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An institutional approach to brain drain

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Abstract

This paper suggests that institutional factors which reward social networks at the expenses of productivity can play an important role in explaining brain drain. The effects of social networks on brain drain are analyzed in a decision theory framework with asymmetric information. We distinguish between the role of insidership and personal connections. The larger the cost of being an outsider, the smaller is the number and the average ability of researchers working in the domestic job market. Personal connections partly compensate for this effect by attracting highly connected researchers back. However, starting from a world with no distortions, personal connections also increase brain drain.

JEL codes: D82, F22, I20, J24, J44.

Keywords: Brain Drain, Social Networks, Institutions, Asymmetric Information, Italian Academia.

1 Introduction

American universities attract 34% of all foreign students from the OECD area, followed by British Universities which attract 16%. While these academic systems are flourishing, others, like Italy, Greece, Portugal etc. are left behind. This raises the question of what makes some countries more exposed to brain drain than others.

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Brain drain has often been attributed to the scarcity of funds in the research sector (low wages, lack of employment opportunities etc.). Most proposals have suggested to increase the investments in R&D. While we recognize that monetary factors may play a role, they are far from telling the full story. Perotti (2002) compares the Italian and the UK academic systems which are both almost entirely public. He shows that if anything, Italian universities are better funded per academic staff or student, than British universities are.

Previous economic studies suggest asymmetric information as a potential explanation for brain drain[1]: employers in foreign countries have better knowledge of students' productivity than employers in the country of origin. We propose a slightly different source of asymmetric information: foreign PhD programs (for instance in the US or in the UK) give a more accurate signal of the students' ability than domestic PhD programs. This informational asymmetry is due to the larger differentiation with respect to quality of the American and British universities compared to their counterparts in the rest of the world[2]. However, asymmetric information alone does not give an exhaustive picture of the brain drain phenomenon. It can not explain why individuals with equal abilities choose different career paths. Therefore, something important is missing.

We suggest that domestic *institutional factors* which reward social networks at the expenses of productivity can play an important role in explaining the brain drain phenomenon. Institutions are here taken to be as "*agreements shaping repeated human interactions*" (Frey 1999: p.3). Examples of institutions include: decision making systems, norms, regulations, and any type of behavioural rules, regardless of whether they are formally laid down or not. The economics literature on migration shows that migrant social networks at points of destination strongly affect where individuals choose to migrate[3]. Social networks reduce the cost of migration by providing information and direct assistance, especially for job search[4]. By analogy, one could expect that *social networks in the country of origin* also influence the choice to migrate. On the

[1] See Kwok and Leland (1982),(1984), Katz and Stark (1984), and Lien (1987).

[2] The US and the UK can boast top universities, such as Harvard, Princeton, LSE, Warwick etc.. but there are also very bad and unknown universities. It seems reasonable to assume that conditional on the choice to go abroad, and given their abilities, students try to be admitted in the best university. Thanks to the thorough selection process of the American and British PhD programs - and the possibility of being expelled from the program if one turns out not to be sufficiently good to face the challenge-, the ranking of the university in which the student gets the PhD gives a strong signal of his/her ability: a student coming from an Ivy League is expected to be of top ability, while a student coming from the university of Tolsa to be of low ability. One could reasonably infer that a student only went to Tolsa because he was not admitted to a better university. The same argument does not apply to the same extent for the PhD in the home country. For instance, conditional on remaining in the home country, the distinction between outstanding and very good students is more difficult to make if there are no universities of the same calibre as the Ivy Leagues.

[3] These studies refer to migration flow from Mexico to the USA. See Winters et al. (2001) and Wilson (1994). Additional literature on how social networks affect migration include: Taylor (1986), Massey (1987), Boyd (1989), Banerjee (1991), Gurak and Caces (1992), Neuman and Massey (1994), Chau (1997) etc. On the role played by latent and direct information on migration outcomes see Banerjee (1984).

[4] See for instance Boyd (1989), Gurak and Caces (1992), and Menjivar (1995).

one hand, individuals with extensive social networks in the home country have less incentive to move abroad. They can exploit the assistance of their local connections to find jobs which are better than the ones they would get abroad[5]. On the other hand, if social networks are an important determinant of success in the domestic job market, individuals with few networks may be penalized by remaining in the home country. The overall effect on brain drain is ambiguous. We analyze this issue in a decision theory framework with asymmetric information about individuals' abilities.

As far as social networks are concerned, it is important to distinguish between the role of *personal connections* and of *insidership*. The former refer to any - direct or indirect - non-professional connections with powerful members of the domestic research community. These include family, friends, and close acquaintances. These networks can be viewed as those discussed in the sociology literature as "strong-ties" networks[6] or, as the "family networks" in Winters et al. (2001). These social networks represent an exogenous source of heterogeneity among aspiring researchers. Individuals with extensive personal connections have better access to the domestic job market thanks to their privileged information, personal recommendations, etc. In our model, this is translated by assuming that in the domestic job market, individuals with extensive personal connections receive better job offer compared to their expected ability, while individuals with few personal connections receive worse job offer compared to their expected ability.

By doing the PhD in the home country, students become "insiders" in the domestic research community network. They get to know the local research environment, they can create relationships with their professors, they have easy access to information etc. These networks can be viewed as those discussed in the sociology literature as "weak-ties" networks or, as the "community networks" in Winters et al. (2001). Depending on the domestic institutions, insidership can strongly penalize researchers coming from abroad, namely the "outsiders". For instance, if universities do not compete for governmental funds, professors have much more incentive to promote their own PhD students regardless of productivity concerns[7]. This is also likely to happen in hierarchical academic systems, where researchers are accountable to a specific academic chair rather than to the department. Similarly, extensive bureaucracy and regulations which discriminate against foreign certificates contribute to increase the "cost of being an outsider". This cost is introduced in our model by assuming that individuals who do their PhD abroad and work in the domestic job market receive a worse job offer than their expected ability.

We build a simple model to investigate who has the incentive to leave the

[5] This holds if social networks in the home country are not positively correlated with social networks abroad, or, as we assume in our model, that the foreign job market is not distorted by social networks.

[6] See Wilson (1998).

[7] It is worth noting that insidership could potentially be used to solve an asymmetric information problem: professors promote their own students because they have a better knowledge of their ability. However, this paper refers to those cases in which professors promote their own students regardless of their ability.

home country and who doesn't. Aspiring researchers can decide to go abroad for the PhD, after the PhD, both, or never. We predict the following stylized results: No researcher does the PhD in the home country and works in the foreign job market. Regardless of their abilities, students with few personal connections do the PhD abroad and remain abroad. Researchers with low abilities and extensive personal connections never go abroad. Unless the cost of being an outsider is very small, only top ability students with extensive initial connections study abroad and return to the home country afterwards. More importantly, our model predicts that researchers working in the foreign job market have, on average, higher abilities than researchers working in the country of origin.

Our comparative analysis shows that in the presence of informational asymmetries, insidership increases brain drain. As the cost of being an outsider becomes larger, more individuals choose to do the PhD in the home country, but both the number and average ability of researchers working in the domestic job market decrease. Personal connections partly compensate for this effect by attracting highly connected researchers back. However, starting from a situation where being an outsider is not costly, personal connections also increase brain drain. We conclude that overall, institutional mechanisms which reward social networks in the home country increase brain drain.

The rest of the paper is organized as follows. In section 2 we describe the model. Section 3 shows the equilibrium properties. Section 4 provides a comparative analysis. Section 5 describes the special case of the Italian academic system. The discussion of the results, extensions, and policy recommendations can be found in section 6 and 7. Section 8 concludes. All proofs are in the appendix.

2 The Model

Consider the following environment: aspiring researchers with heterogeneous abilities and personal connections must choose their career path given the expected job offers[8] made by foreign and domestic employers (mostly universities, but also private or public research entities etc.). Abilities are uniformly distributed over the range $[\underline{a}, \overline{a}]$, where $\underline{a}$ is strictly positive. Similarly, personal connections are uniformly distributed over the range $\left[\underline{k}, \overline{k}\right]$, where $\underline{k} = \frac{2k_0}{k_0+k_1} > 0$ and $\overline{k} = \frac{2k_1}{k_0+k_1}$, so that $E[k_i] = \frac{\underline{k}+\overline{k}}{2} = 1$ [9]. Abilities and personal connections are orthogonal[10].

Individuals' abilities are not directly observable by employers. However, PhD programs can be used as signalling devices. We assume informational

[8] Job offers may have properties beyond the wage. They can also represent the prestige and the duration of the research position. One could also interpret it as the expected probability of getting a job multiplied by a fixed wage.

[9] What is relevant for our model is the relative value of family connections - compared to the average- rather than the absolute value.

[10] For an easier tractability we assume uniform distributions. However, the results still hold under much more general distribution functions as long as personal connections and abilities are independent.

asymmetry between foreign and domestic PhD programs: while the former give a perfect signal of the individuals' abilities, the latter is fully uninformative[11].

Aspiring researchers must also choose in which job market to apply after they complete their PhD. We assume that due to institutional factors, the domestic job market is distorted by two types of social networks: personal connections and insidership. Contrary to what happens abroad, job offers in the home country do not fully reflect researchers' abilities. Job offers are discounted (augmented) if individuals' personal connections with the domestic research community are below (above) average[12]. Thus, by definition, personal connections are observable by domestic employers only[13]. Insidership operates as a cost of doing the PhD abroad if one returns to the home country afterwards. Throughout the paper we refer to it as "the cost of being an outsider". The latter, defined by $B \in [1; \infty)$, reduces the job offers of individuals who return to their country of origin after completing the PhD abroad[14].

Aspiring researchers can choose among four career paths:

- doing the PhD abroad and working in the foreign job market (AA)
- doing the PhD in the home country and working in the foreign job market (HA)
- doing the PhD in the home country and working in the domestic job market (HH)
- doing the PhD abroad and working in the domestic job market (AH)

Consistently with Lien (1987), individuals, before deciding whether to study abroad or not, consider explicitly whether they will want to return to the home country or remain abroad. We assume no job rationing: every individual can be employed in the job market where he applies. What varies are the job offers that researchers receive. This assumption rules out the strategic interactions between individuals.

Researchers doing the PhD abroad and applying to the foreign job market receive a job offer equal to their true ability. Thus the job offer of a researcher with ability a_i will be:

$$w_{AA} = a_i \tag{1}$$

Researchers doing the PhD in the home country and applying to the foreign job market receive a job offer equal to the average ability of all researchers who choose the same path:

$$w_{HA} = E(a_i|_{HA}) \tag{2}$$

[11] For easier tractability we assume that PhD programs abroad give a perfect signal of students' ability, while PhD programs in the home country do not give any additional information on students' ability. However, for the results to hold, it is sufficient that PhD programs abroad give a more accurate signal than PhD programs in the home country.

[12] Indeed, the benefits one gets from own social networks usually depend on their relative size rather than on their absolute size.

[13] The results would not change if one assumed that personal connections with the domestic research community could be signaled to foreign universities through the letters of recommendations.

[14] We assume B to be homogenous across individuals to emphasize the fact that insidership is not used as a solution to the asymmetric information problem. The cost of being outsider is the same regardless of abilities.

Researchers doing the PhD in the home country and applying to the domestic job market receive a job offer equal to the average ability of all researchers with the same personal connections who choose the same path, discounted or augmented by one's own personal connections with the domestic research community. Thus, the job offer of a researcher with ability a_i and personal connections k_i will be:

$$w_{HH} = k_i E(a_i|_{HH;k_i}) \tag{3}$$

By doing the PhD in the home country, these researchers can not signal their ability. If researcher i has average personal connections with the domestic research community ($k_i = 1$), he receives a job offer which reflects his expected ability. If researcher i has few personal connections ($k_i < 1$), he receives a worse job offer compared to his expected ability. If researcher i has extensive personal connections ($k_i > 1$), he receives a better job offer compared to his expected ability.

Finally, researchers doing the PhD abroad and applying to the domestic job market receive a job offer equal to their true ability, discounted by the cost of being an outsider, and discounted or augmented by one's own personal connections with the domestic research community. Thus the job offer of a researcher with ability a_i and personal connections k_i will be:

$$w_{AH} = \frac{k_i}{B} a_i \tag{4}$$

By doing the PhD abroad, these researchers can signal their true ability. Researchers whose personal connections are so extensive to more than compensate for the cost of being an outsider ($k_i > B$) receive a better job offer compared to their true ability, while the remaining researchers receive a job offer which is worse than their true ability.

We now solve the model and identify the properties of the equilibrium.

3 Properties of the equilibrium

Equilibrium will be described by four sets of individuals (which may be empty): a first set of individuals who study and work abroad, a second set of individuals who study abroad and return to the home country, a third set of individuals studying and working in the home country, and a fourth set of individuals who study in the home country and leave afterwards.

Proposition 1 *Conditional on working in the foreign job market, individuals are always better off by doing the PhD abroad than in the home country.*

Intuitively, for any individual's type, strategy (HA) is dominated by strategy (AA). To see that, suppose that among the individuals who work abroad, those with above average abilities got the PhD abroad, while the remaining individuals got the PhD in the home country. Then, the average ability of the individuals who chose (HA) would be $\frac{\underline{a}+\overline{a}}{4}$. Because of asymmetric information, the job

offer by foreign universities would also be $\frac{\underline{a}+\overline{a}}{4}$. But those individuals whose ability is in the range $\left[\frac{\underline{a}+\overline{a}}{4}; \frac{\underline{a}+\overline{a}}{2}\right]$ could have had a higher job offer if they signaled their ability by doing the PhD abroad. So these individuals would choose to do the PhD abroad. It follows that the average ability of individuals choosing (HA) becomes $\frac{\underline{a}+\overline{a}}{8}$. But again, individuals whose ability is in the range $\left[\frac{\underline{a}+\overline{a}}{8}; \frac{\underline{a}+\overline{a}}{4}\right]$ could have a higher job offer if they signaled their ability by doing the PhD abroad, and so on... until the average productivity of individuals choosing (HA) is equal to $\underline{a}$ and all individuals who have the incentive to work in the foreign job market prefer to do the PhD abroad[15].

Corollary 2 *In equilibrium,* $E(a_i|_{HA}) = \underline{a}$. *No individual does the PhD in the home country and works in the foreign job market.*

Proposition 3 *a) Individuals with few personal connections* $(k_i < 1)$ *study abroad and remain abroad. b) Individuals with extensive personal connections* $(B \geq k_i > 1)$ *study and work abroad if and only if their abilities satisfy:*

$$\overline{a} \geq a_i \geq \min\left(\frac{k_i \underline{a}}{2-k_i} \quad ; \quad \overline{a} \right) \tag{5}$$

Individuals with few personal connections always prefer to undertake a research career abroad since they would be penalized in the domestic job market. According to proposition 1, conditional on working abroad, it is always optimal to do the PhD abroad. Individuals with extensive personal connections can still decide to study and work abroad if their ability is high enough to more than compensate the opportunity cost of not exploiting the personal connections.

Proposition 4 *Individuals who study and work in the home country have extensive personal connections* $(k_i > 1)$ *and abilities such that:*

$$a_i < \min\left\{ \frac{k_i \underline{a}}{2-k_i}; \quad \frac{B\underline{a}}{2-B}; \quad \overline{a} \right\} \tag{6}$$

In general, individuals for whom inequality (6) holds, choose (HH) for a combination of reasons: they don't have a strong incentive to signal their ability by doing the PhD abroad, and they can exploit their personal connections in the domestic job market. More specifically, individuals for whom $a_i < \min\left\{ \frac{k_i \underline{a}}{2-k_i}; \quad \frac{B\underline{a}}{2-B}; \quad \overline{a} \right\} = \frac{k_i \underline{a}}{2-k_i}$, have not enough personal connections to study abroad and to return to the home country afterwards, because $k_i < B$. Besides, the opportunity cost of working and studying abroad - namely, the non exploitation of personal connections- is too large compared to the benefit of signalling their ability, which is low. Thus, they will choose to study and work in the home country. Individuals for whom $a_i < \min\left\{ \frac{k_i \underline{a}}{2-k_i}; \quad \frac{B\underline{a}}{2-B}; \quad \overline{a} \right\} = \frac{B\underline{a}}{2-B}$, have too large personal connections $(k_i > B)$ to decide to work abroad. Furthermore, they don't have abilities high enough to justify studying abroad and

[15] Except for individuals with abilities equal to $\underline{a}$ who are indifferent between (AA) and (HA). For a more formal proof of proposition 1 and corollary 2 see the appendix.

becoming an outsider. Therefore, they choose to study and work in the home country.

Proposition 5 *Individuals who study abroad and return to the country of origin afterwards have very extensive initial networks ($k_i > B$), and abilities such that:*

$$\overline{a} \geq a_i \geq \min\left(\frac{Ba}{2-B} \quad ; \quad \overline{a} \right) \tag{7}$$

Returning to the country of origin after completing the PhD abroad can only be afforded by top ability individuals whose personal connections are so extensive to more than compensate for the cost of being an outsider $\left(\frac{k_i}{B} > 1\right)$. In the second stage, individuals with such extensive personal connections are better off by working in the domestic job market. In the first stage, they find it optimal to invest in signalling their top abilities at the expenses of becoming an outsider. The results above are summarized in figure 1.

Corollary 6 *In equilibrium, individuals working in the foreign job market have, on average, higher abilities than individuals working in the country of origin.*

This result is consistent with some empirical evidence. Perotti (2005) shows that Italian professors abroad are on average much more productive - in terms of scientific publications- than Italian professors in the home country. The difference in productivity is strongly significant.

We now turn to the comparative analysis.

4 Comparative analysis

We investigate how personal connections and insidership affect the brain drain equilibrium.

Proposition 7 *The higher the cost of being an outsider, the larger is the number and the average ability -$E(a_i|_{HH;k_i})$- of students doing the PhD in the country of origin .*

Consistently with proposition 7, inequality (6) becomes less binding. The intuition is quite straightforward: conditional on working in the domestic market, as B increases, the cost of doing the PhD abroad increases. It follows that an increasing number of students with higher abilities - who would have otherwise done the PhD abroad - have now the incentive to do the PhD in the country of origin. Whether this is desirable from a welfare point of view, is a delicate issue. On the one hand, raising the average ability of students with a PhD from the country of origin increases the attractiveness and the reputation of domestic PhDs. On the other hand, a larger number of PhD students increases the financial burden on tax payers and the teaching burden on academic staffs. The latter could, in turn, negatively affect research productivity.

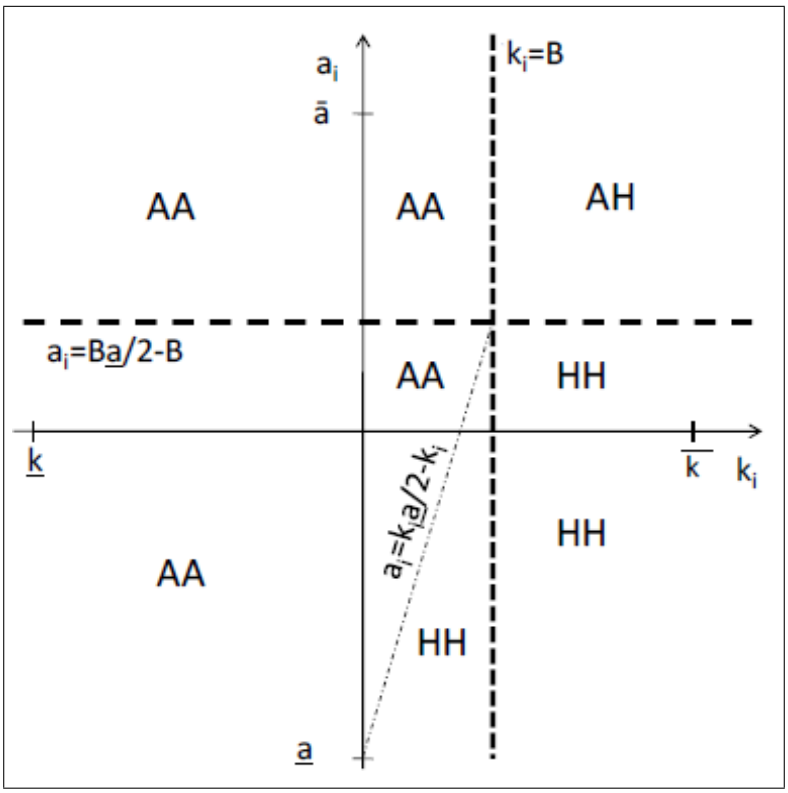

Figure 1: This graph shows the optimal career path for each individual i with characteristics (k_i, a_i) for a given value of B. Since a_i and k_i are independent and uniformly distributed, to each point (k_i, a_i) in the graph is attributed the same density.

It is plausible to assume that a country's decision-makers want to reduce brain drain in the academic job market and in particular to retain and attract researchers with higher abilities.

Proposition 8 *In the presence of asymmetric information, the larger the cost of being an outsider, the larger is the brain drain. More specifically, both the number and the average ability of researchers working in the domestic job market are lower as B is higher.*

In order to understand the role played by informational asymmetries, consider the case where domestic PhD programs signal ability as accurately as foreign PhD programs do. If this is true, according to our model, the choice between working in the domestic or in the foreign job market only depends on personal connections. If anything, an increase in B make some individuals switch from strategy (AH) to strategy (HH). This does not change the number or the ability of students choosing to work in the domestic job market.

However, in the presence of informational asymmetries, as B increases, not all individuals for whom strategy (AH) is no longer optimal now choose strategy (HH). In the set of individuals choosing strategy (AH) prior to the increase in B, only those with lower abilities and larger personal connections have now the incentive to undertake the entire career path in the home country. Researchers with higher abilities want to signal them, so they will do the PhD abroad. Since coming back to the country of origin after doing the PhD abroad has become more costly, some of them - those with smaller personal connections - have now the incentive to undertake the entire career path abroad (AA). As a result, the number and the average ability of researchers working in the domestic job market decrease.

It is worth noting that if B is large enough, such that $B > \overline{k}$ or $Min\left(\frac{B}{2-B}\underline{a}; \overline{a}\right) = \overline{a}$, then the set of individuals doing the PhD abroad and returning to the country of origin is empty. If doing the PhD in the country of origin becomes a pre-condition to access the domestic job market, in equilibrium all researchers study and work abroad except for those with either low abilities or very extensive personal connections. On the other hand, if there is no cost of being an outsider, namely $B = 1$, no individual does the PhD in the home country. The intuition is that insidership is the only cost of doing the PhD abroad assumed in our model. By setting $B = 1$, since it is equally costly to do the PhD abroad or at home, all individuals have the incentive to signal their abilities by doing the PhD abroad. Then, all those with extensive personal connections - half of the distribution - return to the country of origin.

We now look at the effects of personal connections on brain drain. By assumption, what matters in our model is the inequality in the distribution rather than the absolute value of personal connections. If the latter are equally distributed, such that $k_i = 1$ for every i , they have no effects on researchers' job offers. This corresponds to assuming that the domestic job market is not distorted by personal connections.

Proposition 9 *If being an outsider is costly* $(B > 1)$*, personal connections play a fundamental role in reducing brain drain. This is especially true the larger is the inequality in the distribution of personal connections . However, starting from a world where there is no cost of being an outsider, if anything, personal connections increase brain drain.*

By eliminating personal connections, if $B > 1$, the equilibrium is full brain drain: all individuals study and work abroad. Following the same reasoning as in proposition1, the initial decision of the best researchers to signal their abilities lead all individuals to signal their abilities, and thus to remain abroad. On the contrary, personal connections create an incentive to return in the home country. Besides, for any given B, the more unequal the distribution of personal connections is, the larger is $\overline{k}$, and thus the larger is the set of individuals studying abroad and returning to the country of origin after the PhD.

Now, suppose that asymmetric information is the only distortion in the model. In this case, the model predicts that individuals are indifferent between

strategy (AA) and strategy (AH). This occurs because all financial and personal costs of leaving the country are omitted in our model. However, it is sufficient to assume that there is a small cost $\varepsilon \to 0$ to live abroad, to obtain an equilibrium where all individuals choose (AH). In this situation, adding personal connections increases brain drain as all researchers with $k_i < 1$ will now choose to remain abroad.

The intuition for these different results is that while in the first case personal connections compensate for the cost of being an outsider, in the second case, if anything, they create a cost to work in the domestic job market for the individuals with few personal connections.

5 A special negative case: the Italian academic system

The Italian case is often taken as an important example of government's failure in addressing the brain drain problem. Italy loses a high share of its own skilled resources and is unable to attract skilled human resources from abroad. Between 1996 and 1999, more than 2.300 Italian graduate students left the country, while the share of foreign students in Italy was about 3%[16]. We argue that a major explanation for this high level of brain drain is given by Italian institutional factors: the Italian mechanism of recruitment and promotion in academia - the so-called "concorso" - rewards social networks at the expenses of productivity. The recruitment process of researchers is not directly controlled by the universities, but by a nationally elected committee whose members have no reason to internalize the benefits and the costs of the universities hiring the researchers. Instead, each commissioner has the incentive to promote his own candidates[17]. Furthermore, the allocation of governmental funds across universities is not based on scientific productivity. Therefore, most universities have no incentive to change the current recruiting system by selecting more productive researchers. Such institutional mechanisms promote favoritism and manipulation by power groups[18].

As far as insidership is concerned, the cost of being an outsider in the Italian academic job market must be very large. In order to advance in their career, PhD students are often required to work without pay for very influential domestic professors - the so-called "barone". Students doing the PhD abroad obviously won't have this "opportunity". Everything else being equal, this decreases their chance of winning public competitions because they lack the protection of at least one member of the commission. Empirical evidence shows that insidership

[16] These statistics are taken from Giannoccolo (2005)

[17] For more details on the concorsi procedure and for an excellent overview of how the academic system works in Italy, see Perotti (2002). Many of the stylized facts used in our model closely follow the charcteristics empirically analysed by Perotti (2002).

[18] For more details on the role of nepotism in the Italian academic system see the book by Perotti (2008): *L'università truccata.* On the specific role of family connections see Nino (2009): *Quando l'università è un affare di famiglia.*

is an important determinant of success in the Italian academic job market[19]. Several economic studies emphasize the negative effects of insidership on potential Italian returnees[20]. Last but not least, the huge bureaucratic cost to apply to the Italian domestic job market[21] and the national regulations which do not recognize foreign certificates[22] for certain public competition strongly contribute to penalize the outsiders.

The model can also explain some stylized facts of the Italian brain drain. Consistently with proposition 1 and corollary 2, circumstantial evidence suggests that only a small minority of Italian professors abroad got their PhD in their home country. Similarly, in line with corollary 6, Perotti (2005) shows that Italian professors abroad are on average much more productive - in terms of scientific publications - than Italian professors in the home country.

However, it is worth noting that the negative effects of brain drain in the Italian academic system are likely to be underestimated by our model. The wages of Italian researchers do not depend upon productivity. Besides, while the wage are very low at beginning of the career, they increase substantially for the *professori ordinari* (professors with permanent position).This means that even if there were no asymmetric information problems, individuals with high ability would want to work abroad to have a higher wage.

6 Discussion and extensions

This paper argues that the causes of brain drain can lie outside the financial sphere. As in Kwok and Leland's framework, low wages in the domestic job market can be the result rather than the cause of brain drain. However, compared to previous studies, we emphasize the role played by institutional factors in addition to asymmetric information in explaining the brain drain phenomenon. Asymmetric information, alone, can not explain why some individuals leave the home country while other remain, unless as in Kwok and Leland (1982), one

[19] *"By far the single most important determinant of success is being an insider."* Perotti (2002: p.21)

[20] *"... scientists need to leave Italy to advance their careers but they also face massive reintegration problems when they return ... [she] attributes this paradox partly to the influence of the so-called 'barone', the professors who are allegedly the 'deal-makers' in the university jobs market, often requiring scientists to work for them for up to two years without pay in order to progress."* Mobex study, ESCR (2004)

" General lack of a relationship between excellence or performance and progression in Italy with the result that stay-at-home Italians that had "served their time" in the academic system were often privileged over and above well published and experienced potential returnees." Morano – Foadi (2003)

[21] See Perotti (2005) for a detailed overview of these costs.

[22] An example is the distinction that the Italian system makes between the specialization school and the PhD, in some sub-fields related to the Biology discipline. While both require to do research for 4 years in the lab, only the former is accepted to participate to some public competition. It follows that any researcher coming from abroad will be a priori excluded from the public competition.

assumes exogenous preferences for working in the home country[23]. We show that a domestic job market which reward personal connections and penalize outsiders - namely individuals who did not study in the home country - induce most researchers with either high ability or small personal connections to start a career abroad.

Our model can also explain why brain drain can vary across different academic disciplines and systems. Everything else being equal, we expect brain drain to be larger in those disciplines where research is done in teams (such as in science) and when the academic system is more hierarchical (researchers are accountable to a specific professional chair rather than to the department). In these contexts, the cost of being an outsider is likely to be higher because of the stronger relationships between the domestic professors and their PhD students.

It is important to emphasize that our analysis is likely to underestimate the negative effects of these institutional factors on the research sector. Our model does not directly take into account foreign researchers. The latter are very likely to be outsiders and to have very few personal connections with the domestic research community. Accordingly, our model would predict no foreign researchers in the domestic job market. This is consistent with some empirical evidence. Perotti (2005) points out that there are almost no foreign academics in the Italian university system.

In practice monetary factors can also play a role in choosing whether to leave or remaining in the home country. However, they do not change the fundamental results of our analysis. Everything else being equal, if the level of wages are lower in the domestic job market than in the foreign job market, additional people will prefer to work abroad rather than in home country. This can only increase brain drain.

One could claim that the large financial costs of doing a PhD abroad - and sometimes to start a life abroad - can bind students to the home country. While this is certainly the case, it only partially affects the results of our analysis. Individuals who are more likely to be subject to financial constraints have low abilities and few personal connections. Nowadays, with the huge amounts of money spent to promote international education and mobility, students with high abilities are very likely to get scholarships to study abroad. On the other hand, individuals with initially large personal connections usually come from high social classes which can afford to pay for expensive PhDs programs. To the extent that this is true, what could change in our results is the choice of part of individuals with low abilities and few personal connections: those who can not afford to move abroad, will undertake an academic career in the home country. This means that if anything, adding financial constraints to our model reduces the brain drain of students with lower abilities. The remaining results still hold.

[23] We think that an economic analysis should use "exogenous taste for home" as an intepretation for exceptions in behavior rather than as the rule of behavior.

7 Policy implications

Our analysis suggests that increasing wages may not be the optimal solution if brain drain depends on institutional factors and asymmetric information.

Informational asymmetries can be reduced only to a small extent, as the American and British academic systems are already far ahead: it will take a long time before PhD programs in the rest of the world will be able to compete with PhDs programs in Harvard, LSE, etc.. Any evaluation of policies against brain drain should be made in a framework with asymmetric information.

Brain drain can nevertheless still be reduced by changing the institutions. The comparative analysis above suggests that institutional changes should be made first to reduce the cost of being an outsider, and only subsequently, to reduce the role of personal connections in the job market. Several options are available to reduce the cost of being an outsider. As far as the academic sector is concerned, regulations could prevent universities from hiring their own PhD students right after they complete their PhD and encourage them to turn to scholars coming from outside. Some economics departments, including Bocconi, Toulouse, LSE etc. already adopt this policy. Similarly, protectionist regulations should be abolished. If foreign certificates are not recognized to apply to public competitions or to practice some professions (especially in medicine and biology), the domestic job market will obviously become less attractive to researchers with foreign PhDs.

Once the cost of being an outsider is reduced, policies should be taken to weaken the influence of personal connections in the domestic job market. Incentive mechanisms should be designed to motivate domestic universities and public research organizations to promote researchers based on their expected ability rather than on their social networks. Researchers with foreign PhDs could then internalize the entire benefit of signalling their ability and thus will have an incentive to return to their home country. Potential incentive mechanisms include a more competitive allocation of funds across public universities and research centers. Government funds should be allocated more according to scientific productivity and universities should be free to hire whoever they want. This should induce them to select high abilities researchers rather than highly connected researchers. In this respect, our model gives a potential explanation to the recent empirical findings by Aghion et al. (2007). They show a strong positive correlation between universities' autonomy in hiring, wage setting and funding with research performance. According to our paper, institutional mechanisms which encourage universities' autonomy, reduce the social networks effects that we discussed. As a result, the domestic job market becomes much more attractive to high ability researchers from both abroad and the country of origin .

Finally, one could be concerned with inequality issues. On the one hand, wealthy individuals are the most likely to be penalized by a high cost of being an outsider. In fact, an increase in B, affects those individuals who want to study abroad and return to the home country afterwards, namely, those individuals with extensive personal connections - which we expect to be positively correlated with social background. On the other hand, the job market distor-

tions due to personal connections harm in particular the poor individuals. This is true even if personal connections were not correlated with social background. Indeed, while wealthy individuals with few personal connections have always the option to go abroad and get a job offer which reflects their expected ability, poor individuals with few personal connections are likely to be financially constrained. They are stuck in the domestic job market and must accept a job offer which is systematically lower than their expected ability.

8 Conclusions

Some countries, Italy being an example, are more strongly exposed to brain drain compared to others.This papers proposes a new explanation for this phenomenon: in addition to the common problems of scarcity of funds and asymmetric information, institutional factors in the domestic job market can strongly contribute to produce brain drain. Protectionist regulations and decision making systems which reward social networks at the expenses of productivity strongly penalize the "outsiders", namely the researchers who got their graduate education abroad and who wish to go back to their country of origin. We show that in the presence of informational asymmetries, as the cost of being an outsider becomes larger, more individuals choose to do the PhD in the home country, but both the number and the average ability of researchers working in the domestic job market decrease. Finally, our model suggests that if being an outsider is costly, personal connections reduce brain drain by attracting back some highly connected researchers who studied abroad. However, starting from a situation without such distortion, personal connections also increase brain drain. We conclude that overall, institutional mechanisms which reward social networks in the home country increase brain drain.

These results should be taken into account in the selection and evaluation of policies against brain drain.

9 Appendix:Proofs

Proposition 1: We need to identify the set of individuals with characteristics $(a_i; k_i)$ who choose to take the PhD in the home country and work in the foreign job market (HA). In equilibrium, the expected ability of the individuals in this set must be equal to the job offer made by foreign universities. The latter do not observe neither k_i , nor a_i , so they offer $E(a_i|_{HA})$ to any job applicant.

We can divide individuals in three groups: those with few personal connections ($k_i < 1$), those with extensive personal connections ($B > k_i > 1$) and those with very extensive personal connections ($\overline{k} > k_i > B$). Throughout the proof it becomes more clear why we decide to distinguish between these three groups only. We can define the average ability of individuals choosing (HA) as

follows:

$$E(a_i|_{HA}) = \frac{1}{2}E\left(a_i|_{HA;k_i<1}\right)+\alpha(B)E\left(a_i|_{HA;B>k_i>1}\right)+\left(\frac{1}{2}-\alpha(B)\right)E(a_i|_{HA;\overline{k}>k_i>B}) \tag{8}$$

where $\frac{1}{2}$ is the density of individuals with few personal connections, $\alpha(B) = \int_1^B f(k_i)dk_i = \frac{B-1}{\overline{k}-\underline{k}}$ is the density of individuals with extensive connections and $\left(\frac{1}{2}-\alpha(B)\right)$ is the density of individuals with very extensive connections. We now need to find $E\left(a_i|_{HA;k_i<1}\right)$, $E\left(a_i|_{HA;B>k_i>1}\right)$, $E(a_i|_{HA;\overline{k}>k_i>B})$. Let us set $E(a_i|_{HA}) = e$.

For individuals with $k_i < 1$:

1) $w_{AA} > w_{AH}$, so they prefer (AA) to (AH).

2) $w_{HA} > w_{HH}$ if and only if:

$$E(a_i|_{HA}) > k_i E(a_i|_{HH}) \tag{9}$$

Let us suppose that (9) holds. This assumption will turn out not to be relevant since we will show that strategy (HA) is always dominated by either strategy (AA) or strategy (AH). So we now have to compare choice (AA) with choice (HA).

Individuals choose (HA) over (AA) if and only :

$$e > a_i \tag{10}$$

The average ability of individuals for which (8) holds is given by:

$$E(a_i < e) = \int_{\underline{a}}^{e} a_i f(a_i)da_i \tag{11}$$

Since $f(.)$ is a uniform distribution, we get:

$$E(a_i < e) = \frac{\underline{a}+e}{2} \tag{12}$$

This means that in equilibrium:

$$E(a_i|_{HA;k_i<1}) = \frac{\underline{a}+e}{2} \tag{13}$$

For individuals with $B > k_i > 1$:

1) $w_{AA} > w_{AH}$, so they prefer (AA) to (AH).

2) $w_{HA} > w_{HH}$ if and only if (9) holds. Let us suppose that this indeed the case.

So again, individuals have to choose between (HA) and (AA). Individuals choose (HA) over (AA) if and only if (10) holds.

Following the same reasoning as above, in equilibrium we have:

$$E(a_i|_{HA;B>k_i>1}) = \frac{\underline{a}+e}{2} \tag{14}$$

For individuals with $\overline{k} > k_i > B$:

1) $w_{AH} > w_{AA}$, so they prefer (AH) to (AA).

2) $w_{HA} > w_{HH}$ if and only if (9) holds. Let us suppose that this indeed the case.

Individuals have to choose between (AH) and (HA). Individuals choose (HA) over (AH) if and only if:

$$e > \frac{k_i}{B} a_i \tag{15}$$

The average ability of individuals for which this holds is given by:

$$E\left(a_i < \frac{B}{k_i}\right) = \frac{\underline{a} + \frac{B}{k_i} e}{2} \tag{16}$$

Since k_i is not observable by foreign universities, they form their expectations $E(k_i)$ knowing that equation (15) and (16) refer to individuals with very extensive personal connections ($\overline{k} > k_i > B$). This gives us $E(k_i) = \frac{\overline{k}+B}{2}$. In equilibrium:

$$E(a_i|_{HA;\overline{k}>k_i>B}) = \frac{\underline{a} + \frac{2B}{\overline{k}+B} e}{2} \tag{17}$$

Equation (8) becomes:

$$e = \frac{1}{2}\frac{\underline{a}+e}{2} + \alpha(B)\frac{\underline{a}+e}{2} + \left(\frac{1}{2} - \alpha(B)\right)\frac{\underline{a} + \frac{2B}{\overline{k}+B} e}{2} \tag{18}$$

Solving, we get:

$$e = \frac{\underline{a}}{\frac{3}{2} - \left[\alpha(B)\left(1 - \frac{2B}{\overline{k}+B}\right) + \frac{1}{2}\frac{2B}{\overline{k}+B}\right]} \tag{19}$$

Thus, in equilibrium:

$$E(a_i|_{HA}) = \max\left[\ \underline{a}\ \ ;\ \ \min\left(\ \frac{\underline{a}}{\frac{3}{2} - \left[\alpha(B)\left(1 - \frac{2B}{\overline{k}+B}\right) + \frac{1}{2}\frac{2B}{\overline{k}+B}\right]}\ \ ;\ \ \overline{a}\ \right)\ \right] \tag{20}$$

Now we show that $E(a_i|_{HA}) = \underline{a}$ for every B. For this to be true it is sufficient to prove that

$$\alpha(B)\left(1 - \frac{2B}{\overline{k}+B}\right) + \frac{1}{2}\frac{2B}{\overline{k}+B} \leq \frac{1}{2} \tag{21}$$

for every B. Rearranging inequality (21), we get

$$2\alpha(B)\left(1 - \frac{2B}{\overline{k}+B}\right) \leq \left(1 - \frac{2B}{\overline{k}+B}\right) \tag{22}$$

which always holds, since by definition: $\left\{ \begin{array}{cc} 0 \leq \alpha(B) \leq \frac{1}{2} & for \quad B < \overline{k} \\ \alpha(B) = \frac{1}{2} & for \quad B > \overline{k} \end{array} \right\}$.

Because $w_{HA} = E(a_i|_{HA}) = \underline{a}$, no individuals choose (HA). Any other job offer can only be better than w_{HA} .This follows from the fact that strategy (HA) is always dominated by either strategy (AA) or by strategy (AH). This also means that conditional on working in the foreign job market, it is always preferable to take the PhD abroad.

Proposition 3a): For individuals with $(k_i < 1)$, $w_{AA} > w_{AH}$. This means that individuals with few personal connections prefer to work in the foreign job market rather than in the domestic job market after getting their PhD from abroad. We now compare choice (AA) with choice (HH). First, we need to calculate $E(a_i|_{HH;k_i<1})$. Since, by definition, domestic universities observe the personal connections of the candidates with their professors, both $E(a_i|_{HH;k_i<1})$, and w_{HH} , can vary across individuals with different k_i.

Individuals with $(k_i < 1)$ choose (HH) over (AA) if and only if:

$$k_i E(a_i|_{HH;k_i<1}) > a_i \tag{23}$$

Let us set $E(a_i|_{HH;k_i<1}) = e$. The average ability of individuals for whom (23) holds is:

$$E(a_i < k_i e) = \frac{\underline{a} + k_i e}{2} \tag{24}$$

In equilibrium:

$$e = \frac{\underline{a} + k_i e}{2} \tag{25}$$

Solving, we get:

$$e = \frac{\underline{a}}{2 - k_i} \tag{26}$$

We can conclude that:

$$E(a_i|_{HH;k_i<1}) = \max \left[\begin{array}{ccc} \underline{a} & ; & \frac{\underline{a}}{2-k_i} \end{array} \right] \tag{27}$$

Since $k_i < 1$, $E(a_i|_{HH;k_i<1}) = \underline{a}$ for every i. As a consequence, equation (23) never holds. This shows that individuals with few personal connections always choose to study and work abroad. (to be more precise those with ability equal to $\underline{a}$ are indifferent between (AA) and (HA).)

Proposition 3b) & 4: We now investigate the choices of individuals with extensive personal connections, $(k_i > 1)$. Again we should distinguish between individuals with $B > k_i > 1$ and individuals with $\overline{k} > k_i > B$.

For individuals with $B > k_i > 1$:

1) $w_{HH} > w_{HA}$ so they all prefer (HH) to (HA)

2) $w_{AA} > w_{AH}$ so they all prefer (AA) to (AH).

Individuals choose (HH) over (AA) if and only if their ability is such that inequality (23) holds. This means that in equilibrium, inequalities (25)and (26) must hold too. In this case, since $B > k_i > 1$, we can conclude that:

$$E(a_i|_{HH;B>k_i>1}) = \min \left(\begin{array}{ccc} \frac{\underline{a}}{2-k_i} & ; & \overline{a} \end{array} \right) \tag{28}$$

Thus, individuals who choose (HH) over (AA) have abilities such that:

$$a_i < \min\left(\begin{array}{ccc} \frac{k_i \underline{a}}{2-k_i} & ; & \overline{a} \end{array} \right) \tag{29}$$

This proves proposition 3b).

For individuals with $\overline{k} > k_i > B$:

1) $w_{AH} > w_{AA}$, so they all prefer (AH) to (AA).

2) $w_{HH} > w_{HA}$, so they prefer (HH) to (AH)

Individuals choose between (HH) over (AH) if and only if their ability is such that:

$$k_i E(a_i|_{HH;k_i>B}) > \frac{k_i}{B} a_i \tag{30}$$

Setting $E(a_i|_{HH;k_i>B}) = e$, this gives us:

$$Be > a_i \tag{31}$$

The average ability of individuals for whom the inequality above holds, is:

$$E(Be > a_i) = \frac{a_i + Be}{2} \tag{32}$$

In equilibrium, $E(Be > a_i) = e$, which gives:

$$e = \frac{\underline{a}}{2-B} \tag{33}$$

We can conclude that:

$$E(a_i|_{HH;k_i>B}) = \min\left(\begin{array}{ccc} \frac{\underline{a}}{2-B} & ; & \overline{a} \end{array} \right) \tag{34}$$

It follows that individuals who choose (HH) over (AH) have abilities such that:

$$a_i < \min\left(\begin{array}{ccc} \frac{B\underline{a}}{2-B} & ; & \overline{a} \end{array} \right) \tag{35}$$

Putting equation (29) and equation (35) together, individuals with $k_i > 1$ who choose (HH) have abilities such that:

$$a_i < \min\left\{ \begin{array}{ccccc} \frac{k_i \underline{a}}{2-k_i}; & \frac{B\underline{a}}{2-B}; & \overline{a} \end{array} \right\} \tag{36}$$

Proposition 5: We want to identify the set of individuals who choose to study abroad and to return to the country of origin afterwards. Strategy (AA) always dominates strategy (AH) except for individuals with very extensive personal connections $\overline{k} > k_i > B$. For those individuals, (AH) is preferable to (AA) and (HH) is preferable to (HA). The condition under which (AH) dominates (HH) is $k_i E(a_i|_{HH;k_i>B}) < \frac{k_i}{B} a_i$. Following the same procedure as above, our results suggest that individuals who choose (AH), have abilities such that:

$$\overline{a} \geq a_i \geq \min\left(\begin{array}{ccc} \frac{B\underline{a}}{2-B} & ; & \overline{a} \end{array} \right) \tag{37}$$

Proposition 7: As B becomes larger, inequality (6) becomes less binding. Individuals with abilities at the margin switch from strategy (AH) to strategy (HH). Thus, both the number and the average ability of individuals doing the PhD in home country increase. This is clearly shown in figure 1.

Proposition 8: The larger is B, the lower is the number of individuals whose personal connections more than compensate for the cost of being an outsider ($k_i > B$). The condition under which (AH) is preferred to (AA) becomes more binding. Some high ability individuals with personal connections at the margin switch from strategy (AH) to strategy (AA). The final result is a lower number and average ability of individuals working in the domestic job market. This is clearly shown in figure 1.

Proposition 9: Let us suppose that personal connections are equally distributed across individuals such that $k_i = 1$ for every i, or that they do not matter in the domestic job market. Job offers in the domestic job market become: $w_{AH} = \frac{a_i}{B}$ and $w_{HH} = E(a_i|_{HH;k_i})$.It is clear that if $B > 1$, $w_{AH} < w_{AA}$ for every i. Thus, individuals must choose between (AA) and (HH). Individuals who choose (HH) over (AA) have abilities $a_i < E(a_i|_{HH;k_i})$. Setting $E(a_i|_{HH}) = e$, the average ability of this set is given by $E(a_i < e) = \frac{\underline{a}+e}{2}$. In equilibrium $\frac{\underline{a}+e}{2} = e$, which gives: $E(a_i|_{HH}) = e = \underline{a}$. If there is a cost of being an outsider, but personal connections do not affect job offers in the domestic job market, there is full brain drain: all individuals whose ability $a_i > \underline{a}$ choose (AA), while individuals with $a_i = \underline{a}$ are indifferent between (AA) and (HH). However, starting from a situation where $B = 1$, $w_{AH} = w_{AA}$, so individuals will be indifferent between remaining abroad or returning to the home country. By simply adding a small cost of living abroad (financial cost or personal cost of leaving the family), we can assume that most people will return. Thus, if personal connections are included in this world, individuals with $k_i < 1$ will remain abroad, while individuals with $k_i > 1$ will return home. We can conclude that if anything, personal connections increase brain drain when $B = 1$.

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