Beyond the Economics of the Brain Drain

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Beyond the economics of the brain drain

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Abstract

This paper derives from the authors’ interest in understanding how scientific mobility affects developing countries. Many authors have addressed the topic previously, both from an economic and from a sociological perspective. However, little theoretical progress has been made since the 1960’s, which we argue is necessary to further understanding of a changing global context where national policies designed to ‘compete for talent’ have become prevalent. This paper is a contribution to understanding the historical and theoretical foundations of the ‘brain drain’ debate, with the aim of progressing towards greater conceptual clarity regarding human capital and its international mobilization for scientific knowledge production and use. We develop a critical review of the economics of the brain drain, highlighting the work of some key early thinkers and pointing out the way subsequent work has taken up selected aspects of their approaches leaving other challenges aside. The paper summarises some other social scientific literature that has moved into the space left vacant by economics. This literature is characterised as taking a ‘connectionist’ approach to issues of highly skilled itinerancy in general and of scientists and engineers in particular. We identify a fundamental problem that stretches across much of the economic and sociological
literature – the failure to adequately disentangle the concepts of human resources for science and technology (HRST) and human capital (HC). We conclude by arguing that brain drain questions would be better framed by a socio-economic conceptual approach to human capital. Such an approach would be based on an alternative set of fundamentals, derived from evolutionary economics and the social studies of science, which we introduce in the final section of the paper.

**Keywords:** Brain drain, scientific mobility, human capital, human resources in science and technology

1. Introduction

Scientific discovery and scientific knowledge diffusion have been associated with the itinerancy of scientists and scholars since the beginning of written history. Gaillard and Gaillard (1997) describe the historical itinerancy of science as a socio-anthropological phenomenon. In the modern era, flows of scientists and intellectuals increased after the Second World War, during the subsequent Cold War and the last decades of the 20th century, linked to the social, economic and political disparities between countries and the development of systems of mass long distance transportation (US House of Representatives 1977). A prominent framing of contemporary global intellectual itinerancy is that which has been labelled the ‘brain drain’. The conception of the ‘brain drain’ can be loosely summarised as the permanent knowledge and welfare loss suffered by home countries when highly qualified scientists emigrate.

The term ‘brain drain’ was used for the first time in 1963 in reference to the exodus of British scientists to the US (US House of Representatives 1977). Perhaps unsurprisingly, the bases of human capital economic theory were being laid down around the same time. Theodore Schultz published his first reflections on the role of education and human capital formation in economic development (1961, 1963) while Gary Becker diffused his theory of human capital (1964). While economists were designing a theory addressing the crucial role that the accumulation of embodied skills and education play in economic development, policy makers started to be increasingly concerned about the consequences of the emigration of highly skilled human resources, as a source of human capital loss. The debate continues nowadays. Voices from Africa and Latin-American countries claim the need to counterbalance or find a solution to the damaging effects that the brain drain has for their scientific systems and their
In this paper we argue that this is largely due to the failure to disentangle two theoretical concepts, namely human resources for science and technology (HRST; OECD, 1995) and human capital (HC). Despite being obviously closely related and intertwined, these concepts belong to distinct ontological registers. However, most work on the brain drain tends to conflate these terms, leading to a situation where human capital is conceived as a bounded entity enclosed by an individual body without justification being provided as to why such a conflation – one unit of human resources is equivalent to one discrete allocation of human capital – is justified theoretically or by empirical evidence. Of course, this conceptual conflation is not unique to studies of the brain drain. However, we consider it particularly problematic in relation to the brain drain issue due to the methodological straightjacket into which it effectively fits economic analysis. To summarise crudely, conflating human capital and human resources forces the analysis of highly skilled mobility to be conducted in aggregative terms. A highly skilled individual crossing a national frontier becomes the methodological equivalent of an addition and a minus in two parallel accounting systems: population and human capital.

Such an analysis could be justified if it was explicitly argued that human resources and human capital were interchangeable in economic analyses and no ‘extra-individual’ attributions could be attached to human capital. However, quite the opposite is the case, even within relatively ‘mainstream’ economic analyses which attribute ‘externalities’ such as a ‘social product’ to human capital to try and account for the ‘spillover’ benefits of its accumulation. Furthermore, as we will show, in the early debate regarding the brain drain in the 1960s, human capital was not treated as an easily divisible and ‘countable’ category by all economic theorists. Indeed, human capital was described by

1 Multiple references may be found in the “brain drain” section of the Science and Development Network website: http://www.scidev.net
Boulding as a non-count noun, in his terms a ‘structure’, that was quite clearly not bounded by individual bodies or to be accounted for methodologically simply by using the proxy of units of HRST.

To illustrate our claims, the paper takes a genealogical approach to the foundations of the economics of the brain drain debate. We first develop a critical review of the economics of the brain drain. We highlight the work of some key early thinkers, particularly Harry Johnson and Kenneth Boulding, pointing out the way in which subsequent work has taken up selected aspects of their approaches that can be more easily assimilated to the general equilibrium economic assumptions that, we argue, underlie a ‘technology of the brain drain’. This technology of the brain drain uniformly treats the mobility of HRST as equivalent to the allocation of human capital resources. The movements of the highly skilled can then simply be ‘read off’ as processes of aggregation and disaggregation of human capital. Such an understanding has important policy implications, as we point out.

The paper then summarises some themes in other literature that has moved into the space left by the methodological enclosing of economic analyses. This literature can be characterised as taking a ‘connectionist’ approach to issues of highly skilled itinerancy in general and the circulation of scientists and engineers in particular. Meyer (2001, 96) argues that the human capital approach has been unsuccessful in addressing the core concern underlying the brain drain, and that network approaches open the possibility of a “paradigmatic shift between a substantialist and a connectionist understanding of highly skilled migration”. The connectionist approach has undoubtedly enriched the brain drain debate over the last decade. New empirical methodologies such as bibliometrics have enabled analyses of international co-authorships for scientific papers, for example, which as a proxy for spatially distributed collaborative work has served to put flesh on the bones of connectionist arguments. However, in our opinion further fundamental revision is required to constitute an actual ‘paradigm shift’ and provide a well-founded alternative approach to human capital issues in social and economic development research. We conclude the paper proposing that progress in this direction can be achieved by constructing a ‘theory of distributed human capital’, by building on evolutionary economics and social studies of science. We introduce some building blocks for such a theory derived from these fields, whilst acknowledging that such a shift also entails turning back toward ideas first raised some four decades ago.
2. The economics of the brain drain: the 1960s debate

The first academic debate concerning the brain drain opposed two views of the consequences of scientific migration phenomenon: the so-called ‘nationalist’ and ‘internationalist’ models. Harry Johnson provided the touchstone for the internationalist model. He was one of the first authors to discuss ‘the economics of the brain drain’, pointing out that the term ‘drain’ conveyed a strong implication of serious loss (Johnson 1965). The questions to be addressed were therefore “to whom does the loss occur and what sort of loss is it?” Clearly the loss does not affect “the brains that are being drained” (Johnson 1965, 299). In fact, Schultz (1961) had earlier considered migration as a form of an individual’s investment in human capital, together with investments in formal education, health and on the job training. The loss derived from migration would thus affect those who continue to reside in the country of origin.

Johnson (1965, 300) thus connected concern about outward migration with “the philosophy of economic nationalism” and proposed an alternative “internationalist model” (Johnson 1968). Johnson’s model discussed some of the possible losses but also the potential benefits of the outflow of the highly skilled, both for the home country and the world economy, especially in the case of scientists’ mobility. He criticized policymakers automatic association of outflows with ‘drains’, concluding that the variety of potential gains and losses to the world economy as a whole and to sending and receiving economies did not allow for such simplistic interpretations. In contrast, authors like Patinkin (1968) and Boulding (1968) rejected the viewpoint that the world should be considered as a single aggregate and argued the importance of human capital for national economies and the potential dangers of emigration from developing countries.

The debate was set, overall, within a broad conceptual framework that highlighted the complexity of the phenomenon under study. Johnson found more reasons to be optimistic about the final welfare creation and distribution effects of the brain drain whereas Kidd (1965), who commented on Johnson’s (1965) Minerva article, Patinkin (1968) and Boulding (1968) placed more emphasis on the potential negative consequences for developing economies. Table 1 summarises the main arguments sustaining the views of these authors.
Table 1: Two visions of the brain drain: the 1960s debate in economics

<table>
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<th>Nationalist - pessimistic</th>
<th>Internationalist - optimistic</th>
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<td>If education is financed by general taxation of the resident population, every educated</td>
<td>Migrants from developing countries frequently maintain the family ties and send remittances,</td>
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<td>migrant takes with him a gift from the place he leaves to the place he goes to (Johnson</td>
<td>which may compensate for the eventual losses (Johnson, 1965, 1968; Boulding, 1968)</td>
</tr>
<tr>
<td>1965, Boulding, 1968)</td>
<td>Migrants may also return, letting the home country benefit from the learning and skills</td>
</tr>
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<td></td>
<td>acquired abroad. New ideas and discoveries are frequently generated by the confrontation of</td>
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<td></td>
<td>an individual with a new and different culture (Boulding, 1965, 1968)</td>
</tr>
<tr>
<td>Human capital accumulation generates economies of scale, which are lost as a consequence</td>
<td>Exporting skilled trained adults implies a loss of learning capacity and therefore of growth</td>
</tr>
<tr>
<td>of emigration (Johnson, 1965).</td>
<td>potential for the sending society (Boulding, 1968).</td>
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<tr>
<td>Highly skilled human resources perform important social functions that are not captured</td>
<td>Skills embodied in human capital are complementary to other inputs into research or</td>
</tr>
<tr>
<td>by market prices and salaries (these are considered therefore “externalities” within</td>
<td>production. It is too easy to assume wrongly that the migrant would have made the same or a</td>
</tr>
<tr>
<td>economic analysis), such as teaching and mentoring, inspirational and leadership</td>
<td>comparable contribution to research or to national income in the country from which he</td>
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<tr>
<td>qualities, institutional entrepreneurship, etc. These functions are particularly crucial in</td>
<td>migrates (Johnson, 1968).</td>
</tr>
<tr>
<td>The movement of a few scientists and engineers can cripple and destroy a field or a</td>
<td>The services of emigrants are available to a region if they are needed to the extent that the</td>
</tr>
<tr>
<td>department in less developed countries (Kidd, 1965; Patinkin, 1968)</td>
<td>region is prepared to pay for them, especially given the cheapness of modern transportation</td>
</tr>
<tr>
<td>(Kidd, 1965)</td>
<td>(Johnson 1965)</td>
</tr>
<tr>
<td>Science and technology must be adapted for and in less developed countries if they are to</td>
<td>Discoveries from basic scientific research benefit the world as a whole, including the home</td>
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<tr>
<td>be useful for economic development: much research done on applied problems in one</td>
<td>country of emigrated scientists (Johnson, 1965)</td>
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<tr>
<td>environment is not transferable to another (Kidd, 1965)</td>
<td></td>
</tr>
<tr>
<td>Emigrants can influence policies in the country of their new residence toward their</td>
<td></td>
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<td>native country (Johnson, 1965)</td>
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A certain conception of human capital - and of the economic world in which individuals deploy their action – can be argued to underlie the statements in Table 1. This conception contains several key elements structuring the analytical world of reflection for these authors:

- individuals are: heterogeneous, interconnected, face uncertainty, and are embedded in temporal spaces;
• the productivity and value of human capital varies depending on the social and economic context of its use; and
• factors of production are complementary.

These fundamental assumptions have much in common with thinking in contemporary evolutionary economics. As such, they differ markedly from neoclassical equilibrium approaches in general and from Gary Becker’s (1964) human capital theory in particular.

It is perhaps unsurprising that such assumptions can be found in the 1960s brain drain debate, given the close involvement of Kenneth Boulding, considered to be one of the fathers of evolutionary economics (Boulding 1981). Boulding developed a comprehensive body of economic theory, which moved away from Newtonian mechanics analogies and therefore from the Walrasian general equilibrium paradigm (Walras 1874-1877) and the subsequent Samuelsonian neoclassical synthesis (Samuelson 1947), which formed the bases for what is commonly known as ‘standard’ or ‘mainstream’ economics. Instead, Boulding explicitly derived his evolutionary economic theory from biological sciences. For him, the role of genetic material in biological evolution is played by “knowledge in the head of persons” in social systems (Boulding 1981, 25).

What is perhaps surprising is the extent to which Boulding’s approach to human capital has been largely supplanted by Becker’s (1964) description, which builds on the ‘standard’ mechanical paradigm. A clue to this eventual effacement may lie in the methodological difficulties undoubtedly created by Boulding’s conception of human capital. When addressing the brain drain phenomenon Boulding (1968) starts by pointing out the differences between physical and human capital, insisting on the greater importance of the latter for economic development. “Physical capital is merely human knowledge imposed on the physical world” but “it is not the existing stock of knowledge in a society which determines its rate of development as much as its capacity for learning” (Boulding 1968, 112-113). In fact, Boulding even questions the extent to which embodied knowledge and skills are actually ‘capitalizable’ since the property of the individual is inalienable (in a non-slave society) and therefore can neither enter an accounting system nor be exchanged (Boulding 1968, 113). For Boulding,
...human capital even more than physical capital is a structure, rather than an aggregate. We do not necessarily increase the productive capacity of a society by adding another person to it, even if he is very expensively trained, if that person does not fit into the matrix of information flows in a way that increases the productivity of the society (1968, 113, emphasis added).

The problem of economic development is thus for Boulding (1956, 1966, 1991) – as for Hayek (1945) – mainly one of organisation of knowledge in society. His conception of the world as system brings him to stress the connections between the different factors contributing to production processes, of which know-how and learning are of major importance. His focus on the dynamic and interactive dimension of the system contrasts with the mechanical models involving constant parameters relied on by mainstream economics (Boulding 1981). Boulding acknowledges the value of mechanical systems as a necessary prelude to the understanding of larger and more complex evolutionary systems, but argues they cannot express the richness of interaction of the real world (Boulding 1981, 86).

Consider the argument supported by Kidd (1965) and Patinkin (1968) that the movement of a few scientists and engineers can cripple and destroy a field or a department in less developed countries (see Table 1). As Boulding implies, a few scientists may play crucial roles in social structures (as educators, leaders, entrepreneurs) that might be broken into disparate parts if they migrate. Ongoing learning processes might also be interrupted after emigration, implying negative consequences for development. It is therefore not the number of emigrants that is crucial but where they are integrated into the human capital structure.

We might also recall Johnson’s (1968, 74) statement that the

“skills embodied in human capital are complementary to other inputs into research or production. It is too easy to assume wrongly that the migrant would have made the same or a comparable contribution to research or to national income in the country from which he migrates”.

Johnson is arguing that the migrant might fit better into a production structure in the country he migrates to than in his country of origin. It is wrong to assume a priori that his role was crucial in the home country. Rather it is location of this human capital within a structure it can complement that is decisive. Additionally, migrants may return
to, or establish connections with, such structures from abroad, possibly supporting change and development (see Table 1).

According to this analytical framework, heterogeneity (in roles, connections, fit to the productive structures) and complementarity (between production factors and social and economic structures) are key elements for understanding the varied consequences of geographical flows of highly skilled human resources (HRST). Human capital is understood as entering a specific production structure in which it needs to fit. This structure evolves over time, mainly as a consequence of learning and interaction with other productive or social structures. This implies, for example, that a society or an economy cannot be defined or evaluated in terms of the number of biologists it trains and keeps. In order to assess the value derived from having biologists there is a need to study what, if any, role they play in social and productive structures.

As this overview suggests aspects of the 1960s brain drain debate were conceptually sophisticated and considered human capital as a heterogeneous structure characterised by knowledge, learning and complementarity. However, despite the broadness of this initial debate, the subsequent economic models which assessed the role of the brain drain in economic development followed a conceptually and methodologically ‘standard’ tradition relying on neoclassical general equilibrium premises. The following section describes the main contents and contributions of this neoclassical economics of the brain drain, which eventually became consolidated into what we term as ‘the economic technology of the brain drain’.

3. The neoclassical economics of the brain drain

In contrast to the diversity of the economic debate on the brain drain of the 1960’s, our review found that subsequent methodological approaches to the brain drain have been predominantly built on the assumptions of general equilibrium economics and standard human capital theory. General equilibrium models rely on the concept of homogenous representative agents (an individual with a certain level of human capital defined in terms of years of schooling or experience is representative of any other individual with the same degree or years of experience). Human capital is embodied in individuals who are autonomous and respond to market signals when making decisions about investments in education and their professional choices, including migration. Human
capital enters the production function as a production factor with distinctive properties, notably increasing returns to scale. The accumulation of human capital results in a higher growth potential. Furthermore, the positive social role of human capital – the effects of social interaction of skilled individuals with other members of society – is not entirely captured by the market, which implies the existence of positive externalities.

The basic neoclassical model for homogenous labour

The conceptual starting point is a market that operates in perfect competition and in which workers earn an income that is equal to their marginal product. Differences in skills or human capital endowments of workers are not yet considered. Labour is considered a homogenous input to the production function: any worker is a perfect substitute for any other worker in the economy. All agents have perfect information about market prices and automatically respond to changes. Wages are flexible and labour markets adjust to the equilibrium levels of supply and demand assuring full employment. A person leaving the productive system would not harm the national economy, as she would only take away the value of her marginal product, which she herself earns anyway. The departure of a person could even raise the nation’s capital-labour ratio (Grubel and Scott 1966). Assuming diminishing returns to scale in the use of labour implies that emigration will raise per capita income of the economy if the endowments of all other factors of production remain constant (Bhagwati and Rodriguez 1975).

The basic brain drain framework (with heterogeneous labour)

To assess the effect of the emigration of the highly skilled some of the above assumptions need to be changed. Workers are no longer considered homogenous but endowed with different levels of human capital, which implies the recognition of certain market inefficiencies. This is due to the particular characteristics of human capital compared to other production factors. According to Becker (1993, 312), “knowledge is not subject to diminishing returns in the same way as is physical capital because greater knowledge raises the productivity of further investment in knowledge”. The increasing

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2 Bhagwati and Hamada (1974) point out that if finite instead of infinitesimal shifts of labour are considered, emigration will cause a loss to those left behind. However, depending of the size of the emigration and the nature of the production function, this loss may still be very small.
returns of human capital imply that the rate of return on human capital grows as the stock of human capital increases.

Economies of scale are therefore associated with the accumulation of human capital in the economy. External economies also appear, as highly skilled persons have not only the capacity to increase their own productivity but also to encourage other agents’ productivity. The social product of skilled persons is therefore higher than their marginal product. The inefficiency relies on the fact that the market that rewards skilled individuals with an income equivalent to their marginal product fails to compensate them for their contribution to society. The market thus fails to provide an optimum level of investment in human capital because social benefits of this investment are higher than private ones. This failure is normally addressed through governmental investment in education.

Some implications of the above premises are: (i) skilled individuals will be attracted to locations with high stocks of human capital and therefore higher returns to their accumulated skills; ³ (ii) skilled emigrants take not only their marginal product with them but also their social product; and (iii) if skilled emigrants’ education was financed by the government, then emigrants fail to repay this investment through their contribution to the tax system.

In addition, emigration of skilled personnel may imply adjustment costs due to temporary inefficient employment of the factors of production (capital, unskilled labour) depending on cooperation with the skills of the emigrated workers (Grubel and Scott 1966). It follows that low-income countries will suffer the consequences of net welfare losses associated with skilled individuals’ departures. The net losses will be especially high if the government funds education, as is normally the case.

Returning to the questions posed by Johnson (1965) (to whom does the loss occur and what sort of loss is it?), we may summarize the implications of the above basic framework pointing out that the particular economic properties of human capital and the fact that the market fails to allocate it efficiently, imply that emigration of skilled individuals has a negative effect on the home economies, as they lose their investments

³ According to Becker (1993, 346) this explains why the brain drain of educated and skilled persons almost invariably occurs from poorer to richer countries.
in education and the productive potential of the emigrated capital. This would justify why an outflow tends to be automatically considered as “a drain”. Since the late 1970’s, the economic debate on the brain drain revolves around discussion of this basic framework and its effects. Below, we review the principal arguments that have contributed to this debate. First, we focus on the discussion of losses (drains) and, second, we review the discussion on the potential gains that have also been linked to skilled emigration.

**Discussing the basic brain drain framework**

Grubel and Scott (1966) start from the basic model but argue that losses associated with skilled human resources emigration are normally only temporary. In the long run, economies will adapt to frictional inefficiencies associated with skilled migration. Other skilled workers will replace emigrants. This applies also to the social loss associated to positive externalities (Grubel and Scott 1966, 271). In relation to the loss of public investment in education these authors argue that emigrants take along their contribution to tax revenue, but also their children, on whom this share of revenue would have been spent. According to Grubel and Scott, the losses that a country suffers due to skilled emigration are not as great as the basic brain drain model would suggest.

Bhagwati and colleagues challenge this optimistic outlook, which supported Johnson’s ‘internationalist view’. Bhagwati and Hamada (1974) acknowledge the possible losses of skilled emigration described in the basic brain drain framework. However, they focus on other additional factors that may cause welfare losses in sending/developing countries. In Bhagwati and Della Far (1973), Bhagwati and Hamada (1974), Bhagwati and Rodriguez (1975) and Bhagwati (1979) the assumption of perfectly competitive labour markets is removed. Wages respond to market forces but also to other forces.

According to these authors’ models, in developing countries the salary levels of the educated elites tend to imitate the wages of comparable groups in more developed countries, reaching a level above the equilibrium market price and encouraging unemployment among the educated. The high salary levels encourage the demand for education, which in turn may accentuate skilled unemployment if wages do not react to

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the higher supply of skills in the economy and remain high. Additionally, the wages of the unskilled tend to be pulled up by the highest wages, also encouraging unskilled unemployment. In these models migration of skilled manpower leads to a distortion of salary levels, encouraging general unemployment and an overexpansion of educational facilities (Bhagwati and Dellalfar 1973). Additionally, the possibility of migration inhibits the internal diffusion of skills. Bhagwati (1979, 20) illustrates this phenomenon with the example of a Filipino doctor, working as a cab driver in Manila while he awaits to pass an examination to migrate to the US, instead of starting medical practice in his own country.

In summary, these authors conclude that skilled emigration from developing countries entails important losses for the sending economies that go far beyond the consequences of frictional temporary adjustments. This results in higher levels of public expenditures and lower welfare. More recent models have supported these conclusions. Wong and Yip (1999) build a model in which growth is endogenously determined by human capital accumulation and reduced by the human capital loss that follows migration. Pieretti and Zou (2009) challenge Grubel and Scott (1966) by focusing on the effects on per-capita income of different grades of substitutability between skilled and unskilled labour. Another possible negative effect follows from changes in the composition of human capital in sending countries. Different paths of development require different types of skills. Migration prospects may distort the agents’ incentives to accumulate the most appropriate skills for their country of origin, which reduces growth rates (Di Maria and Stryszowski, 2009). However, other models challenged these conclusions by adding new dimensions to the analysis and arguing these turn the ‘brain drain’ into a beneficial phenomenon, an argument to which we now turn.

5 Fan and Stark (2007) follow Bhagwati and Hamada to further study the formal causal links between the prospect of migration and educated unemployment.
6 To compensate developing countries for their losses, the authors propose to build a new global tax system that allows taxing skilled emigrants’ incomes (Bhagwati & Dellalfar 1973; Bhagwati 1979).
7 Following Becker (1964), Di Maria and Stryszowski (2009) distinguish between general and specific skills, assuming that developing countries require more specific than general skills, which are more demanded by developed economies. Stark (2004) applies a similar kind of reasoning but assumes that the prospect of migration will encourage individuals to accumulate the “specific skills” needed in the country of destination. Independently of their particularities, the main assumption of this type of models is that migration prospects modify the skills structure of the sending countries.
The beneficial brain drain or brain gain:

Alternative models to those described in the previous section argue that the overall impact of the brain drain is eventually beneficial due to internal dynamics. The important argument here is that the prospect of migration encourages human capital formation (Stark, Helmenstein, and Prskawetz 1998). As discussed earlier, individuals tend to under-invest in human capital because they do not consider the social benefits. The possibility of migration raises the expected potential returns on education and encourages workers to invest more in human capital than in the absence of the possibility of migration. This raises the average level of human capital and the productivity levels of the economy (Stark 2004).

The positive effects of the prospect of migration on human capital accumulation and productivity of the sending countries have been also addressed by Mountford (1997), Beine and colleagues (2001, 2008), Kapur and McHale (2005), Easterly and Nyarko, (2008) and Solimanos (2008). Beine, Docquier and Rapoport (2008) conduct an empirical analysis of 127 developing countries estimating brain drain and gain effects. They conclude that from a global perspective the benefits to major gaining countries, such as China, India and Brazil, outweigh the losers’ losses. These recent studies refer to this phenomenon as beneficial brain drain or brain gain. Methodologically these studies retain the assumptions of the prior neoclassical models and general equilibrium theory and, as pointed out above, they consider the changes in expected returns on education that the possibility of migration entails. Table 2 summarizes the elements these studies have added to the 1960’s discussion.
Table 2: Brain drain and development: the ‘mainstream’ debate

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<th>Nationalist - pessimistic (2)</th>
<th>Internationalist - optimistic (2)</th>
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<tr>
<td>Salary levels of the highly skilled in developed countries encourage an increase of wages in developing countries, inducing unemployment and an overexpansion of educational facilities (Bhagwati and Dellafur, 1973)</td>
<td>The losses a country suffers from skilled emigration are only temporary, frictional, in the long term the economy will adapt to changes or to a certain migration rate (Grubel and Scott, 1966).</td>
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<tr>
<td>Migration prospects inhibit the internal diffusion of accumulated skills in developing countries (Dhargwati 1979)</td>
<td>The prospect of migration encourages human capital formation, which may compensate the loss caused by emigration (Deinc, Docquier, and Rapoport 2001, 2008, Easterly and Nyarko 2008; Mountford 1997; Stark, Helmenstein, and Prskawetz 1998; Stark 2003; and others)</td>
</tr>
<tr>
<td>Emigration reduces the endogenous growth capacity of the economy (Wong and Yip 1999)</td>
<td></td>
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<tr>
<td>Emigration prospects encourage a change of skill composition which may harm sending countries economics (Di Maria and Stryszowski 2008)</td>
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4. Assessing the economics of the brain drain: the lost fundamentals

There are fundamental reasons why Tables 1 and 2 should not be merged. As pointed out earlier, economic models developed from the Grubel and Scott (1966) contribution on, are framed by general equilibrium economic analysis. The 1960's discussion summarized in Table 1 was not enclosed by the general equilibrium assumptions and was influenced by evolutionary thinking. Accordingly, it considered the consequences of systemic heterogeneity and complementarity among agents and production factors, and the uncertain timeframe in which social action is deployed.

In contrast, the general equilibrium based brain drain models provide formal descriptions of human capital accumulation (or un-accumulation) dynamics. Economic growth and welfare automatically benefit from the aggregation of human capital units. Human capital may be accumulated through the training of new people within the national education system and their incorporation to the labour force or through
immigration. In turn, human capital is mainly lost through emigration, retirement or mortality of skilled personnel.

The neoclassical brain drain models discussed reach different conclusions depending on which elements of these aggregative dynamics they emphasise. For example, in Bhagwati (1979) emigration prospect *discourages* highly skilled persons to look for a job in their home country, leading to brain drain and un/under-employment – a net human capital loss. Alternatively, in Beine, Docquier and Rapoport (2001, 2008) emigration prospect *encourages* more persons to get tertiary level education, some of whom will remain in the national labour force – a potential net human capital gain.

These models could be further developed, for example, by adding demographic dynamics to the set of equations. We could ask ourselves how different patterns of population growth affect the above two models. We would remain in the “aggregative” approach, a conceptualisation of human capital as physical accumulated *and unrelated* units that enter the production functions of the economy and contribute to its outcome. This “aggregative” approach has automatic implications for how mobility of human capital may be conceptualised. We will refer to this conceptualisation as *the technology of the brain drain*. Within this framework brain drain or gain are the net possible results of aggregative dynamics.

From a policy perspective, the implications of technology of the brain drain analyses are therefore straightforward. An economy or a scientific system should *maximise* the number of human capital units as what matters is *accumulation*. The precise policy strategies adopted to achieve maximisation would depend on the particular aggregative model considered. Utilising Beine, Docquier and Rapoport’s (2001, 2008) model, for example, the ideal level of emigration would not be nil, as emigration prospects encourage internal human capital formation.

In Europe, a policy approach that accords with the technology of the brain drain has indeed emerged, promoting three main actions to achieve the accumulation objective: to train, to retain and to attract human capital (including attracting emigrants back to their

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8 In the neoclassical tradition human capital units are fundamentally unrelated. The connection among them is only partially captured through the concept of externalities. This concept simply reflects the idea that the market is not able to fully capture the value generated through social interactions but does not permit us to address the nature of those interactions and of the social value created.
countries of origin). The document that sets the bases for the formation of the European Research Area (CEC, 2000), clearly states that Europe suffers a brain drain (mainly to the United States) and sets the objectives of “attracting the best researchers from all over the world [...]”, and encouraging the return to European laboratories of researchers who have left” (CEC, 2000: 19). At the same time, it states that in the case of developing countries, Europe should encourage the return of researchers that benefit from European training to their home countries in order to “spread the knowledge they have acquired” (CEC, 2000:19). The ‘train, retain, attract’ policy strategy has recently been restated by the European Commission (CEC, 2007: 10), but it has been enriched by other approaches to which we will later refer.

Numerous examples may also be found of policies in developing countries where ‘train’ and ‘attract back’ rationales predominate. In China, overseas PhD support funded by the Chinese Scholarship Committee requires the recipient to return to China to work for two years following completion of their doctorate abroad. A common practice in Latin-American countries has been the conditionality of international research training grants. In Argentina for example, researchers granted by the CONICET compromise to return to their home country after their training period abroad for a period of at least the same length than their international experience. The same applies in Peru where the brain outflow increases while public funding opportunities to train abroad remain vacant due to the lack of opportunities to find a job in the country after compulsory return (Portillo, 2010). The limited success of this type of programme has been acknowledged (Villanueva, 2009). Claims have emerged for multifaceted policies in developing countries that go beyond ‘classical programs’ aimed at preventing outflows and encouraging the return and reintegration of emigrated specialised human capital (Tuirán, 2009). We will return to the policy debate later. These examples aim simply at illustrating the influence of the neoclassical economics of the brain drain and its aggregative approach.

In contrast, as was discussed earlier, the bases for a different vision which were laid-out on the eve of the brain drain debate have had little apparent influence. Boulding’s (1968) description of human capital as a “structure” which resists aggregation is admittedly a methodologically challenging conception. However, further compatible thinking has developed within the evolutionary economics frame. As Loasby (2008, 50) describes,
[e]ach individual and each established connection between individuals may be regarded as a bearer of capital, but the effectiveness of each unit of capital depends on the structure in which it is embedded.

Capital conceived in such as way, as a structure of differentiated complementary elements, is indeed resistant to aggregation (Loasby 2008). It is almost as if the thinking that reflected Boulding’s earlier description of human capital has re-emerged in economics discourse after a prolonged hiatus. Meanwhile, the economic technology of the brain drain has enclosed debate, resulting in the relegation of fundamentals from the 1960s that hold the potential to underpin analyses that go beyond determinants of allocation and aggregation.

It is these lost fundamentals which explain why a number of the elements summarised in Table 1 cannot be simply added to by those later elements shown in Table 2. For example, new ideas and discoveries are frequently generated by the confrontation of an individual with a new and different culture (Johnson 1965, 1968; Boulding 1968). In a ‘standard’ economics framework, no genuine feedback connection is conceptually possible between human capital productivity and the cultural context.

Similarly the idea that migration frequently acts as a liberating force, freeing the human mind for creative work that it would not otherwise produce (Johnson 1965) is not analytically includable in a theoretical context which excludes uncertainty. Finally, the idea that emigrants can influence policies in the country of their own residence toward their native country (Johnson 1965) implies a social connective dimension that is excluded by the assumptions framing the technology of the brain drain.

It seems reasonable to us to assume that human capital mobility in general and scientific mobility in particular imply the emergence of new connections (in the brains of individuals and between individuals and organisations) and that it therefore plays a key role in the establishment of dynamic links between the components of economic and scientific systems. Clearly such connections are significant in the era of globalization for trans-national processes of social and economic development. In contrast, the lost fundamentals have allowed economic thinking about the brain drain to be restricted to aggregative and non-connectionist analyses, which are at the basis of the conflation between HRST and human capital. If human capital is assumed to be embedded in individuals without connecting its value or potential to the context in which it is
mobilized, then measuring human capital equates to counting individuals. This has limited the intellectual development of analysis of the mobility phenomenon within the economics discipline. As pointed out above, this is important due to the influence of analyses from economics in framing policy discussion in recent decades. At the same time the fundamental inability of the economic technology of the brain drain to address the connective dimension of scientific mobility has left a space for the emergence of literature that stresses neglected social and connectionist elements. It is to this literature that we now turn.

5. The connective dimension: networks, diasporas and circulation

There is a great variety of social science literature that, directly or indirectly, makes a contribution to understandings of the brain drain and/or scientific mobility. In this section we only address literature that has directly addressed the ‘brain drain’ question. This literature is thus not intended to represent a review of the field. It is the intention to illustrate the way issues of connection and distribution, largely left aside by the economic technology of the brain drain, have been taken up by scholars working from different perspectives and with varying goals.

*Dispersed and diaspora knowledge networks*

The identification of scientific diasporas (Barré et al. 2003) or diaspora knowledge networks (DKNs) (Meyer et al. 2001) as a sub-set of the trans-national organization of scientific work, collaboration and knowledge production has come about largely through sociological efforts to explore development implications of outflows of human capital from developing countries. Thinking about diaspora knowledge networks explicitly starts from a recognition of the conceptual limitations of mainstream economic approaches (Meyer 2001), in particular those imposed by an assumption of agents’ autonomy. As pointed out earlier, within the neoclassical economic framework, external economies (externalities) are used to conceptualise the income loss that an individual may suffer due to his non-remunerated contribution to other individuals’ productivity and to justify public investments in education. However, the genuine nature and reciprocal dynamics of these interactions between people, as well as their effects on economic or scientific development, are not really addressed.
The theoretical foundations of DKN are generally framed and have implications that are not limited to developing countries. The central premises of DKNs make this clear: first, these are networks organized around diaspora or cultural identification; second, the objective of DKNs is “to contribute to the development of their members’ place of origin through their skill input” (Meyer and Wattiaux 2006, 5). Diaspora knowledge networks are thus defined as distinct from other quite typical distributed forms of organization of science that may stretch across national frontiers by their explicitly cultural content and their purposive character in relation to transferring benefit to a national/cultural ‘base’.

The originators of the DKN approach argue this has conceptually subverted the traditional “brain drain” migration outflow into a “brain gain” skills circulation by converting the loss of human resources into a remote although accessible asset of expanded networks. This shifted the traditional emphasis on embedded knowledge of potential returnees in a human capital approach (return option) to a connectionist approach where social capital, including technical and institutional links, is crucial (diaspora option) (Meyer and Wattiaux 2006, 5).

The DKN approach thus attempts to conceptualise the potential for ongoing benefits of national investments in highly skilled human capital, subsequently located offshore, to flow back to the ‘home’ system in various ways. In this sense, Meyer (2003) refers to a paradigm shift that emphasises the circulation of skills and brains instead of their drain.

However, a “population of expatriate individuals does not automatically constitute a diaspora” (Meyer et al. 1997, 298), much less a knowledge network. Rather the development of a DKN requires the construction of a “community” based around ongoing communication, a sense of collective organization and some shared goals and activities (Meyer et al. 1997; Meyer and Wattiaux 2006). As an empirical study of the Columbian Caldas network found (Meyer et al. 1997), dispersed and heterogenous expatriates are most able to be drawn into a diaspora connection through electronic communication hubs such as websites and electronic information distribution techniques such as mailing lists. At the same time nodes of the diaspora are likely to be organised into local committees or groups that gather together. These assemblies of expatriates may be relatively formal or informal in their processes and pursuit of
collective objectives, and also tightly or loosely integrated into the wider diaspora network (Meyer et al. 1997). The location, the numbers of nodes, and the ‘critical mass’ or density of each node, may be quite varied, both between and within DKNs. An important inference that may be drawn from the description of DKNs, however, is that they have the potential for *creating original connections*, that is, intra-diaspora connections, that may otherwise not have occurred, for example on the basis of disciplinary, organisational, project or other affiliations typically associated with the collective and collaborative nature of scientific work.

Empirical studies of DKNs have identified some of the benefits that can accrue to home countries. These benefits include: exchanges of information; specialist knowledge transfer; promotion of the ‘home’ country abroad; joint projects; training; enterprise creation; and expert consultations such as peer review and technology assessment (Meyer and Wattiaux 2006, 7-8). What is evident from this range of benefits is that DKNs are not just conceived in terms of ‘connection’ but also in terms of ‘circulation’. For example, training may be facilitated both through the hosting of nationals abroad with established diaspora professionals and through visits by these professionals to the home country. In such a way DKNs inscribe a fuller sense of the term network, as both a space defined by connections between nodes but also a particular form of ‘space of circulation’ (Callon 2002) through which knowledge, skills and technologies flow. DKNs thus make ‘something more’ accessible to the home country, by facilitating the circulation of scientific, human and social capital benefits that have been accrued by expatriates subsequent to leaving the home country, whilst at the same time providing avenues for other nationals to accumulate capitals by circulating through the network.

This alternative interpretation of mobility influenced policy programmes in several countries, which started to put the stress in ‘re-linking’ instead of return of emigrated talents (Didou-Aupetit, 2009). Since the 1990’s programmes to encourage the organisation of scientific diasporas have proliferated. Some examples from Latin-America are RAICES (Argentinean network of expatriate scientists and researchers⁹), *Chileglobal*¹⁰ in Chile, Red Caldas in Colombia, TALVEN in Venezuela (Venezuelan talents abroad). Examples from Africa are SANA (South African Network of Skills

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⁹ http://www.raices.mincyt.gov.ar  
¹⁰ http://www.chileglobal.org
abroad), ANA (Association of Nigerians Abroad\(^{11}\)). Asian DKN’s are also operative, such as ATER (Association of Thai Professionals in Europe\(^{12}\)) and CHISA (Chinese Scholars Abroad). A recent example from Europe is REDIEX in Spain (Communication system for researchers abroad\(^{13}\))\(^{14}\).

Despite the proliferation of this type of networks, their contribution to scientific and technical development in the countries of origin has been put into question. Gaillard and Gaillard (2003) compare the ‘promise’ with the ‘reality’ of the diaspora model. They acknowledge the increasing number of countries that have taken initiatives to identify, mobilise and reconnect their expatriate scientists. However, the sustainability and effectiveness of this approach remains unproven (Meyer and Wattiaux 2006). In relation to the Colombian Red Caldas, Gaillard and Gaillard (2003) argue that “ten years after its inception it is little more than a friendship network”, and they question the utility of the DKN approach for African science. The investments required to organise and mobilise a scientific diaspora are high, yet its efficiency is not guaranteed and depends on the “absorptive capacity” (Cohen and Levinthal 1990) within the home systems. The relative size of the home-based scientific community and their connections with the diaspora are particularly important. In addition, the dynamic dimension of the network is crucial; its long term survival is a challenge since its population is mobile and may not always focus on national scientific interests (Gaillard and Gaillard, 2003).

There are apparent limitations to diaspora networks as practical mechanisms for collective action and change in developing countries. However, from our perspective, much of the thinking underlying the network approach that has been drawn from the diaspora experience studied by Meyer and colleagues points us in the right direction regarding approaches to mobility and human capital. As Meyer (2001: 95) argues, the assumption that skills are “individually-based properties bounded by human bodies” has been undermined by science and technology studies that “show the relational dimension of skills, which is inherent to their development as well as to their application”. In fact, as Meyer is suggesting, the skills, know-how and formal knowledge embedded in human capital has reduced (and in some cases zero) utility without a range of

\(^{11}\) http://www.ananet.org
\(^{12}\) http://www.apter.org
\(^{13}\) http://www.rediex.es
\(^{14}\) For a thorough review of DKNs operating at the end of the 1990’s see Meyer and Brown (1999) and Barré and colleagues (2003).
complementary assets (equipment, theory) including complementary human resources (Callon 2002). This relationality or complementarity reflects the ‘spilling over’ and ‘fitting together’ of human capital through processes of observation, demonstration, skill transfer and collective work. Dispersed or diaspora knowledge networks (Barré 2003) are not just interconnected individuals, they are also relational complements of human capital attributes.

The relational nature of the capabilities embedded in human capital is thus what is reflected by the integration of ‘specializations’ within collectives, such as research teams. Processes of integration and relationality were what Boulding was referring to as productive of a specific ‘matrix’ or human capital ‘structure’. By pointing out the relational dimension of skills the network literature effectively rejects the isolationist ontology of self-contained units of human capital bounded by individual human bodies. Whilst it does not itself then take the explicit step to conceptually disentangle distributions of human capital from networks of human resources, this remains a fundamentally important contribution on which we hope to build. In essence, the key insight we draw from this literature in relation to the problematic of the brain drain is that the mobility of human resources will in all likelihood (although not necessarily) reconfigure distributions of human capital. That such reconfigurations may be productive or destructive in their effects (on a developing country, for instance) is contingent and requires empirical investigation and interpretation.

Highly skilled migration and scientific mobility

One of the major difficulties in conceptualising the economics of the brain drain relates to the entanglement of migration and professional mobility. Much of the literature on highly skilled migration (HSM) and mobility recognises this problem (Ackers 2009; Iredale 2001). The open-endedness and complexity of professional mobility leads migration researchers to move towards a conceptualisation of ‘brain circulation’ rather than ‘brain drain’ or ‘brain gain’ as reflection of the fact that HSM is often not based on single permanent moves (Ackers 2009) but also to the global integration of (and competition between) highly skilled labour markets, the pursuit of elite careers in professional occupations and the role of intra-corporation transfers of human resources in global capitalism. A strength of the ‘circulation’ approach is that it distinguishes the embedded issue of skills and technology transfer from the spatial location of individual
migrants at any particular time (Ackers 2009), instead understanding highly skilled migration as a dynamic system of “knowledge transactions” (Williams 2007). Whether conceptualised as primarily migration or professional mobility, the movement of individuals is always mediated to some extent by networks of inter-personal human relationships and cultural connections (Iredale 2001).

Differentiation within HSM should be expected according to Iredale (2001, 15), who identifies a “unique situation that pertains in each professional area”. Mahroum (2000) describes “scientific mobility” in just these specialized terms, as an institutionally bound process of moves that build scientific careers, peer networks and the reputations of institutions as international centres of excellence. Mobility emerges as a ‘value’ that enhances individual credibility, accumulates human capital and builds social capital networks (Bozeman et al. 2001) in the process of re-producing the scientific field. However, the ‘expectation of mobility’ in scientific careers varies considerably between disciplines and national contexts (Ackers 2009).

‘Scientific mobility’ is thus conceptualised as structured by professional career pathways that augment human capital and build peer networks, whilst building individual credibility and reinforcing institutional reputations. Connections between scientists and organisations evolve over time, expanding and transforming spaces of circulation for the following generations of scientific talent. Sometimes these younger generations will follow the pathways laid out by their intellectual mentors (Melin 2004). At the same time, national policies supporting the research training and experience of individuals in preferred overseas countries and organisations have been highlighted by the role of scientists and engineers returning from the USA to the rapidly expanding scientific research systems in Northeast and Southeast Asia (Jonkers 2010; Krishna and Khadria 1997; Saxenian 2005; Song 1997; Zweig 2007).

As described earlier the return and retention of highly skilled migrants in science and engineering professions has become a particular focus of policy-makers (Ackers 2009). Mahroum (1999, 180) identifies three key push/pull factors that influence the return of scientists: the bottom up development of the national science system (capacity building); the nature and conditions of work; and institutional prestige. Policies to assist the (re-)integration of returning scientists have been judged as successful in Korea (Song 1997) and China (Zweig 2007) At the same time, many of the newly
industrialised countries in the Asian region have long recognised the value of ‘off-shore’ stocks of human capital (diasporas) (Jonkers 2010). Importantly, many policies in the Asian region now target short-term or temporary stays to enable ‘home’ countries to leverage knowledge and learning from their off-shore nationals (Turpin et al 2010). Global initiatives also exist, such as the TOKTEN programme from the United Nations Development Programme (Transfer of Knowledge through Expatriate Nationals) The freedom to continue to circulate professionally and maintain concurrent commitments overseas has also been a particularly crucial factor in encouraging the return and contribution of foreign-based scientists in the case of China (Zweig 2007).

Table 3. Connectionist approach v economic technology of the brain drain approach

<table>
<thead>
<tr>
<th></th>
<th>Connectionist approach</th>
<th>Economic technology of the brain drain approach</th>
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<tr>
<td>Diaspora knowledge networks</td>
<td>Collective agents organise around national/cultural interests</td>
<td>Agents interact through the market</td>
</tr>
<tr>
<td></td>
<td>Emergent connections create a space of circulation for national benefit</td>
<td>Human capital (HC) embedded in autonomous individuals. The space of circulation for HC given by the market.</td>
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<tr>
<td></td>
<td>Circulation transfers benefits across national boundaries</td>
<td>Allocation transfers HC units from one location to another</td>
</tr>
<tr>
<td>Highly skilled migration</td>
<td>Human and social capital underlies migration - pursuit of opportunities and excellence</td>
<td>Agents driven by market prices in their decisions to migrate</td>
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<tr>
<td></td>
<td>Professional and institutional contexts of migration/mobility vary</td>
<td>Context for migration given by market conditions</td>
</tr>
<tr>
<td></td>
<td>Circulation augments human and social capital</td>
<td>Migration augments the migrant’s returns to his/her investments in HC</td>
</tr>
<tr>
<td>Scientific mobility</td>
<td>Mobility an expectation and positive value in science careers</td>
<td>Mobility enables individual to augment his/her earnings</td>
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<tr>
<td></td>
<td>Peer networks structure spaces of circulation and expand credibility</td>
<td>The space of circulation is given by the market</td>
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motivations for action and the principles of their organisation are evident. The influence of collective actors, social institutions (broadly defined), social capital networks and other professional connections on the mobility patterns of the highly skilled are clearly described in this literature. The dynamics of mobility are shaped by a range of non-market factors, whilst the benefits of migration for sending and receiving countries are conceptualised as overflowing national frontiers. These elements appear to echo some of the ‘lost fundamentals’ of the 1960s debate to a significant degree.

In summary, these connectionist approaches go beyond an economic market rationale to explain the nature of mobility and its role in the definition and formation of spaces for scientific interaction and development. It is ‘connectionist’ in the sense that it considers dynamic interactions among heterogeneous agents as a building block to explain the nature of mobility and its role in professional careers. Innovative policy responses have emerged that acknowledge the diverse allegiances, multiple affiliations and preference for global mobility and engagement of many of the highly skilled, including the motivation to work with leading research groups and access excellence in terms of infrastructure and other forms of research support. These initiatives are no doubt reflective of an enlarged and diversified discourse regarding the mobility of the highly skilled. By acknowledging the relational dimension of human capital, they make important progress towards resolving the conceptual conflation between HRST and human capital. However, in our opinion, this resolution needs to be made explicit within a fundamental revision that should provide an alternative approach to human capital issues in social and economic development research. In the next section we introduce steps that we propose in this direction.

6. Beyond the economics of the brain drain: towards a socio-economic approach to distributed human capital

The previous sections have illustrated how the conception of mobility of highly skilled human resources in general or scientists and researchers in particular has evolved over time and has influenced public policy. Despite the fact that the influence of this mobility in developing countries has been studied and assessed for more than four decades, many scholars and policy makers, particularly those in developing countries, are unsatisfied with the progress made to date. It is argued that the phenomenon is empirically under-
studied due to the lack of data (CEC, 2004; Fontes, 2007; Didou-Aupetit, 2009), as demographic, education and R&D statistics do not really capture the type of flows under study. The effects of the mobility of HRST on the complementary human capital structures they exit and seek to integrate into remain largely ignored. We would argue that this is largely because a conceptualisation of human capital as distributed and configured by its context of use is yet to be fully developed.

Instead, policy makers now look for an optimum combination of the ‘aggregative’ and the ‘connectionist’ in their policy mix (Villanueva, 2009). The EU put stress on the ‘train – retain – attract’ policy approach only some years ago, but has recently incorporated the connectionist policy discourse by recognising the value of European researchers working in the US and the need to build links with them (CEC, 2005). The current policy-mix thus seeks to combine a competitive “war for talent” (Kapur and MacHale, 2005) rationale with a collaborative connectionist approach designed to leverage human capital located off-shore (probably often as a substitute for return). Whilst this represents an expansion in the theoretical framing of the brain drain and subsequent diversification of policy design, the limitations of these approaches in terms of the intertwined issues of HRST mobility, knowledge and development issues remain. In fact, the major limitation remains relatively unchanged since the time Boulding’s 1960s argument. The concepts of human capital and HRST remain largely entangled and interchangeable in discourse. The configuring of human capital by its context, its location within the ‘matrix of information flows’ and hence its potential for use and evolution, remains obscured by the technology of accounting for stocks, flows, and now connections between, researchers. The challenge of a theory of distributed human capital is thus precisely to be able to describe the dynamics of human capital reproduction, transformation and circulation without being reduced to the study of individual units of HRST.

In order to progress toward a theory of distributed human capital we need to first, disentangle the concept of human capital from the category human resources. Second, there is a need to reconceptualise human capital in a way that allows us to address the complementarity of its formation, use and distribution. Third, it is important to address human capital flows from a systemic perspective that considers its interdependencies with other production factors and its changing and dynamic role in economic and social structures. Fourth, it is essential to understand how the properties of human capital,
including its economic properties, are thereby configured by its context of use (Woolley & Cañibano 2010). In this theorizing task, we draw on literature from evolutionary economics and social studies of science, as well as turning back to the lost fundamentals from the early debate on the brain drain.

As we have earlier discussed, despite the early contribution of Kenneth Boulding to the debate on the brain drain, the economics of the brain drain has been enclosed for almost four decades within the “legacy of mechanical thinking” (Dopfer, 2005) that we have called ‘the technology of the brain drain’. The independence of economic agents is one of the major axioms in which the mechanistic paradigm relies. The translation of this axiom to human capital theory implies that a human capital entity/unit – and therefore its economic value - remains unchanged regardless of the context in which it is applied and of the other entities to which it relates. In contrast, Dopfer (2005:17) reviews the main empirical axioms of what he calls “an evolutionary ontology”. Among these axioms are: “the recognition of relations and connections”, that generate “associations” and therefore “structures”, and the recognition of “existences as process”; a process is conceived as “structure in time”.

The evolutionary literature has thus mainly focused on the collective dimension of knowledge, usually conceptualised as organisational ‘routines’ (Nelson and Winter, 1982; Becker, 2004) and ‘capabilities’. Zollo and Winter (1999: 10) define dynamic capabilities as “learned patterns of collective activity” and Dosi and colleagues (2000: 2-4) as “collective learning processes”. Despite these notable contributions to the theory of organisations, a comprehensive theory of how knowledge embedded in individuals is constructed, deployed, used, diffused and reproduced and of how this knowledge affects social systems and economic development is yet to be developed within evolutionary thinking. Recent contributions claim the theoretical need to address the micro-foundations of these ‘collective learned patterns of behaviour’ (Felin and Foss, 2009; Felin and colleagues, 2009). We believe that important theoretical fundamentals for an alternative theory of human capital may be found in this evolutionary literature.

Important insights are also to be found in the social studies of science and the science and technology studies literature. Of particular relevance is the work of Callon (1994) on the extrinsic configuring of the economic properties of scientific knowledge, which also highlights the requirement for complementary assets (instruments and statements
(codified knowledge) to make highly skilled human capital *usable* in research activity (Woolley and Cañibano, 2010). In addition we seek to build on the work of Bozeman and colleagues (2001) in their conceptualisation of ‘scientific and technical human capital’ (STHC). Their theoretical and empirical studies highlight the context dependence of human capital and the social and experiential processes of its extension and augmentation. Other important work for the development of a theory of distributed human capital includes studies of the economics of knowledge (Foray 2004) and of the role of pedagogy in the (re-)production and dispersion of tacit and explicit dimensions of scientific knowledge (Kaiser 2005).

The building blocks we propose for a socio-economic theory of ‘distributed human capital’ are the following:

- **Structure**: Human capital should be conceived as a structure (a system composed of elements and connections among them), not as an aggregate.
- **Heterogeneity**: Human capital structures are heterogeneous; each structure is particular and unique in its own form.
- **Context**: Human capital is not automatically transferrable between contexts; the structure is developed and located in particular social, spatial and temporal contexts.
- **Complementariness**: The context is partly determined by the complementary assets that make human capital valuable in certain circumstances or for certain purposes, such as instruments and physical capital, information or complementary skills.
- **Uncertainty**: The human capital structure acts in a context of uncertainty, which is at the basis of its expansive potential as it provides freedom of imagination.
- **Dispersability**: This is an ambivalent category in the sense that it refers to dispersion as diffusion and diversification of the human capital structure, but also to dissipation in the sense of loss or redundancy. A human capital structure may grow and be diversified and expanded as a result of interactive learning or may stagnate or deskill, for example in extremely stable environments or those in which complementary assets are lacking.

A theory built around the above fundamentals would allow us to assess mobility in a different and enriched way. It would permit us to address, for example, the survival or disintegration over time of knowledge networks and other types of productive collectives. It would frame the study of HRST mobility focusing on the alteration of human capital structures it may induce, without assuming *a priori* any aggregative or loss effects. It is beyond the purpose of this introductory paper to undertake these tasks.
However, we raise the proposed list of fundamentals in order to pursue the development of our theoretical proposal in future studies. A renewed theoretical approach needs to recognise the feedback properties of human capital and include the ongoing nature of its augmentation, undermining simple dichotomies between spaces of investment and deployment/expenditure. If human capital is considered to be a transforming structure that is socially and historically formed, transferred and distributed in particular arrangements, then the framing of the brain drain question is modified. The implications of such a re-framing for policy and for approaches to scientific development could be similarly fundamental.

References:


