Industrial Policy: implementing a vision

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Introduction

Following the Oil Shocks of the 1970s and the increasing structural problems for developing economies that resulted, the attention of development specialists turned to macroeconomic reform and the liberalization of product and factor markets. [1] Structural Adjustment Lending grew to claim a significant proportion of World Bank and IMF business during the 1980s and 1990s and interest in detailed sector intervention, including industrial assistance, was correspondingly attenuated. However, by the 2000s decade the difficulties in meeting developmental goals through reforms at the macro level have resulted in a revival of interest in sector specific interventions and industrial policy in particular.

Interest in industrial policy, defined broadly as government interventions to alter resource allocation, has also seen a revival of interest because of the slow pace of industrial development, and even de-industrialization, in some of the poorest parts of the developing world, such as within Africa, in the face of growing domination of the manufacturing sector by Asian economies, particularly China. However, while the case for an active industrial policy has been resuscitated, the extent of intervention and the criteria to guide that intervention remain highly uncertain.

In this context the debate between two leading Asian economists, H-J Chang (University of Cambridge) and Justin Lin (Chief Economist of the World Bank) (Development Policy Review 2009) provides a fascinating insight into alternative visions on technological upgrading and structural transformation in industrializing economies. While both agree on the need for government support they disagree on how far and how fast it is wise for countries to move, for example into 'distant' products in the sense of goods that are far removed from current comparative advantage.

Industrial policy is about more than a strategic vision of a future technological destination; it is about political economy, including the interaction between the state and the private sector and the policy instruments used to drive this interaction, and it is also about the techniques applied to assess priorities and guide the allocation of support between competing uses.[2] The Chang-Lin debate whilst drawing out theoretical issues in a highly accessible manner says little explicitly about these latter dimensions. This paper in turn does not attempt to address all of these gaps, but focuses on the very practical question of how in a low income, relatively non-industrialised environment like most of sub-Saharan Africa one can identify investment priorities to operationalise the vision of a technologically upgraded economy.

[1] The case for macroeconomic reform was made, for example, in the influential report for the World Bank Berg (1981) '*Accelerated Growth in Sub-Saharan Africa; an Agenda for Action*', authored by Eliot Berg and others for the World Bank in 1981.

[2] For analyses of industrial policy see for example Weiss (2011) chapter 7, UNIDO (2011), Chang (2009), Rodrik (2007) and several of the chapters in Szirmai et al (forthcoming).

There are different views on whether public support for industry should be available to all activities that meet a certain characteristic (for example to innovators to compensate for an information externality) or should be targeted at activities with high growth potential. The facilitating state of Lin appears to imply the former and the more transformational *comparative advantage defying* policies advocated by Chang clearly imply the latter. Under the first approach the state allows firms to set their own priorities and determine where they wish to take risks, whilst under the latter funds and therefore risks are shared between public and private sectors, with the government channelling support to sub-sectors with the greatest perceived potential. However regardless of which approach is adopted it is useful to have a broad indication of the sort of activities which might be developed in the process of upgrading and moving up the ladder of comparative advantage – either as a guide to potential private investors or as a means of selecting priority areas for support. In addressing this question the analysis here is more in line with that of Lin – for example in building on existing trade specialisation – than that of Chang, but it recognises that risk-taking based on moves into new products or processes will have role to play in any successful industrialisation.

This paper discusses practical techniques for identifying priority areas for industrial support – we leave open the question of the form any support might take (import tariffs, credits, tax breaks, subsidies and so forth). We begin with the domestic resource cost (DRC) ratio, an indicator that was once widely used as a planning tool for assessing comparative advantage and economic efficiency. This measure has been relatively neglected in recent years but is clearly of relevance to what Lin terms a *comparative advantage conforming* approach. Complications of both a practical and conceptual nature are highlighted and then a discussion follows on how the DRC can be made more operationally useful by linking it as an indicator to amore dynamic approach drawing on concepts from the recent literature on the product composition of trade which highlight the desirability of moving into technologically more sophisticated or higher productivity goods. This latter approach offers a means of operationalising the goal of export upgrading whose importance is recognised by both Chang and Lin.

Another section considers risk-taking and product innovation in line with the larger product or technological leaps envisaged by Chang. A final section concludes. The aim is not a definitive analysis of options for industrial policy, but to suggest ways in which a helpful but largely abstract debate can be given a more operational focus in terms of the sort of information governments might need to collect to inform their decisions on support for industry.

The Domestic Resource Cost (DRC) indicator and comparative advantage

Developed originally to analyse the efficiency of import substitute activities in Israel and Turkey the DRC indicator can be seen as a means of operationalising planning based on comparative advantage (Bruno 1972, Krueger,1966). As Chang points out in neoclassical economics the theoretically correct means of assessing the international efficiency of manufacturing activity is to conduct a form of cost benefit analysis treating manufacturing output as an internationally tradable good – as an exportable or import substitute - whose value is determined by its price of the world market. The value of the resources required to produce this output incorporating any external costs or benefits - can then be compared with the net foreign exchange value of the output after subtracting the cost of imported or exportable inputs. When this analysis is carried out for an individual project, output

and input values must be projected over the project life and discounted back to the present to derive an economic NPV and IRR (Little and Mirrlees 1974, UNIDO 1972 and Squire and van der Tak 1975).

The DRC indicator has been used in the past 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 form of efficiency analysis. 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. Put 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.[3]

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

Where a full set of future data are available a DRC analysis is equivalent to the form of project-based cost-benefit analysis noted above.[4] The advantage of the DRC approach is both that it can be used with data for a single year (with an annual capital charge added to operating cost) and that it has an intuitively clear interpretation as a project-exchange rate that can be compared with an estimate of the long-run value of foreign exchange to the economy. 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 ranking activities by the size of their DRC is only strictly correct under restrictive assumptions relating to constant unit cost, constant relative prices and production divisibility – we

[3] 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.

[4] In practice three versions of the DRC indicator may be used: a) a full DRC calculation over the life of an investment where DR and FE are identified each year, each is discounted (at an opportunity cost discount rate) and capital costs are entered in the year in which they arise; b) a short-run DRC for current operating efficiency (omitting the capital cost); c) a single year DRC ratio ('snapshot' of efficiency) including capital cost based on an annualized capital charge applied to replacement cost, which can be interpreted as a long-run efficiency measure.

can be reasonably confident that activities with ratios well above unity (in the formulation DR*SER/FE) will not be activities in which an economy has a current comparative advantage, so that investment to expand these will be *comparative advantage defying* in Lin's terminology. Conversely where the DRC is close to or below unity the reverse will hold and expansion here will be *comparative advantage conforming*.

Although it appears we have a simple and well tried indicator on which to base a strategy, there are several complications with the use of the DRC indicator as guide to industrial policy that are not always fully appreciated. These are both practical – in terms of data availability - and conceptual in relation to resource valuation and to uncertainty.

Data requirements

Application of the DRC analysis to test for the efficiency of production rests on the assumption that domestic manufacturing is competing directly with foreign goods either in the local market as an import substitute or in foreign markets as an export. Where this is the case prices at the border of the country, cif or fob respectively, provide a measure of economic value for the commodity.[5] Similarly imported inputs used in the production of the finished product must be valued at prices at the border and their value deducted from the value of output at border prices to get the net foreign exchange generated by an activity.

Getting accurate border or world prices to use is thus an important empirical part of the analysis. Ideally they should be collected on a product by product basis through a firm survey. This should allow comparable products to be considered and is the first best approach to the analysis. Where possible, price surveys for baskets of comparable goods should be undertaken to allow a comparison between domestic and world prices for internationally traded outputs and inputs. Some information on this may be available from in-country research on purchasing power parity exchange rates. Where firm surveys are not available an alternative is to derive data for DRC calculations from aggregate Census figures which combine data in sub-sectors or branches within manufacturing. .

Of the two sources firm surveys will be considerably more detailed and accurate because specific products, both outputs and inputs, can be identified and reasonably accurate prices established. Surveys also allow firms to be asked directly for data on the replacement cost of their capital assets, which is important for establishing long-run potential in different sub-sectors, [6] Acomplication may be that many firms will be multi-product so overhead costs of capital will be contributing to the production of a range of products and it will be necessary to allocate total capital cost between products probably in proportion to their share in output (either in output value or in output quantity). The survey should also comprise a sample of firms as far as reasonably possible representative of the sub-sector, which will allow a weighted average cost structure to be calculated

[5] In the case of lower quality local production with respect to imports there will need to be a downward adjustment to reflect a quality discount, although as far as possible goods of similar quality need to be compared. Here we use the terms border and world price interchangeably.

[6] Although even surveyed producers sometimes have only vague data on actual replacement cost, particularly where their asset stock is relatively old.

for the sub-sector.With firm level data it is also possible to distinguish between import-competing and exporting firms and to calculate separate DRCs for these categories.

Census data provides only an aggregate picture of a sub-sector (say at the 3 or 4 digit level). Costs from a Census are averages by definition so new or efficient producers cannot be distinguished from older or inefficient ones. In addition it is rarely possible to distinguish between costs for import-competing and export producers. Specific information on outputs and inputs are also rarely available from this source, which makes it difficult to compare domestic and world prices for similar goods. As a rough approximation the import tariff system is sometimes used to proxy the difference between domestic and world prices.[7] This approach involves the need to estimate 'representative tariffs' based on judgement on what is a likely representative output and input for a sub-sector. Thus for clothing, for example, this requires identifying an appropriate tariff on competing clothing imports and another for imported fabric made-up by domestic producers. This is relatively simple where only a relatively small number of tariff bands are used in the country concerned, but is much more difficult to apply in economies where there are still a large number of different bands.[8]

In addition, Census data typically give historic book values for capital assets, which may be a very poor guide to replacement cost, particularly where the capital stock is relatively old. If values cannot be adequately adjusted through the use of price indices or other means then Census data are better suited to estimating short-run rather than long-run DRCs and provide only approximate aggregate estimates.

Table 1 gives an illustration of a DRC analysis of production of a man's cotton shirt. For reasons of confidentiality the numbers are illustrative not actual, but work along these lines has been conducted recently by the authors in sub-Saharan Africa .[9] The approach involved surveying a number of firms producing a comparable output and taking a weighted average of revenue and costs from this firm sample.

In table 1 output and imported fabrics are valued at their cif prices. Domestic resources are given net of indirect taxes. Annual capital costs are derived by applying a capital recovery factor (assuming an asset life of 10 years and a 12% discount rate) to the replacement value of assets. The foreign

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[7] Here DPi is assumed to equal WPi + ti, where for good i , DP and WP refer to domestic and world prices respectively and ti is the import tariff on i ; thus WPi = DPi/(1+ ti).

[8] Census data at the sub-sector (say 3 or 4 digit level) may be used with world prices approximated by domestic prices adjusted for rates of import tariffs on outputs and inputs. However the DRC estimates derived in this way will simply be picking up the effect of import protection rather than underlying resource efficiency. DRCs estimated in this way will be mirror images of effective rates of protection, meaning that only activities with negative protection will be efficient by the DRC indicator. This follows since where there is no shadow pricing of domestic resources or foreign exchange and non-traded inputs are treated as part of value added, the value added at domestic prices would equal domestic resource costs and value added at world prices would equal net foreign exchange. The equivalence condition would be: effective protection (ERP) is

ERP = (VAdp - VAwp)/VAwp or VAdp/VAwp -1, while DRC = VAdp/VAwp, so ERP = DRC-1

[9] The numbers are approximated on the basis of the findings of research carried out in relation to a World Bank competitiveness study in East and Central Africa and do not reflect any actual production operations.

exchange content of electricity, fuel and water and capital cost is estimated based on earlier work and is deducted from the foreign value of output. No shadow pricing is applied to labour or other domestic costs. Values in the table 1 are given in aggregate monetary terms in US$ equivalents converted at the prevailing exchange rate. If this rate is taken as reflecting the long-run value of foreign exchange the DRC is 1.10 (784545/711300.3). If a shadow exchange rate is needed to reflect the long-run value of foreign exchange the value of domestic resources can be reduced (to reflect a depreciation of the local currency) or increased to reflect an appreciation.

Table 1 DRC Illustration: Men's Cotton shirt production

Net foreign exchange effect in US $		**Domestic resources converted into US $**	
CIF price import saving from cotton shirts	801795.0	Domestic materials net of taxes	641318.4
Minus		Packaging net of taxes	10812.7
Direct fabric imports at cif price	69136.0	Labor	92644.7
Electricity (forex component)	482.4	Electricity	723.6
Fuel/water (forex component)	1227.9	Fuel/water	818.6
Annualized Capital cost (forex component)	19648.3	Annualized Capital cost	11613.9
		Professional Services	2881.5
		Repair and Maintenance	2365.7
		Administration	21365.8
Net Foreign Exchange	**711300.3**	**Total Domestic Resources**	**784545.0**

Resource valuation

To be a true measure of comparative advantage the DRC should be based on a valuation of domestic resources at their opportunity cost. In economies with significant market distortions or imperfections it may be necessary to replace prevailing prices for domestic resources with alternative shadow price values,.[10] Estimating the divergence between actual prevailing prices and these concepts of opportunity cost at the national level ('national economic parameters') is typically very approximate and few African economies have up to date estimates. The argument that market liberalisation, as part of earlier Structural Adjustment programmes, has removed the most serious divergences between actual prices and opportunity cost may be true for wages but it is less convincing for the most critical parameter in terms of the DRC indicator - the value of foreign exchange. The introduction of relatively flexible exchange rates has not in most cases guaranteed

[10] For a textbook discussion see Curry and Weiss (2000).

that the market value of foreign exchange has settled at close to its long-run equilibrium real value, given the volatility introduced by the liberalisation and the expansion of capital flows.

The value placed on foreign exchange will not affect the ranking by DRC (as it is only applied to one side of the ratio) but it will determine the cut-off between efficient and inefficient activities. Strictly what is required is an estimate of the long-run real value of foreign currency which may differ from the current market-determined exchange rate at base year prices.[11] For practical purposes it can be interpreted as the long-run equilibrium real exchange rate for the economy viz a viz the main currency in which it trades.[12] . Given the uncertainty attached to future exchange rates the sensitivity of the results to alternative exchange rate values can be tested and 'switching values' estimated; that is the exchange rate necessary for an activity to be competitive.[13] Thus if the key parameter determining the cut-off point for efficiency is inherently uncertain then DRC estimates must be treated as only approximate indicators of comparative advantage.

Dynamic potential and product upgrading

While the DRC ratio is a practical measure of efficiency Chang argues that tools, such as cost benefit analysis and the DRC, derived from neoclassical economics are essentially static and cannot address issues of dynamic long-run potential due to learning and technical change. There is merit in this argument, but also an overstatement. 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 reducing domestic resource cost (lower DR) or improved demand prospects raising the foreign exchange value of certain types of product (higher FE); similarly as noted above the exchange rate (SER) should be a projected long-run value. However these adjustments are uncertain and do not address the type of big structural leap Chang has in mind – partly because DRCs by definition focus on the existing range of products and partly because of the potentially lengthy period of transition to competitiveness and the 'fundamental uncertainty' in Chang's term over whether it will ever be achieved.

[11] Londero (2003) chapter 2 has an extensive discussion of the shadow exchange rate from a project perspective with both a general equilibrium derivation and a discussion of simple operational formulae. His main specification defines the SER as the long-run equilibrium real exchange rate adjusted for the net effect of tariffs and subsidies on trade that raises domestic prices above world levels. In recent years the incidence of tariffs, taxes and subsidies on trade has declined significantly for most African economies, so in practice the SER for use in DRC analysis can be based on an estimate of the long equilibrium real exchange rate.

[12] The analysis is complicated by the instability of relative real exchange rates. In the face of relative exchange rate movements application of the DRC analysis becomes more complicated because it is necessary to distinguish between sources of competing imports or to specify export markets for goods. Thus where in the long-run it is anticipated that a currency (like the Birr) will depreciate relative to that of a trading competitor (like China) this means that in the DRC analysis for Ethiopia if China is the key competitor, goods from China will become more expensive and the DRC ratio for import competing goods made in Ethiopia will fall.

[13] There are several techniques that have been used to estimate long-run equilibrium real exchange rates. The best known is to apply a regression model based on economic fundamentals as set out in Edwards (1991). Hobdari (1988) applies this approach to Tanzania finding a projected real equilibrium appreciation up to 2012 of between 2% and 20% relative to the baseline, with the key difference the likely future value of capital inflows.

As noted major shifts to new products or processes have a role to play in any successful industrial transformation, but if they take a very long time to come to fruition they may not be very sensible ways for poor countries to invest before preconditions become more promising. This can be seen as a timing issue with premature investment by poor countries simply locking up scarce resources that could be used more productively elsewhere. However the point that DRC and other standard cost-benefit indicators are essentially static is well taken

A more dynamic perspective can be given to aggregate DRC results by reporting complementary data on simple indicators like output or productivity growth, at the same sub-sector level. Trends in output or productivity can be used as a proxy for dynamic learning effects. Some activities can commence as either import competing or internationally non-traded domestic production, protected by either tariff and non-tariff barriers in the case of import substitutes or relatively high internal transport and trade costs in the case of non-traded goods. However through the experience of growth within the domestic market they may reach internationally competitive cost and quality levels. Although this pattern has been observed in parts of Asia and Latin America it remains relatively uncommon in sub-Saharan Africa. None the less dynamism within the domestic market as evidenced by relatively rapid growth in production and labour productivity, for example, can be an indication of potential efficiency in the longer term for particular sub-sectors. A sub-sector with a DRC ratio above unity currently may be inefficient overall, but if there is evidence of domestic dynamism this provides a justification for looking more closely at investment possibilities within parts of the sub-sector.[14]

Recent literature on the composition of trade at the product level has added to the toolkit of techniques available to give a more dynamic dimension to industrial policy by building 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 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. For this reason the desirability of poor countries upgrading their export structures into higher value, technologically more sophisticated products, is shared by Lin and Chang.

The analysis of trade structure was advanced by path-breaking work by Lall which created a taxonomy of products based on a combination of earlier data on their R and D intensity (that is R and D costs as a proportion of sales value) and personal knowledge of industrial processes, which has been used widely to classify export structure (Lall 2000). This groups exports into nine technology categories by this R and D measure. The vast of majority of manufactured exports from

[14] Another simple indicator that can be used in conjunction with sub-sector DRCs is the degree to which production in the sub-sector utilises domestically-sourced raw materials. At low levels of industrialization it is well established that natural-resource based manufactures play a relatively important role in both production and export structure. The share of local raw materials in total raw materials therefore may be another useful structural indicator of potential competitiveness. The expectation is that the availability of natural resources provides the potential for resource-based manufacturing to develop competitively, since where natural resources are abundant their opportunity costs tend to be relatively low.

sub-Saharan Africa are in the low technology labor-intensive and natural resource-based categories, with little in the medium and high technology categories.[15]

A limitation of this analysis is that it does not allow for a distinction between production processes and products, since even relatively technologically advanced goods can still have simple labour-intensive stages in their production. In response to this Lall et al (2006) attempted to differentiate between products at the disaggregate level and to create an index (calculated at the 4 digit level) to capture their sophistication. This sophistication index (SI) was calculated for 766 individual product categories and gives each a unique score by taking a weighted average of the incomes of all exporters of the good concerned with the weights given by their share in total world trade in the good.

Lall et al (2006) use SI in various ways including ranking between countries at the aggregate level (where SI is aggregated over all products in total trade), for comparing technology classifications and for establishing patterns within broad categories like textiles and electronics. 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.

Independently Hausmann et al (2007) applied the same approach, but using a different weighting system.[16] Here PROD represents the productivity level of a particular good (calculated at the 6 digit level) but unlike the SI the weights used are the revealed comparative advantage of each country in the good concerned. Thus

$$PRODi = \sum ((X_{ik} / X_{tk})/(X_{iw}/X_{tw}))*Y_k$$

where *PRODi* is the income level for good *i*, X_{ik} is exports of *i* from country *k*, X_{iw} is world exports of *i*, Y_k is income per capita in *k* and summation is for all *k*. In addition X_{tk} is total exports of country *k* and X_{tw} is total world exports.

Rearranging:

$$PRODi = \sum ((X_{ik} / X_{iw})* (X_{tw} / X_{tk}))* Y_k$$

The weights that result from the expression in brackets are then normalized to sum to unity. The PRODY weighting system has the effect, which is intentional, of giving a higher weight to goods exported from small countries. Hence in this view even if the US exports more shirts say than

[15] For example, for Ethiopia in 2009 manufactured exports were dominated by leather and footwear (57%), food and beverages (25%) and textiles (12%), which are either natural resource-based or simple labour-intensive goods (CSA 2010).

[16] Weiss (2010) contrasts the two approaches.

Bangladesh if shirts are a product in which Bangladesh has specialized, but the US has not, they should be seen as a low productivity product.

Hausmann et al (2007) apply their PROD indicator to total trade of individual countries to calculate an overall measure akin to the sophistication index. What they term the 'productivity level of an economy's export basket' EXPY is a weighted average of PROD for all commodities with the weights given by their share in a country's trade. Their focus is on long term trends and they relate EXPY to growth performance over time and contrast actual EXPY with that expected for an economy's income level. African countries have the lowest EXPY score in their sample so for 2001 the values for Niger and Ethiopia are $2,398 and $2,715 respectively (in 2000 US$) as compared with the highest score in the sample of $24,552 for Luxembourg. When they incorporate their productivity of exports measure in a growth analysis they find that controlling for a range of other factors countries with a low productivity export basket grow more slowly. Further testing of this result for other samples and time periods is necessary, but it provides confirmation that it is not just openness to trade that is critical for growth prospects, but in addition the composition of that trade may be just as important.

The implication of this analysis for industrial policy is that it is important to look to ways of raising the technological sophistication and productivity levels of production and exports. There will be many new products which a poor country cannot realistically aspire to produce, so the short-term DRC for these goods will be unacceptably high. The difficulty of moving into a new product is linked directly with the degree of specificity of the assets, capabilities and operating environment (such as the physical assets, labour skills, technological knowledge and infrastructure needs) associated with the products in which a country is currently specialised. Where these attributes are either very general – that is relevant for the production of a wide range of goods – or production conditions are similar in the new products, the transition to a new specialisation may be relatively easy. For any economy there will be some 'new goods', in the sense that it is not currently specialised in these, which are relatively easy to move into. These are 'nearby' products where economic distance is low, due to the similarity of the assets and capabilities they require relative to those needed by the economy's current pattern of specialisation.[17]

An important insight of the PRODY and SI indicators are that they reveal that even within what are generally low productivity or unsophisticated groups (like textiles or clothing for example) there will some product lines with higher than average PRODY or SI scores whose production may be relatively easy for poor countries to move into. This shift into 'nearby' products is a relatively easy way of product upgrading by raising the overall EXPY score for a country and is something to be supported by policy. For example using 2006 US $ table 2 shows that within the HS category 84 for Textiles and Clothing the PRODY score ranges from US$5316 (HS 8464 Undergarments) to US$$11,066 (HS 8482 Other apparel). The intuitive meaning of the difference in these dollar values is the resources employed in HS 8464 have a productivity that is less than half the productivity of the resources employed in HS 8482. Hence there is scope for upgrading production in similar product lines to those in which most poor economies are already operating. The DRC analysis can highlight current comparative advantage at the aggregate level (where DRC is close to or below 1.0) and the PRODY or

[17] The concept of economic distance is developed formally by Hausmann and Klinger (2006) who calculate the probability that countries will have a comparative advantage in pairs of products. The higher the probability the lower is the distance between the two products. Countries are advised to balance the desirability of moving to high PRODY goods against the difficulty of moving into distant products.

SI indicator can suggest nearby higher productivity goods that offer potential for upgrading within the broad product category

This type of analysis needs to be supplemented by individual market and feasibility studies, but it does give an indication of how a strategy of building on existing comparative advantage might be carried forward.

Table 2 PRODY estimates for Textiles and Clothing (US$ 2006 prices)

HS category	Product	PRODY
8421	Male outerwear: textile fabrics	8617
8422	Male outerwear: textile fabrics	8245
8423	Male outerwear: textile fabrics	8410
8424	Male outerwear: textile fabrics	9453
8429	Male outerwear: textile fabrics	10699
8431	Female outerwear: textile fabrics	9853
8432	Female outerwear: textile fabrics	6600
8433	Female outerwear: textile fabrics	8205
8434	Female outerwear: textile fabrics	8087
8435	Female outerwear: textile fabrics	8389
8439	Female outerwear: textile fabrics	10,549
8441	Under-garments: textile fabrics	7947
8442	Under-garments: textile fabrics	7956
8443	Under-garments: textile fabrics	6908
8451	Outerwear knitted	15,241
8452	Outerwear knitted	10,657
8459	Outerwear knitted	11,1189
8462	Under-garments	10,266
8463	Under-garments	9947
8464	Under-garments	5316
8465	Corsets, garters	12,035
8471	Clothing accessories: textile fabrics	7907

8472	Clothing accessories: knitted	11,180
8481	Apparel: leather	8604
8482	Apparel: other	11,066
8483	Fur clothing	17,808

Source: UNIDO (2011) table 13

Industrial Strategy, risk-taking and large leaps

Having examined some techniques for identifying promising industry subsectors, we now turn briefly to ask who are the actors – for example what is the role of Government and the private sector in exploiting the identification of subsectors? The capacity of poorer economies to develop a diverse manufacturing sector is limited by factors such as skills, technology and size of the domestic market. There is a multiplicity of new products which investors may choose to produce, but as Chang points out in the example he cites of Nokia, to innovate it may be necessary to cross-subsidise a loss-making new product with the profits from well established products. We also know that cross-subsidisation of exports by the profits from sales in the protected domestic market was important in the relatively early stages of the Korean export boom (Westphal 1981). These examples reflect long-term private sector strategies that were clearly rational ex post, although ex ante they must have appeared high risk. Their relevance for contemporary industrial strategy in sub-Saharan Africa appears limited however, given the absence of an indigenous private sector with the resources to fund long-term loss-leading activities.

This raises the question of how far public funds can or should provide the cross-subsidies necessary to support innovation. Chang has argued consistently that historically no country has succeeded in industrialisation without some form of state support for industry and that the restrictions on such supportive measures posed by WTO rules or the lack of technical capacity within national bureaucracies have been exaggerated (Chang 2009). How far this view is relevant in the African case remains highly contentious, but there is a well established case in principle – alluded to by Lin- to justify subsidies to innovators as their initiatives provide market information to other follower investors for which they are not compensated.[18] This case is neutral as between sub-sectors, types of activity and to the question of whether these new goods or processes should be labour, resource or capital –intensive. It will up to the investors to choose the processes that they think make sense in terms of market potential.

Such subsidies can be provided in various ways but the most effective approach (which is compatible with neoclassical economic theory in terms of minimising by-product distortions) is likely to be the provision of investment funding to support activities new to the economy. There are various instruments that can address this need. They may include project loans through a Development Bank established to support innovation, appropriate loan guarantee schemes to private commercial banks, or equity funding in a Venture Capital institution. However the latter allows a genuine sharing of risk and provides governments with a ready exit strategy, but has limited

[18] Rodrik (2007) makes this one of the key recommendations in his discussion of industrial policy.

relevance where the stock market is not well developed. The Development Banking model would require loans at interest rates that cover the cost of capital to the government, but which do not reflect the risk-level of the innovator firms, so the difference is the subsidy to innovation. Thus the Development Bank shares in the downside risk, but does not share in the benefits if the innovation is commercially successful. This does not matter where a small number of schemes are highly successful, since the whole economy will benefit and the government will gain the tax revenue from profits and incomes directly and indirectly linked with the innovative activities. The loan guarantee approach involves a similar sharing in the downside risk, in return for a fee which can be subject if appropriate to some level of launch subsidy.

In the case of development banks however there are limits to how far this lending model can be pushed since funding high risk innovative projects in difficult economic environments can easily run into high levels of non-performing loans, which threaten their viability. Further despite Chang's point about fundamental uncertainty in innovative areas bank or venture finance would need to be supported by a form of business plan, which may or may not involve projections in formal discounted cash flow statements.. This banking model is supported by theory and has a role to play in supporting innovation and risk taking, but given the pressures on government budgets in low income economies realistically it is difficult to see it being able to intermediate large volumes of funds.

Conclusions

The starting point for this paper is that in low income economies government has a significant role in supporting industry, which is a significant departure from thinking associated with the era of economic liberalization. Nonetheless any such support needs to be informed by an assessment of where the potential for successful new investment lies since governments will rarely have the resources to provide significant broad-based support. Thus the broad visions for the industrial sector set out in the Chang-Lin debate usefully can be complemented by a discussion of the data and indicators needed to throw light on what are priority areas for support.

A full treatment of the problem of identifying promising subsectors requires detailed feasibility and market studies on new activities, but an interim screening approach starts from an assessment of existing comparative advantage utilising the Domestic Resource Cost indicator, which has been part of the toolkit of applied development economics for nearly 50 years. This type of screening exercise is inevitably aggregate and in practice even in low income economies there are thousands of new products that could potentially be produced. It is clearly not the role of industrial policy to prescribe what these should be. The role of screening is to get an overview of potential areas of efficiency and to offer support to investment in areas with potential.

There are both practical and conceptual complications involved in using the DRC ratio but when combined with more dynamic indicators and an analysis of trade structure, as suggested here, it provides a potentially useful guide for poor countries wishing to identify priority areas for industrial support. Information on growth trends of output or productivity indicates the potential for learning even in the presence of currently relatively high DRCs. By adding these indicators priorities can be assessed by a combination of current efficiency based on the DRC and future potential.

In addition recent work on the composition of trade has allowed a differentiation between disaggregate product categories by creating unique product scores based on the average per capita incomes of the countries which specialise in these goods. On the grounds that higher value goods with higher scores have greater demand prospects, higher profit margins and potential for quality improvements there is a case for using these product scores as a means of signalling the scope for upgrading within a broad product category. Thus they offer a dynamic dimension to the DRC analysis by indicating of where within a category with an existing comparative advantage it may be justified to look to produce new goods.

For activities totally new to an economy there may bea case for modest financial support to innovators through either bank lending or Venture Capital Funds. Such support would reduce the uncertainty for investors of technological leaps and offers an alternative to the more gradualist path identified through DRC ratios or similar indicators and would allow investors 'animal spirits' rather than precise cost-benefit calculations to drive decision-taking.

There are of course limits to what industrial policy can achieve in any economy. The paradox remains that where in low income economies, such as most of sub-Saharan Africa it is most needed, due to limitations of financial markets and the weakness of the local private sector, it is most difficult to implement. This paper hopefully has put forward some practical suggestions about implementing the vision of industrial transformation that underlies the Chang-Lin debate.

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