Implementing Industrial Policy: how to choose?

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I. Introduction

The last few years have seen a resurgence of interest in industrial policy in higher income, as well as in emerging and still developing economies. In terms of the discourse on development there has been a renewed interest in the role of economic structure and the importance of shifting resources from lower productivity, technologically stagnant activities (the traditional sector) to higher productivity, technologically dynamic ones (the modern sector). Industrial policy is interpreted as a set of interventions designed to shift resources into higher return, higher growth activities more rapidly than would be the case if, in the absence of intervention, markets determined the pace of change. In principle any modern sector activity can be the focus of this policy although as here much of the discussion focusses on manufacturing given its important role in growth and employment generation, particularly at low income levels. The case for such intervention can be can be rationalised by appeals to historical experience, by a reading of structural constraints in particular countries or in terms of standard economics by the failure of markets due to investors' attitude to risk, lack of information, or because of the existence of significant externalities.

There is recognition that the successful country experiences with industrial policy have seen the form and content of policy adapted over time in the light of changing economic conditions. Two broad categorisations based on stylized facts can be used to distinguish between the role of industrial policy in low and lower-middle/middle income economies. At relatively low income levels the key goal is to support the transfer of low skilled workers out of agriculture into relatively labour intensive activities using relatively simple technologies (or the simplest labour-intensive parts of a more sophisticated production process). The capabilities required of local producers will be essentially mastery over relatively mature production processes through technological 'know-how'. Manufacturing is typically organised around large numbers of small firms, an even larger number of micro enterprises and a small number of larger firms which may be a mixture of subsidiaries of MNCs, private sector firms and still in some places SOEs. The role of industrial policy in this context is to stimulate and accelerate this process and with limited resources, selectivity within manufacturing, and other parts of the modern sector, is likely to be required. In all but the largest economies most of the market for industrial goods will be overseas and trade specialisation in a limited number of competitive manufacturing activities will be critically important. At low income levels key constraints on expansion will often be a shortage of funds for long-term investment (a capital market constraint), lack of skills (a labour market constraint) or lack of incentives (a product market constraint).

As economies become more sophisticated in terms of production capabilities and as real wages rise the industrialisation process will see a relatively decline in relative roles of labour-intensive and resource-based manufactures and a shift into medium technology activities or into the labour-intensive segments of relatively high technology goods. Capabilities required of producers will increasingly focus on mastery of technology rather

than production in terms of 'know-why', as well as 'know-how'. The pattern of manufacturing will see greater diversification in the sector with a relative decline in the share of large relative to small and medium sized firms. At this stage the role of industrial policy is likely to shift from encouraging a relatively small number of branches of manufacturing intensive in an economy's resource endowments into one of stimulating a specialisation in product lines relatively new to the economy and involving more sophisticated technologies. Once the stage of a reliance on cost advantages determined by wages or natural resources is past the range of potential new products expands greatly with considerably greater scope for 'discovery' of competitiveness. A key role for industrial policy here is to encourage a dialogue with the private sector to facilitate 'product discovery' and the emergence of ideas relating to market niches or novel products.

Considerable effort has gone into classifications of different versions of industrial policy and there are now a growing number of case-studies of its implementation, so that the East Asian story from Japan, Korea and Taiwan can be supplemented by evidence from elsewhere.[1] It is recognised that there are a wide range of policy instruments that can be employed to draw resources into favoured activities and that these can operate either through markets or can by-pass markets through direct provision of support or services. Furthermore the promotional effect of industrial policy can be offered to all eligible firms (horizontal policy) or selectively to a subset (vertical policy). For illustration, Table 1 gives a classification of a range of instruments of industrial policy depending on the markets through which they operate and whether support is market-based or direct provision.[2] In the taxonomy no distinction is drawn between horizontal instruments and vertical instruments as a given instrument or support measure can be applied in general or selectively.

Table 1 Taxonomy of Industrial Policy

Policy domain	Instruments:	
	Market based	Public goods/direct provision
Product market	Import tariffs, export subsidies, duty drawbacks, tax credits, investment/FDI incentives,	Procurement policy, Export market information/trade fairs, linkage programmes, FDI country marketing, one- stop shops, Investment promotion agencies,

[1] See the country examples in Altenburg (2009), Salazar-Xirinachs et al (2014), Crespi et al (2014), Felipe (2015) and Weiss and Tribe (2016).

[2] This classification combines elements of Warwick (2013), UNIDO (2013) and Perez and Primi (2009). Market-based interventions impact on prices and taxes and thus operate through pricing links. Public inputs reflect the provision of goods or services, which firms themselves would not supply adequately, either because they cannot be marketed or because significant external benefits are involved. Institutions required to implement industrial policy are included under this heading.

Labour market	Wage tax credits/subsidies, training grants	Training institutes, Skills councils
Capital market	Directed credit, interest rate subsidies,	Loan guarantees, Development Bank lending,
Land market	Subsidised rental	EPZs/SEZs, factory shells, infrastructure, legislative change, incubator programmes
Technology		Technology transfer support, technology extension programme

Source: the author

The evidence on the impact of industrial policy remains mixed, but there is a consensus in the more recent literature that the choice of instruments per se is much less important than the need to focus support on the key constraints on new investment. These constraints are to be identified by a dialogue between government (though the agency that implements industrial policy) and the productive sector (whether private or public enterprises). Instruments are to be used flexibly so that where one is ineffective it should be replaced by another or overall support ended. Support should be linked with performance and the achievement of targets, and it should not be open ended. Furthermore there is now far more attention on the export market than in earlier discussions, with the implication that high levels of import tariff protection for domestic sales (even where these tariff rates are below the bound levels allowed by WTO) are unlikely to offer a major form of support, for anything other than the very short-term.

The ability of governments to 'pick winners' is now widely questioned, but this does not rule out the possibility of some producers emerging as winners, through internationally competitive production, in part as a result of policy support. Most governments, even those of high income economies, in practice operate a form of selectivity with a focus on particular sectors or technologies.[3] However there is also a danger that where there is differential treatment producers in disfavoured sectors lobby for similar treatment, and may receive it whether or not there is an economic case. Kaplan (2016: 411) describes the case of South Africa where each new industrial plan has added additional sectoral targets, so that over 80% of manufacturing employment is in targeted priority areas.[4] If governments are 'doomed to choose' (Hausmann and Rodrik, 2006) in the sense that resources are limited and priorities for support need to be set if interventions are to be effective, so that a genuinely horizontal policy is impossible, what guidance is available, particularly for policy-makers in low and lower middle income countries? The remainder of this paper surveys the options on this important but still unresolved question and offers some suggestions.

[3] Warwick (2013) gives examples of a combination of a horizontal and vertical approach in, for example Korea, Netherlands the UK and even the US.

[4] He concludes that 'The danger of selecting so broad a range of sectors is that it severely stretches government resources and capacities. There are a myriad of policy initiatives and programmes, few of which command significant resources and the prospect therefore is that each of the sector programmes lacks critical mass and is therefore likely to have only a marginal impact at best' (Kaplan 2016: 411). A similar pattern of priority sectors being added is described for Ethiopia in Gebreeyesus (2013).

II. Focus on the investment climate/business environment

Standard policy advice from many sides, but particularly the Washington institutions, in the past has been to get the investment climate and the business environment right. Priorities would then emerge from the decisions of enterprises, predominantly from the private sector, which in the face of a reformed set of market incentives would decide in which activities to invest. This position can be linked with the idea of a 'latent comparative advantage' (Lin, 2010). Here activities which are in line with an economy's comparative advantage determined by its resource endowments (or with its potential comparative advantage in the not too distant future) are currently uncompetitive internationally, because of high transactions costs determined by infrastructure and other aspects of the business environment, not because of inherent production inefficiency. If transactions costs can be lowered, on this argument, internationally cost-competitive production can emerge.

There is in fact considerable overlap between aspects of a business environment approach and parts of the industrial policy agenda, so the former can be part of the latter (Weiss, 2013). The stated goals of business environment reform (DCED 2008: 4) are

- To reduce the costs of doing business
- To minimise the risk attached to new investment
- To increase competition as a stimulus to productivity improvements.

In principle industrial policy also aims to achieve these goals. Transaction costs and risk are to be reduced by providing infrastructure and public goods important to the private sector and by listening to the views of producers as a means of identifying the constraints to growth. Competition is to be increased by encouraging the development of private sector activities that after a learning period can operate competitively in national and international markets. Investment climate surveys are critical to both. They provide an important insight into how producers perceive their operating environment and are an important starting point for a dialogue with the private sector as part of industrial policy.

Conceptually horizontal industrial policy interventions have strong complementarities with business environment reform. Horizontal interventions can be designed to make markets work more effectively by compensating for 'market failures' such as lack of information and external effects, or by removing monopoly or monopsony structures. They offer incentives or public goods equally to all firms with the intention of improving the functioning of markets. Their rationale is thus directly complementary to the logic behind investment climate/business environment measures.

Welfare theory justifies market corrections, such as publicly funded skills training, R and D subsidies or credit guarantees, with the qualification that the interventions used should not themselves create too many undesirable side effects (Corden, 1974). Whilst it is not difficult to find examples of horizontal measures that are perfectly compatible with the theory underlying business environment reform the case of vertical or selective measures is more controversial because these *aim to alter market incentives and to anticipate future market development rather than compensate for the imperfections in the current market environment.* Theory provides a rationale for differentiated vertical measures based on the propositions that

- Externalities in both a positive or negative sense will vary as a proportion of a firms' sales revenue
- Coordination failure as an example of an externality – where activity by one firm is needed to stimulate activity by others - will be more important in some sectors or value chains than in others
- The potential for productivity growth and the learning period in terms of technology mastery will vary between technologies and thus between activities
- The capacity to generate future productivity growth and technical change will also vary between firms using the same technology.

Each proposition implies that, as in theory there is no reason to expect uniformity between types of activity or firms, there is a case for a selective intervention that has a non-uniform impact on firms' revenue. The investment climate approach of using horizontal measures to reduce transaction costs leaves it to producers to determine where invest and in what activities, where necessary, to seek government support. However given risk aversion amongst investors and commercial financial institutions, interest in new areas with dynamic potential may need to be fostered by incentives and the financial and on-financial support offered through industrial policy. As resources are limited choices have to be made on which areas such support should be offered to.

III. Support types of activity not sectors

Whereas in practice this may be difficult to demonstrate that certain types of production generate more positive externalities than others in line with standard theory it is widely mentioned frequently in the context of industrial policy are the externalities from labour training (where workers can take their skills to other employers) and innovation (where first mover investors provide a demonstration effect for followers even where there is patent protection). Most governments offer tax credits for both types of expenditure, but support for externality-inducing activity particularly innovation, is the centre-piece of an influential restatement of the case for industrial policy which goes much further than this (Hausmann and Rodrik, 2002, 2005, Hausmann et al 2008).

The authors have built on the standard argument on market failure by adding the important insight that the driver of development is innovation, and thus it is important to do things in different ways and create new products (or products new to an economy). The role of policy is therefore not just to correct for market failure in a static sense, but critically to encourage the innovation that will foster long-term productivity growth. Their key focus is on providing financial support and public inputs which will support innovation and a process of 'product discovery'.

Innovation can operate at different levels in terms of both product and process innovation. Hence support can be targeted at R and D, for example through tax allowances for R and D expenditure or government funding of joint research in a research consortia. Projects to create output embodying new products can be supported through the provision of credit through a development bank or state venture capital fund or through a cash subsidy (or tax allowance) for production of a good new to an economy until the total value of the production of the good across the whole economy reaches a threshold.[5]

Support for innovation is wholly compatible with theory, as it rewards the demonstration externality from first mover firms, and is best done through the provision of risk capital from a development bank or venture capital fund. It allows a focus on products distant from the current specialisation, what the authors' term 'strategic bets'. Whether it removes completely the need for a sectoral focus is less clear. The authors themselves are ambivalent.[6] Their key point is that a measure like support for innovation spans a range of sectors and therefore access to this support should not be restricted simply because a firm is not located in what is deemed a 'priority' area. However they acknowledge that in some circumstances it may be easier to support specific sectors, both as a way of co-ordinating firms and of organising the provision of key public goods. Thus selectivity in some forms of support can be combined with a horizontal approach in key areas like innovation.

A more recent focus on innovation relates to the priorities for middle income economies operating close to the global technology frontier. Whereas Hausmann and Rodrik talk of support for innovation in general the new suggestion is that for middle income countries the type of innovation matters. Drawing on Korean and Taiwanese experience the argument is that a focus on short-cycle technologies is critical because these are the technologies where the advantage of established producers is least and which are located in sectors offering the greatest prospects for new technologies that middle income economies can take up (Lee

[5] This scheme was applied as an export subsidy in Chile in the 1990's and was abandoned as WTO-incompatible in 2003: see Agosin et al (2010)

[6] In Hausmann and Rodrik (2005: 79) they suggest.. 'In principle, interventions should be as horizontal as possible and as sectoral as necessary'.

2013).[7] The technological diversification inherent in this approach is seen as a 'detour' strategy because it allows a follower economy to avoid investing in original, long-cycle technologies common in high income economies.

The implication is that in upper middle income economies technology policy becomes central to industrial policy and that governments need to work with producers to build up technological capabilities to allow the application of these technologies. Public-private research consortia with public funding for basic and applied research, the imposition of national standards that local producers can meet and public procurement policy are each mentioned as aspects of an industrial policy to support these new technologies (Lee, 2013, chapter 7). This targeting of specific technologies will have implications for the allocation of support between sectors (many of the examples cited in Lee (2013) refer to electronics and telecommunications), but sectors per se are not target. The approach underlines the fact that in high income economies industrial policy tends to be dominated by concerns about competitiveness through technology. For upper middle income economies wishing to sustain their growth it is also of considerable relevance. For low and lower middle income economies, learning to master more standardised, long cycle technologies obtained from abroad is likely to remain the key focus of policy up to the medium term.

IV. Follow the patterns of change

There is now an extensive literature charting the evolution of economies as incomes rise. Earlier work by Chenery and other has now been updated to allow a categorisation of 'early', 'middle' and 'late' industries (or more accurately branches of manufacturing). Here industries can be dated in this way depending on the level GDP per capita at which their value added (either as a percentage of GDP or in value added per capita) reaches a peak. Typical early industries are food processing and garments. The implication is that economies at low levels of income should look initially to find product niches in these early industries as this has been the pattern in other low income economies at an earlier stage of their development. This simple copying of earlier patterns of expansion has led some to conclude that industrial policy should be simpler to apply in poor countries (Wade 2009).

Recent reworking of the original cross country analysis in Chenery (1960) explains a measure of manufacturing activity by 18 sectors at the 2 digit ISIC level by a country's income level, population size, a measure of natural resource endowment and dummy variable for geography (Haraguchi and Rezonja 2013, Haraguchi 2016). For most activities the coefficient on income is positive and significant and on income squared it is negative indicating a rising role for each activity with income controlling for other factors, which peaks at a different

[7] A short cycle technology is measured by the number of years between the application or grant year of the citing patent and the year of cited patents (Lee 2013: 19). A gap of 8 years for example for a country shows that on average firms cite 8 year old patents.

income level for different activities. Industries are classified into early, middle and late depending on the level of GDP per capita at which each reaches its peak share in GDP. The analysis is conducted separately for small and large economies based on absolute size of GDP. Table 2 summarises the overall results.

Table 2 Development stages of manufacturing industries

Early	Middle	Late
Food and beverages	Coke and refined petroleum	Rubber and plastic
Tobacco	Paper	Motor vehicles
Textiles	Basic metals	Chemicals
Wearing apparel	Fabricated metals	Machinery and equipment
Wood products		Electrical machinery
Publishing		Precision instruments
Furniture		
Non-metallic minerals		

Source: Haraguchi (2016 table 3.1) Note: Early industries have a peak share in GDP before $6500 GDP/capita in PPP 2005 prices; middle industries have a peak between $6500 and $15,000; late industries have a peak after $15,000.

Broadly speaking as expected early industries tend to be either labour intensive or natural based; middle industries tend to be capital intensive often involving resource processing; late industries tend to be knowledge and technology intensive. However, the analysis also reveals that country-specific effects are important in influencing the scale of manufacturing at any given income level and that this is particularly the case for the sub-sample of small economies. Sectors where income explains less than 70% of the change in manufacturing value–added in small countries are textiles, tobacco, wood products, basic metals, non-metallic minerals, coke and refined petroleum, fabricated metals, wearing apparel, motor vehicles and precision instruments (Haraguchi and Rezonja 2013, table 4.7). There appears more regularity for large economies, but there is also evidence that the investment climate issues discussed above have an impact on patterns of manufacturing.[8]

Clearly the more country-specific factors drive manufacturing development the less reliable will be a focus on international growth patterns to set planning priorities. Past patterns of manufacturing development say nothing about whether in a relatively open world trading environment any individual economy will be able to sustain a competitive manufacturing base in any individual sector. In addition a 2 digit level of aggregation covers vast range of specific products so that there is little guidance on the product niches to look to from this analysis.

[8] Haraguchi (2016, table 3.3) shows the size of country fixed effect coefficients, which pick up the effect of country conditions, are generally related significantly to measures of the investment climate with the expected sign.

The rule of thumb put forward by Lin and Monga (2010) in their 'growth identification and facilitation framework' is an approximate ways of addressing these concerns, whilst keeping a focus on past experience. Their suggestion is that any individual country should target activities which a country with similar structural characteristics and an income per capita of about double that of the country concerned (in PPP) was able to export successfully in the past 15 to 20 years. The argument is that if the comparator country has a similar structure and resource endowment the industries in which it became competitive 20 years earlier will be likely to require production capabilities that the follower country has or can develop readily, so that these will be activities

in which the follower has a latent comparative advantage. As the comparator economy grows its wages will rise, potentially freeing space in the global market that the follower economy can fill. Industrial policy therefore requires a two stage procedure; finding a comparator economy with an income not too far ahead of the country concerned and then identifying sectors in the comparator from which the follower economy can export successfully (Lin and Wang, 2015).

Despite the simplicity of this rule its practical usefulness has been questioned. It may be little more than common sense in relation to fairly standardised, labour-intensive products, where for example in relation to garments, with rising wages in older established production centres and the ending of the Multi Fibre Agreement, producers from new exporter economies, such as Bangladesh and Cambodia, have emerged. In sectors where technical change is rapid, however, products exported 20 years ago may have undergone significant redesign. Their technical content and the required production capabilities may have changed as a result, making it less clear that the comparator-follower path is straightforward as a guide to industrial targeting.

Furthermore there is an element of arbitrariness in the choice of guidelines of twice per capita and 20 years export experience. The historical accuracy of the rule has been questioned as a reading of East Asian experience to demonstrate that with effective industrial policy it may be possible to take greater leaps to produce 'distant' products than those implied by rule. Chang (2014) argues that Japan targeted its auto sector in the early 1960's when its income per capita was one sixth of the market leader economy the US and Korea entered semi-conductors in the mid 1980's when its income per capita was one seventh of that of the US. This does not invalidate targeting export industries successful elsewhere, but it does imply that comparative advantage may need to be created through for example an active policy on technology and training, as well as significant financial support for the nascent activities.[9]

[9] Lin and Wang (2015) set out a list of interventions to support the new export activities so the disagreement with Chang is really one of degree and scale of support. Lin and Chang (2009) set out the contrasting views. Lin argues that in the early 1960's Japan's income was 40% of the US, so that the auto example fits his rule of thumb.

V. Use a trade-based indicator

As an alternative to looking at international patterns of expansion there is a tradition in planning circles of trying to establish a form of quantitative indicator to guide investment selection. Early efforts at industrial planning up the 1970's typically started with a focus on the domestic market as part of an import substitution drive. The existence of imports demonstrated a demand for the goods concerned and the question was then which import-competing goods could be produced domestically. Lewis (1953) in his analysis of policy options for industrialisation in the then Gold Coast (now Ghana) provides an early and influential example of the approach.

His starting point is that prospects for industrialisation are limited for two mains reasons – the low productivity in agriculture which limits the growth of the home market and the relatively high local wages due a high land-labour ratio which makes exporting difficult. From a review of the import list a limited number of possible activities are identified for the home market as import substitutes. In deciding what are the most promising activities he uses four simple criteria – where raw materials are available locally, there is natural protection from transport costs and the capital and skills requirements are not too demanding. Using these four criteria a number of items currently imported are identified for further study and possible promotion. The most likely (termed Favourable Industries) are some of the classic early industries noted above – food processing, salt, beer, bricks, cement, glass, industrial alcohol, chemicals, and wood products. A longer list of possible activities (termed Marginal Industries) is also produced based on imported raw materials, which do not lose weight in manufacturing. Weaving (based on imported yarn) and foundry products (based on imported pig iron) are seen as offering the greatest scope for expansion and employment growth. It is acknowledged that some industries could be successful without assistance, whilst other would need 'nursing', some for a considerable period of time. By identifying activities with potential from a list of imported products, Lewis is implicitly adopting a vertical as opposed to horizontal approach to policy with incentives tailored to the needs of individual product ranges (or firms) rather than available to all.

Domestic resource cost ratio

Subsequent analyses of import substitution activities pointed out that despite its employment effect import replacement is only a rational strategy where there is the potential for economically efficient production in the longer term (Little et al 1970). This led to the use of efficiency indicators to assess the short-term efficiency of either particular branches of manufacturing, or of individual project proposals. The indicators applied were a variant of economic cost-benefit analysis with benefits of import substitution in terms of saved foreign exchange and costs in terms of the opportunity costs of the resources associated with their domestic production (Little and Mirrlees 1968, 1974, UNIDO 1972). Of

the different ways of expressing this information the domestic resource cost (DRC) ratio, developed originally for planning decisions in Israel, was intuitively the clearest and was probably the most widely applied in discussions of investment priorities (Bruno 1972, Krueger 1966).

For an individual year this compares the domestic resources required to earn or save a unit of foreign currency with an estimate of the value of that foreign currency to the economy. Simply

DRC = DR/FE

and efficiency requires that DR/FE < SER, where DR refers to domestic resources in domestic currency), FE is net foreign exchange (output minus traded inputs at world prices) in foreign currency and SER (or shadow exchange rate) is the long-run economic value of a unit of the foreign currency in units of domestic currency.[10] Alternatively where domestic resources and net foreign exchange are expressed in a common currency (either local or foreign, efficiency requires that costs (DR) be below benefits (FE), so that where US dollars are used DR*SER/FE< 1.0, where SER is in US$ per unit of local currency.

Comparative advantage for an activity requires that the domestic resources involved (normally specified in terms of labour and non-traded goods) when valued at their economic opportunity cost are less than the long-run real value of foreign exchange to the economy, so that efficiency by the DRC criteria becomes an indicator of comparative advantage (Schydlowsky 1984). Although the ranking of activities by the size of their DRC is only strictly valid under restrictive assumptions relating to constant unit cost, constant relative prices and production divisibility –there is a strong livelihood that sectors with ratios well above unity (in the formulation DR*SER/FE) will not include activities in which an economy has a current comparative advantage. Investment to expand these will be *comparative advantage defying* in the terminology of Lin (2010). Conversely where the DRC is close to or below unity the reverse will hold and expansion will be *comparative advantage conforming*.

The DRC indicator has been used as a means of comparing efficiency between different sub-sectors or branches of industry (say at the 3 or 4 digit level) in a form of screening exercise. At the stage of initial screening it is rare that detailed project data will be available and the DRC approach offers a simpler, less data-intensive, form of efficiency analysis. Whilst the focus away from import substitution as a strategy has meant there is now less emphasis on

[10] More formally DRC = $\sum(D*Pd)/(Wpi - \sum ajiWpj)$

Where i and i refer to internationally traded output and inputs respectively and Wp is their world price; aji is the units of input j per unit of i. D is set of domestic factors of production required to produce a unit of i and Pd is their economic or shadow price value. In theory all indirectly traded inputs into good used to produce i should be included in the denominator with a negative sign as part of ∑j.

this indicator it was used to compare investment alternatives in the World Bank study Light Manufacturing in Africa (Dinh et al 2012, table 8.4).[11] There priorities were discussed on the basis of a ranking by the DRC.

The DRC analysis gives a snapshot picture of efficiency at a point in time and where accurate data can be collected it highlights where there is current or short term efficiency. However its weakness as a guide for industrial policy priorities is that it needs to be applied to assess dynamic not static comparative advantage. The DRC ratio can be given a more dynamic form by projecting both sides of the ratio into the future to take account of learning or technical change reducing domestic resource cost (lower DR) or improved demand prospects or product redesign raising the foreign exchange value of certain types of product (higher FE); similarly the exchange rate (SER) should be a projected long-run value. However these adjustments are uncertain and they do not address the type of big structural leap involved in investment in 'strategic bets'. Much of the risk-taking around which Venture Capital funds, for example, are based cannot be addressed in this way. It is highly unlikely, for example, that salmon fishing by Fundacion Chile or the development of mobile phone technology by Nokia of Finland would have passed the DRC test referred to above had it ever been applied. For such genuine innovations formal calculations may have to be replaced by judgements about the development of markets and about the capacity and vision of the innovators. Where public funds are involved in supporting products or technologies new to an economy some form of quantitative comparison of costs and benefits will be required, but the key point is that the more innovative the area the less likely will it be that we can place too much reliance on projections of what the future will bring.

The most that can be said is that production in sectors with well above average or high DRC ratios is likely to continue in operation only because of high protection from trade barriers and this short-run inefficiency makes the sectors in which they are operating unlikely candidates for dynamic new activities. Hence the indicator may be useful in a negative sense of ruling out high cost areas of production.

Product space analysis

Reflecting changed attitudes and international trading conditions, the most recent version of a trade-based indicator focuses on potential exports, rather than import substitutes, with the suggestion that policy should aim to build on existing comparative advantage through product upgrading. The current pattern of trade and specialisation is important in predicting future trends since it is likely that in the short-term countries will move into the production of goods that require similar skills, technology and capital assets to those in which it is already competitive. There is evidence that within broad product categories (like textiles or clothing) there is significant diversity in terms of product technology content and

[11] The present author did the calculations for the DRC values reported there.

branding, which means that price, profit margins and demand prospects can differ between products. This offers scope for a country to upgrade into higher value segments within a broad product category. There is also some evidence that different patterns of trade specialization have different implications for growth and that exporting higher value products is associated with faster economic growth (Hausmann et al 2007).

In applying this approach a measure of technological sophistication is required at the individual product level to gauge how far a shift in the composition of exports is adding to the sophistication (and hence growth potential) of the export basket. Initial measures of the sophistication of products were based on a weighted average of the incomes per capita of the countries which exported the goods, with the weights determined either by revealed comparative advantage (Hausmann et al 2007) or share in world exports (Lall et al 2006).[12] The rationale is that within individual product categories the average income of exporting countries can be a useful proxy for the technological depth of a product; hence an electrical good from Japan may be deemed to have higher technology content than the same good from the Philippines. Similarly within apparel products exported by rich countries –or processes undertaken by them – are taken to be more skill, technology or marketing intensive and to yield higher profit margins and wages than the more standardized goods exported by poorer countries.

A simple way of setting planning priorities using this information is to look at the goods which an economy is exporting successfully at present and to see within an individual product category where there are options to export goods with a higher level of sophistication or productivity. For example, within the HS category 84 for Textiles and Clothing the PRODY score (in 2006 prices) ranges from US$5316 (HS 8464 Undergarments) to US$$11,066 (HS 8482 Other apparel). Hence there may be considerable scope for upgrading production within sectors by shifting to higher value product niches (UNIDO 2011).

More complex versions of this approach quantify the 'economic distance' between goods since there can be a trade-off between moving to close goods with a low additional value to the economy and distant goods with a higher value.[13] Hausmann and Klinger (2007) provide a measure of distance between pairs of products based on the conditional probability that a

[12] Weiss (2010) compares the two approaches. Use of revealed comparative advantage gives a higher to goods exported from small countries. Hence even if the US exports more shirts than say Cambodia if shirts are a product in which Cambodia has specialized, but the US has not, they will be treated as a low income product. Sophistication following Hausmann et al was termed a PRODY index and following Lall et al a sophistication index.

[13] This 'product space' analysis has gained popularity in recent years and has been applied for example in Hausmann and Klinger (2008) for Colombia and Hausmann and Chauvin (2015) for Rwanda. Cruz and Riker (2012) have a list of country applications up to 2012.

good is exported with comparative advantage by pairs of countries.[14] The argument is that 'close' products require similar production capabilities for competitive production and that a country that specialises in goods that are close to others in this sense will find it easier to diversify its export basket. For any individual unexploited product (in the sense that the good whilst exported is not one in which the country is specialised by the revealed comparative advantage indicator) a 'density' measure can be calculated which gives the distance between the product and goods exported with revealed comparative advantage. For any individual good the expectation is that the lower is the density figure the more difficult it will be to develop successful exports.[15]

The most recent applications of the product space approach apply a different measure of product sophistication, now termed 'product complexity'. Using an income –based product level indicator to explain growth of income across countries risks being tautological and hence a revised measure of product sophistication was developed by Hidalgo and Hausmann (2009) and Hausmann et al (2011). This is an index number based on an iterative calculation which combines information on the number of products a country exports, where it has revealed comparative advantage (a measure of diversification) and the number of countries which also export these products (a measure of ubiquity). Complex products with a high score on this index are those where diversified economies with high levels of capability have a specialisation.[16] As would be expected the most complex goods by this measure are machinery, chemicals and metal products and the least complex are raw materials and primary commodities. Similarly as incomes of countries' rise, so does the share of complex goods in exports.

In this case the product space analysis calculates the total product complexity of a country's exports as a weighted average of the product complexity index for each good weighted by the share of goods in total exports.[17] New potential targets for exports are then goods with a higher than average product complexity, so their expansion raises the complexity of the overall basket, which are not located too far away from existing specialisation in terms of the product space. Distance is determined by the density measure but what is not too far away is ambiguous. A simple expedient is to require that selected target products have a distance which is below the median distance for all goods exported without comparative

[14] Distance between two goods is the minimum P (A/B) and P (B/A), so if a country exports pig meat and copper it is the minimum probability of all meat exporters exporting copper and all copper exporters exporting pig meat, both with revealed comparative advantage.
[15] Distance between a good and the current set of specialised exports can be measured as the inverse of density, so where density is low distance in this sense is high.
[16] The form of calculation is complex and an intuitive explanation, along with product complexity scores for over 5,000 products are in Abdon et al (2010).
[17] This gives an index number not a dollar value as in the original analysis where EXPY was calculated as weighted average of the PRODY values for a country's exports

advantage.[18] An efficient frontier is defined by goods which meet the product complexity and distance criteria.[19]

The product space approach provides a rigorous objective technique, with a sound theoretical basis, for identifying potential new exports. However the original authors' stress that it is not designed to 'pick winners', as candidates for export subsidies or other forms of support (Hausmann and Klinger 2008). The idea is that the export priorities implied by this analysis should suggest areas in which governments should engage with producers to establish the constraints that need to be overcome, for example in policy reform, public infrastructure or training investment and credit allocation, to allow the emergence of competitive exports. Similarly it could inform which types of foreign investors to approach to encourage inward investment for the export market. Since the capabilities required for competitive production in the identified product ranges are not too dissimilar from those required in areas where successful specialisation has already been achieved the implication is that these are areas in which public support can help create a new or dynamic comparative advantage. Although the analysis can be highly dis-aggregate (typically at the 4 digit HS level) this still rarely identifies individual products, so that priority targets become relatively narrowly defined product categories or niches.

However, similarity in capabilities between a target niche and goods already exported successfully does not, in itself, guarantee that efficient production can be established. Policy support may help, but efficiency will be determined by a range of factors (whether access to technology, skilled labour, raw material supplies, marketing links and so forth). The data from a product space analysis is no more than a first step in an identification process and business plans and investment economic appraisals will be needed at a subsequent stage to firm up any conclusion.

It is also worth pointing out that the potential export products which emerge from this detailed analysis typically cover a wide range and often accord with a-priori expectations. For Rwanda, for example, for exports to global markets 72 potential export product categories at the 4 digit level are identified, which use local materials, are generally labour intensive and have below average transport costs (Hausmann and Chauvin, 2015). The classification of these priority areas into three categories groups them as (1) Processed agricultural products, beverages, tobacco and agro chemicals; (2) Specialised textiles and

[18] This is used in Hausmann and Chauvin (2015). Hausmann and Klinger (2008) use different standard deviations from the mean distance to show the sensitivity of the results to the choice of distance.

[19] For an economy the total value of all unexploited exports (that is those exported without comparative advantage) can be derived as a weighted average of the score for each product (either PRODY or complexity score) with the weights given by the density for each product. This shows how close the current export basket is to potential high value export opportunities. An individual product will have an opportunity gain determined by the change in opportunity value it creates. The size of opportunity gain can be third criteria. Earlier versions of the approach based on PRODYs used the terms 'open forest' for opportunity value and 'strategic value' for opportunity gain.

garments; (3) Construction materials, metal and wood products. These are exactly the areas that might be suggested by an analysis based on a simple review of the existing structure of exports or an analysis of 'early' industry based on international trends.[20]

VI. Conclusions

The basic message of this review is that there is no single objective approach or technique to allow governments to base industrial policy on a simple set of priorities, in terms of key sectors or firms. Each of the possible techniques reviewed here offer little more than indications of potential in relatively broad areas of production. The most detailed suggestions come from the recent additions to the policy literature – the Lin-Monga rule of thumb and the product space approach, with the latter offering the most rigorous guide. However ultimately it is decisions by producers which will determine which of the possible export product niches are taken up, with governments offering support and making suggestions. Unless a government has the resources and commitment for a public sector investment programme in internationally tradable activities, these will be decisions taken by the private sector so governments can influence but not force investment in any specific area.

Should then governments abandon the idea of priorities and selectivity? The limited financial and human resources available suggests the need to concentrate efforts on where they can generate the maximum impact. If ex ante it may be impossible objectively to determine a 'winning' sector, in the sense of an area with potential for internationally competitive production, it may still be possible that policy support can help producers in a limited number of areas to emerge as internationally competitive. There is no 'right' answer to the question what should be the priority areas, since what matters is to create a sustainable, not necessarily an optimal, pattern of export growth and experimentation is necessary.[21]

Experience across many countries suggests that it is very difficult to restrict fiscal incentives to a narrowly defined list of priority sectors, since producers from excluded sectors will inevitably lobby for their inclusion. Hence in relation to fiscal issues there is a strong case for offering broadly horizontal support across sectors, for example in terms of import tariff

[20] The authors comment that their priority list does not differ markedly from the priorities in the National Export Strategy for non-traditional exports, which were derived from expert judgements.

[21] The comments of Lall and Teubal (1998: 1381) on technology policy apply equally to the type of industrial policy discussed here.. "Technology policy is an art rather than science (there is an irreducible element of judgement) ….Frequently any one of several choices can work; what is important is not to identify the unique 'equilibrium' but to assemble a smaller set of 'reasonable' choices and implement them comprehensively and systematically. Since mistakes are inevitable (as with firms) the government has to be flexible and responsive to evolving characteristics – policy has to allow its own learning and adjustment."

protection (where it is used), profits tax rates and tax credit allowances, and R and D and labour training allowances.

At the same time a dialogue with the private sector can be initiated in a few selected areas with these identified either by detailed analysis, such as the product space approach, or simply focusing on areas with recent export success or at low income levels on 'early' industries, where local raw materials and low cost labour are available. This dialogue should aim to identify the key constraints to growth in these areas. This will almost inevitably mean that certain activities will receive disproportionate amount of government funding, for example due to infrastructure investment, joint R and D collaboration or the public funding of training. It will also mean that certain activities take up a disproportionate amount of the time of public officials in assessing how to address their problems, such as locating overseas markets or poor quality of local raw materials. Any public investments as part of industrial policy would need to be assessed by a form of cost-benefit calculation the results of which should provide a mechanism for implementing selectivity. Where selected areas fail to deliver exports within a relatively brief time period the dialogue should shift to another possible area.

Alongside this limited vertical approach other less selective interventions are possible. For example, support for innovation can also be offered by a development bank or public sector venture capital fund to innovators from any productive area provided a plausible case for investment can be established. Alternatively fiscal exceptions could be offered for innovation in any sector, provided the innovation can be defined clearly and its novelty demonstrated. In practice real world policy is likely to be a combination of the general and the selective. The suggestion here is for a limited vertical policy that concentrates public funding and officials' time on a limited set of activities, but one which does not distort severely the prices and incentives facing producers in other areas.

References

Abdon, A. Bacate, M. Felipe, J and Kumar, U (2010) 'Product complexity and economic development', *Levy Economics Institute Working Paper* 616

Agosin, M. C, Larrain and N, Grau (2010) 'Industrial Policy in Chile' *IDB Working Paper Series*, WP-170, Inter-American Development Bank

Altenburg, T (2011) 'Industrial Policy in Developing Countries' *German Development Institute, Discussion Paper* 4/2011

Bruno, M (1972) 'Domestic resource cost and effective protection: clarification and synthesis' *Journal of Political Economy*, 80, 1, 16-33.

Chang, H.J (2013) Comments on "Comparative advantage: the silver bullet of industrial policy" in *The Industrial Policy Revolution 1,* J. Stiglitz and J. Y Lin (eds) IEA Conference Volume 151-1, Palgrave, Macmillan, New York.

Chenery, H.B (1960) 'Patterns of industrial growth' *American Economic Review*, 50, 4, 624-54

Crespi, G. E, Fernando- Aria and E, Stein (2014) *Rethinking Productive Development: sound policies and institutions for economic transformation*, Inter-American Development Bank, Palgrave, Macmillan

Corden, W, M (1974) *Trade Policy and Economic Welfare*, Oxford University Press

De la Cruz, J and Riker, D (2012) 'Product space analysis of exports of Brazil' *US International Trade Commission, Office of Economics Working Paper* 2012/06.A

DCED (2008) Supporting Business Environment Reforms, Donor Committee on Enterprise Development downloaded from www.dced.org

Dinh, H. Palmade, V. Chandra, V and Cossar, F (2012) *Light Manufacturing in Africa: targeted policies to enhance private investment and create job*s, World bank, Washington DC 2012

Felipe, J (ed) *Development and Modern Industrial Policy in Practice*, Edward Elgar, Cheltenham

Gebreeyesus, M (2013) 'Industrial policy and development in Ethiopia' WIDER Working Paper 2013/125, Helsinki, United Nations University- World Institute for Development Economics Research

Haraguchi, N and Rezonja, G (2013) 'Emerging patterns of structural change in manufacturing' in *Pathways to Industrialization in the Twenty First Century*, Smirzai, A. Naude, W and Alcorta, L (eds) Oxford University Press, Oxford.

Haraguchi, N (2016) 'Patterns of manufacturing change and structural development' in Weiss, J and Tribe, M.A (eds) *Routledge Handbook of Industry and Development*, Routledge, Abingdon and New York

Hausmann, R and Chauvin, J (2015) 'Moving to the adjacent possible: discovering paths for export diversification in Rwanda' *CID Working Paper* 294, Centre for International Development, Harvard

Hausmann, R. Hidalgo, C.Bustos, S. Coscia, M. Chung, S.Jimenez, J and Simoes, A (2011) *Atlas of Economic Complexity*, Puritan Press, Cambridge, MA

Hausmann, R. D, Rodrik and C, Sabel (2008) Reconfiguring Industrial Policy: A Framework with an Application to South Africa, *CID Working Paper* 168, Centre for International Development, Harvard

Hausmann, R and Klinger, B (2008) 'Achieving export-led economic growth in Colombia' *CID Working Paper* 182, Centre for International Development, Harvard

Hausmann, R and Klinger, B (2007) 'The structure of the product space and the evolution of comparative advantage' *CID Working Paper* 146, August, Centre for International Development, Harvard University

Hausmann, R, Hwang, J and Rodrik, D (2007) 'What you export matters' *Journal of Economic Growth*, 12, 1, 1-25.

Hausmann, R. and Rodrik, D (2006) 'Doomed to choose: industrial policy as predicament' downloaded from www.ias.edu/faculty/rodrik/papers

Hausmann, R. and D, Rodrik (2005) 'Self-discovery in development strategy in El Salvador' *Economia*, Fall

Hausmann, R. and Rodrik, D (2002) 'Economic development as self-discovery' *NBER Working Paper* 8952, National Bureau of Economic Research

Hausmann, R. Hidalgo, C.Bustos, S. Coscia, M. Chung, S.Jimenez, J and Simoes, A (2011) *Atlas of Economic Complexity*, Puritan Press, Cambridge, MA

Hidalgo, C and Hausmann, R (2009) 'The building blocks of economic complexity' *Proceedings of the National Academy of Sciences'*, 106, 26, 10570-75.

Kaplan, D (2016) 'Manufacturing in post-Apartheid South Africa: Performance and Policy' in Weiss, J and Tribe, M.A (eds) *Routledge Handbook of Industry and Development*, Routledge, Abingdon and New York

Krueger, A (1966) 'Some Economic Costs of Exchange Control: the Turkish case' *Journal of Political Economy*, October, 466-480.

Lall, S. Weiss, J and Zhang, J (2006) 'The sophistication of exports: a new trade measure' *World Development* 34, 222-237

Lall, S and Teubal, M (1998) 'Market stimulating technology policies in developing countries: a framework with examples from East Asia' *World Development*, 26,8, 1369-85.

Lee, K (2013) *Schumpeterian Analysis of Economic Catch-Up*, Cambridge University Press, Cambridge.

Lewis, W. A (1953) *Report on Industrialisation and the Gold Coast*, Government of the Gold Coast, Accra.

Lin, J. Y and Chang, H.J (2009) 'Should Industrial Policy in Developing Countries Conform to Comparative Advantage of Defy it? A debate between Justin Lin and Ha-Joon Chang' *Development Policy Review*, 27, 5, 483-502

Lin, J (2010) 'New structural economics: a framework for rethinking development policy' *World Bank Policy Research Working Paper* 5197, World Bank

Lin, J and Monga, C (2010) 'Growth identification and facilitation: the role of the state in the dynamics of industrial change' *World Bank Policy Research Working Paper*, 5313.

Lin, J. Y and Wang, Y (2015) 'Catching up: structural transformation and diversification' in *Development and Modern Industrial Policy in Practice*, Felipe, J (ed) Edward Elgar, Cheltenham

Little, I and Mirrlees, J (1974) *Project Appraisal and Planning for Developing Countries*, New York, Basic Books

Little, I. Scitovsky, T and Scott, M (1970), *Industry and Trade in Some Developing Countries*, Oxford University Press, Oxford

Perez, W and Primi, A (2009) 'Theory and Practice of Industrial Policy: evidence from Latin American Experience' *CEPAL Desarrollo Productivo* Serie 187, CEPAL/Economic Commission for Latin America, Santiago

Rodrik, D (2008) 'Normalizing industrial policy' Paper prepared for The Commission on Growth and Development, Working Paper 3 downloaded from www.ias.edu/faculty/rodrik/papers

Salazar-Xirinachs, J. Nubler,I and Kozul-Wright, R (2014) (eds) *Transforming Economies: Making industrial policy work for growth, jobs and development,* International Labour Office, Geneva.

Schydlowsky, D (1984) 'A Policy-Makers Guide to Comparative Advantage' *World Development* 12, 4, 439-449.

UNIDO (2013) *Industrial Development Report,* United Nations Industrial Development Organization, Vienna.

UNIDO (2011) *Strategic Directions on Industrial Policy in Mongolia*, UNIDO and Government of Mongolia, United Nations Industrial Development Organization, Vienna.

UNIDO (1972) *Guidelines for Project Evaluation*, United Nations Industrial Development Organization, UN New York

Wade, R (2009) 'Rethinking Industrial Policy for Low Income Countries' *African Development Review,* 21, 2, 352-366

Warwick, K (2013) 'Beyond industrial policy: emerging issues and new trends' *OECD Science, Technology and Industry Policy Papers* No 2

Weiss (2013) 'Strategic Industrial Policy and Business Environment Reform: are they compatible?' *Donor Committee on Enterprise Development Working Paper*, June 2013 available at www.dced.org

Weiss, J (2010) 'Changing Trade Structure and Its Implications for Growth' *World Economy,* November, 1269-1279

Weiss, J and Tribe, M.A (2016) (eds) *Routledge Handbook of Industry and Development*, Routledge, Abingdon and New York