

2 An innovation-driven industrial policy for Europe

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1 Introduction

With the stated objective of both curbing inflation and fighting global warming, the American administration has enacted the so-called Inflation Reduction Act (IRA). This law gives the green light to a considerable increase in public spending of \$737 billion over ten years, including \$369 billion in tax credits and subsidies.

The protectionist consequences of the IRA are fairly obvious. In particular, it provides for a subsidy of up to \$7500 for any American consumer who purchases an electric car assembled in the United States, and that has batteries relying on at least 40 percent US input components. It also offers generous tax exemptions to any producer of solar panels that chooses to operate on American soil, and it heavily subsidises green research and development activities that are being carried out in the United States. Consequently, some companies have decided to freeze projects elsewhere and relocate to the US.

The IRA penalises not only European producers of electric cars, such as BMW or Fiat, but also European firms that operate already in the US but which rely on production chains partly located in other countries.

How can Europe react to the IRA and preserve its competitiveness worldwide? How can it stop and hopefully reverse the declining trend in its industrial production and exports? How can it avoid being leapfrogged by China and becoming an innovation laggard? European industrial policy is part of the answer, provided it is adequately designed and financed.

2 The case for industrial policy

In the years following the Second World War, national industrial champions were at the forefront of industrial policy in many developed countries. In France, this pro-champion policy was a pillar of the reconstruction of the economy and of the thirty years of post-war growth. In the United States, it played a decisive role in particular for the defence, aeronautics and aerospace industries in pursuit of supremacy over the Soviet Union. At the same time, the World Bank, under the direction of Robert McNamara, supported trade protection and import substitution in developing countries, to allow them to nurture their infant industries.

The infant industry doctrine can be summarised as follows (List, 1841). Consider a developing country with two sectors of activity: a large agricultural sector and a nascent domestic manufacturing sector. This country wishes to develop its manufacturing sector because of the resulting positive technological externalities on the economy as a whole. Manufacturing, however, entails high initial fixed costs that will decrease over time thanks to experience and learning-by-doing. Total and immediate liberalisation of international trade would lead this country to import manufactured products from developed countries, where they are initially cheaper to produce. This in turn would lead to less local manufacturing activity, less learning-by-doing, and thus less technological progress and domestic growth. To avoid these repercussions, proponents of the infant industry argument endorse temporary protectionist policies, such as provisional tariff barriers, so that infant industries can grow and catch up to the technological frontier.

Over time, industrial policy fell out of favour. Little by little, economists became aware of the problems it creates in practice. First, it favours existing large domestic firms – the national champions – thus limiting or distorting competition. But we know that product market competition is key for innovation and productivity growth: more competition induces firms to innovate more intensely in order to surpass their rivals (Aghion *et al*, 2005). Second, governments are not great

at picking winners, that is, choosing which firms they should support with subsidies or tariffs, as they do not have access to all of the relevant information. Furthermore, they may be receptive to lobbying by large incumbent firms. The larger the resources of these firms, the more they are in a position to influence public policy. Anne Krueger (1993, 1995) was among the most forceful and vocal opponent of industrial policy.

This challenge led to a preference for what are known as 'horizontal' policies for stimulating innovation and growth, meaning policies that apply to all sectors of the economy (Acemoglu *et al*, 2006; Aghion and Howitt, 2006). Among the main vectors of horizontal policy are: 1) investing in the knowledge economy (especially higher education and research); 2) reforming labour and product markets to make them more dynamic, through appropriate policies for competition, unemployment insurance and professional training; and 3) developing venture capital and private equity to provide funding for innovation.

Are these horizontal measures enough? Or does the state still have a role to play in industry, and if so, what is that role? Objections to industrial policy from the 1950s through the 1980s are difficult to counter, especially because later work, such as that of Laffont and Tirole (1993), pointed to several sources of inefficiency in state intervention, because of asymmetric information or the potential for collusion between some private actors and the state. Still, this alone does not disqualify state intervention, which remains legitimate for several reasons. One reason is the existence of positive knowledge externalities, such as patents, that individuals do not take into account. An individual deciding whether to invest in education or in R&D does not take into account the positive externalities on his or her co-workers, or on the economy as a whole. As a consequence, individuals tend to underinvest in education and in R&D. Credit constraints exacerbate this tendency. Still, this does not justify state intervention that is not purely horizontal.

A first argument in support of a non-horizontal industrial policy is the phenomenon known as path dependence. A quintessential example is green innovation. For example, car manufacturers that innovated

in combustion engine technology in the past will tend to innovate in combustion engine technology in the future because of path dependency (Aghion *et al*, 2016). Imposing a carbon tax or subsidising green innovation makes it less costly to adopt a new technology and redirects the innovation activities of car manufacturers to electric engines. This example shows that governments have a role to play, not only in stimulating innovation in general, but also by directing innovation through targeted interventions.

Another argument has to do with problems of coordination. Bolton and Farrell (1990), and Rob (1991), suggested that government action can help resolve coordination problems, thereby enabling or accelerating entry into strategic sectors where the initial fixed costs of entry are high. Consider a new potential market for which entry is costly and where future profits are uncertain and depend on information (such as the level of consumer demand) that cannot be known until the market is active. No single firm wants to be the first to pay the fixed costs of entry. Every firm prefers to let other firms bear the fixed costs first, and then to benefit from the information they generate, without bearing the risk and cost of acquiring this information. In other words, the absence of state intervention leads to the free-rider phenomenon, which results in delay or even an impasse in creating the market. To solve this problem, the state can subsidise the first entrant, which encourages other firms to follow its example.

This coordination argument explains the success of state intervention in the aeronautics industry (Boeing, Airbus), where fixed costs are high and demand is uncertain. It also explains the success of the US Defense Advanced Research Projects Agency (DARPA), established in 1958 to facilitate the transition from basic research to applied research and marketing for breakthrough innovations ('tough technologies'), where this transition entails substantial fixed costs and requires coordinated efforts by various economic actors (Azoulay *et al*, 2019). We discuss DARPA in more detail below.

3 Governing industrial policy

Once we recognise that industrial policy can be useful, how can we determine in which sectors the state should intervene? Policymakers should first address economic and social priorities including fighting climate change and developing renewable energies, health, and defence. After that, they should focus on sectors that use highly skilled labour or have a high degree of competition. Thus, a study analysing international microeconomic data showed that public investments targeting skill-intensive sectors are more effective in stimulating productivity growth (Nunn and Trefler, 2010). Similarly, a study based on Chinese data showed that targeting more competitive sectors helps stimulate productivity growth (Aghion *et al*, 2015).

The question then arises of the governance of industrial policy and sectoral state aid. A priority is for industrial policy to be competition-friendly. Thus, Aghion *et al* (2015) showed that sectoral aid stimulates productivity growth more when it is not concentrated on a single firm or a small number of firms – in other words if the aid operates to maintain or increase competition in the sector.

Equally important is to minimise the extent to which subsidising incumbent firms discourages the entry of new, higher-performing firms (Acemoglu *et al*, 2018). Subsidising established firms can hinder the entrance of new, more innovative firms as a result of a reallocation effect: incumbent firms increase the demand for skilled labour and other factors of production, thereby increasing their cost. This extra cost in turn reduces the profits that potential new entrants can expect, discouraging them from entering the market.

Aghion *et al* (2019) illustrated this reallocation effect in an analysis of how the Eurosystem's Additional Credit Claims (ACC) programme, implemented in February 2012 by the European Central Bank, affected firm dynamics in France. Mario Draghi, ECB president at the time, created this programme to prevent a recession in the euro area following the 2008-2009 financial crisis. The idea was as follows: in the euro area, banks could pledge high-quality corporate loans as collateral for

refinancing from the ECB. These loans thus enabled banks to obtain additional liquidity. Firms that are most likely to repay their debt have a rating of 1. They are followed by the firms rated 2, then 3, then 4, then 5, with decreasing probabilities of repaying their debt. A rating of P means the firm is close to bankruptcy. Before February 2012, commercial banks could use only loans to firms rated better than 4 as collateral for refinancing from the ECB. The ACC programme extended eligibility to firms rated 4.

What happened after implementation of the ACC programme? The first consequence was that loans to firms rated 4 increased relative to loans to firms with a rating worse than 4, in particular those one step below, at 5+. The second consequence was that the productivity growth of firms rated 4 increased. In other words, relaxing credit constraints on these firms allowed them to invest, in particular in innovation. But this positive effect was offset by a reallocation effect: the implementation of the ACC programme reduced the fraction of firms rated 4 that exited the market, and the biggest impact was on the lowest-performing firms in terms of initial productivity. In other words, the ACC programme impeded the replacement of the lowest-performing firms rated 4 by new, potentially higher-performing firms.

The existence of a reallocation effect pointed out by the above-mentioned studies suggests that any public policy to subsidise firms should take into account the impact of the policy not only on existing firms, but also on potential new entrants to the sector.

Next, sectoral state aid should be regularly reassessed to avoid the perpetuation of programmes that prove ineffective. Co-financing by state and private investors, such as development banks, can facilitate the establishment of adequate exit mechanisms.

Overall, industrial policy is not a 'yes or no' issue; the question is rather to redesign the governance of industrial policy to make it more compatible with competition and, more generally, with innovation-led growth.

4 The DARPA model

The so-called DARPA model is a successful attempt at reconciling industrial policy with competition and entry. DARPA is a research agency within the US Department of Defense, responsible for innovations with military applications. The history of DARPA's success demonstrates that a well-managed industrial policy can successfully foster rather than inhibit innovation. DARPA was created after the United States lost a battle in the space race against the Soviet Union: in October 1957, the Soviet satellite Sputnik became the first artificial satellite to orbit the earth. This event had a huge international impact. It substantiated the advance of the Soviet space programme and stunned the American public. Lyndon B. Johnson, then a senator, wrote of *"the profound shock of realising that it might be possible for another nation to achieve technological superiority over this great country of ours"* (Johnson, 1971). Within five months, in February 1958, even before the creation of NASA, President Eisenhower established DARPA as America's primary tool in the military race and the space race against the Soviet Union.

DARPA still exists, and its novel model has been studied in detail (Azoulay *et al*, 2019). In areas such as defence and space exploration, it is difficult to make the transition from basic research to implementation and marketing. This can be represented by an S curve. The beginning of the curve represents the origin of a concept to which not much development effort has been devoted because the returns on such efforts are low. The median part of the curve corresponds to the take-off phase: returns on development efforts are higher, enabling the technology to advance more quickly. Lastly, the phase of maturity implies diminishing returns to development efforts and slower improvements to the technology. Because the initial phase requires substantial efforts, the anticipated social gains from future exploitation must be considerable in order for the project to generate interest and be eligible for DARPA funding. Accordingly, DARPA projects have three characteristics: they are midway between basic and applied

research; it is possible to organise research toward a precise objective; and the existence of coordination problems makes large-scale funding and testing of the technology difficult without public intervention.

This model of scientific development enabled the United States to catch up steadily with the Soviet Union in the space race. Even though in the initial years after DARPA was created the USSR had a series of successes, thanks to an equally ambitious space programme (for example, the first animal in space in 1957, the first man and first woman in space in 1961 and 1963, respectively, and first unmanned lunar landing in 1966), the United States ultimately won the race in 1969, when it first landed humans on the moon. Today, DARPA's annual budget is over \$3 billion, and it funds over one hundred programmes. DARPA has played a decisive role in the development of high-risk projects with high social value, such as the internet, originally called Arpanet (at the time DARPA had been renamed ARPA), and GPS.

The DARPA model is particularly interesting because it combines a top-down approach with a bottom-up approach⁴. On the top-down side, the Department of Defense funds the programmes, selects the programme heads and hires them for a three- to five-year period. On the bottom-up side, the programme heads, who come from academia or the private sector, or who are investors, have full latitude to define and manage their programmes. They can freely organise partnerships between start-ups, university labs and large industrial firms, and they enjoy great flexibility in recruiting collaborators.

And most importantly, programme heads elicit new competing projects. A good example is BARDA (the Biomedical Advanced Research and Development Authority), which is the equivalent of DARPA for the US biotech sector. During the COVID-19 crisis, BARDA financed

4 The top-down approach refers to a hierarchical process in which the state is the decision maker and imposes its decision on decentralised actors. Conversely, in a bottom-up approach, the state sets out the broad lines of a policy, but allows local actors flexibility to determine how to implement it.

several competing vaccine projects, including BioNTech and Oxford-AstraZeneca, which were initiated outside the US.

5 The case for European DARPA's

Having to compete with the US and China, both of which are promoting very assertive industrial and innovation policies, why not create European DARPA's? A first reason for creating European DARPA's is to enable Europe to assume greater responsibility for its own defence. A more fundamental motive is that Europe faces major technological challenges, in particular in the energy and environment, digital and healthcare sectors. The projects of these European DARPA's would be funded directly from participating nations' governmental budgets, and also from borrowing by the European Union as a whole.

Most importantly, as it is already the case for the funding of basic research by the European Research Council (ERC), the selection of projects by these European DARPA's should escape the *juste retour* principle, according to which each member state expects to receive, in monetary returns, at least as much as it contributes. Project selection by European DARPA's should also avoid member states' obsession with veto rights. Some EU countries have expressed the fear that European DARPA's would systematically favour larger EU members at the expense of the smaller. Here again, governance is the adequate response and there are at least two models one can build upon. First, BARDA during the COVID-19 crisis: it included labs located outside the US when selecting which vaccines to push for mass production; in particular it took BioNTech and Oxford-AstraZeneca. Second, the European Research Council and its international jury panels: excellence, not nationality, is the primary criterion for selecting those research projects that receive ERC funding.

Who should take part in these European DARPA's? Our preference would be for an open 'coalition of the willing', with the possibility for the United Kingdom to also join, given their academic and industrial expertise in defence, health and energy.

6 Moving beyond Hayek

Our call for establishing EU-funded European DARPA is somewhat at odds with what mainstream European policy advisers would advocate. Thus, Kleimann *et al* (2023), on responding to the US IRA, wrote: “*the EU should not just seek to protect its competitiveness relative to the US but to pursue broader aims, including competitiveness in general ... these aims imply that the EU should not impose local-content requirements of its own, should not loosen state-aid rules and should not mimic the IRA’s approach to manufacturing subsidies. Rather, it should focus on boosting its structural competitiveness*”.

In other words, in response to the IRA and the climate challenge, Europe should not change its doctrine, in particular it should not contemplate the possibility of new sectoral state aid – those are seen as being anti-competitive *a priori* – but should instead deepen its reliance on structural reforms and adequate carbon taxes and regulations.

A contrasting view is that, in the face of fiercer competition from China and the United States, both of which implement forceful industrial policies, the EU should rethink its economic doctrine: not to throw it away, but rather to adapt it to the new circumstances. The EU doctrine took shape in the late 1980s. Centred around the idea of a large single market and a broad set of regulations, but with a very small EU budget, this paradigm is directly inspired by Hayek. The basic idea, well explained in *The Road of Serfdom* (Hayek, 1944), was that Europe and its institutions should be thought of primarily as a federation, with the main objective of preventing member states from yielding to local political and social pressures. Hence the three pillars of European economic governance: 1) the single market and the European Commission’s primacy with regard to competition policy – in particular it is up to the Commission to detect and punish sectoral state aid in member states; 2) the Maastricht Stability and Growth Pact, which limits the budgetary power of individual member states – the Commission ensures the compliance with the 3 percent deficit rule; and 3) an EU budget of only 1 percent of European GDP.

Interestingly, following the enactment of the IRA, some new ideas have been put forward by the European Commission, which depart from a literal interpretation of the Hayekian doctrine. A first suggestion is to soften the rules governing sectoral state aid. This has raised strong criticisms from some countries, including the Netherlands and Sweden, which see it as a threat to the single market, and something that would favour large countries at the expense of smaller member states⁵. This objection should not be disregarded, yet in the previous section we argued that suitable governance of European DARPA's would help avoid such an undesirable outcome. A second idea is to use the €750 billion of the post-COVID-19 Resilience and Recovery Fund and to even increase Europe's investment capacity by creating a European Sovereign Fund for Industry, which, like the Recovery Fund, would be financed by a loan directly contracted by the European Union. This second idea met strong reluctance from countries such as the Netherlands⁶, for which this is just a trick to circumvent the budgetary rules of the Union.

We are not calling here for a phase-out of the existing rules. In particular, in Aghion *et al* (2005), we provided strong empirical evidence of the importance of competition and the single-market as the main drivers of innovation-led growth. We also strongly support the Growth and Stability Pact, which underlies the credibility of the euro and guarantees macroeconomic stability in the euro area, both of which can only favour innovation-led growth. Yet, the current circumstances call for an updated interpretation of the rules.

- *Stability Pact*: countries that successfully engage in structural reforms and show seriousness in the use of public funds, should

5 See for example *Euractiv.com with Reuters*, 'Eleven EU countries urge 'great caution' in loosening state aid rules', 15 February 2023, <https://www.euractiv.com/section/economy-jobs/news/eleven-eu-countries-urge-great-caution-in-loosening-state-aid-rules/>.

6 Sam Fleming, 'Netherlands opposes new EU money to counter US green subsidies', *Financial Times*, 24 January 2023, <https://www.ft.com/content/flcfc042-2620-453d-b0c0-585c79571d9a>.

be granted an entry ticket to invest more and better in education, innovation and energy transition.

- *Competition policy and the single market*: rather than *a priori* forbidding any kind of sectoral state aid *ex ante*, an *ex-post* approach should be adopted and sectoral aid should be tolerated as long as it does not result in a decline in product market competition or in obstacles preventing the entry of new innovative firms.
- *EU borrowing*: Europe's investment capacity should be enhanced using EU borrowing, to fund new – and properly governed – European DARPA's aimed at making Europe more competitive in the world economy.

Without any accommodation of the rules and any evolution in the underlying doctrine, Europe runs the risk of an irreversible decline.

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