Capabilities, Competitiveness, Nations

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Abstract

This paper discusses the role of capabilities and competitiveness for the economic growth of nations. The capability concept is commonly used in analyses of firms, however, as this paper shows, it may also be used at the level of nations. Capabilities at the national level may be defined broadly as "social capabilities", as done by the economic historian Moses Abramovitz, or more narrowly as "technological capabilities" as suggested by the development scholar Lin-Su Kim. The paper discusses the relationships between these two dimensions of capabilities and examines recent empirical evidence on this matter for a group of 114 countries worldwide on different levels of development. It also considers the relationship between capabilities and competitiveness, and analyses the effects of capability change and other aspects of competitiveness on economic growth on data for the period 1995-2013. The final section presents the conclusions from the study and raises issues for future research.

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1. Introduction

One of the most challenging questions in economics is this: Why do some countries perform so much better economically than others over long periods of time? This is of course a matter of great theoretical and practical importance, and for this reason, it has attracted interest from economists for centuries. In fact, already Adam Smith struggled with this question. And, as the below quotation from Friedrich List - in a rebuttal to Smith's reasoning about the subject - shows, the idea that this has something to do with a country's capability to absorb, exploit and create knowledge has been around for a long time:

"The present state of the nations is the result of the accumulation of all discoveries, inventions, improvements, perfections and exertions of all generations which have lived before us: (...) every separate nation is productive only in the proportion in which it has known how to appropriate those attainments of former generations and to increase them by its own acquirements" (List 1841, p. 113).[1]

Nevertheless, the issue continues to be surrounded by controversy. One of the reasons has to do with resistance by many economists to the use of concepts such as knowledge, capabilities and competitiveness in connection with analyses of how countries perform. Such factors, it is commonly argued, are attributes of individuals, not collectives. What economists should do, following this view, is to analyze economic development as the result of interaction between individuals that seek to maximize their own welfare. However, whatever the merits of this approach, what seems clear is that it substantially reduces the range of phenomena that the analyst can meaningfully say something about (and hence influence). Arguably, many if not

[1] Cited after Soete et al (2010), p. 1161.

most issues that policymakers are concerned about simply slip under the radar of analysts basing themselves solely on this individualist approach.

Policymakers' need for advice is instead met by a more practically oriented literature, often related to the consultancy industry, based on the exploration of popular concepts, frameworks and exemplars considered to be relevant for decision-making in organizations at various levels. With respect to nations a typical example is the construction of composite indicators of competitiveness ranking countries according to how competitive (successful) they are (IMD 2012, WEF 2011). By taking into account the various dimensions that go into such indicators and how they are weighted together analysts may derive conclusions about the sources of a country's success – or a lack of such – relative to others and hence what might be done about it. Although the construction of these indicators is often almost void of theory (and based on very simple empirical methods), the interpretation of reality they convey and the advice this leads to receive much attention both in the media and among policy-makers.

Arguably, economists should be able to do better when it comes to providing relevant policy advice. While the individualist approach may be useful for analyzing certain issues, it should also be recognized that a collective cannot always be reduced to the sum of the attributes of the individuals joining it. Collectives such as firms, organizations and nations are more than the mere sum of their parts. They are also repositories of knowledge, institutions and resources that significantly influence the actions – including interactions – of their members in efforts to create and exploit economic value.

Nevertheless, it is often argued that use of concepts such as capabilities and competitiveness at the country level implies wrongly applying firm-level theories to the analysis of entire nations. This is so, the argument goes, because firms and nations are altogether different entities, and, hence, require different theoretical approaches to be adequately understood. However, while it

is certainly true that there are differences between firms and nations that should not be overlooked, there are also similarities that ought to be taken into account.[2] Both firms and countries are organized entities in which populations, based on their skills and resources, interact to create value, which is then distributed across the population according to certain criteria. Moreover, they both have systems of governance which significantly influence the creation and distribution of economic value and that affect their performance.

Hence, although there are important differences between countries and firms, the economic environment in which these entities operate, with its capitalist, knowledge-based dynamics, is essentially the same, and so are many of the factors that influence their performance. Using related concepts and understandings to analyze these challenges should therefore not be regarded as a deadly sin but on the contrary as quite natural. Doing so may also have the added arguably non-trivial benefit that it provides policy makers and managers with a common language for dealing with some of the challenges and opportunities they are facing.

The structure of the paper is as following. Section 2 discusses the part played by knowledge in economic growth, and the role of technological and social capabilities for the successful exploitation of knowledge towards this aim. How such capabilities can be measured is the topic under consideration in Section 3. Section 4 presents a model linking capabilities with growth and competitiveness. The subsequent section contains results from estimating the model on

[2] A common argument is that firms can go bankrupt (and eventually be forced out of business) while nations cannot. However, history is replete with examples of nations that did not survive, often because they were less efficient than others economically. The Soviet Union and the previously socialist countries in Eastern Europe come to mind as relevant examples. More recently, the governments of Greece, Portugal, Spain and others have been exposed to a lot of pressure for not governing their economies in a sufficiently good way.

cross-country data from the two last decades. Finally, Section 6 presents conclusions and points to topics for future research.

2. Knowledge, Economic Development and Capabilities[3]

Most people today would easily accept the view that knowledge and development are two sides of the same coin. But this is not the way growth and development normally has been analyzed in economics. Rather, from the classical political economists onwards, growth and development has been seen as arising from accumulation of (physical) capital. One possible explanation for this may be the close connection that existed during the so-called industrial revolution between introduction of new machinery and economic growth. Since new technology entered the economic sphere through investments (in machinery) it was the latter that was seen as the constraining (or enabling) factor and that hence merited most attention.

This tendency to reduce technology to machinery (or knowledge to artifacts) was something that not only affected economic orthodoxy. Even a highly heterodox economist such as Torstein Veblen argued along these lines in what may have been the first scholarly attempt to analyze catch-up processes in the world economy (Veblen 1915). In earlier times, Veblen argued, the diffusion of technology had been hampered by the fact that technology was mostly embodied in persons, so that migration of skilled workers was a necessary prerequisite for its spread across different locations. However, according to Veblen, the advent of ‘‘machine technology’ changed this logic completely (ibid. 191). In contrast to the conditions that had prevailed

[3] The issues covered in this section are surveyed in greater depth in Fagerberg and Srholec (2009) and Fagerberg, Srholec and Verspagen (2010).

previously, he argued, this new type of knowledge ‘‘can be held and transmitted … and the acquisition of it by such transfer is no laborious or uncertain matter’’ (ibid.). Hence, because of these changes, catch-up should be expected to be relatively easy and was under ‘‘otherwise suitable circumstances,’’ largely ‘‘a question of the pecuniary inducement and . . . opportunities offered ’’ (ibid. 192).

This optimistic mood with respect to what could be obtained through participating in technology diffusion came to be shared by most neoclassical economists in the early post-war period. According to Robert Solow, the most famous contributor to the development of the neoclassical theory of economic growth (Solow 1956), knowledge – or technology – should be regarded as a public good freely available to anyone with a desire to share it independent of their background or location. It follows that it should be expected to benefit everybody to the same extent. This was also the assumption adopted in subsequent applied research based on this perspective. Edward Denison, the leading researcher of cross country differences in economic growth in the Western world in the early post war period, put it as follows: "Because knowledge is an international commodity, I should expect the contribution of advances of knowledge (...) to be of about the same size in all the countries..." (Denison 1967, p. 282). To the extent that differences in income and productivity across countries remained, these would largely be explained by differential rates of capital accumulation in the past, related differences in saving behavior and demographic trends.

However, these optimistic predictions have not always been confirmed in reality (Fagerberg and Srholec 2005, Milanovic 2009). For example, during the 1980s and 1990s, what was called the “lost decades” for development (Easterly 2001), the difference between the poor and the rich part of the world was hardly reduced at all. One important reason for the failure of these predictions, we shall argue, has to do with how technology and its contribution to economic development were conceived by those who made them. Arguably, there is no such thing as a

worldwide stock of homogenous knowledge that flows across the globe at the speed of light and which everybody can exploit as much as they like. Rather there are many different types of knowledge and knowledge holders. Not all knowledge is scientific, as Friedrich von Hayek pointed out long ago (Hayek 1945). Much knowledge is practical and context specific (which does not make it less useful economically of course). Knowledge is also widely distributed across actors and contexts. As Hayek repeatedly stressed it is totally impossible for any actor, being a person or a firm (or a government for that sake), to know "everything" that may be relevant for the solution of an economic problem (what is often called "perfect knowledge"). In fact, just to identify what the relevant areas of knowledge are and how these can usefully be approached may be quite challenging.

Even in the case when the relevant knowledge can be identified, is codified and easily accessible, there is no guarantee that it will be successfully transferred. The knowledge may for example be difficult to understand and absorb. Higher education – even a doctorate or a whole group of people with such qualifications – may be required. Hence, it not sufficient to have access to knowledge, you must also have the necessary capabilities to understand, absorb and exploit it. Building such capabilities may be demanding, costly and time-consuming. Moreover, firms cannot rely on only one type of knowledge. They need to be able to access, absorb, combine and use many different types related to, for example, finance, logistics, products, markets, production etc. Access to necessary resources, such as ICTs, means of transport and skilled labor, and knowledge about how to access, keep and exploit those, is also crucial. It is of little help, say, to be aware of some promising knowledge if you cannot get hold of the resources necessary to reap the potential benefits from its exploitation.

Hence, if economic development primarily is about knowledge, then it must also be about the abilities of social actors to engage in the process of accessing, absorbing and using knowledge, so that income and welfare grow. Under capitalist conditions the most important social actor in

this respect is the firm. From this perspective the gradual enhancements of firm's capabilities in accessing, absorbing and using knowledge must be regarded as a crucial factor in economic development. The Korean development scholar Linsu Kim suggested the term "technological capability" for this phenomenon. He defined it as "the ability to make effective use of technological knowledge in efforts to assimilate, use, adapt and change existing technologies, (….) to create new technologies and to develop new products and processes…" (Kim 1997, p. 4).[4]

Kim's analyses were based on lessons from how Korean electronics firms, such as Samsung, gradually upgraded from a passive role of implementing imported technology, to a more active role of introducing incremental improvements, and eventually ventured into the forefront of innovation-based competition. He therefore distinguished between different layers of technological capability depending of the complexity of the challenge: production capability, investment capability and innovation capability. Production capability - the most basic requirement - is needed to operate productive facilities efficiently. Investment capability is required for the arguably more challenging task of establishing new productive ventures. Finally, innovation capability is seen as necessary for the development of new goods or services that better meet the requirements of the market. Kim expected the requirements to become more stringent, in particular with respect to innovation capabilities, as countries climb up the development ladder. Thus, following his view, for a firm or country in the process of catching up, the appropriate level of technological capability is a moving target.

[4] To the best of our knowledge the first to use this concept in print was Kim in an article in Research Policy (Kim 1980). It quickly became widely used, see for example Fransman and King (1984) and Lall (1987). For a survey and an application to the national level see Lall (1992).

Having pointed out the important role that firm level technological capabilities play in the process of development we now turn to question of how the development of such capabilities depends on the firm's environment. Firms are not isolated islands and their performances are also influenced by the characteristics of the environment in which they operate. That the social, institutional and political characteristics of the environment in which a firm operates influence its performance, is not a new insight. In fact, already in the 1960s Irma Adelman and Cynthia Morris pointed out, on the basis of an in-depth study of a number of indicators on development for a large number of countries, that "the purely economic performance of a community is strongly conditioned by the social and political setting in which economic activity takes place" (Adelman, Morris 1965, p. 578). This was also emphasized by the economic historian Moses Abramowitz, who used the term "social capability" for this aspect (Abramovitz 1986). He defined it as "countries' levels of general education and technical competence, the commercial, industrial and financial institutions that bear on the abilities to finance and operate modern, large-scale business, and the political and social characteristics that influence the risks, the incentives and the personal rewards of economic activity" (Abramovitz 1994a, p. 25).

Many of the concerns that led Adelman and Morris and Abramovitz to focus on the role of social, institutional and political aspects in development are also central in the more recent literature on "national innovation systems" (NIS). The NIS concept first appeared in work by Christopher Freeman (Freeman 1987), Bengt Åke Lundvall (Lundvall 1992) and Richard Nelson (Nelson 1993), and this analytic framework has since been extensively used in both scholarly and policy-analytic work (Sharif 2006). The concept may be used in a narrow as well as a broader sense (Edquist 2004). The narrower definition of the national innovation system includes innovative firms and the public research infrastructure with which they interact in varying degrees (Nelson 1993). The broader definition, which arguably is closer to Abramovitz'

reasoning, extends this to all learning and innovation activities in a country regardless of where these take place (Lundvall 1992, Edquist 2004).

The discussion so far leads to two propositions: 1) that generation of technological capabilities is a must for countries that wish to catch up and 2) that the degree of success in this aim to a large extent depends on wider economic, social, institutional and political factors. While many would sympathize with these propositions, they might perhaps have doubts about the possibility to explore these through empirical research, the issue to which we now turn.

3. (How) Can Capabilities be Measured?

The approach that will be pursued here is to assemble a set of indicators considered relevant for the phenomenon we wish to capture and construct a composite variable. In this respect, the underlying assumption is that indicators reflecting the same dimension of reality should be expected to be strongly correlated so that we can use factor analysis for this purpose. [5]

A challenge in empirical analyses of this type is to get high quality information on all the dimensions of reality that we wish to take into account for a sufficiently large number of countries and long enough time-span. Typically, there is a trade-off between availability of high quality information and the size and composition of the sample. Indeed, many potentially interesting indicators only exist for a small number of (mostly) developed economies. Annual data may also be problem, since many countries do not supply the type of information we wish to use on a yearly basis (and the years for which data exists may differ across countries).

[5] See Adelman and Morris (1965), Temple (1998), Temple and Johnson (1998) and Fagerberg and Srholec (2008) for earlier applications of factor analysis to cross-sections of countries.

Balancing the quest for high-quality of information on the one hand against sample size and time period on the other hand led to the choice of a cross-section sample of 114 countries on different levels of development between 1995 and 2013 (or the nearest year available).

The indicators of technological and social capabilities used in the study are listed in Table 1, while further information on definitions and sources can be found in Appendix.[6] In the case of technological capability the indicators taken into account here include the quality of a country's research system (as reflected in scientific publications), invention and innovation (as measured by patent applications and R&D expenditure) and development of the ICT infrastructure (proxied by internet users). While the two former dimensions may come close to what Kim had in mind with his concept "innovation capability", the latter may also be relevant for what he called "production" capability, since access to state of the art ICT is very important for firms' ability to produce and market goods and services and compete in global markets. With respect to social, institutional factors, or social capability, we were able to include three broad dimensions, the first of which is the skill-level of the population (as reflected in tertiary attainment, enrolment in (all forms of) education, and literacy). A second dimension refers to the quality of the governance in a country. Indicators taken into account in this case include measures how effective the government is, the extent to which corruption is a problem and, finally, whether law and order prevails. [7] Third, we included a range of indicators reflecting the

[6] In some cases observations were lacking and had to be estimated with the help of the other indicators in the data set. See Appendix for more information.

[7] Note that when it comes to measuring the quality of a country's governance, we have several sources of relevant information for each of the "sub-dimensions" taken into account here. Following Srholec and Verspagen (2012), therefore, a two-stage hierarchical approach to factor analysis was used. In the first stage information for each sub-dimension was synthesized into a

possibility of a nation's population to engage in political, social activities and (to some extent) economic activities.

Although the indicators taken into account cover many relevant dimensions, there were also certain aspects that we were not able to measure as well as we ideally would have liked. For example, both Kim and Abramovitz emphasized the importance of managerial capacity and supporting sources of finance. We are, however, not aware of any source of information that can be used to measure managerial capacity, apart from perhaps the availability of highly qualified labor (tertiary attainment, included in education), which is arguably much broader than what Kim and Abramovitz had in mind. The same goes for supporting sources of finance. For instance, with respect to the ability of organizing and financing new ventures, what Kim called "investment capability", supply of venture capital might perhaps been a relevant indicator. But unfortunately such information was only available for some of the countries included in our data-set and could therefore not be taken into account. Failing to do so, we considered broader measures of financial development, such as the size of a country's financial market, but eventually sided against their inclusion because we considered their relationship to a country's capability to exploit knowledge commercially to be problematic. Indeed, excessive "financialization" may also be a burden for the real economy of country rather than a capability. Finally, as emphasized by Abramovitz, it would have been interesting to be able include the prevalence of culturally embedded norms, e.g., social capital, of importance for economic development but again lack of available data for a sample of the present size precluded this.[8]

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common factor, which was then used in the second stage. See the Appendix Tables A1-A3 for results of the first-stage factor analysis.

[8] See Fagerberg and Srholec (2009) for a discussion of how such factors may be explored (for a more limited set of countries).

The factor analysis (Table 1) leads to the identification of four (for the most part) quite different capabilities, labeled Technology, Education, Governance and Empowerment, respectively. Technological capability is highly correlated with R&D, patenting and scientific publication but also, to a lesser extent, with advanced skills (tertiary attainment) and the proliferation of the internet. The analysis suggests that there are three different aspects of social capability. The first, Education, loads particularly highly on the two most basic education indicators, literacy and enrolment (in all types of education), but also on tertiary attainment and internet. The second, associated with quality of governance, is highly correlated with government effectiveness, (lack of) corruption, the prevalence of law and order and, to some degree, the related "physical integrity rights". Finally, the analysis suggests a third type of social capability reflecting the possibility of the population to take active part in society, we call this Empowerment.

[INSERT TABLE 1 ABOUT HERE]

Figure 1 plots the development of a country's technological capability over the period 1995-2013 against its initial level in 1995. In this way four quadrants appear. Up to the left, in the quadrant labeled "losing momentum", we find countries with a high but stagnating (or declining) technological capability. Very few countries appear in this category (Ukraine is the most obvious example). In contrast, the countries in the top right quadrant combine a high initial capability-level with an above average capability-increase. Hence, these are countries that are "moving ahead" technologically. Korea, Taiwan, Singapore, Israel and Finland are countries that particularly excel in this regard, but many other developed countries are also to be found in this category. Another group of countries with above average performance can be found down to the right. These countries, a mixed crowd of Asian (China for instance) and European

countries (from the Southern and Eastern part of the continent), are "catching up" technologically from a relatively low initial level. Finally, in the quadrant down to the left we find countries that are "falling behind" technologically, i.e., countries that combine a low initial level with below average performance. Many countries in Africa, Latin-America and Asia belong to this category, as do some previously socialist countries (i.e., countries once dominated by the former Soviet Union).

[INSERT FIGURE 1. ABOUT HERE]

For technological capability what can be observed is a strong tendency towards divergence, with the great majority of countries either moving ahead or falling behind. However, when it comes to education (Figure 2) there is clearly more convergence going on, with many highly developed and previously Socialist countries in the "losing momentum category" and a number of developing countries, particularly from Africa, "catching up". However, there are also many African countries in the "falling behind" category, so the performance of this continent in the educational area is far from uniform. Among the countries that are "moving ahead" on the educational front we find among others some of the Asian Tigers (Korea, Singapore and Taiwan) and Spain, Greece and Ireland.

[INSERT FIGURE 2. ABOUT HERE]

The tendency towards convergence in capability levels, which could be observed in the case of education, is even more pronounced for governance (Figure 3). In particular, many African, Asian and Eastern European countries improved their governance over this period, while it was the other way around for some developed countries (with already very high quality-levels at the outset). However, a number of previous Soviet republics, now independent, saw their governance deteriorate over the period. With respect to the degree of "Empowerment" (see

Figure 4), all quadrants are relatively well populated, indicating a lot of variation across countries both in the levels and trends.

[INSERT FIGURE 3. ABOUT HERE]

[INSERT FIGURE 4. ABOUT HERE]

4. Capabilities, growth and competitiveness: A model

In the previous section it was discussed how technological and social capabilities can be measured, and the distributions and dynamics of these capabilities were examined. However, our primary interest is in the relationship between these capabilities and economic growth. As a step towards analysing that issue we will in this section, following earlier work on the subject by Fagerberg (1988a,b) and Fagerberg, et al. (2007), go deeper into the relationships between capabilities and economic growth with the help of a formal model based on Schumpeterian logic. In the model growth is assumed to be the outcome of innovation and diffusion of technology and capabilities necessary for their economic exploitation.

Consider that the (volume of) GDP in a country (Y) is a function of its technological knowledge (T) and its social capacity for exploiting the benefits of knowledge (C):

(1) $$Y = f(T, C),$$

where T is a function of knowledge (or innovation) created in the country (N) and knowledge diffused to the region from outside (D):

(2) $$T = h(N, D).$$

Assume further that the diffusion of external knowledge follows a logistic curve (Metcalfe, 1988). This implies that the contribution of diffusion of externally available knowledge to economic growth is an increasing function of the distance between the level of knowledge appropriated in the country and that of the country on the technological frontier. Hence, for the frontier country, this contribution will be zero by definition. Let the total amount of knowledge, adjusted for differences in size of countries (e.g., per capita, hence the *cap* superscript), in the frontier country and the country under consideration, be T_*^{cap} and T_i^{cap} respectively and let *d* be the rate of growth of knowledge diffused to the region from outside (*D*):

(3) $d = \gamma - \gamma T^{gap}$, where $T^{gap} = \frac{T_i^{cap}}{T_*^{cap}}$

By differentiation and substitution we arrive at the following solution for growth of GDP, using small case letters for growth rates (e.g., $y = dY/Y$ etc.):

(4) $y = \gamma\, \varepsilon_{YT}\varepsilon_{TD} - \gamma\, \varepsilon_{YT}\varepsilon_{TD} T^{gap} + \varepsilon_{YT}\varepsilon_{TN} n + \varepsilon_{YC} c$

where $\varepsilon_{YT} = \frac{\partial Y}{\partial T}\frac{T}{Y}$ refers to the partial elasticity of GDP with respect to technology (similar for other variables) .

In the model, three sets of factors determine the rate of growth of a country: (1) The potential for exploiting knowledge developed elsewhere; (2) the creation of new knowledge within the country; and (3) the growth in the social capacity to exploit (or "absorb") knowledge (independently of where it is created). The model encompasses many of the empirical models found in the literature on catching-up and differences in economic growth across countries. For instance, many if not most empirical models used in the "catching-up" literature are variants of equation (4) when we drop the innovation term (see, for example, Baumol et al., 1989). Focusing more explicitly on the role of innovation for catch-up, Fagerberg (1987, 1988a)

showed that countries that caught up very fast also had very rapid growth of innovative activity. The analysis suggested that superior growth in innovative activity was the prime factor behind the huge difference in performance between newly industrialized countries (NICs) in Asia and Latin America in the 1970s and early 1980s. Fagerberg and Verspagen (2002) have shown that the rapid increase in its innovative performance was the primary cause of the continuing rapid growth of the Asian NICs relative to other country groupings in the decade that followed. The research (Fagerberg, 1987; Fagerberg and Verspagen, 2002) also indicates that innovation may have become more important for economic growth over time (while imitation has become more demanding).

The above model abstracts from trade but to get a more complete understanding of the role played by competitiveness[9] we will in a second step include trade as well. To see how this may be done consider a two-economy model, in which one "country" interacts with the rest of the "world". Let exports be *X*, imports be *M* and *W* be world demand, all measured in terms of volume. In addition to the two explanatory factors already taken into account, i.e., (1) The country's technological competitiveness (its knowledge assets relative to competitors) and (2) Its social capacity to exploit technology commercially (again relative to competitors), we now also include (3) Its price competitiveness (relative prices on tradeables in common currency); and (4) World demand. The two first factors, technology and social capacity, are the same as earlier but measured relative to the world average. Consider exports as:

(5) $$X = f(T, C, P, W),$$

[9] A common definition of competitiveness is: "the degree to which, under open market competition, a country can produce goods and services that meet the test of foreign competition while simultaneously maintaining and expanding domestic real income" (OECD 1992, p. 237).

where T, C, P is technology, capacity and price competitiveness in country i, relative to the world: $T = \frac{T_i}{T_{world}}$, $C = \frac{C_i}{C_{world}}$, $P = \frac{P_i}{P_{world}}$

Since imports in this model are the "world's " exports, we can model imports in the same way, noting that the competitiveness variables in this case are the inverse of those in equation (5) and that domestic demand (Y) replaces world demand:

$$M = g\left(\frac{1}{T}, \frac{1}{C}, \frac{1}{P}, Y\right) \tag{6}$$

If we - for the time being - take world demand and technology, social capacity and price competitiveness as given, equations (5)-(6) give us two relationships between three endogenous variables (Y, X and M).[10] To solve the open economy model for, say, GDP growth we need an additional constraint linking growth to trade. It is common to assume in the literature that there exist economic mechanisms that prevent a country from continuing on paths that would not be sustainable in the long run, such as accumulating ever-increasing debts or claims on a grand scale vis-à-vis the rest of the world. This may occur through adjustments of the fiscal and monetary policy stance, but it may also be the result of working of markets, such as the capital, labor and currency markets. Fagerberg (1988b) and Meliciani (2001) tested this restriction on evidence from developed economies and found that it was supported by the data. Formally, following earlier contributions by Thirlwall (1979) and Fagerberg (1988b), what we assume is balanced trade (equation (7) below) which is equivalent with balancing savings and investments. Note that an alternative way to formulate this restriction that would be consistent with the model

[10] A feedback from the endogenous variables (growth and trade) on capabilities and prices cannot be excluded a priori but we have at the present stage of the analysis chosen to regard capabilities and prices as exogenous (see Fagerberg et al. (2007) for an extended discussion).

is to assume that the surplus (deficit) used to service foreign debts (financed from foreign assets) is a constant fraction of exports (or imports).[11] Thus, the analysis presented here is consistent with a world in which countries have foreign debts or assets.

(7) $XP = M$

We assume as before (equations (2)-(3)) that technology depends on both national sources (*N*) and diffusion (*D*) from abroad, and that the latter follows a logistic curve. By totally differentiating (2)-(3) and (5)-(7), substituting and rearranging, the following solution for growth of GDP follows:

(8)

$$y = \gamma\ \varepsilon_{TD}\frac{\varepsilon_{XT}+\varepsilon_{MT}}{\varepsilon_{MY}} - \gamma\ \varepsilon_{TD}\frac{\varepsilon_{XT}+\varepsilon_{MT}}{\varepsilon_{MY}}T^{gap} + \varepsilon_{TN}\frac{\varepsilon_{XT}+\varepsilon_{MT}}{\varepsilon_{MY}}n + \frac{\varepsilon_{XC}+\varepsilon_{MC}}{\varepsilon_{MY}}c + \frac{\varepsilon_{XP}+\varepsilon_{MP}+1}{\varepsilon_{MY}}p + \frac{\varepsilon_{XW}}{\varepsilon_{MY}}w$$

We see that the growth of a country now depends on five factors: (1) The potential for exploiting knowledge developed elsewhere, which depends on the country's level of technological development relative to the world frontier; (2) Creation of new knowledge (technology) in the country relative to that of competitors; (3) Growth in the social capacity to exploit knowledge, independently of where it is created, relative to that of competitors; (4) Change in relative prices in common currency and (5) Growth of world demand weighted by the ratio between the income elasticity for exports and that of imports.

By comparing equation (8) with the reduced form of the simple growth model considered previously (equation 4), we see that, apart from the two last terms on the right hand side, the model has the same structure. The only difference is that the coefficients of the growth equation

[11] As is easily verified, we may multiply the left or right hand side of (7) below with a scalar without any consequence for the subsequent deductions.

(the reduced form) now are sums of coefficients for the similar variables in the equations for exports and imports divided by the income elasticity of imports. Hence, the higher the income elasticity for imports is, the lower the effect on growth of all other factors will be. Moreover, the two last terms in (8) resemble the open-economy growth model suggested by Thirlwall (1979). The first of these two terms is the familiar Marshall-Lerner condition, which states that the sum of the price elasticities for exports and imports (when measured in absolute value) has to be higher than one if deteriorating price competitiveness is going to harm the external balance (and – in this case – the rate of growth of GDP). The second reflects the argument put forward by Thirlwall (1979) and Kaldor (1981) that the extent to which a country is specialized in industries that are in high (low) demand at home and abroad may be of vital importance for its economic growth. Thus, the simple growth model outlined previously and the Kaldor-Thirlwall model may be seen as special cases of the more general Schumpeterian open economy model presented above.

5. The competitiveness of nations: An empirical analysis

In this section we will, following Fagerberg, et al. (2007), exploit the reduced form of the above model (equation 8) to explain growth performance for a cross section of 114 countries between 1995 and 2013. The analysis that follows extends earlier work on the subject in various ways. First, we are going to consider a more recent time period. [12] Second, we aim for a richer treatment of technological and social capabilities (and their impacts) than what was possible previously. This allows us, for example, to include ICT infrastructure in a more satisfactory

[12] The earlier analysis of Fagerberg, et al. (2007) covered the time period 1980-2002.

way than before. However, the biggest difference compared with earlier work regards the treatment of social capabilities, which instead of being summarized into a single variable,[13] are included here as three different dimensions, each with its own distribution and dynamics. Third, to better take into account the role played by global demand for economic growth we allow for differences in export specialization with respect to goods and services as well as markets (trading-partners). [14]

Hence, the empirical model to be estimated contains the following variables:

[13] Fagerberg, et al. (2007) used the term "capacity competitiveness" for what we here, following Abramovitz (1986, 1994a,b) and Fagerberg and Srholec (2008), call "social capabilities".

[14] Demand (w_i) is computed by weighting the growth of world demand by product or market (g_j) (i.e. the log difference) with the initial composition (specialization) of each country's exports (s_{ij}):

$$w_i = \sum_{j=1}^{m}\left(g_j \times s_{ij}\right), \text{ with } \quad s_{ij} = \frac{X_{ij}^{t-1}}{\sum_{j=1}^{m} X_{ij}^{t-1}} \quad \text{and} \quad g_j = \ln\left(\sum_{i=1}^{n} X_{ij}^{t}\right) - \ln\left(\sum_{i=1}^{n} X_{ij}^{t-1}\right),$$

where *i* is the exporting country and j is either a product or a market. X_{ij} denotes the country's *(i = 1…n)* exports of a product/to a market *(j = 1...m)* while *t-1* and *t* are two points in time. A high score indicates favorable demand conditions for a country's exports. Both merchandise trade and trade in services are included in the computation of demand by product, while only the former is available for demand by market. Demand by product is based on data for merchandise trade at 3-digit level of SITC, rev. 3, with 255 product categories and trade in services distinguished in three categories (transport, travel and other services). Demand by market is based on data for merchandise trade by 215 partner countries.

Dependent variable:

- GDP growth 1995-2013(log difference)

Explanatory variables:

- Gap: Log of the ratio of initial GDP per capita to the frontier country in 1995

- Capabilities: Change of technological and social capabilities 1995-2013

- Price: Growth of the real effective exchange rate 1995-2013 (log difference)

- Demand: Growth in world demand 1995-2013 (log difference) weighted by the initial commodity and market composition of each country's exports in 1995

For more information on sources and definitions, see Appendix.

Table 2 contains the results. Four different regressions are reported. The first column contains ordinary-least-squares (OLS) estimates of the basic model, while the second and third columns repeat the same exercise with methods that adjust for the possible impact of outliers, using the iteratively-reweighted-least-squares estimator suggested by Li (1985) and OLS excluding outliers,[15] respectively. The results are very similar across the three different specifications and the explanatory power is quite respectable, around 50%. In all cases the economic growth of a country is positively related to a large scope for imitation, growing technological capability, increased education, improved governance and high demand for the goods and services the country produces (and to some extent the markets it sells to as well). However, neither (change in) empowerment nor price competitiveness seems to matter much.

[15] The countries identified as outliers on the base of Cook's distance and excluded from the third column are Algeria, Azerbaijan, Democratic Rep. of Congo, Qatar, and Venezuela.

[INSERT TABLE 2 ABOUT HERE]

To test for the robustness of these results to the inclusion of other exogenous variables, reflecting differences in history, geography and nature, we add in the third column a battery of such indicators to the model and eliminate these variables one by one using a backward search, applying the 10% level of significance as criterion for whether to retain a variable or not. The exogenous variables included in this robustness test were: Ethnic, linguistic and cultural fractionalization, size of domestic market, oil and gas endowments, access to ocean, natural disasters, climate (tropics or subtropics), and malaria ecology drawn from Alesina, et. al (2003), Fearon (2003), Gallup et al. (1999), Kiszewksi, et al. (2004) and Université catholique de Louvain (2014). As shown in the fourth column of Table 2, only two such variables were retained, but with minimal influence on the estimates of the other variables included in the model, which hence may be deemed reasonably robust.[16]

An interesting question on which there is little evidence so far concerns the extent to which countries that increase one capability in tandem with other capabilities get an extra bonus (i.e. if there is a "complementarity" effect). This was tested adding interaction terms between the capability variables one by one to the regression in the fourth column. However, in no case did the interaction effect turn up significantly different from zero at the 10% level. We also tested

[16] Being a tropical country is positive for growth, which may seem surprising given the challenges that many of these countries face. However, many of the potentially negative effects of being a tropical country, related to extreme weather for instance, are also covered by the "natural disaster" variable. So the positive effect of being a tropical country may be interpreted as being conditional on accounting for some other effects in the model.

for the possibility of longer lags for the capability variables by including the initial level alongside the change of the variable. However, this was not supported either, except for the empowerment variable, which came out with the opposite sign (negative) of what should be expected.

To explore the implications of the main findings in more detail we provide in Table 3 below a decomposition of how the model explains the relative growth performance of groups of countries with similar characteristics (with respect to their geographical location, history and level of development). The prediction is based on the fourth model reported in Table 2 (with control variables, subsumed under "Other" in Table 3). The various country groupings in the table are mostly self-explanatory except, perhaps, for "Other former socialist countries" which consist of countries once belonging to - or dominated by - the then the Soviet Union and which have not later joined the European Union (see Appendix Table A4 for more details).

[INSERT TABLE 3 ABOUT HERE]

Table 3 reveals that the prediction is reasonable for most country groupings, confirming that the model explains the growth pattern of the last two decades rather well. Nevertheless, the model fails to fully account for the very rapid growth of the catching-up economies in Asia (e.g., China) during this period. The analysis confirms that differences in the scope for imitation (the Gap) are crucial for explaining differences in growth. According to the decomposition, the developed countries should for this reason alone be expected to grow about 3.3% less per year than the countries of Sub-Saharan Africa (the poorest country group in the sample), which is not far from what actually happened.

Besides the scope for imitation the most powerful factor for "why growth rates differ" appears to be changing technological capability. For example, this is the major reason why the Asian Tigers outperformed the other developed countries during this period. The failure of many

poorer countries to improve their technological capabilities (relative to the countries in the developed part of the world) also go some way in explaining why opportunities for growth were not fully exploited. However, increases in education and improvements in governance also mattered, although less. For example, improved skills added about 0.2 % per year for the Asian Tigers, while a similar reduction in growth occurred for the "Former Socialist Countries" due to deteriorating education there. Improved quality of governance was of greatest importance for the countries which joined the European Union after the dissolution of the Soviet empire: the decomposition attributes about one third of their catch up vis-à-vis the developed countries to this factor.

The important role played by changes in technological capability may merit a more detailed analysis. Figure 5 reports the contributions from the various indicators that make up the composite technological capability variable. It is interesting to note the different roles that the various indicators play for country groups at different levels of development. In many countries on a medium to low level of development the major contribution to growth of technological capability tends to come from diffusion of ICTs. This is particularly notable for the "Former socialist countries", the Latin American countries and the countries in the Middle East and North Africa. At a higher level of development, however, growing "innovation capabilities" as reflected by increases in science, R&D and patenting are of much larger significance. This pattern is especially evident for the "Asian Tigers" for which more than three quarters of their (exceptionally high) capability growth come from such advanced sources. Moreover, among the countries in the developing part of the world, the countries of East Asia stand out by having both the fastest growth of technological capability and the largest share of this growth coming from R&D investments, indicating – perhaps - that the innovation-based growth model spearheaded by the Asian Tigers is spreading to other countries in East Asia.

[INSERT FIGURE 5. ABOUT HERE]

6. Conclusions

This paper has argued that concepts such as capabilities and competitiveness are not only relevant for firms (Teece 2010) but also for nations. Countries are more than mere sums of the characteristics of the individuals that happen to live there. They are also repositories of knowledge, institutions and resources that underpin the economic activities within their respective borders. Such country-level characteristics influence the economic activities of its firms and citizens.

Previous research has identified two main types of capabilities, technological and social. Technological capabilities refer to the ability to create and exploit knowledge to produce goods and services. Such capabilities are often firm-specific but are also influenced by environments in which firms operate, as firms increasingly depend on external sources for developing and improving their capabilities. Technological capability also has an important national dimension as countries regularly devote large resources to develop and maintain such capabilities.

While technological capabilities largely are attributes of firms, social capabilities are characteristics of the social environment that firms share, and that influence firm's operations in various ways, from being a source of much needed resources, such as skills, to for example providing an institutional and legal framework for firms' activities. Although politicians may influence the development of technological capability, and many examples – not the least from the emergence of the Asian Tigers as technological and economic powerhouses in the world economy – testify to that, their say is probably even larger when it comes to social capabilities.

The formal model and its application to data for a large number of countries highlight the important roles played by technological and social capabilities for competitiveness. The main argument put forward here is that both technological and social capabilities are required. While technological capability provides a basis for competitiveness, social capability is a prerequisite for successful economic exploitation of technology. The empirical results presented here indicate that such capability building may be vastly more important economically than so-called price-competitiveness, which traditionally has been the major focus of economists.

However, the research reported in this paper also point to several issues that deserve to be explored further in future work on the role of capabilities for competitiveness and economic growth. For example, there is a need to improve indicators to better measure aspects of technological and social capabilities that have not been measured adequately so far. This relates, for example, to relatively basic technological capabilities associated with production, distribution and (incremental) learning, what Kim called "production capabilities", that are generally taken for granted in developed economies but that may vary a lot in the developing part of the world. It also holds for the impact of more informal institutions such as beliefs, norms and routines for which relevant indicators for large, cross-country samples have been hard to come by. The inconclusive results reported in this paper for the "Empowerment" variable also calls for more conceptual work on the role of political, institutional and social factors for growth and competitiveness. Moreover, as noted existing research has not come very far in measuring the impact of capabilities in management and finance of new ventures. Related to this is also the broader issue of the role of the financial sector for the performance of the real economy, and hence growth and competitiveness, on which both conceptual and empirical work should be welcomed.

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Appendix (data & sources)

A brief overview of definitions and sources of the indicators is given in the table below. The main source of data is the Conference Board (2014), UNESCO (2014), World Bank (2014), PRS Group (2014), National Science Board (2012 and 2014), USPTO (2014), Barro and Lee (2010), Kaufmann, et al. (2014), Cingranelli, et al. (2014), Freedom House (2014ab), Darvas (2012), UNCTAD (2014), Gallup, et al. (1999) and Université catholique de Louvain (2014). The database has been complemented by international data from other sources such as Castellacci and Natera, (2011) and OECD (2014), while national sources were only used Taiwan if necessary.

Sample size and composition was given by the availability of data. GDP, price and demand data were fully available for all countries in both periods. For the indicators of technological and social capabilities we used data form the nearest available year to 1995 and 2013. Although the selected indicators have broad coverage, in some cases there were missing values that had to be dealt with. A number of the advanced countries do not monitor literacy anymore. We assumed that all of these countries maintain 99.5% literacy. The remaining missing data were estimated using the *impute* procedure in Stata 11.2 (see the Stata 11.2 Manual for details). We based the estimation on data for the other indicators used to construct the capability measures. The number of observations (in both periods) estimated by the procedure is given in the last column of the following table.

Indicator & definition	*Scaling*	*Source*	*Estimated observations*
GDP: Gross Domestic Product (GDP) converted to 2013 price level with updated 2005 EKS PPPs.	USD	Conference Board (2014)	0
Scientific and engineering articles: Counts of articles published in journals covered by Science Citation Index (SCI) and Social Sciences Citation Index (SSCI).	per mil. people	National Science Board (2012 and 2014)	0
USPTO patent applications: Counts of applications for utility patens filed in the United States Patent and Trademark Office (USPTO) classified by country of residence of the first named inventor.	per mil. people	USPTO (2014)	0
R&D expenditures: Intramural expenditure on research and experimental development (R&D) performed on the national territory.	% of GDP	UNESCO (2014), OECD (2014), Castellacci and Natera, (2011) and national sources	34
Internet users: Internet users are individuals who have access to the Internet (from any location or device).	per 100 people	World Bank (2014)	0
Tertiary attainment: People aged 25 and over whose highest schooling level attained is tertiary.	%	Barro and Lee (2010)	24
Literacy rate: People aged 15 and over who can read, understand a write a short, simple statement on their everyday life.	%	World Bank (2014)	1
Education enrolment: Primary, secondary and tertiary education enrolment, regardless of	%	World Bank (2014)	37

age (gross), expressed as a percentage of the total population of primary and secondary school age and the five-year age group following on from secondary school leaving.			
Bureaucracy quality: An assessment of the institutional strength and quality of the bureaucracy, which represents a shock absorber that tends to limit revisions of policy when governments change.	index	PRS Group (2014)	14
Corruption: An assessment of corruption within the political system not only in the form of financial corruption but also excessive patronage, nepotism, job reservations and 'favor-for-favors', secret party funding, and suspiciously close ties between politics and business.	index	PRS Group (2014)	14
Law and order: An assessment of the "Law" element, in which the strength and impartiality of the legal system are considered, and the "Order" element, which is an assessment of popular observance of the law.	index	PRS Group (2014)	14
Bureaucracy and policy consistency: An assessment of the quality of the country's bureaucracy, how confident businesses can be of the continuity of economic policy stance and the extent to which policy-making is far-sighted, or conversely aimed at short-term economic advantage.	index	Global Insight Business Risk and Conditions (WMO) – data retrieved from Kaufmann, et al. (2014)	1
Corruption: An assessment of the intrusiveness of the country's bureaucracy. The amount of red tape likely to be countered is assessed, as is the likelihood of encountering corrupt officials and other groups.	index	Global Insight Business Risk and Conditions (WMO) – data retrieved from Kaufmann, et al. (2014)	1

Judicial independence and crime: An assessment of how far the state and other outside actors can influence and distort the legal system and how much of a threat businesses face from crime.	index	Global Insight Business Risk and Conditions (WMO) – data retrieved from Kaufmann, et al. (2014)	1
Quality and excessiveness of bureaucracy: An assessment of institutional effectiveness and the extent of red tape.	index	Economic Intelligence Unit (EIU) – data retrieved from Kaufmann, et al. (2014)	15
Corruption: An assessment of corruption among public officials.	index	Economic Intelligence Unit (EIU) – data retrieved from Kaufmann, et al. (2014)	15
Rule of law: An assessment of the legal system in terms of fairness of judicial process, enforceability of contracts, speediness of judicial process, the risk of confiscation and expropriation, intellectual property rights protection, private property protection and the extent of violent and organized crime.	index	Economic Intelligence Unit (EIU) – data retrieved from Kaufmann, et al. (2014)	15
Civil liberties: An assessment of the degree of the freedoms of expression, assembly, association, education, and religion and personal autonomy without interference from the state. The scale of the indicator has been reversed into increasing order, while keeping its original range.	index	Freedom House (2014a)	2
Freedom of the press: An assessment of legal, political and economic environment for the media. The scale of the indicator has been reversed into increasing order, while keeping its original range.	index	Freedom House (2014b)	0

Empowerment rights: An assessment of the degree of the freedoms of foreign movement, domestic movement, speech, assembly and association, workers' rights, electoral self-determination and freedom of religion.	index	Cingranelli, et al. (2014)	2
Women's rights: An assessment of adherence to women's economic, political and social rights.	index	Cingranelli, et al. (2014)	2
Physical integrity rights: An assessment of adherence to a group of four rights known as the "physical integrity rights": rights to freedom from extrajudicial killing, disappearance, torture, and political imprisonment.	index	Cingranelli, et al. (2014)	2
Price: Real effective exchange rate	index	Darvas (2012)	0
Demand by product: Growth in world demand weighted by the initial commodity composition of each country's exports.	index	UNCTAD (2014)	0
Demand by market: Growth in world demand weighted by the initial market composition of each country's exports.	index	UNCTAD (2014)	0
Tropics: Land in Koeppen-Geiger tropical climate (Af+Am+Aw) as the proportion of total land area.	%	Gallup, et al. (1999)	0
Natural disasters: Log of people killed in natural disasters (earthquake, volcano, storm, drought, flood, extreme temperature, wildfire, landslide and epidemic) per total population.	per mil. people	Université catholique de Louvain (2014)	0

Table A1: Government effectiveness: Results of the factor analysis

	Factor loadings
Bureaucracy quality (PRS)	0.84
Bureaucracy and policy consistency (WMO)	0.90
Quality and excessiveness of bureaucracy (EIU)	0.91

Note: 78.1% of total variance explained, the extraction method is principal factors, oblique oblimin rotation, based on pooled data in 114 countries in 1995 and 2013, hence 228 observations in total.

Table A2: (Lack of) corruption: Results of the factor analysis

	Factor loadings
Corruption (PRS)	0.79
Corruption (WMO)	0.89
Corruption (EIU)	0.93

Note: 76.2% of total variance explained, the extraction method is principal factors, oblique oblimin rotation, based on pooled data in 114 countries in 1995 and 2013, hence 228 observations in total.

Table A3: Law and order: Results of the factor analysis

	Factor loadings
Law and order (PRS)	0.79
Judicial independence and crime (WMO)	0.95
Rule of law (EIU)	0.94

Note: 79.8% of total variance explained, the extraction method is principal factors, oblique oblimin rotation, based on pooled data in 114 countries in 1995 and 2013, hence 228 observations in total.

Table A4: Regional groups of countries

Developed countries	Australia, Austria, Belgium, Canada, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, Malta, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States
East Europe (new EU members)	Bulgaria, Croatia, Czech Rep., Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia
Other former socialist countries	Albania, Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Macedonia, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan
Latin America	Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Rep., Ecuador, Guatemala, Jamaica, Mexico, Peru, Trinidad and Tobago, Uruguay, Venezuela
Asian Tigers	Hong Kong, Korea, Singapore, Taiwan
East Asia	Cambodia, China, Indonesia, Malaysia, Philippines, Thailand, Vietnam
South Asia	Bangladesh, India, Pakistan, Sri Lanka
Middle East and North Africa	Algeria, Bahrain, Egypt, Iran, Jordan, Kuwait, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, Turkey, United Arab Emirates, Yemen
Sub-Saharan Africa	Angola, Burkina Faso, Cameroon, Cote d'Ivoire, Democratic Rep. of Congo, Ethiopia, Ghana, Kenya, Madagascar, Malawi, Mali, Mozambique, Niger, Nigeria, Senegal, South Africa, Tanzania, Uganda, Zambia

Tables and Figures (in the main text)

Table 1: Capabilities: Results of the factor analysis

	Factor loadings			
	Technology	Education	Governance	Empower-ment
Scientific and engineering articles	0.51	0.05	0.44	0.06
USPTO patent applications	0.89	-0.02	-0.02	0.02
R&D expenditures	0.70	0.06	0.21	0.08
Internet users	0.39	0.48	-0.14	-0.02
Tertiary attainment	0.32	0.56	0.00	0.13
Literacy	-0.13	0.84	0.06	0.04
Education enrolment	0.05	0.83	0.13	0.00
Government effectiveness	0.05	0.08	0.86	0.02
(Lack of) corruption	0.02	-0.03	0.92	0.08
Law and order	0.02	0.09	0.91	-0.01
Civil liberties	0.08	0.13	0.03	0.83
Freedom of the press	0.06	-0.13	0.23	0.80
Empowerment rights	-0.06	-0.02	-0.08	0.99
Women's rights	0.10	0.27	0.03	0.60
Physical integrity rights	-0.08	0.06	0.45	0.40

Note: 78.2% of total variance explained, the extraction method is principal factors, oblique oblimin rotation, based on pooled data in 114 countries in 1995 and 2013, hence 228 observations in total.

Table 2. Explaining GDP growth: Regression results, various estimators, 1995-2013

	OLS	*Iteratively re-weighted least squares*	*OLS Excluding outliers*	*OLS Excluding outliers*
Gap	-0.59***	-0.64***	-0.75***	-0.74***
	(5.38)	(7.64)	(8.42)	(7.22)
Δ technology	0.20***	0.19**	0.24***	0.25***
	(2.67)	(2.21)	(3.24)	(3.56)
Δ education	0.16***	0.17**	0.18***	0.18***
	(2.65)	(2.57)	(2.86)	(2.86)
Δ governance	0.22**	0.17**	0.20***	0.21***
	(2.15)	(2.46)	(2.97)	(2.98)
Δ empowerment	-0.07	-0.04	-0.06	-0.06
	(0.97)	(0.53)	(0.97)	(0.97)
Δ price	0.00	-0.05	-0.04	-0.04
	(0.03)	(0.77)	(0.55)	(0.51)
Demand by product	0.33***	0.24***	0.31***	0.30***
	(3.01)	(3.43)	(4.36)	(4.51)
Demand by market	0.17**	0.14*	0.10	0.11
	(1.99)	(1.94)	(1.38)	(1.55)
Tropics	..	..	..	0.15*
				(1.73)
Natural disasters	..	..	..	-0.12**
				(2.01)
F-test	14.49***	13.69***	22.94***	26.16***
R^2	0.47	0.43	0.58	0.61
Number of observations	114	114	109	109

Note: Absolute value of robust t-statistics in parentheses. *, **, *** denote significance at the 10, 5 and 1 per cent levels. Cook's distance used to exclude outliers with the conventional cut-off point at 5 / number of observations. Beta values reported.

Table 3. Explaining annual GDP growth: A decomposition, 1995-2013

	N	Actual growth	Estimated Growth	Contribution of the explanatory factors to difference from the world average								
				Gap	Δ tech-Nology	Δ edu-cation	Δ gover-nance	Δ empo-werment	Δ price	Demand by product	Demand by market	Other (geo, etc.)
Developed countries	26	2.12	2.21	-1.45	0.40	-0.06	-0.19	0.01	0.02	-0.13	-0.13	-0.15
East Europe (new EU members)	11	3.15	3.50	-0.41	0.03	0.05	0.34	-0.05	-0.06	-0.18	0.01	-0.12
Other former socialist countries	13	4.82	4.62	0.73	-0.31	-0.19	0.15	0.05	0.01	0.01	0.31	-0.01
Latin America	14	3.56	3.82	-0.14	-0.22	0.04	0.02	-0.02	-0.01	0.05	-0.07	0.28
Asian Tigers	4	4.17	4.15	-1.30	1.24	0.19	0.21	0.01	0.04	-0.28	0.05	0.08
East Asia	7	5.54	4.36	0.76	-0.05	0.07	-0.19	-0.03	0.00	-0.24	-0.04	0.20
South Asia	4	5.43	4.45	1.34	-0.25	-0.11	0.07	0.05	-0.01	-0.40	-0.06	-0.06
Middle East and North Africa	12	4.31	4.12	-0.32	-0.18	0.10	-0.13	0.01	0.00	0.72	0.09	-0.06
Sub-Saharan Africa	18	5.10	5.52	1.83	-0.29	0.05	0.05	-0.02	0.00	0.01	-0.03	0.03

Note: Based on column 4 in Table 2. Average annual GDP growth in the world, i.e. the intercept, is estimated at 3.88 per cent. N is number of observations.

Figure 1. Technology (1995-2013)

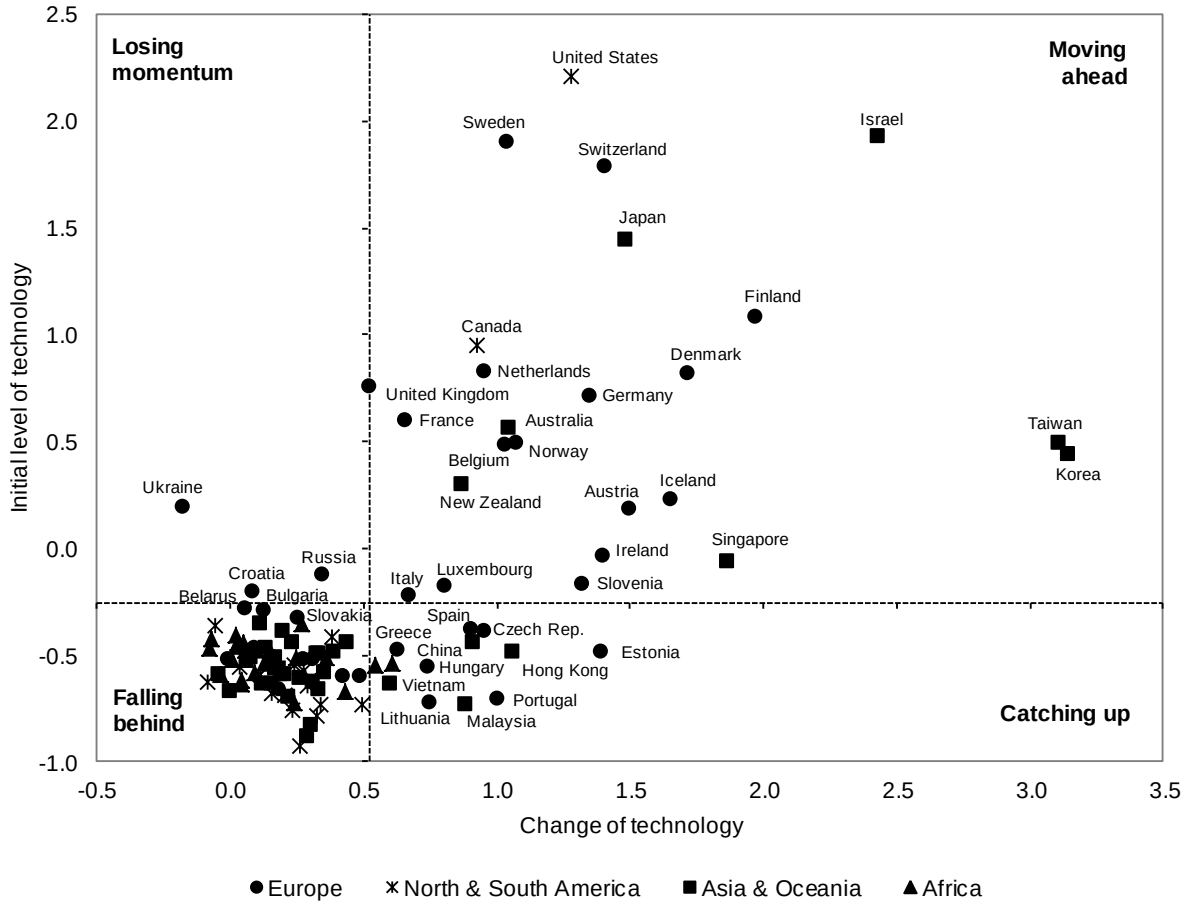

Figure 2. Education (1995-2013)

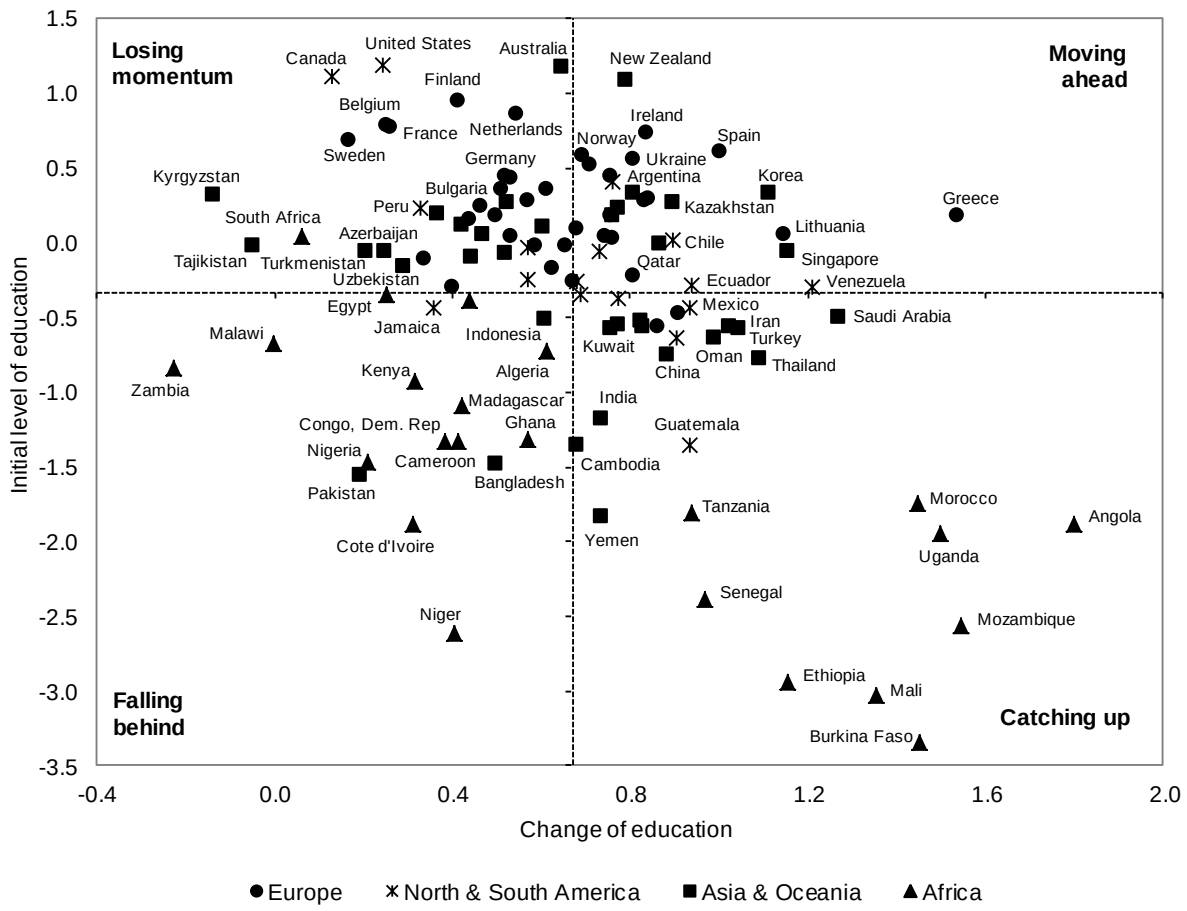

Figure 3. Governance (1995-2013)

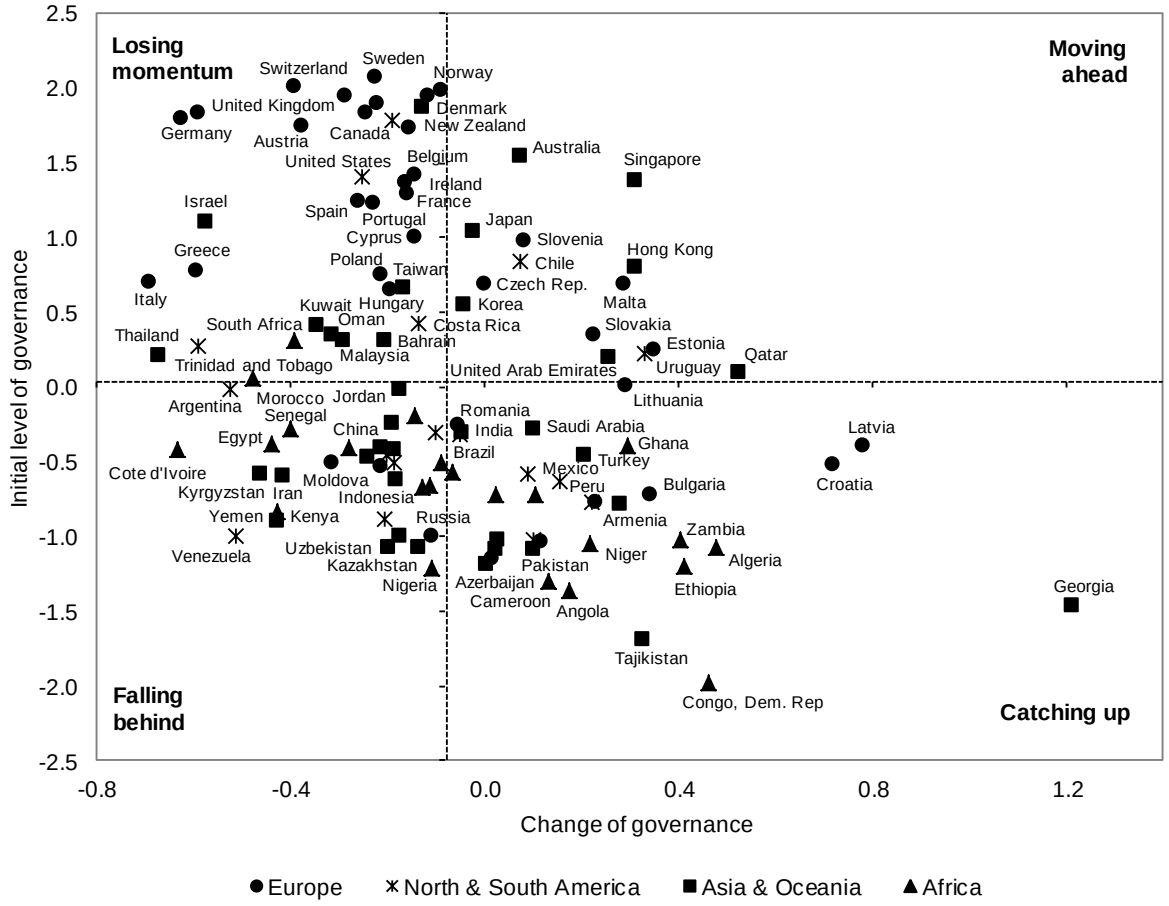

Figure 4. Empowerment (1995-2013)

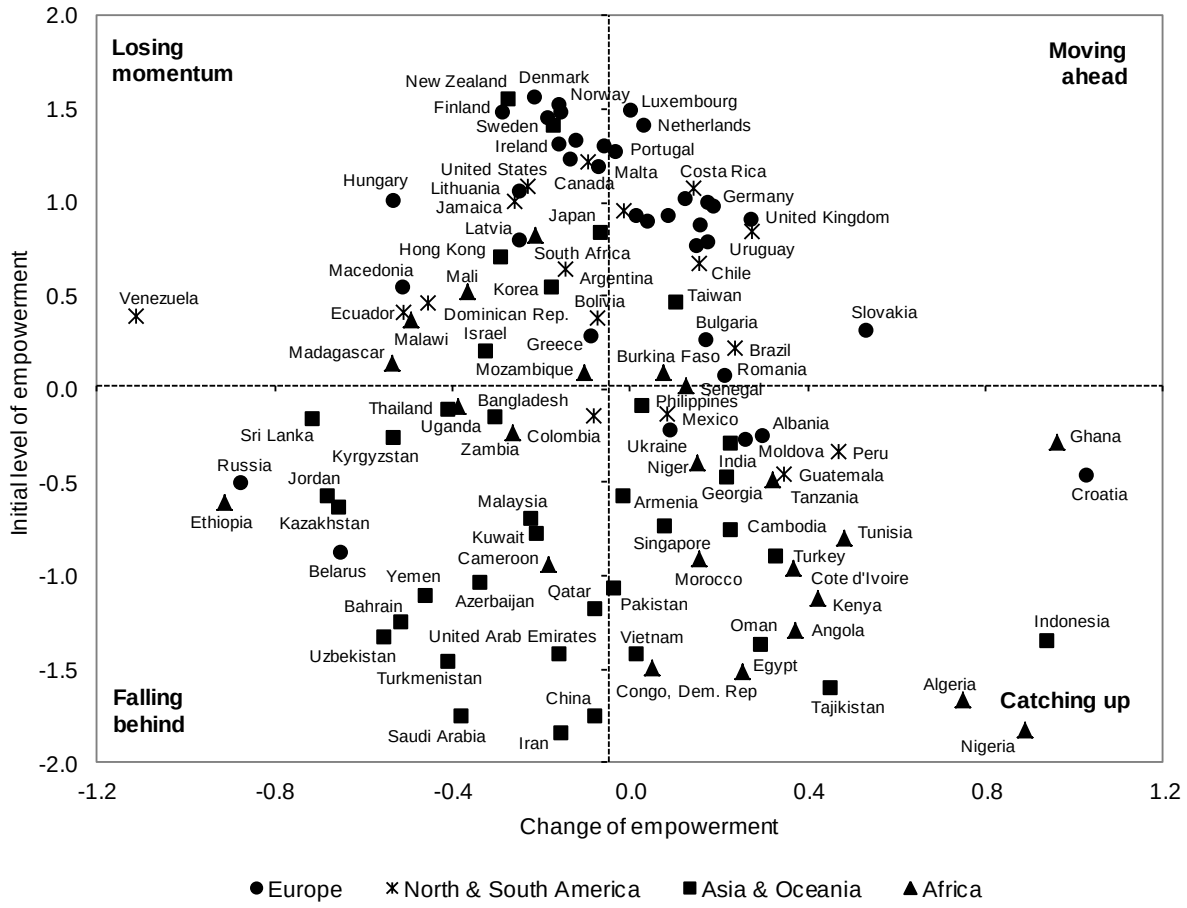

Figure 5. Contribution to growth of technological capability