TRAJECTORIES, CONVERGENCE AND DIVERGENCE IN ECONOMIC DEVELOPMENT

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1) INTRODUCTION

In this paper we intend to discuss the relationship between long term development trajectories, which in principle can be expected to affect the functioning of all economic systems, and the deviations which can be expected to occur at a local level in particular countries or regions. We will first discuss this relationship at a very general level in terms of the forces and factors which can affect the convergence and divergence of separate but interacting economic systems at the national or regional level. Subsequently we will analyse the implications of the different existing theories of international trade for the convergence of divergence of the economic systems of different countries . Finally we will take into account the trajectories which can be empirically identified in long run economic development and the deviations which can be detected in particular countries.

2) CONVERGENCE AND DIVERGENCE.

The world economic system is constituted by separate but interacting subsystems. Different countries and regions are separated by boundaries including differences in languages, cultures, institutions and natural endowments amongst others. Interactions between different countries have

existed since the beginning of human history in the form of trade and war. However, the amount of interaction has increased recently due to the progress of travel and communications. Within the development paths of countries we can identify both phenomena occurring locally and forces which tend to diffuse habits and routines created locally over very large portions of the world economic system. Innovation would be an example of the former phenomena, trade and technology transfer examples of the latter diffusive forces. Local phenomena can be expected to raise the heterogeneity of the world economic system and diffusive forces to reduce it, or to raise the homogeneity. The dynamic combination of local phenomena and of diffusive forces will determine the extent of convergence and of divergence in the world economic system at any given time. The growing speed of transport, the enormous improvements in ITC which occurred recently have enormously facilitated trade and the flow of ideas and knowledge between countries, both examples of extremely powerful diffusive forces tending to homogenise the world economic system. The expression 'the death of distance' has been used to signify that there is no more need for people to be at the same place in order to collaborate since modern ITC would allow to coordinate their actions over very long distances. It must be noticed that the terms convergence and divergence can be referred either to outcomes of the process of economic development (for example GDP per head) or to institutional structures and productive processes used to achieve it. The latter can be considered ingredients required to obtain the former. Then we can expect less developed countries to observe and possibly to imitate the institutional structures and/or the productive processes which seem to be linked to particularly high rates of growth. Their objective is to develop (for example to reach a higher GDP per head), that is, to catch up in outcomes by imitating the ingredients used elsewhere to develop. If to create the adequate institutional structures and the productive processes which seem to be linked to development were the only possible mechanism of economic development we should expect the extent of convergence towards outcomes to be reflected in an equivalent convergence of institutional structures and of productive processes. However, if more than one development path which can create comparable outcomes exists then convergence in outcomes may not imply an equivalent convergence in institutional structures and in productive processes. To put it differently countries can use different ingredients, or mixtures of, to develop.

Before proceeding to analyse in greater detail the socio-economic phenomena and diffusive forces which could determine convergence or divergence it is worth noticing that the previous discussion can be applied in general terms to any type of complex systems. In fact, the concepts of *reactions* and *forces* have been derived from the study of physical and chemical systems (see Nicolis, Prigogine, 1989, Haken, 1983) but they can equally be applied to social and biological systems. Of

course, the variables involved are specific to each type of system and the dynamics potentially similar although not necessarily identical. Socio-economic systems have a *structure,* constituted by their subsystems separated by boundaries but generally interacting. (see Frenken et al, 1998) This structure changes in the course of time as new subsystems are created and as some old ones become extinct. This provides us with a generalized definition of structural change, a phenomenon which has been studied in a narrower way in economics. Perhaps the best known example of structural change is the massive reallocation of labour from agriculture to manufacturing and services that accompanies the growth process. However, structural change can be detected also within the manufacturing or the services sectors (e.g. Salter 1962; Fagerberg, 2000).

In Socio-economic systems innovations occur locally, typically in already highly developed countries, and then diffuse to the rest of the world. Complete convergence would be conceivable only if the rate at which new innovations were created (R_{In}) was systematically smaller than the rate at which diffusive forces continued to operate (R_{Diff}), that is if $R_{Diff}>R_{In}$. If the two rates change in the course of time then the extent of convergence or of divergence of the system depends on their ratio.

We are now going to examine what existing theories of growth, of international trade or of innovation can tell us about the possible convergence or divergence of economic systems. The first growth models which provided us with very clear, if not necessarily right, implications about this problem were those based on Solow's (1956) model. According to this model economic growth resulted from increasing capital intensity or from technical progress. In fact, Solow found (1957) that technical progress accounted for the largest share of growth in the USA between 1909 and 1949. In this vintage of growth models the addition of capital to the economic system raised productivity but at a decreasing rate. Thus, if growth had been based only on physical capital one should have expected all countries eventually to reach the maximum possible intensity of capital and different national economic systems to converge. Of course, the extent to which technical progress was an important factor contributing to economic growth depended on

the ways in which it could be organized in different countries. Unfortunately Solow's model did not allow any answer to be given to this particular question since technical progress was determined as a residual, that is, what was left over after the contribution of capital was accounted for. Denison (1962) subsequently decomposed the residual into many different components, including scale economies, the educational levels of the labour force, shorter working days, the increased participation of females in the labour force etc. However, although Solow was the first economist to explicitly account for the importance of technical progress in economic growth, since the residual was not decomposed by most users of his model, no clear implications could be derived about the possible convergence or divergence of national economic systems. A serious limit of Solow's model was the exogenous character of technical progress. Subsequent vintages of growth models, such as the so called endogenous growth ones (Romer, 1990; Aghion and Howitt, 1992; Helpman Grossman 1991) or evolutionary growth models (Dosi, Fagiolo, Roventini, 2006, 2008, Saviotti, Pyka, 2004, 2008, Montobbio, 2002) placed innovation at the centre of the growth process. Innovation had now become an economic phenomenon funded by economic resources and contributing to economic outcomes. Within this more recent vintage of growth models increasing returns were possible and allowed economists to explain why rates of growth would not systematically decline in the course of time. As for convergence, the presence of increasing returns and the uncertainty surrounding the possible outcomes of innovation made any prediction very difficult but it certainly excluded that convergence would be the only or the necessary final stage of economic development.

The theories of international trade which emerged in the course of time began with the Ricardian theory based on comparative advantage, which was then followed by the Hescher-Ohlin theory in which comparative advantage depended on national endowments, mostly of natural resources, until the so called new technology theories of international trade (Posner, 1961, Vernon, 1966; Fagerberg, 1988, Soete 1987, 1982, Krugman,

1979, 1980) started to stress the role played by technology and innovation. According to these theories more innovative countries, typically in the North, would create innovations which would subsequently diffuse to less developed countries where they would be first purchased and used and later produced, once the technologies on which they were based had moved from innovative to mature. In their earliest versions these theories allowed for an avenue by means of which initially less developed countries could move up the development ladder, if not necessarily to catch up. Low income countries in the South could be expected to imitate the technologies created in the North and to gradually climb on the development ladder. Of course, this mechanism would not necessarily lead low income countries to catch up with high income ones. It could simply keep the income gap between the two constant or to let it grow at a slower pace than if low income countries did not imitate at all. As for the high income countries they need to keep innovating if they wish to keep the advantage they have with respect to low income countries.

Recent research results show that a development strategy based only on imitation becomes increasingly less effective (Fagerberg, Verspagen 2007) or can at best serve to lift countries from low to middle income levels but no further (Lee et al 2008). According to Fagerberg and Verspagen to catch up by means only of imitation is becoming increasingly difficult. Countries which have managed to develop after the 1980s have done so by creating their national innovation system. Thus, it seems as if the strategies required to catch up keep evolving in the course of time. If in the 1960s and 1970s it was possible for some countries of the South to develop by imitating some technologies created in the countries of the North, this development path seems to become increasingly difficult to follow. This result is not altogether very surprising. It simply reflects the growing knowledge intensity of the most advanced countries in the world. In the period 1962-1999 the R&D intensity and the level of human capital of many countries increased substantially. During this period we can expect the R&D

intensity of most innovations to have grown. This implies that those innovations which were created with R&D need R&D to be imitated. In fact, R&D is used both to create new knowledge and to create an absorptive capacity (Cohen, Levinthal, 1989) for what competing firms or organisations have done. Thus, R&D carried out in a given field of knowledge creates absorptive capacity for the same field. This implies that imitation is no longer possible by simply using labour of low wages and low skills but that it requires the same ingredients used by the initial innovators. Thus, as Fagerberg and Verspagen found, simple imitation is no longer possible. In the most recent period (1980-2000) only those countries which managed to create their innovation systems, within which higher education and R&D were central factors, succeeded in catching up. Conversely, there could still be a number of innovations which can be *simply* imitated without constructing an innovation system, but the imitation of such innovations could only lift a country from low to middle income per head (Lee et al, 2008). For example, LDCs can still enter the production of textiles, but only in particularly low skill and low technology subsets. Even within textiles subsets of much higher knowledge intensity have emerged, the imitation of which would require a more complex and sophisticated innovation system than most countries at very low levels of economic development can afford. This means that imitation in some form is still possible but that it requires much more complex and sophisticated ingredients than in previous periods. In this context we can call simple the imitation processes which can occur based on low labour costs, on low levels of human capital and by targeting the production of goods the demand for which is price sensitive. We can expect the scope of this simple imitation to shrink as most emerging innovations are increasingly R&D intensive.

The previous considerations mean that the targets of imitation required to catch up and the barriers involved change in the course of time. This has interesting implications for development. The concept of the advantages of backwardness (Gerschenkron, 1962) needs to be revisited in this context. This may be interpreted as meaning that the

further away a country is from the technological frontier the greater its development scope. Such scope could be represented by the repertoire of productive processes which the country has not yet used and can in principle learn. However, the distance from the frontier as a measure of the advantages of backwardness, is at best a necessary but not a sufficient condition for development. If the leading countries keep moving the technological frontier forward by changing the ways in which knowledge can be created and used, the potential advantages of backwardness can increase for LDCs but their ability to make use of these advantages may not necessarily follow. Only those LDCs which manage to create the required institutions, such as higher education and R&D, will be able to imitate and to reduce their distance with respect to the technological frontier. This means that total convergence would only take place if all LDCs could create the institutions required to catch up with a moving technological frontier.

3) TRAJECTORIES AND NATIONAL INNOVATION SYSTEMS

The previous section showed that various theories of growth or of international trade do not lead us to foresee the convergence of different countries of the world economic system either for what concerns outcomes (for example levels of GDP per head) or for what concerns the institutional structures and the productive processes required to attain such outcomes. If anything the theories considered predicted a dynamically evolving combination of phenomena created locally, such as innovation, and of diffusive forces, such as diffusion and technology transfer, which would tend to diffuse innovations and the relevant knowledge to all countries. In this section we discuss the implications for convergence and divergence of the concepts of trajectories and of National Innovation Systems (NIS). A trajectory can be defined as a path defining a long term trend in the space of some variables. For example, if one were to plot the values of GDP per head of the countries of the world during a period of time one would find a cloud of points oriented in a direction implying a growing GDP per head. We could say that the curve best fitting the points of the diagram represents the trajectory of GDP per head in

the course of time. However, although the curve is likely to have a positive slope, meaning that most countries will have had a positive rate of growth of GDP per head, it is possible for some or even for most countries to have had a lower or higher than average growth rate of GDP per head. Thus, the existence of a trajectory does not imply that the trajectory is followed in the same way by all countries or in general all the members of the population affected by the trajectory. The concept of trajectory involves a trend and a dispersion around the trend, the extent of such dispersion varying in individual cases. A more sophisticated, although more difficult to define operationally, concept of trajectory has been used in the literature on innovation where Nelson and Winter (1977) used the concept of natural trajectories and Dosi (1982) that of technological trajectories. In both of these cases trajectories define directions for the evolution of given technologies or designs which are followed by most socio economic agents. The emergence of a trajectory acts as constraint on the population of socio-economic agents who can in principle be affected by it by ruling out alternative modes of behaviour. However, as previously pointed out, a trajectory does not rule out a residual variance in the behaviour of the members of the population affected by it.

Previous work showed the existence of a trajectory leading to the growth of output variety in the regions of the Netherlands (Frenken et al, 2007), of the export variety of OECD countries (Saviotti and Frenken, 2008) and of the export variety of all the countries of the world (Saviotti, Nesta, Javaid, 2008). The results of this work showed that the growth of export variety is a determinant of the growth of GDP, of GDP per head and of labour productivity. An interesting distinction has been introduced into this work by Frenken et al (2007) between related and unrelated variety. The former is the variety which one can measure at a relatively low level of aggregation amongst the entities which are members of the same group and which can also be called intra-group variety. On the other hand, unrelated variety can be measured at a higher level of

aggregation at which the entities considered have a higher level of dissimilarity. For example, we could measure related variety within a group of products in consumer electronics while unrelated variety would be measured at a level of aggregation at which consumer electronics, chemicals, shoes, equipment etc existed. An interesting result of the previous work is that only related export variety is a determinant of growth in the short run while unrelated export variety becomes a determinant of growth in the longer run. These results can be interpreted by saying that countries need to diversify their exports if they want to grow but that in the short run they can only do it profitably if they diversify in the neighbourhood of their previous production and knowledge structures. Obviously to try and diversify by introducing into their production structure goods and services completely different from the pre-existing ones would not pay off in the short run. However, the fact that unrelated export variety becomes a determinant of growth in the longer run means that unless the goods and services which will contribute to future export performance of the country are prepared in advance of their commercial success, the continuous incremental improvement of past export types is likely to run into diminishing returns. These results imply that the existence of this trajectory does not necessarily imply that successful countries will converge on the same types of exports, or even less so on the same institutional configurations. First, the fact that in the short run only related export variety is a determinant of growth means that the productive structure of a country cannot be changed overnight and that the near future preserves a memory of the immediate past, thus involving a degree of path dependency. In other words, development can occur but by 'small' steps, a result compatible with that of Hidalgo et al (2007) with completely different techniques. Since countries start from different situations, they could at best converge without necessarily becoming identical. Even this outcome is not guaranteed. If the output variety of the world economic system increases during economic development each country can choose its future exports in a range of growing width. Whether each country becomes more similar to the others or more

specialized depends on the ratio of world output variety and of national export variety. If the former rate is greater than the latter countries raise their export variety without becoming more similar to one another. In the next section we will describe some empirical results aimed at testing the convergence or divergence of different countries based on their export variety. However, before passing to the discussion of empirical results we need to take into account the literature on national innovation systems.

The concept of national system of innovation (NSI) emerged in the 1980s to take into account the important roles played by both innovation and knowledge in economic development while simultaneously stressing that innovations were developed and used within institutions and that such institutions were interacting (Freeman, 1987; Lundvall, 1992; Nelson, 1992; Edquist, 1997). The concept of NSI is thus truly systemic, (Lundvall, 2007) in that one cannot expect any type of emerging institution required for economic progress to fit within all pre-existing NSIs. As a consequence we cannot expect any NSI to be equally able to develop a successful R&D or higher education system. Furthermore, the concept of NSI was based on two persistent asymmetries in (i) output structures and in (ii) institutional configurations. On the whole, for the purposes of the present paper the concept of NSI tends to imply that the above asymmetries can persist for considerably long periods of time giving rise to national interpretations of general trajectories.

4) EMPIRICAL RESULTS

In our previous work we have shown that export variety, either in its related or in its unrelated form is a determinant of GDP, of GDP per capita and of labour productivity of OECD countries (Saviotti, Frenken, 2008) and of all the countries of the world (Saviotti, Nesta, Javaid, 2008). Related (REV) and unrelated (UEV) export variety are measured at different levels of aggregation, higher for UEV and lower for REV. The meaning of the previous results is that countries need to diversify their exports in order to grow but in the short run they have better chances of growing by diversifying in the neighbourhood in product space of their previous exports. This result coincides with that obtained by different means by Hidalgo et al (2007). In the previous papers we also showed that while related export variety (REV) is a determinant of growth in the short run unrelated export variety (UEV) becomes a determinant if we lengthen our period of observation. Thus, while the pay-off obtained by diversifying one's exports in the neighbourhood of the previous ones is greater

than by beginning to export completely new products, continued growth in the longer run can only be sustained by gradually creating new types of exports. If this were the only mechanism of economic development we would expect to observe a trajectory according to which the export variety of countries rises in the course of economic development. However, our previous work showed that, although this trajectory emerges as an important mechanism of economic development, it may not necessarily be the only possible one. If the trajectory exists, at any given time there is a dispersion of behaviours around the trajectory. This is not to deny that the export variety of some countries may fall in the course of time. If such countries were only those which do not develop, the existence of the trajectory would be confirmed and reinforced. However, what seems to be happening is that some countries which grow do it without having a growing export variety and others have a more complex development path with export variety growing in some periods and falling in others. For example, some countries which are very rich in natural resources, and in particular in oil, such as Norway, Venezuela and Algeria, manage to grow while having very low and/or falling export variety. Furthermore, the ratio of REV to UEV is very different for different countries. Finally, as world output variety grows we can expect individual countries to have a growing possibility to raise their export variety without necessarily becoming more similar or identical to other countries. Thus, even if growing export variety were a dominant mechanism of economic development for most countries, this would not necessarily lead to the convergence of these countries.

To study the trade off between convergence and divergence in presence of a trajectory we represented the distribution of outcomes (GDP per capita) and of possible mechanisms used (related, unrelated export variety and exports) during the period 1962-1999. We used the UN data on world exports cleaned by Feenstra et al (2002). In all these cases (see Figs 1-4) the distributions are multimodal, trimodal for GDP per capita and bimodal for REV, UEV and exports. Since in each of the figs 1-4 the variables are represented separately for the sub periods 1962-1970, 1970-1980, 1980-1990 and 1990-1999 we can see that the distributions become generally flatter and wider and that the average distance between the peaks tends to increase. While their flatter nature would seem to indicate that distributions are becoming more even, the growing width and distance between the peaks implies that the distance between the richest and the poorest country or between the most and the least export intensive country tended to grow during the period 1962-1999. Thus, it seems that during the period of study there has been divergence of outcomes (GDP per capita) and of mechanisms used (TEV, REV, UEV, Exports).

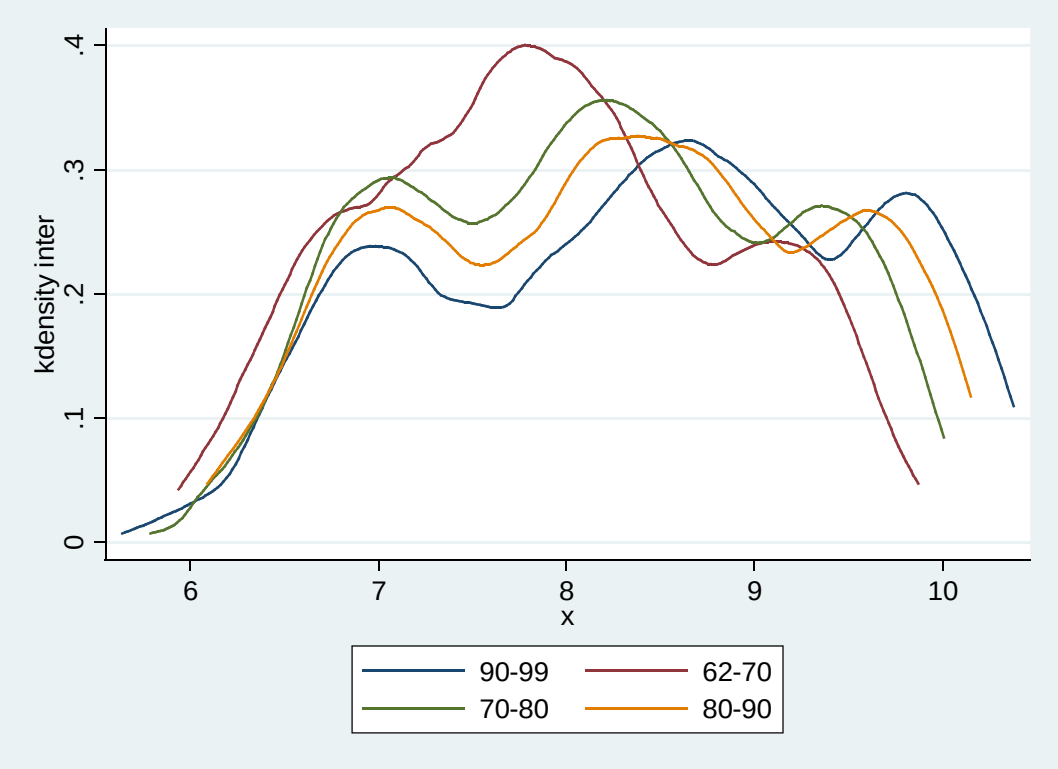

Fig 1. Distribution of GDP per capita during the periods 1962-1970, 1970-1980, 1980-1990 and 1990-1999

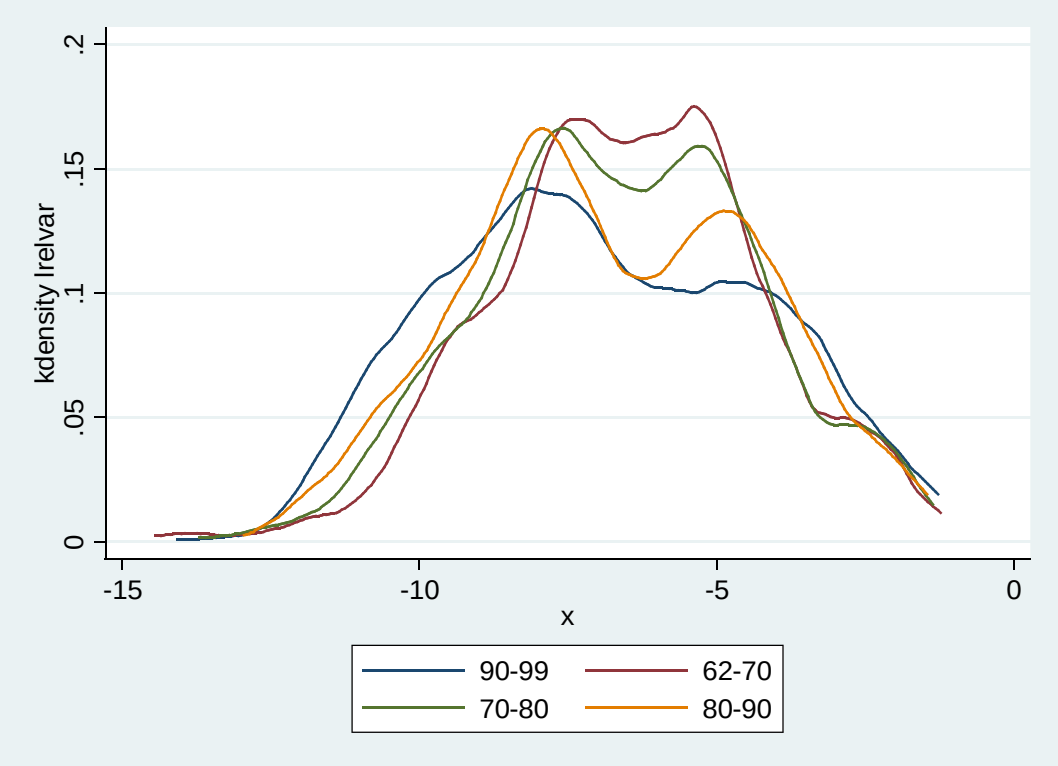

Fig 2. Distribution of related export variety (REV) during the periods 1962-1970, 1970-1980,

1980-1990 and 1990-1999

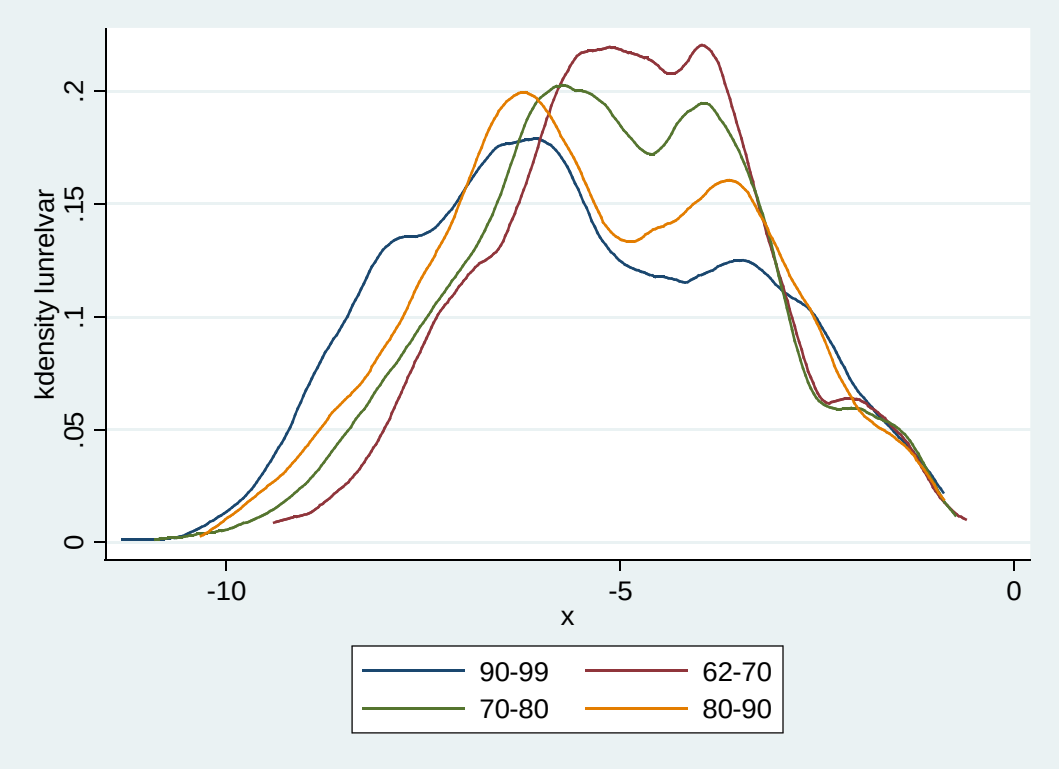

Fig 3. Distribution of unrelated export variety (UEV) during the periods 1962-1970, 1970-1980, 1980-1990 and 1990-1999

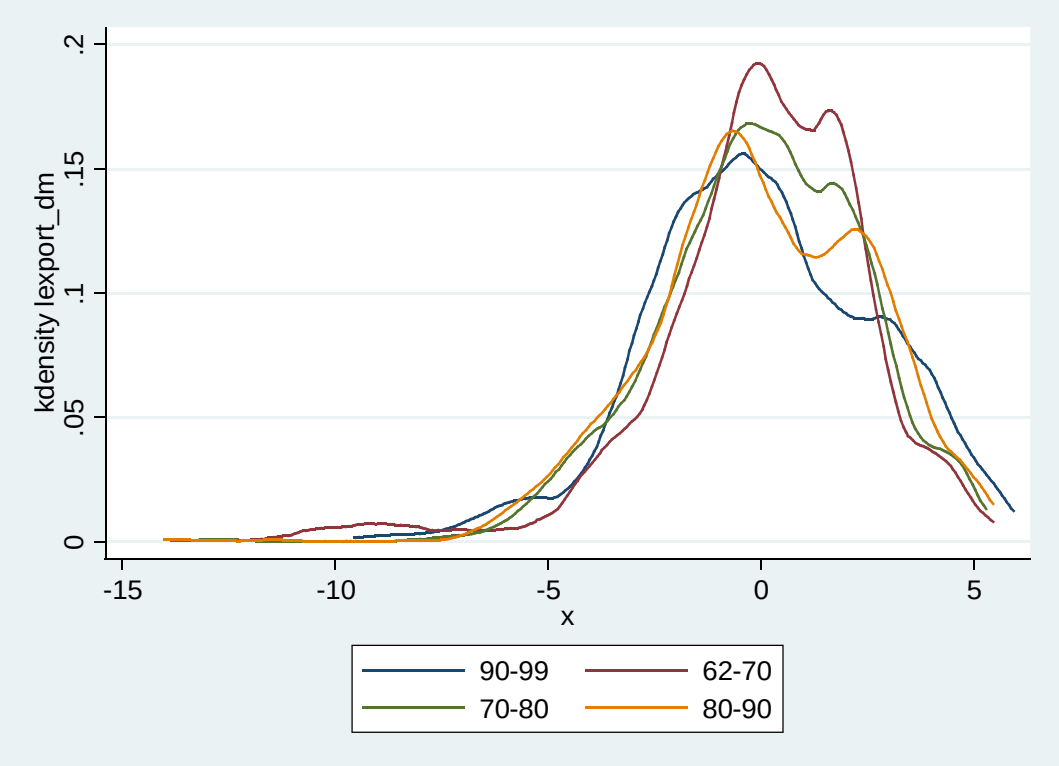

Fig 4. Distribution of exports during the periods 1962-1970, 1970-1980, 1980-1990 and 1990-1999

To achieve a better understanding of the situation we studied the influence of Related Export Variety (REV), of Unrelated Export Variety (UEV) and of proximity on the GDP per capita of countries in different periods and for different starting income ranges (Table 1). The first two variables have already been defined. Proximity is measured as the inverse of the similarity of the exports of countries. In turn, similarity is measured by means of a cosine function already used by ecologists (Pielou, 1984) and by Jaffe (1986) to measure the similarity of biological species and of innovations respectively. GDP is always a determinant of growth but with a negative sign. This means that the higher the starting GDP the lower the expected rate of growth. Equivalently, the further away a country starts from the (GDP) frontier, the higher we can expect its growth rate to be. The regressions for the whole sample indicate that in the short run both related export variety

	-1	-2	-3	-4	-5	-6	-7	-8
VARIABLES	WHOLE SAMPLE	WHOLE SAMPLE	WHOLE SAMPLE	62-80	81-99	low GDP per capita	middle GDP per capita	high GDP per capita
lngdp	-0.0502	-0.0493	-0.0500	0.0225	-0.128	-0.0841	-0.0687	-0.00659
	[0.0153]***	[0.0151]***	[0.0153]***	[0.0432]	[0.0274]***	[0.0356]**	[0.0296]**	[0.0234]
lnopenc	0.0310	0.0330	0.0310	0.0431	0.0232	0.0235	0.0400	0.0310
	[0.00432]***	[0.00415]***	[0.00432]***	[0.00762]***	[0.00683]***	[0.00812]***	[0.00823]***	[0.00782]***
lnrgdpwok	-0.00710	-0.00339	-0.00766	-0.147	-8.24e-05	0.0151	-0.0145	-0.0621
	[0.0151]	[0.0151]	[0.0151]	[0.0445]***	[0.0247]	[0.0339]	[0.0289]	[0.0222]***
lnpop	-0.00613	-0.00278	-0.00482	-0.0249	-0.00926	-0.0780	0.0188	-0.0482
	[0.0158]	[0.0156]	[0.0158]	[0.0414]	[0.0375]	[0.0586]	[0.0354]	[0.0266]*
lunrelvar	-0.0300		-0.0337	0.00269	-0.0629	-0.0332	0.0279	-0.0323
	[0.0102]***		[0.0104]***	[0.0203]	[0.0180]***	[0.0206]	[0.0203]	[0.0160]**
lrelvar	0.0276		0.0301	0.00289	0.0543	0.0282	-0.0179	0.0313
	[0.00837]***		[0.00846]***	[0.0173]	[0.0142]***	[0.0174]	[0.0161]	[0.0121]***
proximity_1dc		0.0141	0.0173	0.0292	0.0179	0.0308	0.0152	0.0205
		[0.00834]*	[0.00850]**	[0.0144]**	[0.0147]	[0.0174]*	[0.0170]	[0.0122]*
Constant	0.940	0.819	0.919	01/01/53	01/02/71	01/01/97	01/01/71	01/01/18
	[0.123]***	[0.115]***	[0.123]***	[0.293]***	[0.293]***	[0.467]***	[0.295]***	[0.184]***
Observations	3945	3945	3945	1945	2000	1347	1292	1306
R-squared	0.088	0.085	0.089	0.115	0.094	0.085	0.122	0.208
Number of cid	131	131	131	106	131	55	73	58

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in brackets

Table 1. Influence of Related Export Variety (REV), Unrelated Export Variety (UEV) and of proximity on the GDP per capita of countries in different periods and for different starting income levels.

and proximity are determinants of GDP per capita. While the former result confirms our previous findings, the importance of proximity means that although in the course of time countries tend to raise their export variety they do it in an increasingly similar way. This result would seem to contradict the conclusions we drew from the distribution curves of GDP per capita, of REV, of UEV and of exports, according to which the difference between the top and the bottom performer in each of the variables had been increasing during the period studied. To clarify the situation we ran separate regressions for two sub-periods (1962-1980 and 1981-1999) and for three income levels (low,middle and high). In the first period (1962-1980) GDP, openness, labour productivity and proximity are significant. The significance of proximity means that some degree of convergence

was occurring, but that such catch-up was not obtained by means of growing export variety. Interestingly, labour productivity is significant but with a negative sign. This means that the further away a country is from the frontier of labour productivity, the higher we can expect its growth rate to be. While the significance of labour productivity might seem simply to reinforce that of GDP we distinguish between the frontiers of different variables, and in particular between those of outcomes (e.g. GDP per capita) and those of inputs or intermediate inputs. For example, labour productivity or export variety can be considered ingredients required to achieve the growth of GDP. If the relationship between GDP per capita and labour productivity or export variety were to remain constant in the course of time we could expect their distance with respect to their relative frontiers to be the same and to remain constant in the course of time. However, if in the course of time or for different income ranges the mechanisms of economic development change we can expect the relative roles of various potential determinants of growth to change. For the period (1981-1999) openness, UEV, and REV are significant determinants of growth. Labour productivity is no longer a determinant of growth while REV and UEV are, although UEV has a negative sign. Thus, (i) the distance from the frontier of GDP still matters but that from the frontier of labour productivity does not; (ii) related export variety (REV) is a determinant of growth in the short run (we have no delays in these regressions) but unrelated export variety (UEV) is a negative determinant in the short run. Clearly, the mechanisms of growth and catch up have changed from 1962-1980 to 1981-1999. While in 1962-1980 countries could develop without worrying about the variety of their exports in 1981-1999 they needed to raise their export variety to develop. Two observations are in order here: first, during the period 1981-1999, and particularly at its beginning, the strategy of export led industrialisation started to be considered by some scholars of development as the 'good' development strategy, as opposed to import substitution industrialisation; second, in order to raise its export variety a country is likely to need to start innovating and producing new types of output. In this sense our result is quite compatible with that of Fagerberg and Verspagen (2007) according to whom imitation was a possible catch-up mechanism only in the first period while in the most recent period countries needed to create their innovation system to catch up. As already pointed out, we distinguish between simple imitation, which is possible without carrying out R&D, and a more complex form of imitation, which requires the construction of an absorptive capacity for those innovations which have been created by R&D in the first place. Of course, such a level of R&D cannot be developed without creating an innovation system. A further contribution to the change in development and catch-up mechanisms between the two periods could come from the lesser importance attached to exports in the first period. During this period countries could have focused more on substituting imports than on creating exports and they could have switched to a more

export intensive strategy in the second period.

Development mechanisms seem to differ also amongst different starting income levels. Amongst the variables used in the regressions for countries of low income per capita GDP, openness and proximity are significant, for middle income per capita only GDP and openness are significant, and for high income per capita openness, labour productivity, population, REV, UEV and proximity are significant. For high income per capita countries labour productivity, population and UEV are significant but negative determinants of growth. These results mean that (i) development, and consequently catch-up, mechanisms and strategies differ depending on the starting level of income per capita of countries. Only countries having reached high levels of income per capita need to increase their related export variety to grow. The negative signs of labour productivity, population and UEV mean that (i) the lower the starting labour productivity the higher the expected rate of growth for this income per capita level; (ii) the lower the population the higher the expected rate of growth; (iii) as we had already found out in our previous study (Saviotti, Nesta Javaid, 2008) in the short run to raise REV is an economically sustainable strategy while to raise UEV is not. In this respect our results coincide with those of Lee et al (2008).

5) SUMMARY AND CONCLUSIONS

In this paper we have analysed the changing balance between convergence and divergence in economic development in presence of trajectories which in principle can provide a common constraint for all countries. We did not find in the literature on growth, on international trade and on innovation any strong reasons or overwhelming evidence to believe that the convergence of national economic systems is likely. Rather, all these theories stress both factors which could lead to convergence and factors which could lead to divergence. In general we can expect that possible paths of economic development will be determined by the dynamic equilibria between factors leading to convergence and factors leading to divergence. Our results show that: (i) there is no overall convergence since the distributions of GDP per capita, of REV, of UEV and of exports are consistently multimodal and become wider, although slightly flatter, between 1962 and 1999. Some evidence for the significance of proximity exists in econometric regressions in which GDP per capita is the dependent variable, but only for particular periods or for particular ranges of starting GDP per capita. Thus, a limited amount of convergence can exist at given times or for particular groups of countries but we find no evidence of a general convergence. The results of our calculations show that (i) the mechanisms of growth and consequently of catch-up change (a) in the course of time and (b) with the starting level of GDP per capita. Thus, the growth strategy using

export variety seems to have been used effectively only in the period 1981-1999 while it was not a significant determinant of growth in the previous period. Likewise, export variety is a significant determinant of growth only for countries of high starting GDP per capita. These results can be explained if the target of catching up countries is not a fixed one but if it keeps changing both qualitatively and quantitatively as a result of the previous development of leading countries. Thus, in the period 1981-1999, in order to raise their export variety, countries needed to start doing more systematically R&D, which means to develop innovation systems. In a similar way growing export variety is a significant determinant of growth only for countries with a high starting level of GDP per capita. The closer you get to the frontier of the time the more difficult it becomes to progress. In summary, development paths change as a result of the previous development by leading countries. At any given time the ingredients required to grow and the difficulties involved change as one moves closer to the technological frontier.

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