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Economic Convergence in the Old and the New Economies of the OECD

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A rapid process of income convergence or catch-up of per capita income occurred in the industrialized group of countries in the post-war years. The process was limited to the rich group of nations, to a "convergence" club, and developing countries did not benefit. Also, within the convergence club itself, the post-war convergence thrust lasted only till the mid-1970s. More recently, the process of economic integration in Europe has visibly reduced income differentials within the bloc. But the question is whether the mere fact of EU membership did the trick, or whether other factors such as the advent of the "***new economy"*** (information technology) have played a role. We explore this issue by disaggregating the economies of the OECD into IT and IT-using sectors and non-IT using sectors, and testing for income and productivity growth convergence or catch-up separately for these sectors.

Introduction

The optimistic belief that incomes per capita will converge in course of time, voiced by a number of economists and soothsayers, has been belied by developments in the last few decades. Instead of catching up with the affluent west, the less developed countries of the southern hemisphere have fallen still further behind in terms of income per resident.

In this paper, we address the same issue for the OECD group of countries, and also analyze the impact on the convergence of the income-catch up process of certain fresh factors which have emerged or have become relevant recently in this regard. In particular, a distinction is made between the convergence process in traditional sectors of the economy, and the 'new economy' - i.e., the sectors which use significant inputs of information technology.

Related literature and approaches

The notion that relatively backward countries, with a comparatively low income per capita, will grow faster than the richer nations, thus effectively closing the income gap, seems to have been prevalent for several decades. Such a process of income catch-up clearly occurred in the aftermath of the war years, when barriers to trade and capital flows fell rapidly, heralding a golden age for international commerce which lasted well into the 1960s. In fact, this may have been the most expansive era for trade since the classical age that was spearheaded by Great Britain.

The income-catch up hypothesis basically postulates that countries with lower per capita incomes will grow faster than the leader with the highest income per capita in a group

of trading nations. The rate of growth will be related to the income gap relative to the leading nation. This hypothesis has been considered even in the analysis of the productivity slowdown in the OECD countries since early 1970s (Lindbeck, 1983). Generally speaking, the hypothesis has been considered relevant only in explaining the catch-up process within the group of industrialized nations, which are said to belong to a 'convergence club' in the words of Baumol (1986). Baumol et al., (1994) have also postulated that the convergence process among the OECD countries may have run it's full course by now, after an extended process of strong convergence in the post-war decades, and echoes in this respect, the study by Lindbeck (1983).

Testing of the catch-up hypothesis has not been limited to the use of the variable income per capita. The convergence process with respect to labour productivity levels as well as total factor productivity has been the subject of scrutiny in recent years, and are important in their own right as indicators of international competitiveness. Normally, convergence in income per capita would imply catch-up also in productivity terms, but there ned not be a one to one correspondence. It may be noted that (OECD, 2002) total factor productivity (TFP) has been growing at different rates in the OECD countries and that the convergence process in TFP has bee quite strong even during periods of relatively weak income convergence. Thus it ought to be of interest to dwelve more into the possibility that convergence can occur in more than just one sense, and then sectoral level analyses loom even more important.

It is indeed quite conceivable that while not much convergence or catching up is observable in aggregate economies, interesting developments are occurring at sectoral levels. An interesting exercise, would be then, to look at agriculture, manufacturing and services sectors separately. Technology diffusion should be occurring to a greater extent in the advanced manufacturing sector than in other areas. Against this observation should be weighed the fact that the advanced manufacturing sector , especially the firms which produce hardware for information technology (IT) applications, is only a small part of the manufacturing sectors (not to mention the whole economy) of industrial countries. But it is important to note that technical diffusion would also be occurring in the sectors which ***use*** products of the advanced manufacturing sector. Thus it will be worth distinguishing between sectors in the aggregate economy which use IT inputs from more traditional sectors. In fact,

within each sector, there will be establishments which use IT inputs intensively as well as those which rely on more conventional processes.

The importance of such a distinction can be seen in Pilat et al. (2002), who show that labour productivity growth in IT producing and IT using sectors have been greater than in other sectors for virtually every country in the OECD area (with some nineteen countries included in their sample). But this also means that the degree of catch-up can vary between sectors, depending on their intensity of IT inputs usage. This point is further developed in the next section, with supporting data.

It seems worthwhile to emphasize while dwelling at length on the role played by IT inputs in pushing up productivity growth that, other factors have also played key roles in the growth process in OECD countries in the past decades. Thus, to get a complete picture or model of economic growth, one may to have to adopt a growth accounting approach - which may have to be extended in an appropriate manner to include factors other than just the traditional inputs. The potential sources of catching up can be then seen to include physical capital accumulation, technical progress, human capital development or accumulation, trade liberalization and openness in other respects, economic structure and change, institutional framework etc. of these factors, some may have been more important for the developing world, while others may be more applicable to the industrial nations and emerging markets.

The historical sources of growth for the successful nations are elaborated on with country-specific information in Maddison (1995). The dramatic and unprecedented catching up of Japan with the industrial nations of Western Europe and North America was due to physical as well as human capital accumulation. While capital intensity in production increased multifold – almost 207 times! – between 1890 and 1992, there was also tremendous progress in levels of education. Probably it is not widely known that Japan became fully literate by the beginning of the twentieth century, thus laying the foundation for the knowledge accumulation process. By 1992, the Japanese average levels of education had approached very close to the U.S levels. The other East Asian countries have also exhibited great ability to increase savings and investment rates, at times close to 40% in certain periods, which meant consistently high rates of addition to capital stock. Both in terms of capital stock accumulation and in the educational advancement of their people, these East Asian economies left other emerging markets, successful in terms of some other criteria such

as export orientation, far behind, and this progress has been reflected in the vigorous growth of income per capita.

Income per capita and productivity levels are seen to rise more rapidly during periods of trade liberalization, both for emerging markets and industrial nations. What is observed is that both multilateral trade liberalization and entry into a regional trading arrangement push up exports and also labour productivity levels in export sectors. Often, increased foreign direct investment, attracted by the liberalization process, is an underlying cause. But it must be noted that a greater degree of openness, particularly to capital flows, has not been always associated with higher income growth; the crisis in the open economies of southeast Asia in the 1990s immediately springs to the mind. Still, overwhelming evidence from historical developments underlines the positive effect of openness on growth. Such a belief is also implicit in the structure of macroeconomic models of open economies, with the traded sector perceived as experiencing faster productivity growth (see Lindbeck, 1977).

However, while linking openness to greater economic growth, it is important to note how openness is being defined in that context.[4] In fact, while export-orientation has proved to be consistently beneficial, with most – if not all – of the evidence stacked up on the positive side, a new consensus seems to have emerged about the need to exercise some restraint on short-run capital flows. Success in trade expansion – and therefore income growth – itself is seen to be linked to appropriate industrial policies while promote productivity and international competitiveness rather than to a passive reliance on comparative advantage based on costs (Batavia et.al., 2003). In this paper, we do, however, include possible effects of openness on productivity growth and convergence by considering the impacts of foreign direct investment flows, which are considered to be more growth promoting and less volatile than short-run flows.

Shifts in economic structure, such as the steady increase in the size of the services sector, may also bode well for overall productivity growth. It can be noted that such a shift and the service sector growth rates are particularly pronounced in the successful emerging market economies, much more so than in developing economies or developed industrial nations.[5] However, it must be added that what is typically observed in these emerging

[4] for a related discussion, see Batavia, Nandakumar and Wague, 2003.
[5] See Batavia, Nandakumar and Wague (2004).

market economies is a healthy development in ***all*** (industrial, agricultural and service) sectors, so that it is a process of balanced growth – unlike the process of unbalanced growth observed in developing nations or highly industrialized countries.[6]

The slowdown in the convergence of per capita income and productivity among the industrial countries could well be a result of 'having arrived', of all the members of the group having caught up with the leaders. In fact, this hypothesis is implicit in studies on the slow down of productivity growth among the affluent countries (see Lindbeck 1983). But new factors have emerged in the last decade which may have caused the growth to accelerate again despite the narrowing of the income gaps. The advent of the new economy age, and the move towards economic unions are a couple of such factors. The process of economic integration may have had effects which are not just limited to the effects of union membership. For instance, it has been noted that trade between countries which are not in the same regional integration arrangement has increased, when at least one of the trading partners is a member of such a union. Thus, trade liberalization per se is seen to increase the volume of trade (see Montenegro and Sologa, 2004). Outsider countries, not part of a regional arrangement would have gained depending on their ability to take advantage of the overall liberalized environment.[7] As regards the effects of joint union membership, the trade volume effect (increase) is estimated to lie anywhere between 6 and 200 percent.[8] This would have also affected productivity and per capita income positively, though a strict causal relationship would be difficult to establish. Thus, factors lying outside the realm of the basic growth accounting approach can also have significant effects on income per capita and productivity growth.

[6] For the industrial nations as a group, a process of de-industrialization can be observed for the 1990s, with growth in the services and the industrial sector being negatively correlated (Batavia, Nandakumar and Wague, 20040.

[7] Batavia, nandakumar and Wague note that while India and Korea have increased their trade shares to NAFTA and the EU after the formation of these blocs, quite a few developing countries have lost out in terms of export shares.

[8] See Persson (2001), Rose (2000).

A model of labour productivity catch up can be formulated on lines similar to the income per capita convergence estimation procedure, but a one to one correspondence will not be present due to certain offsetting factors. One important offsetting factor in this regard would be the changes in the rate of capital productivity growth. In many developing countries such as India, increasing capital-output ratios have been observed. The reason could be many, such as an important role for public sector enterprises, and non-competitive industrial structures and industrial policy. Changes in the population structure, population growth and employment levels would also contribute to differential rates of growth of income per capita and labour productivity. In this paper, we model processes leading to convergence in income per capita, labour productivity, and also total factor productivity.

Data and Models to be estimated.

In this paper, the catch-up process of both income per capita and labour productivity are modeled. As noted in the previous section, there will not be a one to one correspondence between these processes. To see this, we may write the expression for output growth as

1) $y = \alpha (\iota + \gamma) + (1 - \alpha) (k + \eta)$.

In 1), output growth is decomposed into a weighted average of the growth rates of labour, ι, and of capital, k, with α representing the wage share . γ (= y - ι) and η (= y – k) are the rates of productivity growth of labour and capital respectively. From 1) it can be seen that while labour productivity growth increases the rate of growth of output, this effect can be reduced by a fall in capital accumulation or in the rate of growth of the productivity of capital. The productivity growth of labour and capital are also affected by technological change. Disembodied technical progress will also serve to bring about differential developments of income per capita growth and labour productivity growth.

Note that the labour productivity term can be disaggregated to represent the effects of sectoral allocation , i.e., as a weighted average of sectoral labour productivity growth:

2) $\gamma = \sum i \ \phi i \ (yi - \tau i)$

This representation shows that there would be changes in overall labour productivity growth as labour is reallocated between sectors. Reallocation to a sector with high productivity

growth will increase the productivity growth for the economy as a whole. This may be incorporated into 1) as in Syrquin (1986). For a representation where other factors such as economic integration with the rest of the world are considered, see Taylor and Rada (2003).

In the empirical estimation here, we do incorporate the effects of factors internal and external to the economy, such as openness, human capital accumulation, and membership in regional trading arrangements. Also, the analysis is carried out at the level of the aggregate economy as well as for specific sectors. From the scrutiny of the growth rates in per capita income and in labour productivity at the aggregate as well as the sectoral level (see Pilat et al., 2002), it may be seen that convergence in income and productivity has not followed the same pattern, and that the picture varies between sectors as well.

At the level of the aggregate economy, the following estimations are made;

3) $y = a0*GUS + b0*Science + c0*Fdi + d0*Educ + e0*Energy + f0*De + g0*Dn + \varepsilon 0.$

In 3), the rate of growth of per capita income is represented as a function of the gap between country level and the US level, the stock of scientific personnel per million, foreign direct investment per capita, public spending on education as a share of GDP, energy consumption per capita, and dummies for membership in the European Union (EU) and the North American free trade Association (NAFTA). Table 1 provides the definition of all variables used in estimating this equation and the ones to follow. Data was available for all these variables from World bank and International Monetary Fund sources. Equation 3) is run for the 1980s and the 1990s separately, as a cross-country regression for all the 33 countries in the OECD bloc.

Table 1. Definition of Variables

Variable	**Definition**
Y	Growth rate of per capita income
GUS	US per capita income – country per capita income (The 'Income Gap')
Science	Stock of engineers and scientists per million population
Energy	Energy consumption per capita
Fdi	Foreign direct investment per capita
Educ	Public spending on education as % of GDP

De	Dummy for EU membership (1990s only)
Dn	Dummy for NAFTA membership (1990s only).
QUS	Labour productivity difference between the USA and the sample country
GQUS	Difference in manufacturing sector labour productivity, USA – sample country
TFP	Total factor productivity growth, aggregate economy
Q	Labour productivity growth, aggregate economy
QITM	Labour productivity growth, IT using manufacturing sector
QITS	Labour productivity growth, IT using services sector
QNITM	Labour productivity growth, manufacturing sector without IT inputs
QNITS	Labour productivity growth, sevices sector not using IT inputs.

Rerunning equation 3 using the per capita income gaps with Germany and Japan gave similar results, and are not reported here.

Similar estimations are made for labour productivity growth in the whole economy:

4) $Q = a1^* GUS + b1^*Science + c1^*Fdicap + d1^*Educ + e1^*Energy + f1^*De + g1^*Dn + \varepsilon 1.$

5) $Q = a2^*QUS + b2^*Science + c2^*Fdicap + d2^*Educ + e2^*Energy + f2^*De + g2^*Dn + \varepsilon 2.$

4) and 5) estimate the labour productivity growth in the aggregate economy of the 33 OECD countries as a function of the per capita income and the productivity gap relative to the USA, and other factors representing the external linkages and the human and infrastructure capital of these countries.

Equation 6) below is run for total factor productivity growth (tfp)in a smaller sample of 19 countries, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, netherlands, Sp;ain, Sweden, UK, Canada, New Zealand, Australia, Norway, USA and Japan. While the data for the earlier runs on labour productivity were taken from World bank

sources, the data for tfp was obtained from OECD (2002). The equation is estimated, as in the case of other equations, for the 1980s and the 1990s.

6) TFP = a3*GUS + b3*Science + d3*Educ + f3*De + ε3.

Next, we take up the estimation of the convergence process in specific sectors of the economy, distinguished on the basis of their usage if information technology (IT). We consider manufacturing and services sectors which use IT inputs intensively, and sectors falling under these classifications which do not use any significant amount of IT inputs. The classification follows that in Pilat et. al (20020). The growth rates of labour productivity in these sectors are taken from the same source. The specifications of the relationships are as follows:

7) QITM = a4*GUS + b4*Science + c4*Fdi + d4*Educ + e4*Energy + f4*De + g4*Dn + ε4.

8) QITM = a5*QUS + b5*Science + c5*Fdi + d5*Educ + e5*Energy + f5*De + g5*Dn + ε5.

7) and 8) estimate productivity growth in IT using manufacturing sectors as a function of the income and productivity gap relative to the USA, as well as the other factors considered in this study. The regressions are run for the periods 1990 –95, 1996-2000, and for a pooled series of these two time periods.

Equations 7 and 8 are rerun using productivity growth in the IT-using service sector (QITS) and in the non-IT-using manufacturing and service sectors (QNITM and QNITS) as dependent variables.

The results of these estimates are presented in the next section.

Empirical Results

Results of the estimates of income and productivity catch-up for the aggregate economy are presented in Table 2.

Table 2. Cross-section Estimates: Income & Productivity Convergence, Aggregate Economy

Regression No, period	Dep. Variable	GUS	QUS	Science	Fdi	Energy	De	Dn	Const.	Rsq
1. 1980-89	Y	0,047							2.246	0.17

		(1.27)							(6.62)	
2. 1980-89	Q		0.0003 (1.85*)	-0.0032 (0.619)	0.008 (1.61)				2.58 (1.67)	0.26
3. 1990-99	Y	0.005 (1.27)							1.47 (1.26)	0.16
4. 1990-99	Q	-0.086 (1.96*)							1.703 (2.85*)	0.35
5. 1995-99	Q	0.002 (0.26)							1.6 ((0.19)	0.11
6. 1990-99	Q	-0.094 (4.9**)		0.0005 (3.48**)		0.002 (0.51)		0.59 (1.11)		0.353
7. 1990-99	Q		-0.0001 (3.13**)	0.0005 (2.107*)					-1.123 (1.14)	0.291

't' statistics are given below coefficient values, with a single star indicating significance at ten percent level, and two stars that at five percent level.

Table 3 summarizes the results obtained at the sector levels, for the IT-using and non-using manufacturing and service sectors.

Table 3. Cross-section Estimates, Productivity Catch-up in IT-Using and non-IT-Using Sectors #

Regression No, Period	**Dep. Variable**	**GUS**	**QUS**	**Science**	**Energy**	**De**	**Const.**	**R-Sq**
1. 1990-95	QITM	0.6156 (6.11***)					-0.154 (0.11)	0.61
2. 1990-95	QITS	-0.0337 (4.09**)					0.1628 (1.91*)	0.706
3. 1990-99	QNITM	-0.04276 (2.102*)					0.703 (3.49**)	0.38
4. 1990-95	QNITS	0.0012 (0.96)					-0.0291 (0.97)	0.03
5.1996-2000	QITM	-0.0137 (1.276)					0.2875 (2.45*)	0.153
6. 1996-2000	QITS	-0.0098 (1.10)					0.549 (3.20**)	0.06
7. 1996-2000	QNITM	-0.00938 (0.816)					0.3445 (2.96*)	0.09
8. 1996-2000	QNITS	0.0083 (0.93)					-0.1495 (1.103)	0.115
9. 1990-2000	QITM	-0.0236 (3.144*")		0.0024 (3.05**)	-0.001 (1.20)	0.82 (0.74)	-0.312 (1.40)	0.39

10.1990-2000	QITM		0.0001 (1.589)	0.0002 (2.072*)			-0.28 (0.93)	0.17
11. 90-2000	NQITS		- 0.0003 (0.477)	0.0003 (0.962)	-0.0002 (1.385)	- 0.1117 (0.79)		0.16

#Three, two and one star denote significance at 1, 5 and 10 percent levels respectively.

Results for the aggregate economy

The results in table 2 indicate that the catch-up pattern in the economies as a whole differs between the two decades under study. Regression no. 1 shows that there is very little per capita income catch-up occurring during 1980-89; the coefficient for the per capita income gap of countries towards the US level is insignificant. The estimates for total factor productivity growth gave poor results, and are not reported here. But in regression 2, with the dependent variable specified as the economy-wide growth of labour productivity, the country-US productivity gap has a positive and significant coefficient.

For the 1990s, the growth in per capita income and labour productivity cannot be explained at all by income and productivity gaps, so that no convergence seems to have occurred- at least not that which can be explained by the catch-up hypothesis. In regression 3 to 7 in Table 2, the coefficient for the income and productivity gaps are either not significant, or has the wrong sign when they turn significant. The 'wrong' sign, of course, indicates that the richer countries are experiencing faster growth in per capita income and productivity.

What is interesting to note is that the stock of engineers and scientists has a positive effect on productivity growth. Other variables indicating possession of human capital like the spending on education as a percentage of GDP did not perform well. The amount of FDI inflows, and the use of energy per capita, did not also give any noteworthy effects on labour productivity growth in this cross-section analysis. Regional dummies also fall among those variables which did not perform well. So it seems that membership in regional trade blocs does not, in itself, contribute to increased per capita income or productivity growth. With investment in human capital, resulting in a sizeable stock of engineers and scientists, even non-members are able to capitalize on the trade liberalization measures carried out by the reforming and integrating countries – and narrow the gap between them and the leading industrial nations.

Results for IT (using) and non-IT(using) sectors

The estimates for the IT-using and non-IT-using sectors reveal different patterns for the two halves of the 1990s. Regression 1 in table 3 shows that a process of productivity catch-up towards US levels had occurred in the IT-using manufacturing sectors, in the first half of the 1990s. However, the coefficient for the productivity gap has a negative coefficient (in regression 2) for the IT-using service sectors. The reason may well be that advances in service sectors have been more pronounced among the advanced post-industrial welfare states of the OECD bloc. The negative coefficients in regression 3 and 4 for the non-IT using sectors may be explained by the fact that productivity growth has been relatively (compared to IT-using sectors) poor in these activities.

The catch-up of productivity in the IT-using manufacturing sectors, well-clarified by the productivity gap in the first half of the 1990s, cannot be explained by recourse to this gap in the send half of the decade (see regression 5). Instead, when the estimate is done for the whole decade of 1990s, it is the scientific workforce variable which is significantly positive (in regressions 9 and 10, table 3), and seems to thus explain differences in productivity growth between the countries in the sample. Thus, as for the aggregate economy, being a laggard does not, by itself, assure a catch-up in productivity; investment in human capital is a prerequisite for this desirable state of affairs to emerge.

Concluding remarks

Our results seem to confirm the proposition that the income and productivity convergence process within the group of richer, industrialized nations has run its course, but with certain qualifications.

There is, indeed, no evidence of income convergence in the last two decades among the OECD nations. However, at the aggregate economy level, there is weak evidence for productivity catch-up, explained by the productivity gap, having occurred in the 1980s.

Disaggregation into the modern, IT-using sectors and traditional, non-IT using sectors reveals some interesting variations. That section of the manufacturing industry which uses IT inputs, has experienced productivity convergence during the first half of the 1990s, a phenomenon, which, however, has not lasted the decade out. On the other hand, no

productivity convergence has occurred in the 1990s - which may be explained by the productivity gap- in the IT-using service sectors and the non-IT using sectors..

In fact, even for the IT-using manufacturing sectors in the OECD countries, which has experienced productivity convergence in the 1990s, the later growth in labour productivity, in the latter half of the decade, is seen to be due to the possession of skilled labour forces. It may be noted that regional bloc dummies, the EU and the NAFTA dummies, are seen to have no explanatory power. Thus, with an appreciable stock of human capital, even non-member countries are seen to have narrowed down the productivity gap towards leading nations if they possessed an advantage in terms of skilled workforce endowment. Such a resource would have helped them to take advantage of the process of liberalization set off within regional trade blocs, even as outsiders. This is consistent with the results in the literature on trade volume effects on member and non-member countries of regional bloc formation.[9] Even for the IT-using manufacturing sectors, after the initial leap towards narrowing the productivity gap against leaders, further productivity catch-up seems to have needed a skilled, scientific workforce.

[9] See Montenegro and Soloaga (2004)

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