

'Modern Capitalism' in the 1970s and 1980s

by

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Abstract

John Cornwall built his analysis of Modern Capitalism on a combination of two strands of thought; the Schumpeter-Svennialson view of capitalist development as a process of qualitative change driven by innovation and diffusion of technology, and the Kaldorian idea of static and dynamic economies of scale in manufacturing as the driving force behind economic progress in the industrialized world. Combining these (and other) insights into a coherent perspective on modern economic growth was an important achievement in itself. He also provided convincing evidence from a group of industrialized countries in the fifties and sixties that supported his interpretation of the events. What we have done in this paper is to update and extend his empirical analysis using a larger sample of countries and more recent data. We have found that the Schumpeter-Svennialson perspective of growth as a process of qualitative (and structural) change, and the emphasis on the importance of skills and flexibility, has a lot to commend it. On the second set of ideas the evidence is more ambiguous. At least for many of the technologically and economically most advanced countries, manufacturing does not seem to be the 'engine of growth' assumed by Kaldor and Cornwall.

1. Introduction

The last decade has witnessed important changes in how economic growth is conceived by the economic profession. The traditional neoclassical model (Solow 1956), based on the ideas of perfect competition, decreasing returns and exogenous technology (a global public good), has had to give way to more realistic approaches emphasizing among other things innovation (through R&D investments or learning in private firms), scale economics and market power.¹ This change of perspective was clearly anticipated by John Cornwall in his path-breaking study *Modern Capitalism* (1977). Here he suggests a model of economic growth in which technological progress is endogenized, i.e., an “endogenous growth model” to use a more recent term. Manufacturing, Cornwall argues, plays an important role in this context, because it is the locus of technological progress, whether in the form of learning by doing (scale economics) or as the result of search activities by entrepreneurs. Hence his main focus is on what shapes growth in manufacturing (since this is considered to be the main source of overall growth).

A central issue in the recent discussions on economic growth is the so-called “convergence-controversy”. Do poor countries catch up with the rich ones and if so, why? Under the standard assumptions,² the traditional neoclassical model predicts that due to decreasing returns to capital accumulation, convergence in GDP per capita will more or less automatically occur.³ This was - as might be expected - not Cornwall’s position. He argued that although the existence of technology-gaps between rich and poor countries does imply a potential for technological catch-up through imitation, the realization of this potential requires a lot of extra effort (and in particular, investment). Hence, according to Cornwall’s view, convergence is conditional on investment and other necessary supporting factors. He was probably the first to present empirical tests for what since has been dubbed “conditional convergence”, and to discuss the implications of this notion for long run differences in growth between countries.

¹ For overviews see Verspagen (1992) and Fagerberg (1994).

² These include among other things a common technology, equally available to all countries (a global public good), identical saving-rates (or more generally that the incentives to save are the same) and a identical rates of labor force growth, see Fagerberg (1994) for an extended discussion.

³ If saving behavior and labor force growth differ across countries, countries will still converge towards the same *rate of growth* of GDP per capita (given by exogenous technological progress), but the *levels* of GDP per capita in long-run equilibrium will differ. Hence, only countries that share the same characteristics (in terms of savings behavior and labor force growth) will converge towards the same level of GDP per capita. This is often called “conditional convergence” (Barro and Sala-i-Martin, 1995)

As Cornwall himself was the first to recognize, his theoretical perspective was richer than his modeling efforts or subsequent empirical work. For instance, he pointed out that the prospects for growth were not the same across all manufacturing industries and that, indeed, some of them might be more important than others in fostering technological progress and, hence, growth. However, in his model and empirical tests he focused on manufacturing as a whole. His empirical work, mainly based on data for the fifties and sixties, gave some support to the idea of manufacturing as an “engine of growth”, as well as to his emphasis on investment-embodied catch-up as an important source of growth in manufacturing. In this paper we return to these and related questions for a larger group of countries and a more recent time period. We ask: is there any evidence that manufacturing is an “engine of growth” in this later period, and are all manufacturing industries equally conducive to growth? What does this more recent evidence have to say about the impact on growth of investment in physical capital compared to the impact of other supporting factors such as, for instance, education and R&D? Finally we raise the issue of what all this tells us about the working of contemporary “modern capitalism” as compared to that of the fifties and sixties.

2. Manufacturing - an 'engine of growth' ?

One of the most crucial hypotheses in “Modern Capitalism” is that of the manufacturing sector as the engine of economy wide growth. Cornwall points to two main arguments for this.

First, the manufacturing sector displays dynamic economies of scale through so-called “learning by doing” (Young, 1928, Kaldor, 1966, 1967): When production expands, the scope for learning and productivity increases becomes larger. Hence, the rate of growth of productivity in manufacturing will depend positively on the rate of growth of output in manufacturing (the Kaldor-Verdoorn law⁴).

The second line of argument concerns the special role of the manufacturing sector in enhancing productivity growth through its linkages with the non-manufacturing sectors. Cornwall argues that the manufacturing sector is characterized by strong backward linkages, i.e., increased final demand for manufacturing output will induce

⁴ There is an extensive literature on this topic, both theoretical and empirical, which it is beyond the scope of this paper to summarize (see, e.g., McCombie and Thirlwall, 1994).

increased demand in many sectors ‘further down the line’.⁵ In other words, increased output in manufacturing, due to increased final demand, does not only lead to increased productivity in the manufacturing sector (the Kaldor-Verdoorn law), but also to increased output and, perhaps, productivity in the sectors further down the line. In addition to these backward linkages, Cornwall emphasizes that the manufacturing sector also has many forward linkages, through its role as a supplier of capital goods (and the new technologies that these goods embody). In fact, he considers capital goods from the manufacturing sector to be the main carriers of new technology (Cornwall 1977, p. 135). Moreover, although “learning by doing” may be an important source of productivity growth in non-manufacturing industries as well, it is argued that the realization of this 'learning potential' will in many cases require capital goods supplied by the manufacturing sector.

Cornwall's model of economic growth can be summarized in two equations as follows (ibid., p. 139):

$$\hat{Q} = c_1 + a_1 \hat{Q}_m \quad (1)$$

$$\hat{Q}_m = c_2 + a_2 \hat{Q} + dq_r + e(I/Q)_m \quad (2)$$

In these equations, Q is output, q_r is GDP per capita relative to the technology leader (the U.S.), I/Q is investment as a fraction of output, c , a , b , d and e are parameters and the subscript m indicates the manufacturing sector. Equation (1) states that manufacturing is the engine of growth, hence the parameter a_1 is expected to be positive, and larger than the share of manufacturing in GDP. Equation (2) introduces a feedback from overall demand growth on manufacturing production, hence a_2 is expected to be positive. In addition it allows for catching up by industrial latecomers (hence d is expected to be negative). The inclusion of the investment share (e positive) reflects Cornwall’s emphasis on investment as a necessary supporting factor for successful catch-up.

⁵ An empirical approach to the study of such linkages is the so-called triangulation of input-output matrices (Cornwall 1977, pp. 130-135). This procedure takes an input-output table and rearranges the order of the sectors (rows and columns) of the table such that (in the ‘ideal’ case) a sector only supplies to sectors listed above it, and only purchase from sectors listed below it. Hence, sectors ranked at the top tend to purchase large quantities from other sectors (further below) and supply mostly to final demand, while sectors ranked at the bottom tend to supply mostly to other sectors (instead of final demand), only being dependent on a limited number of other sectors for their inputs. Cornwall argues that work based on this methodology show that manufacturing is a sector with strong backward linkages: it supplies a relatively large part of its output to final demand, and purchases large quantities of inputs from other sectors.

Cornwall does not estimate equation (1), but refers to OLS estimates by Kaldor (1966), Cripps and Tarling (1973) and the UN (1970). Based on data for developed market economies in the fifties and sixties, these studies estimate a_1 to be about 0.6, more than twice the share of manufacturing in GDP. Hence, the evidence from these studies seems to support the hypothesis of manufacturing as an engine of growth. However, in Cornwall's model, both GDP growth and growth of manufacturing output are endogenous variables, and in that case equation (1) should have been estimated by a method other than OLS. Indeed, the OLS estimate of 0.6 may be seriously biased.

Looking at the model in equations (1) and (2) from a simultaneous equation perspective, one must conclude that the second equation is not identified. It does not satisfy the order condition, which says that the equation must exclude at least $N-1$ exogenous variables, where N is the number of equations in the model (in this case 2). Hence, it cannot be estimated by any estimation technique.⁶ The first equation, however, is over-identified, and may be estimated by a single equation technique that takes the simultaneous equation bias into account, such as for, instance, the instrumental variables/two-stage least squares method (2SLS).

The analysis here will proceed by using such a procedure to estimate equation (1) for a large sample of countries. The sample includes 67 countries: 19 developed countries (including Japan), 6 countries from East Asia and the Pacific (excluding Japan), 18 countries in Latin America and the Caribbean, 17 sub-Saharan African countries, and 7 other countries (among which 2 oil exporters). We thus have a rather heterogeneous set of countries. The dependent variable is the growth rate of GDP in real terms over 1973 - 1989 (taken from the Penn World Tables⁷, version 5.5). The independent variable is the growth rate of manufacturing value added (in fixed prices) for the same period, taken from World Development Indicators (World Bank).⁸ However, for some of the developed countries, no data on manufacturing growth were available in World Development Indicators. For these countries data were taken from

⁶ Cornwall solved the identification problem by estimating only the reduced form of the model, which is adequate for testing the overall explanatory power of the model. However, when one wants to test the role of manufacturing as an engine of growth separately from the other elements of the theory, this approach is not sufficient, because in general one can not calculate a parameter estimate for a_1 from the reduced form.

⁷ We use the RGDP variable, i.e., real GDP in international prices using a Laspeyeres price index.

⁸ Version on CD-ROM, 1997.

the STAN database (OECD). Both growth rates are average annual compound growth rates over the period specified.

To estimate the equation with the chosen (instrumental variable) technique, we need a number of exogenous variables (or instruments). The chosen variables are in most cases well known from previous econometric work in this area: *Initial GDP per capita* (in log-form, taken from the Penn World Tables), *investments in physical capital* as a share of GDP (mean value over 1973 - 1989, also from the Penn World Tables),⁹ *education* (enrollment of the relevant age group in secondary education, from the World Development Indicators) and *inflation* (yearly average increase in the CPI 1973-1989, taken from the World Development Indicators). Finally, and less conventionally, we include a variable for *technology investment*¹⁰ as proxied by patents (taken out in the US over the 1975 - 1985 period per head of the population of the country in question, as recorded by the U.S. Patent and Trademark Office).¹¹

A well-known problem in estimations using cross-country data sets is the possible bias from inclusion of outliers, i.e., countries with patterns that deviate from the other countries in the sample. If such countries are included, we may be lead to conclusions that in fact are not valid for the majority of the countries in our sample. We therefore adopt a procedure which identifies and excludes such outliers.¹²

⁹ Due to data availability we use economy wide investment as a share of GDP instead of investment in manufacturing as a share of manufacturing output.

¹⁰ See Fagerberg (1987,1988) for discussion of different indicators of technology gaps and technology investment, and an analysis of the impact of technology gaps and technology investment on growth.

¹¹ As with most of the literature in this area we use patents taken out in the U.S., because this provides us with the more consistent and economically relevant data than data drawn from a variety of different national sources.

¹² This method identifies outliers by calculating the so-called hat-matrix, $X(X^T X)^{-1} X^T$, where X is the matrix of independent variables. Observations with entries larger than $2*k/n$, where k is the number of independent variables, and n the number of observations in the regression, were excluded. See Belsley *et al.* (1980).

Table 1. Estimation results for Cornwall's 'manufacturing as an engine of growth' equation, OLS and 2SLS, various country samples, 1973 - 1990

Eq. num	Est. Method	Sample (n)	Manufacturing Growth	constant	adj. R ²
1	OLS	Market economies (17)	0.104 (0.70)	0.024 (11.55***)	0.00
2	2SLS	Market economies (14)	0.083 (0.21)	0.024 (6.01***)	0.00
3	OLS	East Asia, Latin America (22)	0.721 (12.36***)	0.008 (3.20***)	0.88
4	2SLS	East Asia, Latin America (17)	0.829 (8.45***)	0.006 (1.82*)	0.83
5	OLS	Other countries (22)	0.371 (4.47***)	0.014 (3.00***)	0.47
6	2SLS	Other countries (15)	0.827 (2.86***)	-0.005 (0.35)	0.40
7	OLS	all countries, no dummies (61)	0.514 (10.54***)	0.014 (7.49***)	0.65
8	2SLS	all countries, no dummies (49)	0.488 (5.98***)	0.016 (5.62***)	0.49
9	OLS	all countries, dummies (61)	0.473 (8.45***)	continent dummies	0.69
10	2SLS	all countries, dummies (45)	0.719 (4.54***)	continent dummies	0.57

Values between brackets are absolute *t*-statistics. One, two and three stars denote significance at the 10%, 5% and 1% level, respectively, in a 2-tailed *t*-test.

The results of the instrumental variable/2SLS estimations are given in Table 1. The results for OLS are also provided for reference.¹³ Estimates are reported for the three country groupings and for the sample as a whole. The three country groupings are the developed *market economies*, comparable to Cornwall's sample (though larger), the

¹³ Note that the 2SLS estimates generally have fewer observations, due to missing values for some of the instrumental variables.

industrializing countries of *East Asia and Latin-America* and a group of *other countries* (low income), most of which are from Sub-Saharan Africa.

In general, the results obtained by the instrumental variable/2SLS method are not very different from those obtained by OLS.¹⁴ Hence, simultaneity bias does not seem to be an important problem here. This might indicate that the feedback from overall growth on manufacturing output is not so important after all, i.e., that manufacturing growth is important for overall growth, but not the other way around.

For the sample as a whole there appears to be a significant positive relationship between manufacturing growth and GDP growth, with coefficient estimates close to the 0.6. estimate cited by Cornwall, and significantly larger than the share of manufacturing in GDP at the 5% level. This might be interpreted as supporting the idea of manufacturing as an engine of growth. But from inspecting the estimates for the three subsamples it becomes clear that this result is very much dependent on the inclusion of countries other than the developed market economies. For the East Asia - Latin America group as well as the 'other countries', we find a highly significant and positive relationship between the two variables. However, for the developed countries the evidence is less clear. Initially, a significant and positive relationship was found for the developed market economies, but this result turned out to depend heavily on the inclusion of three outliers (Italy, Japan and Finland). When these countries were excluded, we found no evidence of a relationship between the growth of GDP and manufacturing growth.¹⁵ Thus, although manufacturing may explain some of the difference in growth between the three outlier countries and the remaining developed countries in the sample, it clearly does not explain the differences in growth performance among the latter.

¹⁴ The 2SLS estimates are higher than the ones obtained by OLS in three cases, and in two cases is it the other way around. However, in no case are the 2SLS estimates significantly different from those obtained by OLS at a 5 % level of significance.

¹⁵ It is possible that the engine of growth equations as estimated here suffer from a bias due to omitted variables. Manufacturing may indeed be an important factor explaining growth in other sectors, but there may be other factors explaining economy wide growth, or growth in non-manufacturing sectors, which should have been taken into account when estimating the relationship. For instance, one might argue (e.g., Cornwall, 1977, p. 133) that some of the factors explaining growth in manufacturing also explain economy wide growth, i.e., one may include some of the instrumental variables in our 2SLS procedure as exogenous variables in equation (1). We tested various equations from this perspective, but always found that the results reported above are robust to the inclusion of other possible explanatory factors. These results are available from the authors on request.

In summary, the results in this section indicate that for most developed market economies, manufacturing no longer plays the important role it was found to play in the 1950s and 1960s. This is in sharp contradiction to Cornwall's theory in 'Modern Capitalism', which posits that such a relationship should exist, particularly for developed countries.¹⁶ However, Cornwall's argument on the relevance of manufacturing seems to hold good for a number of fast-growing 'newly industrializing countries' (NICs) as well as for some developing countries.

3. Growth and transformation

In "Modern Capitalism" Cornwall depicts growth as a process of qualitative change (transformation), with large and persistent differences in factor-returns between dynamic and less dynamic activities. Hence, he points out, the economic success - or lack of such - of a country will to a large extent depend on its "flexibility", i.e., its ability to devote (transfer) resources to new and promising activities. As discussed in the previous section he attaches a lot of importance to the performance in manufacturing which he saw as the center of technological progress in the economy. Within manufacturing, he especially emphasizes the importance of the chemical, electronic and machine tools industries, both as conduits of technological progress and suppliers of new and improved products and processes to the entire economy (ibid., p. 135). These three industries, he notes, totally dominate "the technology sector" of the economy. This raises the question of the relationship between the industries that make up what he terms "the technology sector" and other manufacturing activities. To put it bluntly: Are all parts of manufacturing equally conducive to growth?

As mentioned in the introduction, Cornwall also emphasizes the potential for catch-up in productivity through imitation for countries behind the world technology frontier. However, he is at pains to stress that this catch-up is far from a free ride. Among the supporting factors, he especially emphasizes the supply of skills (workers and entrepreneurs), materials and capital equipment (ibid., p.111). In his modeling efforts and subsequent empirical work, however, he confines attention to investment as a share of value added which, together with the potential for imitation (proxied by GDP per

¹⁶ More recently, Cornwall has argued that above a certain threshold level of development, the importance of manufacturing for growth should be expected to decrease, since the rise in income per capita encourages a shift in demand from manufacturing products towards services (see Cornwall and

capita), are assumed to determine the growth of manufacturing output. Note that this relationship, can be seen as a reduced form of the model discussed in the previous section (*ibid.*, p. 139)

In this section we will return to the relationship between growth, catch-up and structural change discussed by Cornwall, taking into account the possible impact on growth of structural changes within manufacturing, as well as that of other, "conditioning" factors, to use a more recent term. To do so, we need data that are less aggregated than those used earlier. UNIDO publishes data on manufacturing value added and employment for a large number of countries at different level of development, and it seems natural to try to use these data here. The data cover both three and four digit ISIC, but the coverage of the latter is too restricted in terms of countries and time span for our purposes. Since the relationship between productivity growth and structural change is of a long-term nature, a sufficiently long time span is necessary. After examining the data, the years 1973 and 1990 were chosen, since this allows more countries to be included than any other combination of years spanning roughly two decades. The desire to include other conditioning factors, such as investments in education, physical capital and R&D, also limits the number of countries that can be included in the analysis. Furthermore, the analysis is confined to market economies (broadly defined). The final data set consists of forty countries from all parts of the world; Africa, America, Asia, Europe and Oceania. With the exception of the former, the data set appears quite representative (due to data problems only three African countries could be included).

The dependent variable in our analysis is the growth rate of labor productivity (not production). Labor productivity is defined as value added divided by employment measured at current prices and converted to US dollars by the exchange rate (as supplied by UNIDO). The entries for 1990 are deflated to constant 1973 dollars by dividing by an index reflecting the growth in US producer prices over the period. Hence, productivity growth as defined here reflects changes in the quantities of the products that a country produces, changes in the relative prices of these products and changes in the exchange rate. The use of current exchange rates introduces a possible bias, to the extent that the exchange rates of any country in 1973 and/or 1990 were seriously over- or undervalued. However, one should expect any such effect, although important from a short run perspective, to be small over the longer run.

Cornwall, 1994a,b). While this may be true, it does not explain the finding of no correlation at all between growth of GDP and growth of manufacturing for a cross-section of developed countries.

The hypothesis that we wish to test is that it matters for a country whether it puts its resources into expanding areas or chooses to concentrate its efforts on activities where prospects for growth are bleak. This hypothesis - obvious as it may seem - is not trivial since, as noted by Cornwall, it is often disputed by neoclassical economists. We define growth industries as the upper third of the distribution of the industries in our sample, ranked in terms of their productivity growth rates. The top ranking growth industry during this period was electrical machinery (including electronics, arguably the technologically most progressive industry in recent decades). We therefore divide the growth industries into two groups, electrical machinery (ISIC 383) and high-growth (ISIC 351, 352, 341, 385, 382, 342, 313) and, for each country, calculate the change in the share of the manufacturing labor force that goes to these two groups. The assumption, then, is that if structural change does not matter for growth, then the changes in these shares should not be correlated with growth, at least not significantly so.

However, we have to take into account that structural change within the manufacturing sector is not the only factor that affects the growth of manufacturing productivity. If there are other omitted variables, and these tend to be correlated with our measures of structural change, we may get a biased estimate. To control for this, we include a number of variables that relate to the country as a whole and which may be thought of as characteristics of "the national system of innovation", or the pool of factors available at the national level for manufacturing (and other sectors of the economy). Among the variables included are those emphasized by Cornwall: initial productivity (in manufacturing) and the ratio of investment to GDP. In addition, we include some of the variables fashioned in recent econometric work on growth such as primary and secondary education (share of age group enrolled) and export orientation/openness (exports as a share of GDP). In contrast to most analyses in this area, we also control for the effort devoted to innovation (R&D as a share of GDP), since this may be a source of growth in its own right. All of these variables are measured mid-period (1980 or closest available year).¹⁷

Table 2 contains estimation results for the growth of manufacturing productivity as a function of the increase in the employment shares of *high-growth* and *electrical machinery* industries and the other variables mentioned above. As in the previous

¹⁷ The industry data (productivity and employment shares) are from UNIDO, investment and exports as shares of GDP and education from World Development Report (World Bank, various editions), and

section, we adopt a procedure that identifies and excludes outliers. This reduces the number of countries by between two and five depending on the specification.

TABLE 2. STRUCTURAL CHANGE AND PRODUCTIVITY GROWTH

	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8
HIGH GROWTH	0.29 (1.73) *	0.11 (0.62)	0.15 (0.79)	0.20 (1.17)	0.08 (0.59)	0.17 (1.07)	0.07 (0.34)	0.19 (1.59)
ELECTRICAL MACHINERY	0.47 (1.94) *	0.57 (2.98) ***	0.52 (2.91) ** *	0.46 (2.26) **	0.41 (2.38) **	0.49 (2.79) ***	0.57 (3.01) ***	0.48 (2.69) ***
PRIMARY EDUCATION		3.51 (0.96)	3.11 (0.79)		2.85 (0.82)	4.21 (1.34)	5.67 (1.31)	6.79 (1.34)
SECONDARY EDUCATION		2.36 (1.99) *	2.10 (1.50)		1.07 (0.87)	2.42 (1.91) *		
INVESTMENT		-1.33 (0.69)						
INITIAL PRODUCTIVITY		-0.58 (0.86)	-0.52 (0.73)		-0.42 (0.58)	-0.54 (0.69)	-0.60 (0.67)	-0.76 (0.98)
EXPORT-SHARE						-0.46 (0.62)		
R & D							1.03 (1.49)	0.74 (1.20)
INTERACTION RED-ELECTRICAL MACHINERY							0.01 (0.04)	0.23 (1.22)
CONTINENT-DUMMIES	NO	NO	NO	YES	YES	YES	NO	YES
R ² (R ²)	0.16 (0.11)	0.48 (0.37)	0.42 (0.32)	0.50 (0.41)	0.61 (0.48)	0.52 (0.42)	0.48 (0.34)	0.64 (0.49)
N	35	35	34	34	34	35	29	32

Note: Estimated with OLS. Absolute t-statistics in brackets under coefficients. One, two and three stars denote significant at the 10%, 5% and 1% level, respectively, in a two-tailed test. R² in brackets is adjusted for degrees of freedom.

Equations 1 and 4 report the results with only the two structural variables and a constant term (not reported) included, with and without continent dummies, respectively.¹⁸ The latter may be thought of as a rough test of the impact of other non-identified factors that happen to be correlated geographically. Equations 2 and 5 repeat these regression with education, investment and initial productivity, all in log-form, included as conditioning factors, i.e., we test to what extent structural change matters

R&D data are from OECD and UNESCO. In a few cases these data were supplemented with data from national sources.

¹⁸ Oceania (Australia and New Zealand) is included in Asia in this study.

when the effects of other growth-inducing factors have been accounted for. The results are very clear. High productivity growth and increases in the share of resources devoted to the electrical machinery industry go hand in hand. A one per cent increase in the employment share of the electrical machinery industry implies about one half percent higher overall growth of manufacturing productivity. Increasing the share of employment going to other high-growth industries matters much less, though. The inclusion of other conditioning factors does not change these results to a significant extent, but the explanatory power of the model increases. Among the additional factors, education (especially secondary) is the most important.¹⁹ Neither the share of investments in GDP, nor the initial level of productivity seems to matter much for growth. The same holds - surprisingly perhaps - for "openness" as reflected in exports as a share of GDP (equation 6).²⁰

The two last equations in the table (7 and 8) take into account investments in R&D (measured as a share of GDP), which recent theorizing in this area would suggest as being important (see, e.g., Romer 1990). This leads to a reduction in the number of countries included. Doubts may also be raised about the quality and comparability of the R&D data. Anyway, for this sample of countries, secondary education and R&D are so closely correlated, that only one of them can be retained. When R&D is chosen, the coefficient is positive as expected, but not significantly different from zero at the 10% level.²¹ We also include an interaction variable, reflecting the hypothesis that the effects of R&D investment on growth are larger if undertaken in conjunction with an expansion of the electrical machinery industry. This hypothesis, however, receives only very moderate support.

The results from this section give ample support to Cornwall's argument regarding the importance of flexibility, or the ability to transfer resources to technologically

¹⁹ In most cases, the countries that were identified as outliers (and hence excluded) were poor countries with low educational standards. In the initial estimations (with these countries included) education (especially primary education) had somewhat more impact.

²⁰ We also estimated a version more akin to Cornwall's reduced form, i.e., with only initial productivity (Y_{73}) and investment (INV) as exogenous variables, and growth of labor productivity (G) as the endogenous variable. This model turned out to have very little explanatory power. The result was (absolute t-values in brackets)

$$G = 0.75Y_{73} + 3.19INV$$

(1.32) (1.77)

$$R^2 (R^2) = 0.11(0.06)$$

progressive areas, for productivity growth. Hence, transformation clearly matters for growth. However, Cornwall's emphasis on investment in physical capital in this context is not justified for the period under study here. Rather, the recipe for high growth of manufacturing productivity seems to be a combination of flexibility (targeting the right industries) and investments in skills.

4. Quo Vadis Modern Capitalism?

Cornwall built his analysis of Modern Capitalism on a combination of two strands of thought; the Schumpeter-Svennilson view of capitalist development as a process of qualitative change driven by innovation and diffusion of technology, and the Kaldorian idea of static and dynamic economies of scale in manufacturing as the driving force behind economic progress in the industrialized world. Combining these (and other) insights into a coherent perspective on modern economic growth was an important achievement in itself. He also provided convincing evidence from a group of industrialized countries in the fifties and sixties that supported his interpretation of the events.

What we have done in this paper is to update and extend his empirical analysis using a larger sample of countries and more recent data. We have found that the Schumpeter-Svennilson perspective of growth as a process of qualitative (and structural) change, and the emphasis on the importance of skills and flexibility, has a lot to commend it. On the second set of ideas the evidence is more ambiguous. At least for many of the technologically and economically most advanced countries, manufacturing does not seem to be the 'engine of growth' assumed by Kaldor and Cornwall. Rather, it is for countries in the process of industrialization (NICs) that manufacturing seems to matter most. This may have to do with the role of the manufacturing sector in acquiring foreign technology and generating learning and skills, in combination with forward and backward linkages, as argued by Cornwall in the case of the developed countries. However, it may also have to do with another issue discussed extensively by Cornwall (*ibid.*, chapter IV): the existence of persistent differences in productivity levels (and growth) between sectors ("the dual economy"),

²¹ In the initial estimation (before exclusion of outliers) the impact of R&D was found to be both larger and significant (at the 1% level).

and the role of the manufacturing growth in speeding up the transfer of labor from low to high productivity activities (from agriculture to manufacturing, for instance).

The differences in findings between the studies cited by Cornwall and the present study may also reflect a change in the way “Modern Capitalism” works. Arguably, the first decades after the second world war constituted a period during which the diffusion of scale-intensive technology, from the USA to Europe and Japan, and learning from the use of these technologies, played a large role (Abramovitz 1994). However, the role as “engine of growth” has relocated to electronics and other industries characterized by a strong science base and heavy investments in R&D. Our results indicate that there is a strong, positive and very robust correlation between a country’s performance in these new growth industries and the rate of growth of manufacturing productivity. This may indicate that there are strong positive spillovers from these kinds of activities, and that these spillovers, to some extent at least, are nationally embedded. However, there are reasons to believe that the technologies that emerge from the new growth industries (especially electronics), and the learning that follows, are equally (or even more) relevant in many service industries. This is, of course, consistent with the finding of this paper that in most advanced countries, the distinction between manufacturing and services has lost much of its economic significance.

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