INTERNATIONAL INDUSTRIAL POLICY EXPERIENCES AND THE LESSONS FOR THE UK

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Abstract
The present study reviews a diverse set of countries with the most successful industrial policy experiences since the Second World War – namely, the US, Germany, Japan, Italy, Finland**,** (South) Korea, Singapore, China, and Brazil – with a view to deriving lessons for the UK. In Section 1 an industrial competitiveness benchmarking analysis opens by tracking long term countries' trajectories and revealing the current alarming state of UK's manufacturing. Section 2 discusses some of the key theoretical issues in the debate on industrial policy, namely: (a) different definitions of industrial policy and problems related to the standard distinction between 'horizontal' and 'vertical' measures; (b) the special role of the manufacturing sector in the overall economy, especially as the source of productivity growth, innovation, learning, and resilience; (c) main theoretical justifications for certain widely adopted industrial policy tools and institutions. Section 3, then, reviews the industrial policy experiences of the nine comparator countries. While historical material dating back from the 18th century is covered when appropriate, the focus is more on the recent period, since the 1980s or the 1990s. In Section 4, we draw lessons for the UK's industrial policy from the nine country experiences that we review in Section 3, filtered through the theoretical discussions provided in Section 2. We draw the lessons along several dimensions: (a) the role of 'vision'; (b) institutional settings and policy coordination; (c) finance and corporate governance; (d) promotion of innovation; (e) management of transnational corporations; (f) support for SMEs; (g) skills and training. Finally, section 5 looks ahead for the future of the UK's manufacturing sector and policies, taking into account our theoretical discussions, country case reviews, and the lessons we have drawn from those discussions.

Keywords: Industrial policy; manufacturing; policy challenges; UK; US; Germany; Japan; Italy; Finland; (South) Korea; Singapore; China; Brazil

JEL Codes: O14; O25; O50; P51.

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Executive Summary

The present study reviews a diverse set of countries with the most successful industrial policy experiences since the Second World War – namely, the US, Germany, Japan, Italy, Finland**,** (South) Korea, Singapore, China, and Brazil – with a view to deriving lessons for the UK.

In section 1, we start by reviewing the current state of the manufacturing sector in the UK, especially, although not exclusively, comparing it with the nine countries whose industrial policy we review in this state. The picture that emerges is an alarming one, in which the UK's industrial performance distinguishes itself for being poor and is still declining further.

In section 2, we discuss some of the key theoretical issues in the debate on industrial policy. We discuss: (a) different definitions of industrial policy, especially focusing on the relationship between and the relative merits of 'horizontal' (or 'general') and 'vertical' (or 'selective') industrial policies; (b) the special role of the manufacturing sector in the overall economy, especially as the source of productivity growth, innovation, learning, and resilience; (c) main theoretical justifications for certain notable industrial policy tools and institutions used in the countries reviewed.

In Section 3, we review the industrial policy experiences of the nine comparator countries. While historical material dating back from the 18th century is covered when appropriate, the focus is more on the recent period, since the 1980s or the 1990s, depending on the country.

In Section 4, we draw lessons for the UK's industrial policy from the nine country experiences that we review in Section 3, filtered through the theoretical discussions provided in Section 2. We draw the lessons along several dimensions: (a) the role of 'vision'; (b) institutional settings (e.g., coordination within the government, the role of surrounding institutional networks); (c) finance and corporate governance; (d) promotion of innovation; (e) management of transnational corporations (TNCs); (f) support for SMEs; (g) skills and training.

In Section 5, we look ahead for the future of the UK's manufacturing sector, taking into account our theoretical discussions, country case reviews, and the lessons we have drawn from those discussions.

1. Introduction

Since the 2008 global financial crisis, there has been a widespread acceptance – even among many of the traditional proponents of finance-led service economy – that the UK needs to 'rebalance the economy' and generate a 'manufacturing revival' through what George Osborne, the Chancellor of the Exchequer, called 'the march of the makers' (BIS, 2012, and TSB, 2012 are the recent examples). However, few people realise the scale of challenge that the UK faces in engineering a manufacturing renaissance.

The UK was the epicentre of the Industrial Revolution, which has given birth to the modern world. And until the late 19th century, its industrial dominance was absolute. In 1860, it produced 20% of world manufacturing output, despite having only about 2.5% of the then world population (28 million out of 1.2 billion). Today, China produces only about 15% of world manufacturing value-added (MVA) (see Table A.1 in the appendix), despite having 19% of world population (1.3 billion out of 6.9 billion). In 1870, the UK accounted for 46% of world trade in manufactured goods. The current Chinese share in world exports is only around 14% (Table A.1 in the appendix).

Today, the UK's manufacturing sector is a pale shadow of its former self. People often have taken comfort in the fact that the country is still the 8th largest manufacturing nation in the world, but in per capita terms (MVA per capita), it is only the 24th in the world (see Table 1), behind even Iceland (ranked the 16th) and Luxembourg (ranked the 19th), not to speak of the Japans and the Finlands of this world. By 2012, it had also fallen behind its traditional rival, France (ranked the 22nd, with $3,810 against the UK's $3,731) (Table A.2 in the appendix provides more indicators for the top 60 manufacturing nations).

And it is not just the shrinking size of the manufacturing sector that is the cause for concern. The fact that the UK has failed to generate a manufacturing export boom despite a 30-35% devaluation of its currency since the 2008 global financial crisis is a powerful testimony to the underlying weakness of its manufacturing sector.

Table 1. Ranking of countries by per capita MVA in 2012 (in 2000 dollars)

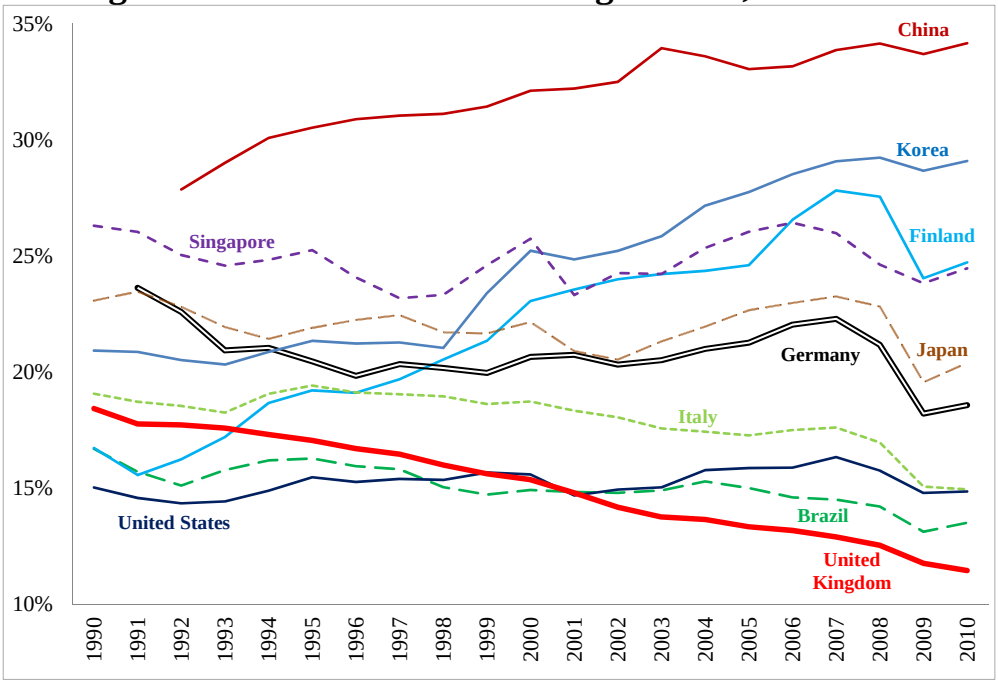
Rank	Country	Per capita MVA	Rank	Country	Per capita MVA
1	Ireland	11,772	33	Kuwait	2,391
2	Switzerland	10,191	34	Hungary	2,347
3	*Singapore*	8,800	35	Poland	2,336
4	*Finland*	7,997	36	Turkmenistan	1,962
5	*Japan*	7,693	37	Portugal	1,945
6	Sweden	7,489	38	Bahrain	1,909
7	Austria	7,300	39	Seychelles	1,771
8	*Germany*	7,075	40	Lithuania	1,750
9	*South Korea*	6,226	41	Malaysia	1,715
10	*United States*	5,786	42	Malta	1,708
11	Norway	5,690	43	Estonia	1,634
12	San Marino	5,452	44	Belarus	1,570
13	Denmark	5,421	45	Greece	1,560
14	Belgium	5,227	46	Turkey	1,533
15	Netherlands	4,948	47	Mexico	1,522
16	Iceland	4,926	48	Saudi Arabia	1,453
17	Taiwan	4,856	49	Oman	1,436
18	Qatar	4,179	50	Argentina	1,398
19	Luxembourg	4,083	51	Croatia	1,316
20	*Italy*	3,885	52	Romania	1,205
21	Canada	3,830	53	Thailand	1,186
22	France	3,810	54	*China*	1,147
23	Czech Republic	3,755	55	Chile	1,094
24	**United Kingdom**	**3,731**	56	Cyprus	1,042
25	Australia	3,680	57	Costa Rica	1,001
26	New Zealand	3,474	58	Mauritius	996
27	Slovenia	3,437	59	Uruguay	978
28	Israel	3,192	60	Russia	947
29	United Arab Emirates	3,161			
30	Spain	2,780	67	*Brazil*	764
31	Brunei Darussalam	2,723	85	Indonesia	444
32	Slovakia	2,417	117	India	163

Note: Countries whose names are in italics are the ones included in this report.
Data source: UNIDO (2013)

The UK's de-industrialisation, which started in the 1970s, has progressed at a continuous and alarming pace. As we see from Figure 1, no country among the 10 countries that we have chosen to study in this report for comparison with the UK (in alphabetical order, Brazil, China, Finland, Germany, Italy, Japan, Singapore, South Korea, and the United States) has experienced de-industrialisation in the relentless way in which the UK has experienced it.

Table 2 shows the comparative manufacturing performance of the 10 countries during the 20-year period between 1990 and 2010 across a diverse range of indicators compiled by UNIDO (2013). The table shows that the UK performed the worst (or joint-worst) in 7 out of 8 indicators across our 10 countries. Three aspects are worth highlighting here.

Figure 1. Share of Manufacturing in GDP, 1990-2010



Data source: UNIDO (2013)

Table 2. Manufacturing indicators in selected countries, per annum rate of change (%), 1990-2010

Country	MVA per capita	MVA as % of GDP	MHT MVA as % of total MVA	MVA as % of World MVA	MX per capita	MX as % of total exports	MHT MX as % of total MX	MX as % of WMT
Brazil	0.5%	-1.1%	-1.7%	-0.6%	7.5%	-0.5%	-0.2%	1.2%
China	10.7%	1.1%	0.2%	8.5%	17.6%	0.8%	4.3%	10.0%
Finland	3.6%	2.0%	1.5%	1.4%	4.4%	-0.2%	0.8%	-2.8%
Germany	-0.1%	-1.3%	0.9%	-2.6%	5.8%	-0.3%	0.3%	-1.9%
Italy	-0.5%	-1.2%	-0.4%	-2.8%	4.6%	-0.1%	0.4%	-2.7%
Japan	0.2%	-0.6%	0.3%	-2.2%	4.6%	-0.3%	-0.2%	-2.8%
Korea	6.2%	1.7%	1.3%	4.2%	9.7%	0.1%	2.0%	2.4%
Singapore	3.8%	-0.4%	0.6%	3.3%	6.2%	-0.2%	0.5%	0.6%
UK	-0.8%	-2.4%	-0.3%	-2.9%	3.3%	-0.3%	-0.2%	-3.8%
US	1.4%	-0.1%	0.3%	-0.1%	4.2%	-0.3%	-0.6%	-2.3%

Source: Authors' calculations based on UNIDO (2013)

Notes: Manufacturing Value Added (MVA) and GDP are in constant 2000 US dollars. MHT, MX and WMT refer to medium and high-technology, manufacturing exports and world manufacturing trade respectively. Due to data gaps, China's compounded annual growth rates (CAGRs) were calculated for the period 1992-2010 while Germany's CAGRs were for the period 1991-2010.

First, the UK de-industrialised at the fastest pace among the 10 countries during this period (2.4% p.a. decline in the share of MVA as a percentage of GDP), resulting in the lowest manufacturing share in GDP (11.4%) in 2010 among the 10 countries, as shown in Figure 1.

Second, the UK's industrial competitiveness has been eroded at a faster pace than the other countries. Both the shares of the country's MVA in World MVA and its share of manufacturing exports (MX) in world manufacturing trade (WMT) fell faster in

the UK (-2.9% p.a. and -3.8% p.a. respectively) than in the other countries between 1990 and 2010.

Third, the UK has not successfully upgraded the quality of its manufacturing sector. Among the developed economies in the sample, it was the only country that saw declines in both the share of medium and high-technology (MHT) MVA in total MVA (-0.3% p.a.) and the share of MHT MX in total MX (-0.2% p.a.) between 1990 and 2010.

The typical, albeit increasingly less frequent, response to the kind of information that we have provided so far is that the UK's industrial decline is the result of market forces and therefore that there is nothing to be done about it. However, those apparently 'natural' market outcomes are in the end the results of deliberate decisions by economic agents – productive enterprises, financial investors, and trade unions. And shaping all these decisions is the government, which sets the boundaries of the market, decides on the types of permissible behavior, and (explicitly and implicitly) manipulates incentives through interest rates, taxes, subsidies, regulations, procurement decisions, and many other means. Particularly important in relation to the manufacturing sector is industrial policy, which is policy specifically targeted at industries, rather than more general policies (e.g., monetary policy, fiscal policy) or policies targeted at other things (e.g., social policy, education policy) – we will provide a more rigorous definition in the next section.

In this report, we discuss how the UK government may improve the country's manufacturing sector performance through industrial policy by looking at the industrial policy experiences of nine other countries, all with important achievements and strengths at least in some respects. We have deliberately chosen a range of countries in terms of size (from huge China, the US, and Brazil to tiny Singapore and Finland), level of overall economic development (from the richest US and Finland to the poorest Brazil and China), and areas of strengths in terms of industries (from electronics in Japan and Korea to aircraft in the US and Brazil), firm size (from huge firms in the US and Korea to medium-sized firms in Germany and Japan and small firms in Italy), and technological intensity (from high-tech Japan, Finland, and Korea to medium-tech Germany and Italy to low-tech China).

Before we look at individual country experiences, however, we need to look at some general issues related to industrial policy, including its definition, theoretical justifications, and evaluation, in order to provide a framework for our case discussions.

2. Theoretical Issues

2.1. Definitional issues

The controversial nature of industrial policy is testified to by the fact that there is actually no universally agreed definition of the term (see Warwick, 2013, pp. 14-18).

The most literal interpretation of industrial policy would be to define it to include any policy that affects industry (usually interpreted as the manufacturing industry), in the same way in which we would define fiscal policy as policy that affects government revenue and spending, and monetary policy as policy that affects monetary variables. Indeed, some commentators who adopt this definition would include even infrastructure policy, education policy and tax policy as parts of industrial policy (see Chang, 1994a, pp. 58-61, for some examples).

The majority of the commentators on industrial policy, however, define industrial policy to mean 'selective' industrial policy, 'sectoral industrial policy' or 'targeting' – namely, a policy that deliberately favours particular industries/sectors (or even firms) over others, against market signals, usually (but not necessarily) to enhance efficiency and promote productivity growth, for the whole economy as well as for the targeted industries themselves.[1]

Industrial policy thus defined has been even more controversial than more generally defined industrial policy.[2] Many people believe that industrial policy should be of general (or functional or horizontal) kind, rather than of selective (or sectoral or vertical) kind. In this view, industrial policy should focus on 'public goods' that benefit all industries equally but are likely to be under-provided by the market – e.g., education, research and development (R&D), and infrastructure – and not involve 'picking winners'.

The fundamental problem with this view is that the distinction between selective and general industrial policies cannot take us very far. *In a world with scarce resources*, every policy choice you make, however general the policy involved may look, has discriminatory effects that amount to implicit targeting.

For example, many people believe that education is one of those general industrial policies, but beyond the basic level (say, the first 9 years), education becomes specialised. So, for example, when we produce engineers, it does not produce some generic engineers but engineers specialised in certain areas. Therefore, a government providing more funding to electronics engineering departments than to chemical engineering departments is implicitly favouring the electronics industry. Likewise, there is no such thing as generic physical infrastructure. Physical infrastructure is always location-specific, so it affects different industries differently. Moreover, different modes of transportation have different impacts on different industries –

bulky goods (e.g., iron ore, wheat) will be helped more by developments of seaports and railways, while lighter goods, especially when they are perishable (e.g., flowers, fresh fish), will be helped more by developments of airports. Finally, if a government is giving out R&D subsidies, it is implicitly favouring the more R&D-intensive higher-tech sectors.

Thus seen, selectivity (targeting) is inevitable. Except in the case of the provision of basic education, calling which an 'industrial policy' is really stretching the term beyond credulity, there is really no policy that does not involve some degree of targeting.[3]

Now, it may be said that, while targeting may be unavoidable, the less targeted a policy is, the better it is. However, this is a one-sided view. While less targeted policies may open themselves less to the possibilities of lobbying and 'regulatory capture', thus making it easier to maintain the necessary myth that the government is impartial, they are more costly to implement. Being less precise and thus more difficult to monitor, they have more 'leakages' than more targeted policies. Indeed, many mainstream economists have long argued – and many politicians, including the members of the current British government – that the welfare state should be more precisely targeted because there are simply too many leakages in the system of universal welfare (on targeting in social policy, see Mkandawire, 2005). It is curious that this point is almost entirely ignored in relation to industrial policy.

Given all this, we have to admit that we cannot 'not target' and should try to attain the best possible degree of targeting, which may differ across industries and countries. We cannot assume that there is a linear relationship, positive or negative, between the degree of targeting and policy success. Some degree of targeting is inevitable, while some more of it may be desirable, but too much of it may not be good, although how much is too much is debatable (and one's position on it will depend on one's economic theories and political values). The best way to think about it is 'targeting within universalism', as some people propose in relation to social policy (Skocpol, 1991, as cited in Mkandawire, 2005, p. 23), rather than 'targeting vs. universalism'.

2.2. The Special Role of the Manufacturing Sector

Industrial policy, according to our definition, does not involve only manufacturing industries. It could target service industries, as the UK, Ireland, Iceland, and Dubai did with the financial industry in the last two, three decades – albeit all unfortunately with highly negative consequences. Or it could involve promotion of certain industries in the primary sector – prominent examples include the dairy industry in Denmark in the late 19th and the early 20th century (Chang, 2009a and 2009b), and more recently, the salmon and the forestry industries in Chile **(**Meissner, 1988; Clapp,

1995; UNCTAD, 2006) and the soybean industry in Brazil (Hosono & Hongo, 2012; Andreoni, 2013a).

However, those who are interested in selective industrial policy tend to put great emphasis on the need to promote the manufacturing sector. The reasons to promote the manufacturing industries are many and diverse.

First, it is widely recognised that the manufacturing sector is the main source of technology-driven productivity growth in modern economies. It is not much of an exaggeration to say that manufacturing is what has made the modern world. Thanks to the fact that the manufacturing activities lend themselves much more easily to mechanisation and chemical processing than do other types of economic activities, the manufacturing sector has been the main source of productivity growth throughout history. Productivity increase in agriculture is highly constrained by nature in terms of time, space, soil, and climate. By their very nature, many service activities are inherently impervious to productivity increases. In some cases, the very increase in productivity will destroy the product itself. If a string quartet trots through a 27-minute piece in nine minutes, we won't say that its productivity has trebled. For some other services, the apparently higher productivity may be due to the de-basement of the product. A lot of the increases in retail service productivity in countries like the US and the UK have been bought by lowering the quality of the retail service itself – fewer shop assistants, longer drives to the supermarket, lengthier waits for deliveries, etc. The 2008 global financial crisis has also revealed that much of the recent productivity growth in finance had been achieved through the de-basement of the products – that is, the creation of overly complex, riskier, and even fraudulent products.

Second, many economic historians and economists argue that the manufacturing sector, especially the capital goods sector, has been the 'learning centre' of capitalism in technological terms (Rosenberg, 1963 and 1982; Kaldor, 1981; Cohen & Zysman, 1987; Rowthorn & Wells, 1987; Park & Chan, 1989; Mokyr, 1990 and 2002; Mowery & Rosenberg, 1999; Guerrieri & Meliciani, 2005). Because of its ability to produce productive inputs (e.g., machines, chemicals), what happens in the manufacturing sector has been extremely important in the productivity growth of other sectors. The increases in agricultural productivity that we have seen in the last century and half would not have been remotely possible without the developments of manufacturing industries producing agricultural machinery, chemical fertilizers, pesticides, and increasingly genetic engineering. The rapid increases in the productivity of services like logistics and retail in the last couple of decades were also made possible by manufacturing industries producing more efficient transport equipment, computers, and mechanised warehouses.

Third, the manufacturing sector has also been the source of organisational innovation. Productivity growth in the last two centuries has been driven not just by technological changes but also organizational changes, most of which originated in the manufacturing sector. For example, these days many fast food restaurants use 'factory' techniques, turning cooking into an assembly job and sometimes even delivering food on conveyor belts (Yo! Sushi being the most familiar example for the UK citizens). For another example, large retail chains – be they supermarkets, clothes shop chains, or on-line retailers – apply modern inventory management techniques, developed in the manufacturing sector. Even in the agricultural sector, productivity has been raised in some countries through the application of manufacturing-style organisational knowledge, like computer-controlled feeding (the Dutch agriculture is the prime example here).

Fourth, the manufacturing sector has been the main source of demand for high-productivity activities in other industries. For example, most of the service activities that have high productivity and have seen high productivity growths – sometimes even faster than those of some sub-sectors of manufacturing – recently (e.g., finance, transport, and business services) are 'producer' services, whose main customers are manufacturing firms. Of course, countries can specialise in those services, but in the case of many producer services (e.g., engineering, design, management consulting), their ability to export cannot be maintained in the long run without a strong manufacturing sector. In those services, insights gained from the production process and the continuous interaction between the provider and the clients are crucial. Given this, a weakening manufacturing base will eventually lead to a decline in the quality, and exportability, of those services (Tassey, 2010; Fuchs & Kirchain, 2010; Pisano & Shih, 2012).

Fifth, the manufacturing sector, producing physical and non-perishable products, has higher tradability than agriculture and, especially, services. At the root of the low tradability of services lies the fact that many services require their providers and consumers to be in the same location. No one has yet invented ways to provide haircut or house cleaning long-distance. Of course, this problem will be solved if the service provider (the hairdresser or the cleaner in the above examples) can move to the customer's country, but that in most cases means immigration, which most countries severely restrict. Given this, a rising share of services in the economy means that the country, other things being equal, will have lower export earnings. This, in turn, means that, unless the exports of manufactured goods rise disproportionately, the country won't be able to pay for the same amount of imports as before. Also, the high tradability of manufacturing imparts a crucial resilience to an economy with a strong manufacturing sector, as it can better protect itself from external shocks – as we have seen this with the resilience of the German economy, following the 2008 financial crisis.

2.3. Theories of Industrial Policy

Unless we live in the fantasy world of perfect markets, industrial policy does not lack theoretical justifications (for reviews, see Dosi et al., 1989; Chang, 1994a and 2011; Stiglitz, 1996; Lall, 2004; Rodrik, 2004 and 2008; Aiginger & Sieber, 2006; Bianchi & Labory, 2006; Cimoli et al., 2009; Spence, 2008; Aghion et al., 2012). This is not a place to review these theories in any detail, so let us just provide an overview of the key types of arguments.

2.3.1. Interdependences

There are various arguments that justify industrial policy, especially of selective type, on the basis of the existence of interdependence between different activities.

The best-known of this type of argument are those based on demand complementarities and increasing returns (to scale) in manufacturing industries, which were prominent in Classical Economics and in early Development Economics (Toner, 1999, provides an excellent review; also see Andreoni & Scazzieri, 2013). The first variety of these is the so-called Big Push argument – or the balanced growth model – of Paul Rosenstein-Rodan (1943) and Ragnar Nurkse (1952), which argues that there needs to be a coordination of investment between interdependent activities, as their returns depend on there being all the complementary investments. Using a similar insight, the so-called linkages argument of Albert Hirschman (1958) advocates industrial policy that first promotes industries with particularly strong interdependences with other sectors, whether as suppliers of inputs into other industries (forward linkages) or as purchasers of outputs of other industries (backward linkages), thus setting off chain reactions in different directions. This argument is also known as the unbalanced growth model, in the sense that the government initially focuses on the leading industries, rather than trying to promote all industries together.

Second, there are less well-known justifications for industrial policy based on interdependences between competing – rather than complementary – activities. In oligopolistic industries with lumpy investments, simultaneous investments by competing firms may result in excess capacity, which may push some firms into bankruptcy, which in turn means that the resources invested in them will have been wasted – unless the machines and skills involved are of very general nature and can be redeployed elsewhere easily, which rarely is the case in modern industries. In order to prevent such ‘wasteful competition’, countries, especially Japan and Korea, have used entry restrictions and government-approved investment cartels so that investments are staggered at suitable intervals (see Chang, 1994a, pp. 66-7; Amsden & Singh, 1994).

Coordination problems among competing investments may be related not only to investment but also to situations of temporary disinvestment or structural change in the industrial sector. Recession cartels and mechanisms of negotiated exit have been widely used to face periods of economic crisis or accompany structural transformation (Dore, 1986, is the classic study). In these situations industrial policies introduce "a 'protective' element – that is 'helping losers' by temporarily shielding them from the full forces of the market" (Chang, 2003, p. 262). More generally, support for declining sectors may be seen as an attempt to socialise risk to encourage and sustain the process of structural change and productivity growth**,** from which economic development derives.

Third, there is the externality argument (Scitovsky, 1954), in which industrial policy is deployed to compensate for under-investment in (and thus under-production of) certain activities due to the fact that their providers do not reap the full benefits from their efforts. Supports for basic R&D or worker training are classic cases. More recently, some commentators have developed an argument for industrial policy based on 'information externality'. The argument is that investments are not made in industries because the potential 'pioneer' firm is afraid of providing 'free experiment' to competitors, who may then imitate it and deprive it of what Schumpeter would have called 'entrepreneurial profit' (Hausmann & Rodrik, 2003; Rodrik, 2004 and 2008; Lin, 2012). Lin's (2012) new structural economics proposes the 'growth identification and facilitation framework', while Hidalgo and Hausmann (2009) develop the so-called 'atlas of economic complexity', whose aim is to reveal the existence of linkages and different countries' capability endowments.

2.3.2. Capabilities

Another important set of arguments for industrial policy is based on the time-consuming and costly nature of the process of accumulating productive capabilities (Lall, 1992 and 2001; Chang, 1994a; Lall & Teubal, 1998; Loasby, 1999; Andreoni, 2013b). Productive capabilities are personal and collective skills, productive knowledge and experience that are embedded in physical agents and organisations (Andreoni, 2011).[4]

The most famous argument along this line is the infant industry argument. This is based on the understanding that productive capabilities can be accumulated only over time and in an unpredictable way. Given this, new producers need a period of protection – through tariffs, subsidies (related to equipment investments, R&D, and worker training), regulation on foreign direct investment (FDI), and other measures – from competitive forces coming from abroad, in the same way in which children need protection before they can go out and compete in the labour market unassisted. This argument applies to the catching-up economies particularly strongly, but can hold for all countries, insofar as their producers in certain sectors are trying to catch up with

superior producers abroad. The ultimate example of the latter case is the development of Airbus by the European governments against what looked like an insurmountable US dominance in the civilian aircraft market.

Another capabilities-related justification for industrial policy is based on policies providing support for small producers – such as small and medium-sized enterprises (SMEs) in the manufacturing sector and small farms. The problem is that capability accumulation needs some indivisible inputs (thus high fixed costs) that small producers cannot provide on their own – whether in R&D, machinery, or worker training. There are many industrial policy measures intended to solve this problem. The government can directly provide these inputs into the capability building process through public R&D, training of workers in public universities and training institutes, and the provision of 'extension service' for small firms and small farmers. It may subsidise those inputs through the provision of R&D subsidies, credit guarantees (which will promote physical investments, among other things), or training subsidies. Not all of the above-mentioned measures are specifically targeted at small producers, but they may be of disproportionate help to such producers insofar as they are disproportionately disadvantaged in providing such inputs through market-based arrangements. On top of all these, the government may provide legal and other backings for voluntary cooperative arrangements among small producers – such as tax advantages for cooperatives among small producers or subsidies for particular joint activities (e.g., R&D, processing, export marketing).

The third capability-based justification for industrial policy rationale is known as the 'industrial commons' argument. The argument is rooted in the fact that productive capabilities have a fundamental collective nature, that is, their development and application is very much the result of interdependent processes of learning and production, each of which involves a variety of actors (Richardson, 1972 and Abramovitz, 1986 are the classic references). Given these interdependences, the effective coordination of actors endowed with different capabilities becomes a key determinant of the competitiveness of any sectoral innovation system (Metcalfe, 1995, Malerba, 2002: for a review, see Laranja et al., 2008). Such coordination has become increasingly important in modern manufacturing systems. As eloquently documented in Tassey (2010): "Most modern technologies are systems, which means interdependencies exist among a set of industries that contribute advanced materials, various components, subsystems, manufacturing systems and eventually service systems based on sets of manufactured hardware and software" (p. 6). The modern global economy is therefore constructed around supply chains, whose tiers (industries) interact in complex ways". A representative study in this line of argument is Pisano and Shih (2009). Using information from the semiconductor, electronics, pharmaceutical and biotech industries, the study shows how the production and innovation capacities of a given economic system depend on the presence of multiple resources, such as R&D know-how, engineering skills, technological capabilities, and specific manufacturing and prototyping competences. The study points out that many

of these resources are scattered across a large number of manufacturing and services companies as well as other organisations (such as universities and vocational schools), so all those actors need to be located close to each other, if they are to utilise those 'common pool' resources effectively.

The industrial commons literature stresses that even the development of high-tech cutting-edge products often depends (amongst other factors) on the commons of a mature manufacturing industry. The maintenance of industrial commons necessitates not only the maintenance of a manufacturing base of a certain size and diversity but also various forms of what we call in this report 'intermediate institutions' – industry associations, trade unions, research institutes, and educational institutions. These institutions maintain and nurture the industrial commons by developing research and innovation activities in new industrial processes and products, both within and across sectors (O'Sullivan, 2011; Best, 2011; Andreoni 2012a).

Fourth, there are measures to do with the establishment of local technological capabilities in cases of 'direct' technology imports. The problem being addressed here is that, when technologies are imported in a 'direct' way through technology licensing or FDI, there is less incentive, on the part of both the importer and the provider, to create technological capabilities in the importing country than when compared to cases of 'indirect' technology imports through machines. On the one hand, the buyer of technology would find it easier not to develop its own capabilities to adapt and improve the imported technologies, which means that they either import obsolete, 'easier' technologies or become dependent on the provider in technological terms. On the other hand, the provider would be reluctant to transfer core technologies, for fear of losing future customs and creating another competitor. In order to overcome this problem, the government can impose conditions on these direct forms of technology imports. Some countries (e.g., Japan, Korea) require approval for technology imports, to ensure that overly obsolete technologies are not imported while the licensing fees for up-to-date technologies are not excessive. In relation to FDI, many countries we have reviewed – Japan, Korea, Finland, and even FDI-friendly China and Singapore – have used 'carrots' and 'sticks' to ensure that core technologies are transferred and, more importantly, that the relevant local technological capabilities are created. The 'carrots' include the customised provision of necessary skills and subsidies for the establishment of R&D facilities. The 'sticks' include requirements for TNCs for technology transfer, local sourcing, hiring of local workers in higher capabilities, and exports (as export markets typically have higher quality requirements).

2.3.3. Risk and Uncertainty

There are a lot of justifications for industrial policy that are based on the recognition that there are inherent discrepancies in the ability to deal with risk and uncertainty between individual producers (whether they are corporations or individual workers) and the society as a whole – often expressed somewhat misleadingly as 'capital market failure' (implying, implausibly, that a 'perfect' capital market will finance any project that is viable).

One classic argument of this kind is based on the observation that the government often has the 'deepest pocket' in the country and thus the strongest ability to deal with risk. This is why many ambitious, high-risk projects have had to be subsidised by the government – as in the case of Airbus – especially when the country's capital market is of 'impatient' variety, like in the UK. When it comes to backward economies entering technologically most demanding industries, the risk is incalculable and thus turns into uncertainty. In such cases, establishing state-owned enterprises (SOEs) may be the only solution. Korea's steel-maker (POSCO), established in the late 1960s when the country's income was only 4% of the US income, and Brazil's aircraft manufacturer (EMBRAER), established in the late 1950s when the country's income was only 8% of the US income, are the supreme examples of this kind.

Second, governments have often deployed industrial policy to restructure companies in trouble on the recognition that a major corporate restructuring – or even restructuring of an entire industry (like the shipbuilding industry in Japan in the 1980s or the automobile industry in the US after 2008) – requires risk of scales that private sector investors are simply not interested in taking. Policies involved include government taking of an equity stake (which often results in majority control), state-mediated mergers, coordinated capacity scrapping, provision of loan guarantees, public subsidisation of severance payments, and transitional subsidies.

Third, some governments, especially those in Scandinavia, have taken cognisance of the fact that, in a fast-changing world, individual workers are exposed to levels of risk that they cannot simply bear on an individual basis. On this recognition, these governments have provided a comprehensive welfare state – especially strong unemployment insurance, job search services, subsidised retraining, and even subsidies for re-location (e.g., government providing bridging loans to workers who have to sell their house to move to their new jobs) (Landesmann, 1992; Chang, 1994b). These are not 'industrial policies' in the sense we have defined in this report, but they help industrial developments by promoting smoother structural change.

2.4. Implementation Issues

All the above justifications of industrial policy, of course, do not mean that industrial policy measures are bound to succeed. From the disasters of China's Great Leap Forward to the white elephant of Concorde, there have been many cases of industrial policy that have failed because the goals were set wrongly. Moreover, industrial policy measures that are theoretically sound can also fail because of various types of 'government failure', owning to lack of political commitment, 'capture' by interest groups, lack of bureaucratic capabilities, and other reasons. Therefore, we need to understand why some attempts succeed and others fail and think of ways to maximise the chance of success and minimise the chance of failure. The industrial policy literature since the 1980s has always highlighted the implementation issues, but these issues have been getting renewed attention and more refined discussions in the more recent literature (Chang, 2011; OECD, 2013; Andreoni, 2013c).

First, the success of industrial policy depends critically on the country's political economy. If there is no political base for industrial policy, it will fail in the face of policies that undermine it. It is well known that countries with a strong landlord class or a strong financial capitalist class have always found it difficult to implement good industrial policy, as those classes want policies that may be detrimental to manufacturing. One such prominent example is the US landlords in the South up till the Civil War constantly putting pressure for free trade despite the fact that it would have deterred the development of the country's manufacturing sector. In the more recent period, we have seen the strong financial capitalist classes of the UK and Brazil wanting policies that lead to overvalued exchange rates, thereby destroying large swathes of their export-oriented manufacturing industries.

However, all of this does not mean that a country is bound by its history. New political coalitions can be built and policies changed. For example, in the late 19th century, Bismarck managed to make the landlord class (the Junkers) accept high tariff protection and other industrial policy measures for the emerging heavy and chemical industries by providing it with its own protection too – in the so-called 'marriage of iron and rye'. For another example, in 1860, the Northern manufacturing states of the US established their national hegemony by establishing the Republican Party, which brought on board the Western states, traditionally in favour of free trade, by offering them free distribution of public land (embodied in the Homestead Act of 1862) – and eventually winning the Civil War. For a more recent example, the recent counter-offensive by the industrial capitalists in Brazil following the 2008 global financial crisis has led to the fall of real interest rates and a diminution of currency overvaluation, which had beleaguered the country's manufacturing sector since 1996.

Second, the relationship between the government and the industrial capitalist class matters. Experiences show the importance of continuous dialogue and exchange of information between the two, if the policies are going to be well informed and relevant. However, it is also important that the government does not get beholden to particular industrial interests and thus avoid the danger of 'capture'. Peter Evans (1995), the eminent American sociologist, has captured this point beautifully in his notion of 'embedded autonomy', which means that the 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 create a state that imposes an 'inorganic' vision on the society through force, while embeddedness without autonomy means that the state is turned into Marx's executive committee of the bourgeoisie. Evans used the case of Japan, Korea, and Taiwan to illustrate this point, but the other countries that we have examined in this report – most notably Singapore, Germany, Italy (local governments), and Finland – fit this case.

Third, the nature of a country's prevailing ideology matters. If the ideology is too rigid – like the free-market ideology in the UK from the 1980s until the 2008 financial crisis, or the autarchic variety of communism practised in Mao's China – a country will use industrial policy of wrong type in wrong quantity. All the countries we have reviewed in this report showed a considerable degree of flexibility in ideological terms during most of the periods reviewed (except for the obsession with inflation control in Brazil between 1996 and 2008). And their industrial policy was compromised when ideologies became hardened, as in the case of the free-market ideology in Korea, especially between the 1997 financial crisis until the last government (2007-12). Singapore is the ultimate example of industrial policy success based on pragmatism, mixing some of the most 'free market' measures (free trade) with some of the most 'communist' ones (public ownership of land, huge role for SOEs).

Fourth, the capabilities of the organisations implementing industrial policy matter. Not only the relevant government ministries and public agencies but also the private sector agencies needed in actually implementing some of the policy measures (e.g., employers' association, industry associations, trade unions) need to have adequate policy capabilities. This requires staffing these organisations with individuals with appropriate skills and experiences. One important thing to note is that capabilities here do not imply training in standard economics, as testified to by the fact that the industrial policy-makers of the East Asian 'miracle' economies were mainly non-economists – lawyers in Japan and, to a lesser extent, Korea and scientists and engineers in Taiwan and China (see Chang, 2011). Moreover, capabilities are not just those possessed by the individuals working in those organisations. Organisations themselves possess capabilities in the forms of particular command structure, institutional routines, and organisational 'memories' (e.g., past records). Of course, the difficulty is that it takes time and investments to build up these capabilities and

coherences, although they are not as difficult to build up as many critics of industrial policy would like us to believe (see Chang, 2011).[5]

Fifth, not only the capabilities of but also the interactions between the organisations implementing industrial policy are important. The relevant bodies (public and private) need to have good working relationships with each other. They also need some mechanisms to coordinate their actions, whether through some intellectual exercises (e.g., indicative planning, foresight exercise) or through organisational structures that make coordination easier (e.g., some coordinating super-ministry, such as France's Planning Commission or Korea's Economic Planning Board [EPB]).

Last but not least, how sensible the policies are obviously matters, although what is 'sensible' would be different across different commentators. Two aspects – policy realism and policy adaptation – need consideration. First, as for 'policy realism', policy targets need to be commensurate with the capabilities of the producers (and, secondarily, those of the policy-makers themselves). This is true for all countries but particularly relevant for countries at early stages of development, whose inadequate productive capabilities make industrial upgrading risky. Given the risk, these countries should not try to leap too far from where they are. However, the nature of the game is such that, without some risk-taking, industrial policy will achieve little (Chang in the Lin-Chang debate emphasises this point; see Lin & Chang, 2009). Striking the balance between realism and the need for risk-taking is, of course, not easy, but it can be – and has been – done.[6] As for 'policy adaptation', policy targets need to be adjusted according to changes in conditions, especially the country's technological capabilities (which take long and cumulative processes to build and efforts to maintain, as we emphasised above) and the world market conditions (e.g., overall demand conditions, what the existing and potential competitors are doing). It is widely recognised that, as the country moves up the technological ladder, the focus of industrial policy needs to shift to innovation policy. It is less widely recognised that countries at higher stages of economic development need timely but orderly phasing-out of 'geriatric' (as opposed to 'infant') industries (see Chang, 1994, ch. 3, for further discussions).

2.5. Evaluating Industrial Policy

There have been various attempts to ascertain the effectiveness of selective industrial policy by looking at the relative performances of the targeted industries against those of non-targeted industries. Apart from various methodological and factual problems with individual studies (two prominent studies – World Bank, 1993 and Lee, 1996 – are reviewed in Chang, 2011), there is a problem with this general approach.[7]

First, there are serious problems with the way in which these studies identify targeted sectors. Some studies define targeted industries in terms of some general characteristics without actually ascertaining that the industries *were* in practice favoured by government policies. For example, the famous *East Asian Miracle* report of the World Bank argues that industrial policy in the East Asian 'miracle' economies (except for some periods in Japan) was a failure on the grounds that the targeted sectors did not perform better (World Bank, 1993). However, the study assumed that the higher it's value-added component and the higher its capital intensity, the more favoured an industry was. However, industrial targeting was never practiced in this kind of simplistic way in those countries. For example, during the 1970s and the 1980s, the textile industry was promoted heavily as a 'strategic' industry in Korea, as it was the most important export industry (see Chang, 1995, for further details).

Other studies do look at the *actual* (as opposed to theoretical) degree of state support to define targeted sectors. For example, Lee (1996), in analysing Korean industrial policy for the 1962-83 period looks at tariffs, non-tariff barriers, tax incentives, and subsidised loans for each sector and finds no correlation with a number of performance indicators (e.g., labour productivity, total factor productivity or TFP, and capital intensity), thus concluding industrial policy to have been ineffective. However, many important industrial policy measures cannot by definition be captured through quantifiable indicators. Such measures include: (i) coordination of complementary investments (the Big Push); (ii) coordination of competing investments; (iii) policies to ensure scale economies (e.g., licensing conditional upon production scale, emphasis on the infant industries starting to export from early on, state-mediated mergers and acquisitions); (iv) regulation on technology imports; (v) regulation on foreign direct investment.

More recent studies (see the special issue edited by Lenihan et al., 2007) have overcome the problems of identifying the promoted sectors and the supports they get by looking at very specific programmes, such as R&D tax credits (Cappelen et al., 2012), government sponsored R&D consortia (Lechevalier et al., 2010) or programmes for supporting manufacturing jobs (Criscuolo et al., 2012), using micro data and industrial surveys. They then try to identify the effects of those policies by comparing the 'treated firms' with 'non-treated firms', using the randomisation technique or the 'differences in difference' technique.[8]

However, even these studies do not give us reliable results.
First of all, there are inherent difficulties in clearly linking the observed changes in the targeted sector (or firms) with the implemented policy. This is because it is not easy to understand how policies implemented in different sectors, geographical locations, and timing interact with each other (Lenihan, 1999; Wren, 2007).

Moreover, our definition and discussions above emphasised that, while industrial policy may target certain industries (or even firms), this is done ultimately for the benefit of the overall economy – a lot of selective industrial policy is about externalities, linkages, coordination, and shifts across industries, with the aim of upgrading the structure of the entire economy. If this is the case, it will be wrong to evaluate industrial policy only in terms of its direct outcomes in the targeted industries. We also need to look at its indirect impacts on the rest of the economy by adopting system-level evaluation techniques. For example, when we assess the industrial policy of a particular country, we need to look at things like its ability to generate new technologies, make structural shifts, and compete in the world market**,** and not just what is going on in the targeted industries. All of these will be ultimately reflected in the country's growth rate, but it is a rather catch-all indicator, so we may have to supplement it with more specific indicators regarding things like the (overall and sectoral) balance of payments, changes in the share of manufacturing in total output, or the changes in the world market share overall and, in particular, 'leading' industries with technological dynamism and demand expansion (see, for example, UNIDO, 2002 and 2013).

The problem of evaluating industrial policies does not end with the difficulties related to addressing systemic effects (such as displacement effects or linkage effects) of the policy. An added layer of problem is that the evaluation framework has to account for the existence of long-run effects arising from cumulative dynamics (Wren, 2007). Even if we recognize the existence of 'time lags' – and thus of qualitative transformations, discontinuities, truncations, and reversals – we still have to explicitly take into account the question of time scale – that is, the amount of time that firms require to build productive capabilities (as a result of, say, an infant industry policy) and move from low- to medium- and high-tech industries (Andreoni, 2011).

These time issues become increasingly complex when we attempt an evaluation of a full package of industrial policies but are also extremely relevant even in the more narrow evaluation of specific policies, such as the increasingly widely-adopted randomised control trials. This technique implicitly assumes that the effect of a certain treatment (i.e., policy) unfolds in a 'proper' way, that is, in a monotonically increasing and linear manner. However, this is not often the case, and therefore we can come out with completely different evaluation results, depending on the moment we compare the observed (e.g. treated firms) and the counterfactual (non-treated firms). As Woolcock (2009) highlighted, "[w]e know we need 'baseline' (at time t_0) and follow-up data (at time t_1), but the content and shape of the proverbial 'black box' connecting these data points remains wholly a mystery, to the development industry's peril" (p. 3).

This section has reviewed various issues related to the evaluation of industrial policy. Problems related to actually identifying the targeted sectors and the benefits they received were discussed. We also pointed out the problem arising from the systemic nature of industrial policy – linkages, displacements, and other interactions between industries make it difficult to evaluate a sectoral policy purely in terms of its impacts on the targeted sector. Time factors – problems associated with time lags and time scales – also need to be considered. All of these issues, of course, do not mean that we should not, or cannot, evaluate industrial policy. Good evaluation is necessary to improve policy. However, they mean that we need to use a plurality of both quantitative and qualitative evaluation tools and be cautious about any evaluation result.

3. Country Case Studies

3.1. Japan: The quintessential example

Japan is not the only country that has successfully used industrial policy. However, it occupies a special place in the modern debate on industrial policy in the sense that it is the rise of Japan as an industrial powerhouse between the 1960s and the 1980s that prompted such debate (the early debate is summarised in Chang, 1994a, ch. 3).

Japan's industrial policy remained lopsided and unsystematic until the Second World War, being constrained by external forces (the country could not use tariff protection until 1911, when the so-called unequal treaties, signed upon the forced opening of 1853, expired) and driven by unrealistic imperialist ambitions, which over-developed the heavy and chemical industries (on pre-WWII Japanese industrial policy, see Allen, 1981; Johnson, 1982; Macpherson, 1987). Until the Second World War, Japan was actually on the whole not the economic superstar that it later became. Between 1900 and 1950, Japan's per capita income growth rate was only 1% p.a., which was below the average for the 16 largest now-OECD economies, which was 1.3% p.a. (Maddison, 1989).[9]

Japan went through an extremely difficult patch following the end of WWII, in which output collapsed by almost half (from the peak of $2,897 in 1941 to $1,555 in 1946, GDP per capita in 1990 dollar; Maddison, 2001, p. 206, table A-j) and enterprises were in such a state that even Toyota had to be bailed out with public money (in 1949). It started to recover rapidly from 1950, partly thanks to the export boom due to the Korean War (1950-3), but until the late-1950s, the country was still not very developed – its biggest export item was still silk and silk-related products and its export products were bywords for shoddy products.

However, from the 1950s, the Japanese government used strong industrial policy to develop higher value-added industries, such as steel, automobile, electronics, and machinery (further details can be found in Magaziner & Hout, 1980; Johnson, 1982; Hall, 1986; Dore, 1986; Okimoto, 1989).[10]

The Japanese government did not give much outright subsidies (thus making some people who equate industrial policy with subsidies believe that it did not have much industrial policy), but provided long-term finances through the Japanese Development Bank (JDB) and other public financial institutions, such as the Long-Term Credit Bank of Japan and the Industrial Bank of Japan. Protectionist measures (tariffs and quantitative restrictions) were actively used, while the country had arguably the world's toughest regulations on FDI (Chang, 2004) and on technology imports (to make sure that imported technologies were not overly outdated and the royalties paid were reasonable). The targeted industries were often also provided with subsidies for export, investment, R&D, and utility bills, while also being given preferential tax breaks (Goto & Wakasugi, 1988). The Japanese government also used indicative planning and foreign exchange rationing. Laws were introduced in the 1950s to prevent large firms from abusing their monopsony or oligopsony positions to squeeze their suppliers, which prompted the large firms to invest in enhancing the capabilities of their suppliers (e.g., some equity participation, secondment of technicians), rather than constantly squeezing them and thus depriving them of the resources to invest in capability enhancement.

The Japanese performance after the 1950s, especially during the "Golden Age of Capitalism" (1950-73), was simply spectacular. During this period, per capita income in Japan grew at the amazing rate of 8.05%, which is more than double the average of the 12 European countries (3.93%).[11] It was over 3% points higher than the second-best performer, West Germany (5.02%), and over 3 times higher than that of the USA (2.45%). By the 1970s, Japan started breaking into markets that had until then been considered the exclusive 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, had become synonymous with quality, innovative design, and reliability.

Behind the success of these industrial policies were the corporate governance and financing structures that made long-term-oriented investments possible. Between the mid-1960s and the late 1990s, Japanese companies insulated themselves from short-termist pressures through cross-shareholding among friendly enterprises, which accounted for 35-50% of all Japanese shares during this period (it is still 20% today, after two decades of battering by economic recession). Banks were closely involved with enterprises and provided not only 'patient capital' but also *de facto* management consultancy for smaller firms, which could not afford them in the open market. The 'core' workers – roughly, 2/3 of the workers in large firms and 1/3 of them in the smaller ones – were integrated into the enterprise governance structure through the

granting of lifetime employment and opportunities for consultation. With more cooperative workforces, firms found it easier to restructure themselves and thus minimised the need for hostile takeover.

As we mentioned earlier, in today's industrial policy debate, Japan plays the role of the benchmark. However, many of the industrial policy measures used by the Japanese government until 1990 were not very different from the ones used by other governments. And we are not talking about countries like Korea, Taiwan, and China, which emulated Japanese industrial policy to one degree or another, but we are also talking about most of other developed countries today, including Britain (between the mid-18th to the mid-19th century), the US (between the mid-19th and the mid-20th century), Germany (in the late 19th and the early 20th century), and post-WWII France (see Chang, 2002, for further details).

However, this is not to say that Japan was only repeating what other countries had done before. Japan's postwar industrial policy involved some important policy 'innovations'. Two things are notable here.

One notable Japanese innovation is the establishment of deliberation councils for policy-making in key industries, comprising the government officials, industry representatives, and more 'objective' observers (e.g., journalists, 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 the private sector firms themselves, on the other hand.

Another Japanese innovation, or rather improvement over past practices of its own and in other countries, is the improved technique of managing cartels. Rather than regarding all cartels as negative, as has the US done, the Japanese government recognised that cartels can help 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 postwar 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 investments, upgrading technology, avoiding price wars in the export market, orderly phasing-out of declining industries) and life spans.

The stock market crash of 1990, followed by the so-called 'lost decade', triggered profound changes in the government approach to industrial policies (OECD, 1998; Nezu, 2007).[12] Overall, industrial policy became less targeted at the sectoral level and more decentralised to the regional level. For example, between 1989 and 1993, SME development, R&D investments and export credit insurance programmes accounted for almost 90% of total expenditure. Policy interventions for SMEs programmes

alone were half of the total budget and were managed and financed by regional governments.[13] Funds for sectoral policies targeting, focused on the energy, computer and shipbuilding industries, accounted for less than 10%.

During the mid-1990s, the industrial policy agenda became increasingly dominated by the deregulation agenda, further weakening the traditional industrial policy framework. In 2000, this change in the industrial policy approach culminated in the institutional transformation of the MITI (Ministry of International Trade and Industry) into the METI (Ministry of Economy, Trade and Industry) and, later, with an amendment to the Japanese Corporate Law that allowed mergers and acquisitions (M&A) by foreign companies of Japanese enterprises through swapping of stocks. Despite these changes, considerable amount of industrial policy has continued in the two new key areas of SME promotion and innovation.

SMEs have always played a key role in the Japanese economy as suppliers of components and intermediate inputs to internationally successful large firms, especially in the automotive, electronics and other assembly industries. However, in the stagnation of the 1990s and the early years of the 2000s[14], they were particularly stressed by the slow growth of internal demand and the increasingly competitive international environment. During this period, Japanese SMEs were indirectly helped by the injection of public funds into the banking sector, which enabled them to have access to low interest-rate borrowing. On top of that, the Japanese government deployed a comprehensive package of industrial and innovation policies under the coordination of the METI's council for SMEs, in order to promote start-ups and boost the innovation capacities of existing SMEs. Various forms of subsidies (such as favourable tax treatment for R&D investment) and regulatory reforms (such as the removal of the minimum capital requirement for start-ups) were mixed with measures aiming at nurturing the science and technological infrastructure.

From 2001 to 2010, the Science & Technology Plan had a budget of almost 50 trillion yen (very roughly £400 billion), which were invested in four major priority areas: life science, ICT, environment, and nanotech/materials. Also, a number of industries were identified as key for satisfying future social needs. They are: robots, fuel cells, digital content, and digital consumer electronics. METI's policy targets and selection of key technologies were underpinned by a strategic technology roadmap. Among the policy measures, particular emphasis was given to the establishment of 'regional consortium clusters' (defined as networks of regional industries, on the one hand, co-located universities and research centres, on the other), linked by both cooperative and competitive relationships (Weiss, 2005; Goto & Kodama, 2006). Finally, in 2006, the new policy initiative for competitiveness and productivity encapsulated in the idea of an 'Innovation Super High-Way' for Japan stressed the importance of strengthening the linkages between science, technology and industry.

3.2. Germany: The teacher?

Especially given its influence on Japanese industrial policy, Germany is often considered to be the 'teacher' for Japan. This was true, however, only in the old days. After WWII, Germany's industrial policy was considerably different from that of Japan or of other European countries such as France, Italy and the UK, as we shall see below.

During the first two decades after the WWII, Germany's recovery was driven by those industries in which the country had a long-standing competitive advantage and it was sustained by the high demand of investment goods from the rest of Europe. Between 1950 and 1970, investments remained high at 22-24% of national income, while exports rose from 9% to 19% of national income.

After the war, the giant chemical company, I.G. Farben, was broken up into Bayer, Hoechst (now part of Aventis), Agfa, and BASF. These companies allowed Germany to regain a world leading position in the modern science-based chemical industry. In electrical engineering Siemens quickly became a European leader in power engineering, telecommunications and other electronics. The non-electrical machinery and, more broadly, machine tools industries developed thanks to a dense network of highly productive small and medium sized firms, the so-called *Mittelstand*, supported by a whole array of public and quasi-public institutions (see below).

The German model (*Modell Deutschland*), as Helmut Schmidt called it in the 1970s, was developed during the first two decades after the WWII thanks to an articulated package of industrial policies operating both at the national and regional (Lander and municipalities) levels. The German industrial policy mainly focused on four axes: regulation of the labour market, the development of an integrated vocational training system, creation of a basic science and industrial research infrastructure, and public support for industrial finance.

In the early 1950s, the Works Constitution Act and the Collective Bargaining Law introduced a set of legally binding sectoral collective bargaining agreements between employers' associations and unions. These agreements introduced a 'labour constraint' for employers with respect to the remuneration, mandated or state-provided social security benefits, working condition, dismissal of workers, and rights of work councils (Muller-Jentsch, 1995; Vitols, 1997; Feldenkirchen, 1999).

Such measures had four main effects. Firstly, they guaranteed a low level of wage dispersion across firms, much lower than those of the US, the UK, and even Japan, and even declining throughout the 1980s (OECD, 1993; Streeck, 1992). Second, they encouraged long-term attachment of employees to firms – for example, in 1993, the average length of employment was 7.5 years, as against 4.4 years in the UK and 3 years in the US. Low turn-over, in turn, encouraged firms to invest in developing

firm-specific skills and in retraining (Abraham & Houseman, 1993). Third, these measures enabled work councils to get involved in firms' strategic decisions regarding the introduction of new technologies or organisations, hiring and firing, mass layoffs, working hours, and early retirement pensions. Finally, they prevented companies, especially those exposed to international competition, from building their competitiveness on lower wage costs, producing a 'productivity whip', whereby less productive companies were forced to change or to leave the market (Vitols, 1997).

The potential competitive disadvantages introduced by strict labour regulations were counterbalanced by a set of measures aimed at providing companies with a highly skilled labour force. Differently from the US and the UK, the public vocational training system was expanded and training standards upgraded throughout the three decades after WWII. The so-called 'dual' training system was based on the idea of mixing company-based training with theoretical instruction in specialised vocational schools. In 1969, the Vocational Training Law regulated apprenticeship contracts by defining company's duties as well as by assigning the responsibility to supervise and assess the achievement of certain training standards to Chamber of Commerce and Industry or Chambers of Artisans, the latter funded by compulsory fees for all companies.

While this integrated vocational training system increased the functional flexibility of workers and their adaptability to technological change, a series of laws were passed for alleviating the tensions arising from more radical structural changes as well as from business cycles (e.g. the Work Promotion Act in 1969). For example, adjustments to short-term demand contractions were dealt with through reductions of the average hours worked instead of reductions in the number of workers (Abraham & Houseman, 1993). During the crises in the mid- 1970s, beginning of the 1980s, and the early 1990s, regional labour offices widely resorted to subsidies for shorter working hours or even to early retirement schemes, to keep unemployment down. The latter were particularly important for facilitating the maintenance of a balanced age structure, especially in traditional sectors (Vitols, 1997; Feldenkirchen, 1999).

From the mid- 60s until the mid- 70s Germany's investments in basic science and industrial research tended to be sectoral and technology-targeted. In 1962 the Ministry for Atomic Questions was converted into the Ministry of Research and Technology (BTFM). Three major industrial strategies were implemented. The first was on data processing and computer hardware development, which channeled resources mainly to Siemens. The second was on nuclear power, focusing on fast breeder reactors. Third, both the federal and land governments heavily supported civil aircraft projects through subsidies and organised 'rationalisation' and concentration, which led to the creation of the MBB group, later one of the main partners in the Airbus consortium (Owen, 2012). Even when the federal government decided to privatise national companies – starting from the 1960s (e.g. Volkswagen and VEBA) and increasingly since the 1980s (e.g. Deutsche Telekom AG and Deutsche Post

AG).[15] – the Länder governments often maintained their shares in the company, as in the case of Volkswagen (the government of Lower Saxony) (Fasbender, 2004; OECD, 2003; TUC, 2011).

Since the mid-1970s, the German government increasingly developed its public R&D infrastructure built around two publicly funded networks of institutes, the Fraunhofer Society and the Max Planck Society. Fraunhofer institutes were explicitly aimed at filling the gap between basic science and company-based industrial research and at overcoming the disadvantages and scale bottlenecks faced by *Mittlestand* companies, that is, firms with a number of employees between 100 and 500. This public technological infrastructure was also complemented by a network of sectoral and local associations, focused on technology transfer, provision of training, and organization of focus groups for problem-identification and cooperative problem-solving.

The last pillar of the German model was a banking system focused on long-term lending to industry. During the 1950s, the German government built a number of public or quasi-public special-purpose banks, whose functioning and mandate adapted over the years with the changing needs of industries. For example, the Bank for Reconstruction (KfW), founded in 1947, increasingly moved away from direct lending and became a long-term refinance bank specialized in lending to banks strongly linked with industrial companies.[16] The *Mittelstand* companies were mainly served by the German Bank for Settlements (AG) as well as by a strong network of public saving banks and credit cooperatives, linked by a 'three tier' organizational structure, which allowed them to overcome scale disadvantages by aggregating credit demands (as well as savings) at the upper tiers (regional or national) while remaining strongly embedded in the local community.

The German Model went through important changes since the 1980s due to internal dissatisfaction and the re-unification.

In 1982, Helmut Kohl began to reduce the role of the government by cutting public expenditure and taxes as well as partially de-regulating the labour market.[17] These measures, coupled with a massive privatization, involving sales of shares of companies like Volkswagen and Lufthansa, reduced the size of the government from 52% to 46% of GDP between 1982 and 1990.

With the reunification, the government adopted a dual system of industrial policy: continuity of the industrial policy for West Germany (*alte/old Länder*) and policies directed towards East Germany (*Neue/new Länder*) (OECD, 1998). The industrial policy measures in East Germany focused on the creation and development of new SMEs (both in manufacturing and services), infrastructural investments, and the privatisation and rationalisation of state owned enterprises (SOEs) (the public agency in charge was *Treuhand Gesellschaft*). In West Germany, industrial policy has

remained very much focused on existing *Mittelstand* companies and their innovative capacity, especially those large medium-size companies (up to 1,000 employees), known as 'hidden champions', many of which dominate global niches, with 40%-90% of the global market shares (Simon, 1996; Venohr & Meyer, 2007).

The exact extent and details of Germany industrial policy are difficult to ascertain, as there are many different measures and actors (federation, Länder or municipalities) and different statistics cover different things.[18] However, it is fair to say that it has one of the most active industrial policies in Europe (Karl et al., 2003).

Even with recent changes, the German public sector still owns important shares in companies and uses public procurement strategically. In 2006, the federal government had important direct holdings of more than 25% in 33 enterprises and owned some shares in further 112 enterprises. Resources obtained through privatisation have been used, especially by Länder governments, for venture capital and public support for innovation.[19] Public procurements are, while transparent, strategically designed. For example, they prescribe the use of certain materials, technologies or compliance to certain standards, which enables the government to promote certain types of companies or technologies.

Despite the maintenance of the basic policy framework, there has been a major shift in German industrial policy since the mid-1990s. Almost half the public spending on industrial policy has been devoted to environmental sustainability, energy efficiency, and renewable energy. Also, the support for the enhancement of the innovation capacities and synergies of Mittelstand companies has been further strengthened, as testified by the ZIM project for Mittlestand and the BioRegio programme aimed at the creation of regional public-private partnerships.

3.3. The US: The real pioneer

In the contemporary debate on industrial policy, the US is often considered to be the antithesis of Japan and the other East Asian countries in this respect. Whether they praise the US model or criticise it, most commentators start from the assumption – and it is no more than an assumption, as we shall see below – that the US does not have much industrial policy. However, the US has employed a huge amount of industrial policy throughout its history.

First of all, from its early days, the US was a pioneer of industrial policy (Chang, 2002 and 2007; Rauchway, 2007). One key justification of industrial policy we mentioned above – the infant industry argument – was invented by none other than the first American finance minister (Treasury Secretary), Alexander Hamilton, in his 1791 *Report on the subject of Manufactures by the Treasury Secretary*. The *Report* was, contrary to what many believe, *not* narrowly focused on tariff protection but

discussed a whole range of (general and selective) industrial policy measures, including targeted subsidies, infrastructural development, financial development (the banking system, the government bond market), and the promotion of innovation through the development of the patent system.

Although it took a few decades since the publication of the *Report* before the pro-industrial-policy faction in US politics became strong enough to implement Hamilton's programme, from the 1830s, the US remained the most protectionist country in the world until World War II. Although its tariff protection lacked the careful selectivity of its East Asian counterpart, it was not a blanket protection either, as some sectors were more protected than others. Especially between the mid-19th century and the mid-20th century, the US government also invested heavily in infrastructure (e.g., the Pacific Railways, the mid-western canals), higher education (e.g., land grant colleges), and R&D (especially in agriculture), all with a considerable degree of explicit and implicit targeting.

Even after WWII, when the country attained industrial supremacy and started championing the cause of free trade and free markets, the US did not abandon industrial policy. Throughout the Cold War period, the US implemented a comprehensive industrial policy package including long-term procurement contracts, subsidies, investment guarantees, and strategic bailouts (Markusen, 1996). However, the post-WWII world order made it necessary for the US to play the role of new hegemon of the 'free trade' system and of the defender of the 'free enterprise' system against Communism, so it had to pretend that it was not engaged in industrial policy. As a result, industrial policy in the US after WWII was conducted under other names – defence policy, health policy, agricultural policy, and what have you – prompting the eminent American economic sociologist Fred Block to talk of a 'hidden developmental state' (Block, 2008).

Post-WWII US industrial policy was also strongly focused on translating cutting-edge technological research, much of which was generated through massive public funding of R&D (especially in defence and health), into commercial use. This was achieved through cooperation among a network of people with high levels of technological expertise – variously situated in state agencies (e.g. the ARPA [Advanced Projects Research Agency] of the Pentagon, the NIHs [National Institutes of Health], the NSF [National Science Foundation], and NASA [National Aeronautics and Space Administration]), industries, universities, and other research institutes. Between the 1950s and 1980s, the share of government funding in total R&D in the supposedly free-market US accounted for, depending on the year, between 47% and 65%, as against around 20% in Japan and Korea and less than 40% in several European countries (e.g., Belgium, Finland, Germany, Sweden).[20]

More recently, R&D funding has taken the form of grants, deferral of liability, tax provisions and exemption (62% of which was spent on accelerated depreciation of machinery and equipment**)**. During the 2000s, these industrial policy tools were structured within three main programmes. The first of these programmes, the Advanced Technology Program (ATP), managed by the National Institute of Standards and Technology (based under the US Commerce Department), focuses on the specific industrial technological needs and promotes private-public sectors partnerships, early-stage investment and risk-sharing in order to promote innovative technologies.[21] The second programme, called the Small Business Innovation Research (SBIR), supports small technology companies by funding early-stage R&D projects and guaranteeing them full IPRs on the new technologies they develop, even though it was partly funded by the SBIR. To be eligible for this programme, companies must be American owned, employing less than 500 employees and being for profit. The third programme, that is, the Small Business Technology Transfer (STTR) addresses the same company types but, differently from the SBIR, it funds only R&D collaborations among a plurality of institutions and organisations (university, federally-funded R&D centres, non-profit research institutes) (Buigues & Sekkat, 2009)

Direct measures in support of R&D and SMEs are coupled with both trade policies and a strategic use of public procurements by local (that is 'state') governments. As for the former policy, bilateral agreements are used for opening new markets for American firms but, also, for restricting foreign competition and providing short-term economic reliefs to industries under stress. Even though antidumping and countervailing duty measures have been less frequently used since 2001, sectors such as agriculture, textiles forest products and steel have known various forms of protection or were subsidised (WTO, 2006; Ketels, 2007). As for demand side industrial policies, that is, public procurements, each local governments has its own procurement agency and defines its strategy independently under the overall supervision of the Office of Management and Budget (OMB). Some states assign preferences to local manufacturers or set local contents requirements.

Unfortunately, the 'clandestine' nature of post-WWII US industrial policy has meant that it has suffered from unstable funding, lack of coordination across different policy areas and between different actors, and excessive commoditisation of knowledge (Block, 2008; Ketels, 2007). In 2006, for instance, while the American Competitiveness Initiative established by President Bush announced a renewed commitment to science and technology policy, the Congress reversed this decision and proceeded with spending cuts in many programmes (Buigues & Sekkat, 2009, p. 172).

However, on the whole, post-war industrial policy in the US has been quite successful, as testified to by the fact that the majority of the industries in which the US has international competitiveness have been developed through public funding of R&D and public procurement, especially in the names of 'defence' (computer, semiconductors[22], aircraft, internet) and 'health' (drugs, genetic engineering) (Medeiros, 2003; Block, 2008; Mazzucato, 2011; Pisano & Shih, 2012).

3.4. Korea: The most dramatic example

Between the 1960s and the 1980s, Korean industrial policy has followed a trajectory that is very similar to the Japanese one, but in a much more dramatic fashion than the Japanese one. This was partly out of necessity – Korea, technologically being so much more behind than Japan was, needed more forceful government intervention if it were to raise internationally competitive firms. However, it was also because, for historical reasons[23] the private sector was far weaker than in Japan so that the Korean government was far less constrained in dictating the private sector than its Japanese counterpart did.

Korean industrial policy-making and -implementation were also more centralised than the Japanese ones (see Chang, 1993, for further details). The Korean planning ministry, the Economic Planning Board (EPB), which was ultimately in charge of industrial policy (although the Ministry of Commerce and Industry executed many of the policy measures), was much more powerful than the Japanese planning agency (not even a full ministry), the Economic Planning Agency. The EPB even controlled the government budget, which is in most countries including Japan the turf of the finance ministry. As a result, Korea's 'indicative' planning (the Five Year Plans for Economic Development, practised between 1962 and 1993) – and industrial policy as a key component 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 exchanges. Credit rationing was possible because all banks, and 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 through heavy regulations until the early 1990s.[24] Foreign exchange rationing was conducted through the so-called 'foreign exchange budgeting' system, which was based on legally mandated government monopoly of all foreign exchange transactions until the early 1990s (see Chang, 1993, for details). This gave the government a huge leverage over private sector companies, as Korea's then low level of technological development and its paucity of raw materials meant that, without access to foreign

exchanges, companies could not acquire necessary capital goods, intermediate goods, or raw materials.

The infant industries were heavily protected from imports – average manufacturing tariff rates were 30-40% until the 1970s and quantitative restrictions (e.g., import quotas) abounded well into the late 1980s (Chang, 1993 and 2005). Foreign exchange rationing also gave producers manufacturing consumer goods some 'natural' protection, as imports of those goods were far down the priority list in the government foreign exchange budget and therefore they could often not be imported due to the lack of the means to pay for it, not due to import controls and tariffs. Sometimes domestic taxes (e.g., luxury consumption tax) were used to restrain the imports of luxury consumption goods, even though their tariffs were not 'prohibitive' – in the 1980s, Scotch Whiskies, which had 'only' 100% tariff, fetched 9 times world market prices (Chang, 1993).

Domestic producers in strategic sectors were also protected from competition from TNCs producing in Korea, as there were regulations on FDI that were almost as strict as the Japanese ones (Chang, 1998). There were also regulations on technology licensing (both in terms of the quality and the price of the imported technology). As in the Japanese case, the purpose was eventually developing local producers with world-class productive capabilities.

Unlike in Japan, where there have been no significant SOEs in the manufacturing sector since the early 20th century, the government in Korea did not mind using SOEs when necessary. The most prominent example in this regard is the now-privatised (privatised in 2000) POSCO (Pohang Steel Company), which was the second largest steel producer in the world until the recent mega-mergers in the world's steel industry and still the fourth largest.[25]

The Korean government was also a lot more involved in corporate restructuring in the private sector than the Japanese government was, not least because stock market regulations made hostile Mergers and acquisitions (M&A) virtually impossible. Especially when business downturns put firms into the danger zone, the Korean government would wade in to initiate M&A and production rationalisation (see Chang, 1993 and 2006, for further details). The state-owned development bank (Korea Development Bank) played a key role in the process, sometimes providing subsidised loans on extended maturity to firms under restructuring and sometimes taking a stake in those firms (sometimes even majority stakes, thereby in effect nationalising the firms in question).

Since the 1990s, the Korean industrial policy has gone through some dramatic changes – mostly decline (see Chang & Evans, 2005, for further details), although we may be entering a period of at least partial revival with the new government (as of

2013) showing distinctively more interest in industrial policy than any government since the mid-1990s.

Strongly influenced by neo-liberal ideologies propagated by US-trained free-market economists and intense lobbying by the private-sector conglomerates (the so-called chaebols) increasingly impatient to break away from state control, the Korean government started scaling down industrial policy since 1993. The most symbolic of this move were the termination of the Five Year Plan in 1993 and the abolition of the Economic Planning Board (EPB) in 1994 (it was merged with the Ministry of Finance). There was a further round of reduction of industrial policy following the 1997 financial crisis, which established neo-liberal ideological hegemony in the country. One important result of this round of reform was the transfer of international trade policy remit from the Ministry of Trade and Industry (MOTI) to the Ministry of Foreign Affairs (MOFA), which signalled that the government now understood international trade to be a matter of diplomatic negotiation (based on the international consensus that completely free trade is the goal) rather than an element of industrial policy.[26]

Capital market liberalisation since 1997 has exerted short-term pressures on companies and has negatively influenced the private sector's role in investment and R&D. Between 1998 and 2010, private gross fixed capital formation (GFCF) as a percentage of GDP averaged 18.4%, a significant step down from the 23.7% between 1990 and 1997 (OECD, 2012c). The share of gross domestic expenditure on R&D (GERD) that was financed by the private sector also declined from 76.3% in 1995 to 71.8% in 2010 (OECD, 2012a).

Despite this general trend towards the diminution of industrial policy in the last two decades, the practice of designating certain industries as 'strategic' and providing targeted supports has continued in Korea, albeit at a lower key. Bio-tech, nano-tech, and green-tech industries have been subject to such support, in the forms of R&D funding, credit guarantees and public funding for training (especially for the green-tech industries) (Kim & Koh, 2010). While these supports were not of the scope and scale of pre-1990s industrial policy, they were not insignificant either. The share of public spending in total R&D spending has crept up from the traditional 20% region to 26.7% in 2010. Given the continuous rise of R&D spending as a share of GDP in Korea in the recent decades, this means that the country, at 1.00% in 2010, has one of the highest government-financed R&D as a proportion of GDP in the world, behind Austria (1.08%) and Iceland (1.03%), tying with Finland, and above the OECD average of 0.74%. Since the late 1990s, there have also been attempts to develop industrial clusters in economically weaker regions (MKE, 2010; OECD, 2012b), but these have not been very successful, due to the lack of the thick institutional networks present in countries like Germany and Italy that have been the most successful with those policies.

3.5. Singapore: The ultimate pragmatist

Not least because of its status as a small[27] city-state without natural resources, Singapore's industrial policy has been very different from those of other East Asian countries, but in many ways the most successful – its per capita GDP (at current market prices) rose from US$516 in 1965 (when it gained independence) to US$50,123 in 2011 (SDOS, 2012). As of 2010, it had become the most industrialised country in the world, producing the highest MVA in the world (see Table 1).

Singapore's small domestic market (2 million people at the time of separation from Malaysia in 1965) meant that it had to rely exceptionally heavily on external demand to industrialise.[28] Accepting this, the country adopted a free-trade regime, making its industrial policy regime very different from those of the other East Asian countries. Moreover, given the paucity of local entrepreneurial talent and the lack of industrial technology, the Singapore government decided to work with TNCs much more closely than the other East Asian countries. As a result, its FDI as a share of GFCF was the highest in the world (22.9% between 1971 and 1995), higher than even that of *laissez-faire* Hong Kong (7.6%) (Chang, 2006).

However, all of this does not mean that Singapore pursued a *laissez-faire* industrial policy, as many free-market economists suggest. On the contrary, the Singapore government has consistently taken a proactive role to support the manufacturing sector's growth.

First of all, the Singaporean government has shown itself to be even more interventionist than that of Japan or Korea in certain respects, such as forced saving schemes, the labour market, and public housing programmes.[29] The Central Provident Fund, which imposed mandatory contributions by employers and workers, accounted for 30% of domestic savings or 12% of national income since the early 1980s (Findlay & Wellisz, 1993, p. 8). The high saving rates stimulated higher levels of investments and capital accumulation in the Singapore economy – according to Huff (1999), Singapore had the highest national savings rate in the world in the1980s (over 40%) and 1990s (48.2% between 1990 and 1997). The labour market was also highly regulated. Singapore initially started as a high-cost manufacturing producer (Huff, 1995, p. 1424), whose wage costs were higher than other competing newly industrialising Asian countries (Lim, 1983, p. 757). However, to enhance the competitiveness of Singapore's labour-intensive industries, the government introduced a series of labour market regulations that included wage repression between 1972 and 1979 and curbs on wage increases through a centralised wage system (Fields & Wan, 1989). Through its Housing Development Board, the Singapore government has supplied around 85% of all housing in the country.

Second, precisely because of the recognised scarcity of resources and vulnerabilities as a small open economy, the government has set explicit directions to nurture the manufacturing sector's growth. In 2010, a high-level committee (comprising the government, labour movement, private sector and academia), tasked by the Prime Minister to formulate medium-term economic strategies, recommended the retention of a "globally competitive manufacturing sector" at between 20-25% of the economy (SESC, 2010). As a city-state, policy formulation is highly centralised, with the implementation of industrial policy falling primarily under the mandate of the Economic Development Board (EDB) (see Schein, 1997; Chan, 2011, for more details on the EDB and its work). Strategic manufacturing clusters that are assessed to have long-term economic potential are identified and targets are actively pursued. During the nascent stage of building the biomedical manufacturing cluster in the early 2000s, Singapore targeted to attract 15 world-class biomedical science companies by 2010. This goal was surpassed, with Singapore succeeding in attracting over 30 leading companies by 2012. Most recently in 2013, Singapore announced ambitious plans to build manufacturing capabilities in satellites to serve the space industry.

Third, Singapore's policy towards TNCs, while extremely friendly, has not been *laissez faire*. Rather than taking a hands-off approach to the inflows of FDI and let the TNCs decide what to do, the Singaporean government has worked hard to attract FDI into certain areas that it regards as important for the future of the country's economy, by offering a whole slew of custom-designed financial incentives. Subsidies offered to TNCs targeted desirable industries based on criteria such as employment, growth potential, technical contents, and value-added (Huff, 1999, p. 39). Between 1980 and 1990, Singapore received more FDI than any other developing country (Huff, 1995, p. 1425). Today, Singapore continues to offer Pioneer incentives (corporate tax exemptions on income from qualifying activities), Development and Expansion incentives (reduced corporate tax rate on incremental income from qualifying activities), and the Research Incentive Scheme for Companies (grants to develop R&D capabilities in strategic areas of technology). Singapore's generous incentives were cited as a key reason why hard disk manufacturer Seagate chose to invest in Singapore over Hong Kong and Korea in 1982 despite Singapore's lack of a domestic supply base (Peebles & Wilson, 2002, p. 100). This initial investment eventually earned Singapore the distinction of being the largest producer of hard disk drives in the world (45-50% of annual world output) between 1986 and 1996 (Wong, 2000, p. 155).

Fourth, in sectors assessed to be critical, the Singapore government set up SOEs – comprising Government-linked Companies (GLCs) and government statutory boards (such as the Housing Development Board) – rather than inviting TNCs. The world-famous Singapore Airlines is an SOE, while industries such as shipbuilding and telecommunications are also run by SOEs. As a result, it has a huge SOE sector (estimated to be 21.8% of GDP in 1998) (SDOS, 2001).[30] For example, between 1970

and 1990, the share of the public sector in GFCF in Korea was around 10%, whereas the corresponding figure in Singapore was over 30% – 36% in the 1960s, 27% in the 1970s and 30% in the 1980s (Shin, 2005). It would not be an exaggeration to say that virtually all large firms in Singapore that are not transnational corporation (TNC) subsidiaries are SOEs.

Fifth, land use policies in Singapore incorporate a significant sectoral-targeting dimension, particularly given its lack of land resources.[31] For instance, waterfront land that is allocated to the petrochemicals industry cannot be used to expand the port (and grow maritime services). In a recent land use plan (with a time horizon until 2030), the government announced new manufacturing zones "to support the growth of the manufacturing sector" (SMND, 2013). Land-related industrial policy measures also target specific clusters within the manufacturing sector. For instance, the land mass of seven small islands was tripled and amalgamated through the reclamation of 22km^2 of land to create Jurong Island – a petrochemicals hub. Contiguous land was also allocated to facilitate the growth of clusters in industries such as aerospace (Seletar Aerospace Park) and pharmaceuticals (Tuas Biomedical Park and Biopolis).

3.6. Finland: Defying gravity?

On the back of state-led corporatist industrialisation, Finland radically transformed itself from one of the poorest economies in Europe into one of the richest. According to the authoritative statistical work of Maddison (1989), among the 16 largest rich countries of today, only Japan (3.1%) achieved a higher rate of annual per capita income growth than Finland (2.6%) during the 1900-87 period (p.15, table 1.2).[32] Norway tied with Finland in second place, and the average for all 16 countries was 2.1%.[33]

Industrial policy in Finland involved close cooperation between the state, trade unions and private sector agents, such as the banks and industrial firms. This corporatist nature of Finland's growth model has led to comparisons with the Asian economies, such as Korea and Taiwan (Vartiainen, 1999).

Like Singapore, Finland is a small open economy that emphasised state-directed capital accumulation that was supported by high public savings.[34] During the 1950s and 1960s, public savings comprised as much as 30% of aggregate savings, and these surpluses were used to support private investments in capital equipment and to form public companies (Jäntti & Vartiainen, 2009).[35] SOEs were established in industries that were more capital-intensive or deemed too risky for private enterprises. These industries included basic metal (Rautaruukki), pulp and paper (Stora Enso), chemical fertilizer (Kemira), and petroleum and oil products (Neste). In the early 1980s, SOEs were estimated to contribute 18% to Finland's industrial value-added (Kosonen, 1992).[36]

However, unlike Singapore, Finland eschewed foreign involvement during its early phase of industrialisation. Having been subjugated to foreign rule for centuries, draconian restrictions were imposed on foreign investments.[37] In 1919, soon after the independence from over a century of Russian rule (which was preceded by six centuries of Swedish rule), it was stipulated that foreigners had to get special permission to establish a business and guarantee in advance the payment of taxes and other charges due to the central and the local states. In the 1930s, a series of laws were passed in order to ensure that no foreigner could own land and mining rights. It was also legislated that a foreigner could not be a member of the board of directors or the general manager of a firm. Companies with more than 20% foreign ownership were officially classified as 'dangerous companies' and therefore foreign ownership of companies was effectively restricted to 20%. As a result, while there was considerable foreign borrowing, there was little FDI during this period, a pattern that persisted at least until the 1980s when there was some liberalisation of foreign investment.[38]

To achieve high levels of investments, the Finnish government invested heavily in productive equipment and offered accelerated depreciation and investment allowances.[39] Other measures encouraging capital accumulation included interest rate controls and preferential credit for investments in capital equipment. Between 1961 and 1990, Finland's share of investments (GFCF) in GDP was 26.9%, higher than the OECD average of 22.8% (World Bank, 2012).

To enhance the competitiveness and growth of its export industries, Finland repeatedly devaluated its currency in 1957, 1967, 1977 and 1982. Although devaluations are generally regarded as a 'horizontal' macroeconomic stabilisation policy, it also involves implicit targeting of sectors, as we highlighted earlier (see section 2.1). In Finland's case, more outward-oriented sectors, such as the paper and pulp industry, benefited more from the devaluations than industries dependent on the domestic market.

In the past few decades, Finland's industrial policy focus has shifted towards promoting innovation in general rather than particular industries, with the government continuing to play a key role, directly through R&D spending and indirectly through 'horizontal' measures that strengthen the science and technology foundation for industries. During the recession in the early 1990s, the government remained committed to raising public R&D, even as it reduced most public expenditures (Georghiou, et al., 2003). Within the OECD, Finland had the third highest government-funded GERD (normalised by GDP) (1.00%) in 2010.

Finland's 'horizontal' measures to create an enabling business environment that is conducive for innovation mark a departure from past initiatives which explicitly targeted specific sectors. Nonetheless, these measures still involve some degree of implicit targeting at technology-intensive sectors, as we had argued earlier.

First, access to funding for innovation was improved through various government initiatives (e.g., the Finnish Innovation Fund – SITRA) and organisations (e.g., Tekes – the Finnish Funding Agency for Technology and Innovation). SITRA, supervised by the Finnish Parliament, provided corporate funding to companies and played a key role in developing the venture capital industry in the early 1990s (Ylä-Anttila & Palmberg, 2007). Tekes, on the other hand, is the main source of R&D subsidies in Finland (see Toivanen, 2006, for more details on Tekes and the impact of Finland's R&D subsidies.)

Second, nationwide networks of science parks and centres of expertise were developed from the 1980s to facilitate technology transfer and the commercialisation of research results (Lemola, 2002). At the macro-level, new innovations were supported through the specialisation of and cooperation between regions and clusters. At the micro-level, spin-off projects and incubators were nurtured by the science parks.

Third, Finland pioneered the concept of a 'national innovation system' in the 1990s (Miettinen, 2002), to foster public and private sector cooperation in developing, diffusing and utilising new knowledge and technologies. This involved adopting a broader and more holistic approach towards innovation processes and policies, ranging from education and science to innovations by firms and commercialisations of technological innovations (Georghiou et al., 2003). Today, the Strategic Centres for Science, Technology and Innovation (SHOKs) continues to emphasise innovation through the enhancement of collaborative platforms between the government, private sector, universities and research institutes.

3.7. Italy: Small is beautiful?

In 1960, Luigi Spaventa described Italy as a country whose economic position "is *in between* that of an underdeveloped and an advanced economy". He pointed out that "though the initial 'big push' took place later than elsewhere, the Italian economy as a whole has been growing at a good, and often rapid pace over the past eighty years or so. [However] there has been some growth in the South only in recent years and only owing to heavy public intervention…" (Spaventa, 1960, p. 1077)

During the first two decades after the Second World War, the persistent technological backwardness of the Italian economy as well as the problems encountered by the central government in developing the South (the so-called 'Mezzogiorno') were at the centre of the policy agenda.

The central government tried to encourage the reconstruction and the expansion of the production capacity in selected strategic sectors, such as automobile, by providing money as well as subsidised intermediate goods (produced by SOEs) to private companies, such as FIAT. Moreover, engineering and mechanical companies that were not able to pay state loans back were nationalised under the holding company, the EFIM (Ente Finanziamento Industrie Meccaniche). Nationalisation was also used with respect to certain strategic industries, the most remarkable example being the constitution of ENEL in 1962, a new national agency for the provision of (very often subsidised) electric energy (Baldassarri, 1993; Federico & Giannetti, 1999).

During the 1950s and 1960s, SOEs were also very active in the modernisation of utilities, building of infrastructure, and investments in heavy industries, such as steel (through the Sinigaglia Plan) (Barca & Trento, 1997) and energy, initially with AGIP (for gas) and later with ENI (for oil and chemical products) (Sapelli, 1992). The IRI (Istituto per la Ricostruzione Industriale), a multi-sectoral holding company founded in 1933 and fully owned by the state, was a major tool for supporting the central government's industrial policies aimed at reducing the North-South gap. A major innovation was represented by the Law No. 634/1957, according to which SOEs had to have 40% of their total investments and make 60% of new investments in Southern Italy.

IRI's strategic investment was also complemented by the loans provided by the Cassa per il Mezzogiorno (Cassa), a development bank set up in 1950 with the strong support of the US Government (USAID), as well as the Ten Year Development Plan for Employment and Income (Schema di sviluppo della occupazione e del reddito del decennio, 1955-1964), better known as 'Schema Vanoni'. During the 1960s, thanks to the reform of the Cassa, as well as to a number of special banks supporting industrial and public investment – such as Special Banks for Industry and Infrastructure Development, or Istituti di Credito Speciale per l'industria e le opera pubbliche (ICS) – new resources were channelled towards a selected number of capital-intensive industries, such as steel and chemicals, or traditional sectors, such as food processing and textiles.[40]

Throughout the 1950s and 1960s, while the Southern regions experienced a state-led process of 'dependent industrialisation' (Andreoni, 2013d), the SMEs of the Northern regions experienced a fast export-led development. In 1957, by joining the European Economic Community, Italy signed a quadrennial plan of tariffs cuts (30% each time) which would have to be totally removed by 1969 (in fact Italy achieved this goal a few years ahead of schedule!). As it was accompanied by equivalent tariff cuts by other members, the fast industrialising regions in the North were able to boost the export of strategic products such as machine tools and automotive as well as textiles and other low-tech products, in which Italy was then competitive thanks to lower wages.

Differently from other European countries, during the 1970s Italy's attempt to face the oil crisis through incomes policy resulted in massive failures. The government's response to the crisis led to an overall increase in public subsidies from 1.2% of GDP in 1964 to 4.6% in 1975, up to 8.9% in 1985 (Federico & Giannetti, 1999). Unfortunately**,** subsidies were not strategically used for encouraging structural adjustments. For example, subsidies for temporary lay-offs of workers became permanent and were indifferently applied across industries. Strategic industries (steel-making, energy, petrochemicals) were granted subsidies and other measures for facilitating their industrial restructuring (Adams, 1991). Many troubled firms in strategic (and non-strategic) sectors were bailed out, resulting in the expansion of the SOE sector.[41]

While national champions struggled over the 1970s, Northern SMEs, very often operating in traditional labour-intensive sectors (e.g. textiles, machine tools, furniture, etc.), successfully found their own flexible institutional responses to the crisis. 'Industrial districts' developed, based on clusters of co-located SMEs whose flexibility and productivity were mainly driven by external economies of scale, complementarities in production, industrial commons, and reduced transaction costs (Piore & Sabel, 1984; Becattini, 1987; Gobbo, 1989). Although industrial districts initially developed spontaneously, the national and regional governments encouraged their diffusion and growth by providing soft loans, which accounted for one-third of the total funds for investments over the 1970s.

The economic crisis and policy failures of the 1970s led to a profound reformulation of Italy's industrial policy strategy. The 1980s witnessed a significant shift in industrial policy targets that became more and more focused on supporting R&D, innovation, and competitiveness, as well as the enlargement and the modernisation of SMEs increasingly challenged by increasing international competition especially in traditional medium- and low-tech sectors. With the exception of Japan, in the early 1980s, Italy saw the highest increase in public investments in R&D, although the results were quite modest, given the narrow range of policy tools adopted and the complex bureaucratic system which regulated the access to public support.

While other European countries started implementing privatisation and liberalisation policies over the second half of the 1980s, Italy resisted until 1992 when it faced the risk of a national bankruptcy. Over the 1990s, privatisation and liberalisation were aimed at reducing public debt but also improving the productivity of the newly privatised companies, while reducing SOE monopoly and inter-SOE collusion. Privatisations proceeded in two steps: firstly, major national banks owning shares of many public corporations were sold; secondly, SOEs were directly sold to private companies. In some sectors, privatisation produced the desired results, while in many others the lack of strategic vision led to the loss of control of strategic production assets, minimal benefits for consumers, and even the simple replacement of public

monopolies with private monopolies (examples are in the telecommunications, with Telecom Italia, and in infrastructure, with Autostrade).

During the mid- 2000s the privatisation process slowed down and state-owned holding companies (e.g., ENEL and ENI) even managed to increase their presence in the European and global markets. At the same time, the government intervened in the restructuring of FIAT by allowing the company to benefit from a strong line of credit offered by recently privatised banks. The short-lived government of Romano Prodi (2007-8) attempted to start a new industrial policy course by both deregulating the service sector and, more importantly, proposing a new national industrial policy agenda called Industria 2015.

The Industria 2015 agenda recognised the need for coordinating some of the industrial policies that regional governments (almost exclusively in Northern regions such as Emilia Romagna) had been implementing over the years. The industrial policy package of Industria 2015 pursues three main strategies: (i) promotion of investments in innovation projects in areas of energy efficiency, logistics, life sciences, and the protection of artistic heritage; (ii) promotion of network amongst firms; (iii) new national venture capital funds. The political instability of the last years has, unfortunately, largely undermined the effectiveness of this national industrial policy strategy.

3.8. Brazil: Against all odds

The period of 1950-1980 in Brazil was characterised by a long period of state-led industrialisation (Ocampo, 2006). Public sector indicative planning was the norm in Brazil as well as in the rest of the Latin American region. Industrial policy was mainly aimed at creating new industrial sectors, changing the prevalent pattern of specialisation in primary commodities and promoting technology-intensive activities.

The main industrial policy strategy of this period was set up in the 1950s and consisted in the introduction of a protectionist regime based on *ad valorem* tariffs. The Federal Government had the discretionary power to control the level and the types of imports. The Law of Similarities (*Lei do Similar Nacional*) stated that a product could only be imported if it could be proved that a similar product was not produced in Brazil. These measures were intensified during the 1960-80 period within an import substitution industrialisation (ISI) strategy.

As a result of these industrial policy measures, Brazil successfully entered new strategic sectors, such as petrochemical and renewable fuels (ethanol production with the Pro-alcohol policy which led to Petrobas) and established the bases for the development of new technologies. Brazil’s upgrading into new technological areas was sometimes very successful, as in the case of the aircraft industry (Embraer) or

agribusiness (Embrapa; see Andreoni, 2013a) but not in some others, such as in the attempt to develop the computer industry or in the attempt to upgrade existing sectors, such as textiles and automotive.

The Debt Crisis during the 1980s induced the Brazilian government to introduce, at least formally, a 'New Industrial Policy' package (1985-1988). The total number of special trade regimes was reduced and the average manufacturing tariff rates went from 90% to 43%. However, given the strong opposition of domestic producers, reforms were not so radical. Non-tariffs barriers and the Law of Similarities were not removed, and these, together with the remaining tariffs, allowed many marginal producers to survive (Kume, 1989; Hay, 2001; Figueiredo, 2008). During the late 1980s and throughout the 1990s structural adjustment policies (financed by conditional financing programmes from the IMF and the World Bank) were initially directed to trade liberalisation and privatisation of public enterprises, while from the mid-1990s they increasingly focused on macroeconomic stabilization (the 'Real Plan').

The 2000s signaled the return of selective (sector specific) industrial policies in Brazil. In November 2003, the first Lula government announced the Guidelines for an *Industrial, Technology and Foreign Trade Policy* (PITCE), whose goals were twofold: (i) increasing industrial competitiveness by boosting technological development in key sectors and, thus, promoting the export of higher value-added products; (ii) developing the scientific and technological systems for capturing opportunities in production activities such as oil and gas, agriculture and pharmaceuticals. The Brazilian Industrial Development Agency (ABDI) and the Council for Industrial Development (CNDI) (made up of 23 Government Ministers, the BNDES President and 14 industry representatives) were created for coordinating and implementing the new PITCE industrial policy package and for facilitating the dialogue between the public and private sectors. Four strategic sectors were targeted: semi-conductors, software, pharmaceuticals and medicines, and capital goods.

In terms of innovation strategy, PITCE was focused on three industries: biotechnology, nanotechnology and biomass/renewable energies. Also, a new legal framework was introduced comprising the Innovation Act (*Lei do Bem*), the Biosecurity Act and the Biotechnology Development Policy. Both industrial and innovation policies were coupled with highly specific financing programmes, such as the Profarma (pharmaceutical) and the Prosoft (software) as well as two super-sectoral programmes called Strong Industry and Innovate Brazil, managed by the Brazilian Development Bank BNDES (for a total investment of R$ 4.4 billion). The sectoral programmes are aimed at overcoming infrastructural bottlenecks and increasing Brazil's competitiveness in targeted sectors. The super-sectoral programme targets the innovation capacity of Brazil and promotes various forms of cooperation and partnerships among private companies, universities and research institutes, government agencies and labour unions. In 2004, the adoption of an

integrated funds management model 'made it possible to integrate a large fraction of investments in funds by transversely bridging them in line with government policies, eliminating duplication and scattershot initiatives' (ABDI, 2006, p. 20).

For the 2008-10 programme, the second Lula government launched an ambitious industrial policy package Productive Development Policy: Innovate and Invest to Sustain Growth (PDP) aimed at addressing for main challenges: (i) to sustain the expansionary cycle by maintaining the rate of growth in GFCF ahead of the GDP; (ii) to upgrade and diversify the export basket, which is dominated by primary commodities and low-tech manufactures; (iii) to boost the innovation capacity of Brazilian companies through specialisation in high value production activities and through the development of large firms controlling global value chains; (iv) to increase the competitive and distributive effects of the expansionary cycle by broadening access to credit for micro- and small enterprises.

The PDP is a complex policy package structured along three main axes. First, there are programmes promoting strategic areas (healthcare, ICT, nuclear energy, defense, nanotech and biotech), managed by the Ministry of Science and Technology (Bothelo, 2011). Second, there are programmes to consolidate and expand international market positions with the help of the state-owned development bank, the National Bank for Economic and Social Development (BNDES). The targets of these programmes are: aeronautics, oil, natural gas and petro-chemicals, bio-ethanol, mining, steel, pulp and paper, and meat. Third, there are programmes to strengthen industrial competitiveness under the direct control of the Ministry for Development, Industry and Foreign Trade (MDIC) (Government of Brazil, 2008; Ferraz et al., 2009).

During the implementation of the PDP, particular emphasis was given to the increase in competitiveness and the increase in international investments by the national champions in resource-based industries (Devlin & Moguillansky, 2012, p. 13). Also, the funding base of BNDES was substantially expanded in order to allow the country to reach the GFCF of 21% by 2010 while the spread for credit lines in trade of capital goods was substantially reduced (Government of Brazil, 2008 p. 24).

The current industrial policy – Plano Brasil Maior (PBM), issued by the Roussef government in August 2011, embraces a broader scope and concentrates more on infrastructure, compared to the PDP. PBM also focuses on strengthening production chains and diversifying/upgrading exports (especially for SMEs) through tax reliefs, trade remedies (e.g., anti-dumping measures), and financing and loan guarantees for exporters. Since the 2008 global financial crisis, Brazilian producers have been protected from exchange rate appreciation and the worldwide economic slowdown, especially through the financial support of the BNDES, exemption of payroll taxes, and preferences in government procurement.

In the last few years, the Brazilian government has finally changed its restrictive macroeconomic policies, implemented since 1996, which contributed hugely to the dramatic premature de-industrialisation of Brazil – the share of manufacturing in GDP fell from the peak of 27.2% in the mid-1980s to 14.6% in 2011 (World bank: http://www.tradingeconomics.com/brazil/manufacturing-value-added-percent-of-gdp-wb-data.html). First, tentatively following the 2008 crisis and then aggressively since 2012, it has abandoned the high interest policy (for much of the time since 1996, it had literally the highest real interest in the world). The lowering of interest rates has naturally led to the depreciation of (the very overvalued) Real, the local currency. These macroeconomic changes have significantly relieved pressure on the manufacturing industry as a whole and especially the export-oriented firms.

In April 2012 the PBM entered in its second phase and is now concentrating on the Brazilian industrial competitiveness challenges (Canuto et al., 2013). The PBM is redesigning the policy target based on production systems concepts, instead of production chain ones, and trying to identify new instruments to strengthen industrial policy effectiveness and favour public-private collaboration (such as by establishing a new public-private governance scheme, including sectoral competitiveness councils) (Kupfer, 2012).

3.9. China: The new frontier

Since the late 19th century, the Chinese government has played an important role, with varying degrees of success, in mobilising resources, developing infrastructure and nurturing strategic industries, regardless of the political regime (the Qing dynasty, the Nationalist government, and the Communist government).[42]

During the transition towards a market economy in the 1980s and the 1990s, industrial policy continued to weigh heavily on the minds of Chinese state planners and many initiatives in the 1980s were inspired by the experiences of Japan and Korea. In 1987, an Industrial Policy Department was established under the State Planning Commission and in March 1989 the concept of industrial policy was explicitly mentioned for the first time in an official document, that is, the State Council's paper *Decision on Current Industrial Policy Priorities*. It was followed by the more comprehensive and integrated *Outline of State Industrial Policies for the 1990s* in March 1994, which highlighted the need to accelerate the development of mainstay and high-technology industries, and to readjust the composition of foreign trade by strengthening manufacturing competitiveness. The June 1995 *Provisional Regulations of Guidance on Foreign Direct Investment* and subsequent December 1997 revision mapped out guidelines for high-technology sectors where foreign investments were encouraged, restricted or prohibited (see Zhang & Long, 1997; Yu, 1999, pp. 75-6; Liu, 2005, pp. 34-43, for further details).

China's industrial policies are embodied within its Five-Year Plans. The Sixth Plan (1981-1985) marked a departure from past industrial plans by being more comprehensive and outward-oriented. Foreign trade and capital were encouraged in order to facilitate the import of advanced technology into the country. Promotion of high-technology industries and R&D were recurring themes in later Five-Year Plans. Strategic industries, or "pillar industries", were identified based on their importance to China's national security and economy (e.g., defence, coal, electric power and grid, telecommunications, petroleum and petrochemical, civil aviation and shipping in 2006) and growth potential (e.g., alternative fuel cars, biotechnology, environmental and energy-saving technologies, alternative energy, advanced materials, new-generation information technology, and high-end equipment manufacturing in 2007).

As China undertook economic liberalisation, it drew on the experiences of East Asia. Similar to Singapore, China's export growth has been supported by the investments of TNCs. Like Korea and Japan, China has successfully developed large domestic enterprises. As such, China's industrial policy shares certain characteristics with its East Asian counterparts and goes beyond direct tariffs, subsidies and trade protectionism.[43]

First of all, key industries that have been identified in the Five-Year Plans for development were given targeted supports. They were protected from foreign competition through tariffs and non-tariff barriers, such as local contents requirements. They were supplied with subsidised loans from state 'policy banks', such as the Export-Import (Exim) Bank of China, the Agricultural Development Bank of China (ADBC) and China Development Bank (CDB).[44] Commercial bank loans were also made in line with industrial policy goals.[45] According to Ferri and Liu (2010), SOEs received 65% of the loans from commercial banks between 1998 and 2003, despite accounting for only 25% of China's economy. Imputed interest rates on debts offered to private enterprises were also found to be 25% to 33% higher than that offered to SOEs.

Second, through the licensing system, investments were directed in strategic ways. For example, foreign investments were channelled into targeted sectors[46] and designated geographical areas such as Special Economic Zones (SEZs). For another example, the government also controlled the geographical distribution of investments. This was evident in the 1960s when the government located new industries in inland areas so as to distribute industrial development away from the concentrated coastal areas.[47] In the early days of the open-door policy, coastal areas were reprioritised for government investments, in order to maximise their growth impacts and the access to foreign markets. More recently, the growing concern with regional disparities has once again compelled the government to shift the focus of its investments (especially infrastructural investments) to the inland areas.[48]

Third, to develop what Nolan (2001) described as a 'national team' of enterprises in strategic sectors, the Chinese state initiated M&A by administrative decree. For example, state-mediated consolidation of smaller, uncompetitive firms in the electronics industry led to the formation of larger companies such as China Electronics Corporation and SVA Group. Over the years, the government has continued to pursue its policy of industry consolidation to develop large internationally competitive companies[49], with one recent example involving the merger of two SOEs – when China Electronics Corporation acquired Irico Group, a photovoltaic equipment manufacturer – in early 2013.

Fourth, industrial clusters were promoted to harness the benefits of agglomeration effects, such as closer integration between suppliers, producers and customers, on the one hand, and more rapid innovation growth, on the other hand (OECD, 1999; Arvanitis & Qiu, 2008; Barbieri et al., 2012). Emphasis was placed on developing clusters in different towns and cities with unique pillar industries. For instance, manufacturing districts such as Shunde specialise in electrical goods while manufacturing towns such as Xiaolan (locks and electronic acoustics) and Guzhen (lighting fittings) have also emerged within major cities such as Zhongshan.

Fifth, policies were deployed to facilitate transfers of technologies from more economically advanced nations. There were regulations on technology imports and TNCs were made to form joint ventures with Chinese companies, most of them being SOEs or associated with government partners.[50] Through joint ventures, the state retained effective control over foreign affiliates so as to advance Chinese interests (Roehrig, 1994). Other technology transfer strategies included majority-stake acquisitions of and mergers with foreign companies from advanced countries (some more successful than others) – including Sweden (Volvo), the UK (MG Rover), the US (IBM's personal computer business), Austria (Fischer Advanced Composite Components), France (Adisseo) and Korea (Ssangyong Motors)[51] – and incentives to entice foreign companies to set up R&D centres in China.
Finally, export subsidies and currency devaluations have been used in order to enhance China's export competitiveness in international markets. China's export restraints, such as on rare earth used by industries, have also influenced global supply and prices. With export subsidies and restraints prohibited under the World Trade Organization (WTO), trade disputes against China's alleged practices remain commonplace (USTR, 2010, 2012a, 2012b).

4. Lessons for the UK

4.1. Some general remarks on 'drawing lessons' from international experiences

Before we draw concrete policy lessons for the UK from the experiences of other countries, let us make a few remarks on the exercise itself.

It should be made absolutely clear right at the beginning that we are not trying to derive from the case studies presented in this study some universal recipes transferable to any country, when each country has its unique political conditions, policy traditions, and economic conditions (see Rose, 1991, on the limits of policy transferability). Instead they are aimed at expanding policymakers' imagination by presenting a plurality of possibilities in terms both of policy goals and of policy tools.

Attempts to draw lessons from other countries in relation to any policy generate scepticism in all countries, but that reaction is particularly strong when it comes to industrial policy in the UK – industrial policy, it is often argued, however successful it may have been in other countries, like Germany, China, or Finland, simply cannot work over here, because it is against the country's history of *laissez-faire* capitalism and its tradition of individualism.

One problem with this view is that it is based on a mistaken view of the British history. As we briefly mentioned earlier, between the industrial policy reform of Robert Walpole in 1721 until the country's transition to free trade in the 1860s, Britain (as it was then) was in fact the pioneer of industrial policy (Chang, 2002, pp. 19-24). It is because he knew this history that Friedrich List, the German economist who is mistakenly known as the father of the infant industry argument (when the real father is Alexander Hamilton), wrote in the 1840s that Britain's preaching of free trade to relatively backward nations, like Germany and the US, was like 'kicking away the ladder' (Chang, 2002, pp. 4-5). In turn, Alexander Hamilton is known to have drawn inspirations from Walpole's policies in inventing his infant industry argument, so much so that he was accused of being a 'Walpolean' by his opponents who did not like his belief in government intervention (Chang, 2002, p. 25). So, it is a convenient myth for the opponents of industrial policy that industrial policy is against the British tradition, but this is simply not true.

Now, even those who acknowledge the importance of the Walpolean tradition in propelling Britain to the position of the world's leading industrial economy may, rightly, point out that the tradition has been forgotten over the last two centuries, with a partial exception of the period between the 1940s and the 1960s, when the country tried – not very successfully – to establish a more systematic industrial policy, prompted by the successes of Germany and France, which then used such policy much more actively. How would you revive a tradition that has been dormant for most of the last 150 years? However, one should remember that old traditions can be,

and have been, revived after long intervals. Indeed, France, a country that most British people think has been run on an unbroken policy tradition of active state intervention, was very non-interventionist between the fall of Napoleon in 1815 and the end of World War II in 1945 (and much less protectionist in the first half of the 19th century) (Kuisel, 1981; Chang, 2002). Its interventionist tradition was revived after a 130-year hiatus.

More generally, all the success cases of industrial policy are countries that have actively learnt from the more successful countries, despite the fact that the latter are very different from themselves, in terms of policy traditions, institutional set-ups, and culture. Just to cite some prominent examples from the countries we examined in this report: in the 18th and the early 19th century, the US and Germany learnt from Britain's industrial policy; in the late 19th century Japan imported a lot of policies and institutions from Germany; in the 20th century, Korea and China have aggressively learnt from Japan. Indeed, the history of economic policy shows that the most successful countries are those that willingly admit their shortcomings and do their utmost to learn from other more successful countries.

Also, there is a curious asymmetry in the view of the British sceptics of learning lessons from other countries. While they are very keen to emphasise the difficulty of the UK learning lessons from countries with different institutions and history, they tend to be quite cavalier when it comes to other countries learning lessons from the UK's policies and institutions, as seen especially in the constant lecturing by those people to their European neighbours that they should make their labour market more flexible or their financial markets more liberal, following the British examples (although these lectures have become less frequent and less strident after the 2008 crisis). They never explain why the British institutions and policies are easier to transplant than others, but the argument is, at best, based on the unwarranted (implicit) assumption that more market-oriented institutions are somehow more 'natural' and therefore more easily transplantable and, at worst, a blatant case of double standards.

Indeed, if anything, an active use of industrial policy has been much more widespread than the UK model of 'industrial policy by default'. As we mentioned above, the UK itself had used industrial policy actively in the past, and almost all the other successful economies have used active industrial policy to one degree or another at one point of time or another. While this does not mean that it will be easy to transplant some industrial policy measures from Finland or Brazil to the UK, it does mean that there cannot be any presumption that such transplantation would be impossible.

4.2. Specific Issues

4.2.1. Vision

One thing that comes out strongly through the review of industrial experiences in other countries is the importance of the national vision. If Hamilton's vision that his country can one day become a powerful industrial nation, like Britain, lost out to Jefferson's vision, harking back to the days of yeoman farmers, the US may have remained a richer version of Argentina today. Without Japan daring to dream that one day it will beat the Americans in the car industry (in 1955, the US produced 7 million cars, against 70,000 for Japan), we would have had no Toyota, and its luxury brand, Lexus. If Finland – a tiny nation of 3-4 million people with seven centuries of colonial history – did not aspire to compete in the most difficult industries with the best nations in the world, it would have maintained its specialisation in logging – not an easy thing to avoid, when you have one of the largest endowments of timber per capita in the world. Without China – once one of the poorest nations in the world – believing itself to be capable of becoming the next superpower (which may or may not come true), its industrial policy efforts would have been much less ambitious than what it has been and the result of it much more modest. And so on.

Economists are usually averse to talk in terms of 'vision' because it introduces an element of unpredictability and arbitrariness in what they see as a 'science'. Indeed, the rationalist framework with which most economists work these days has become a critical hindrance to our understanding of the economic world, as it reduces all our decisions to a totally predictable (at least in probabilistic terms) response to structurally given incentives. However, the world is shaped by those people who refuse to do the 'rational' things and who come up with an alternative vision that most other people think will fail. That is what the inventors of radical new technologies do. That is what entrepreneurship is really about. And that is what the successful industrial policy-makers have achieved.

In the last three decades, the UK has been dominated by a vision of its future that has turned out to be highly misleading. This vision has told people that the decline of the British manufacturing industry is nothing to worry about – or even something to celebrate – given that we have now entered a post-industrial society where manufacturing does not matter anymore. The vision has exaggerated the extent of and the potential for productivity growth in the financial industry by ignoring the extent of fraudulent and/or socially unproductive financial activities. This vision has constantly told people that industrial policy is not a reason why other countries may be doing better than the UK and that, even if that were the case, such policy cannot be used in the UK because it is fundamentally against the country's tradition and values.
The events following the 2008 financial crisis have given a shock to the UK national complacency based on this faulty vision. Now there is a greater recognition in the UK establishment that the vision that it has held over the last three decades may have

been mistaken and that there has to be an alternative long-term economic vision. However, old habits die hard and the old vision keeps re-asserting itself, not least because powerful financial interests back it up, so the UK has not been able to come up with a viable alternative vision for its future.

Without a new vision rejecting the comforting stories about the inevitability of the British industrial decline and the futility of industrial policy, the UK will never be able to come up with a viable economic strategy for the coming years, whatever the detailed measures of industrial policy it may want to adopt. We are glad to report that the Secretary of the Department of BIS himself was effectively stressing the same thing when he said in a private letter to the UK Prime Minister and Deputy Prime Minister that "sense however that there is still something important missing - a *compelling vision* of where the country is heading beyond sorting out the fiscal mess; and a clear and confident message about how we will earn our living in future [italics added]" (Cable, 2012).

4.2.2. Institutional settings

Our review shows that different countries have run industrial policies in very different institutional settings, which have differed not just across countries but also across time within the same country. The conclusion we draw from our case studies is that, while some institutional settings are more favourable for the success of industrial policy, it is not as if there is one particular institutional setting that a country must have in order to have a successful industrial policy. Two aspects may be highlighted.

First, our study reveals that a 'joined-up' government – with good communication between different departments and between different levels (national, regional, and municipal) and ideally with an effective coordinating agency (like the French Planning Commission, Japan's MITI, or Korea's EPB) – is certainly more conducive for successful industrial policy. This is not only because a lot of industrial policy is about coordinating interdependent activities but also because different things are done more effectively in different departments and at different levels of government, which inevitably leads to a coordination problem. In this regard, it is also helpful to be explicit about the existence of industrial policy, as pretending that it does not exist increases the chance of different departments failing to coordinate their activities or even undermining each other, as we have seen in the case of the US.

In this regard, the current institutional setting of the UK government is actually not against an effective industrial policy. The Department of Business, Innovation, and Skills (BIS) may not have the budgetary control that Korea's EPB had (which actually was a huge exception), but it has a remit that is much broader than what a typical 'ministry of trade and industry' has had in most countries, including many we

have reviewed in this report. The BIS controls and works with agencies in a variety of issues, ranging from skills development to insolvency, from consumer protection to intellectual property rights, from international trade to land use, and from low-pay issues to space technology. If the activities between these agencies are well coordinated, it can actually be a very powerful vehicle for industrial policy.

The second institutional dimension of industrial policy that we wish to highlight concerns non-governmental institutions. Our study confirms the conclusion from earlier studies, mostly related to the Japanese and other East Asian experiences (Johnson, 1982; Dore, 1986; Wade, 1990; World Bank, 1993) that 'intermediate' institutions that promote communication and cooperation between the government and the private sector increase the likelihood of industrial policy success. General employers' associations, sectoral industry associations, 'deliberation councils' (especially in Japan and Korea), and trade unions (especially in Germany and Finland) have played important roles in this regard.
Our study actually permits us to go one step further and argue that industrial policy success is promoted by the existence of thick networks of public, semi-public, and private agencies, variously (depending on the country) made up of government agencies, large enterprises (both private-sector – national and foreign – enterprises and SOEs), key financial institutions (including regional, as opposed to national), alliances of SMEs, sectoral industry associations, trade unions (and other bodies representing worker interests), universities, research institutes, and so on.

Depending on how they are structured and interact with each other, these networks of institutions have played key roles in innovation in cutting-edge technologies (especially in the US, Finland, Brazil, and Korea), diffusion of technologies (especially in Singapore, Germany, Brazil, and China), skills formation (especially in Japan, Germany, and Singapore) and the development of world-class SMEs (especially in Italy, Japan, and Germany). Once again, there are no set formulas here, but the lesson is that the 'industrial commons' – created through the cooperation in the provision of inputs with public goods character and/or high fixed costs and through the cross-fertilisation of ideas – that these networks establish and nurture are vital in promoting technological innovations and quality improvements.

The UK may not be able to easily replicate these networks, given that they have been the results of a long evolutionary process, based on trial-and-error (with some degree of luck thrown in), but there are some of the above-mentioned institutions that may be established without fundamentally changing the country's overall institutional structure and political economy. We discuss some of these in the issue-based sections below (e.g., institutions that may promote more 'patient' capital or help SME developments).

4.2.3. Finance and corporate governance

One thing that should be obvious from our review is how much of industrial policy is *not* about money. There are many important industrial policy measures that are about the sharing of vision, coordination among interdependent activities, network-building among relevant actors, and encouraging selective cooperation among potentially competing agents, in which financial transfers play at best the role of sweeteners. This is good news in times of 'austerity'.

However, many industrial policy measures are about money. When so many technologies are embodied in machines, there is no way a significant increase in productivity or a significant shift in production structure that can happen without major investments. Provision of adequate infrastructure and skills also costs money – sometimes vast sums, especially in countries like the UK that has neglected these things for substantial periods. A serious increase in R&D will require a lot of money, while even the schemes to help SMEs may require a non-negligible amount of money, if they are to have significant impacts. In countries with more successful industrial policy records, various ways have been found to finance and subsidise these necessary things through government intervention and public-private partnerships.

The UK government of course spends vast sums of money in funding or subsidising R&D and infrastructural development, but, compared to other countries, these spending are often less (in proportional terms) and less well targeted. The UK's government-financed R&D spending as a percentage of GDP was 0.58% in 2010, lower than the average in the European Union-27 (0.68%), OECD (0.74%), and the US (0.92%), a vocal advocate against government intervention. Arising from weaker public investments, the UK's average share of government GFCF in GDP was 1.8% between 2000 and 2010, lower than its OECD counterparts such as Korea (5.4%), Japan (3.8%), Finland (2.6%), the USA (2.5%) and Italy (2.3%) (OECD, 2012c).[52]

Recently, the establishment of a national development bank in the UK, in the image of the likes of the German KfW or the Brazilian BNDES, has been discussed, but unfortunately the coalition government has settled for creating a small investment fund, rather than a real development bank. But, given the positive role that development banks have played – not just in Brazil and Germany but also in Japan and Korea, this option should be considered more seriously.

Financial regulation could also play an important role in industrial policy. Even if the UK does not want to go as far as countries like Japan and Korea in the old days, or China today, and explicitly compel banks to lend to particular industries or projects ('directed lending') or to introduce regulation requiring that they lend more than a certain proportion of their money to productive enterprises, it could introduce other regulatory measures to simulate the effects. For example, it could discourage

consumer loans and housing loans by increasing capital reserve requirements for them. This would, as well as dampening the housing bubble and reducing consumer debts, indirectly increase loans to productive enterprises. With two major banks (the RBS and the HBOS) in public ownership, such re-direction of lending does not even have to be based on a new regulation – it could be done simply through an internal directive of a corporation. The fact that the British government refuses to do even such a thing shows how beholden it is to the financial sector lobby – it is not even willing to exercise the ultimate shareholder prerogative, the supposed bedrock of Anglo-American capitalism, for fear of offending the financial sector.

More broadly speaking, the UK needs to find a way to make its financial market provide more 'patient capital' so that long-term-oriented industrial policy is in sync with enterprise management. Of course, this cannot be done in a way that was done in, say, Germany (where the co-determination system made hostile takeover virtually impossible) and Japan (where cross-shareholding made it very difficult). However, the point is to reduce the power of short-term shareholders, and we can certainly find some other measures that provide such service without fundamentally changing the architecture of the British financial system. Possible measures include, most mildly, the prevention of the publication of quarterly results (as recommended by the Kay report), tax reduction for dividends from longer-term shareholding, heavier taxes for capital gains made from shorter-term shareholding, and, most strongly, the introduction of greater voting rights for longer-term shareholders.

4.2.4. Innovation

Countries with successful industrial policy all show strong commitments to innovation and technological developments. Of the seven advanced countries reviewed in this report (that is, nine countries minus China and Brazil), only Italy had a lower R&D intensity (gross R&D spending as a percentage of GDP) than the UK in 2010 (1.26% vs. 1.80%).[53] The UK's figure was lower than that of Singapore (2.09%) and the OECD average (2.38%), while the other countries were more than 55% higher (Germany, 2.80%; the US, 2.83%; Japan, 3.26%). Notably, Korea (3.74%) and Finland (3.90%) had more than double that of the UK.
Of particular concern is also how the UK's R&D intensity has declined over the years. Among the 10 countries in our study, the UK is the only country that saw a fall in its R&D intensity between the periods 1991-1995 (1.98%) and 2006-2010 (1.79%) (Table A.2 in the appendix). Improvements for the other countries ranged from 0.12%-points (Italy) to 1.54%-points (Finland) during the period.

The UK is certainly capable of doing much better than this, not least because it is one of the world leaders in scientific research (around 10% of world output). However, such research is poorly translated into industrial strength (it produces only around 1% of world patents). Between 2004 and 2011, the number of patents in force in the UK

fell by 6% (from 473,904 to 445,380) (WIPO, 2012). By contrast, the number of patents rose in the US (by 29%, 1.63 million to 2.11 million), Japan (by 40%, 1.10 million to 1.54 million) and Korea (by 105%, 331,437 to 678,005) over the same period. Korea, which lagged behind the UK less than a decade ago, now has 1.5 times the number of UK patents. Some believe that the solution to this problem is to introduce the US-style system, where maximum incentive is created for academics to establish profit-making firms based on their research, but other countries – Japan, Finland, Korea, and Singapore – have promoted their technological developments mainly through other means. Alternative arrangements need to be explored (see O'Sullivan, 2011; Wessner & Wolff, 2012), while current efforts like the catapult centres as well as the attempts to overcome the so-called 'valley of death' and the scaling-up challenges should be strongly supported (House of Commons, 2013).

The UK government also needs to reassert its role in boosting innovation. The UK's poor performance in total R&D expenditure is to an important degree due to its weak support for public R&D spending.[54] In the OECD, the UK had the second lowest publicly-funded R&D (as a percentage of GDP) at 0.59% in 2010, marginally ahead of Italy (0.55%) – a result that is reflected in its relatively low and declining R&D intensity (Table A.2 in the appendix). Even the US government, the supposed champion of free markets, spent significantly more on public R&D. Its publicly-funded R&D intensity was 1.01% in 2010.

4.2.5. Managing TNCs

As it should have been clear throughout our report, one important – and increasingly important – issue in industrial policy is how to maximise the benefits from the presence of TNCs, while minimising their costs.

In the UK context, the most contentious issue regarding TNCs has been tax avoidance through transfer pricing, especially through the overcharging of brand licenses, technology fees, and certain inputs. While this has significant fiscal implications, especially in the short run, it is less important for the long-term health of the economy, for which what the TNCs do in terms of technology transfer, training, and local sourcing matter far more than the tax revenue they generate.

Until recently, countries, including many of the ones reviewed in this report (especially Japan, Finland, Korea, and China), have put explicit conditions on technology transfer, local sourcing, and ownership restrictions (including joint venture requirements). These days, some of these – such as local contents requirements and foreign exchange balancing requirements (where the subsidiary of a TNC is required to export at least as much as it imports) – are banned through the TRIMs (Trade-related Investment Measures) agreement of the WTO. However, there are other measures that are not, such as those imposing conditions regarding joint venture requirement, the hiring of local labour, technology transfer, and the conduct

of R&D in the host country. Governments can also provide targeted subsidies, directed credits, and tailor-made infrastructure for TNCs, provided that these do not violate the MFN (most-favoured nation) provision (Thrasher & Gallagher, 2008, cited in Chang, 2011).

Moreover, even explicitly banned performance conditions for TNCs have always been used informally, based upon negotiations with the TNC concerned, including by the UK government in the 1980s and the 1990s. However, if these informal requirements are to be effective, the government needs to know what it wants to achieve through them, so the establishment of a clear vision is going to be helpful in this respect too. Moreover, the UK, now increasingly dependent on attracting and retaining TNCs in manufacturing industries, should learn from the more active use of 'carrots' by the Singapore government, often tailor-made for the needs of the particular TNCs that it wants to attract.

4.2.5. SMEs

Different countries reviewed in our report have helped SMEs in different ways, and with different degrees of successes, but some of the measures used may be applicable to the UK. Realistically speaking, it will be very difficult for the UK to replicate the thick institutional tissues supporting the SMEs in Germany or Italy – made up of industry associations, local banks, universities, specialised training institutes, and so on – but it can do at least some certain things to improve its support for SMEs.

First of all, it should be able to at least increase financing for SMEs. Once again, given the country's existing financial structure and political economy, it may be very difficult for the UK to set up a specialised bank for SMEs, whether explicitly (as in Korea) or implicitly (as in the case of regional banks in Germany or Italy), but the UK government can still increase credit availability for SMEs by imposing some conditions on the lending by the state-owned banks or in relation to the 'funding for lending' scheme in such a way that financing for SMEs is increased.

Second, it would be possible for the UK to replicate some of the institutions that help SMEs in countries like Germany and Italy. Organisation of similar SMEs into cooperative arrangements for high fixed-cost activities – like export marketing, R&D, and the purchase of technical or management consultancy services – may be encouraged. The UK government may help this by providing subsidies or tax reductions for these arrangements or providing some subsidies towards bringing in Italian or German experts to advise on the issue. It may also provide some of these inputs itself, by setting up agencies providing 'extension services' for SMEs.

4.2.7. Skills and training

Our study shows that more skills, higher-level skills and different kinds of skills need to be developed, if the UK wants to be able to enhance its industrial competitiveness, that is, expanding and scaling-up its manufacturing base and developing industrial activities with higher value-added and higher wages. The UK government cannot ignore the existence of skills gaps and mismatches, which are hindering the country's firms' capacities for transforming and translating research outputs into industrial activities at the shopfloor level. Skills cannot be built in a day: their development requires long-term investments in learning processes and institution building, as the development of the German integrated vocational training system has shown. Moreover, today's skills supply not only has to match today's skills demands but should also anticipate tomorrow's skills demands, as the Singaporean and Korean success stories have shown.

Future transformations of the industrial landscape in a given country are not only the results of quantitative expansions of existing activities but continuous introduction of new activities and qualitative changes in existing activities. This means that existing companies' perceptions of future skill needs may not necessarily be accurate. A way to prepare the country for both these quantitative (more skills) and qualitative (different and higher skills) transformations is to develop what we call skill profiles benchmarks, based on the knowledge of industry-specific skill profiles, which are stylised representations of the kinds of skills that the generic firm in a specific industry has to be equipped with in order to perform certain productive activities (Andreoni, 2013e). Skill profile benchmarks complement the assessment of current industrial skills gaps and mismatches by suggesting the specific kind of industrial skills required by countries which want to prepare their future manufacturing landscape.[55]

5. Looking Ahead

Policies for the future depend on key decisions that are made today. The continued loss of manufacturing capabilities in the UK disadvantages the economy over the long-term because the manufacturing sector boosts technologically-driven productivity growth and has strong interdependencies with other high-value sectors, especially high-value-added services, in the economy. Although exactly what would be high-value industries in 20, not to speak of 50, years' time is difficult to predict, what is certain is that the UK's potential to tap into the most profitable supply chains of the future and capture value will largely depend on the industrial capabilities that it builds and retains today.

Despite what the opponents of industrial policy may have us believe, industrial policy has always been around, even though some countries have given it another name, like the US has done throughout its history, and even though others have had it without

realizing and thus failing to properly organise it, like the UK has done in the last three decades. However much it thinks it is avoiding 'bad' kind of industrial policy by avoiding targeting, the UK government is still targeting its policies at different types of activities. Given this, it is better to accept that targeted industrial policy is necessary and try to get the targeting right, rather than pretending that there is no targeting and making a mess of the policy.

And industrial policy is here to stay. Countries like China and Brazil are going to step up their industrial policies, as they try to break into the premier league of world industry. Whatever the big rhetoric at the central government is, a lot of industrial policy is going to chug along in countries like Germany and Italy, as their industrial policies are deeply rooted in local structures. The US will keep at its industrial policy through federal R&D funding, and perhaps keep denying that it has any industrial policy. Singapore may continue its emphasis on free trade, but it will keep targeting strategic industries and setting explicit goals, in order to maintain its manufacturing base. Countries like Japan and Korea, having toned down their industrial policies since the 1990s for various good and bad reasons, are now trying to revive at least some of their industrial policy measures, especially in high-technology industries. Finland has successfully restructured its industrial policy by putting great emphasis on funding innovation and will press on with that strategy. Most of the countries we have reviewed in this report are also very keen to take pole positions in the 'green' technologies and are introducing a lot of industrial policy measures to promote them.

By constantly being in denial about the need for better industrial policy, the UK is going to fall further and further behind in manufacturing industries. The once-comforting thought that this does not really matter because the City will step into the breach is looking increasingly unrealistic. Unless something is done to reverse the manufacturing decline of the country – and industrial policy will be an integral part of that something – the UK risks falling behind.

Notes

1 This is a more refined version of the definition provided in Chang (1994a, ch. 3, pp. 60-1), which defines industrial policy 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*.

2 OECD (1975), World Bank (1993) and UNCTAD (1998 and 2009) adopt the narrower industrial policy definition of selective, sector-specific measures, while OECD (2009) and the European Commission (2002 and 2010) include horizontal policies within industrial policy.

3 Karl Aiginger, a key author of the European Commission's industrial policy, acknowledges that, while the Commission has maintained "the primarily horizontal approach [in which] measures are general and provide for a favourable competitive environment (that is, they are not industry-specific, selective, or conducive to the deceleration of structural change)", it increasingly acknowledges that "the effects of broad horizontal policies can vary significantly from industry to industry, that competitiveness needs specific policy mixes for specific sectors, and that some sectors may require complementary measures that are not necessary or relevant in other sectors" (Aiginger & Sieber, 2006, p. 579).

4 Production capabilities are those capabilities specifically needed for firms to perform different production tasks as well as to adapt and undertake in-house improvements across different technological and organisational functions.

5 An interesting consideration in the context of poor developing countries is that they can be locked up in what Pritchett et al. (2012) calls 'capability trap'. This refers to a situation in which a developing country government develops only a narrow set of standard capabilities that are necessary for the continuous attraction of foreign aid, which in the long run undermine its ability to develop policies that are genuinely necessary for the country. OECD (2013) also discusses this issue.

6 So, for example, Japan and Korea succeeded in their industrial upgrading efforts because they started developing difficult industries well before they looked 'realistic' – the automobile industry for Japan in the 1950s or the steel industry for Korea in the 1960s – by using the export earnings from industries like textiles, cheap garments, and electronics, which conformed to their comparative advantage at the time.

7 Rodrik (2008) stresses that '[t]he conceptual difficulties involved in statistical inference in this area are so great that it is hard to see how statistical evidence could ever yield a convincing verdict' (p. v).

8 More specifically in relation to randomized controlled trials (RCTs), they can be useful techniques for evaluating policies that are implemented at the local level because they have fewer problems with selection bias than observational methods do. However, they tend to be less effective when we want to evaluate policies, like industrial policy, whose aim is to generate spillovers and long term impacts. Even when RCTs have strong "internal validity," meaning that they are very likely to have identified the effect of treatment among the participants (e.g. certain firms receiving a research grant), they are less likely than observational methods to have "external validity", meaning that the causal effect found among the participants may not apply to other groups (Rodrik, 2008). Also, because most randomized controlled trial studies cannot measure the outcomes very frequently, the evaluators may miss the true causal effect if the policy has a nonlinear effect, as it is often the case (Woolcock, 2009).

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

10 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 postwar Japanese invention, is a measure that was actively used by the UK in the 18th century, especially by the government of Robert Walpole (see Chang, 2002, on the history of development policy in today's rich countries).

11 The 12 countries are Austria, Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, Norway, Sweden, Switzerland, and the UK.

12 In the last two decades, the Japanese economy has not done as well as the four decades preceding it. However, its economic performance, especially in the 2000s, has not been as bad as people often think. First of all, despite two decades of lacklustre growth, at 4-5%, its rate of unemployment has remained one of the lowest in the OECD. In terms of growth, during the 1990s, at 1.0%, Japan was the second most slowly-growing economy (in per capita terms) in the OECD (the slowest was Switzerland at 0%). In the 2000s, however, its performance was basically median among the 16 core OECD countries (see footnote 2 above for the list). Its annual per capita GDP growth rate, at 0.9%, was higher than that of Italy (-0.3%), Denmark (0.5%), and France (0.6%) and basically the same as those of the US, the UK, Canada, Belgium, and Norway (all 1.0%) and only marginally lower than those of Germany and Switzerland (both 1.1%). During this period, Australia and Finland did best at 1.8%, followed by Sweden (1.6%), Austria (1.4%), and the Netherlands (1.2%).

13 Over the 1990s, only 37 of the 235 implemented programmes were administered by the central government.

14 It is reported that, between 1991 and 2004, 'the percentage of closure of enterprises was systematically higher than the percentage of new business launches' (Buigues & Sekkat, 2009, p.188).

15 In the 1960s, additional shares of some state-owned companies (Volkswagen, VEBA, etc.) were issued at sub-par value so that they could be bought by people with limited incomes for a preferential price. These shares were called people's shares (Volksaktien). This procedure enabled some 4.5 million Germans to become shareholders with a total amount of roughly 500 million Euro. Later on, this complicated procedure (because of the necessity of reviewing the income situation of purchasers) was changed (Fasbender, 2004).

16 Today KfM is still owned by the Federation (80%) and the Lander (20%).

17 The measures aimed at introducing higher degrees of flexibility in the labour market and reducing unemployment rates were also at the core of Schroder's Agenda 2010.

18 The German government's statistics include financial subsidies, interest free-grants, subsidies for R&D and (increasingly) tax reliefs as public industry support. However, aids to SOEs or semi-public institutions as well as funds for basic research and institutes such as Fraunhofer, Max Planck, Leibnitz and Helmholtz are not included (Buigues & Sekkat, 2009).

19 The emphasis and destination of resources to high tech and innovation is also detailed in the recent Government Report on 'The High Tech Strategy for Germany' 2010.

20 The share of federal government in total R&D spending in the US was 53.6% in 1953, 56.8% in 1955, 64.6% in 1960, 64.9% in 1965, 57.1% in 1970, 51.7% in 1975, 47.2% in 1980, 47.9% in 1985, and 47.3% in 1989 (estimated). See Mowery & Rosenberg, 1993, p. 41, table 2.3.

21 The positive and significant impact of the ATP projects on multi-use innovation, infrastructural technologies and inter-industry licensing is assessed in Nail and Brown (2006).

22 Semiconductors were first developed through US defense research funding. When the two main firms – Fairchild and Texas Instruments – subsequently got locked in costly patent suits, the US Department of Defense intervened to resolve the situation by imposing a patent pool between the two companies (Perelman, 2003, p. 56). The US government gave the industry a further boost by setting up SEMATECH, a joint venture of 12 firms with ARPA funding, in 1987 set up as a means to fight off the Japanese technological challenge (see Block, 2008, on SEMATECH).

23 Compared to Japan, Korea had a shorter history of capitalism, having been forced to open up to the outside world only in 1876, as opposed to 1853, in the case of Japan. Also, during the colonial rule by Japan (1910-45), growth of Korean capitalists was discouraged, if not made impossible. The political and social turmoils that followed the end of the colonial rule and the Korean War (1950-53) also resulted in a lot of churning in the enterprise hierarchy. On top of that, the government of General Park Chung Hee, which came to power in a coup d'etat in 1961, nationalised all banks in 1961 (see Amsden, 1989, for historical backgrounds to Korean industrialisation).

24 For example, until the early 1990s, the government *de facto* decided who are going to become the top managers of the banks.

25 When the Korean government decided in 1968 to apply to build its first modern steel mill, the World Bank advised a group of donor countries to decline the application on the grounds that the project was not viable. This was not an unreasonable advice, given the circumstances. 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 of iron ore and coking coal. At the time, it could not even import them from nearby China because of the Cold War, so they had to be imported from Australia and Canada. And, to cap it all, the Korean government proposed to run this as an SOE. A perfect recipe for disaster from the mainstream view, but the company became the most efficient steel-producer in the world within 10 years of establishment and is now the second largest steel producer in the world. For further details on POSCO, see Amsden (1989) and Chang (2010, ch. 12).

26 This change has been reversed by the in-coming government (as of 2013), which is one clear signal that it takes industrial policy more seriously than recent governments.

27 The land area of Singapore was 582km^2 when it gained independence in 1965, one-third the size of London (1,570km^2) and half the size of New York City (1,213km^2).

28 Between 1970 and 2010, the sum of total trade (exports and imports) as a percentage of GDP, a measure of an economy's openness, averaged 345%, significantly higher than the US (20.8%), Japan (22.7%), Germany (53.8%) and Korea (66.6%) (World Bank, 2012).

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

30 In 2001, GLCs were estimated to account for 12.9% of Singapore's GDP in 1998, with the non-GLC public sector accounting for another 8.9% (SDOS, 2001).

31 The majority of land in Singapore is publicly owned, with the government empowered to acquire the rest.

32 For the list of the 16 countries, see the Japan section.

33 Despite the massive external shock that it received following the collapse of the Soviet Union, which accounted for over one-third of its international trade, Finland ranked at a very respectable joint-5th among the 16 countries in terms of per capita income growth during the 1990s. According to the World Bank data, its annual per capita income growth rate during 1990-99 was 2.1% (equal to the Netherlands), exceeded only by Norway (3.2%), Australia (2.6%), and Denmark and the USA (2.4%).

34 Public investments were primarily to strengthen the industrial base and encourage private capital accumulation (Kosonen, 1992).

35 Following the Second World War, the Finnish government made a strategic decision not to lower the tax rate to pre-war levels.

36 Industrial value-added includes the value-added from both manufacturing activities and the processing of raw materials. In Norway, another Nordiac country that established SOEs in basic industrial sectors, SOEs contributed only 10% of industry value-added in the early 1980s (Kosonen, 1992).

37 From the 12th century until 1809, Finland was part of Sweden; thereafter, it existed as an autonomous Grand Duchy within the Russian empire until 1917.

38 Nonetheless, although the foreign ownership ceiling of companies was raised to 40% in 1987, this was still subject to the consent of the Ministry of Trade and Industry (Bellak & Luostarinen, 1994, p. 17).

39 Accelerated depreciation allowances benefited holders of existing capital while investment allowances encouraged firms to invest in new capital.

40 With the centre-left government in power in 1963, which attempted an overall redesign of the national industrial plan (the so called *piano straordinario*) and the reform of the Cassa in 1965, investments in manufacturing development reached half of total IRI's investments.

41 The number employed in manufacturing SOEs went from 185,000 in 1953 to 451,500 in 1974 (Federico & Giannetti, 1999).

42 Written archives of industrial planning in China generally date back to Sun Yat-sen's (1922) Shiye Jihua (Industrial Plan), which emphasised the state's key role in creating "socialism" and developing basic heavy industries (Kirby, 1990).

43 Chang (2011) provides a detailed list of industrial policy measures in East Asia.

44 Marukawa (2011) provides examples on how companies in the automobile industry benefited from state credit. For example, Chery expanded into overseas markets with financial support from the China Exim Bank while Geely borrowed funds from local governments to finance the acquisition of Volvo Cars in 2010.

45 Chapter IV, Article 34 of the 1995 *Law of the People's Republic of China on Commercial Banks* highlights that "A commercial bank shall conduct its loan business in accordance with the need for the development of the national economy and social progress and under the guidance of the state industrial policy".

46 Foreign investments are classified into four categories in different industries: (i) encouraged, (ii) permitted, (iii) restricted, and (iv) prohibited.

47 In the early 1950s, the coastal area contributed 70% of China's industrial output, despite making up less than 20% of total land area (Zhang & Long, 1997).

48 Between 1993 and 2003, the average annual FDI inflows as a percentage of GDP was significantly higher in eastern coastal regions such as Guangdong (13%) and Fujian (11%) compared to the national average (4%) (Poncet, 2010, p. 115).

49 China's policy stance on industry consolidation was reaffirmed by its Ministry of Industry and Information Technology (MIIT)'s *Guidance on Corporate Mergers and Acquisitions to Accelerate the Growth of Key Industries* in January 2013, which highlighted its aim to grow global champions in the automotive, iron and steel, cement, shipbuilding, aluminium, rare earth metals, electronics and pharmaceutical industries (MIIT, 2013).

50 While explicit technology transfer conditions are curtailed under China's WTO obligations, implicit measures are not forbidden. In China's 2011 *Catalogue for the Guidance of Foreign Invested Industries*, ownership restrictions are listed in most manufacturing industries.

51 Ssangyong, acquired by SAIC in 2004, was sold on to Mahindra Motors of India in 2011.

52 Among our chosen countries within the OECD, only Germany had a lower share of government GFCF in GDP (1.6%) between 2000 and 2010, compared to the UK.

53 The UK's R&D intensity is also higher than China (1.76%) and Brazil (1.13% in 2008) but this is cold comfort as the two countries are at a different stage of development.

54 A large body of research indicates that public R&D spending does not crowd out private R&D spending, but rather, has a complementary effect across a diverse range of countries: Finland (Czarnitzki et al., 2007), Germany (Aerts & Schmidt, 2008; Hussinger, 2008), Japan (Koga, 2005) the United States (Feldman & Kelley, 2006) and the OECD (Guellec & Van Pottelsberghe, 2003; Falk, 2006).

55 Of course, defining specific skill profile benchmarks for each industry should not make us forget that the same production process can actually be performed by different combinations of production capabilities. Nor should we be tempted to ignore the fact that these skills have to be complemented by appropriate investments in the expansion of firms' production capacity.

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Appendix

Table A.1: Manufacturing Indicators for the 10 Countries in the Study, 2010

Country	MVA per capita	MVA as % of GDP	MHT MVA as % of total MVA	MVA as % of World MVA	MX per capita	MX as % of total exports	MHT MX as % of total MX	MX as % of WMT
Brazil	622	13.5	35.0	1.7	668	67.3	36.3	1.2
China	820	34.2	40.7	15.3	1,124	96.2	60.5	14.1
Finland	6,795	24.7	45.4	0.5	12,001	91.1	49.0	0.6
Germany	4,667	18.6	56.8	5.3	13,397	86.8	72.3	10.2
Italy	2,848	14.9	39.3	2.3	6,935	91.6	53.9	3.8
Japan	7,994	20.4	53.7	14.1	5,521	91.6	79.8	6.5
Korea	4,783	29.1	53.4	3.2	9,280	96.9	75.8	4.2
Singapore	8,198	24.5	73.4	0.5	35,709	89.8	69.0	1.5
UK	3,162	11.4	42.0	2.7	5,248	79.5	63.2	3.0
US	5,522	14.9	51.5	24.0	2,736	76.8	64.7	8.0

Data source: UNIDO (2013)

Notes: Manufacturing Value Added (MVA) and GDP are in constant 2000 US dollars. MHT, MX and WMT refer to medium and high-technology, manufacturing exports and world manufacturing trade respectively.

Table A.2: Manufacturing Indicators for Top 60 Manufacturing Nations by MVA per capita, 2010

	Country	MVA per capita	MX per capita	MHT MVA as % of total MVA	MVA as % of GDP	MHT MX as % of total MX	MX as % of total exports	MX as % of WMT	MVA as % of World MVA
1	***Singapore***	8,198	35,709	73.4	24.5	69.0	89.8	0.52	1.5
2	***Japan***	7,994	5,521	53.7	20.4	79.8	91.6	14.13	6.5
3	Switzerland	7,168	23,652	34.9	18.4	69.7	91.5	0.75	1.7
4	***Finland***	6,795	12,001	45.4	24.7	49.0	91.1	0.50	0.6
5	Sweden	6,559	15,376	47.0	20.0	57.7	89.7	0.84	1.3
6	Ireland	6,507	23,960	64.1	23.1	53.8	91.6	0.41	1.0
7	Taiwan	6,153	10,825	61.9	29.9	72.4	96.0	1.97	2.3
8	***United States***	5,522	2,736	51.5	14.9	64.7	76.8	24.04	8.0
9	Austria	4,869	14,926	41.7	18.4	60.0	87.0	0.57	1.2
10	***Korea***	4,783	9,280	53.4	29.1	75.8	96.9	3.22	4.2
11	***Germany***	4,667	13,397	56.8	18.6	72.3	86.8	5.32	10.2
12	Iceland	4,008	4,001	14.2	11.4	45.6	26.8	0.02	0.0
13	Denmark	3,887	12,839	30.5	12.5	51.9	72.8	0.29	0.7
14	Belgium	3,794	34,138	42.3	15.0	54.9	87.4	0.55	3.3
15	Norway	3,767	7,396	24.1	9.2	52.2	27.1	0.25	0.3
16	Luxembourg	3,737	24,557	5.0	6.6	38.0	85.8	0.02	0.1
17	Netherlands	3,325	22,081	40.1	12.5	55.0	74.0	0.76	3.4
18	Israel	3,236	7,728	55.6	13.8	55.8	96.2	0.33	0.5
19	***United Kingdom***	3,162	5,248	42.0	11.4	63.2	79.5	2.69	3.0
20	Canada	3,078	6,668	37.3	11.9	55.7	62.1	1.44	2.1
21	France	2,885	7,237	45.4	12.2	65.8	88.4	2.49	4.2
22	***Italy***	2,848	6,935	39.3	14.9	53.9	91.6	2.33	3.8
23	Slovenia	2,716	11,094	45.5	20.9	63.0	90.8	0.08	0.2
24	Australia	2,661	4,521	23.0	10.1	20.0	46.7	0.79	0.9
25	Slovakia	2,304	11,125	43.3	27.4	66.3	93.8	0.17	0.6
26	Kuwait	2,224	6,899	18.1	10.3	13.5	40.9	0.09	0.2
27	Czech Republic	2,148	11,816	44.6	28.1	67.9	91.0	0.30	1.1
28	Qatar	1,989	8,817	17.4	2.8	28.2	15.9	0.02	0.1
29	New Zealand	1,986	3,214	13.9	12.8	21.3	46.4	0.12	0.1
30	Spain	1,897	4,572	34.3	12.0	57.4	83.7	1.18	1.9
31	Argentina	1,749	878	25.8	16.4	45.0	52.4	0.99	0.3
32	Portugal	1,504	4,098	22.4	12.9	40.5	90.2	0.22	0.4
33	Poland	1,490	3,640	35.3	22.5	58.1	87.8	0.78	1.3
34	Malaysia	1,427	5,931	41.8	27.1	63.5	83.3	0.55	1.5
35	Uruguay	1,343	626	13.4	14.5	22.6	39.1	0.06	0.0
36	Greece	1,290	1,429	17.2	9.1	37.2	73.7	0.20	0.1
37	Malta	1,257	8,407	44.9	11.3	56.2	93.0	0.01	0.0
38	Hungary	1,210	8,292	53.5	21.1	78.0	87.0	0.17	0.8

Table A.2 cont.: Manufacturing Indicators for Top 60 Manufacturing Nations by MVA per capita, 2010

	Country	MVA per capita	MX per capita	MHT MVA as % of total MVA	MVA as % of GDP	MHT MX as % of total MX	MX as % of total exports	MX as % of WMT	MVA as % of World MVA
39	Saudi Arabia	1,157	2,021	41.1	11.8	35.5	21.7	0.42	0.5
40	Thailand	1,054	2,517	46.2	36.6	61.8	83.9	0.95	1.5
41	Costa Rica	1,035	1,421	16.6	20.1	58.9	73.3	0.07	0.1
42	Turkey	1,013	1,287	30.0	20.2	42.5	87.7	1.09	0.9
43	Mexico	1,008	2,166	38.5	16.0	78.7	80.1	1.54	2.2
44	Croatia	999	2,356	31.8	16.2	49.5	90.4	0.06	0.1
45	Estonia	979	8,360	25.7	15.5	42.3	86.2	0.02	0.1
46	Chile	972	1,943	18.9	15.4	11.8	47.0	0.23	0.3
47	Lithuania	964	5,343	18.5	18.3	37.8	85.6	0.04	0.2
48	Oman	941	1,858	16.8	8.2	42.7	16.3	0.04	0.0
49	Cyprus	918	641	12.3	6.6	60.4	75.2	0.01	0.0
50	Belarus	907	2,362	18.8	32.9	39.0	89.2	0.12	0.2
51	Venezuela	895	750	34.3	16.5	8.1	32.5	0.36	0.2
52	Trinidad & Tobago	868	5,480	39.4	8.4	17.7	74.0	0.02	0.1
53	China, Macao SAR	832	265	3.6	2.2	7.1	43.5	0.01	0.0
54	***China***	820	1,124	40.7	34.2	60.5	96.2	15.33	14.1
55	Mauritius	804	1,104	3.0	15.6	2.9	95.6	0.01	0.0
56	Lebanon	625	727	19.9	9.2	46.8	72.2	0.04	0.0
57	***Brazil***	622	668	35.0	13.5	36.3	67.3	1.71	1.2
58	South Africa	567	991	21.2	14.9	45.7	68.3	0.39	0.5
59	El Salvador	513	564	19.1	22.9	14.9	89.6	0.05	0.0
60	Russia	504	1,029	23.1	17.1	24.4	36.1	0.98	1.3

Data source: UNIDO (2013)

Notes: Countries whose names are in italics are the ones included in this report. Manufacturing Value Added (MVA) and GDP are in constant 2000 US dollars. MHT, MX and WMT refer to medium and high-technology, manufacturing exports and world manufacturing trade respectively.

Table A.3: Gross R&D expenditure as a percentage of GDP (%) (average)

Country	1991-1995	1996-2000	2001-2005	2006-2010	2010
Brazil[1]	0.83	0.87	0.97	1.08	1.13[2]
China	0.68	0.71	1.14	1.54	1.76
Finland	2.16	2.92	3.41	3.70	3.90
Germany	2.29	2.32	2.51	2.68	2.80
Italy	1.08	1.02	1.10	1.21	1.26
Japan	2.64	2.91	3.16	3.39	3.26
Korea	2.06	2.30	2.57	3.38	3.74
Singapore	1.05[3]	1.64	2.11	2.30	2.09
UK	1.98	1.80	1.75	1.79	1.80
USA	2.56	2.61	2.62	2.80	2.83

Source: Authors' calculations based on OECD (2012a)

Notes: 1/ Excludes missing data for 1991-1993, 1997-1999 and 2009-2010; 2/ Data is for latest available year of 2008; 3/ Data gaps for the period 1991-1993 were supplemented with data from SDOS (2012).

Table A.4: Gross Fixed Capital Formation (GFCF) as a percentage of GDP (%) (average)

Country		1991-1995	1996-2000	2001-2005	2006-2010	2010
Brazil[1]	Private	15.8	na	na	16.2	16.5
	Public	2.7	na	na	2.7	2.9
	Total	**18.5**[2]	**16.7**	**16.1**	**18.1**[2]	**19.5**
China[1]	Private	7.9	8.0	9.9	20.4	23.7
	Public	26.5	25.7	28.3	22.1	22.1
	Total	**33.5**[2]	**33.7**	**38.2**	**42.4**	**45.7**
Finland	Private	15.8	16.4	16.8	17.7	16.4
	Public	3.0	2.7	2.6	2.5	2.5
	Total	**18.8**	**19.2**	**19.4**	**20.3**	**18.9**
Germany[1]	Private	19.7	19.3	16.5	16.4	15.8
	Public	2.2	1.9	1.6	1.6	1.7
	Total	**22.7**[2]	**21.3**	**18.2**	**17.9**	**17.4**
Italy	Private	17.4	17.3	18.5	18.3	17.5
	Public	2.6	2.3	2.3	2.3	2.1
	Total	**20.0**	**19.6**	**20.7**	**20.6**	**19.6**
Japan[1]	Private	na	na	18.6	18.5	16.8
	Public	na	na	4.3	3.2	3.3
	Total	**29.4**	**26.4**	**22.8**	**21.7**	**20.1**
Korea	Private	32.0	27.1	23.5	23.6	23.2
	Public	5.2	5.5	5.5	5.2	5.1
	Total	**37.2**	**32.6**	**29.0**	**28.8**	**28.3**
Singapore	Private	27.4	28.2	19.5	21.0	20.5
	Public	5.8	6.7	5.2	3.2	3.7
	Total	**33.2**	**34.9**	**24.7**	**24.2**	**24.2**
UK	Private	14.5	15.8	15.3	14.1	12.4
	Public	2.2	1.3	1.4	2.2	2.5
	Total	**16.7**	**17.1**	**16.7**	**16.3**	**14.9**
US	Private	14.5	16.7	16.3	14.7	12.0
	Public	2.4	2.4	2.5	2.5	2.5
	Total	**16.9**	**19.1**	**18.8**	**17.2**	**14.4**

Source: Authors' calculations based on World Bank (2012), OECD (2012c), SDOS (2012)

Notes: 1/ The public-private GFCF breakdown was unavailable in the countries for some periods: Brazil (1995-2007), China (1991-1994), Germany (1991-1994), and Japan (1991-2000); 2/ Percentages for private GFCF and public GFCF may not sum to total GFCF because their averages use a shorter time period due to data limitations.

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