely the relationship between prices, costs and quantities. The admissible efficiency gains, therefore, are only those dealing with cost savings (Strohm 2004).

6 This problem plays a particular role in the application of Article 81, according to Odudu (2002).

- Efficiencies must be defined to take into account only the reduction of variable costs (Stennek and Verboven 2001). This is based on a theoretical scenario in which the variable costs from an increase in output alone exercise an influence on prices. Fixed costs are, in this model, not part of the price calculation of a profit-based company, since cost limitation is the key factor.

- Product analysis must be limited to homogeneous goods. Factors unrelated to products in the market determining cost-cutting goals are irrelevant. The implication here is that we are dealing with efficiency gains and cost savings related to the manufacture of existing products.

- Efficiencies must be exactly quantifiable. Price theory evaluates the most profitable price/quantity combination, that is, whether cost cuts lead to optimum profit at reduced prices.

- Projected price cuts resulting from efficiency gains must be achievable in the short term. The price-theory reference model is comparative static, meaning the situation before and after the merger will be compared against an identical demand curve. A change in demand would change the profit-maximising relationship of price and output. Failure to realise efficiency gains in a timely manner makes the drawing up of a realistic scenario for decision-making significantly more difficult.

2.3.2 Efficiencies under the EC Merger Regulation

In practice, efficiency criteria have not played a role under the old market-dominance test of the ECMR, but it would have been legally possible to integrate them into this test.

A look at the real-world practice of ECMR reveals that efficiency criteria under the old market-dominance test have not played a role. Furthermore, there was no legal security as to whether and in which form real-world efficiencies would be taken into account at all by the Commission. The cases of Aerospatiale-Alenia/de Havilland[7] and MSG Media Service[8] in particular caused some confusion. In the first case, the Commission clearly included the parties' claims regarding efficiency gains in its appraisal of the case, whereas the efficiency claims of the parties in the MSG Media case were rejected without additional examination due to the foreseeable consequence that the merger would have resulted in clear market dominance. On the other hand, in the case of BASF/Eurodiol, the emergence of market dominance was examined in the context of a restructuring model according to Article 2 ECMR, which reflects in its two-stage approach an 'efficiency defence'. The economic literature on this matter remains divided on whether the negative consequences of market dominance can be adequately offset by achievable efficiency gains (Berg 2004).

The change in ECMR's dominance tests under its 'Significant Impediment to Effective Competition' (SIEC) criterion was not aimed at giving more consideration to economic efficiencies of mergers. Greater integration of efficiency questions within the legal parameters played no role whatsoever in the Council's compromise process. However, the efficiency chapter of the guidelines for horizontal mergers, which had been drafted in parallel to the reform debate, was provided to the Commission in rough-draft form at a time when it was assumed the agency would maintain its dominance test unchanged. In other words, in the view of the Commission it would have been legally possible to integrate efficiency criteria into the unchanged market-dominance test.

The introduction of the new primary criterion SIEC has no self-contained economic concept. Being a decision reached by the EU Council of Ministers, it is chiefly a reflection of political compromise and aims to ensure that certain oligopolies remain accessible to regulation. The revision of the legal parameters do not therefore represent any obligation on the part of the Commission to take into account efficiency gains as possibly critical criteria.

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7 European Commission Official Journal (1991) L 334/42 – Aerospatiale Alenia/de Havilland.
8 European Commission Official Journal (1194 L 364/1 – MSG Media Service.

On the other hand, the SIEC test does not explicit disallow it either (Berg 2004). Recital 29 of ECMR states that it is possible "that the efficiency advantages of a merger could counterbalance the effects of the merger on competition, especially the possible drawbacks for the consumer, so that effective competition in the common market or a major part of it will not be significantly impeded through, in particular, the creation or strengthening of a dominant position." In the guidelines for judging horizontal mergers, the Commission makes clear that for the analysis of merger effects it is advisable to take into account well-founded and relevant efficiency advantages.

In its guidelines for appraising horizontal mergers, the Commission's basic criteria for including efficiencies are summed up in a single chapter. Efficiencies are systematically treated as dampening factors. While Section III describes the analytical parameters for the evaluation of possible impediments to competition resulting from a merger, the following sections deal with special factors that might contribute towards dampening these effects. Specifically, these factors are: countervailing power (Section IV), the probability of market entry (Section V), efficiencies (Section VI), and failing firms (Section VII**)**. Alone from the systematic approach – not to be confused with the use of this term to refer to, among other things, both forms of efficiency analysis (Verouden *et al.* 2004) – it is clear that we are dealing not with an 'efficiency defence', but with an integrated approach.

This means that efficiency gains cannot counterbalance a definite anti-competition effect. They can only come into play in a marketplace in which a competition problem already exists (in the relevant market) – and not in tertiary markets. This precludes the possibility of negative effects of a merger for a specific group of consumers being measured against advantages for another group.

According to the horizontal merger guidelines of the Commission, efficiencies should be quantifiable and result in lower variable production costs.

Two further criteria of the guidelines can be situated within this price-theory context. According to the guidelines, efficiencies should, if possible, be quantifiable[9] and the primary concern regarding an admissible efficiency is the reduction of variable costs[10]. This conforms to the price-theory model by which only a reduction in variable costs (but not fixed costs) combined with a boost in output can lower prices. To be able to calculate on a case-by-case basis whether the merged company has the incentive to pass the merger-related efficiency gains on in the form of lower prices, cost cuts must be measured as precisely as possible. Only if one can assume that cost cuts are so significant that they can boost profit as prices fall, can efficiency gains actually be a key factor.[11] If we abandon this defined framework – such as through a broader definition of admissible efficiency categories – the immediate result is that the basic method of quantitative effects can no longer be used: "(…) mergers leading to technological change and improvement in the quality of the product can improve consumer welfare even with price increases. But these aspects are not measurable and cannot be taken into account with the usual methods." (Ilzkovitz and Meiklejohn 2001, p.20).

2.3.3 Perspectives: the practical impact of efficiencies for decisions

The efficiency chapter in the guidelines for evaluating horizontal mergers is directly related to the stated goal of the Commission to appraise mergers in the merger-control process primarily on the basis of their economic effects. The evaluation of effects requires however the prior clarification

9 European Commission (2004, Recital 86).

10 European Commission (2004, Recital 80).

11 Drauz (2003, p. 266): "Price is one of the main and most visible parameters of competition. It is also in this dimension in which the neo-classical economic benchmark of consumer welfare has been developed and most studied. Following the theory, there are situations in which cost reductions attributable to a merger are passed on to consumers in the form of lower prices, namely, where this is profit maximising for the merged unit. For example this would hold where the merged entity would achieve reductions in marginal costs. Consequently, a merger should be cleared if such a situation is present."

of this concept. The declared merger-control goal of 'consumer welfare' provides, according to its proponents, not only a clear reference point within price theory, but a concept that, assuming these theories can be reliably applied, leads to greater objectivity and justifiability of decisions by virtue of its focus on quantitative analysis.

Taken to its logical conclusion, such an approach to merger control would greatly marginalise the significance of market-structural criteria, since the primary concern would be the price expected after the merger. It follows that mergers with significant efficiency advantages would theoretically lead to a break with the traditional structural approach, since sufficient efficiency gains take the form of reduced prices if the merger parties already hold a powerful market position prior to the merger. The criteria stated in the Commission's guidelines follow directly from price theory since they base the admissibility of efficiency claims on a blueprint of relevant parameters (reduction in variable costs, efficiencies shall be quantifiable and have an effect on the relevant market). The analysis focuses therefore on the post-merger price.

But on the other hand, the possibility for efficiency gains becoming the key factor in the approval of a merger is itself limited by structural criteria. According to the guidelines, the inclusion of efficiency advantages can become a decisive factor in an approval only if the anti-competitive effects of a merger are limited. If we also consider that the guidelines themselves stipulate criteria to be qualitatively tested, which, in accordance with Article 2 (1) ECMR, are to be valuated with a view to the structural evaluation of the market affected by the merger, the question arises which sort of practical significance a quantitative efficiency analysis can possibly have for the overall result. Conceptually, the integration of a price-theory welfare analysis into a structural approach results in a sort of hybrid, the two aspects of which are based on fundamentally different principles. Therefore, it remains difficult to combine into a consistent whole.

The fact that the guidelines' intended "step toward greater convergence" (Verouden *et al.* 2004, p.285) with American merger control law is not yet within reach can be most clearly seen in the case of efficiency analysis. It may be true that a broad agreement with US guidelines exists in terms of form and content, but that does not necessarily mean a greater convergence of decisions.

Unlike the Commission, US agencies are not obliged to justify merger approvals or defend them in court.

Unlike the Commission, US agencies are not obliged to justify merger approvals or defend them in court, which implies that the criteria stipulated in the guidelines would be legally relevant only if the agencies planned to deny approval (and bring it to court themselves). Previous experience shows us – there being not a single case so far that was decided in favour of the parties on the basis of efficiency gains – that the demand for 'consumer pass on' in particular does indeed pose a serious hurdle (Drauz 2003). Therefore, the application of these criteria under EU law – accountability for approval decisions as well with the possibility of a lawsuit brought by a competitor—poses a significant legal risk for the Commission should it opt to approve a merger on the basis of efficiency gains. This is especially critical considering the fact that an exact quantification of future events is very difficult to verify (Montag 2004).

What alternatives exist?

With welfare theory as the basis, competition decisions are being considered on a model of 'second best', the basis being not the narrow consumer standard but welfare as a whole (Schmidtchen 2004). Whether such an approach can be achieved, *de lege lata*, under ECMR is another thing. But from an economic viewpoint, an 'efficiency defence' would be the logical approach according to these guidelines. Anti-competition effects (such as price increases) could be weighed against efficiency gains resulting from the merger (increase in producer benefit). This leads to an expansion of the

cost categories (to include, for example, fixed costs), but does not solve the problems resulting from the static nature of the analysis and which, in this context as well, regularly occur during the investigation into the necessarily precise quantification of effects.

If such a 'defence' were to apply not only to an increase in welfare through improved production of an existing product, but also to possible efficiency gains that might lead to new products or improved quality, then it is unavoidable that a case-by-case evaluation encompasses a qualitative appraisal. Certainly there are welfare-based appraisals that claim that, with the help of inter-personnel utility comparisons, precise statements as to welfare effects are possible. However, these models, when applied to an actual case, are saddled with significant speculative elements: if a merger can only take place provided that a new product will be brought to market in the future, then it can be assumed that the product does not yet exist. But how can we then exactly calculate the benefit it represents (for the consumer)?

There are welfare-based appraisals that claim that precise statements as to the welfare effects of mergers are possible, but they are speculative.

Upon closer examination, the guidelines, although largely conforming to the pattern of an 'integrated approach', do not entirely rule out economic efficiencies which are only admissible in the context of an 'efficiency defence'. Recital 79 of the guidelines, for instance, states that efficiency advantages must affect the relevant market, but only "in principle." Recital 81 goes on to say that consumers may benefit also from the products or services that result from efficiency gains in research and development or innovation. Assuming the welfare-theory foundation of the guidelines is to be adhered to, applying this rather carefully worded criterion demands however a rather broad interpretation of the term consumer welfare, such as the definition suggested by Drauz (2003, p. 266): "Consumer welfare can be conceived as the difference between consumers' willingness to pay for consumption and the price paid. It is a multidimensional concept, incorporating all aspects that have an impact on consumers."

However, it is important to emphasise that the legislator has not equated the 'interests of the consumer' – as referred to in Article 2 (1) ECMR – with the term 'consumer welfare', which is borrowed from the vocabulary of welfare economics. As indicated above, a qualitative comparison of various factors is ultimately always necessary in individual decisions, even if the quantitative factors alone are recognised as cognisable efficiencies in the narrow concept of partial market analysis. When it comes to promoting efficiency as a factor of key practical significance, the most useful method would certainly not be to saddle it with the burden of proof regarding quantitatively examined welfare effects.

3. Economic approach under Article 82 of the EC Treaty

At present, the EU policy on the abuse of market power – the application of Article 82 – is under review. Commentators have held that the current policy of the Commission was too focussed on the application of *per se* rules instead of taking into account the economic effects of the behaviour of the market-dominant firm. The British Institute of International and Comparative Law states: "…the effectiveness, efficiency and coherence of European competition policy requires a modernised approach to the application of Article 82, involving an analysis of the economic effects of conduct on competition on the market, and in particular on consumer welfare". In no way would it be desirable to develop a policy alongside better economic performance and improved welfare.

However, it is not yet clear whether a 'rule of reason' would guarantee that the results on welfare would indeed be better than the application of '*per se* rules' and it remains unclear how to achieve sufficient certainty on this.

According to welfare theory, the objective of competition policy shall be the reduction of 'type one' and 'type two' errors. Translated into the application of Article 82 it means that the behaviour of a market-dominant firm shall be disallowed if it reduces consumer welfare. But how could this be proven? The welfare analysis of a conduct requires a benchmark, which is – unfortunately – hypothetical. To analyse, for example, the welfare effects of a rebate system, the competition authority must exactly identify to what extent the system has influenced the market process. This is not an easy exercise. Notwithstanding that the conduct is a fact and so is the economic result, 'how' the conduct (rebate system) has influenced consumer welfare is a difficult question to answer.

But even under the assumption that a new generation of extremely skilled economists using econometric studies were able to establish wisdom on welfare scenarios, such a policy may carry some undesired side effects. The more sophisticated the approaches of the new generation of economists will be in establishing these scenarios, the less a dominant firm would be able to anticipate its outcome. As a consequence it would perhaps not know whether its conduct (introduction of a new rebate system) is illegal or not. As aggressive market conduct is generally very beneficial to consumers, the policy itself may have endogenous effects on welfare. To my knowledge there is not yet a theory that can handle this problem.

But apart from that, would a case-by-case assessment deliver the answers to all kinds of problems in the field of abuse regulation?

Let us look at an example: the restrictions of parallel trade for pharmaceuticals. These restrictions have taken the form of Supply Quota Systems (SQS): a manufacturer refuses to deliver the full quantity requested by a dealer or refuses to deal altogether. Such behaviour could fall under Article 82 of the Treaty, provided the manufacturer holds a dominant position for the product in question. Already at this stage we can see that the powers of a competition authority to develop a policy is limited since an intervention on the basis of the abuse regulation requires evidence that 'this firm' on 'this market' holds a dominant position.

The more a competition authority bases its decision on the concrete economic effects of an individual case, the less information can be gathered from the decision as to whether the future behaviour of market participants is unlawful or not.

What are the consequences in terms of policy options? An individual case, which is to be decided by the Commission, is subject to jurisprudence, and it will take many years for the case to pass all instances. The more a competition authority bases its decision on the concrete economic effects of the individual case, the less 'information' can be gathered from the decision as to whether the future behaviour of market participants (e.g., application of a SQS) is unlawful or not. The added value of the decision in terms of developing a policy for a sector would thus be rather limited. It seems thus to be obvious that individual decisions, which would only stipulate that the application of a conduct (the application of a SQS) was only unlawful under the particular circumstances of the individual case, would have only little effect on the behaviour of market participants. In our example, traders and wholesalers of pharmaceuticals would still not have much more legal certainty as to what the manufacturer has an 'obligation' to deliver other patent products in any desired quantity, and the manufacturer might still have no certainty whether it would be legal to impose a SQS to another product.

There is probably some sort of conflict – between the idea to assess abuse cases on the economic effects that have to be proven individually within an economic analysis of the individual case and an approach that prefers to set out policy orientation for future cases. Perhaps the conflict is less evident in other areas of Article 82, but here it is. I do not advocate the end of a reasonable use of economic theory in abuse cases. But it needs a well-balanced approach, which – in line with the Commission's industrial policy – has to be orientated on the needs of the different industries.

4. State aid

4.1 Community control of state aid

Granting financial support may be considered as an important element of industrial policy. Therefore, there is strong interaction between the industrial policy of Member States and the competition policy of the Commission: Article 87 of the EC Treaty prohibits any aid granted by a Member State or through state resources in any form that distorts or threatens to distort competition by favouring certain firms or the production of certain goods in so far as it affects trade between Member States. However, the Treaty allows exemptions to the ban on state aid where the proposed aid schemes may have a beneficial impact in overall Union terms.

The following types of aid may be exempted under Article 87(3) if one or more criteria for exemption are met: (i) aid to promote the economic development of areas where the standard of living is abnormally low or where there is serious underemployment; (ii) aid to promote the execution of an important project of common European interest or to remedy a serious disturbance in the economy of a Member State; (iii) aid to facilitate the development of certain economic activities or of certain economic areas, where such aid does not adversely affect trading conditions to an extent that is contrary to the common interest; (iv) aid to promote culture and heritage conservation, where such aid does not affect trading conditions and competition in the community to an extent that is contrary to the common interest; (v) such other categories of aid as may be specified by decision of the Council acting by a qualified majority on a proposal from the Commission.

The way in which the Commission exercises its discretionary powers is outlined in a number of regulations and in so-called 'soft law provisions', such as guidelines and communications. Specific soft law provisions exist in order to set out criteria to assess compatibility for aid measures of a horizontal nature (e.g., Research and Development Framework, Rescue and Restructuring Guidelines, Rules applicable to Services of Economic Interest, the Environmental Guidelines, the Regional Aid Guidelines) and for measures in certain sectors (e.g., shipbuilding, broadcasting, 'stranded costs' in the electricity sector).

4.2 The Lisbon Strategy for growth and jobs

Competition policy rests upon the idea that a market-based economy provides the best guarantee for raising living conditions in the EU to the benefit of citizens. Functioning markets are also essential elements to enhance the competitiveness of the European economy, as it creates an environment in which efficient and innovative companies are rewarded properly. State aid control is necessary to maintain a level playing field for all undertakings active in the Single European Market. There is a particular need to be concerned with those state aid measures that provide unwarranted selective advantages to some firms, preventing or delaying the market forces from rewarding the most competitive firms, thereby decreasing overall European competitiveness.

Competition policy rests on the idea that a market-based economy provides the best guarantee for raising living conditions in the EU.

As it was clearly expressed by the European Council of November 2004, there is a need for renewed impetus to the so-called Lisbon Strategy. The European Council of March 2005 has called on Member States to continue working towards a reduction in the general level of state aid, while making allowance for market failures. This movement must be accompanied by a redeployment of aid in favour of support to certain horizontal objectives such as research and innovation and development of human capital.

Total state aid granted by the fifteen Member States was estimated at €53 billion in 2003, Germany granting the most aid (€16 billion), followed by France (€9 billion) and Italy (€7 billion). In relative terms, state aid amounted to 0.57 percent of EU gross domestic product (GDP) in 2003. The share of total aid to GDP ranges from 0.26 percent in the United Kingdom to 1.41 percent in Finland. Aid to fisheries and agriculture excluded, Finland represents only 0.36 percent of GDP, just below the EU-15 average of 0.40 percent. Germany (0.68 percent) and Portugal (0.96 percent) remain well above the average. From the relatively high levels of state aid in the early and mid-1990s, the overall volume of aid fell from €74 billion in 1996 to €55 billion in 1999. However, since 1999 the level of state aid has not shown significant change.

Besides the objective of reduction in total aid there is a need for more clarity. Increasing complexity and the number of documents progressively adopted by the Commission over time have created a need to streamline aid policy, focus attention on the most distorted types of aid, and make state aid control more predictable.

How does the Commission react to these challenges?

In its State Aid Action Plan, the Commission seeks a modification of existing state aid rules, as to both substance and procedures.

In its State Aid Action Plan, the Commission seeks a modification of the existing state aid rules, as to both substance and procedures. Any effective assessment of the allocation of distribution effects of state aid must take into account their actual contribution to commonly agreed, politically desirable objectives. The aim is to present a comprehensive and consistent reform package based on the following elements: (i) less and better targeted state aid; (ii) a refined economic approach; (iii) more efficient procedures, better enforcement, higher predictability and enhanced transparency; and (iv) a shared responsibility between the Commission and Member States: the Commission cannot improve state aid rules and practice without the effective support of Member States and their full commitment to comply with their obligations to notify any envisaged aid and to enforce the rules properly.

4.3 Economic approach to state aid analysis

To best contribute to the re-launched Lisbon Strategy for growth and jobs, the Commission intends to strengthen its economic approach to state aid analysis. By encouraging a Member State to target state aid better, it "can improve the functioning of markets and therefore improve the competitive dynamics, thereby increasing economic welfare. This is the case when markets do not function optimally, e.g. because market players do not sufficiently take into account some side effects of their actions…. In economic terms, a market is said to work efficiently when it is not economically possible to improve the outcome of the market process for some stakeholders without harming some other stakeholders." (Kleiner 2005, pp. 30-31)

The Commission's State Aid Action Plan identifies competition as being vital for the economy, to unlock Europe's growth potential. In this context, efficiency refers to the extent to which welfare is optimised. Translated into terms of policy this means that the Commission seeks to focus its analysis on market failures which "may be reasons why markets do not achieve desired objectives of common interest, in particular if they are of an economic nature. In those cases, identifying the market failure at stake will help evaluate better whether state aid could be justified and acceptable, would represent the most appropriate solution, and how it should be implemented to achieve the desired objective." (European Commission 2005, p.6)

Consequently implemented, Member States' state aid would be directed towards situations where the market does not lead to an economically efficient outcome ("less and better targeted

aid"). The State Aid Action Plan identifies notably the following origins for these market failures: (i) externalities, which exist where actors do not take full account of the consequences of their actions on other actors in society; market players may not have to pay for the full social cost of their actions or may also be unable to reap the full benefits of their actions; (ii) public goods, which are beneficial for society but are not provided by the market, given that it is difficult or impossible to exclude anyone from using the good; (iii) imperfect information, which may lead to transaction costs, agency costs or moral hazard (e.g., difficulties for start up firms in finding adequate funding); and (iv) coordination problems, which exist – for example – in the field of standard setting, transport infrastructures, or in the area of innovation.

Market failure appears to be the key element of the Commission's state aid policy to foster growth and jobs. However, there are three additional elements in order to design state aid policy alongside the Lisbon Strategy (Kleiner 2005, pp.32-33):

Market failure appears to be the key element of the Commission's state aid policy to foster growth and jobs.

- Incentive effect: state aid can change the incentives of the beneficiaries and therefore include a change of behaviour, possibly then resolving the market failure and leading to a better outcome (example: aid to start-up companies in order to compensate the specific costs for banks to evaluate their pay-off potential).

- Proportionality: the aid must be proportional, meaning that all its components are necessary for the aid to achieve the desired effect and that it is well targeted to the problem addressed. In order to be acceptable, an aid measure may therefore have to be limited in time, or differentiate between, for instance, large and small companies, or between regions. Also, the amount of the aid should be designed so as to precisely match the intensity of the market failure.

- Minimising distortions to competition: before approving state aid it must be ensured that the distortion of competition is kept to a minimum. Even if a measure targets a well-defined market failure, it could result in excessive market power, barriers to entry, and foreclosure in the market at stake or in other markets. It is therefore possible that the overall impact of the aid is negative.

4.4 Application of the theory in practice: an outlook

Discussions on the interface between economic theory and competition policy are not new. Today it appears that welfare economics is experiencing a sort of come back in the discussion of competition policy in Europe. However, the crucial question seems to be how much we can rely on the economic concepts put forward to assess concrete cases. Naturally, welfare economists are very optimistic here. Stimulated by their optimism, they propose to design state intervention as close as possible to and alongside economic concepts derived mainly from neoclassical welfare theory. The idea is indeed tempting: in the presence of a clearly defined benchmark one might be confident that the effects of state intervention would be objectively predictable and would only be admissible if it is proven that the action increases welfare.

In theory, the economic concept is based on the assumption that the elements to assess a market failure are present, in other words: the necessary elements to calculate the 'optimum' of a market – such as the demand curve and the relevant cost curves – are available in the form of objective information. If the market has not reached this optimum, there is scope for intervention and the economist may exactly identify what to do (Kleiner 2005). But is this a realistic scenario?

From a general point of view, one may reflect on why competitive markets normally bring better economic results than any other form of organising economic activity. Competition is a process of

rivalry in which the market participants constantly try to discover 'new' information and increase their knowledge on the relevant market parameters – which are always in flux in a dynamic, evolving economic environment. Exactly for this reason, something like a 'market optimum' – to be used as a benchmark to identify 'market failure' – simply does not exist in the real world.

Knowledge on market parameters is widely spread among the market participants, and it is one of the key advantages of the market system that competition forces a great number of competitors independently from each other to reduce the inherent uncertainty and complexity – in order to gain profits and avoid market exit. Thereby, the process of competition constantly forces rivals to develop 'new' solutions, innovate, and adapt their plans to new situations. In other words: nobody has perfect information. New knowledge arises from a 'trial and error' process: a company, planning investment and innovation for a new product, will only find out whether it is profitable when the product finally arrives on the market. Thus, error and failure is inherent to the market economy and competition is the driver that those who erred and were inefficient must improve or will be driven out of the market. Competition, however, only selects negatively, therefore we never know if the 'survivors' in the competition process are efficient in terms of an 'optimum'.

The theory of market failure, however, is carried out on a comparative static basis. Applied in the way that Kleiner (2005) has suggested, the economic analysis would compare two static situations – with and without the aid. The fundamental question is whether the aid would bring the market closer to the defined (static) optimum. Assume, for a moment, that state aid intervention could be exactly designed so that it increases welfare (by granting state aid to respond to a identifiable market failure). Would there be a reason why not to encourage the granting of state aid? As long as the 'winners' of a state intervention can compensate those who were negatively affected by the state aid, there would still be a gain in total welfare.

This touches upon the core of the issue: welfare theory is a static approach where the economic parameters are kept stable. It is assumed that there is 'information' in the form of objective 'data' so that the analysing economist can calculate the net benefit of state action. Within such a scenario the economic analysis aims to identify the optimal allocation of existing resources.

But how does this fit into the philosophy of Article 87, which imposes a general ban to state aid? Shall competition policy deal with allocation of resources on a comparative static basis? Or should it rather be concerned with the dynamic process of rivalry?

Although industrial policy may stimulate innovation and employment, there is no certainty about any particular outcome or increased market efficiency.

Industrial policy may create stimulus for innovation and incentives for profit-seeking companies, thereby creating jobs. Incentives may also take the form of state aid. But it is not possible to define an optimum for a market and identify market failure in a way that could guarantee that the aid creates better economic performance. Industrial policy or the granting of state aid may (perhaps) increase 'chances'. And maybe there are 'ideas' which forms of government intervention might be more promising than others. But in no way is there certainty about any particular outcome or 'increased market efficiency'.

The reason why governments should stay away from granting state aid is the negative impact on the process of rivalry. This element of state aid policy is broadly recognised. The State Aid Action Plan expressively points out why the 'effects' of state aid on competition must be assessed: in the longer run, state aid discourages successful competitors and sets wrong signals. For this reason, the relationship between the identification of 'market failure' as the proposed first pillar of state aid control and the 'effects on competition' needs clarification. Market failure is a static concept and the concept of rivalry is dynamic – and thus difficult to apply within optimum-thinking of welfare theory.

Again: a policy to create jobs on the basis of stimulating innovation and growth can only aim to increase 'chances'. The economic theory of market failure may perhaps deliver some elements of such a policy. But these elements must be checked within the right context – any role as a *conditio sine qua non* for the approval of state aid would largely overstress the magnitude of static welfare considerations for the objectives identified by the Lisbon Strategy.

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ABSTRACT

There is plenty of evidence for market failures that motivate government intervention for innovation in general and research and development (R&D) in particular. *R&D subsidies are a policy tool of major importance – both in theory and practice. The empirical evidence for the effectiveness of R&D subsidies is mixed, with some studies finding them effective and others concluding the opposite. In part this could be because methodological problems plague the literature. Finland and Norway have relied extensively on R&D subsidies in their innovation policy, yet Finland seems to have succeeded where Norway has failed. A comparison of the countries suggests that the difference may be due to the more horizontal nature and implementation of Finnish R&D subsidy policy with regard to both firms and industries, but the Norwegian failure may also be due to a shift in the technological regime.*

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Jarle Møen, Associate Professor at the Norwegian School of Economics and Business Administration (Bergen, Norway), was instrumental in giving background information on Norway and Jyrki Ali-Yrkkö, Head of Unit at the Research Institute of the Finnish Economy in helping with numbers regarding Finnish firms' R&D investments. The author is responsible for all opinions and remaining errors.

Innovation and research policies: two case studies of R&D subsidies

1. Introduction

Otto Toivanen

At least since the 1950s it has been recognised that innovation is central to economic growth. Similarly well appreciated have been the twin facts that, first, although individual innovations are often created within firms, these rely in many ways on central inputs that are external to the firm and, second, the benefits from an innovation are not confined solely to its originator. These twin facts serve as the basic justification for public sector actions today jointly labelled innovation and research policies. Rooted in the policies following the Second World War (e.g., Mowery 1995), they have risen to prominence and taken centre stage, for example, in the Lisbon strategy of the European Union.[1]

Subsidies for research and development (R&D) are one of the most important tools of innovation policy in practice (Nevo 1998). As R&D subsidies have also been singled out by the endogenous growth literature as the main policy tool (e.g., Howitt 1999, Segerstrom 2000), it seems worthwhile to consider the theory and practice of R&D subsidy policy.

To this end, this paper essentially has two parts. One – comprising Sections 2 and 3 – reviews theoretical justifications for R&D subsidies, fundamental challenges of implementing an R&D subsidy policy, methodological difficulties in estimating the effects of such policies, and empirical results on the effectiveness of R&D subsidies. Two key messages transpire from this part. For one thing, while the theoretical foundation for R&D subsidies is sound, implementation problems might call into question the wisdom of such policies in practice. A key characteristic of R&D subsidies is that they require active decision making from the agency administering them. This is unlike tax credits, the other popular tool for enhancing R&D investments of firms. This practical requirement might be viewed as being at odds with the supposed horizontal nature of R&D subsidies. For another, R&D subsidies – innovation related activities in general – are more challenging to study than many other economically interesting topics because of the inherent heterogeneity, unobservability, and uncertainty of both the decision making regarding inputs and the output of research and development.

All this sets the stage for the second part – comprising Sections 4 to 6 – which presents two case studies of R&D subsidy policies: Norway and Finland. In Section 4, I provide a few key background statistics on both countries' innovation inputs and outputs to prepare the ground for the country-specific analyses in Sections 5 and 6. The presentation of the Finnish case has two broad goals. One is to describe the policy environment, i.e., what has been called the 'innovation support system' (Section 5.1), including the role of Tekes, that is, the National Technology Agency of Finland (Section 5.2). The second goal is to review the empirical evidence on the effectiveness of R&D subsidies in Finland (Section 5.3) and to analyse the R&D subsidy process, which involves firms' application for subsidies, Tekes' decision to grant them, and firms' subsequent R&D spending (Section 5.4). For Norway (Section 6), I concentrate on the R&D subsidy programme as implemented in the second half the 1980s and first half of the 1990s. The emphasis will nevertheless be on Finland because its innovation and research policies have been regarded as particularly successful. Section 7 concludes.

1 See http://europa.eu.int/comm/enterprise/innovation/communication.htm.

2. Theoretical justification for innovation policies and their challenging implementation

2.1 Theoretical justifications and their empirical relevance

The economic justification for innovation policy rests on various externalities.

The economic justification for innovation policy rests on various externalities. In short, so long as the benefits from innovative activities are not completely captured by whoever conducted them, there is a potential wedge between social and private benefits. Think of a new good, for example: so long as the firm introducing it is not capturing all the surplus generated by the new product, the benefits to society from introducing the new good will be larger than to the firm itself. In this case, society benefits through the increased profits of the firm and the consumer surplus that the new good yields (see Box 1). This example may sound simplistic in that most people would view it as 'business as usual'. But there lies the crux: firms will have less of an incentive to invest in the creation of new goods than society, the reason being that society benefits from them more than

Box 1. A simple model of optimal R&D subsidies

Designing and implementing optimal R&D subsidies requires considerable information. The aim of this box is to briefly illustrate this with a very basic model, which is a greatly simplified version of that studied by Stenbacka and Tombak (1998).

Imagine that there is just one firm. It can either succeed or fail in its innovation, and the costs of innovation are a convex function of the probability of success, which – in turn – depends on the intensity of R&D efforts. Profits are higher when the innovation is successful than when it is not. Further assume that the government pays a share s of the firm's R&D costs. So, s is the R&D subsidy. The firm's problem is then to choose the optimal success probability, or research intensity, by maximising the following objective function:

$$\Pi = p\bar{\pi} + (1-p)\underline{\pi} - (1-s)c(p) \quad (1)$$

where Π indicates total profit, p is the success probability, $\bar{\pi}$ stands for profit if the innovation is a success and $\underline{\pi}$ if it is not, and $c(p)$ is the cost of innovation, with $c'>0$ and $c''>0$. Optimising and rearranging gives:

$$c'(1-s) = \Delta\pi \quad (2)$$

where $\Delta\pi = \bar{\pi} - \underline{\pi}$. Equation (2) has a straightforward economic interpretation: the firm chooses the success probability (i.e., research intensity) so that the marginal return to the firm from innovating ($\Delta\pi$) is equal to the firm's marginal cost ($c'(1-s)$) of efforts to increase the probability of success. As long as the left-hand side of (2) is smaller than the right-hand side, it is profitable for the firm to raise the success probability.

The government, while taking firm profits into account, is also interested in consumer surplus (denoted CS). One may think of CS as the spillover effects to other firms without any changes needed in the model. The objective of the government is to maximise social welfare, which is determined by the profit of the innovating firm, the consumer surplus, and the R&D costs. The latter is larger than $c(p)$ if one takes into account that the government probably cannot raise the finance for the R&D subsidy in a non-distortionary way. Specifically, assume the

the firm, but the cost is the same for both as the firm pays all the (R&D investment) costs. Such instances are called externalities, and they make markets, if left alone, fail in allocating resources optimally.

The empirical literature on new goods typically estimates large consumer surpluses from new innovations. Examples of studies with such findings are Trajtenberg's (1989) analysis of computerised tomography scanners and Petrin's (2002) analysis of the introduction of minivans in the United States. It is worth noting, however, that private returns to R&D tend to be highly skewed. This view is backed, for instance, by empirical research on patent value (Pakes 1986, Lanjouw 1998). Put simply: many innovations are of little value to the innovator, but some are very valuable. It is entirely plausible that this holds for the social returns too. To take but one example, Gao *et al.* (2005) analyse early mobile internet services and find that both consumer surpluses and profits are very low.

government faces a shadow cost of public funds, i.e., raising one euro of tax revenue costs $\lambda > 1$ euros. All in all, the government's objective is to maximise society's welfare Γ and its objective function is thus

$$\Gamma = p\overline{W} + (1-p)\underline{W} - \{1 + (\lambda - 1)s\}c(p) \quad (3)$$

where $W = CS + \pi$. Note that for $\lambda = 1$ the cost of R&D to society is simply $c(p)$; for $\lambda > 1$, it is larger than $c(p)$ by a factor of $(\lambda - 1)s$. Optimising (3) and rearranging gives

$$\{1 + (\lambda - 1)s\}c' = \Delta\pi + \Delta CS \quad (4)$$

where $\Delta\pi = \overline{\pi} - \underline{\pi}$ and $\Delta CS = \overline{CS} - \underline{CS}$. Thus, to reach a social optimum, the research intensity (and thereby the success probability) should be chosen so that the marginal return to society from innovating ($\Delta\pi + \Delta CS$) is equal to society's marginal cost of innovating ($\{1 + (\lambda - 1)s\}c'$).

The question, then, is which amount of R&D subsidy would ensure that the firm chooses the socially optimal R&D level. The optimal R&D subsidy (s^*) can be derived from (2) and (4) by taking into account that the c' in (2) must be the same as the c' in (4). Using this and slightly rearranging yields

$$s^* = \frac{\Delta CS}{\lambda\Delta\pi + \Delta CS} \quad (5)$$

Equation (5) offers important insights. First, if there are no R&D spillovers to the domestic economy ($\Delta CS = 0$), there is no reason to subsidise R&D activity. Second, the larger the expected spillovers, the higher the optimal subsidy. Third, the larger $\Delta\pi$ (i.e., the bigger the increase in firm profits), the lower is s^*. Fourth, the shadow cost of public funds has a decreasing effect on the optimal subsidy. Finally, although derived from the simplest of models dealing with the question of optimal subsidies, equation (5) illustrates the heavy informational requirement for designing and implementing optimal policies for promoting R&D: the government needs to estimate the shadow cost of public funds (often estimated at around 1.2) and the expected increase in firm profits and consumer surplus. Estimating all this is far from straightforward. In particular, note that to estimate $\Delta\pi$ and ΔCS, the government needs to know not only profits and consumer surplus when the firm innovates successfully, but also when it fails.

The informational requirement for designing and implementing optimal R&D policies is substantial.

Knowledge spillovers are another externality commonly linked to R&D. There is considerable empirical evidence of knowledge spillovers between universities and firms and between firms. The seminal paper of Jaffe (1986) found that other firms' R&D affects the productivity of firm R&D positively. Jaffe (1989) found that university R&D has a positive direct effect on commercial innovation (measured by patents) – at least in some industries, and a positive indirect effect by raising industrial R&D. Jaffe *et al.* (1993) looked at patent citations and found that citations from later patents to earlier ones are greatly affected by geography, so that a new patent is more likely to cite a patent that was granted to an applicant geographically close to the new applicant. In a recent paper, Cassiman and Veugelers (2002) use Belgian data to show that firms that put more weight on external information in their innovation process are more likely to engage in cooperative R&D joint ventures with other firms.

Externalities possibly justifying innovation support policies include: knowledge spillovers, other benefit spillovers, and financial market imperfections.

Yet another market failure is that the firm owning the innovation has to share its rents with its employees. There may be various efficiency reasons for doing so, but at least in some instances such rent sharing will lead to diminished incentives to innovate. It is this type of an argument that lead van Reenen (1998) to study the relationship between (quasi-) rents and wages with a long panel of British manufacturing firms. Finding that innovation (measured by innovation counts) leads to significantly higher wages, he concluded that the most plausible explanation is rent sharing between the firm and its employees.

A prominent market failure related to innovation policy is that of financial markets. Indeed, various policies aimed at supporting private sector R&D have been motivated by the perceived failure of financial markets to provide adequate financing to firms. Notice that this is a market failure that comes on top of externalities that exist in the product market. In other words, if firms do not reap all the benefits from their innovation and face difficulties in financing R&D, their investments are even further away from what would be optimal from society's viewpoint. Himmelberg and Petersen (1994) tested this hypothesis by studying the sensitivity of R&D investments to cashflow using data from small US firms and found evidence of financial constraints.

Finally, it is important to mention that several of the above mentioned market imperfections might take added relevance if technologies are what Bresnahan and Trajtenberg (1995) label general-purpose technologies – GPT for short. To cite them (pp. 84): "Most GPT's play the role of 'enabling technologies', opening up new opportunities rather than offering complete, final solutions." An important characteristic of GPTs is that they foster complementary innovations. They, in turn, may lead to improvements in the GPT, which in turn benefits other (unrelated) complementary innovations. Often cited examples of GPTs are the steam engine, electricity, and semiconductors. GPTs give an extra role to innovation policy in that they easily feature multiple equilibria. In practice, when GPTs are important, it is possible for a country's industry to either stay in a low-activity equilibrium, or be pushed, by carefully implemented policies that foster coordination among firms' R&D decisions, to a high-activity equilibrium.

The theoretical arguments for innovation policy might lead one to think that there is plenty of scope for government action, with any identified market failure calling for government intervention of some sort. However, such a conclusion makes strong demands on governments' ability to design policies that would rectify identified market failures. Especially with regard to R&D, it is very questionable whether a government has all the information needed to design 'perfect' policies. In real life, governments face informational constraints that might be as or more severe than those of firms. Modern economic theory offers an alternative benchmark: markets are said to be 'interim efficient' if a benevolent social planner (designing policies with the goal of maximising social surplus) could not improve on the market outcome if she is subject to the same informational

problems as the market.[2] Many phenomena considered market failures when comparing the actual state of affairs to the outcome of perfectly competitive markets cease to be market failures when using this more realistic but still demanding benchmark. As an example (see Box 1), to design perfect R&D subsidies for an individual R&D project, a government should be able to calculate the present value of expected firm profits and consumer surpluses from a yet-to-be-made innovation. This is, to say the least, a highly demanding task.

Things need not be as bleak as one might be tempted to conclude. The government is in a unique position because it does not necessarily need to cover the costs of information gathering and dissemination by the revenues so generated. So, an active government could in some circumstances be able to achieve better than interim-efficient outcomes. Whether such outcomes are achievable in practice is a separate question.

2.2 Challenges of implementation

The constraints a government faces in gathering relevant information raises another important point, namely that of heterogeneity. Firms, R&D projects, and innovations are highly heterogeneous. A policy that is optimal in the strict sense of achieving Pareto-efficiency should vary not only from firm to firm, but also within a given firm depending on the particular R&D project in question. Such policies might be homogenous *ex ante*, i.e., the terms are the same for all firms, but heterogeneous *ex post*, meaning that although the rules of allocating R&D subsidies are the same for all, the actual R&D subsidies are likely to vary considerably. Whether or not this state of affairs is compatible with demands for horizontal government aid is a question this essay does not attempt to answer.

Strictly speaking, optimal innovation support policies should vary not only from firm to firm, but also within a given firm depending on the particular R&D project in question.

Further problems arise if innovation policy takes more active forms, such as venture capital financing. To illustrate, in Finland, the state has been an active venture capitalist in the last 15 years or so. Without taking a stand on how successful the policy has been, it is nonetheless clear that the people administering government venture capital operate under a very different set of incentives than private sector venture capitalists. Briefly, private sector venture capitalists are driven by powerful monetary incentives (through profit-sharing schemes) so that they choose the best investments and manage them as best as they can. What is more, venture capital funds have a limited lifespan, and private sector venture capitalists (at least those who do not retire after the current financing round) need to raise financing for their next fund. This provides an additional incentive for private sector venture capitalists to perform well with their ongoing investments. Government civil servants on fixed salary, no matter how intelligent, hard working, and diligent, face no such incentives. One is therefore bound to question, for example, government venture capitalists' ability to cut financing for underperforming firms.

Worries about how governments are even in principle able to substitute a perceived or genuine lack of private venture capital funding (or other forms of active financing) are not idle. For example, the Finnish government has in the last couple of years both started a new venture capital financier (within Finnvera, see Section 5.1) and become more active as a direct investor through an existing venture capital fund (Finnish Industry Investment).

Good design of government policy takes such constraints into account and seeks to choose such roles for government and its officials where their relative strengths lie. Finnish innovation policy provides an example of such an activity: the Finnish government finances the Foundation for Finnish Inventions, which provides expert advice to private inventors and small and medium-sized

2 This concept was introduced by Holmström and Myerson (1983).

enterprises (SMEs) when they seek to patent their inventions. The very fact that it is an impartial government employee (operating under strict non-disclosure agreements) might be what makes such an activity feasible. A privately run agency would always be subject to the suspicion of trying to capture the invention from the inventor.

In sum, while a quick reading of the economics of innovation suggests a large scope for government intervention to rectify market failures, modern economic theory points to many pitfalls, both of principal and practical nature, that lead to a more restrained view of what the possibilities and potential of government intervention are. Good policies necessitate careful consideration.

3. Empirical methods and results on the effectiveness of R&D subsidies

3.1 Methodological issues

The empirical literature on R&D subsidies goes back at least until the early 1980s, and by now some surveys and methodological papers exist.

The empirical literature on R&D subsidies goes back at least until the early 1980s, and by now some surveys and methodological papers exist (e.g., David *et al.* 2000 and Klette *et al.* 2000). A useful way to categorise the literature is by the type of data used. Some studies use macro (nation-level) data, others use industry data. Yet another group comprises papers using firm-level data. If anything, there is a trend towards less aggregate data – studies using firm-level data have become more common in recent years.

Another way of categorising the studies is by the dependent variable. Many studies look at how R&D subsidies affect private R&D investment. Here the central question has been whether public funding crowds out private investment, i.e., whether one euro of subsidy leads to an increase in firms' investment (the sum of private investment and public support) of less than one euro. A considerable number of other studies take the productivity effects of publicly (and privately) funded R&D as the dependent variable. In the next sub-section, I will mostly concentrate on the former type of studies that use firm-level data. There is compelling reason for focusing on the effects of R&D subsidies on private R&D investments: it is the very basic question that needs to be answered first when examining the impact of R&D subsidies; obviously, evidence on complete crowding out would imply that R&D subsidies have no (positive) effects on firm conduct – unless, that is, one is willing to entertain the idea that subsidies lead to a different, economically more beneficial type of R&D.

The key problems in studying the effectiveness of R&D subsidies are that (i) there is no agreed-upon theoretical model of how R&D subsidies affect firm behaviour,[3] (ii) there are good reasons to suspect that unobserved firm heterogeneity causes various problems in carrying out such research, and (iii) the (changes in) behaviour of subsidised firms might affect the non-subsidised firms. The first problem means that empirical researchers have mostly relied on models that have only an indirect link to economic theory. While such research can be useful, it limits the number and type of questions that can be addressed. Especially regretful is that such reduced-form analysis cannot answer counterfactual 'what-if' questions. But many important policy questions are of this type.

The second problem is empirical and can be illustrated by the following two examples. For a start, suppose that firms vary in the quality of their R&D personnel. It seems reasonable to think that firms

3 This situation may be compared to the widespread use of Mincer wage equations in the research on returns to education (see e.g., Angrist and Krueger 1991).

with better R&D engineers spend more on R&D (e.g., by having higher-paid engineers). Imagine also that the civil servants granting R&D subsidies can with some accuracy find out the quality of R&D engineers. For example, it seems plausible that better engineers write better applications. The implication of this set-up is twofold: first, firms with better engineers invest more in R&D with or without subsidies and, second, they are more likely to get subsidies. Just 'explaining' R&D investments of a firm by R&D subsidies is therefore going to lead to a high positive (partial) correlation coefficient. But the true cause for this coefficient might be the differences in the quality of the R&D engineers, something difficult for an economist to observe – let alone quantify.

Imagine then that for a given firm with a given set of R&D engineers the quality of ideas varies from year to year. The better the idea, the more the firm invests in developing it. The engineers are capable of describing the quality of their ideas to the civil servants who decide on R&D subsidies. If the civil servants are more likely to grant subsidies to good ideas, we again will observe a positive partial correlation coefficient between subsidies and firm R&D. And *vice versa*: if the civil servants are less likely to grant subsidies to good ideas, we will observe a negative partial correlation coefficient between subsidies and firm R&D. But in both cases it would be false to give such a correlation a causal interpretation. The firm would have invested more in R&D in the year(s) when it had good ideas anyway – regardless of getting a subsidy. This type of issue has risen to prominence only lately, despite examples of earlier work where researchers took steps to control for these problems (e.g., Lichtenberg 1988).

Key methodological problems in studying the effectiveness of R&D subsidies are: lack of agreed-upon theoretical model, unobserved firm heterogeneity, and presence of general equilibrium effects.

The third problem has been given different names in different contexts, but is most often called the assumption of 'no general equilibrium effects' (e.g. Heckman and Smith 1995). To my knowledge, essentially all the work on R&D subsidies (and many other government policies) relies on this assumption. Its central meaning is that the model used assumes that a given R&D subsidy for a given firm only affects that firm, but no other firms. This condition is, however, very likely violated in the case of R&D subsidies for three reasons. First, if R&D generates informational spillovers between firms, for instance, R&D subsidies will affect these spillovers and, by implication, other firms' behaviour. Second, in many countries (e.g., Finland), R&D subsidies are a prominent part of innovation policy, and one therefore cannot rely on the argument invoked in other settings that the group of awardees is so small as not to affect economic aggregates. Third, it is possible that awardees and non-awardees compete against each other in the product market and/or in the input market. The proper way of accounting for such effects is to explicitly model them.

A final methodological note concerns the increased use of so-called matching methods in evaluating R&D subsidies. These methods, developed in labour economics to assess labour market policies, rely crucially on the assumption that all aspects of a firm that affect the probability of getting an R&D subsidy are observed and controlled for by the researcher.[4] The current view in labour economics is that matching methods are in practice rather sensitive to violations of this and other assumptions. Clearly, applying these methods in an R&D context calls for great care as many of the features determining the success and quality of R&D are inherently unobservable – or at least nonmeasurable – by the economist. To take one example, it seems hard to quantify the quality of the R&D engineers of a particular firm. Yet such quality may well be observable and recognisable to a well-trained civil servant deciding on subsidies. That said, it is surely beneficial for the research programme on the effectiveness of R&D subsidies to remain open-minded, though critical, about new research methods applied to the questions at hand.

4 For a recent textbook treatment see Cameron and Trivedi (2005). See also Smith and Todd (2005).

3.2 Empirical results

The relatively recent survey of David *et al.* (2000) lists 33 empirical studies on the effects of R&D subsidies on private R&D investment. Of these, 19 were conducted using firm-level data while the remaining 14 used either industry or macro data. Of the 19 studies using firm-level data, nine found a crowding out effect, i.e., on average, a subsidy of one euro led to an increase in overall R&D investment of less than one euro. Things cannot be solved by a simple count of results, however, and two important points should be kept in mind. First, studies should be evaluated on a case-by-case basis on the methods and data they used. Second, there is little reason to believe that the result should be universally the same over different countries, industries, and time periods. A more convincing starting point is that there is a lot of heterogeneity in how firms invest and succeed in R&D and, therefore, one should expect such heterogeneity to also prevail in firms' reactions to R&D subsidies even within narrowly defined sets of firms. In what follows, I mainly concentrate on papers published after the survey of David *et al.* (2000).

Recent empirical research often finds that R&D subsidies foster innovation, but this does not necessarily mean that they are welfare enhancing.

Two important papers are those by Lerner (1999) and Wallsten (2000), both studying the US Small Business Innovation Research Program (SBIR).[5] Lerner, using matching methods discussed above, finds that SBIR grants led to higher growth and employment, especially for firms in areas where venture capital financing is available. In contrast, Wallsten finds, controlling for the endogeneity of R&D subsidies, that there is essentially complete crowding out. The suspicion that Lerner's findings might result from not controlling for all firm characteristics that determine (non-)participation in the SBIR programme has been voiced earlier – by Klette *et al.* (2000), for instance. Gonzalez *et al.* (2005) study the effects of R&D subsidies in Spain. Controlling carefully for the endogeneity of subsidies, they find no evidence of crowding out. In fact, they find that subsidies induce firms that (i) would not have conducted R&D to embark on it and (ii) would have spent on R&D anyway to spend more.

Lach (2002) studies the Israeli R&D subsidy system. He uses a so-called difference-in-difference estimator to take firm heterogeneity into account. He finds that subsidies have a substantive positive effect on the private R&D investments of small firms, but a negative albeit statistically insignificant effect on large firms.

While Lach's paper uses repeated observations on 136 firms, Hussinger (2003) uses a cross-section on almost 4,000 German firms. Because her data is a cross-section, her estimation methods also differ, but she also uses methods that consider the endogeneity problems. Using a variety of estimators, she finds a 'positive treatment effect', i.e., that firms increase their own R&D investment in response to a subsidy.

Czarnitzki and Fier (2002) also use a cross-section of German firms. Their sample consists of around 1,000 services-sector firms. In contrast to Hussinger (2003), they resort to sophisticated matching methods that nonetheless rely on the potentially problematic assumptions discussed above. They find 'additionality', i.e., private R&D investment increases when a firm receives a subsidy.

To conclude, the more recent empirical research is more often than not encouraging from a policy viewpoint: it often reports significant positive effects of R&D subsidies. It is critical to keep in mind, however, that the type of study surveyed above does not provide an answer as to whether such programmes are welfare improving or not. A more structured approach is needed, and I will elaborate on one such attempt in Section 5. But let us first turn to some basic facts about innovation in Norway and Finland.

5 See http://www.sba.gov/sbir/indexsbir-sttr.html.

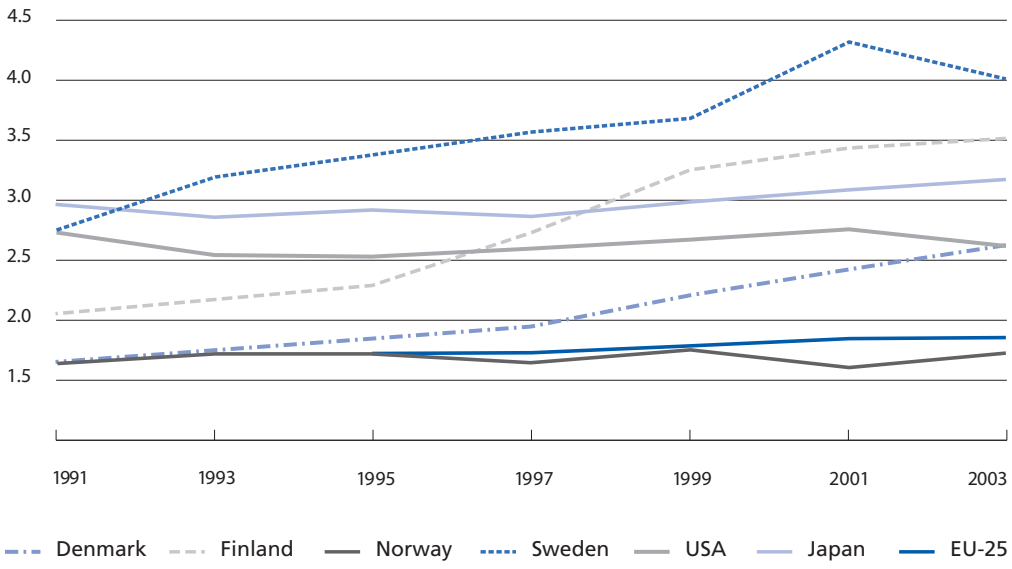
4. Innovation in Norway and Finland

R&D activities in Finland and Norway are characterised by active government involvement, dominance of a few large firms, and involvement of various interests groups in the policy formation process.

Norway and Finland are very similar in many ways and this is reflected in the structure of their economies. Both are wealthy countries with a well-educated, well-paid, and highly-taxed workforce. Government support to the tertiary education sector is one element of regional policy. In both countries, R&D activities are characterised by active government involvement and planning and by the dominance of a few large firms.[6] In both countries, innovation policy follows the practice set forth in other sectors of the economy: the various interests groups are actively involved and explicitly included in the policy formation process.

There is no need here to dwell on the Norwegian and Finnish economies and their political systems. Rather, a few facts about R&D inputs and outputs are worth highlighting. To start with inputs, as Figure 1 shows, Finland is one of the countries exhibiting a consistent upward trend in R&D expenditure, measured in percent of GDP. Moreover, it is one of the most R&D-intensive economies, surpassed only by Sweden. By contrast, in Norway, the ratio of R&D expenditure to GDP – virtually constant since the early 1990s – is way below that of other Nordic countries. In fact, Norway currently spends less on R&D than the average EU country, with this average including the relatively poor new member states of Central and Eastern Europe.

Figure 1. Trends in R&D expenditure (% of GDP) in selected countries

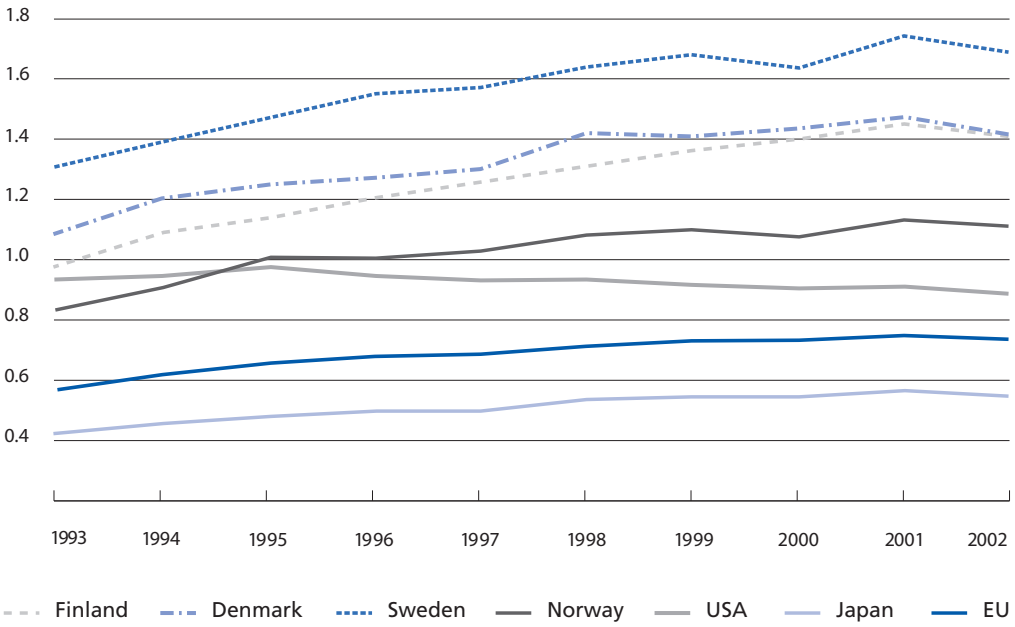


Source: www.research.fi

Turning to the R&D output, Figure 2 shows the number of scientific publications per 1,000 inhabitants. Norway and Finland produce a relatively large number of publications considering the size of these countries – both outperform the United States, for example. Although both countries exhibit a growing trend, Finland has consistently done better than Norway, producing 30-40 percent more publications per inhabitant.

6 For example, in Finland, the ten top-R&D investing firms account for some two thirds of all private R&D spending according to estimates by Jyrki Ali-Yrkkö, derived on the basis of a survey by the magazine Tekniikka & Talous and Ali-Yrkkö's statistics on the share of each firms' R&D carried out in Finland. In Norway, the same figure is over 70 percent (Statistics Norway 2004)

Figure 2. Scientific publications per thousand inhabitants in selected countries



Source: www.research.fi
Note: EU = EU-15, in contrast to Figure 1.

Table 1 provides further insights into the output of R&D. It shows for a fairly large set of countries, including Finland and Norway, information on the granting of patents in the United States. The first message from the table has been pointed out by Trajtenberg (2001): although it is reasonable to look at statistics scaled by the size of economies, as in Figures 1 and 2, the statistics for the larger economies like the United Kingdom show that scale does have a considerable impact.

Finland succeeded in raising innovation output considerably by increasing R&D inputs. Norway has consistently been on a lower level than Finland on both measures.

What matters in the end is not how R&D intensive or successful an economy is in relative terms, but in absolute terms, especially in technologies where patents are an effective way to protect intellectual property (such as in the pharmaceutical industry). That said, the table shows that Israel and Finland are doing very well considering their size, and – like some of the Asian Tigers – are among the countries that have been able to significantly improve their innovative output as measured by US patents. Norway, too, has increased its average annual patenting, when one compares the 1968-97 and 1992-97 averages, from 101 (roughly half the Finnish number) to 137. The latter, however, is less than one third of the Finnish number. The same relative decline can be seen when comparing patenting per capita, which has remained stagnant in Norway. This trend is visible, too, when comparing annual average growth in US patents: Norway (around 4-5 percent) remained considerably behind Finland (around 9-10 percent) and Israel (around 10-13 percent).

The overall picture emerging from this section is that Finland has succeeded in raising innovation output considerably by increasing R&D inputs to a level seen only in a few other countries – both in terms of scientific (academic publications) and commercial (patents) output. Norway has consistently been on a lower level than Finland on the above measures, and the gap between the two countries has widened during the last fifteen years. With this broad image in mind, I turn to a more detailed analysis of R&D subsidies in Finland and Norway.

Table 1. US patents for selected countries, 1968-97

	Patents per year		Annual patents per 100,000 inhabitants		Annual growth in %	
	1968-97	1992-97	1968-97	1992-97	1968-97	1992-97
G7						
Canada	1,525	2,401	6.1	8.1	3.4	5.5
France	2,423	2,896	4.5	5.0	1.9	0.5
Germany	6,338	7,250	9.8	8.9	2.3	2.4
Italy	937	1,197	1.7	2.1	2.8	0.4
Japan	13,226	23,847	11.5	19	8.4	2.8
UK	2,547	2,494	4.4	4.3	0.2	3.1
USA	46,913	66,325	19.8	25.2	1.6	5.3
Reference group						
Finland	214	438	4.5	8.6	8.6	10.0
Ireland	35	60	1.0	1.7	6.8	5.5
Israel	234	577	5.3	10.2	10.1	13.3
New Zealand	42	61	1.3	1.7	4.9	16.9
Norway	101	137	2.4	2.9	4.9	4.3
Spain	105	173	0.3	0.4	4.2	3.1
Asian Tigers						
Hong Kong	39	95	0.7	1.5	12.5	9.6
Singapore	22	83	0.8	2.6	16.5	10.3
South Korea	443	1,989	1.1	4.4	27.7	27.9
Taiwan	554	2,006	2.8	9.3	33.8	15.7

Sources: Trajtenberg (2001) and author's own calculations using the NBER patent data for Norway.

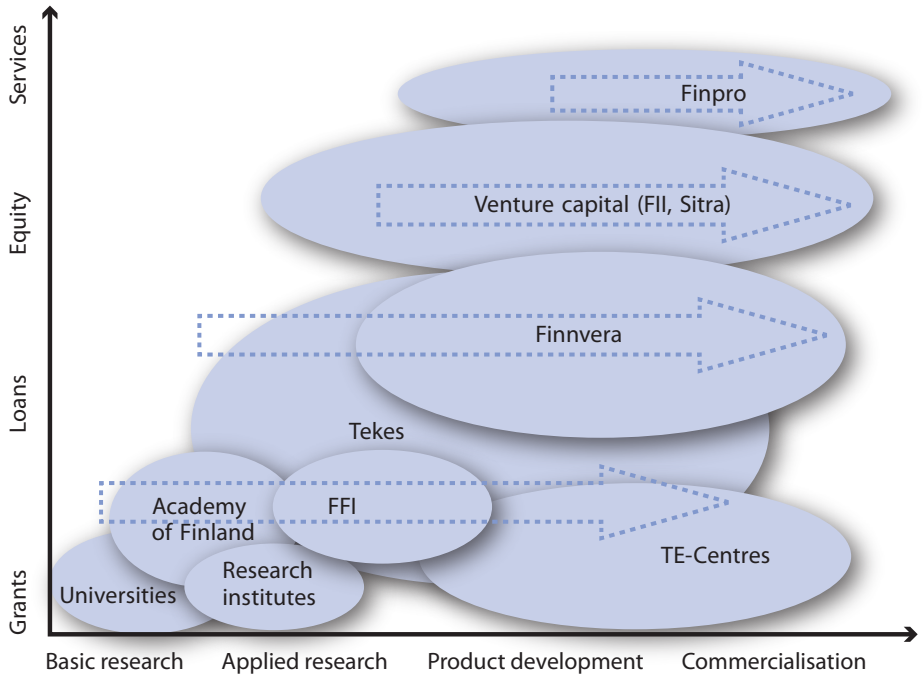
5. R&D subsidies in Finland

5.1 Policy environment

This sub-section briefly reviews the structure of institutions of innovation policy in Finland, i.e., what has been called the 'innovation support system'. The emphasis is on painting the broad picture of how government aims to aid private sector innovative activities.

In a recent evaluation of the Finnish innovation support system, Georghiu *et al.* (2003) provide a description of the system and a short overview of its historical development. The Finnish government – as many other governments – employs several agencies to conduct innovation policy. The most important ones are depicted in Figure 3.

Figure 3. The Finnish innovation support system



Source: Georghiu *et al.* (2003).

In Finland's innovation support system, various institutions get involved at different stages of the innovation process, using different instruments.

As the figure suggests, despite some overlap, various institutions get involved at different stages of the innovation process (horizontal axis), using different instruments (vertical axis). The volume of financial support for R&D splits about equally between applied research, product and process development, and product and process commercialisation, on the one hand, and basic research on the other.[7]

Academy of Finland is the main source of government funding for basic research. However, as the figure suggests, the Academy nowadays also funds applied research. The government also runs a number of research institutes, the most important of which is VTT, the technical research institute.

Foundation for Finnish Inventions (FFI) helps individuals and SMEs to protect their intellectual property. To a limited extent, FFI also participates in marketing innovations.

TE-centres are regional government offices whose task is to provide business support services, consultation and advice, and finance to SMEs.[8] These centres operate under the joint management of the Ministry of Trade and Industry and the Ministry of Labour.

Finnvera is a state-owned financing company. Its main tasks are to promote and develop SMEs, foster the internationalisation of firms, and contribute to regional policy. Only a small part of the activities of Finnvera fall under innovation policy.

7 See http://www.research.fi

8 TE stands for 'Employment and Economic Development Centre'. In total, there are 15 centres.

Tekes, i.e., the National Technology Agency of Finland, is the main organisation of Finnish innovation policy. Although it provides smaller financial support than Finnvera, for instance, it fully concentrates on innovation policy related tasks. Tekes provides funding and expert advice and promotes national and international networking. Since the provision of R&D subsidies is the main activity of Tekes (in fact, it is the sole source of R&D subsidies in Finland),[9] it will be discussed in more detail below.

Finnish Industry Investment (FII) and Sitra are the government's venture capital funds. Finally, Finpro is responsible for providing business support services for the internationalisation of firms.

The way technology policy is organised shows the long tradition of how public policy is organised and conducted in Finland. Interactions between policy makers, policy-making bodies, and interest groups are explicitly organised. This is reflected in the Science and Technology Policy Council of Finland. The Council – which is "responsible for the strategic development and coordination of Finnish science and technology policy as well as of the national innovation system as a whole"[10] - is chaired by the Prime Minister and comprises key ministers and representatives of interest groups, labour unions, and academia. All in all, the role and existence of the Council reflects the importance of innovation policy in Finland.

It is important to note that while Finland's innovation policy during the last few decades can in many ways be deemed a success, it is much harder to pinpoint which parts of the policy have been most crucial. For example, in discussing the supply of engineers and scientists, Georghiu *et al.* (2003) point out that since the early 1970s there has been a steady increase in the number of graduating engineers and scientists. In the interviews conducted for their evaluation, firms often considered the presence of relatively low-cost engineers in Finland a strong point for innovation activities.

While Finland's innovation policy can be deemed a success, it is much harder to pinpoint which parts of the policy have been most crucial.

5.2 Tekes – the National Technology Agency of Finland

It is worth describing in a little more detail how Tekes operates its R&D subsidy policy. This helps to set the stage for an evaluation of studies looking at the effects of R&D subsidies in Finland. Tekes' main objective is to promote the competitiveness of Finnish industry and services by providing funding and advice to both business and public R&D. To this end, it grants about €400 million a year in subsidies. Tekes can provide a subsidy of up to 50 percent of costs incurred (60 percent for SMEs when EU funding is included). Besides supporting specific R&D projects, Tekes funds feasibility studies and university research. The agency receives some 3,000 applications a year. Of this, about half relate to business sector R&D projects, some two-thirds of which are accepted. Tekes takes unsolicited applications, but also runs special programmes. The latter are usually designed in close cooperation with the industry.

Tekes has three funding instruments: grants (i.e., subsidies), low-interest loans, and capital loans. In 2001, the share of each instrument in the funding allocated to business R&D was 69 percent, 18 percent, and 13 percent. Low-interest loans are 'soft' in other respects, too: if the supported firm can demonstrate that its R&D project failed, Tekes may waive the payment – in part or fully. Capital loans are a Finnish speciality: they are granted when the debtor cannot give collateral and they need to be paid off only when unrestricted shareholders' equity is positive.

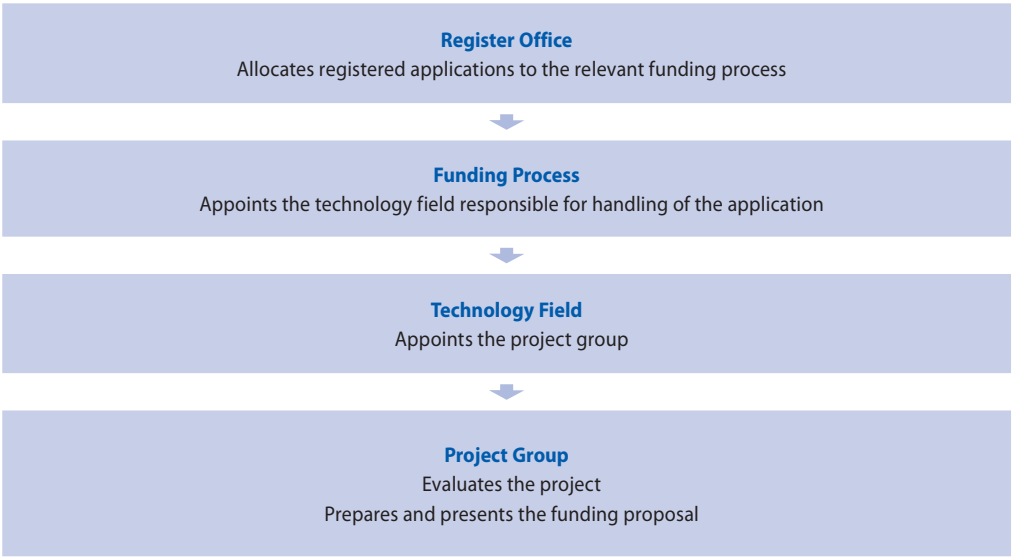
9 Other institutions may and do provide other forms of R&D financing. However, their volume is small compared to *Tekes'* financing.

10 See http://www.minedu.fi/tiede_ja_teknologianeuvosto/eng/index.html.

The decision making on R&D subsidies in Finland involves four steps: screening of requests, identification of technology field, evaluation of requests, and funding decision.

Tanayama *et al.* (2005) provide a description and a game theoretic model of the application process. In a nutshell, the application process goes as follows: the firm applies for support; Tekes usually does not solicit applications; in the application, the firm describes the objectives and planned execution of the project, and a proposed budget; in practice, firms are in touch with Tekes officials before submitting their application. The decision-making process of Tekes is pictured in Figure 4: after receiving an application, the agency screens it along a variety of dimensions and identifies the technology field and the project group that evaluates the project and prepares the funding proposal. Which level of the Tekes hierarchy (head of the technology field, process leader, director general, or board) takes the decision depends on the size of the subsidy proposed. To illustrate, in 2005, the head of the technology field decided on subsidies below €200,000 and the board on subsidies above €1.7 million.

Figure 4. The Tekes decision-making process



Source: Tanayama *et al.* (2005)

5.3 Empirical evidence on the effectiveness of R&D subsidies in Finland

There are several studies on the effects of R&D subsidies in Finland, although some of them are still at the stage of working papers. This sub-section will briefly review some of these studies before turning to one in more detail.

Ali-Yrkkö and Pajarinen (2003) first replicate Wallsten's (2000) study using data on 117 firms for the year 2000. The authors' cross-section estimates suggest – in line with Wallsten – that subsidies completely crowd out firms' private R&D spending. The authors then use the time-series (panel) dimension of their data and find that Tekes funding, lagged by one year, has a positive impact on private R&D spending.

Ali-Yrkkö (2005) looks at how R&D subsidies affect employment at firms. He separately analyses the effects of R&D subsidies on R&D and other employment, controlling for the endogeneity of subsidies. Also controlling for the effects of lagged R&D employment, he finds that an increase in last year's public support for R&D increases current R&D employment. While he does not control

for current or lagged private R&D spending, this is presumably highly correlated with lagged R&D employment. This result holds for domestic (Finnish) and global R&D personnel.

Piekkola (2005) studies total factor productivity (TFP) growth and how R&D subsidies affect it. Using a large (over 3,000 observations) panel of Finnish manufacturing firms and methods that allow for the endogeneity of subsidies, he finds that R&D subsidies have a nonlinear effect on TFP growth: the coefficient for the linear subsidy variable (subsidy-to-sales ratio) is positive and significant and the one for the squared subsidy variable is negative and significant. Within the sample limits, the positive effect appears to dominate.

Hyytinen and Toivanen (2005) adopt a somewhat different research methodology by adopting the cross-country and industry approach developed by Rajan and Zingales (1998) to a cross-region and firm setting. Their central question can be rephrased as follows: do firms characterised by (i) an industry that is fairly dependent on outside finance and (ii) locating in a region where the supply of government R&D support is fairly good invest more in R&D and/or expect to grow faster than firms not having these characteristics? Using firm-level survey data on about 500 firms, they answer both questions affirmatively and conclude that financial constraints affect firm innovation and growth and that government funding alleviates capital market imperfections.

All in all, the studies reviewed here do not corroborate the hypothesis that public support for private R&D crowds out private spending and has no effect on firm productivity. The next sub-section, which draws on a paper by Takalo, Tanayama and Toivanen (2005, TTT hereafter), turns to a deeper analysis of firms' decision to apply for R&D subsidies, Tekes' decision to grant them (and how much), and firms' subsequent R&D spending.

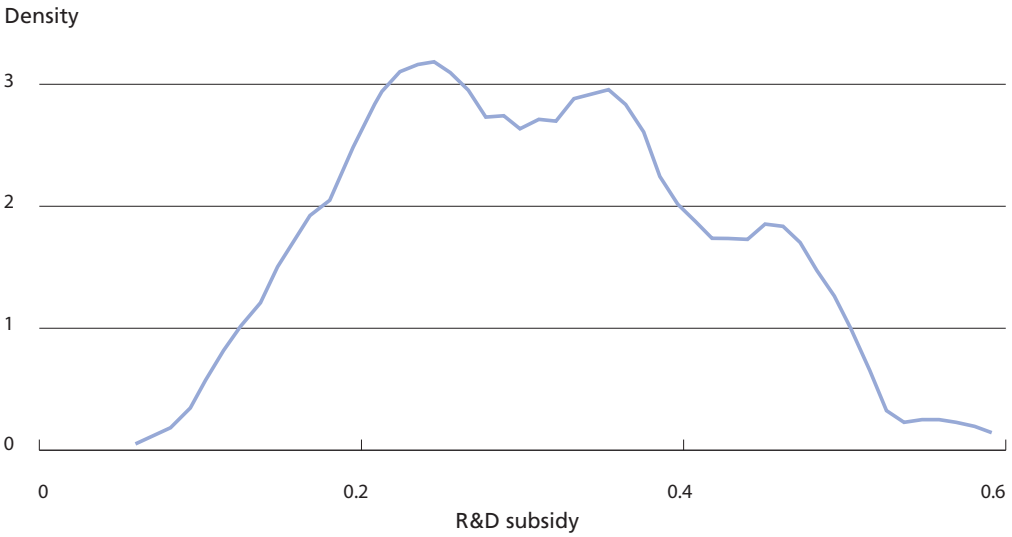
The Finnish experience does not corroborate the view that public support for private R&D crowds out private spending and fails to raise firm productivity.

5.4 Modelling the R&D subsidy process

TTT build a game theoretic model where, first, firms have an R&D idea. They then decide whether to apply for funding. This stage is important because Tekes (and comparable organisations in other countries) sometimes voices concerns about the low propensity of some firms to apply for subsidies and because it is crucial from society's viewpoint that the 'right' firms apply for subsidies. Firms are assumed to make the application decision knowing the general rules by which Tekes grants subsidies, but not knowing exactly how it will treat their application. If firms apply, they need to describe their project and state a proposed budget. To make the model meaningful, it is important to assume that there is a cost for applying and that this may be firm specific. In the next stage of the game, Tekes screens the application and decides whether to grant a subsidy. In the final stage, firms implement their R&D projects. This simple model seems to capture the essence of firms' and Tekes' decision-making process.

TTT show that in equilibrium some firms apply and get funded, some apply and get turned down, and others do not apply. The existence of such an equilibrium is crucial given that the outcome described is indeed observed in practice. Considering the period 2000 to mid-2003, Tekes data show that of roughly 11,000 firms (potential applicants), some 1,000 firms applied. Around 30 percent of these applications were rejected. The remaining firms received a subsidy, varying across firms, however. Figure 5 shows a nonparametric (kernel) estimate of the frequency distribution of subsidies. It turns out that subsidies vary greatly in size, the smallest being close to zero, and the highest equivalent to 60 percent of R&D costs incurred, i.e., the maximum possible in the period considered here.

Figure 5. Frequency distribution (in %) of size of R&D subsidies granted by Tekes



Source: Takalo *et al.* (2005) and author's own calculations.
Note: The subsidy amount (horizontal axis) is expressed as a ratio of the underlying R&D spending.

The key equations estimated in the TTT model concern (i) Tekes' decision rule, (ii) firms' R&D spending, and (iii) the application decision of firms. The authors estimate their model both using standard assumptions (the error terms are normally distributed and homogeneous, etc.) and allowing the error terms to be freely distributed.

Except for firm size, firm characteristics do not seem to significantly affect Tekes' R&D subsidies, but project characteristics do.

To start with the equation concerning Tekes' decisions rule, the TTT estimates reveal how firm characteristics affect the subsidy a firm gets – if it applies. An interesting finding is that the subsidy a firm gets is largely independent of the industry the firm is in. That said, firms in the food industry get higher subsidies, mainly because during the observation period Tekes actively solicited applications from that industry. The only other industry systematically receiving different subsidies is data processing – firms in that industry get lower subsidies than firms in other industries. SMEs get some eight percentage points higher subsidies – this reflects the explicit Tekes rules by which firms meeting the SME criteria of the European Commission are entitled to the maximum subsidy of 60 percent. Large firms, measured by (the log of) employment get higher subsidies. If one believes in Tekes acting like a benevolent social planner, the interpretation is that, for the same R&D project, big firms generate larger spillovers than small firms. However, other interpretations are possible depending on one's stand on what it is that Tekes maximises. Other firm characteristics do not affect the subsidies, but project characteristics do. For instance, projects facing (in Tekes' evaluation) considerable technical challenges benefit from relatively large subsidies. There is some but less conclusive evidence suggesting that projects facing large commercial risks (again by Tekes' evaluation) get lower subsidies.

Whatever interpretation one wants to give to these results, they suggest that subsidies are in practice decided on in a horizontal manner. Note however that nothing in Tekes rules or the economic reasoning for optimal subsidies (Box1) suggests that this should necessarily be the case. Indeed, if anything, one would not expect the same consumer surplus in all industries; likewise, one would expect greater variation in knowledge spillovers between firms in different industries

than within a particular industry. To illustrate, think of an industry/product with a major domestic impact, such as snow tires, and another where the market largely lies outside Finland, such as a cure for bird flu or hepatitis B. Having said this, it is important to keep in mind that subsidies vary greatly, as shown in Figure 5. Depending on what view one takes on Tekes' decision-making and objectives, one might see this variation either as a strength (Tekes being able to tailor its support to the socially optimal level) or a weakness (Tekes being able to tailor the subsidy to whatever level it finds convenient for the firm in question).

Turning to firm's R&D spending equation, it is important to note that determinants of R&D are notoriously difficult to identify. Loosely speaking, a good deal of what determines R&D spending is not reflected in the variables usually observed, but is embedded in things researchers cannot observe. Examples already elaborated on above include the quality of management and of R&D engineers. Despite these difficulties, estimating R&D spending equations furthers our understanding of firm characteristics related to R&D. The benefit of TTT's structural model is that the parameters of their R&D spending equation can be interpreted as effects of the variable in question on the marginal profitability of (log) R&D. They find that the profitability of R&D is higher, all other things being equal, for large firms and firms with a higher value added of production and a chief executive officer (CEO) who is not chairman of the board. The robustness of the CEO result is weaker than that of the two others, however. Other firm characteristics did not affect R&D profitability, but there were differences over industries and regions: firms in the food industry have low R&D profitability, whereas firms in the radio, TV, and telecoms industries have high R&D profitability; firms in eastern Finland have lower profitability than firms in southern Finland – the geographical core of economic activity in Finland.

TTT identify the cost of applying for a subsidy as a major determinant of firms' application decisions. These costs comprise much more than the cost of filling in and submitting an application. In fact, a major cost element is the opportunity costs of management time of potential applicants. In the TTT data set, the median firm has only five employees, suggesting that the managing director has a large role also in R&D and, thus, would be heavily involved in writing an application were the firm to decide to submit one. The cost of applying is then largely what the firm would achieve if management spent its time on R&D and related tasks instead of optimising the application. A key finding of TTT is that the costs of applying for subsidies rise with the quality of the underlying R&D idea, meaning that ideas promising large profits come with large application cost. TTT find application costs substantial.

TTT are able to calculate the social return to subsidies, a key assumption being that Tekes acts as a benevolent social planner. Although there are several caveats, their estimate is 9 percent. This, if correct, is a relatively high return on public investment, but objectively ought to be compared to the shadow cost of public funds, the estimates of which are usually higher. It is however clearly higher than what the Finnish government pays as interest on its bonds.

Estimates suggest a social return on R&D subsidies in Finland of 9 percent.

All in all, by modelling the R&D subsidy process using modern structural methods, the TTT study shows that it is possible to answer a host of interesting questions. However, one should probably view their empirical results as suggestive given that they are based on the first empirical implementation of the model. The main findings are that Tekes decides on subsidies in a horizontal manner and application costs are a significant determinant of firm behaviour, which should be taken into account when evaluating R&D subsidies; the return on Tekes subsidies is estimated at 9 percent.

6. R&D subsidies in Norway

As discussed in Section 4, Norway spends less on R&D and has a lower R&D output than Finland in relation to population. This is not for lack of trying: in the 1980s and 1990s, Norway implemented a rather aggressive innovation policy, largely focussing on the (then-perceived) strength of the Norwegian IT sector. Indeed, during the early 1980s, Norsk Data was one of the leading minicomputer manufacturers in the world. That said, Norwegian policy makers were concerned about the fragmentation of public funds for R&D, too many small and independent firms, and little long-term planning and originality in product development (see Klette and Møen 1999).

The motivation for R&D subsidies in Norway explicitly recognised the goal of fostering general purpose technologies, with a heavy concentration on IT manufacturing.

Norway is an interesting case in that the motivation for R&D subsidies explicitly recognised the goal of fostering general-purpose technologies (see Klette and Møen 1999). Two consequences of the concerns mentioned above and the GPT orientation of Norway's R&D policy are worth mentioning. For one thing, R&D funding of the programme was substantial, reaching some 40 percent of the total funding for research carried out by universities and government laboratories. To initiate the kind of 'positive feedback' loop envisioned by the GPT theory, large-scale initial investments might be necessary. Second, there was a heavy concentration on IT manufacturing, and within this sector large firms where the main beneficiaries. To illustrate, the industry leader, Norsk Data, received some 12 percent of all funds available to firms. Such concentration of effort not only between but also within a sector might also be justified by returns to scale in R&D and the goal to create a positive feedback loop. Despite this and other large-scale public support (see Møen 2004), Norsk Data went bankrupt in 1993.

In what follows, I briefly review three studies on Norwegian R&D subsidy programme. To start with Klette and Møen (1999), they examine the effects of R&D subsidies on firm conduct and performance, measured by growth in employment and sales, return on assets, profit margins, labour productivity, total factor productivity, investment, and the level of R&D spending financed without subsidies. Their approach involves three parts: first, they compare the short-run performance of targeted firms to other firms in the same industry; second, they compare the long(er)-run performance of these firms; finally, they compare the development of the IT industry in Norway with that of other OECD countries in 1983-92.

For the first part, the paper does not find positive effects of R&D subsidies - even when not controlling for firm-specific unobservable variables.[11] When Klette and Møen control for these effects, they find that small subsidies (less than 5 percent of R&D spending) have negative effects on sales growth, labour productivity, and total factor productivity. Because they do not attempt to control for contemporaneous endogeneity, it is not clear whether one can give these results a causal interpretation, but the results do suggest the possibility that (small) R&D subsidies provide a cushion to lean on in the sense that firms do not have to improve their productivity as fast as they would have to without the subsidies. Regarding the R&D spending of targeted firms compared to other firms in the same industry, the paper finds that although subsidised firms were more R&D intensive to start with, their R&D spending (measured in monetary units, not intensity) grew less than the spending of non-subsidised firms. The authors also find evidence that subsidised firms perform relatively poorly when measured by productivity growth and profitability.

As to the second part, Klette and Møen (1999) compare the behaviour and performance of subsidised firms to non-subsidised ones in 1985, and look at the changes between 1985 and 1995. They find that subsidised firms invested more heavily in R&D in 1985, suggesting possible selection bias. However, looking at changes over time they find non-subsidised firms increased their R&D

11 As argued in Section 3.1, unobservable variables could be of substantial importance in studies of this kind.

intensity on average by 15 percent (from 4.1 to 4.8 percent) whereas subsidised firms' R&D intensity decreased by 17 percent. They also find that non-subsidised firms grew faster, but had the same labour productivity growth and exit rates as subsidised firms. Finally, while subsidised firms' profits grew faster than the profits of non-subsidised firms, by 1995, the former had not reached the latter's 1985 profit levels. Overall, the long-run comparison thus does not suggest that subsidies had any major positive effects on firm performance.

Empirical evidence for Norway does not suggest that R&D subsidies had any major positive effect on the performance of firms.

Turning then to the comparison of Norway with other OECD countries, Klette and Møen (1999) note that the Norwegian IT industry was exceptionally R&D intensive. In the period considered (i.e., 1983-92), subsidies to the Norwegian IT industry were substantial and its R&D intensity increased considerably. Yet, Norway was the only OECD country experiencing a fall in IT production.

The second study is that of Klette and Møen (1998). It uses the same data as their later study, but takes a closer look at the mechanisms that might induce effects of R&D subsidies on privately financed R&D. Their initial analysis of some 700 business units from three high-tech industries (ISIC 382, 383, and 385) shows that R&D subsidies have no effect on privately financed R&D spending. They find that cashflow has a significant positive effect, indicating capital market imperfections. They then allow small and large firms to differ in their response to subsidies. The results show that there is neither additionality nor crowding out for small firms, crowding out to the tune of 50 percent for medium-sized firms, and additionality of around 25 percent for large firms.

Klette and Møen (1998) then allow for dynamics by including lagged R&D subsidies in their estimated equations. It turns out that subsidised firms continue to spend more (relative to sales) on R&D after the subsidy period than they otherwise would have. In other words, the positive effects of R&D subsidies come through 'elevating' the firm's level of investment in R&D, rather than through a contemporaneous increase in privately financed R&D spending. In particular, they propose a model of learning-by-doing to account for their finding that R&D subsidies have positive long-run effects.

The third study on the effects of Norway's R&D subsidy programme challenges the claim made by the Norwegian Research Council that despite the bankruptcy of Norsk Data the programme had positive effects by boosting human capital that later diffused through the Norwegian industry. Møen (2004) looks at the productivity effects of workers who worked in subsidised firms and at the performance of firms that are spin-offs from formerly subsidised firms. He finds no support for the suggestion that work experience in the subsidised firms has been valued more than any other experience. Thus, having worked in a subsidised firm did not hurt an employee, but did not produce gains either. What is of course lacking from this analysis is the answer to the counterfactual question of what wages (employment, etc.) would have been without the subsidy programme.

Møen's firm-level analysis echoes the findings of Klette and Møen (1999) on R&D subsidy-receiving firms: he finds that spin-offs from these firms are performing on par with other, similar firms, but are less profitable by both measures used (return on equity, return on assets).

7. Conclusions

Innovation policy in general and R&D subsidies in particular are believed to be important in fostering economic growth. These beliefs are held by politicians and backed by economic research. The consensus seems to be that while economic theory gives ample justification for innovation

policy, the problems lie either in the actual execution of those policies or a government's general ability to conduct anything resembling an optimal policy due to various constraints.

It is standard for researchers (e.g., Klette and Møen 1999) to voice concerns over political economy issues that may divert actual policies from optimal ones. Government failure is the rubric under which one generally collects such and other potential problems in government's ability to deliver. A potentially more fundamental problem is that even when government officials base their arguments for policies on market failure (this is the case at least in Finland), the standard against which they gauge them is the improbable full information Pareto optimal state of affairs. A more reasonable, yet still challenging, yardstick would be to take the informational constraints of the government seriously into account when analysing the need for existing or new policies.

A further important problem that falls under the rubric of government failure is that civil servants – no matter how qualified and competent – are at a disadvantage when it comes to active forms of financing, such as venture capital. This is because they face entirely different incentives than private sector financiers, and realigning their incentives with those of private financiers is most likely not possible nor would it be wise.

An important insight derived even from the simplest model of R&D subsidies is that optimal subsidies are heterogenous, i.e., they ought to vary from firm to firm and from project to project, and that the informational demands for designing optimal policies are potentially prohibitive. Especially the first conclusion should be borne in mind when judging the supposedly horizontal nature of R&D subsidies.

Finland is generally viewed as successful in terms of innovation performance and innovation policies while Norway clearly lags behind.

In the last three sections of this paper I have presented academic research on the effectiveness of R&D subsidies in two rather similar countries, Norway and Finland. While in many ways similar, both in general circumstances and in terms of the R&D subsidy policies, important differences emerge. First, Finland is generally viewed as (comparatively) successful in terms of innovation performance and innovation policies while Norway clearly lags behind. Second, there are important differences in the way R&D subsidy programmes were administered in the two countries. Norway chose to back a 'national champion' and firms operating in fields related to this champion. Finland has followed a more horizontal R&D subsidy policy, although one should acknowledge that Tekes also runs special programmes in parallel to its general R&D subsidy scheme.

The bulk of academic research suggests that in Finland, R&D subsidies work relatively well. There is evidence that they spur private R&D investment, firm productivity, and R&D employment but have no effect on general employment of firms. An analysis of Tekes' subsidy decisions shows that few firm-level variables affect these decisions. The most notable one is firm size: for similar R&D projects, large firms get larger subsidies (measured in percent of R&D spending) than small firms. However, there is little evidence that firms in different industries are treated differently.

The Norwegian evidence suggests that R&D subsidies had few positive effects. Most of the evidence suggests that subsidies were either granted to firms with sub-par profitability and productivity, or even worse, that subsidies lead to sub-par performance. Evidence from spin-off firms suggests that firms spun off from subsidised firms have consistently lower profitability than other firms. The only positive finding is that subsidised firms continue to invest more in R&D than they would have otherwise.

The difference in performance between Finnish and Norwegian R&D subsidy policies naturally raises the question of why the results are so different. Three potential answers emerge.

First, Norway chose to target a national champion and, in general, to heavily concentrate its support whereas Finland chose a more horizontal policy. Targeting might work but relies critically on the ability of the government to pick the 'right' target. Questions can and should be raised about the governments' ability to make such choices. Second, the Norwegian IT industry (Norsk Data in particular) concentrated on minicomputers, and was very possibly a victim of a discontinuous innovation where minicomputers as a technology were superseded by developments in computing. According to this interpretation, the industry would have failed with or without support. Third, one could also take the view that Norway quite clearly understood the winner-takes-it-all nature of innovation deriving from the skewed distribution of payoffs from innovation, but – as it very often happens in such an environment – ended up backing the wrong technology. Thus, while *ex post* a failure, it may be hard to conclude that this could have been known *ex ante*.

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ABSTRACT

This paper assesses the effectiveness of vertical industrial policies within the European Union. *Vertical industrial policy is defined as government support of specific firms or industries ('picking winners' or 'supporting losers'). It is measured as state aid granted by Member States to the manufacturing sectors, with the aim to analyse to what extent this government intervention affects the growth of multifactor productivity (MFP) in manufacturing. The analysis is conducted with both sectoral and horizontal aid, since in many cases vertical aid is disguised as aid pursuing horizontal objectives. Controlling for the potential endogeneity of state aid policy, the results indicate that vertical state aid contributes positively to MFP growth.*

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Vertical industrial policy in the EU: an empirical analysis of the effectiveness of state aid

1. State aid: a key tool of industrial policy in the EU

Jordi Gual

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This paper assesses the effectiveness of vertical industrial policies within the EU. For the purpose of this paper, industrial policy is defined as "the set of government interventions that by way of taxes (or subsidies) and regulations on domestic products or factors of production attempt to modify the allocation of domestic resources that results from the free operation of the market" (Gual 1995, p. 9). To narrow down what otherwise is a very broad definition, we exclude measures directed to primary sectors as well as those related to non-tradable industries, such as housing services or retail trade. Policies that affect most firms in a country to a similar extent – for example, investment tax credits or subsidies for the employment of a particular kind of labour – are also excluded.

State aid is part of the toolkit available for governments to implement their preferred industrial policy. This toolkit is somewhat limited for EU countries due to the agreements and legislation directed towards creating a single internal market, including a common policy with respect to trade barriers, mutual recognition of standards, and so on. European laws defining the legality of state aid constitute perhaps the most important element in the agreed framework for implementing industrial policies within Europe.

The main economic justification for industrial policy, including state aid, is the quest for efficiency. Thus, government aid aims to correct market failures, such as externalities, asymmetric information, market power, coordination problems, and public goods. The most common example of (positive) externalities is the research and development (R&D) activity of private companies. Asymmetric information, in turn, is used as a justification for granting aid to small and medium-sized enterprises (SMEs). Asymmetric information between a bank and an SME about the latter's potential to repay a loan or about the riskiness of its projects may prevent even a profitable SME to access finance.

Market failures such as these justify the general objectives of R&D or SME support. Additional arguments are needed, however, to justify government intervention in specific industries or firms. Optimal use of government resources suggests that intervention should focus on those industries where externalities are particularly important. In the case of R&D, general support to all sectors may be desirable at the European level, while individual Member States tend to focus their support to those sectors where a substantial part of the benefits from the externality are likely to remain within the national boundaries.

Another type of market failure that justifies sector-specific support is the presence of agglomeration externalities. In this case, firms devoted to similar or related activities need to cluster, i.e., to locate in geographic proximity in order to transmit tacit knowledge, with the transmission cost increasing with geographical distance. Industrial policy may foster the creation of clusters by subsidising firms that generate agglomeration externalities. On the other hand, governments may not have all necessary information to determine which industries are capable of generating agglomeration effects. The case for industrial policy on the grounds of agglomeration externalities remains thus uncertain.

Yet another possible justification for sector-specific industrial policy rests on strategic trade considerations, first developed by Brander and Spencer (1983). The basic market failure justifying strategic trade policy is imperfect competition arising from scale economies in production. In oligopolistic market structures firms may realise some excess returns. Governments hence have

an incentive to support national champions in order to maintain those rents within national boundaries. A classical example in the European context is the Airbus case, documented in Neven and Seabright (1995). An argument along this line is used by Collie (2005) to analyse also the effects of state aid to R&D.

This strategic trade policy justification may be particularly important in industries where network externalities are present. Those industries are prone to oligopolistic market structures once standards have been set. Hence, governments may want to intervene with a view to helping national firms during the early stages of competition for the market. Although standards are developed on a market-determined basis within the EU – meaning that national bodies only specify the basic requirements related to public health and environmental and consumer protection – this justification is still applicable to industries with global geographic markets. Thus, industries might exist for which the strategic trade justification could also be in the interest of the EU as a whole. An example is the development of the GSM standard for mobile telecommunications, which was promoted by Europe and declared the mandatory technology to be used in European mobile phones. This intervention may partly explain the faster development in Europe than in the United States of the mobile telecommunications industry. A second example is the development of Galileo, a technology intended to compete with the GPS and GLONASS systems, developed by the United States and Russia, respectively.

Apart from economic efficiency, equity concerns may also justify the provision of industrial policy support to specific industries when the benefits in terms of social equity outweigh the negative effects of compromising economic efficiency. Indeed, some forms of state aid involve a mix of efficiency and equity justifications. This is the case for aid provided under structural adjustment policies targeted at declining industries. It is possible that the existence of some market failure, such as factor market rigidities (Neary 1982), prevents the adjustment through market forces alone in some sectors. Typically, industrial policies towards these industries also involve a redistribution of income.

Regional aid also presents a combination of efficiency and equity justifications. Rodrik (2004) adds a market failure justification to equity goals for aid targeted at depressed regions. He argues that there is a market failure in the process of discovering activities (not necessarily new) that can be profitably adapted to local conditions. The social value of experimenting with new activities is high, whereas private costs for entrepreneurs are significant and benefits, if they exist, would be shared with followers. In such cases, a partnership between the government and private firms could be desirable.

State aid in the EU aims chiefly at alleviating market failures and attaining distributional objectives.

Overall, the design of state aid in the EU aims at alleviating market failures and attaining distributional objectives, while support for cluster-like structures has not been explicitly regulated. However, industrial policy has increasingly concentrated on stimulating regional clusters (OECD 2001). Initiatives of cluster mapping have been launched for example in Belgium, Denmark, France, Austria, Finland, the United Kingdom and Norway (European Commission 2002), and some emphasis has recently been put on potentially positive effects of public policy in supporting clustering initiatives (Trends Business Research 2001). This support is mainly extended through regional or horizontal aid instruments – such as R&D or SME support – or aid for training.

Industrial policy in EU member states is, to a large extent, implemented within the agreed framework of EU state aid legislation. The objective of EU state aid policy is to regulate and monitor that industrial policy by Member States does not distort internal market competition, affect trade, or risk provoking a subsidy war. To this end, a set of regulations describes and limits the types of state aid that can be used in the EU (Box 1).

Box 1. Regulation of state aid in the EU

Industrial policy of EU member states is regulated and monitored in the framework of EU state aid legislation. The basis of EU state aid policy is contained in Articles 87 to 89 of the Treaty of Amsterdam[1]. Article 87(1) stipulates a general ban on state aid that distorts competition and affects trade. Article 87(2) states mandatory exceptions from this general prohibition – including aid with social character granted to individual consumers, aid related to natural disasters, and aid granted to Eastern Germany related to the effects of the post-war division of Germany. Article 87(3) allows some discretionary exceptions, including regional aid, aid to combat serious unemployment, aid for culture and heritage conservation, aid to advance important projects of common European interest, aid to deal with serious economic disturbances, and aid to some specified economic activities.

On top of these statutory foundations, Commission and Council regulations and guidelines specify administrative procedures for the implementation of state aid control. Traditionally, state aid monitored by the Commission has been classified in four broad categories: aid to horizontal objectives, regional aid, sectoral aid, and aid to individual firms for rescue and restructuring. Each of these is briefly described below.

Horizontal aid[2] includes aid to horizontal objectives, such as R&D, environment and energy saving, SMEs, employment, training, and risk capital. Aid to horizontal objectives is mainly justified by market failures.

Regional aid aims to promote the development of disadvantaged regions. It includes aid to assisted regions on the basis of Article 87(3)a and (3)c. In addition, the EU also provides support to projects that are financed jointly with the Member States, e.g., involving Structural Funds.

Sectoral aid has historically included three types of sectors. First, aid to agriculture, fisheries, and transport has been exempted from the general rules on state aid and has to comply with sector-specific regulations (Article 36 for agriculture and fisheries; Articles 73, 76, and 154 for the transport sector). Second, a number of industries have been classified as 'sensitive' due to their particularly severe economic problems. These industries include coal and steel, synthetic fibres, and shipbuilding. Specific rules apply to aid to these industries. In general, the rules try to ensure long-term adjustment. Third, a number of industries are supported because they have been exposed to international competition only recently. These include financial services, air transport, maritime transport, and motor vehicles. The goal was to facilitate a one-time adjustment to exogenous structural changes in market conditions.

Rescue and restructuring aid is aid awarded to individual firms in difficulties. A firm in difficulty is defined as one being unable, through its own resources and without outside intervention by the public authorities, to stem losses that will almost certainly condemn it to go out of business in the short or medium term. Rescue aid is temporary assistance. It should make it possible to keep a firm in difficulty afloat for the time needed to work out a restructuring or liquidation plan and/or for the length of time needed by the Commission or the national authorities to reach a decision on that plan. Restructuring aid, in turn, is based on a feasible, coherent, and far-reaching plan to restore a firm's long-term viability. Since it may distort competition, restructuring aid is governed by the 'one time, last time' condition, i.e., it may be granted only once.

The 1999 'Community Guidelines on State Aid for Rescuing and Restructuring Firms in Difficulty' lay out the conditions and procedures for awarding aid. These guidelines expired on October 9, 2004, and were replaced by 'Community Guidelines Applying Articles 87 and 88 of the Treaty to the Granting of Urgency and/or Restructuring Aid to Firms'. For a more detailed discussion, see Anestis *et al.* (2005).

In recent years, EU practice for new aid schemes has departed from the traditional classification. Horizontal objectives such as SME, training, and employment are handled with block exemptions. Some horizontal objectives – such as R&D aid, environmental aid, and risk capital – have got explicit guidelines for assessment. Special rules for particular sectors include only postal services, broadcasting, audiovisual production electricity, shipbuilding, and steel.

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1 In the Treaty of Maastricht and the Treaty of Rome, the paragraphs on state aid are numbered 92 – 94.

2 Aid for regional development and rescue and restructuring is sometimes also classified as aid for horizontal objectives. For the sake of conceptual clarity they will, however, be treated separately throughout this paper.

To set the stage for the core of this paper, let us sketch trends in state aid in the EU-15 member states (for more details see Riess and Välilä, this volume). For a start, it is important to point out that the analysis of state-aid statistics is affected by the state-aid classification of the European Commission. The primary reporting tool of the Commission is the State Aid Scoreboard, compiled by the Directorate General (DG) Competition, from which the following statistics are drawn. While aid schemes may have different objectives, the Commission classifies them according to the primary objective. Hence, all aid with a horizontal objective as the primary objective is considered horizontal aid (for various types of horizontal objectives see Box 1). Regional aid is usually considered as horizontal aid, whereas aid for rescue and restructuring is included as part of sectoral aid.

Bearing this classification in mind, trends in state aid extended by Member States in the period 1995-2003 show three salient features. First, total state aid in the EU-15 fell from €76 billion in 1995 to €53 billion in 2003. In relation to GDP, this represented a decline from 1 percent to a little more than one half of a percent. There are important differences between countries, however. To illustrate, in 2003, state aid ranged from 0.3 percent of GDP in the United Kingdom to 1.4 percent in Finland.

The drop in total state aid is almost exclusively due to a decline in sectoral aid.

Second, a decline in sectoral aid almost fully accounts for the drop in total state aid. More specifically, the aid classified as sectoral that was directed exclusively to the manufacturing sector decreased most (€13 billion), followed by that directed to coal (€4 billion), agriculture (€3 billion), and transport (€2 billion). As a share of total state aid, sectoral aid decreased from 60 percent in 1995 to 44 percent in 2003 (or from 46 percent to 21 percent if we exclude agriculture, fisheries, and transport from the sectoral aid figures). Concerning the sectoral composition of state aid, the manufacturing sector is clearly the biggest recipient with a share of 55-60 percent. Agriculture is the second biggest recipient (20-25 percent), followed by coal (10-15 percent), services (3-5 percent), transport (2 percent) and fisheries (1 percent). There are significant differences in aid distribution across EU countries. Manufacturing is the biggest recipient in nine Member States, with its share ranging from 74 percent of total aid in Italy to 40 percent in Spain. In five Member States (Finland, Austria, the Netherlands, Ireland, France), agriculture is the main recipient. In Portugal, the services sector is the biggest recipient. Aid to the coal industry is almost exclusively extended in Spain, Germany, and France.

Third – and following from the first two points – state aid with horizontal objectives was fairly stable, amounting to some €30 billion a year. However, separating out aid for regional development offers a different view: state aid for regional development decreased from about €18 billion in 1995 to less than €8 billion in 2003. Thus, state aid for horizontal objectives other than promoting regional development nearly doubled from €12½ billion to almost €22 billion. The most important horizontal objectives include environmental protection and energy saving (29 percent of aid awarded to horizontal objectives in 2003), R&D (18 percent), and SMEs (16 percent). In eight countries (Austria, Belgium, Finland, Greece, Italy, Luxembourg, Sweden, and the United Kingdom), all or almost all state aid (excluding aid to agriculture, fisheries, and transport) is channelled through horizontal instruments. This shift towards horizontal aid is a clearly stated goal in the Lisbon Agenda, but – as we will argue below – it is likely that schemes classified as horizontal in fact correspond to (sectoral) vertical state aid.

Having thus described the substance and recent evolution of state aid in the EU, we now turn to an analysis of how effective vertical state aid has been. Section 2 will provide a review of earlier empirical studies on this topic. Section 3 will present the empirical model to be estimated here, and Section 4 reports the results of the analysis. Section 5 concludes.

2. Earlier evidence of the effectiveness of vertical state aid

As mentioned above, vertical state aid is awarded to specific sectors or firms. It can be broken down into sectoral aid and aid for rescue and restructuring - a split we will follow in this section when reviewing earlier empirical studies on the effectiveness of vertical aid. Sectoral aid is considered vertical aid because it is granted to firms in a particular sector and is subject to specific regulations by the Commission. Aid for rescue and restructuring is usually included in the sectoral aid figures due to its potentially negative impact on competition.[1]

2.1 Studies on sectoral aid

There are two types of studies that examine the effect of sectoral aid: case studies for specific sectors and broader empirical analyses of support to manufacturing.

There are only a few case studies examining the effect of sectoral state aid.

Starting with case studies, there is only a limited number of comprehensive descriptions on the effects of sectoral state aid. Röller and von Hirschhausen (1996) examine state aid to the shipbuilding and synthetic fibre industries in East Germany (the former German Democratic Republic) after the opening up of its markets in the early 1990s. The Danish Competition Authority (2002), in turn, analyses an aid scheme to the shipbuilding industry.

A major restructuring backed by state aid measures was undertaken to turn around the economically unviable East German shipyards after German reunification. Röller and von Hirschhausen (1996) conclude that there was no static economic rationale justifying the large investment in East German shipyards. The market structure was highly competitive and no static gain was to be expected from an increase in competition due to existing overcapacity in the industry in Europe. Moreover, the amount of state aid was very high. The shipbuilding industry most hurt by this additional capacity seems to have been the West German shipyards, whose market share fell from over 30 percent to 21 percent, whereas the distribution of market shares among the other large European shipbuilding countries, i.e., Denmark, Spain, and Italy, was not significantly altered. Taking a dynamic perspective, the authors argue that aid to East German shipyards might have some economic rationale since they are likely to be among the most productive shipyards in Europe. This, however, implies rent shifting between countries, which would be inefficient from a broader European perspective.

As regards state aid to the synthetic fibre industry, Röller and von Hirschhausen conclude that there was no static economic justification for state aid. The industry was highly competitive both on the supply and on the demand side. As in the shipyard case, overcapacity existed, so state aid did not increase competition. Again, the competitors suffering most from this aid seem to have been those in West Germany, since they experienced a significant loss of market share, while the three largest European synthetic fibre producers either increased their market share (Spain, Benelux) or kept it constant (Italy). From a dynamic perspective, there might again have been some rent shifting, but there was no evidence of an immediate adverse effect on European industry.

1 European Commission (2005, p. 20): "In contrast, aid to support specific sectors is likely to distort competition more than aid for horizontal objectives and also tends to favour other objectives than identified market failures. Moreover, a significant part of such aid is granted to rescue or restructure companies in difficulty, one of the most potentially distortive types of State aid."

The Danish Competition Authority (2002) analyses the performance of the shipbuilding industry in Denmark, which received practically all Danish sectoral state aid during the past decade (1995-2005). The study concludes that turnover, employment, and the number of shipyards have all been declining over the past decades, while public subsidies have been increasing, reaching 70 percent of wages in 2001. There is some evidence of rent-seeking activities by the subsidies' recipients, as productivity in Danish shipyards has increased less than in other manufacturing industries and as wages for workers at shipyards have been 8-20 percent higher than for other workers in the metal and iron industry in same regions. However, profits have been low, indicating that state aid has not been channelled into excessive (accounting) profits.

Broader empirical analysis of aid to the manufacturing sector is scarce, too.

Turning then from case studies to broader empirical analyses of aid to the manufacturing sector, very little work has been done so far to measure its impact within the EU[2]: Bergström (1998) and the Danish Competition Authority (2001) analyse the effects of public capital subsidies on total factor productivity and growth. They use firm-level data and compare the development of firms having received state aid with the development of those that have not received any type of aid.

Bergström (1998) analyses 72 companies in the manufacturing sector that received state aid in Sweden during 1989-95 and compares them to a random sample of 832 non-aid-receiving firms. He analyses selective regional subsidies, i.e., subsidies specifically directed towards firms in support areas and for which firms have to apply. These subsidies include localisation subsidies and loans, development support, support to sparsely populated areas, and loans to investment firms. Such subsidies must be used primarily for investments in machinery and buildings. He finds that in the short run, the productivity of subsidised firms increased more than the productivity of non-subsidised firms, but that already after three years productivity was lower in subsidised than in non-subsidised firms. Bergström (1998) concludes that subsidisation might give rise to allocative inefficiencies and/or technical (X) inefficiencies due to slack or rent-seeking activities.

The Danish Competition Authority (2001) conducted a similar study on companies receiving some form of aid during 1994–97. The subsidy objectives mainly included horizontal objectives, such as R&D, quality development, export and international cooperation, entrepreneurs, environment, energy, and regional business development. The study analysed 1,491 aid-receiving companies from industries belonging to five different sectors (manufacturing, business activities, trade/hotels/restaurants, transport, and construction) and compared them to 22,112 non-aid-receiving firms. Using the pooled sample, no significant influence of firm-specific subsidies on productivity growth was found. The authors analysed also the aggregated value at industry level of all firm-specific subsidies. Results showed a negative correlation between overall subsidy intensity at the industry level and firms' productivity growth. The direction of causality in this relationship is, however, unclear: it might be that subsidies are given to firms with lower productivity growth *ex ante,* or that high subsidies actually cause low productivity growth. When the analysis is conducted separately for industries belonging to each of the five sectors, they find that for the manufacturing sector this correlation turns out to be significantly positive: industries with higher productivity growth show higher subsidy intensity.

2 Lee (1996) finds in a study for South Korea that government industrial policies primarily targeted low-productivity industries during 1963-83. He finds that subsidies through tax incentives and subsidised credits have not been successful in promoting productivity growth. Beason and Weinstein (1996) find in a study on Japanese industrial policy that a disproportionate amount of state aid was extended to sectors with decreasing returns to scale and low growth. They also report no evidence of productivity enhancement through industrial policies.

2.2 Studies on rescue and restructuring aid

During 1995-2003, there were 94 rescue and restructuring cases notified to the European Commission. To our knowledge, London Economics (2004) is the only comprehensive study investigating state aid for rescue and restructuring. It was prepared for the European Commission and examined all companies that received state aid for rescue and restructuring during this period, with the aid process having ended by 2004 (i.e., by 2004, the rescue aid had been repaid or restructuring plans had come to an end). London Economics considered 86 cases[3], of which 52 (or 60 percent) were restructuring cases. About 60 percent of the cases were in three Member States: Germany (26 cases), Italy (16), and France (12). Sectors most affected by state aid for restructuring and rescue were construction/engineering (10 cases), the financial sector (9), and machinery (8).

London Economics define an aid-receiving company as having failed if it became bankrupt or was liquidated, the latter result including the sale of parts of its (core) business. Cases where the aid has not been repaid or where the restructuring plans have not been finished (15 cases) are excluded from the analysis, as such cases are not considered closed and thus the aid impact cannot be assessed. Among the 71 companies examined, 29 were rescue aid cases and 42 restructuring aid cases. Out of the 29 rescue aid cases, 14 survived, 14 went bankrupt, and for one the status is still undetermined since the firm is insolvent[4]. Out of the 42 restructuring cases, 33 survived, eight went bankrupt, and for one the outcome is still undetermined.

Restructuring aid seems to be associated with a higher probability of firm survival than rescue aid.

The study seeks to determine which factors affect the survival of aid-receiving firms. It found that firms receiving restructuring aid have a higher probability to survive than firms receiving rescue aid. Moreover, if a firm's difficulties are due to market decline or poor management, its chances of survival after receiving restructuring or rescue aid are higher by as much as 30 percent. On the other hand, firm characteristics such as size, age, legal status, sector growth, its condition at the time of aid (measured in profits per employee), or even the relative size of aid have no significant effect on the probability of survival. Neither has the design of the rescue or restructuring plan, measured as the duration of restructuring, capacity reductions, personnel reductions, focus on core business activities, cost-cutting, financial consolidation, selling or closure of plants and assets, new investment, training and upgrading, or plant relocation.

London Economics (2004) further analyse the post-aid performance of the firms having received aid in the period 1995-99. They analyse relative growth in employment, turnover, profitability, and labour productivity from the year of award of the aid until 2002. They compare aid-receiving firms with a set of firms comparable in terms of geography, activities, and size, with the industry average defined as the average growth of the relevant variables calculated for this set of comparable firms. The results suggest that out of the 22 aid-receiving companies analysed, about half increased employment faster than the industry average. Out of 21 companies analysed, nine (or 43 percent) grew faster in terms of turnover than comparable competitors, with only one company reaching levels of turnover above industry average. In terms of profitability, out of the 18 companies analysed, 13 (or 72 percent) improved their position relative to the industry average, with four reaching above average profitability and the remaining 14 staying well below this average. Finally, in terms of labour productivity, out of the

3 Five cases were excluded due to their location (East Germany); one case was ignored as the aid decision had been pending; one case was considered a R&D case; and two cases collapsed into one as they shared the same state aid package.

4 Insolvency differs from bankruptcy in that the former is a transition state: the firm can either recover and survive or end up in bankruptcy.

21 firms analysed, 16 (or 76 percent) increased labour productivity faster than industry average, with four companies improving the productivity from below to above the industry average.

Firms receiving state aid do not seem to significantly outperform their competitors.

Summarising the empirical evidence on rescue and restructuring aid, two main results seem to stand out. First, design rules of restructuring and rescue aid plans (including the relative amount of aid) do not seem to affect the probability of survival. On the contrary, this probability increases when the difficulties of the firm stem from poor management or market decline. Second, in terms of overall growth (turnover, employment), companies receiving state aid did not significantly outperform their competitors after the grant. However, there are signs that firms in difficulties do partially close the gap regarding profitability and productivity levels after receiving state aid.

3. Model specification

3.1 Reduced-form empirical model

Several variables could be used as a measure of performance to assess the effects of state aid. Productivity is arguably the most important one, given the relationship between productivity and economic growth.

Country differences in productivity can be explained by endogenous growth models, in which the mechanisms of technology diffusion play an important role. These models predict convergence of the technologically lagging countries towards the leading country. Studies analysing convergence of multifactor productivity (MFP) across countries include Bernard and Jones (1996), Griffith *et al.* (2001), Scarpetta and Tressel (2002), and Nicoletti and Scarpetta (2003). The evidence reported in these papers suggests convergence of 'lagging' countries towards the leading country – with convergence the faster, the larger the gap to the leader.

The steady-state equilibrium predicted by endogenous growth models depends on factors such as the cost of innovation/imitation, the regulatory environment, and other institutional factors considered as given and exogenous. Empirical applications need to control for these factors in the estimation of productivity growth, and it seems natural to think of state aid as one of these factors. Griffith *et al.* (2001) focus on the effect of R&D investment. Scarpetta and Tressel (2002) concentrate on the interaction between regulation and convergence. The purpose of our paper is to widen this approach by introducing state aid as another explanatory factor. Our analysis focuses on the manufacturing sector given the measurement problems that characterise non-manufacturing industries. Moreover, manufacturing is a footloose industry and, thus, arguably more likely to receive vertical state aid.

Following the convergence literature, we introduce technology transfer as a source of productivity growth for countries below the technological frontier.[5] The technological frontier is defined by the country with the highest MFP in a given year. Issues related to the measurement of MFP and the distance of a country to the technological frontier are discussed in Box 2.

5 For a detailed derivation see Griffith *et al.* (2000); compare also Scarpetta and Tressel (2002) and Kolasa and Zólkiewski (2004)

Box 2. Measurement of multifactor productivity and distance to the technological frontier

To calculate MFP growth and the MFP level of country *i* relative to the frontier country (i.e, the distance to the technological frontier), the superlative index number approach of Caves *et al*. (1982a, b) is used. It can be considered the discrete-time analogue of the continuous-time formula derived by Solow to measure the rate of technological progress. The difference comes from the use of a translog production function instead of the more standard Cobb-Douglas production function. However, the assumptions of constant returns to scale and perfect competition in the input markets are maintained.

MFP growth is then given by the following expression:

$$\Delta MFP_{i,t} = \ln\left(\frac{Y_{i,t}}{Y_{i,t-1}}\right) - \frac{1}{2}(\alpha_{i,t} + \alpha_{i,t-1}) \ln\left(\frac{L_{i,t}}{L_{i,t-1}}\right) - \left(1 - \frac{1}{2}(\alpha_{i,t} + \alpha_{i,t-1})\right) \ln\left(\frac{K_{i,t}}{K_{i,t-1}}\right)$$

where $\alpha_{i,t}$ is the share of labour in value-added; $Y_{i,t}$ is output, $L_{i,t}$ is labour input, and $K_{i,t}$ is capital input – all at time *t*.

Estimating the level of MFP of country *i* compared to the frontier country rests on a similar approach, essentially involving three steps. First, the level of MFP of each country is evaluated relative to a common reference point – the geometric mean of all countries – using the following productivity index:

$$MMFP_{i,t} = \ln\left(\frac{Y_{i,t}}{\overline{Y_t}}\right) - \frac{1}{2}(\alpha_{i,t} + \overline{\alpha}_t) \ln\left(\frac{L_{i,t}}{\overline{L_t}}\right) - \left(1 - \frac{1}{2}(\alpha_{i,t} + \overline{\alpha}_t)\right) \ln\left(\frac{K_{i,t}}{\overline{K_t}}\right)$$

where an upper bar above the variable denotes a geometric mean across countries. Second, for each year, the country with the highest MFP relative to the geometric mean (MMFP) is defined as the frontier country, denoted $MMFP_{F,t}$. For the identification of the frontier country, non-EU OECD countries (e.g., Canada, Japan, and the United States) are included in the analysis to identify the world technology leader. Third, to derive the position of country *i* relative to the frontier in year *t* ($RMFP_{i,t}$: the superlative index number measure of relative MFP for country *i* in each year), $MMFP_{F,t}$ is subtracted from $MMFP_{i,t}$:

$$RMFP_{i,t} = MMFP_{i,t} - MMFP_{F,t}$$

One problem with this estimation of MFP and the distance to the technological frontier is that the share of labour in value added ($\alpha_{i,t}$) tends to be rather volatile. This might be due to measurement errors, short-run fluctuations in demand, and the fact that wage negotiations are not on an annual basis. Following Harrigan (1997) and Griffith *et al*. (2001), we exploit a property of the translog production function with constant returns to scale and the assumption of competitive input markets to smooth the share of labour in value added. Indeed, for this production function, the equalisation of the marginal product of labour to the wage produces a stable relationship between the share of labour in value added and the logarithm of the capital-labour ratio. Assuming that the observed share differs randomly from this stable relationship, one can estimate:

$$\alpha_{i,t} = \upsilon_i + \varphi \ln\left(K_{i,t}/L_{i,t}\right) + \varepsilon_{i,t}$$

where $\varepsilon_{i,t}$ is an i.i.d. error term and υ_i are country fixed effects. This formulation with country fixed effects assumes that the structure of production differs among countries only through differences in the first-order translog parameters (Caves 1982a, b). The fitted values of $\alpha_{i,t}$ from this equation are used in the calculations of $\Delta MFP_{i,t}$ and $MMFP_{i,t}$.

MFP is modelled as an auto-regressive distributed lag ARDL(1,1) where the level of MFP is cointegrated with the level of MFP of the technological frontier country F:

$$(1) \qquad ln\, A_{i,t} = \theta_1\, ln\, A_{i,t-1} + \theta_2 ln\, A_{F,t} + \theta_3 lnA_{F,t-1} + \omega_{i,t} + \varepsilon_{i,t}$$

where A_F is MFP in the frontier country and ω stands for all observable and non-observable factors influencing the level of MFP. Additionally, we assume convergence towards a steady state where the growth rates of MFP are equal across countries and over time and $\omega_{i,t}$ is constant. Formally, this means that $\Delta lnA_{i,t} = \Delta lnA_{F,t}$ and $\Delta lnA_{i,t} = \Delta lnA_{i,t-1}$. With this and (1) we can derive the steady-state condition: $(1-\theta_1) = (\theta_2+\theta_3)$. Rearranging (1) and assuming steady-state convergence, MFP growth can be written as an error correction model of the form:

$$(2) \qquad \Delta ln\, A_{i,t} = \theta_2\, \Delta ln\, A_{F,t} + (\theta_1-1)\, ln(A_{i,t-1}/A_{F,t-1}) + \omega_{i,t} + \varepsilon_{i,t}$$

Equation (2) describes the variation in the level of technology around its long-run trend as a function of a set of exogenous factors (ω), the variation in the leader's technology around its trend (the first term on the right-hand side of the equation), and an error correction (the second term), which depends on the technology of country *i* compared to the leader. The first term, which captures the diffusion of technological advances from the leading country to the rest, is expected to be positive. The second term, which captures the catch up of lagging countries to the technology leader, is expected to be positive, too. Note, however, that catching up implies that (θ_1-1) is negative because $ln(A_{i,t-1}/A_{F,t-1})$ is negative, too, since $A_{i,t-1} < A_{F,t-1}$. The larger the parameter (θ_1-1) in absolute terms, the stronger the catching-up effect. The MFP of countries further away from the technology frontier is thus expected to grow faster.

Vertical state aid is introduced as another factor affecting the equilibrium level of technology in a country.

The set of $\omega_{i,t}$ variables affects the equilibrium level of technology in country *i*. Therefore, a natural way to assess the effect of vertical state aid on productivity is to introduce it as a component in $\omega_{i,t}$. Its expected sign is ambiguous, since the efficiency-enhancing effect of vertical aid may be quite weak – agglomeration effects, alleviation of credit constraints, and so on – and may not compensate for the distortions it creates – rent capture, allocative inefficiencies, and so on. Moreover, vertical aid may adversely affect productivity through its impact on competition. That said, the relationship between competition and innovation and, thus, productivity is not clear either, as argued by Aghion and Griffith (2005).

Let us now turn to other variables included in $\omega_{i,t}$. They are discussed conceptually below; the data used in the estimations are explained in Annex 1.

As stressed by the endogenous growth literature, the accumulation of R&D knowledge is an important source of output growth. Our measure of MFP growth accounts for what cannot be explained by the accumulation of physical capital and labour. In this respect, the growth of the R&D knowledge stock is part of MFP growth. Following Griffith *et al*. (2001) and Scarpetta and Tressel (2002), we include R&D intensity as an explanatory variable. Assuming a small rate of depreciation of this knowledge stock, its growth is mostly determined by R&D investment. This allows using R&D investment to capture the growth of R&D intensity. To avoid endogeneity problems of current R&D investment, we use lagged R&D investment as an explanatory variable. Similarly, public capital has been shown to exert some influence on growth (see Romp and de Haan 2005), so we include it as another explanatory variable. Since physical capital measures only include private capital, the effect of productive public capital is included in our MFP measure. Hence, we include the growth of public capital as an additional variable.

Scarpetta and Tressel (2002) find that product market regulation (PMR) and employment protection legislation (EPL) have a significant (negative) impact on MFP growth rates. We therefore introduce

PMR and EPL indicators for the different countries. Specifically, we use an indicator of administrative barriers (ADMIN) to proxy for PMR in the manufacturing sector (see Annex).

Other factors, such as the quality of human capital and industry structure are believed to be reasonably stable over the estimation period within individual countries and will hence be captured via the introduction of country dummies.

Due to the relatively small data set, we do not introduce time dummies. The results of Smolny (2002) suggest that a large part of the annual fixed effects can be captured by introducing a dummy for the business cycle.[6] We use the EU-15 output gap as a proxy for the business cycle to capture these effects.

Consequently, the final model specification reads as follows:

$$(3) \qquad \Delta ln\, A_{i,t} = \beta_1 \Delta ln\, A_{F,t} + \beta_2\, ln(A_{i,t-1}/A_{F,t-1}) + \beta_3\, (AID_{i,t-1}/VA_{i,t-1}) + \\ +\beta_4\, (R_{i,t-1}/VA_{i,t-1}) + \beta_5\, ADMIN_i + \beta_6\, EPL_{i,t} + \beta_7\, (Y_t - Y_t^*)/Y_t^* + \delta_i + \varepsilon_{i,t}$$

Similar to equation (2), in equation (3), we would expect $\beta_1 > 0$ and $\beta_2 < 0$, with $\beta_1 \Delta ln A_{F,t}$ and $\beta_2 ln(A_{i,t-1}/A_{F,t-1})$ capturing technology diffusion and catch-up, respectively. *AID* denotes state aid as a share of manufacturing value added (*VA*); *R* denotes R&D intensity, *ADMIN* is a time-stable indicator to proxy for product market regulation, *EPL* a time-varying indicator for employment protection legislation, and *(Y-Y*)/Y** denotes the EU-15 output gap; δ is a country fixed effect; and ε an i.i.d. shock.

3.2 Measurement of vertical aid

In the manufacturing sector, four sub-sectors are eligible for so-called sectoral aid under specific aid schemes: steel, shipbuilding, synthetic fibres, and motor vehicles. Additionally, aid for rescue and restructuring is considered vertical state aid to the manufacturing sector.

Only Ireland and Portugal extend a significant amount of state aid to manufacturing using vertical instruments.

Overall, total state aid to manufacturing (including that with horizontal objectives) dropped from €44 billion in 1995 to €29 billion in 2003. This decrease was almost exclusively due to a drop (of €13 billion) in vertical aid directed to the manufacturing sector, which amounted to only €1.3 billion in 2003. As a result, the share of state aid with horizontal objectives in aggregate aid to manufacturing increased from 68 percent in 1995 to 94 percent in 2003. Only two states channel a significant amount of their state aid to the manufacturing sector through vertical instruments: Ireland (68 percent) and Portugal (91 percent).

However, a closer look at so-called 'state aid with horizontal objectives' for the manufacturing sector reveals some interesting details. First, about 96 percent of total state aid for horizontal objectives is awarded to the manufacturing sector (average 1995-2003)[7]. The share of manufacturing in total horizontal aid ranges from around 80 percent in Sweden and Portugal to almost 100 percent in the United Kingdom, Finland, and Greece.

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6 In a cross-sectoral study on sources of productivity growth in Germany by Smolny (2000), the introduction of time dummies did not affect R^2. But it reduced the influence of a proxy for business cycle by half and rendered it insignificant, indicating that a large part of the fixed time factor is captured by a business cycle proxy.

7 This figure decreased from 97 percent in 1995 to 94 percent in 2003. But in interpreting this figure one should bear in mind that the apparently high share of manufacturing 'state aid with horizontal objectives' might also be due to measurement difficulties when attributing state aid volumes to different sectors. Concerning the sectoral distribution, European Commission (2005, p.15) states: "The data currently available do not provide an accurate picture of the final recipients of the aid. Nevertheless, they do give some indication as to which sectors are favoured by each Member State."

Second, as mentioned in Section 1, state aid is always classified by the European Commission as horizontal when its primary objective is horizontal. However, there are numerous cases of state aid where the primary objective is horizontal, but the aid is limited to a certain industry, sub-sector, or sector.[8] In these cases there appears to be a mixture of horizontal objectives with vertical orientation of the aid. The data published in the State Aid Scoreboard does not allow distinguishing between horizontal aid designed for all sectors and horizontal aid awarded only to specific industries, sub-sectors, or sectors.

An indicator of the extent to which Members States are able to provide vertical state aid in the form of horizontal aid can be obtained from the pattern of, for example, Spanish aid notifications between 1993 and 2005. During this period, Spain submitted around 305 notifications of state aid, the major part of which were notified as aid to investment, to SMEs, to training, or as regional aid. Aid to investment constituted the main objective in 21 cases, 9 of which were explicitly targeted towards specific sectors. Of the 44 notifications of state aid with regional support as primary objective, 22 were targeted at specific sectors, sub-sectors or firms. And then, of the 60 cases notified as SME support as primary objective, 22 were sector-, sub-sector-, or firm-specific.

State aid labelled 'horizontal' can, in fact, be horizontal or vertical aid.

We conclude that state aid labelled as 'horizontal' at the aggregate level for the manufacturing sector can, in fact, be horizontal or vertical state aid. Considering only aid labelled as sectoral (i.e., aid for steel, shipbuilding, synthetic fibres and motor vehicles as well as rescue and restructuring aid) surely underestimates the actual amount of vertical aid. That said, considering all aid to the manufacturing sector as vertical most likely overestimates the actual amount of vertical state aid. In the empirical analysis we will therefore analyse the effects of aid labelled as sectoral and of total state aid to the manufacturing sector.

As about 20 percent of total state aid is in favour of R&D and because such aid affects R&D intensity – another explanatory variable in model (3) – in an unknown way, the inclusion of both total state aid and R&D intensity as explanatory variables would bias the estimation results. A possible solution to this problem is to replace R&D intensity with a function of its determinants, which would include aid for R&D in the manufacturing sector as an unobservable, and to use total aid as the measure for vertical state aid. In this case, the effect of the unobserved R&D aid would be captured by the coefficient of total aid. Due to data constraints, however, we have chosen to include both variables and perform robustness checks by replacing business R&D with a measure of the business R&D component financed by industry alone.

3.3 Endogeneity of state aid

There is a possibility that vertical aid is more likely to go to industries or firms with a particular level of productivity than to other industries or firms. For instance, if the policy objective is to pick winners, vertical aid might overwhelmingly go to high-productivity industries or firms. By contrast, if the objective is to support losers (with a view to helping them to adjust to a changing environment, for instance), aid might largely go to low-productivity industries or firms. In this sense, one cannot say that state aid is exogenous with respect to productivity growth. We thus have to distinguish the effect of state aid on productivity growth from the correlation between these two variables, which follows from the objective of awarding aid in the first place. Hence, instrumental variables are used

8 To give a few examples: state aid case NN15/2000 – UK, Civil Aircraft Research and Technology Demonstration Programme is considered a horizontal R&D measure although directed exclusively at the civil aviation industry; state aid case N443/1999 – Germany, R&D Aid to Institut für Solare Technologien, GmbH is classified as R&D aid and is exclusively awarded to support research of photovoltaics technology; state aid case N74/2005 – Sweden, Environmental Aid to Volvo Truck Corporation is classified as environmental aid and is exclusively awarded to foster environmental measures in the motor vehicles industry; state aid case XS118/2003 – Germany, Polenbürgschaft is classified as an SME block exemption case; however, it is exclusively awarded to the industrial machinery sector in Brandenburg, Eastern Germany.

to estimate the effect of state aid on productivity growth, controlling for the fact that productivity growth may itself determine the amount of aid.

We have used two types of instruments. First, political-economy variables have been used, as political characteristics of a country are likely to determine the willingness to extend aid to particular sectors – either because some political parties care more about equity/efficiency than others or because certain governmental structures are more prone to capture by interest groups. Second, state aid to other sectors have been used, as the willingness to grant aid can also be inferred from the observation of the level of aid granted to other sectors of the economy. These aids are correlated with aid to manufacturing and awarded independently of the productivity of the manufacturing sector. They are thus good potential instruments.

4. Estimation results

4.1 Some descriptive statistics

The computation of MFP levels and growth rates according to the methodology described in Box 1 yields the results summarised in Table 1. We also present the sample means of the state aid variables.

As Table 1 illustrates, among EU-15 countries, France is closest to the technological frontier in the manufacturing sector, which is determined by Canada and the United States during the sample period. The group of countries farthest away from the frontier include Italy, Denmark, and Spain. Nordic countries experienced the highest MFP growth rates, whereas Spain and the United Kingdom show average MFP growth close to zero.

Among EU-15 countries, France is closest to the technological frontier in the manufacturing sector.

Table 1. Descriptive statistics on MFP, MFP growth, and state aid

	MFP growth (%)		Distance to frontier (% of technology level of leading country)		Vertical state aid to manufacturing (% of value added)		Total state aid to manufacturing (% of value added)	
	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation
Austria	1.73	0.0244	75.1	0.0142	0.10	0.0015	1.37	0.0019
Belgium	1.60	0.0231	82.3	0.0214	0.28	0.0043	2.23	0.0054
Denmark	1.47	0.0430	63.8	0.0186	0.07	0.0011	4.49	0.0101
Finland	5.35	0.0325	75.7	0.0819	0.08	0.0013	1.75	0.0038
France	2.61	0.0232	90.8	0.0321	0.39	0.0026	2.10	0.0050
Germany	1.36	0.0236	77.1	0.0215	1.18	0.0115	3.65	0.0117
Greece	n.a.	n.a.	n.a.	n.a.	0.78	0.0146	7.18	0.0444
Ireland	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Italy	0.56	0.0293	67.1	0.0324	0.68	0.0071	4.58	0.0241
Luxembourg	n.a.	n.a.	n.a.	n.a.	0.00	0.0000	2.56	0.0087
Netherlands	0.45	0.0290	82.4	0.0380	0.08	0.0005	1.23	0.0017
Portugal	n.a.	n.a.	n.a.	n.a.	0.63	0.0075	1.86	0.0077
Spain	0.24	0.0135	63.5	0.0348	1.08	0.0098	2.74	0.0088
Sweden	3.49	0.0371	86.4	0.0520	0.00	0.0000	0.77	0.0059
UK	0.11	0.0210	86.9	0.0786	0.01	0.0002	0.79	0.0015

Notes: Based on 1992-2003 data (1995-2003 for state aid data for Austria, Finland, and Sweden); Mean = period average; n.a. = not available due to missing data either on capital stocks or value added.

Germany and Spain grant most vertical state aid in relation to manufacturing value added.

Germany and Spain stand out as the countries granting most vertical state aid in relation to value added in the manufacturing sector. Given their moderate total state aid, it seems that these two countries award a large part of state aid to manufacturing through vertical instruments. By contrast, Denmark awards the majority of its state aid, which is considerable, in the form of horizontal aid. Finally, Sweden and the United Kingdom appear to support their manufacturing sectors least among the sample.

It is also helpful to examine the correlation between state aid and MFP growth rates across the different countries. The correlation coefficients are shown in Table 2. With regard to vertical aid, correlation coefficients show both positive and negative relationships. Overall, however, there seems to be a weak positive correlation between vertical state aid and the growth rate of MFP in the next period for the countries extending significant amounts of vertical aid. This positive relationship is a little more obvious for total state aid, though it is still negative for countries with low levels of total state aid. Spain stands out as the single case of high levels of total state aid associated with a negative correlation with MFP growth.

Table 2. Correlation between state aid in a year and MFP growth in the following year

	Vertical state aid	Total state aid
Austria	0.0126	0.1913
Belgium	0.4009	0.5515
Denmark	-0.0818	0.2509
Finland	-0.2368	0.0323
France	0.5225	0.3284
Germany	0.1881	0.2946
Italy	0.5116	0.3192
Netherlands	-0.3249	-0.2859
Spain	-0.2403	-0.1820
Sweden	--	-0.2373
United Kingdom	0.0098	-0.3163

Note: Correlation between state aid at time *t-1* and MFP growth in *t*.

4.2 Results

Table 3 presents the results of the baseline specification of the model[9]. When the error correction model is estimated without controlling for any of the possible alternative determinants of MFP

9 As the estimation of an error correction model presupposes the existence of a cointegrating relationship between the levels of MFP in each country and the frontier country, one needs to test for cointegration. However, the test would require knowledge of the absolute levels of MFP, which we do not observe, since only levels relative to other countries can be computed. As a less formal test, we performed unit root tests on the MFP growth series and report serial correlation tests for the error terms of the regressions. In addition, we performed Levin-Lin and Im-Shin unit root tests for panel data on the MFP growth of the non-frontier countries. The presence of a unit root was rejected in both tests at the 1-percent level. For the frontier, we used the Dickey-Fuller test with a MacKinnon p-value of 0.073.

growth (column 1), the estimated coefficient (β_2 in equation (3)) for the technological gap (i.e., *RMFP*) is negative as expected, but statistically not significant. On the other hand, technological diffusion, β_1 in equation (3), from the frontier country (i.e., $\Delta MFP_{Frontier}$) appears to be strong and statistically significant.

Fixed effects (introduced in column 2), which control for any unspecified and country-specific variables, are significant for only some countries, with the reference country being the United Kingdom.

Column (3) shows the results when including the output gap (*Output gap EU*), R&D intensity (*R&D/VA*), and the growth of public capital (*gkpub*)**.** With this specification, the coefficient of the technological gap becomes significant and increases (in absolute terms) to -0.175; the technological diffusion coefficient increases and remains significant. We can also see the direct effects of the control variables: R&D intensity appears to have a positive, statistically significant impact on MFP growth, while the impact of the output gap and of public capital is negative – although for the latter control variable, the estimated coefficient is not statistically significant. Fixed effects for Finland and Sweden become insignificant, while a negative fixed effect for Denmark appears significant at the 5-percent level. This may indicate that Finland and Sweden were able to maintain higher MFP growth rates with respect to the United Kingdom due to relatively higher levels of R&D intensity.

Column (4) shows estimation results when we allow for interaction between R&D intensity and the technological gap. The coefficient is negative, suggesting that the effect of R&D spending is the stronger the farther away a country is from the technological frontier. However, contrary to Griffith *et al*. (2001), we cannot find any evidence for this interaction term being significant. This also implies that in our estimates R&D does not affect the speed of convergence.

This study suggests somewhat faster technology diffusion and productivity convergence than some earlier studies.

When compared to other studies, our estimates of the diffusion and convergence parameters appear somewhat higher, especially the diffusion estimate. In particular, the diffusion coefficient as estimated by Griffith *et al*. (2001) is around 0.13 and that of Scarpetta and Tressel (2002) is not significant for manufacturing industries. This compares to our estimate of around 0.5 to 0.6, which hold across the specifications presented in the different tables. The estimates for the convergence parameter vary between -0.07 and -0.097 in Griffith *et al*.[10] and between -0.02 and -0.05 for the manufacturing sectors in Scarpetta and Tressel. In our study, the estimate is about -0.175 for the baseline specification. Those two studies use industry-level data and estimate the same parameters for all industries. Our study uses aggregate manufacturing data, and this implies that the parameter estimate is like an unweighted average of the effects of specific industries, and may incorporate diffusion effects across industries.

10 The estimate decreases to around -0.02 when interaction terms with other variables are included.

Table 3. Baseline specifications of the MFP growth model

Variable	(1)	(2)	(3)	(4)
Austria		0.0069	0.0000	0.0000
Belgium		0.0095	0.0045	0.0045
Denmark		-0.0012	-0.0373**	-0.0373 **
Finland		0.0340***	0.0192	0.0192
France		0.0234***	0.0271**	0.0271 **
Germany		0.0045	-0.0144	-0.0144
Italy		-0.0082	-0.0168	-0.0168
Netherlands		-0.0011	0.0014	0.0014
Spain		-0.0123	-0.0181	-0.0181
Sweden		0.0252**	-0.0034	-0.0033
$\Delta MFP_{Frontier,t}$	0.5171***	0.5348***	0.6260***	0.6259 ***
$RMFP_{i,t-1}$	-0.0008	-0.0414	-0.1751***	-0.1748
Output gap EU			-0.0079**	-0.0079 **
$R\&D/VA_{i,t-1}$			0.6873**	0.6864
$R\&D/VA_{i,t-1}$ x RMFP				-0.0040
gkpub			-0.3151	-0.3154
_cons	0.007	-0.0115	-0.0770***	-0.0769 **
Statistics				
Observations	131	131	100 (b)	100 (b)
Adjusted R^2	0.239	0.363	0.455	0.448
Serial correlation		2.183	2.252	2.443

Notes: Robust standard errors are used due to presence of heteroscedasticity. Serial correlation is Bhargava *et al.* modified DW for balanced panels (b) and Baltagi-WU LBI for unbalanced panels. *** (**) [*] indicates that the coefficient is significant at the 1% (5%) [10%] confidence level.

Next, we analyse the effect of state aid on manufacturing MFP. As discussed earlier, total state aid to manufacturing includes aid awarded to R&D objectives and, thus, estimated coefficients are likely to be biased. To mitigate the possible bias in the coefficients, we have replaced R&D intensity by privately funded R&D. Table 4 shows the estimation results for the effect of vertical state aid, as classified by the European Commission (that is, for sectoral state aid). Three different specifications are estimated, for which we present both weighted OLS and instrumental variables GMM estimates.

We considered two possible sets of instruments: political economy variables and state aid intensities in other sectors of the economy. The political variables we considered as potentially correlated with state aid were the number of years in office for the political party of the head of government, the ideology of the party in office (left-wing, right-wing, or centre), a measure of the strength of the government (where weaker governments are considered to be those formed by a large number of parties with few seats in the parliament), the number of seats of the government in the parliament, a measure of the strength of the opposition (defined as in the case of the governing majority), and the number of seats of the opposition. With respect to aid to other sectors of the economy, we considered state aid awarded to coal, financial services, transport, other non-manufacturing sectors, and to other services.

State aid to other sectors does not affect aid to manufacturing.

State aid to other sectors of the economy do not seem to explain state aid to manufacturing given the rest of exogenous regressors; first stage regression results yield insignificant coefficients for these instruments. Only aid to other non-manufacturing sectors seems to be significant. Nevertheless,

it loses its significance once the other political economy variables are added to the estimation. Therefore, state aid to other sectors of the economy cannot provide any new relevant information to explain the intensity of state aid to manufacturing over and above what is provided by political variables.

Table 4. The effect of vertical state aid on MFP growth

	Specification (1)		Specification (2)		Specification (3)	
Variable	WLS	IV GMM	WLS	IV GMM	WLS	IV GMM
Austria	0.0000	…	0.0000	…	0.0000	…
Belgium	-0.0045	-0.0067	0.0000	…	0.0263	0.0241
Denmark	-0.0351	-0.0319	-0.0505**	-0.0462**	-0.0274	-0.0262
Finland	0.0072	0.0050	0.0019	0.0002	0.0167	0.0119
France	0.0210	0.0163	0.0192	0.0164*	0.0539**	0.0497**
Germany	-0.0308*	-0.0404**	-0.0328**	-0.0371***	-0.0078	-0.0106
Italy	-0.0194	-0.0236	-0.0270	-0.0256	0.0000	…
Netherlands	-0.0018	-0.0047	-0.0320*	-0.0338**	-0.0087	-0.0144
Spain	-0.0216	-0.0316	-0.0510*	-0.0541**	-0.014	-0.0176
Sweden	-0.0125	-0.0128	-0.0468*	-0.0468*	-0.0067	-0.0124
$\Delta MFP_{Frontier,\ t}$	0.5576***	0.5411***	0.5144***	0.4987***	0.5420***	0.5252***
$RMFP_{i,\ t-1}$	-0.1425**	-0.1346**	-0.1508**	-0.1401***	-0.1421**	-0.1374**
$R\&D/VA_{i,\ t-1}$	0.8347**	0.8100**	0.8771***	0.8748***	0.8134**	0.8396***
gkpub	-0.4038	-0.3339	-0.3202	-0.2042	-0.3841	-0.2660
Output gap EU	-0.0053	-0.0035	-0.0001	0.0009	-0.0029	-0.0024
$AIDV/VA_{i,\ t-1}$	0.8280*	1.5728**	0.4918	0.9051	0.8684**	0.8679*
EPL_{t-1}			0.0289**	0.0272***		
ADMIN			-0.0260**	-0.0252***	-0.0249	-0.0253
EPL_{t-1} (med)					0.0318	0.0336
EPL_{t-1} (high)					0.0525	0.0559
_cons	-0.0645***	-0.0616***	-0.0694***	-0.0663***	-0.0501**	-0.0496***
Statistics						
Observations	88	88	88	88	88	88
Adjusted R^2	0.354	0.333	0.407	0.399	0.380	0.369
Serial correlation	2.500	2.500	2.558	2.558	2.525	2.525

Notes: See notes to Table 3. Note further that the instrumental variables (IV) used are: (i) the number of years the party of the chief executive of the government has been in office; (ii) the composition of the government; and (iii) the ideology of the party dominating the government.

Political variables appear then to be the most suitable instruments. Among them, those that appear to jointly better explain the level of state aid, while being uncorrelated with MFP growth[11], are the following: the number of years in office for the political party of the head of government (positive effect), the composition of the government (weaker governments awarding higher levels of aid), and the ideology of the party dominating the government (centrist parties awarding less aid than

11 Shea partial R^2 of the excluded instruments ranges between 0.26 and 0.38, depending on the specification. This is a measure of the adequacy of the instruments to explain the endogenous variable. The absence of correlation between the instruments and MFP growth was assessed through over-identifying restriction tests. All specifications presented in the tables passed the test, meaning that the hypothesis of exogeneity of the instruments could not be rejected.

the rest). These results are in line with the characteristics of governments more prone to capture. The longer a party is in power, the higher is the probability of links with representatives of the different industries. At the same time, weaker governments are formed by small pivotal parties, which can have some lobbying power to implement the measures that please their electorate. Finally, centrist parties are perhaps those whose ideology is less oriented towards particular pressure groups.

Specification (1) shows the estimates obtained for the baseline model with the controls and the vertical state aid variable (*AIDV/VA*). Results show a positive and significant effect of vertical aid on manufacturing productivity: an extra percentage point of vertical state aid generates approximately 0.83 percentage points (0.0083 = 0.828 * 0.01) of MFP growth in the manufacturing sector. It also turns out that when political variables are included as instruments, the magnitude of the vertical-aid coefficient more than doubles. This result holds also for total state aids (see Annex Table A1).

Recall that the OLS estimate of the aid coefficient is the sum of the true parameter plus a bias term, whose sign is given by the covariance between the lagged values of vertical aid and the error term in the equation describing MFP growth. Taking the coefficient of the IV estimates as a consistent approximation of the true coefficient, we conclude that the OLS estimate is biased downwards and, hence, the covariance is negative. We would like to infer from this covariance the sign of the MFP growth parameter in the equation determining the level of vertical aid: that is, whether aid goes to 'winning' or 'losing' sectors. Unfortunately, this is not possible without estimating a model for state aid. Although the expression for the covariance depends on the particular specification of this model, both positive and negative values of the coefficient are compatible with a negative covariance.[12]

The effect of vertical state aid on manufacturing productivity appears positive.

Specification (2) adds to the model the indicator on employment protection legislation (EPL) and that of administrative regulation (ADMIN), which proxies product market regulations. The effect of vertical state aid is again estimated to be positive, but becomes insignificant even after correcting for endogeneity. Administrative regulations have a negative and significant effect on MFP growth. However, we also find a positive and significant effect of employment protection, contrary to the findings of Scarpetta and Tressel (2002). A categorisation of the EPL indicator into three possible levels[13], taken into account by specification (3), seems to suggest that the positive effect of employment protection comes from countries with higher levels of employment protection[14], though the results are not statistically significant. Vertical state aid becomes again significant with this specification, although its magnitude and the bias of the OLS estimate seem to be smaller and almost negligible.

We estimated yet another specification with a categorisation of vertical state aid into low, medium, and high. More specifically, countries with no vertical state aid were classified as having low vertical aid. Countries with a level of vertical aid one standard deviation above the mean were classified as high-vertical-aid countries. The categorisation was time varying, and we took advantage of the fact that there are countries in the sample with no vertical aid in some years and a positive level in other years. Unfortunately, the correlation of the instruments at hand with the outcome of this

12 Consider, for example, the following linear specification for state aid: $AIDV_t = \mu\ AIDV_{t-1} + \alpha\ political_t + \delta\ gMFP_t + u_t$. The expression for the covariance between $AIDV_{t-1}$ (which appears in equation (3)) and the error term ε_t in equation (3) then is: $Cov(AIDV_{t-1}, \varepsilon_t) = -[\delta/(\mu+\delta\beta_3)]\ Var(\varepsilon_t)$. We can see that a negative covariance is compatible with positive and negative values of δ depending on the magnitudes of the other parameters in the equation. However, if we assume that $0<\mu<1$, it is easily seen that the true sign of β_3 is inversely related to the sign of the covariance, which means that not taking into account the endogeneity leads to underestimates of the true parameter.

13 Low-EPL (high-EPL) countries are those with an EPL indicator more than one standard deviation below (above) the sample mean; the remaining countries have been categorised as intermediate-EPL countries.

14 High employment protection could favour MFP growth if protection fosters workers' investment in firm-specific knowledge and skills.

categorisation was not significant. Hence, instrumental variable estimation was not possible for this specification. While we do not show even the results of the OLS estimation, suffice it to mention that these results pointed to a negative effect of vertical aid on MFP growth for medium levels of vertical aid, but a positive effect for high aid levels. Nevertheless, none of the estimates was significant and we cannot exclude the possibility that the bias of the OLS coefficients is underestimating a positive effect in both categories.

The effect of total state aid on manufacturing productivity is also positive.

A similar exercise has been performed using total state aid to manufacturing rather than only vertical aid. The results are presented in detail in Annex Table A1. Suffice it to note here that they are similar to those for vertical state aid. However, the significance of the results is stronger – possibly because total state aid to manufacturing has not fallen, thus avoiding a downward trend in the data that hinders identification. What is more, except for specification (1), i.e., the one that does not control for product market regulation and employment protection legislation, the impact of total aid to manufacturing on MFP growth appears to be higher than the impact of vertical aid. Depending on the specification, an extra percentage point of total state aid intensity yields between 0.76 and 1.05 percentage points of MFP growth.

As a final step in the analysis, we return to the impact of vertical aid on MFP growth and consider specifications where the potential effect of aid depends not only on the level of aid, but also on the distance of any particular country from the technological frontier. Technically, this implies interacting the regressors *RMFP* and *AIDV/VA*. Unfortunately, the limited sample size implies that such a more elaborated specification is harder to estimate precisely. The results we obtain (not shown) add therefore little information to our main conclusions.

To summarise the main findings discussed in this section, our results point to a positive effect of pure vertical state aid on productivity growth in manufacturing. This effect cannot be attributed to the possibility that governments might tend to extend aid to sectors with higher productivity, as we have accounted for any endogeneity there may be between productivity and aid. Nevertheless, independently of the rule followed by governments, there is some evidence that productivity has grown faster the more aid was extended in the previous period. It is also possible that the effect of state aid lasts longer than a single period. However, the short dimension of our panel prevents us from exploring a richer structure for the lagged effects of state aid.

The effect of vertical aid, as classified by the European Commission, provides an estimate for the worst-case scenario since efficiency arguments in favour of such aid are weak. This estimate is positive and significant for the majority of specifications. In turn, total state aid data provides the best-case scenario, given that it includes aid that can be justified on efficiency grounds. In this case, the results are more significant and seem to indicate that the positive effects are reinforced, possibly through a positive impact of state aid on R&D intensity.

With regard to the model proposed, it yields robust estimates for the diffusion of technology (0.5), for the speed of convergence (around -0.15), and for R&D (0.8). The estimated aid coefficient is not as robust, varying in magnitude and significance with different measures of employment protection legislation (EPL). In general, when controlling for EPL, the effect of state aids decreases (becoming non-significant for some specifications). Aid, EPL, and PMR all measure different aspects of state intervention, and a challenge for further work will be to more clearly separate out the impact of aid from other intervention. This would surely call for a structural analysis of the joint determination of the allocation rule for state aid and productivity growth.

Our results have to be interpreted with caution, however, given the short dimension of our panel. Better estimates for private capital stocks should enable us to use the information on state aid for all EU-15 countries. This would include Ireland and Portugal, two countries where the share of vertical state aid in total aid is among the highest in the sample. Moreover, a longer time series would allow us to better capture the influence of common shocks through the use of time dummies and to define a better lag structure for the state aid variable.

5. Conclusions

Sectoral aid and aid for rescue and restructuring are two examples of vertical state aid, that is, aid extended to specific firms or industries. Horizontal state aid, in contrast, is in principle extended in support of broad economic goals (such as R&D, environmental protection, energy savings, promotion of SMEs, and so on) independently of sector. Similarly, regional aid aims at supporting all activities in lagging regions. The European Commission has recognised that vertical aid is "likely to distort competition more than aid for horizontal objectives and also tend to favour objectives other than identified market failures" (European Commission 2005, p.20). As a consequence, the Commission is encouraging Member States to reduce this type of aid.

Existing evidence concerning the effectiveness of vertical state aid is scarce and points to vertical aid resulting in rent shifting in the short term. With respect to rescue and restructuring aid, the only study existing to our knowledge indicates that firms in difficulty seem to partly close the productivity gap *vis-à-vis* other firms. Some studies using a broader definition of aid suggest that state aid may raise the productivity of subsidised firms in the short-term compared to that of non-subsidised ones. However, in the medium- to long run, the effect becomes negative.

Using a model of productivity convergence across countries, we have assessed the effects of vertical state aid in the manufacturing sector. There are several variables that could be used as a measure of performance on which to assess the effects of state aid. However, productivity appears to be the most important given the ultimate relationship between productivity and economic growth. We focus on the manufacturing sector because of the measurement problems that characterise non-manufacturing industries. Moreover, manufacturing is footloose in nature and thus more likely to receive vertical state aid.

Overall, the results point to a positive, significant effect of vertical state aid on productivity growth.

Following our discussion about the possible use of horizontal aid to extend what is *de facto* vertical aid, we consider vertical aid as representing the worst-case scenario of the effects of state aid on productivity. Total state aid, on the other hand, is considered to represent the best-case scenario. Overall, our results point to a positive, significant effect of vertical state aid on productivity growth. The best-case estimates are even more significant, which seems to indicate that the positive effect is reinforced, possibly through a favourable impact of state aid on R&D intensity. Nevertheless, given the correlation with other state interventions, further research on a structural model of state aids seems worthwhile.

Although our results have to be interpreted with caution, they seem to contradict the view that the efficiency justification for sectoral and rescue aid is weak. Indeed, they support the task of the European Commission to focus monitoring efforts on potentially distortionary state aid.

Annex

Data sources

Since state aid data are available on an aggregate basis, the manufacturing sector has to be modelled as a whole. Panel data are used for 11 EU Member States[15] for 1992-2003. The data set is unbalanced due to missing observations and because Austria, Finland, and Sweden entered the EU only in 1995.

Output. We use value added figures from the OECD STAN database (Vol. 2005) for the manufacturing sector. It is customary to use a value added concept for output in the convergence literature since the analysis includes industries with different levels of vertical integration (Schreyer and Pilat 2001).

Capital stock. We use fixed capital stock data from the OECD STAN database (Vol. 2005) for the manufacturing sector. Where data were missing, the fixed capital stock series were estimated with the help of gross fixed capital formation data using the perpetual inventory method.[16] The impact of capital utilisation on the measurement of MFP convergence is an issue in the convergence literature. Griffith *et al*. (2001) adjust capital stock for utilisation by using a smoothed output series, but find no significant impact on their results. Hence, we use unadjusted capital stock.

Labour input. Following Griffith *et al*. (2001) we use the number of people employed from the OECD STAN database (Vol. 2005) as a base measure. We also use total hours worked from the ILO database. Griffith *et al*. (2001) and Scarpetta and Tressel (2002) test for the robustness of their findings using hours worked instead of the number of people employed. They also make adjustments for different skill levels among countries and industries. However, neither modification has a significant impact on their results.

Purchasing power parity. A measure of purchasing power parity (PPP) is needed to convert the value of production into common units while taking into account differences in the purchasing power of each country's currency. To take into account that relative prices might evolve differently across countries, the most recent convergence literature uses industry-specific expenditure PPPs rather than GDP PPPs[17]. However, Scarpetta and Tressel (2002) run a sensitivity analysis on the use of GDP PPPs and find that their results are not significantly altered. Since we are only looking at the manufacturing sector as an aggregate and in a rather homogenous set of countries (EU-15), our baseline estimate uses GDP PPPs taken from the OECD.

Labour share in value added. Data on the labour share in value added are taken from the OECD STAN INDICATORS database.

State aid. Data on state aid are reported as aid to the manufacturing sector in percent of value added. They have been taken from the online version of the State Aid Scoreboard of the European Commission.

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15 Ireland, Luxembourg, and Portugal were dropped from the EU-15 sample due to the short series on gross capital stock formation, which yielded poor estimates of their private capital stocks.

16 See Scarpetta and Tressel (2003) and OECD (1999) for a description of the perpetual inventory estimation method. For estimating average service lives (ASL), data in OECD (1999) were used, taken from OECD (1993). For countries where no ASL data were available, the average of similar neighbouring countries was considered an adequate proxy.

17 See for example Griffith *et al.* (2001), Nicoletti and Scarpetta (2003), and Scarpetta and Tressel (2002). Kolasa and Zólkiewski (2004) use GDP PPPs when analysing the determinants of MFP for Poland and estimating convergence towards Germany.

R&D. Data on R&D intensity are drawn from the OECD ANBERD (Vol. 2004) database. R&D intensity is defined as the ratio of Business Expenditure in Research and Development (BERD) to value added. This database, combined with information from the Main Science and Technology Indicators (MSTI), also from the OECD, enables us to divide the business expenditure on R&D into privately financed and publicly financed.

Public capital. Data on public capital are taken from Kamps (2005). The data covers the period 1960-2001 for 22 OECD countries.

Regulation indicators. Indicators on product market regulation and employment protection legislation are taken from Boylaud *et al*. (2000). We proxy product market regulation for the manufacturing sector using the economy-wide aggregate indicator of administrative regulations (ADMIN), following the reasoning in Scarpetta and Tressel (2002)[18]. The indicator of administrative regulations measures barriers to private entrepreneurial activities, such as administrative burdens for entrepreneurial activity as well as regulatory and administrative opacity (e.g., complexity of rules and procedures for licenses and permits). The indicator was calculated for 1998 and is assumed to be time constant. This probably underestimates efforts for European-wide harmonisation of rules and regulations; however, significant differences in their implementation and administrative processes still persist. For employment protection legislation (EPL), indicators are available for 1990 (for the late 1980s) and 1998; they include both regulations for regular and temporary contracts. The EPL indicator used in the econometric analysis is time varying (1990 and 1998); missing data have been estimated with the help of the compilation of changes in legislation reported in the table 'EPL time series breaking points', OECD Employment Outlook 2004, Chapter 2, Annex.

Output gap. Data on EU-15 potential output, and the output gap as the difference between actual and potential output, are from the AMECO database of the European Commission.

Political economy variables. We use the 2005 update of the DPI2004 database of Political Institutions compiled for the World Bank, which provides data for a large number of countries from 1975 to 2000. From 2000 onwards, data have been updated using the sources cited in the database when possible and official sources for parliamentary elections in European countries.

18 Scarpetta and Tressel (2002) choose this proxy "because it refers to norms and regulations that are applied to all industries, while the overall indicator also includes economic regulations some of which are more sector specific, and do not apply to the manufacturing industries" (footnote 13, p.15).

Table A1.The effect of total state aid on MFP growth

	Specification (1)		Specification (2)		Specification (3)	
Variable	WLS	IV GMM	WLS	IV GMM	WLS	IV GMM
Austria	0.0000	…	0.0000	…	0.0000	…
Belgium	-0.0065	-0.0116	0.0000	…	0.0363*	0.0403**
Denmark	-0.0519**	-0.0599***	-0.0620**	-0.0636***	-0.0413*	-0.0431**
Finland	0.0067	0.0078	0.0015	0.0081	0.0226	0.0214
France	0.0213	0.0128	0.0214*	0.0201**	0.0662***	0.0651***
Germany	-0.0297	-0.0409***	-0.0310**	-0.0346***	0.0036	-0.0016
Italy	-0.0351	-0.0552***	-0.0357**	-0.0463**	0.0000	…
Netherlands	-0.0036	-0.0036	-0.0335*	-0.0249	-0.0072	-0.0130
Spain	-0.0278	-0.0311	-0.0574**	-0.0481**	-0.0110	-0.0071
Sweden	0.0013	0.0053	-0.0358	-0.0223	0.0116	0.0048
$\Delta MFP_{Frontier,\ t}$	0.5623***	0.5032***	0.5298***	0.4831***	0.5498***	0.4913***
$RMFP_{i,\ t-1}$	-0.1592**	-0.1124*	-0.1746***	-0.1260**	-0.1589**	-0.1039*
$R\&D/VA_{i,\ t-1}$	0.7117**	0.5280	0.8140***	0.6299*	0.7233**	0.6564**
gkpub	-0.3631	-0.3663	-0.2746	-0.3278	-0.2973	-0.1764
Output gap EU	-0.0060	-0.0021	-0.0011	0.0015	-0.0039	-0.0004
$AID/VA_{i,\ t-1}$	0.3585	1.0458***	0.1366	0.7626**	0.3597	1.0071**
EPL_{t-1}			0.0290**	0.0233*		
ADMIN			-0.0265**	-0.0233**	-0.0307	-0.0406**
EPL_{t-1} (med)					0.0337	0.0485
EPL_{t-1} (high)					0.0493	0.0540
_cons	-0.0651***	-0.0544***	-0.0718***	-0.0591***	-0.0493**	-0.0373*
Statistics						
Observations	88	88	88	88	88	88
Adjusted R^2	0.375	0.302	0.424	0.368	0.392	0.339
Serial correlation	2.476	2.476	2.558	2.558	2.475	2.475

Notes: See notes to Table 4.

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ABSTRACT

This paper critically examines the role of industrial policy in the economic development of East Asian countries with a view to drawing lessons for other countries, especially European ones. *It describes the evolution of industrial policies in Japan, Korea, Taiwan, and Singapore and evaluates the East Asian industrial policy experience – in general and in relation to the East Asian miracle, the 1997 financial crisis, and the Japanese stagnation since the 1990s. In drawing lessons for other countries, the paper discusses the transferability of the 'East Asian model' – or any other economic model – to other countries and highlights the determinants of industrial policy successes and failures. A key conclusion is that there is scope for successful industrial policy even in countries that have reached the technological frontier and want to push it further.*

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Industrial policy in East Asia – lessons for Europe

Ha-Joon Chang

1. Introduction

Since the end of the Second World War, the East Asian economies – first Japan and then Taiwan, Singapore, Hong Kong, and South Korea (henceforth Korea)– have achieved literally the fastest industrialisation in human history.

Roughly speaking, these economies have grown at a rate of 5-6 percent in per capita terms during the second half of the 20th century. This means that their living standards have doubled every 12½ years. Over half a century, such a rate of growth is capable of producing a 16-fold increase in income. The magnitude of East Asian development can be put in perspective when we recall that per-capita-income growth in today's developed countries during the Industrial Revolution was 1-1½ percent or that the average growth rate in per capita income in those countries during the Golden Age of Capitalism (1950-73) was around 3 percent.

In 1961, per capita income (in current dollars) in Japan, the richest economy in the region, was $402, around one-sixth that of the United States ($2,308), and similar to that of South Africa ($396), Argentina ($378), and Chile ($377). In 2003, its per capita income, at $34,510, was (in current dollars) basically the same as that of the United States ($37,610) and 8-12 times that of the countries with a similar per capita income only four decades ago (South Africa, $2,780; Argentina $3,650; Chile, $4,390).

In 1961, Taiwan's per capita income was $122, less than a third that of Chile ($377), around half that of Colombia ($222), and similar to that of Morocco ($120). In 2003, its per capita income was, at $13,139, ten times that of Morocco ($1,320), more than seven times that of Colombia ($1,810), and more than three times that of Chile ($4,390).

In 1961, Korea's per capita income was $82, which was less than half that of Ghana ($179) and Honduras ($182), and similar to that of Kenya ($72). In 2003, at $12,020, its per capita income was about 12 times that of Honduras ($970), just under 30 times that of Kenya ($390), and nearly 40 times that of Ghana ($320).[1]

In the debate surrounding this spectacular economic transformation, the most contentious has been on the role of industrial policy. While the earlier interpretations of the East Asian experience tended towards a free-market, free-trade story, now most commentators agree that these countries, except for Hong Kong, used a wide range of industrial policy measures. Some argue that their success owes a lot to the intervention by their governments that involved promoting certain industries through a mixture of trade protection, subsidies, government-mediated mergers and acquisitions (M&A's), regulations on entry and capacity expansion, technology licensing, and so on. However, others believe that the East Asian industrial policies were not great successes and that, even if they were successful, they cannot be applied by other countries, as the East Asian success has owed so much to idiosyncratic factors, such as Confucian culture, meritocratic bureaucracy, and Cold War politics (for a critique of these arguments, see Chang 2006).

1 The 1961 income figures are from Kindleberger (1965, pp. 12-3, table 1.1), except for the Korean figure, which is from the Korean central bank statistics (http://ecos.bok.or.kr/). The 2003 figures are GNI (gross national income, the World Bank's new term for GNP) figures from World Bank (2005), table 1, except for the Taiwanese figure, which is GNP per capita data from the Taiwanese government statistical website (http://210.69.121.6/gnweb/english/statistics/stat9.xls#'C3001(2)'!A1).

In this paper, I critically examine the role of industrial policy in East Asian development, with a view to drawing lessons for other countries (especially the European countries). In Section 2, I will discuss some definitional issues. In Section 3, I will discuss the evolution of industrial policy in Japan, Korea, Taiwan, and Singapore (Hong Kong not having pursued much industrial policy). In Section 4, I evaluate the East Asian industrial policy experience, both in relation to the so-called East Asian miracle, the 1997 financial crisis, and the Japanese economic stagnation since the 1990s. In Section 5, I will draw the conclusions and try to extract lessons for other countries, especially the European countries.

2. Some definitional issues[2]

The concept of industrial policy is not clearly defined, resulting in heated but often fruitless debates.

A major problem with the industrial policy debate is that the very concept of industrial policy is not clearly defined, resulting in heated but often fruitless debates.

For example, in the early debate on Japanese industrial policy in the late 1970s and the early 1980s, the opponents of industrial policy often argued that "industrial policy is not the major reason for Japan's success", as the title of one article goes (Trezise 1983), on the grounds that subsidies and governmental loans to industries (as a share of GDP) in Japan were smaller than in many other comparable countries. They argued that, given its sheer quantitative insignificance, it was impossible for Japan's industrial policy to have had much impact on the course of the country's development.

Behind this assertion is the implicit definition of industrial policy as a policy that involves monetary transfers intended to change the incentives facing industries. However, as we will see later, financial transfers have only been a small part of Japanese (and other East Asian) industrial policy. Therefore, unless we abandon this narrow, finance-oriented definition, we cannot understand the true magnitude and influence of East Asian industrial policy.

Having said that, the problem with the (often implicit) definitions of industrial policy in circulation is usually that they are too broad rather than too narrow. For example, Pinder (1982), a leading British proponent of industrial policy in the 1980s, considers all of the following components of industrial policy: general industrial support policies such as manpower policy; fiscal and financial incentives for investment; public investment programmes; public procurement policies; fiscal incentives for R&D; firm-level policies such as specific R&D support; antitrust policy; merger policies to create 'national champions'; support for small firms; regional policies such as the development of physical and social infrastructure and the establishment of industrial complexes; generalised trade protection; sectoral policies such as the organisation of recession cartels in depressed industries; product upgrading in labour-intensive industries. The tendency to adopt an encompassing definition also exists among those who are sceptical of the values of industrial policy. Donges (1980), an ardent critic of industrial policy, categorically states that industrial policy "embraces all government actions which affect industry" (p. 189).

However, although all the above policies would have implications for industrial development, classifying every policy that affects industrial development as industrial policy is not a useful way to proceed. If we did that, virtually every policy could be classified as industrial policy, which would make the concept meaningless.

2 This section draws heavily on Chang (1994), Chapter 3.

In this sense, Landesmann's (1992) emphasis on the 'particularistic', or discriminatory, nature of industrial policy deserves attention. According to him, industrial policy is "designed to be *specific*, i.e., directed towards particular industries, firms, regions, groups in the labour market, etc., rather than general . . . Implicit in industrial policy formulation and execution are therefore always trade-offs between different groups, regions, industries, etc." [italics original] (p. 5). According to this definition, we may exclude such general policies as creating skilled workforces or improvements in labour-management relations from the realm of industrial policy, making the concept more focused.

However, Landesmann's concept of industrial policy is still somewhat overloaded, because it includes policies designed to affect both particular regions and particular groups in the labour market. True, industrial policy affects different regions and different groups differently, but its effects on particular regions and groups are better viewed as by-products than as aims of the policy. Likewise, regional and group-oriented policies may affect particular industries (e.g., setting up an industrial park for the garment industry in a high-unemployment region), but this should not make them industrial policies.

Given the above considerations, I propose to define industrial policy as a policy aimed at affecting particular industries (and firms as their components) to achieve the outcomes that are perceived by the state to be efficient for the economy as a whole. This definition is close to what is usually called 'selective industrial policy' (e.g., by Lindbeck 1981).

Industrial policy is defined here as a policy aimed at affecting particular industries to achieve the outcomes that the state perceives to be efficient for the economy as a whole.

In my definition, first of all, I emphasise the words 'particular industries', and therefore implicitly exclude policies designed to affect industry in general (e.g., educational investment, infrastructure development) and policies aimed principally at affecting other categories than industries (e.g., regional policy, group-oriented policy) from the domain of industrial policy. Second, I emphasise the word 'efficient' to stress that the guiding principle of industrial policy in its purest form is efficiency, and not other aims (e.g., equity). Third, I emphasise the phrase 'the economy as a whole' to stress that, although it is directed at specific industries, industrial policy ultimately aims at improving the efficiency of the economy as a whole and not that of particular industries. Therefore, in an industrial policy regime, whenever the efficiency objective of an individual industry and that of the whole economy clash with each other, the latter is permitted to dominate.[3] Last, I emphasise the phrase 'perceived by the state', to stress that the perception of the state may not necessarily be correct or justifiable to everyone.

Having defined industrial policy, a comment on the distinction between so-called general and selective industrial policies is in order.

There is a tendency among mainstream economists to argue that general industrial policy, which affects all industries equally, is less distortionary and therefore preferable. For example, Corden (1980) states that "the best industrial policy may be to provide an adequate infrastructure, some limits on the powers of monopolies and cartels, an education system that helps to generate the human capital for industrial success, indicative guidance about industrial prospects (without compulsion or subsidies), stability and simplicity in the system of taxation, a free and flexible capital market and a steady movement towards zero sectional protection, whether direct and indirect" (pp. 182-3). In its famous study on East Asian miracle, the World Bank (1993) argues that selective

3 For example, in their study of Japanese industrial policy, Magaziner and Hout (1980) document that Japan's Ministry of International Trade and Industry (MITI) often "will suggest that a company participate in an unappealing foreign investment project or delay a capacity addition to *accomplish a broader end*" [italics added] (p. 34).

industrial policy is not only economically inferior to general industrial policy but it is also unlikely to work in other developing countries because it requires high administrative capabilities, which many of them do not have.

In practice, the distinction between general and selective industrial policies is mostly meaningless.

Whatever one's position is on the relative merits of selective industrial policy, there is one important definitional issue here. As Lall (1994) points out, in practice, the distinction between general and selective industrial policies is mostly meaningless, because virtually all general industrial policies involve an element of selectivity to one degree or another.

This is because, in a world of limited financial resources and limited administrative capabilities, there will always be some degree of selectivity involved in the conduct of industrial policy. For example, it may be thought that a generalised support for R&D (unlike, say, a subsidised R&D fund for a designated industry) does not involve selectivity. However, unless there are unlimited financial and administrative resources, devoting more resources to support R&D activities means that R&D-intensive industries are now implicitly being favoured over other industries. In this way, the so-called general industrial policy may end up targeting certain sectors without acknowledging it, with the consequent risk of policy incoherence.

To take another example from the above quote by Corden, the government cannot just 'provide an adequate infrastructure' in abstract. It has to decide, say, what road to build where, and in deciding this, it would have to consider, among other things, its likely impacts on industries in the relevant localities. To take another example from Corden, it cannot provide 'an education system that helps to generate the human capital for industrial success' without deciding in which areas future scientists, engineers, and skilled workers will be trained – a decision closely linked with its vision for the future of the country's industries. Universities and technical high schools cannot train engineers and skilled workers in abstract – they have to be trained in very specific areas (chemical engineering, operation of computer-numeric-control machines, and so on).

Thus seen, the dichotomy between general and selective industrial policies is in the end untenable, except for policies like primary education and health care provision – policies that should not be classified as industrial policy anyway, at least according to my definition.

Whether or not we use terms like targeting, selectivity is an issue that has to be, and in fact is being, routinely confronted by the practitioners of industrial policy. Indeed, it may be better to explicitly acknowledge the inevitability of selectivity and openly discuss which sectors to target in which ways, rather than trying to pretend there is no targeting going on, thereby increasing the danger of incoherence between different targeting exercises. Moreover, contrary to what the World Bank (1993) says in this regard, countries with weak administrative capacities have a better chance of success with policies that are more precisely targeted, as they save on the scarce administrative resources.

The crucial question, in conclusion, is not whether or not industrial policy should be selective, but how to be selective in the right areas in the right manner, given the overall industrial policy objectives.

3. The evolution of industrial policy in East Asia

To put it briefly, since the Second World War, Japan and the other East Asian countries have promoted industries with high growth potential and widespread externalities through an array of means, which included: infant industry protection; export promotion through export subsidies and export marketing help; coordination of complementary investments; regulation of firm

entry, exit, investments, and pricing intended to 'manage' competition; temporary subsidies and restriction of competition intended to help technology upgrading; subsidies to the private sector or establishment of state-owned enterprises (SOEs) in high-risk large-scale industries. At the same time, these countries could successfully import and assimilate foreign technologies because their governments could: skilfully integrate their education and training policies with industrial policy; effectively initiate and subsidise private-sector R&D while also providing public-sector R&D in key areas; and deliberately regulate technology licensing and foreign direct investments by transnational corporations (TNCs) in a way that maximises technology spillover.

Of course, there are important national differences, as it will become clearer with the following comparison of the four countries in the region – Japan, Korea, Taiwan, and Singapore. Let us first start with Japan, which had been the 'template' for industrial policy in other countries in the region.

3.1 Japan

Until 1911, Japan could not use trade protection, but by 1913, it had become one of the more protectionist countries in the world, although it was still less protective of its manufacturing industries than the United States.

In the earlier days of its capitalist development, Japan was not able to use trade protection, as the series of 'unequal treaties' it was forced to sign in 1858 (following its opening up in 1853) barred it from having tariff rates over 5 percent until 1911 (see Table 1). However, even during this period, in a manner similar to what the Prussian government did in the early 19th century in the absence of private sector entrepreneurial initiatives, the Japanese government established state-owned 'model factories' (or pilot plants) in a number of industries – notably in shipbuilding, mining, textiles (cotton, wool, and silk), and military industries (see Smith 1955 and Allen 1981, for further details). Although most of these were soon sold off to the private sector at discounted prices, many of them were heavily subsidised by the state for many years after privatisation (McPherson 1987). In addition, the Japanese government implemented policies intended to facilitate the transfer of advanced foreign technologies, for example, by hiring foreign technical advisors.

Following the ending of the unequal treaties in 1911, the Japanese government started introducing a range of tariff reforms intended to protect infant industries, to make imported raw materials more affordable, and to control luxury consumption goods (Allen 1981, McPherson 1987). By 1913, Japan had become one of the more protectionist countries in the world, although it was still less protective of its manufacturing industries than the United States (see Table 1). In 1926, tariffs were further raised for some new industries, such as woollen textiles (Allen 1981).

Nevertheless, tariff was "never more than a secondary weapon in the armoury of economic policy" in Japan before the Second World War (Allen 1981, p. 134), although some key industries were indeed heavily protected (e.g., iron and steel, sugar, copper, dyestuffs, woollen textiles). Here we can find some parallel between Japan after 1911, on the one hand, and Germany and Sweden in the late 19th and the early 20th century, on the other hand, in that all of them used 'focused' tariff protection, whereby the overall tariff regime remained moderately protective but strong protection was accorded to some key industries, rather than the 'blanket' protection used by countries like the United States, Russia, and Spain at the time.

During the 1920s, under strong German influence (Johnson 1982), Japan began to encourage the 'rationalisation' of key industries by sanctioning cartel arrangements and encouraging mergers, which were aimed at restraining 'wasteful competition', achieving scale economies, standardisation, and the introduction of scientific management (McPherson 1987). These efforts were intensified and government control over cartels strengthened in the 1930s, in response to the world economic crisis following the Great Depression and the war efforts, especially with the enactment of the 1931 Important Industries Control Law. Thus, the basic pattern of post-war industrial policy was established (Johnson 1982). Japan's military build-up during the 1930s is believed to have contributed to the

development of heavy industries (although with an ultimately disastrous political outcome) by stimulating demand and creating technological spill-over effects (McPherson 1987).

Table 1. Average tariff rates on manufactured products for selected developed countries in their early stages of development (weighted average; in percentages of value)

	1820	1875	1913	1925	1931	1950
Austria[1]	R	15-20	18	16	24	18
Belgium[2]	6-8	9-10	9	15	14	11
Denmark	25-35	15-20	14	10	n.a.	3
France	R	12-15	20	21	30	18
Germany[3]	8-12	4-6	13	20	21	26
Italy	n.a.	8-10	18	22	46	25
Japan	R	5	30	n.a.	n.a.	n.a.
Netherlands[2]	6-8	3-5	4	6	n.a.	11
Russia	R	15-20	84	R	R	R
Spain	R	15-20	41	41	63	n.a.
Sweden	R	3-5	20	16	21	9
Switzerland	8-12	4-6	9	14	19	n.a.
United Kingdom	45-55	0	0	5	n.a.	23
United States	35-45	40-50	44	37	48	14

Source: Chang (2002), p. 17, table 2.1. For a similar table see World Bank (1991, p. 97)
Notes: R= due to numerous and important restrictions on manufactured imports, average tariff rates are not meaningful. Data for 1820 and 1875 are very approximate rates, and give range of average rates, not extremes. 1/ Before 1925, Austria-Hungary. 2/ In 1820, Belgium was united with the Netherlands. 3/ The 1820 figure is for Prussia only.

Despite its developmental efforts, until the Second World War, Japan was on the whole not the economic superstar it became thereafter.

Despite all these developmental efforts, until the Second World War, Japan was on the whole not the economic superstar it became after it. According to the authoritative study by Maddison (1989), between 1900 and 1950, Japan's per capita income growth rate was only 1 percent a year. This was somewhat below the average for the 16 largest now-OECD economies he studied, which was 1.3 percent a year.[4] Table 2, also from Maddison, shows that between 1913 and 1950, Japan's per capita income growth rate (0.89 percent) was slightly below the average of the 12 European countries that appear in the table (0.83 percent) and only half that of the United States (1.61 percent).

After the Second World War, the Japanese economy was in a dire state. The defeat in the war, which had already stretched its capacity to the limit, meant a drastic collapse in the economy; per capita income fell by almost half from the peak of $2,897 (GDP per capita in 1990 dollars) in 1941 to $1,555 in 1946 (Maddison, 2001). Immediately after the war, the situation was so desperate that the government had to forcefully channel resources into steel and coal production in order to keep the economy going at all. Its main car manufacturer, Toyota, almost went bankrupt in 1949, and had to be saved through an intervention by the central bank, the Bank of Japan.

4 The 16 countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Norway, Sweden, Switzerland, the UK, and the United States.

Table 2. GDP per capita growth of today's developed countries in different phases of their development

	1870-1913	1913-1950	1950-73	1973-98
Austria	1.45	0.18	4.94	2.10
Belgium	1.05	0.70	3.55	1.89
Denmark	1.57	1.56	3.08	1.86
Finland	1.44	1.91	4.25	2.03
France	1.45	1.12	4.05	1.61
Germany	1.63	0.17	5.02	1.60
Italy	1.26	0.85	4.95	2.07
Netherlands	0.90	1.07	3.45	1.76
Norway	1.30	2.13	3.19	3.02
Sweden	1.46	2.12	3.07	1.31
Switzerland	1.55	2.06	3.08	0.64
United Kingdom	1.01	0.92	2.44	1.79
European-12 average	1.33	0.83	3.93	1.75
Japan	1.48	0.89	8.05	2.34
United States of America	1.82	1.61	2.45	1.99

Source: Maddison (2001), p. 265, table B-22.
Note: Annual average compound growth rates

The economy started to recover rapidly from 1950, partly thanks to the export boom due to the Korean War (1950-3), but even until the late-1950s, the economy was struggling to move out of exports of low-quality, labour-intensive goods. Until the late-1950s, the country's biggest export item was silk and silk-related products. Indeed, the country was so desperate to increase its exports, it was producing a large amount of fake Made in USA products; so much so that some manufacturers were even exporting Made in Usa products on the excuse that there is a small town near Tokyo called Usa.

The development of the car industry is the most instructive in this regard. When the first Japanese attempt to export passenger cars to the US market spectacularly failed in the late 1950s (Toyota's sub-compact car, Toyopet), the debate on the future of Japan's car industry flared up, with free-market economists arguing that this is what happens when a country whose biggest export item is silk tries to export things like cars. They argued that the car industry should be liberalised by lowering tariff barriers and putting an end to government subsidies. Luckily for Japan (and for the rest of the world, which eventually benefited from better cars), the protectionists around the Ministry of International Trade and Industry (MITI) prevailed and the Japanese government maintained its support to the industry, paving the way to the world leadership a generation later.

In the debate on the future of Japan's car industry in the late 1950s, protectionist economists prevailed over free-market economists, and the state maintained its support to the industry, paving the way to the world leadership a generation later.

The Japanese performance after the 1950s, especially during the Golden Age of Capitalism (1950-73), is famous and there is no need to go into much detail here. As we can see from Table 2, during this period, per capita income in Japan grew at an amazing rate of 8 percent a year, which is more than double the average of the 12 European countries shown in the table. It is over

3 percentage points higher than the second best performer, West Germany and over 3 times higher than that of the United States. By the 1970s, Japan started breaking into markets until then considered the domains of only Europe and North America – automobile, steel, shipbuilding, electronics, and so on. By the 1990s, Japanese products, represented by Toyota's luxury car, Lexus, became synonymous with quality, innovative design, and reliability – a totally different image from the days when desperate Japanese companies were exporting 'Made in Usa' products while their policy makers were debating whether to continue protecting the automobile industry.

While the industrial policy measures used by the Japanese government were not very different from those of other countries, Japan's post-war industrial policy involved important policy innovations.

What is important to note is that many of the industrial policy measures used by the Japanese government were not very different from the ones used by other governments to promote their industries – both before and after it.

Directly following the examples of the United States, Germany, and other more developed countries and continuing some of its own policies before the War, Japan provided trade protection (tariffs and quantitative restrictions) and various subsidies (export, investment, R&D, and infrastructure). It also used indicative planning (most famously used by France), foreign exchange rationing (used in all European countries until the 1970s to one extent or another), and special banks for long-term industrial financing (such as Development Bank of Japan, Long-Term Credit Bank, Industrial Bank of Japan). Even some measures that are frequently thought to be Japanese inventions are, when we go back in history, not so. For example, export promotion through tariff rebate on inputs used for exported goods, which many believe to be a post-war Japanese invention, is a measure Britain had actively used in the 18th century!

However, this is not to say that Japan was only repeating what other countries had done before. Japan's post-war industrial policy involved some important policy innovations. Two of them are worth noting here.

One is the establishment of deliberation councils for policy making in key industries, comprising government officials, industry representatives, and more 'objective' observers (such as journalists and academics). These councils are said to have made industrial policy more effective by improving information flows between the government and the private sector, on the one hand, and between private sector firms, on the other.

Another notable Japanese innovation, or rather improvement over past practices of its own and other countries, is the improved technique of managing cartels. Rather than regarding all cartels as negative, as in the United States, the Japanese government recognised that cartels can be crucial in managing industrial development by reducing 'wasteful competition' that destroys profit and undermines the capacities to invest and innovate in the long run. Of course, the problem, as Japan itself (and many European countries) had seen in the pre-war period, is that cartels can also become conservative forces that prevent progress. Therefore, in the post-war period, the Japanese government tried to minimise this problem by allowing cartels only under clear conditions in terms of their aims (e.g., avoiding duplicative investment, upgrading technology, avoiding price war in the export market, orderly phasing out of declining industries) and their lifespan.

3.2 Korea

Korean industrial policy was very similar to the Japanese one, but there were important differences, too.

The biggest difference is that, especially until the 1980s, the Korean government intervened much more aggressively than the Japanese government. This was partly out of necessity – Korea,

technologically well behind Japan, needed more forceful government intervention to raise internationally competitive firms. However, it was also because the private sector was far weaker than in Japan and, thus, the Korean government felt far less constrained in commanding the private sector than its Japanese counterpart.

Korea's industrial policy-making and -implementation were also more centralised than Japan's. The Korean planning ministry, the Economic Planning Board, was much more powerful than the Japanese Economic Planning Agency (not even a full ministry). The EPB even controlled the budget, which is in most countries – including Japan – the turf of the finance ministry. As a result, Korea's 'indicative' planning (and industrial policy as a part of it) was much more directive than the Japanese or even the French counterparts. As in Japan, deliberation councils existed, but the private sector firms had much less influence in their decisions than their Japanese counterparts.

Especially in the early days of the country's economic development, the Korean private sector was totally at the mercy of government rationing of credit and foreign exchange. Credit rationing was possible because all banks – not just special purpose banks as in the case of Japan – were state-owned until 1983 and because even the privatised ones were in effect controlled by the government until the early 1990s. Foreign exchange rationing was conducted through the so-called foreign exchange budgeting system, which was based on a legally mandated government monopoly of all foreign exchange transactions until the early 1990s.

Unlike Japan, which had no significant SOEs in the manufacturing sector since the late 19th century, the government of Korea did not mind using such enterprise when necessary. The most prominent example in this regard is the recently privatised Pohang Steel Company (POSCO), the second largest steel producer in the world until the recent mega-mergers in the world's steel industry (Box 1 offers more insights into the creation and performance of POSCO). Moreover, in various episodes of industrial restructuring, it practically nationalised many firms (usually temporarily but sometimes for an extended period) by becoming the leading shareholder of certain companies through the equity participation of the state-owned development bank, that is, Korea Development Bank.

The Korean government intervened much more aggressively than the Japanese government, even pushing private sector firms into ventures they did not want.

Given its power, the Korean government could even push private sector firms into ventures they did not want to take on. The most famous story in this regard is Hyundai's entry into the shipbuilding industry in the early 1970s. Although the firm is one of the leading shipbuilders in the world today (and the country is now the biggest shipbuilder in the world), at the time even Jung Joo-Young – Hyundai's legendary chairman at the time, known for bold business gambles – was reluctant to build a large-scale shipyard in a country with no previous experience of modern shipbuilding. However, the Korean government offered Hyundai big sticks (e.g., threat to disfavour it in the rationing of credit and foreign exchange) and some carrots (e.g., trade protection and the offer to buy any unsold ship in the initial period), compelling the company to enter the industry (for further details, see Jones and Sakong 1980).

The Korean government was also a lot more involved in corporate restructuring in the private sector than the Japanese government. Especially when business downturns put firms into danger zone, it would wade in to initiate M&A and production rationalisation. For example, in 1969, the proliferation of inefficient firms after a massive investment boom in the late 1960s (following a premature attempt at financial liberalisation) prompted the Korean state to force dozens of inefficient firms (exact numbers not released) into mergers, sales, and liquidation – sometimes sweetened by debt rollovers by the Korea Development Bank. Also, in the aftermath of the 1970s state-led Heavy and Chemical Industrialisation (HCI), which led to temporary excess capacity in

some major industries, the Korean state stepped in again with the Reorganisation of Heavy and Chemical Industries programme in 1980 (Box 1 presents more details about this programme). Another round of state-led mergers and liquidations of inefficient firms occurred between 1984 and 1988. The focus of this round of restructuring was the shipping, overseas construction, and fertiliser industries – all of them considered industries in decline (see Box 1 for more).

Box 1. Industrial-policy episodes from Korea

The role of state-owned enterprises

In the late 1960s, when the Korean government decided to apply for World Bank support to build its first modern steel mill, the World Bank declined the application on the grounds that the project was not viable. Not an unreasonable decision – so it seemed: the country's biggest export items at the time were fish, cheap apparels, wigs, and plywood; the country did not even possess deposits of the key raw materials (iron ore and coking coal); at the time, it could not even import them from nearby China because of the Cold War; such materials had to be imported from Australia. And, to top it all, the Korean government proposed to run this as a monopolistic state-owned enterprise, which it did until a few years ago; a perfect recipe for disaster from the view of mainstream economists. Nevertheless, the company became the most efficient steel producer in the world within ten years of its creation. For further details on POSCO, see Amsden (1989).

Government involvement in corporate restructuring in the 1980s

Round 1. Following the economic crisis of 1980, four companies in the power generating equipment industry were merged into Korea Heavy Industries and Construction Co. (KHIC), which was subsequently nationalised on the grounds that the state support needed to make KHIC profitable was too big to be given to a single private firm. In the passenger car industry, one of the three producers (Kia) was forced to exit and specialise in trucks and buses with a promise that it would be allowed again to produce passenger cars when demand conditions improved – this actually occurred. One of the three companies in the naval diesel engine industry (Daewoo) was forced to exit, and the other two were forced to split the market into two segments and specialise (Hyundai in over-6,000 hp and Ssangyong in under-6,000 hp engines). In heavy electrical machinery industry, comprising eight companies, three (Hyosung, Ssangyong, Kolon) were merged into one (Hyosung) and allowed to produce only highly specialised and expensive products. A subsidiary of Hyundai was asked to produce only for its sister companies. Four other minor companies were forced to produce only less sophisticated and cheaper products. Each of the four companies in the electronic switching system industry (Samsung, Gold Star, OPC, and Daewoo) was forced to specialise in a different product. The two companies in the copper smelting industry were merged by forcing one to buy the other's equity, which was supported by equity participation of the Korea Development Bank and a moratorium on bank loans repayment. See Chang (1994, chapter 4) for further details.

Round 2. In 1984, three fertiliser producers were liquidated, and 63 shipping companies were merged into 17. In 1986, a major reorganisation of the overseas construction industry was implemented, again involving mergers and liquidations. And between 1986 and 1988, 82 inefficient firms (23 of them in shipping and overseas construction industries) were forced into liquidation and mergers. See Chang (1994, chapter 4) for further details.

3.3 Taiwan

Many of Taiwan's industrial policy measures are similar to those used by Japan and Korea. For example, it also used trade protection, subsidies, government-led corporate restructuring, and other means of industrial policy. Like the Japanese and the Korean governments, the Taiwanese government helped its firms develop technologies and open export markets through state agencies (government research institutes and government export marketing agency, for example). In terms of the control mechanism, it used state-owned banks as Korea (but not Japan), while using foreign exchange rationing as both Japan and Korea. However, industrial policy in Taiwan differs in some important respects from those of Japan and Korea.

Taiwan's industrial policies are similar to those of Japan and Korea. But there are also important differences, often reflecting the relatively small number of large private firms in the Taiwanese economy.

Many of these differences stem from the fact that Taiwan has not had many large firms in the private sector. This has been mainly for two reasons. First, the so-called Three People Principle – the official ideology of the Nationalist Party, which engineered the Taiwanese 'miracle' – is semi-socialist and dictates that key industries have to be nationalised. Second, the Nationalist government was considered an occupation force by the local 'Taiwanese' population[5] and was therefore very reluctant to allow the emergence of large firms in the Taiwanese-dominated private sector that could challenge its political dominance.

As a result, most large firms in the Taiwanese economy have been SOEs or companies known as 'party enterprises', that is, enterprises that are nominally private because they are owned by the Nationalist Party, rather than the government, but in fact operate as *de facto* SOEs (Amsden 1985, Fields 1995). The private sector consists of small firms, with only few notable exceptions (e.g., the Tatung group, Formosa Plastic). This structure introduced an industrial-policy dynamic that is very different from what we see in Japan or Korea.

First of all, Taiwan, together with countries such as Austria and France, has had one of the largest SOE sectors in the world, apart from the oil-producing countries. This means that its government appears to be less interventionist than it really is because when Taiwan's government tells its large firms (most of them SOEs) what to do, this does not count as intervention but as an internal government directive.

Second, the absence of large firms in the private sector induces the Taiwanese government to intervene more heavily than the Japanese and Korean governments in the area of technological development (i.e., an area in which the large financing requirement makes it difficult for small firms to succeed). Thus the Taiwanese government accounts for over 60 percent of total R&D expenditure, whereas the corresponding figure is only around 20 percent in Korea and Japan, which both have large firms with capacities to embark on significant R&D projects. For the same reason, the Taiwanese government has been far more active than its two counterparts in setting up spin-off firms from government-funded high-technology research projects.

Third, not having many large private firms, Taiwan had to be more open to working with TNCs than Japan or Korea (until the 1997 financial crisis), although it was not even very open to FDI by international standard (see Annex Table 1). Japan has been very hostile to TNCs, with the result that its ratio of FDI inflows to aggregate investment is among the lowest in the world (0.1 percent or less). Korea, lacking Japan's technological capabilities, had to be more open to TNCs, but its policies

5 Taiwan's indigenous population, the Kaoshan people, are Polynesians. The 'Taiwanese' are mainly descendants of the Chinese migrants from mainly south-eastern China since the 16th century – and even they can be divided into a few groups. The Nationalist government, when it moved into Taiwan in 1949 following its defeat by the Communists, was made up of people from mainland China, mainly from northern China.

were still very hostile to them outside its free-trade zones until the mid-1990s. The share of FDI in Korea's investment was one of the lowest in the world, after Japan though (see Annex Table 1).

Another statistic illustrating the same point is that, as of the mid-1980s, only about 5 percent of TNC subsidiaries in Korea were wholly-owned by foreign investors, whereas the corresponding figure was 50 percent for Mexico and 60 percent for Brazil, countries often believed to have had much more 'anti-foreign' policy orientations than that of Korea (Evans 1987). In contrast, due to the scarcity of large domestic firms that could become plausible joint venture partners, the Taiwanese government was more flexible on the question of ownership structure of TNC subsidiaries; Taiwan was somewhere between Korea and Latin America, with approximately one-third of the TNC subsidiaries (excluding the ones owned by overseas Chinese) being wholly-owned by foreign investors as of 1985 (Schive 1993).

3.4 Singapore

Given its status as a city-state, Singapore had to differ even more from the Japanese template than Korea and Taiwan in the design and conduct of its industrial policy.

Given its status as a city-state, Singapore had to differ even more from the Japanese template than Korea and Taiwan in the design and conduct of its industrial policy.

To begin with, given its tiny size (2 million people at the time of separation from Malaysia in 1965), infant industry protection was deemed to be too costly. As a result, it adopted a free-trade regime, making its industrial policies clearly distinct from other East Asian countries.

Moreover, given the paucity of local entrepreneurial talent, the Singaporean government decided to work with TNCs much more closely than the other East Asian countries. As a result, it has one of the highest share of FDI in total investment in the world, well before *laissez-faire* Hong Kong (Annex Table 1).

However, this does not mean that Singapore pursued a *laissez-faire* industrial policy, as many free-market economists suggest – on the contrary. First of all, in sectors considered critical, the Singaporean government set up SOEs (called government-linked corporations, GLCs for short), rather than inviting TNCs. Its world-famous Singapore Airlines is an SOE, while industries such as shipbuilding and telecommunications are also run by SOEs, resulting in a huge SOE sector. For example, between 1970 and 1990, the public sector share in gross fixed capital formation in Korea was around 10 percent, whereas the corresponding figure in Singapore was over 30-36 percent in the 1960s, 27 percent in the 1970s, and 30 percent in the 1980s (Shin 2005). Saying that virtually all large firms in Singapore that are not TNC subsidiaries are SOEs would not be an overstatement.

Second, adopting an extremely friendly policy towards TNCs, does not mean that Singapore indulged in *laissez faire*. Rather than taking a hands-off approach to FDI and let the TNCs decide what to do, the Singaporean government has worked hard to attract FDI into certain areas regarded as important for the country by investing in particular types of manpower and infrastructure and providing custom-designed financial incentives.

Third, the Singaporean government has run forced saving schemes and massive public housing programmes, which, on the basis of total public ownership of land, provide most of the houses in the country. Of course, these are not industrial policies, but they show how the Singaporean government is in certain respects even more interventionist than the Japanese or Korean.[6]

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6 Interestingly, even in Hong Kong, the only *laissez-faire* country in East Asia, all land is publicly owned. This shows the particular importance of housing in city-states.

3.5 Concluding remarks

The above examination shows similarities among industrial policies in the four East Asian economies, but highlights important differences too.

At the level of principles, there were important similarities. All four East Asian countries deployed industrial policies aimed at upgrading their industrial structures through long-term investments in physical and human capital. As to the tools used and the mechanisms of policy implementation, however, there were important differences across countries, as shown in Table 3.

Table 3. Summary of industrial policies in four East Asian countries

	Japan	Korea	Taiwan	Singapore
Policy				
Infant industry protection	Very strong	Very strong	Very strong	none
Export promotion	Strong	Very strong	Very strong	Strong, but mostly indirect
SOEs in manufacturing	Not used	Used in some critical industries	SOEs ran most key upstream industries	SOEs ran some key capital-intensive industries
Large private-sector firms	Strongly promoted (especially enterprise groups)	Strongly promoted (especially enterprise groups)	Discouraged (most large firms were SOEs)	Not promoted (large firms were either SOEs or TNCs)
SMEs	Promoted by encouraging large firms to upgrade their subcontractors	Weakly promoted (some SME-specific funds)	Promoted through strong public investment in R&D and infrastructure	Weakly promoted (some SME-specific funds)
Private-sector corporate restructuring	Some involvement	Very deep Involvement	Deep Involvement	Some Involvement
TNCs	Strongly discouraged	Strongly discouraged outside selected sectors	Discouraged outside selected sectors	Strongly promoted, but in a targeted manner
R&D	Private-sector-led	Private-sector-led	Government-led	Government-led
Policy implementation				
Centralisation in policy making	Strong	Very strong	Very strong	Strong
Government-private sector relationship	Two-way cooperation, systematic	Top-down direction, less systematic than in Japan	Mixture of antagonism, benign neglect, and central control	Local private sector unimportant
Role of private-sector associations	Very important	Important, but controlled by the government	Important, but controlled by the government	Local private sector unimportant

Singapore stands out by not pursuing trade protection, but strongly encouraging FDI. Governments in Taiwan and Singapore used SOEs much more widely and played a bigger role in R&D than Japan or Korea, where large private sector enterprise groups were promoted and given a leading

role in organising R&D. In Korea and Taiwan, the government was much more deeply involved in corporate restructuring than in Japan or Singapore. In terms of promoting small and medium-sized enterprises (SMEs), Taiwan and Japan are closer to each other than to the other countries. And as Table 3 shows, there were other similarities and differences.

An interesting point to stress is that these countries cannot be put along a single spectrum. In terms of trade policy, Singapore might be considered much less interventionist than Japan or Korea, but in terms of relying on SOEs, it is way more interventionist than Japan or, to a lesser extent, Korea. Nor is it that they can neatly be grouped. To illustrate, in some policy areas, Singapore and Japan are similar to each other (in terms of government involvement in corporate restructuring, for example) while in others Singapore is closer to Taiwan than the other countries (in terms of the importance of SOEs, for instance). And then, Japan is closer to Taiwan in terms of promoting SMEs than it is to Korea, but in terms of promoting local private-sector enterprise groups, it is closer to Korea than it is to Taiwan. In sum, there was not one industrial policy template for all countries,but there have been several variations on the theme.

4. Evaluating industrial policy in East Asia: successes and failures

4.1 Industrial policy and East Asian miracle

In the beginning, there was reluctance among mainstream economists even to recognise that industrial policy existed at all in East Asia. I have already mentioned this in relation to Japan earlier (Section 2), but even as late as 1988, Bela Balassa was arguing that the role of the state in Korea, "apart from the promotion of shipbuilding and steel . . . has been to create a modern infrastructure, to provide a stable incentive system, and to ensure that government bureaucracy will help rather than hinder exports" (Balassa, 1988, p. S286), while in other developing countries, for example, the Latin American countries, "there are pervasive controls of investment, prices, and imports and decisions are generally made on a case by case basis, thereby creating uncertainty for business decisions" (Balassa, 1988, p. S287).

The important role of industrial policy in East Asian economies is widely accepted, but its contribution to the region's economic miracle continues to be debated controversially.

From the late 1980s, it has been widely accepted that industrial policy played an important role in East Asian economies. However, in judging its contribution to the region's economic miracle, there is still a lot of dispute. As it is not possible, nor is it necessary, to discuss all the technical points raised in the debate on the evaluation of industrial policy in East Asia, I will make four general points.[7]

First of all, we should not judge the success or failure of industrial policy on the basis of individual cases. The critics of East Asian industrial policy love to cite the failure cases to discredit industrial policy. For instance, it is frequently pointed out that in the 1960s the Japanese government wanted to let Nissan take over Honda, which then was a small producer deemed unable to survive. The subsequent success of Honda and the relative decline of Nissan, it is argued, show how wrong the Japanese government was to push this idea and how right Honda was to resist it. Or the critics talk about the mediocre result of the 1980s Japanese supercomputer project.

However, in the same way in which even the most successful businessmen does not make the right decision every time, national industrial-policy makers, however skilful they are, are bound to make

7 A discussion of some technical details can be found in Lall (1994), Rodrik (1994), and Chang (1995), reprinted as chapter 3 of Chang (2006).

mistakes. Therefore, the mere fact that a government has made a poor industrial-policy decision is not an argument against its industrial policy, in the same way a poor decision by Warren Buffet should not be used as an argument against his finance business itself. What makes the difference is that some governments get more decisions right than others – or, to use a sporting analogy, what matters is the 'batting average'. Indeed, in the case of East Asia, for each failure story there are probably a few success stories.

In other words, the real question is not whether a government makes mistakes in industrial policy, as it is bound to do so sometimes, but it is how the mistake ratios are minimised and how quickly and effectively the mistakes are corrected. The records of the East Asian countries in this regard have been rather good.

In assessing industrial policies in East Asia, the real question is not whether governments make mistakes, but whether there are more successes than failures and how quickly and effectively mistakes are corrected.

Second, the evaluation of industrial policy very much depends on the performance measure used. Various measures of profit (e.g., operating margin, ordinary profit, and so on) usually do not make good performance indicators, especially if the government was trying to promote the industries in question against market logic in the short run. Other performance measures – such as labour productivity, total factor productivity, output growth, export growth, capacity utilisation, incremental output-capital ratio, social rate of return (based on social cost-benefit analysis) – all have their merits and problems.

Third, even in judging individual cases, the verdict could be very different, depending on the time frame. For example, in the early 1980s, many critics of industrial policy argued that the Heavy and Chemical Industrialisation programme of Korea in the 1970s was a total failure, on the grounds that many of the industries promoted through the programme failed to achieve full capacity utilisation and needed import protection to survive (Lal 1983). However, many of the industries criticised as failures at the time, such as the automobile industry, became the engine of Korean exports and economic growth by the late 1980s. This example shows that especially when we evaluate infant industry promotion programmes, we need to take a long-term view. Likewise, one should not forget that it took Japan three decades (between the end of the Second World War and the mid-1970s) of protection and subsidies before its car industry made significant inroads into the world market. In this context, it is also instructive to note that it took the electronics arm of Nokia, arguably one of the most successful businesses in human history, 17 years to make any profit at all!

Last but not least, whatever performance measure and timeframe we use, we cannot measure the impact of industrial policy only with reference to what has happened in the industry in question (or its immediate environment), as it is usually done in the mainstream literature. This is because spill-over effects are very important in evaluating industrial policy, which is clear from my definition of industrial policy (see Section 2) as a "policy aimed to affect particular industries (and firms as their components) to achieve the outcomes which are perceived by the state to be efficient for the economy as a whole".

For example, World Bank (1993) uses TFP growth at two-digit level to measure the impact of industrial policy on the ground that spillovers exists only within the boundary of two-digit sectors, but such statement was based on a study "on the pattern of spillovers of R&D in industrial economies [which] demonstrates that the major beneficiaries are closely related sectors, often sectors that would be identified with a two-digit classification" (p. 326). However, especially for developing economies, where more important spillovers might come in the form of, say, developing a skilled labour force and increasing engineering capabilities, it is not very sensible to measure the impact of industrial policy from the narrow sectoral point of view (see Chang 1995, for further details).

4.2 Industrial policy and the 1997 Asian financial crisis[8]

After the 1997 Asian financial crisis, the critics of industrial policy argued that industrial policy was the major cause of the crisis (e.g., The Economist, 15 November, 1997; Brittan 1997). The argument is that Asian governments, in their attempts to promote their favoured industries, have explicitly and implicitly underwritten the investments in them, which naturally encouraged lax management and excessive risk taking. This argument is best summed up in the following passage from The Economist: "Most of the financial mess is of Asia's own making, and nowhere is this clearer than in South Korea. For years, the government has treated the banks as tools of state industrial policy, ordering them to make loans to uncreditworthy companies and industries" (15 November, 1997).[9]

Critics of industrial policy consider it a major cause of the 1997 Asian financial, but there is little empirical evidence in support of this view.

Unfortunately for those who take this line, it is empirically difficult to sustain that industrial policy was responsible for the Asian crisis. First of all, except for Korea, the countries that were hit by the 1997 financial crisis – Korea, Hong Kong, Thailand, Indonesia, and Malaysia – had not used industrial policy very much. Hong Kong has been one of the most *laissez-faire* economies in recent human history. Thailand has had little in the way of systematic industrial policy except in the agricultural processing industry. Indonesia may have had a little more industrial policy, but many of their industrial policy programmes (such as the support for the aircraft industry) were haphazard and poorly conceived. Malaysia has had a more systematic industrial policy, especially in the palm oil and rubber industries, but it can hardly be described as the dominant factor in the country's policy regime (Jomo and Rock 1998). Indeed, just before the crisis, the World Bank (1993) was making a big deal out of the fact that the Southeast Asian countries had grown fast without the East-Asian-style industrial policy, although some of the Bank's critics also argued that the absence of such policy was precisely the reason why these economies failed to achieve an effective industrial upgrading.

Then how about Korea? Is it not one of the archetypal 'industrial policy states' and, therefore, is it not natural that industrial policy was the main factor behind its crisis, as the above quote from The Economist sums it up? Such conjecture sounds even more plausible when we recall that the over-investment at the origin of the Korean crisis occurred mostly in industries, rather than in real estate development as in the case of Southeast Asia. However, this story does not augur well with the facts.

Contrary to the popular perception, industrial policy was largely absent in Korea in the build-up to its 1997 crisis. It is true that up to the mid-1980s the country practised one of the most comprehensive and systemic industrial policies in the world. However, slowly from the late 1980s, and very rapidly from 1993 with the inauguration of the Kim Young Sam administration, the Korean government had dismantled industrial policy, except for R&D support in some high-technology industries (see Chang 2000 and Chang and Evans 2005, for further details). If industrial policy was largely absent, it seems rather difficult to blame the Korean crisis on it.

In fact, we can go even further and argue that it was actually the demise of industrial policy, rather than its continuation, that was mainly responsible for the 1997 crisis in Korea. It was, for

8 This section draws heavily from Chang (2000).

9 Although it is often mixed up with the 'crony capitalism' argument, the industrial policy argument can be, and should be, analytically separated from the latter, as it does not necessarily assume nepotism or corruption in the choice of favoured industries and companies.

example, the termination of the investment coordination policy that allowed the proliferation of duplicative investments in the key industries that fuelled the massive foreign borrowing between 1993 and 1997 (for more details, see Chang *et al*. 1998). In addition, the demise of industrial policy, as well as the official termination in 1993 of the three-decade-old five-year-planning practice, led to the disappearance of the 'rational' criteria by which government supports had been previously allocated and therefore facilitated access to credits for risky ventures through cronyistic connections or clever political manoeuvring (see Chang 2000, for further details).

4.3 Industrial policy and the Japanese stagnation

Given the sluggish performance of the Japanese economy in recent years, one may ask whether industrial policy is promising only for countries well below the technological frontier.

As much as, if not more than, the 1997 Asian financial crisis, Japan's economic stagnation since the 1990s has contributed to the growing scepticism on the value of industrial policy. Specifically, one may wonder whether industrial policy makes sense only for countries trying to catch up with countries at the frontier of technology or whether such policies are promising for countries at the frontier, too.

Since the bursting of the asset bubble in the early 1990s, Japan has seen sluggish growth – the Japanese economy has grown at roughly 1 percent in per capita terms between 1990 and 2003. More importantly, it has been challenged by competitors even in some industries of its traditional strength, such as consumer electronics, computers, and semi-conductors. And during most of this period, the scope of Japanese industrial policy has been narrowed quite dramatically and the Japanese industrial-policy officials themselves seem to have been overcome by a sense of impotence.

In the case of Japan, unlike in the case of the other East Asian countries (see Section 4.2), very few have argued that industrial policy was the cause of the country's recent economic problems. There is broad agreement that much of Japan's economic problems since the early 1990s owes to the failures of macroeconomic and financial policies – the failure to inject sufficient public funds to resolve the post-bubble bad debt problem at an early stage, the failure to lower interest rates sufficiently at the early stage of the post-bubble economy, the untimely raising of taxes in the mid-1990s that killed off the recovery, the excessively fast introduction of the BIS (Bank for International Settlement) capital adequacy standards in the mid-1990s that sharply contracted bank lending, and so on (Johnson 2001 and Lincoln 2003).

However, even some of the commentators in favour of Japanese industrial policy in the past are now arguing that the economy is too advanced for industrial policy (e.g., Anchordoguy 2001). It is often argued that the success of Japanese industrial policy in the past owed greatly to the fact that Japan was a catch-up economy, for which identifying the industries to promote through industrial policy was not a difficult task. When Japan was trying to catch up with the more advanced economies of Europe and North America, it is argued, it was obvious that industries like cars, shipbuilding, electronics, and so on were the industries to promote. But as the Japanese economy has reached the technology frontier, it has become less obvious which industries to promote because of the greater uncertainties inherent in industries using frontier technologies. In such a situation, it is argued, selective promotion of industries by the government becomes less effective.

While this argument is broadly correct, it should not be over-stretched into the assertion that industrial policy is impossible in a frontier economy. Indeed, it is possible for the government to

identify and support promising industries even in such an economy, as it can be seen from the experiences of other economies on the frontier.

The most important example is public support of R&D, and no other country illustrates the point better than the United States. Despite its pretension otherwise, the US government has been promoting strategic industries through aggressive R&D financing. While the ratio has fallen recently below 40 percent due to large R&D spending by the IT industry, during most of the post-war period the US government financed 50-70 percent of R&D in the country. Most industries where the United States has an international competitive advantage today are industries whose key technologies were developed by public R&D money. Semi-conductors, internet, and aerospace are only the most important examples of industries with origins in defence-related R&D, while the bio-technology industry has greatly benefited from R&D support for the National Institutes of Health. In contrast, public money finances only around 20 percent of total R&D in Japan – among the lowest in the OECD. This leaves open the question of whether Japan has sufficiently promoted basic R&D, an area the private sector was not likely to engage in after its economy reached the technology frontier.

Moreover, even in a frontier economy, there are industries that private firms do not enter despite relatively low technological uncertainties because of high entry costs. In such cases, government support can play a critical role in developing the industries. The best example in this regard is the entry into and eventual success in the aerospace industry by the four European countries (France, Germany, United Kingdom, and Spain) through the Airbus consortium backed up by government subsidies. Obviously, here I am not saying that Japan should have entered the aerospace industry, but only pointing out that even in frontier economies there are many industries that do not suffer from huge technological uncertainties but could nevertheless merit support through traditional industrial policy measures.

Even in an economy at the frontier of technology, industrial policy seems much more needed and feasible than many people believe.

All in all, it would seem that even in an economy at the frontier of technology, industrial policy is much more needed and feasible than many people, including the Japanese industrial-policy officials themselves since the 1990s, believe. It is true that the goals and the forms of industrial policy have to change as the economy reaches the technological frontier, but it is not as if industrial policy becomes irrelevant or impossible in such an economy. Thus seen, I would agree with Chalmers Johnson, a renowned authority on Japan, in arguing that the decline of Japanese industrial policy since the 1990s owes more to the influence of free-market ideology promoted by the United States as a part of its new post-Cold-War international strategy than to a realistic assessment of the limits of its industrial policy (Johnson 2001).

Fortunately, since the late 1990s, the Japanese government seems to have acknowledged the need for a revival of industrial policy – although not necessarily in the same form. Three policies are notable. First of all, the Japanese government has set up public funds to purchase bad debts with public money (such as the Resolution and Collection Corporation (RCC) set up in 1998 and the Industrial Revitalisation Corporation of Japan (IRCJ) set up in 2003) and injected public money from the state-owned Development Bank of Japan (DBJ) and the Japan Small and Medium Enterprise Corporation (JSMEJ) into 'private turnaround funds' in order to facilitate corporate restructuring. Second, the Japanese government is trying to increase public R&D support, both through direct financing and through tax exemptions. Third, the Japanese government is increasing financial support for start-ups in high-technology industries (for further details, see METI 2003). While the results of these policies are yet to be seen, they signify the welcome recognition on the part of the Japanese industrial policy makers that economic maturity does not preclude industrial policy.

5. Conclusions and policy implications

5.1 Some general remarks on 'drawing lessons' from East Asia

Whatever lessons we may want to draw from the experiences of the East Asian economies, we will always encounter the sceptics who question whether the 'unique' institutions and cultural elements of the East Asian countries that underlie their industrial policy regimes are replicable in other countries.

The critical question we need to ask here is whether East Asia is so unique that other countries cannot learn from it. The interesting thing is that many people who express scepticism about the transferability of the East Asian model are quite cavalier when it comes to the transferability of the market-dominated models of the Anglo-American economies. However, what makes them think that the Anglo-American model is more easily transferable than the East Asian model?

Rather than arguing about the validity of various 'East Asian special conditions' (see Chang 2006, chapter 4, for a detailed discussion), I would simply point out that the special-conditions argument can just as easily be applied to the US and UK development as it can to East Asian development. Britain, for example, prospered at a time in history when it could (and did) colonise and/or dominate weaker nations, use slaves, openly sell opium to China, and force young children to work twelve-hour days under miserable working conditions. During its development, Britain also routinely violated foreigners' intellectual property rights and, from 1750 to 1842, maintained a law that banned exports of machinery to competitor economies. The US economy benefited from very similar circumstances. Additionally, the United States benefited from its vast geographic scope (as the government was able to exterminate and/or forcibly relocate Native Americans), a large population of immigrant labour, and its exceptionally rich endowment of natural resources.

Many people who question the transferability of the East Asian model overlook that most of today's industrialised countries used an economic model that was far closer to the East Asian model than to the Anglo-American one.

We could go even further and argue that, historically, the East Asian model has been much more universal than the Anglo-American model. An honest examination of the historical record reveals that most of today's industrialised countries, including the United Kingdom and the United States, used an economic model that was far closer to the East Asian model than to the Anglo-American one (Chang 2002). Thus, if anything, it seems that the East Asian model (in all of its national variants) is closer to a world norm than today's Anglo-American model.

To sum up, every country is unique with regard to its mix of history, culture, ethnic composition, the timing of its development, and so on. Thus, the experience of East Asian countries is no more or no less idiosyncratic than the experience of any other country.

5.2 Determinants of industrial policy successes and failures

In discussing the determinants of industrial policy successes and failures, it needs to be made clear at the outset that we are not short of theoretical justifications for industrial policy of the types used in East Asia.

There are various market failures that justify industrial policy: the presence of specific assets that make free entry and exit socially costly; complementarity between investments across industries; externalities present in R&D efforts and other knowledge-generating investments; infant industry considerations arising from the cost of learning; and the capital market failure that makes long-

term financing more expensive than what is socially desirable (see, for instance, Chang 1994, Stiglitz 1996, Lall 2004, and Chang 2006).

Of course, as we all know, there are many examples of failed industrial policy attempts all over the world (including in the successful East Asian countries). However, the risk of failure should not let us deny the usefulness of industrial policy. Arguing against industrial policy on the basis of its potential risk would be like arguing for the ban of sharp knives on the grounds that some people get hurt using them, while some may even harm others with them. However, if we did that, we would lose the benefits of sharp knives altogether. What we need is a better safety education and a better control over their sales, not a ban on sharp knives.

The success of industrial policy critically depends on how exactly it is designed and implemented.

Recent debates have shown that the success of industrial policy critically depends on how exactly it is designed and implemented. Five points, in particular, are worth making.

First, it matters how realistically the target industries are selected in light of the country's technological capabilities and world market conditions. So, Korea started from exporting cheap garments and wigs, turned to assembling transistor radios and black-and-white TVs, moved on to making automobiles and steel, and then - after having been successful in these endeavours - embarked on the production and exports of semi-conductors and LCD displays. Of course, the difficulty is that people have different views on what is 'realistic' – not many people thought it realistic for Korea to enter the steel and the automobile industries in the early 1970s or for Japan to enter the luxury car market in the mid-1980s. However, the success of the East Asian countries owe a lot to the fact that they did not attempt to make too big a leap.

Second, the East Asian experience shows that it matters a lot how closely industrial policy is integrated with an export strategy, especially – albeit not exclusively – for a small economy. This is for a number of reasons. For one thing, for smaller countries, scale economies cannot be achieved without entering the export market early on – and if one gets the production scale wrong, the unit production cost could go up 2-3 times. There are, however, reasons that apply to larger economies as well. For example, export earning is critical in allowing a backward country, big or small, upgrade, as it provides the means to purchase advanced technologies and machinery. In addition, export market performance can provide a tangible criterion for the policy makers to judge the performances of the enterprises promoted by the government.

Third, the success of industrial policy depends critically on how willing and able the government is to discipline the recipients of the rents that it creates through various policy means (tariffs, subsidies, entry barriers). The point is that the suspension of market discipline, which is inevitable in the conduct of industrial policy, means that the government has to play the role of a disciplinarian. The East Asian governments have not always been fair and effective in disciplining the firms that were not delivering the results in return for government favours, but they have been more successful in this regard than most other countries.

Fourth, how competent and politically insulated the implementing bureaucracy is also plays a critical role for the success of industrial policies. Unfortunately, critics of industrial policy, who often argue that countries without a good bureaucracy should never try industrial policy, have hijacked this sensible point. However, the experience of the East Asian countries themselves contradicts this point. Especially in Korea and Taiwan, the bureaucracy was considered corrupt and incompetent until the 1960s – Korea was sending its bureaucrats to Pakistan and the Philippines for extra training until the late 1960s! The East Asian bureaucracies improved through continuous efforts, not because of some magical historical legacy that others cannot aspire to have.

Fifth, how closely the government interacts with the private sector while not becoming its hostage is very important. In his study of industrial policy in Korea and Taiwan, Evans (1995) has captured this beautifully in his notion of 'embedded autonomy', where it is argued that a government needs to have roots in the society ('embeddedness') but also has to have its own will and power ('autonomy') in order to be effective in its intervention. Autonomy without embeddedness can become dangerous, while embeddedness without autonomy means that the state is turned into Marx's executive committee of the bourgeoisie.

5.3 Lessons for Europe

Before I draw specific lessons for European industrial policy from the East Asian industrial policy experience, I would like to point out that the usual 'transferability' argument against learning lessons from East Asia does not apply to Europe.

For one thing, many European countries share industrial-policy traditions that are very similar to the ones in East Asia, not least because the East Asian countries had learned from the industrial policy experiences in a number of European countries in the past – especially Prussia in the 18th and 19th century and France in the post-war period.

For another, the European countries all have sophisticated policy formulation and implementation capabilities, thus no policy used in East Asia will be 'too difficult' for them (as some of them may be for some developing countries with limited bureaucratic capabilities).

With the above general point in mind, what are the lessons that Europe can learn from East Asia in terms of industrial policy?

East Asian industrial policy lessons point to the importance of long term-oriented institutions, non-budgetary industrial policy measures, and a clear purpose and time limit of government interventions.

First, the East Asian experience shows the importance of institutions that enable long-term-oriented business management. In this, government commitment to promote currently unprofitable industries that have future potentials is important, but other factors count as well. For example, the existence of long-term-oriented banks (development banks, long-term credit banks, and so on) can be important in determining the viability of long-term projects. Also important is the corporate structure. Diversified industrial groups make it possible for new ventures to be subsidised in the earlier (but not necessarily short, as we can see from the Nokia example) stage of their existence. This means that the current push to change the European corporate governance structure into the Anglo-American one that values independent firms may be incompatible with long-term-oriented industrial policy.

Second, the East Asian experience shows that budgetary transfers, traditionally a preferred means of European industrial policy, need not be the most important element of industrial policy. As we mentioned earlier, the East Asian industrial policies were much more influential than their counterparts in other countries, despite relatively small budgetary outlays. Of course, this is not to say that budgetary outlays are bad, nor that they do not matter – it can give clout to a policy vision that may not otherwise be realised. However, fixation with budgetary outlays can constrain policy imagination.

Third, the East Asian experience suggests that the European countries could improve their industrial policies by making the purpose and time limit of government intervention (or private actions sanctioned by the government, such as cartels) more explicit. Especially some of the support for declining industries in Europe has been prolonged beyond their necessity because the exact aim,

scope, and timeframe of this support had not been made clear at the beginning. The way in which the Japanese government masterminded the orderly phasing out of a number of declining industries (or the declining segments of otherwise expanding industries) in the late 1970s and the early 1980s is particularly instructive in this regard (see Dore 1986 for a brilliant study of this experience).

Finally, the decline of industrial policy in Japan – the East Asian country closest to most European countries in terms of the level of technological development – should not be interpreted as a proof that industrial policy becomes ineffective at the frontier of technology. The decline of Japanese industrial policy since the 1990s owes more to ideological conversion of the Japanese elite than to a judgment based on careful assessment of the limits of industrial policy in a frontier economy. As experiences like the US government funding of R&D and the European government's support for Airbus show, certain industrial policies are necessary and beneficial even in a frontier economy.

Annex

Table A. 1 FDI Inflows in percent of gross domestic capital formation for selected countries and regions, 1971-99 (annual average)

	1971-75	1976-80	1981-85	1986-90	1991-95	1996-99
All Countries	n.a.	n.a.	2.3	4.1	4.3	10.2
Developed	n.a.	n.a.	2.2	4.6	3.7	9.6
European Union	n.a.	n.a.	2.6	5.9	6.0	14.5
Austria	1.8	0.9	1.3	1.5	2.9	7.2
France	1.8	1.9	2.0	4.1	7.3	11.5
Germany	2.1	0.8	1.2	2.0	n.a.	5.3
Netherlands	6.1	4.5	6.1	13.3	12.7	35.6
Sweden	0.6	0.5	1.6	4.0	19.0	62.3
UK	7.3	8.4	5.6	14.6	9.5	22.2
Switzerland	n.a.	n.a.	2.3	5.3	4.4	14.4
USA	0.9	2.0	2.9	6.9	4.2	11.0
Canada	3.6	1.7	1.0	5.8	5.8	14.5
Japan	0.1	0.1	0.1	0.0	n.a.	n.a.[1]
Developing	n.a.	n.a.	3.3	3.2	6.4	11.4
Africa	n.a.	n.a.	2.3	3.5	5.8	9.0
Latin America	n.a.	n.a.	4.1	4.2	7.5	18.3
Argentina	0.1	2.1	5.0	11.1	15.8	22.5
Brazil	4.2	3.9	4.3	1.7	2.2	17.1
Chile	-7.3	4.2	6.7	20.6	13.6	35.3
Mexico	3.5	3.6	5.0	7.5	11.8	14.8
Asia	n.a.	n.a.	3.1	2.8	5.9	9.2
Bangladesh	n.a.	n.a.	0.0	0.1	n.a.	3.3[2]
China	0.0	0.1	0.9	2.1	11.1	13.3
Hong Kong	5.9	4.2	6.9	12.9	8.0	32.9
India	0.3	0.1	0.1	0.3	1.2	3.0
Indonesia	4.6	2.4	0.9	2.1	4.7	1.1
Korea	1.9	0.4	0.5	1.2	0.7	4.5
Malaysia	15.2	11.9	10.8	11.7	19.3	16.5
Pakistan	0.5	0.9	1.3	2.3	4.5	7.1
Philippines	1.0	0.9	0.8	6.7	7.4	8.0
Singapore	15.0	16.6	17.4	35.0	30.7	28.0
Taiwan	1.4	1.2	1.5	3.7	2.4	3.6[3]
Thailand	3.0	1.5	3.0	6.5	3.9	11.2
Turkey	n.a.	n.a.	0.8	2.1	2.5	1.8
Eastern Europe	n.a.	n.a.	0.0	0.1	8.4	12.5

Source: Own calculation based on UNCTAD (1993), Annex Table 3 for 1971-80; UNCTAD (1995), Annex Table 5 for 1981-92; UNCTAD (1999), Annex Table B.5 for 1993-95; UNCTAD (2002) for 1996-9.

Notes: 1/ 1.1 percent in 1999; 2/ 1997-9 only; 3/ Data for 1998 are not available.

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ABSTRACT

The European Commission has launched a new industrial policy for Europe, which is reviewed in this paper. *While manufacturing industry remains a key building block of the European economy, it faces a number of challenges – as well as opportunities – in the form of rapid technological change; increasing trade and financial integration of the world economy; and the rise of new emerging market competitors. Whilst some sectors are performing strongly, the overall industrial structure of the EU economy makes it less than ideally positioned to face these challenges. The new industrial policy articulated by the Commission is to help the European economy adapt to the new circumstances. In contrast to old policies that sought to 'pick winners', the new approach starts from the screening of horizontal policies and framework conditions in terms of their implications for specific industrial sectors. Second, the Commission has integrated policy by bringing more closely together different policy dimensions of key relevance to various industries. Finally, the new approach attempts to achieve a greater consensus over policy, through the involvement at an early stage of key stakeholders and Member States in policy making.*

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The European Commission's new industrial policy

1. Introduction

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In October 2005, the European Commission (2005a) announced a new industrial policy for Europe in the form of a Communication entitled "Implementing the Community Lisbon Programme: A Policy Framework to Strengthen EU Manufacturing – Towards a More Integrated Approach for Industrial Policy". This policy forms a key part of the Commission's commitment to focus on growth and jobs as a necessary means to preserve the European Union's (EU) social cohesion and maintain high environmental ambitions in Europe.

Manufacturing industry is important for the EU economy. It directly provides around a fifth of EU output and employs some 34 million people. However, manufacturing's importance to the dynamism and competitiveness of the EU economy is much greater than its size might suggest. To start with, manufacturing is key to exploiting the new knowledge economy: over 80 percent of EU private sector research and development (R&D) expenditures are spent in manufacturing. Manufacturing industries therefore provide the major impetus for the development and adoption of new technologies, and they are a key driver of productivity growth.

Moreover, the share of manufactured products in international trade is far larger than that of services. Manufacturing provides some three-quarters of EU exports, thus dominating the current account balance. The ability of the economy to pay for energy and the import of other basic resources therefore depends on manufacturing exports.

Finally, manufacturing makes intensive use of inputs from other sectors of the economy, creating growth and jobs in the wider EU economy. Input-output tables indicate that manufacturing sales are around three times as large as manufacturing value added. For example, as documented in European Commission (2005b), manufacturing's purchases from the services sector alone amount to some two-thirds of manufacturing value added.

The need for a new and modern industrial policy is therefore almost indisputable. Of course, modern industrial policy has to be sophisticated and intelligent. It is nowadays illusory to think that one can select winning technologies and sectors and try to determine exactly where and how jobs should be created. Nor is it possible in today's closely integrated world economy to try to resist globalisation and structural change.

Instead, the role of industrial policy is to provide the right framework conditions for enterprise development and innovation and to help manage the process of industrial change. This will help make the EU an attractive place for industrial investment and job creation. In addition, industrial policy has a key role to play in addressing market failures and complex coordination issues where technological development, standard setting, and the generation of wider benefits to society are linked.

This means that industrial policy covers three distinct, but interrelated elements. First, it is to optimise horizontal framework conditions, as it is necessary to ensure that 'horizontal' policies, such as for example competition policy or R&D policy, are conducive to the development of competitive and innovative enterprises.

Second, it is to optimise sectoral framework conditions through the development of appropriate regulatory frameworks for individual sectors, including at both national and EU level, with the aim to promote competitiveness.

And third, where markets fail due to externalities or complex coordination problems, a sectoral approach is justified. This is likely to be especially important in respect of technology development in conjunction with standard setting and the procurement of (quasi-)public goods. Clearly, this third, more activist, approach will have to be firmly based on robust economic criteria and analysis to avoid a return to the 'picking-the-winners' policies of the past.

Given that the competences for the policy tools are partly at Community level and partly at Member State and even regional level, coordination of initiatives across different policy levels is essential. Indeed, the Treaty asks the Community and the Member States to coordinate their industrial policies.

2. The challenges for industrial policy

The changing nature of manufacturing production and globalisation are clear challenges for EU industrial policy.

The European Commission (2005a) identified two clear challenges for EU industrial policy. First, the nature of manufacturing production continues to change profoundly. Fast technological changes are taking place across the globe. In many industries, traditional manufacturing methods of mass production are being replaced by more adaptable production runs, using intelligent and multitask production equipment. Global production networks are putting a premium on reducing costs and increasing flexibility. Moreover, in increasingly knowledge- and technology-intensive industries, intellectual property, network externalities, and industry standards are ever more important to competition and competitiveness.

Most notably, the information and communication technology (ICT) industries have seen an enormous expansion of technological opportunities resulting in strong increases in both output and productivity. Also, the development of biotechnology and other life sciences technologies has provided the basis for new industries, but raised new challenges in terms of financing R&D and protecting intellectual property. Furthermore, the spill-over effects of these new general purpose technologies provide both challenges and opportunities for other sectors of manufacturing. Major reorganisations of business methods, management techniques, and work practices are required to benefit fully from the new opportunities.

The second challenge for EU industrial policy is globalisation, which is here to stay. The EU cannot turn back the clock. Global production networks are reducing costs and increasing flexibility. In particular, the Asian emerging market economies are today taking their place and fully participating in global markets. The rising internationalisation of production is driven by improved transport linkages and falling communication costs; reduced trade barriers (both tariffs and non-tariff barriers) as a result of successive trade rounds; increased financial integration of the world economy, leading to increased competition for international investment; and an increasingly well-trained scientific and engineering workforce, including in the newly emerging market economies, leading to intensified competition for R&D spending.

Overall, this increasing internationalisation offers enormous opportunities for the EU. But naturally it also intensifies competition for the EU as a location for investment, production, and R&D spending. Of course, the path to globalisation is not easy. There is a need to overcome and manage sometimes

difficult adjustments. However, on the whole, globalisation can and should bring strong benefits for Europe: the EU is the biggest trading bloc in the world and it has most to lose from any rise in protectionism.

3. The performance of EU manufacturing industry

In spite of these challenges, there are reasons to be confident about EU manufacturing industry's place in the world and about its future. Commission analyses show that EU industry has not, by and far, performed as badly as often presumed. The majority of individual EU manufacturing sectors have performed well in comparison with their counterparts in other industrialised economies. Important EU manufacturing sectors like pharmaceuticals, mechanical engineering, chemicals, and motor vehicles sectors have a substantial revealed comparative advantage and record trade surpluses against the rest of the world.

The EU's industrial structure is less than ideal to face globalisation.

Nevertheless, the industrial structure of the EU economy as a whole makes it less than ideally positioned to face the ongoing globalisation process.

First, there has clearly been a productivity growth differential between the EU and other industrialised economies, particularly the United States. To a large extent this has been due to an industrial composition effect. In particular, the ICT-producing sectors are among the growth engines of the US economy. They grow faster and their share in the whole economy is bigger than in Europe. In contrast, some other sectors of EU manufacturing have performed very strongly in relation to the US industry, notably chemicals, motor vehicles, and mechanical engineering.

Second, the industrial structure of the EU economy as a whole makes it less than ideally positioned to face the ongoing globalisation process. Much of EU trade is still concentrated in sectors with medium-high technologies and low to intermediate labour skills (European Commission 2005b and 2005d). This exposes EU countries to competition from producers in emerging economies that are upgrading the skill intensity of their exports and catching up in terms of the non-price factors that often underlie the EU competitive edge on world markets. Hence, adaptability and structural change, allowing a shift towards a more robust situation of comparative advantage, are critically needed if the EU is to maximise the gains from the integration of China, India, and other fast growing economies into the world economy.

Third, whilst EU foreign direct investment flows towards the emerging Asian economies have increased in recent years, their share in total flows remains limited (European Commission 2005d). International relocations of EU jobs to low-cost countries are limited in most manufacturing sectors. Nevertheless, they can still have painful consequences for particular regions and individual sectors, especially as regards lower-skilled workers, thus justifying actions to try to reduce the social and economic costs of these changes.

Fourth, there is newly emerging evidence of increasing international competition for R&D spending (European Commission 2005c and 2005d). Indeed, there is some evidence that the EU is not competitive enough as a location for research. The United States and Japan are attracting more international R&D expenditure than the EU and there is emerging evidence that countries such as China and India are becoming important locations for new R&D investments. The United States has also been more successful than the EU in attracting researchers and highly skilled staff. These trends are a matter of considerable concern in so far as they lead to a loss of R&D investment and researchers from the EU.

4. Policy screening of industrial sectors

The challenge for industry is to maintain and further improve its performance in the future in an environment of ongoing technological breakthroughs and continued internationalisation. How can EU policy makers give a clear and coherent response to these challenges and concerns and make substantial improvements to the general environment in which European industry operates?

The European Commission has made in-depth analyses of 27 manufacturing sectors.

European Commission (2005e), with inputs from stakeholders and the Member States, contains a detailed analysis of 27 manufacturing sectors, identifying for each of them their strengths, weaknesses, and priority challenges. The screening aims to determine to what extent their performance is or could be influenced by the instruments of industrial policy. Policies of particular importance for sectoral productivity growth and international competitiveness include measures to ensure an open and competitive Single Market, including competition policy; the creation of knowledge (such as research), innovation, and skills; better regulation; synergies between competitiveness, energy, and environmental policies; full and fair participation in global markets; and social and economic cohesion

The screening process has resulted in the identification of the most important competitiveness and policy challenges for each individual sector, both quantitatively and qualitatively, as detailed in the Annex. The Commission has identified four main manufacturing groupings, each facing broadly common challenges. These sub-sectors are discussed below, and their share in total manufacturing and their growth rates are summarised in Table 1.

The first group is the food and life sciences industries, including the biotech, pharmaceuticals, and cosmetics sectors. These sectors make up almost 20 percent of EU manufacturing output, with some of the life sciences industries growing particularly fast and having high R&D expenditures. As highly innovative industries, key knowledge challenges for them are R&D, protection of intellectual property rights, and the financing of innovation for highly innovative SMEs. Better regulation of these industries is another key challenge. They rely upon the continued adaptation and updating of regulations in the Single Market to keep up with technological progress, whilst ensuring health and safety standards. International regulatory convergence is also an issue for many of them.

The second group comprises the machine and systems industries, including notably ICT, engineering, motor vehicles, aerospace, and shipbuilding. These industries make up about a third of EU manufacturing value added, and they are characterised by medium to high growth rates and by high rates of R&D spending. These industries also face knowledge challenges, related – in particular – to raising R&D spending, intellectual property protection, and widening and deepening of their skill base. The regulatory environment is also important for many of these industries since their market depends on technical standards. Gaining better access to international markets, many of them still protected, is also of key importance for these industries.[1]

The fashion and design industries, in turn, include the textiles, clothing, leather, footwear, and furniture industries. They account for some 8 percent of manufacturing value added, but their output has been contracting over the last ten years. For these industries, the key challenge is to make structural adjustment successful by moving up the product quality ladder. Obtaining better access to currently heavily protected world markets is also a key requirement for these industries.

1 The motorcar, aerospace, and shipbuilding industries are facing environmental challenges, particularly the need to continually improve the environmental performance of their vehicles, planes, and ships, without compromising their competitiveness *vis à vis* non-EU producers.

Finally, the basic and intermediate goods industries – including chemicals, steel, pulp and paper, and so on – account for some 40 percent of manufacturing value added. As suppliers of key inputs for the rest of the EU industry, these industries can be an important source of innovation. Growth rates in this group have been medium to low. These industries are largely energy intensive; hence, their main challenges relate to energy and the environment. Important sector-specific challenges include the new EU legislation framework for chemical industry (known as REACH) and legislative simplification issues for the construction sector. Structural adjustment is an important issue for some industries, such as the ceramics, printing, and steel industries.

Table 1. Share and growth of sub-sectors in European manufacturing (in %)

	Share in manufacturing value added (2004)	Average annual growth rate 1993-2004
Food and life sciences	18.1	2.4
Machine and systems	33.1	3.5
Fashion and design	7.5	-2.0
Basic and intermediate goods industries	41.3	2.1
Total manufacturing	100.0	2.3

Source: Eurostat

5. Improving the framework conditions for EU manufacturing in competition and research policy

The Commission has started to improve industry's framework conditions in the fields of competition and research policies.

In the context of the Lisbon strategy, the Commission has already made a start in improving the framework conditions for industry in two key policy fields, namely those of competition policy and research policy.

In June 2005, the Commission announced a comprehensive, coherent, and far-reaching reform of state aid policy, designed to take a more economic approach to state aid policy, focusing on market failures and avoiding market distortions. A particular focus has been the reform of state aid policy in relation to innovation and R&D. Following a consultation on state aid for innovation (European Commission 2005f), a new draft "Community Framework for State Aid for R&D and Innovation" was issued in April 2006. Under these proposals, the scope of allowable state aid would be increased to cover many aspects of the innovation process, subject to aid proportionality as well as the avoidance of distortions to competition and the location of trade flows and investment.

Concerning research policy, for a number of years the Commission has been encouraging the development of European Technology Platforms (ETPs; European Commission 2005g). There are now 29 ETPs with 'strategic research agendas' that play an important voluntary role for shaping industrial and policy strategies in key technology domains. In its Seventh Research Framework Programme (European Commission 2005h), the Commission proposed that some of these should be developed into Joint Technology Initiatives to work as an innovative mechanism for supporting industrial research. Reflecting the Commission's proposal, the Competitiveness Council agreed an identification process involving the following set of criteria (to be successively applied): (i) strategic importance of the topic and presence of a clear deliverable; (ii) existence of market failure; (iii) concrete evidence of Community value added; (iv) evidence of substantial, long-term industry commitment; and (v) inadequacy of existing Community instruments.

Finally, the Communication on Research and Innovation (European Commission 2005i) set out a new, integrated approach to policies and actions in support of research and innovation, which included many initiatives highly relevant for industrial sectors.

6. New horizontal initiatives for EU manufacturing

Seven major cross-sectoral policy initiatives have been announced.

In the light of the screening process, seven further major cross-sectoral policy initiatives were announced to address the common challenges across different manufacturing sub-sectors and to reinforce the synergies between different policy areas taking into account competitiveness considerations. These seven initiatives are discussed below in turn.

High-Level Group on Competitiveness, Energy, and the Environment. Competitiveness, energy, and environmental policies are closely interrelated and their impact is of significant importance, in particular for many basic and intermediate product industries. In order to develop an integrated approach to these policies, whilst improving both sustainability and competitiveness, the High-Level Group on competitiveness, energy and the environment was set up early in 2006 at Commissioner-level, with the participation of Member States and a balanced group of all relevant stakeholders. The objective is to create a stable and predictable regulatory framework for competitiveness, energy, and the environment. Amongst the initial issues to be addressed are: (i) the functioning of energy markets, particularly the electricity market; (ii) climate change – particularly the emissions trading scheme – energy efficiency, and renewables; (iii) the improvement of resource efficiency and the adoption of environmental and other innovative technologies; and (iv) the impact of legislation on energy-intensive industries.

External aspects of competitiveness and market access. Access to international markets is a priority issue for most sectors. The Commission is currently working on a Communication on the revision of Market Access Strategy, reviewing the existing strategy and instruments to focus on those sectors and markets with greatest potential for strengthening competitiveness. In cooperation with stakeholders, a detailed strategy will be developed and implemented to tackle barriers in the selected sectors and countries. A specific market access action plan has already been introduced for textiles, and it has been expanded to cover leather and footwear products. A wider process of reflection and debate on the external aspects of EU competitiveness will also be initiated through a further Communication dealing, *inter alia*, with trade issues related to intellectual property rights, regulatory issues, investment and government procurement, particularly the possibility of creating instruments that would improve incentives to third countries to negotiate the reciprocal opening of their public procurement markets.

New legislative simplification programme. Better regulation at various levels has been identified as a key challenge for several sectors, including construction, motor vehicles, ICT industries, and the food and life sciences industries. In addition, waste regulations have been identified as important to a wide range of different sectors, particularly SMEs. The Commission has subsequently set out a Simplification Work Programme in a Communication on Legislative Simplification (COM (2005) 535, published in November 2005). In the Communication, three priority areas were identified for this approach: the automotive sector, the construction sector, and waste legislation. In fact, the CARS 21 High-Level Group has already accomplished the screening of existing legislation in the automotive field and made recommendations (see Section 7 below).

An intellectual property rights and counterfeiting initiative. Intellectual property rights (IPR) are of key importance for competitiveness. While important progress has been made, more could

be done to ensure that the regulatory framework stimulates innovation, provides stability for investment, and encourages the development of efficient new business models. The framing of such IPR rules to balance the needs of all stakeholders is by no means easy. The Commission is therefore launching a dialogue with industry and other interested parties to determine what more might usefully be done to provide the European industry with a sound IPR framework. In addition, the proper enforcement of IPR within the internal market and in third countries is of the highest importance. IPR infringements can jeopardise public health and safety as well as threaten innovation. Counterfeiting continues to be a major problem for many industries. The Commission is therefore reviewing the state of progress in the whole area of IPR enforcement. In this context, the Commission has been working with the US government to develop a Joint IPR Enforcement Action Strategy in time for the 2006 EU-United States Economic Summit.

Improving sectoral skills. Skill shortages were identified as a key challenge in a wide range of different industries, including the ICT and engineering industries, the textile and leather industries, and a number of basic and intermediate goods industries. Moreover, there is some evidence that relocation of industrial activity is in some cases motivated more by skill shortages than by cost factors. The Commission has already begun to address skill shortage issues through a number of policies, such as the Education and Training 2010 work programme, including the European Qualification Framework (EQF). To supplement these existing initiatives, the Commission is making assessments of the nature of the sectoral skill problems, including the identification of current and likely future skill gaps and effects on SMEs. Building upon the on-going work by Cedefop[2], this information base would allow the articulation of future specific policy initiatives in the light of sectoral competitiveness requirements.

The EU has some useful levers at its disposal to anticipate and accompany structural change.

Managing structural change in manufacturing. Whilst the private sector has the primary responsibility for undertaking structural adjustment, the EU has useful levers at its disposal to anticipate and accompany change, as acknowledged in the development of the European Globalisation Adjustment Fund (EGF)[3]. The EGF will complement the efforts of the Member States at national, regional, and local levels by providing one-off funding for measures such as job search assistance and retraining to enable workers to find and retain a new job. Moreover, the Commission intends to ensure that the positive management of economic restructuring is included in the new Structural Funds programmes for 2007-2013, including support for the modernisation of labour markets and the structural adjustment of industries, alongside active measures to reinforce regional economic wellbeing and to improve cooperation between regions facing similar problems and challenges.

An integrated European approach to industrial research and innovation. As part of the follow up to the Communication on Research and Innovation, a European Industrial Research and Innovation Monitoring System will be established in 2006 to provide a consolidated overview and analysis of developments relevant to industrial research and innovation, and a conduit for stakeholder views. This will ensure the availability of industry- and policy-relevant data and intelligence, helping to anticipate both barriers and opportunities to improving research and innovation investment and the commercialisation of new technologies in Europe. A high-level stakeholders group, including policy maker representatives, will be set up to provide guidance and feedback on the focus and relevance of this activity for competitiveness.

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2 Cedefop is the European Centre for the Development of Vocational Training. Established in 1975, it is a European agency that helps promote and develop vocational education and training in the EU..

3 "Proposal for a Regulation of the European Parliament and of the Council Establishing the European Globalisation Adjustment Fund" (3 March 2006).

7. New sectoral initiatives for manufacturing industry

In addition to the cross-sectoral initiatives, the Commission is proposing a series of specific new initiatives for individual sectors. In the shipbuilding, textile, and motor vehicles sectors, very good experiences with the model of sector initiatives have already been made. Therefore, new initiatives are starting in the next months, for sectors such as pharmaceuticals, defence, space, information technology, mechanical engineering, chemicals, and life sciences and biotechnology.

The Commission is also proposing sector-specific strategies.

These initiatives will vary from sector to sector, depending on the priority issues for each sector. What is common to them, however, is that the Commission wants to consult with industry, other stakeholders such as the trade unions, the Member States, and the European Parliament, in order to elaborate a sectoral strategy to improve the context for the sector. The strategy will contain recommendations addressed to the EU institutions, Member States, and the industry itself to improve the overall competitiveness of the sector.

As an example, the recent CARS 21 High-Level Group recently issued a report on the major policy areas that impact on the competitiveness of the European automobile industry. The recommendations included: (i) the simplification of legislation, recommending the replacement of 38 directives by the regulations of the UN Economic Commission for Europe, the introduction of self- or virtual testing where appropriate, and the repeal of another outdated directive; (ii) the improvement of the environmental and road safety performance of vehicles; (iii) multilateral and bilateral international trade negotiations to better safeguard intellectual property; (iv) the development of further research and development cooperation between the EU and industry; and (v) a possible EU directive on passenger-car related taxation.

In terms of the new initiatives, for instance, the new Pharmaceuticals Forum is addressing the fragmentation of the European pharmaceutical market, focussing on R&D issues and regulatory matters at Member State level. The Pharmaceuticals Forum will consist of Member States at the ministerial level, senior representatives of industry, and other key stakeholders, such as patients and health professionals.

In addition, a series of sectoral competitiveness studies have been proposed. These studies will be used to identify future policy initiatives.

8. A new policy for EU manufacturing

The outline of work set out in this paper involves a new approach to industrial policy, aimed at achieving better designed policies that are more relevant and integrated for the EU manufacturing industry.

The new approach starts from the screening of horizontal policies and framework conditions in terms of their concrete implications for specific industrial sectors. This approach makes it easier to identify those policies and framework conditions that are most relevant for each sector.

Second, the Commission has linked together under a single initiative a number of different policy dimensions of key relevance to a number of industries. Such policies may lie in the domains of a number of different Commissioners and Directorates-General. Bringing together such policy dimensions will provide increased coherence and integration between policy areas, with a more powerful effect on competitiveness.

Finally, the new approach attempts to achieve a greater consensus over policy through the involvement at an early stage of key stakeholders and Member States in policy making. Both Member States and the European social partners will therefore contribute to this work, both at the horizontal and sectoral level.

Annex

Table A1. Key EU competitiveness and policy challenges by sector

	Industry	Knowledge				Better regulation				Environment & Energy [2]				
		R&D/ Innvation	IPR, Counter-feiting	Skills	Access to finance for SMEs	Admin. burden/ Complexity of sectoral regulation	Internal Market	Health and Safety	Technical Standards	Climate change [1]	Waste	Water	Air	Intensive Energy Use
Food and Life Science Industries	Food, drink & tobacco	X				X					X	X		
	Cosmetics	X					X	X						
	Pharmaceuticals	X	X	X	X		X	X						
	Biotech	X	X		X	X		X						
	Medical devices	X			X		X	X						
Machine and System Industries	ICT [3]	X	X	X		X			X		X			
	Mechanical engineering	X	X	X	X		X [10]							
	Electrical engineering	X	X	X	X		X [10]							
	Motor vehicles	X	X	X		X	X			X	X		X	
	Aerospace	X												
	Defence industries	X					X							
	Shipbuilding	X	X	X										
Fashion and Design Industries	Textiles	X	X	X								X		
	Leather and leather goods	X	X	X							X	X		
	Footwear	X	X	X										
	Furniture	X	X	X										
Basic and Intermediate Goods Industries	Non-energy extractive industries	X		X							X	X		
	Non-ferrous metals			X						X	X		X	X
	Cement and lime									X	X		X	X
	Ceramics		X							X	X		X	X
	Glass		X							X	X		X	X
	Wood & products of wood	X		X					X	X	X			
	Pulp, paper & paper products	X								X	X	X		X
	Printing & publishing	X		X							X	X	X	
	Steel	X		X						X	X	X	X	X
	Chemicals, rubber, and plastics	X						X		X	X	X	X	X
	Construction	X		X		X	X	X	X		X			

Industrial R&I Monitoring System

IPR

«Improving Sectoral Skills»

New Legislative Simplification Programme

HLG on Competitiveness, energy, and environmental

Table A1. (continued)

	Industry	Trade				Structural change	Sector specifities	Sectoral actions [4]
		Access to markets	Access to raw materials	Trade distortions subsidies/ dumping	Regulatory issues			
Food and Life Science Industries	Food, drink & tobacco	X	X			X		
	Cosmetics	X			X			
	Pharmaceuticals	X			X			Pharmaceutical Forum
	Biotech						X [5]	Mid-Term Review of Strategy «Life sciences and bitoechnology»
	Medical devices				X			
Machine and System Industries	ICT [3]	X			X			Taskforce on ICT Competitiveness
	Mechanical engineering	X						Dialogue for mechanical engineering
	Electrical engineering	X					X [6]	
	Motor vehicles	X			X	X		CARS 21 HLG
	Aerospace			X				European Space programme/ GMES
	Defence industries							HLG Defence
	Shipbuilding			X		X	X [7]	HLG LeaderSHIP 2015
Fashion and Design Industries	Textiles	X				X		
	Leather and leather goods	X	X			X		
	Footwear	X				X		
	Furniture	X				X		
Basic and Intermediate Goods Industries	Non-energy extractive industries						X [8]	
	Non-ferrous metals		X					
	Cement and lime							
	Ceramics	X		X		X		
	Glass	X						
	Wood & products of wood	X	X					
	Pulp, paper & paper products		X	X				
	Printing & publishing					X		
	Steel		X	X		X		
	Chemicals, rubber, and plastics			X			X [9]	HLG (2007)
	Construction							

Notes: The table indicates with crosses the cases in which a policy challenge is considered of the highest priority for each sector amongst the many relevant policy challenges. Hence the absence of a cross does not therefore necessarily denote that the challenge is unimportant to a sector, only that it is not considered as one of the issues of greatest priority.

1 With regard to installations belonging to energy activities all sectors fall under the ETS provided the installation in question is above the capacity threshold indicated in Annex I of the Emisisons Trading Directive 2003(87) EC. The sectors marked in this table are included in the ETS for their process related CO^2 emissions. 2 Many sectors will also be affected by the new legislation framework for chemicals (REACH). 3 ICT: challenges are sector specific; ICT uptake is a general challenge for the industry. 4 Includes legislative actions and/or actions involving members of the Commission. 5 GMO. 6 Energy Using Products (EUP). 7 Financial instrument. 8 Access to land. 9 Energy and feedstock costs, logistics. 10 Market surveillance.

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