Emigration of Skilled Labor under Risk Aversion: The Case of Medical Doctors from Middle Eastern and North African Economies

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Abstract

This is a contribution to the new economics of skilled labor emigration that focuses on the mobility of medical doctors from sending Middle East and North African countries. Economic models under risk neutrality and aversion are used. The findings show that the relative expected benefits and the emigration rate have major effects on the net relative human medical capital that remains in the source country. The effects of relative wages in the destination and sending countries besides the yield of education are likely to change the emigration patterns. Comparisons of theoretical and observed relative human capital per country averages are conducted and ensured the statistical validity of the model. The empirical results based on the available data by Docquier and Marfouk (2006 and 2008) and Bhargava, Docquier and Moullan (2010) allowed further use of the model to understand the current trends in the emigration of medical doctors. These trends confirm the magnitude of relative wages besides the level of education and the attitude toward risk as determinants of the emigration of skilled labor. The countries included in the study are all exhibiting brain gain under 1991-2004 emigration data but two distinct groups of countries are identified. Each country is encouraged to anticipate the likely effects of this emigration on the economy with the increase of health demand, the domestic wages and the increase in education capacity for medical doctors.

JEL Classification: I11-F22- J24-A20

Key Words: Medical skilled emigration; wages; human capital, risks.

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Introduction

Within the tradition of the new economics of skilled labor migration and as a follow-up to Driouchi et al. (2009), it has been important to update and apply the theoretical framework of the above paper to series of sectors and economies to discuss relevant economic and social policies. As the availability of medical doctors is crucial for the provision of health care and with the low ratio of doctors to patients in most of the Middle Eastern and North African (MENA) countries, the emigration of this type of skills is critical.

The current research focuses on the emigration of medical doctors from sending MENA region with data from A. Bhargava, F.Docquier and Y.Moullan (2010). Prior version of the latter database is by Docquier and Marfouk (2006 and 2008).

The objective of this paper is to use a decision model that incorporates economic, social and behavioral parameters that may capture the emigration decisions of skilled labor with focus on medical doctors. The economic is represented by the relative wages between destination and countries of origin, the social dimension is the education level and the behavioral component is related to the attitudes towards risk.

This current article is composed of four sections. The first one is a literature review. The second introduces the decision model and its implications. The third section is mainly focusing on the model validation with applications to the countries composing the region of study. The last part discusses the overall results attained in relation to the economic and social policies in the MENA region.

I. Literature Review

The emigration of skilled labor and especially of medical doctors is an important constraint that limits the satisfaction of the local needs in health care. Several authors have analyzed these types of shortages (Qian, 1994; Cooper et al., 2002; Lashinger et al., 2005 and Nevidjon et al., 2006). More recent publications are also dealing with labor shortages with emphasis on labor and health workers most of the time (Harris, 2010; Jain et al., 2010). Authors such as Commander, Kangasniemi and Winters (2004) emphasized that early models found that emigration of skilled labor would be harmful through the impact on wages, employment, and fiscal costs. They also showed that the more recent literature has argued that a beneficial "brain gain" takes place under the effects of educational externalities. But the empirical findings of Beine, Docquier and Özden (2009) suggest that education-based selection rules are likely to have moderate impact. Bhargava, Docquier and Moullan (2010) quantified the effects of physician emigration on human development indicators in developing countries. The model used suggests a positive effect of migration prospects on medical training but the magnitude of this effect is too small to generate a net "brain gain" in the medical sector. These authors underline also that stopping physician brain drain has a small impact on human development. De la Croix and Docquier (2010) explore the complementarities between highly skilled emigration and poverty in developing countries through a model with human-capital accumulation, highly skilled migration and productivity. Their results show that two countries sharing the same characteristics can exhibit different impacts on poverty. Camacho (2010) **uses a** model with an economy composed of two sectors and two regions while allowing for skilled migration. The solution path attained converges to a steady state that exhibits a distribution of skills between regions but with no evidence of symmetry. The new steady state obtained depends on technology, fixed costs, knowledge spillovers and transportation costs.

Lodigiani (2009) provides stylized facts on the magnitude and skill composition of migration and explores the main findings on "brain drain". It focuses also on diaspora networks and on the major channels that foster economic development in source countries of emigration. Docquier and Rapoport (2009) contribute further to the literature through adding three case studies on the African medical brain drain, the exodus of European researchers to the United States, and the contribution of the Indian diaspora to the rise of the IT sector in India. The three cases are related to the "very upper tail of the skill and education distribution". Their effects on the source countries exhibit mixed results. These mixed types of results are also found in Beine, Docquier and Rapoport (2009).

The most recent empirical studies conducted under the Consortium **for** Applied Research on International Migration (CARIM) show that the North African countries with some other MENA economies are major sources of emigration to the rest of the world. For Morocco (Khachani, 2010), the emigration of highly-skilled labor has become significant. The paper indicates also that while emigration brings a net socio-economic gain at the individual level, it represents a loss from the macroeconomic perspective for the country of origin. Belguendouz (2010) recognizes also the extent of skilled labor expatriates from the experiences and policies devoted to create incentives to reverse the emigration trend. The study on Tunisia by Belhaj Zekri (2010) identifies the preliminary success of skilled Tunisians entering the Gulf countries labor markets. The study recognizes also the domestic difficulties in job markets and thus the emigration of skilled labor in Tunisia, even under new policies for retention and return.

Studies by Nessar (2010) **insists on** the role the education received by the skilled migrants in relation to the transfers in the case of Egypt. Sika (2010) **finds that** highly skilled emigration patterns from Egypt, to the OECD and the Gulf, contribute positively to the development process of Egypt. But, Ghoneim (2010) views that the deteriorating Egyptian education system producing less qualified labor lead to increasing emigration as a result of excess labor supply.

Through series of surveys, Khawaja (2010) identifies further waves for skilled emigration from Palestine. The emigration of skilled labor is also recognized to be pervasive in Libya (Maghur, 2010). Algeria is also suffering from the emigration of skilled labor (Bouklia, 2010 and Labdelaoui, 2010). Olwan (2010) attributes highly skilled labor migration to the prevailing economic and social conditions in Jordan. The same trend is expressed by Syria (Marzouk, 2010 and Yazji Yakoub, 2010).

But, the new economics of skilled labor has identified potential gains that could benefit the source economy as emigration of skills can induce further quantitative and qualitative domestic training and graduation from domestic higher education systems. The overall net effects of the emigration and the domestic training and graduation is translated into a net effect that can be either “brain drain” or “brain gain” depending on the situation of each economy. This new type of literature has emerged following the contributions of Mountford (1997), Vidal (1998), Beine et al. (2003), Stark et al. (2005), Duc Thanh (2004) and M. Schiff (2005), among others.

Open economies with immigration are attractive since wages of skilled workers are higher that those prevailing in the source countries. According to Beine & al (2002), the human capital migration can be globally beneficial to the country of origin when the brain effect dominates the drain effect for the country of emigration.

Stark's theory (Stark et al., 2005) points to the fact that the prospect of migration may result in the formation of a socially desirable level of human capital. The expected higher returns to human capital in the destination country influence the decisions about the acquisition of skills in the country of origin (Stark, 2005).

However, the analysis of the behavior of skilled labor denotes some degree of aversion towards risk that is not really taken into consideration by the literature on skilled labor migration. So, the analysis of labor decisions under risk is important in the process of identifying the optimal human capital and the optimal emigration rates for skilled labor (Schechter, 2005; Schechter, 2006). Other authors emphasized the relationships between the levels of initial wealth, income and levels of risk aversion (Rabin, 2000; Rabin & Thaler, 2001; Chetty, 2003).

II. The Economic Model

The model used in this paper is not different from the one developed in Driouchi, Baudassé, Boboc and Zouag (2009). The basic features of this model are from Stark et al., (2005). After the underlying assumptions, the cases of risk neutrality and aversion are introduced with their related comparative statics.

1. Model Assumptions

Labor productivity in a given economy is represented by β. It is equivalent to private returns to labor, as in Stark et al (2005). In the context of this model, β takes values β_S in the source and β_D in the destination countries. The private returns in the destination countries are considered to be higher than those in the sending countries ($\beta_D > \beta_S$). It is assumed here that emigration decisions are uniquely based on the levels of β that can be either β_D or β_S with respective probabilities m and $(1-m)$.

In this model, each emigrant (given the static nature of the model) seeks a level of education h (considered as an individual investment in human capital) under the linear cost function ch with c being the unit cost of education. Furthermore, the level of education h is valued through a production function $g(h)=ah^{\gamma}$ (the output of human capital) where $0<\gamma<1, g^{'}(h)>0$, $g^{''}(h)<0$ and a is the talent of individuals.

Each agent is consequently assumed to get (as a student) or to have the level of education h (after graduation) based on the maximization of an objective function $V(h)=\beta_S g(h)-ch$ in the absence of emigration (closed economy) and his expected utility in case of emigration (open economy). This latter option is the one considered in this paper where the model is accounting for risk neutrality and risk aversion.

2. Derivation of the theoretical decision rules under risk neutrality

Under the above assumptions, each individual in the economy is assumed to emigrate with probability m in order to achieve an overall net benefit in relation to the realization of the random variable β (β_D and β_S respectively with probabilities m and $(1-m)$).

This implies that the overall objective function in case of risk neutrality is given by the expected earnings related to this choice:

$$V(h)=m\beta_D g(h)+(1-m)\beta_S g(h)-ch$$

The necessary and sufficient conditions (given the concavity of $g(h)$) for a maximum V to hold are given by the optimal value of h:

$$h^*=\left[\frac{c}{\gamma a\left[m\left(\beta_D-\beta_S\right)+\beta_S\right]}\right]^{\frac{1}{\gamma-1}}$$

The aggregate stock of migrant skilled human capital is given by:

$H = N\left[\frac{c}{\gamma a\left[m\left(\beta_D - \beta_S\right) + \beta_S\right]}\right]^{\frac{1}{\gamma-1}}$ where N is the total population that is willing to emigrate.

The aggregate stock of human capital remaining in the country (non emigrant) is:

$$H_N = (1-m)N\left[\frac{c}{\gamma a\left[m\left(\beta_D - \beta_S\right) + \beta_S\right]}\right]^{\frac{1}{\gamma-1}} \qquad (1)$$

Under absence of emigration (m=0), the stock of human capital in the country of origin is:

$$H_{N0} = N\left[\frac{c}{\gamma a\left[\beta_S\right]}\right]^{\frac{1}{\gamma-1}}$$

The relative domestic human capital remaining in the source country is:

$$\left(\frac{H_N}{H_{N0}}\right) = (1-m)\left[m\left(\beta_D/\beta_S - 1\right) + 1\right]^{\frac{1}{1-\gamma}} \qquad (2)$$

The following questions are related to the variations of the aggregate domestic relative human capital.

2.1 Variations with respect to the emigration rate and optimal emigration

Depending on the level of m, relative wages and gamma, the changes in the relative human capital relative to gamma can be positive or negative. For values of m higher than m*, the derivative is negative while positive below this value.

$$\partial\left(\frac{H_N}{H_{N0}}\right) / \partial m = \frac{1}{H_0}(\partial H_N / \partial m) = \frac{1}{H_0}(1-m)\left[m\left(\beta_D/\beta_S - 1\right) + 1\right]^{\frac{1}{1-\gamma}}$$

As in (Appendix, Demo 1, Demo 2 and Demo 3) the maximal emigration rate among other results is given by:

$$m_N^* = \frac{\left[\beta_D - (2-\gamma)\beta_S\right]}{(\beta_D - \beta_S)(2-\gamma)} = \frac{\left[(\beta_D/\beta_S) - (2-\gamma)\right]}{((\beta_D/\beta_S)-1)(2-\gamma)}$$

Again, m_N^* is a function of relative wages and of γ.

The relative human capital varies in the same sense with respect to relative wages.

$$\partial\left(\frac{H_N}{H_{N0}}\right) / \partial(\beta_D/\beta_S) = (1-m).m.(\frac{1}{1-\gamma})\left[m\left(\beta_D/\beta_S - 1\right)+1\right]^{\frac{\gamma}{1-\gamma}} > 0$$

It also varies following the direction of γ as:

$$\partial\left(\frac{H_N}{H_{N0}}\right) / \partial(\gamma) = (1-m).(1/(1-\gamma))^2 \ln\left[m\left(\beta_D/\beta_S - 1\right)+1\right]\left[m\left(\beta_D/\beta_S - 1\right)+1\right]^{\frac{1}{1-\gamma}} > 0$$

Increases (respectively decreases) in γ leads to increases (decreases) in the relative net human capital gains.

$$\partial m_N^* / \partial(\beta_D/\beta_S) = \partial \frac{\left[(\beta_D/\beta_S) - (2-\gamma)\right]}{((\beta_D/\beta_S)-1))(2-\gamma)} / \partial(\beta_D/\beta_S)$$

The optimal emigration rate increases (decreases respectively) with increases (decreases) of the relative wages (wage in destination relative to that at the origin). The optimal rate of emigration changes also in the same direction with changes in γ.

$$\partial m_N^* / \partial(\beta_D/\beta_S) = \frac{\left[(-(2-\gamma)+(2-\gamma)^2\right]}{((\beta_D/\beta_S)-1)(2-\gamma))^2} > 0$$

$$\partial m_N^* / \partial(\gamma) = \frac{(\beta_D/\beta_S)((\beta_D/\beta_S)-1)}{((\beta_D/\beta_S)-1)(2-\gamma))^2} > 0$$

2.2 The level of m that equates H_N with H_0

This level is given by:

$$\left(\frac{H_N}{H_{N0}}\right) = (1-m)\left[m\left(\beta_D/\beta_S - 1\right)+1\right]^{\frac{1}{1-\gamma}} = 1$$

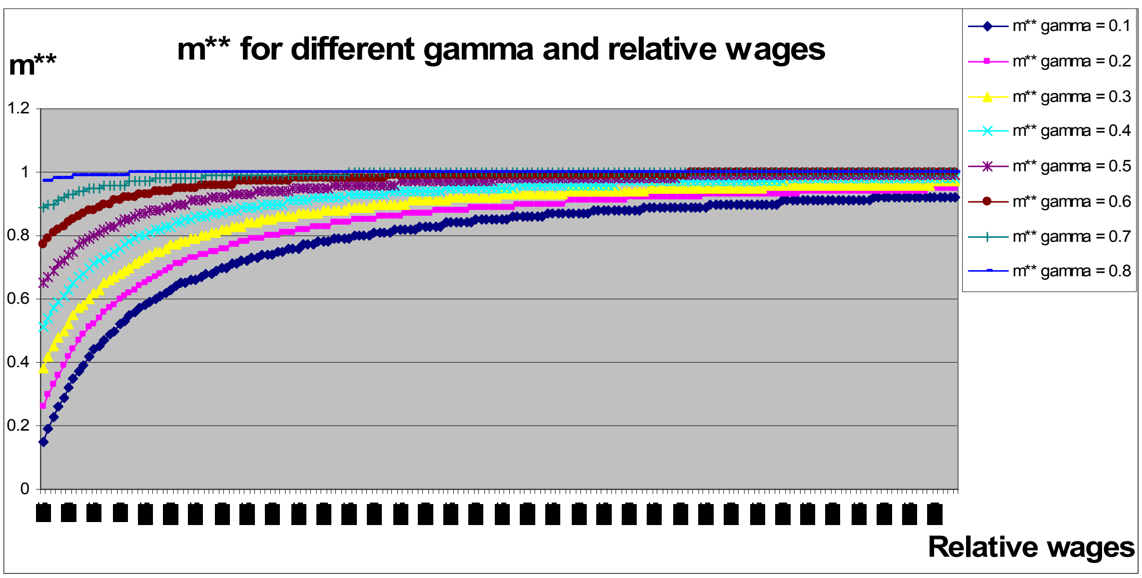
This is achieved with m=0, with $H_N = H_0$ and with m=m* because of the concavity of H_N.

This implies that m** is given by the second zero of the following equation:

$$(1/(1-m)^{(1-\gamma)}) = m\left(\beta_D/\beta_S - 1\right) + 1$$

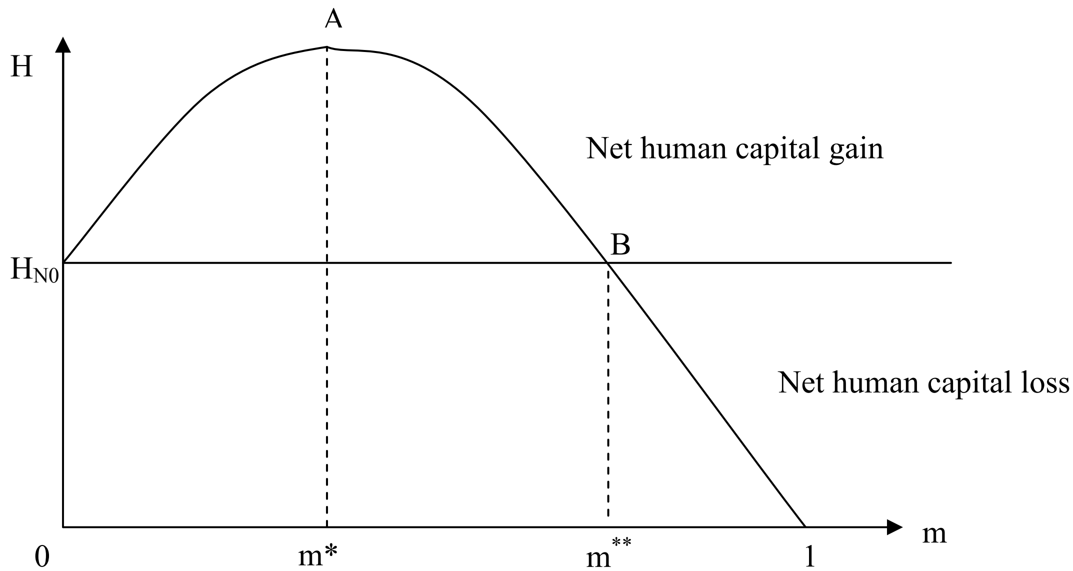
The values of m** indicate how the economy enters the net brain drain phase. The higher is m**, the better off is the economy as the brain drain occurs at higher probabilities of emigration. Lower m** is an indication of higher brain drain and then the sensitiveness of the economy to the loss.

These trends are discussed below under different simulations of the relative wages and the schooling yield γ.



m** increases with relative wages meaning that the relative human capital starts to be less than the domestic human capital while at lower relative wages, m** is lower. The value of the curve of m** as a function of relative wages is higher under higher gammas. This implies that the changes from lower values to higher values of gammas meaning from lower to higher valuation of education, m** gets higher. It attains the level 1 under gamma = 0.8 or the highest level of valuation of education. Lower m** is expected under lower gamma.

2.3 The shape of H as a function of m



3. Emigration under Risk Aversion:

In case of risk aversion, a constant relative risk aversion (CRRA) function is used (Harrison & al, 2005) as $U(x)=\frac{x^{1-r}}{1-r}$ or $U(x)=\frac{x^{\alpha}}{\alpha}$, ($\alpha \in]0,1]$), where $\alpha = 1-r$ and r is the CRRA coefficient.

Under the above assumptions, the objective function is formulated as:

$V(h)=m.U(\beta_D g(h))+(1-m).U(\beta_S g(h))-ch$ or:

$V(h)=\frac{m}{\alpha}\beta_D^{\alpha}a^{\alpha}h^{\gamma\alpha}+\frac{(1-m)}{\alpha}\beta_S^{\alpha}a^{\alpha}h^{\gamma\alpha}-ch$

Given the concavity of $V(h)$, the necessary and sufficient condition for a maximum leads to the maximal level of education to be:

$$h^{*}=\left[\frac{c}{\gamma a^{\alpha}\left[m(\beta_D^{\alpha}-\beta_S^{\alpha})+\beta_S^{\alpha}\right]}\right]^{\frac{1}{\gamma\alpha-1}} \quad (3)$$

The aggregate stock of skilled human capital in case of risk aversion under emigration is given by:

$$H_T = N.h^* = N\left[\frac{c}{\gamma a^{\alpha}\left[m(\beta_D^{\alpha}-\beta_S^{\alpha})+\beta_S^{\alpha}\right]}\right]^{\frac{1}{\gamma\alpha-1}}$$

where N is the total labor force in the economy.

The human capital remaining in the source economy, in case of emigration under risk aversion is given by:

$H_R = (1-m)H_T$ or:

$$H_R = (1-m)N\left[\frac{c}{\gamma a^{\alpha}\left[m(\beta_D^{\alpha}-\beta_S^{\alpha})+\beta_S^{\alpha}\right]}\right]^{\frac{1}{\gamma\alpha-1}} \qquad (4)$$

$$H_{R0} = N\left[\frac{c}{\gamma a^{\alpha}\left[\beta_S^{\alpha}\right]}\right]^{\frac{1}{\gamma\alpha-1}}$$

$$H_R / H_{R0} = (1-m)\left[m((\beta_D{}^{\alpha}/\beta_S{}^{\alpha})-1)+1)\right]^{(1/(1-\alpha\gamma))} \qquad (5)$$

3.1: Changes in Optimal Human Capital:

The variations of the domestic human capital formation H_R in relation to m are considered also important to be taken into account. These variations are analyzed using the first and second derivatives of H_R that are respectively given by (Appendix, Demo 2):

$$\frac{\partial H_R}{\partial m} = H_R.\frac{(1-m)(\beta_D^{\alpha}-\beta_S^{\alpha})-(1-\gamma\alpha)\left[m(\beta_D^{\alpha}-\beta_S^{\alpha})+\beta_S^{\alpha}\right]}{(1-m)(1-\gamma\alpha)\left[m(\beta_D^{\alpha}-\beta_S^{\alpha})+\beta_S^{\alpha}\right]}$$

$$\frac{\partial^2 H_R}{\partial m^2} = H_R\left(\beta_D^{\alpha}-\beta_S^{\alpha}\right)\left\{\frac{\gamma\alpha(1-m)(\beta_D^{\alpha}-\beta_S^{\alpha})-2(1-\gamma\alpha)\left[m(\beta_D^{\alpha}-\beta_S^{\alpha})+\beta_S^{\alpha}\right]}{(1-m)\ (1-\gamma\alpha)^2\left[m(\beta_D^{\alpha}-\beta_S^{\alpha})+\beta_S^{\alpha}\right]^2}\right\}$$

Under the condition $\frac{\beta_D^\alpha}{\beta_S^\alpha} > \frac{(2-\gamma\alpha)(1-m)}{\left[\gamma\alpha - m(2-\gamma\alpha)\right]}$, the second derivative of H is negative implying that $H_R(m)$ is concave and that the maximum of H is obtained through the necessary and sufficient condition that is $\frac{\partial H_R}{\partial m} = 0$ (Appendix, Demo 3). This implies that the optimal value for the emigration rate is given by:

$$m^* = \frac{\left[\beta_D^\alpha - (2-\gamma\alpha)\beta_S^\alpha\right]}{(\beta_D^\alpha - \beta_S^\alpha)(2-\gamma\alpha)} \qquad (5)$$

The optimal emigration rate that can be obtained for the maximization of H appears to be directly related to most of the parameters of the problem. It has to be noted though that the numerator should be positive in order to meet the conditions imposed on m. This leads to the following restriction: $1 \le (2-\gamma\alpha) \le \frac{\beta_D^\alpha}{\beta_S^\alpha}$ ([i]). This condition implies that $(2-\gamma\alpha)$ is the minimal value for the relative productivity or relative wage below which migration is not optimal.

The above results are shown in Figure 2 where point A refers to the maximum of H attained at m^*. Point B corresponds to m^{**} [ii] where H_R starts getting lower than H_{R0} [iii].

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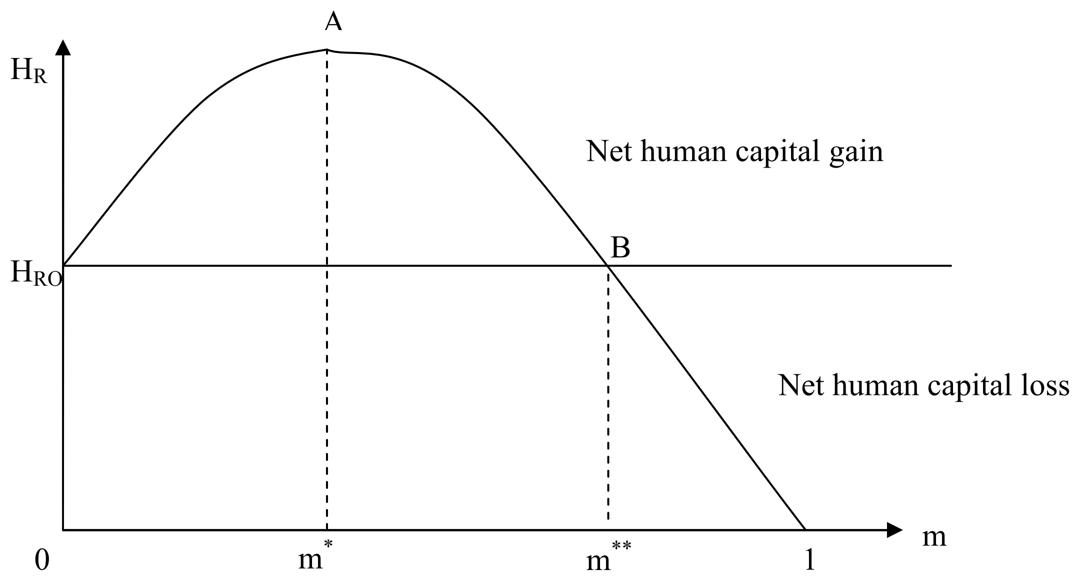
[i] $0 \le m^* \le 1$, means that $0 \le \frac{\beta_D^\alpha}{(\beta_D^\alpha - \beta_S^\alpha)(2-\gamma\alpha)} - \frac{\beta_S^\alpha}{(\beta_D^\alpha - \beta_S^\alpha)} \le 1$. This is equivalent to $\frac{\beta_D^\alpha}{\beta_S^\alpha} \ge (2-\gamma\alpha)$ and $(2-\gamma\alpha) \ge 1$, which implies that $1 \le (2-\gamma\alpha) \le \frac{\beta_D^\alpha}{\beta_S^\alpha}$.

[ii] m^{**} is the solution of the following equation: $(1-m)\left[m(\beta_D^\alpha - \beta_S^\alpha) + \beta_S^\alpha\right]^{\frac{1}{1-\gamma\alpha}} = \left(\beta_S^\alpha\right)^{\frac{1}{1-\gamma\alpha}}$

[iii] H_{R0} is the value of H_R attained at $m = 0$ with $H_0 = N\left[\frac{c}{\gamma a^\alpha \beta_S^\alpha}\right]^{\frac{1}{\gamma\alpha - 1}}$

Figure 2: Domestic human capital stock with emigration and risk aversion



Proposition 2: A net human capital gain (brain gain) results when the value of human capital, under different values of emigration rate, is superior to the value of the initial human capital under the absence of emigration. The human capital gain can reach a maximal value at m^* and returns to its initial value at m^{**}, while brain drain starts when human capital is lower than H_{R0}.

Effects of Changes in risk attitudes:

In order to refine the understanding of aggregate decisions, variations with respect to the level of risk aversion (α) are useful as aggregate decisions include a large variation of risk attitudes of skilled labor migrants.

For that purpose, the relative human capital (H_R/H_{R0}) as well as the optimal (m^*) emigration rate are analyzed in relation to changes in risk attitude (α).

The functions for the relative human capital and its first derivative are respectively given by (Appendix, Demo 4):

$$\frac{H_R}{H_{R0}} = (1-m)\left\{\frac{\left[m\left(\beta_D^{\alpha}-\beta_S^{\alpha}\right)+\beta_S^{\alpha}\right]}{\beta_S^{\alpha}}\right\}^{\frac{1}{1-\gamma\alpha}} \quad (6)$$

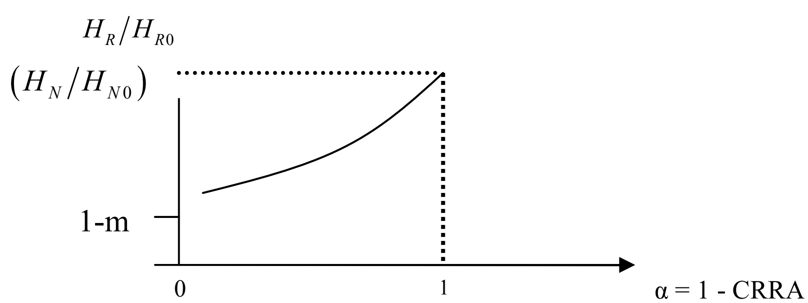
$$\frac{\partial\left(\mathrm{H_R}/\mathrm{H_{R0}}\right)}{\partial\alpha} = \frac{1-\mathrm{m}}{1-\gamma\alpha}[\mathrm{m}(\beta_{\mathrm{D}}^{\alpha}/\beta_{\mathrm{S}}^{\alpha}-1)+1]^{\frac{\gamma\alpha}{1-\gamma\alpha}}\left\{\mathrm{m}.\left[\ln\left(\beta_{\mathrm{D}}/\beta_{\mathrm{S}}\right)\right](\beta_{\mathrm{D}}^{\alpha}/\beta_{\mathrm{S}}^{\alpha})+ +[\mathrm{m}(\beta_{\mathrm{D}}^{\alpha}/\beta_{\mathrm{S}}^{\alpha}-1)+1]\cdot\ln[\mathrm{m}(\beta_{\mathrm{D}}^{\alpha}/\beta_{\mathrm{S}}^{\alpha}-1)+1]\cdot\frac{\gamma}{(1-\gamma\alpha)}\right\} \quad (7)$$

Since $\alpha \in \left]0,1\right]$, $\frac{\partial\left(\mathrm{H_R}/\mathrm{H_{R0}}\right)}{\partial\alpha}$ is positive and the function H/H_0 is increasing with α (Appendix, Demo 4).

Furthermore, using expressions (2) and (6), it can be easily shown that for any $\alpha \in \left]0,1\right]$, $H_R/H_{R0} < \left(H_N/H_{N0}\right)$. Equality in relative human capital occurs when $\alpha = 1$

Figure 2 shows the shape of H_R/H_{R0} as function of α. It has to be noted though that the function starts at value higher than $\left(1-m\right)$ as $\left(\alpha = 0\right)$ is not included. When $\alpha = 1$, this is the case of risk neutrality. In addition, the sign of the second derivative of H/H_0 as function of α is positive (Appendix, Demo 4).

Figure 3: Effects of the Level of Risk Aversion on the Relative Domestic Human Capital Curve



Proposition 3: H/H_0 under relative risk aversion is lower than the level occurring under risk neutrality. This says that higher attainment in relative human capital is achieved under neutrality to risk.

Regarding the optimal level of skilled labor migration, the derivative of m^* (expression (5)) is given by (Appendix, Demo 5):

$$\frac{\partial m^*}{\partial \alpha} = \frac{\beta_D^\alpha \beta_S^\alpha (2-\gamma\alpha)(1-\gamma\alpha)[\ln(\beta_D^\alpha) - \ln(\beta_S^\alpha)] + \gamma\beta_D^\alpha(\beta_D^\alpha - \beta_S^\alpha)}{(\beta_D^\alpha - \beta_S^\alpha)^2 (2-\gamma\alpha)^2}.$$

This derivative is always positive within the interval of definition of $\alpha \in]0,1]$, implying that m^* increases (decreases) with increases (decreases) in α (Appendix, Demo 5).

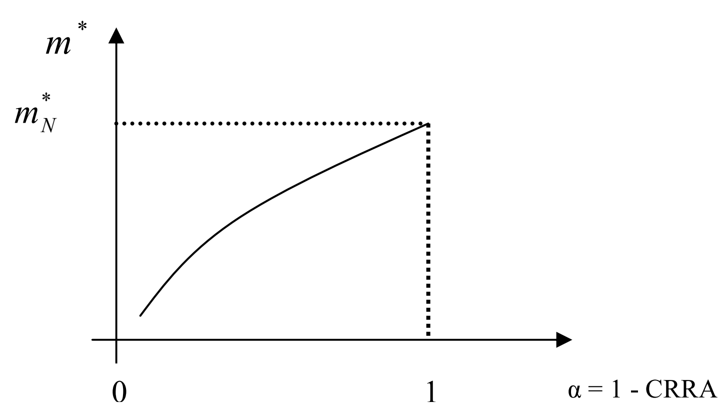
The maximum value of m^* is obtained for $\alpha = 1$, that is $m^*(1) = \frac{[\beta_D - (2-\gamma)\beta_S]}{(2-\gamma)(\beta_D - \beta_S)}$, which equals the value of m^* under risk neutrality (Appendix, Demo 6):

$$m^*_{RN} = m^*(1) = \frac{[\beta_D - (2-\gamma)\beta_S]}{(2-\gamma)(\beta_D - \beta_S)} \qquad (8)$$

In addition, it can be easily shown from expressions (5) and (8) that for any $\alpha \in]0,1]$, $m^* < m^*_{RN}$.

Figure 3 draws the shape of m^* as function of α.

Figure 4: Effects of the Level of Risk Aversion on the Relative Domestic Human Capital Curve



Proposition 4: The optimal emigration rate (m^*) under relative risk aversion is lower than the level occurring under risk neutrality. This says that higher attainment in optimal emigration is reached under neutrality to risk.

III. Empirical Investigations

Using the available data and mainly the database of Marfouk, the case of emigration of medical doctors in the Arab World is used for empirical investigations. This analysis is based on the data on the emigration of medical doctors in the Middle East and North African region provided in A. Bhargava, F.Docquier and Y.Moullan (2010). Prior versions of this database are by F.Docquier and A. Marfouk (2006 and 2008).

1. Descriptive analysis

As said above, the "Medical Brain Drain" is a new panel data on physicians' emigration rates (1991-2004). This dataset is recognized by the authors as a product of the Trade Team - Development Research Group which is part of a larger effort in the group to measure the extent of the brain drain as part of the International Migration and Development Program. According to this database, the MENA countries have shown high levels of emigration of medical doctors. The main countries of destination are UK, USA, France, Canada, Germany, Belgium, Australia, Italy, Sweden, Switzerland and Austria. Given the lack of data on some countries like Mauritania and Sudan, the current empirical investigation focuses on the remaining countries that are Morocco, Algeria, Tunisia, Libya, Egypt, Jordan, Syria, Turkey and Yemen.

The total emigration rate related to all destinations ranges from 0.1% to 12%. Intermediate levels are recognized for the remaining countries with values between two and four percent.

Even though the rate in 2004 appears to be high, the trends expressed over the period 1991-2004 are constant or decreasing for most of the countries in the region. The countries displaying increasing rates are Algeria and Libya. All the other countries have either constant or decreasing annual trends. The decreases, even if statistically significant, are still low. Syria, Jordan and Egypt have revealed an important reduction in their rates of emigration of physicians.

Two observations related to the 1991-2004 trends (table 2) expressed by each country can be introduced. The first observation is that the decreases are low. The second observation is that these trends are obtained from net emigration rates and may also be related to other factors that are outside the willingness of these countries to retain their medical doctors.

The emigration rate needs to be viewed with the domestic availability of medical doctors. When this latter variable is measured by the number of physicians per 1,000 people for each country, large variations appear. Egypt attains a level above two doctors per 1,000 people. The other countries are largely below two doctors per 1,000 people with most of them being between one and 1.5.

Table 1: Country annual trends in number of physicians per 1,000 people

	R squared	Intercept	t-stat constant	Coefficient	t-stat coefficient	Observations
Algeria	0.70	0.84	40.12	0.02	5.31	14
Egypt	0.71	1.32	12.59	0.08	5.49	14
Jordan	0.93	1.38	37.86	0.06	12.60	14
Libya	0.02	1.31	49.78	0.00	-0.51	14
Morocco	0.77	0.24	8.89	0.02	6.40	14
Syria	0.87	0.87	21.58	0.05	9.09	14
Tunisia	0.35	0.62	23.29	0.01	2.54	14
Turkey	0.48	0.94	14.18	0.03	3.36	14
Yemen	0.33	0.17	10.76	0.005	2.45	14

The most important element in this analysis is the trend pursued by each country with regard to the domestic availability of doctors. Table 1 shows the annual trends for each country. These trends are statistically significant for Egypt (0.08), Jordan

(0.06) and Syria (0.05). The other countries have lower annual changes ranging from zero (Libya) to 0.03 (Turkey). The remaining countries have annual rates of 0.01 (Tunisia) and 0.02 (Algeria and Morocco). The estimated rate for Yemen is 0.005. Furthermore, all the countries in the sample have statistically significant intercepts that are generally high, with the exception of Yemen. It can be noted that Lebanon has the highest trend meaning that domestic staffing by medical doctors has been improving during 1991-2004. This is clearly consistent with the trend expressed by the domestic availability.

Table 2: Trends of Annual emigration rates and stocks of medical doctors

Country	*Rate of Migration*			*Stock of Migrants*		
	R^2	*Intercept*	*Coefficient*	R^2	*Intercept*	*Coefficient*
Algeria	0.85	0.002 (0.78)	0.003 (8.19)	0.87	-45.54 (-0.51)	103.95 (8.91)
Egypt	0.50	0.07 (17.85)	-0.002 (-3.49)	0.98	5452.87 (74.90)	248.32 (26.09)
Jordan	0.54	0.08 (43.60)	0.0009 (3.79)	0.99	393.98 (30.87)	57.32 (34.36)
Libya	0.99	0.05 (33.99)	0.006 (33.58)	0.99	265.91 (18.96)	61.48 (33.53)
Morocco	0.46	0.07 (11.56)	-0.003 (-3.21)	0.97	432.98 (42.54)	25.86 (19.43)
Syria	0.37	0.17 (36.11)	-0.002 (-2.69)	0.99	2268.54 (48.09)	195.44 (31.69)
Tunisia	0.002	0.03 (19.46)	-0.00004 (-0.18)	0.92	173.88 (45.50)	5.78 (11.57)
Turkey	0.18	0.04 (12.41)	-0.0007 (-1.63)	0.94	2177.62 (66.57)	60.84 (14.23)
Yemen	0.03	0.01 (9.31)	-0.0001 (-0.59)	0.92	27.44 (17.09)	2.47 (11.76)

2. Testing for the validity of the theoretical model

This conducted in different steps with discussion on different parameters where the first one is related to education, the second one to relative wages while the last one introduces the behavioral parameter related to risk aversion. The assessment of these three sets of parameters will allow for the calculation of the theoretical relative domestic capital in each economy. These values are then compared with the observed relative capital as it is shown the published data on emigration of medical doctors. The theoretical and observed means of the values relative to each country and over 1991-2004 are then compared.

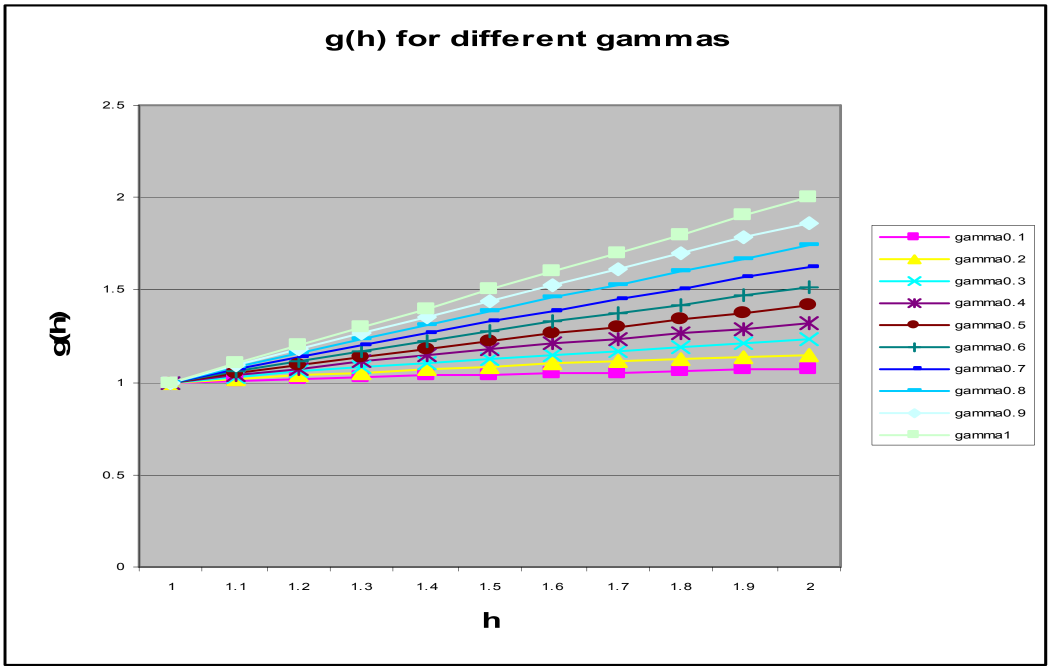
2.1: Estimations of the parameters for education

The parameters γ **and** a are **estimated from a regression model where t**he dependent variable is the normalized Gross Tertiary Enrollment (GTEN) in 2004, published in the WBI website for 86 selected developing economies. The independent variable is the normalized average years of schooling (AYSN) of workers in 2000 (World Bank Institute, 2007) for the same countries. This regression provides the following results. This is used with the 86 countries as no meaningful outcomes are attained with the data on MENA countries, mainly due to limitations in the number of observations. More details about these results are provided in Driouchi et al., (2009).

Regression results for γ and a estimations:

Regression result	R^2	Obs.	γ	a
$\ln(GTEN) = \underset{(5.75)}{0.49} + \underset{(13.88)}{0.73} \ln(AYSN)$	0.70	86	0.73	1.64

The results of this regression show significant intercept and coefficient (t-stat given below each estimate). From these results, the exponent of h in g(h) is also obtained to be 0.73. Using these parameter estimates, country specific effects of emigration of medical doctors are discussed.



The above shows clearly that as γ increases (decreases), the physical productivity of education increases (decreases) as expected from the sign of the derivative of g(h) with respect to γ with h higher than 1. Lower γ is equivalent to lower productivity of education while higher γ is equivalent to higher productivity of education. The above estimated γ may indicate that the candidates for emigration are those with 0.73 and this is a high level of γ.

2.2. Relative wages

Given the distribution of salaries as well as the percent of medical doctors per European and American destinations and using 1 for North African, 1.5 for other Middle East, 2 for Golf, 3 for Europe and 4 for America, a weighted relative wage is computed as given in table 4. The US wage data are provided by the US doctor annual wages for average median specialty and for starting doctors provided under "Physician Compensation Survey, By the American Medical Group Association (AMGA)". The European data are by OECD databases (2009). The MENA wages for medical doctors are taken from different websites for different countries as summarized in table 3. Table 4 introduces the relative wages to be used in the calculations.

Table 3: Minimal wages for medical doctors in MENA countries

Countries	Doctors salaries per month
Morocco	New Generalist: 727 to 1200 €
	Specialist : 1200 to 2000 €
Algeria	Generalist: 250 to 500 €
	Specialist: 550 to 2000 €
Tunisia	Generalist: 791 to 1200 €
	Specialist: 1200 to 2000 €
Egypt	Doctors starts at 53$/month
	Doctors with experience: 1000 $
Jordan	Fresh graduates doctor: 325JD (1 JD=1.41 $ in 2010
	Doctors with experience (more than 15 years): 800JD
Turkey	In western cities, Doctors are paid approximately 3500,00-4000,00YTL in the private sector 1YTL= 0.64 $ in 2010
	Doctors are paid approximately: 15000,00 YTL in public sector
	In eastern and southern cities 15000,00 YTL , average wage in this region is: 10,000YTL
Yemen	The income of Yemeni physicians ranges between YR 19,000 and YR 340,000 1YR=0.005 $ in 2010

Table 4: 1991-2004 Percentage of emigrant medical doctors and relative salaries by major destinations

Country of Training	%EU	% America	Weighted relative wages
Algeria	86.45	13.55	3.14
Bahrain	7.22	92.78	1.96
Egypt	32.41	67.59	3.68
Iran	28.32	71.68	3.72
Iraq	58.40	41.60	3.42
Jordan	42.44	57.56	2.38
Kuwait	16.77	83.23	1.92
Lebanon	11.18	88.82	2.59
Libya	86.89	13.11	3.13
Morocco	95.49	4.51	3.05
Occupied Palestinian Territory	41.51	58.49	3.58
Oman	26.84	73.16	1.87
Saudi Arabia	24.32	75.68	1.88
Sudan	85.17	14.83	3.15
Syria	24.72	75.28	2.50
Tunisia	91.82	8.18	3.08
Turkey	37.18	62.82	3.63
United Arab Emirates	1.27	98.73	1.99
Yemen	82.57	17.43	3.17

2.3: Risk aversion coefficients

Estimates of the constant relative risk aversion (CRRA) coefficient appear to be varying throughout the economic literature but all estimations tend to be around 1. Chetty (2003) found that positive uncompensated wage elasticity can result in a CRRA coefficient below 1.25, while the labor supply literature indicates that CRRA coefficient is close to 1. Szpiro (1986) found that the degree of relative risk aversion (the inverse of the CRRA coefficient) is approximately 2 (meaning a CRRA of 0.5). Cicchetti and Dublin (1994) estimated the degree of relative risk aversion to be of 0.6 (equivalent to a CRRA of 1.66). Fullenkamp et al (2003) considered that significant variations exist in the degree of relative risk aversion (between 0.64 and 1.76) meaning a CRRA of 0.83. Hartley, Lanot and Walker (2005) tried to estimate the degree of risk aversion and the way it varies across individuals using data from a popular TV game-show. The major result of this analysis is that the constant relative risk aversion coefficient is 1.

Halek and Eisenhower (2001) address the issue distinguishing between pure and speculative risks in order to understand risk aversion. Among their findings, they established that under both pure and speculative risks, individuals who already proved to be risk-takers by migrating across national borders are less risk averse compared with the native population. Also, unemployed people are more disposed to risk their current income for the possibility to double it (Haled and Eisenhower, 2001). Harrison, Lau and Rutström (2005) found that the Danish population exhibited constant risk aversion attitudes with coefficients around 0.45, 0.68 and 0.97. These attitudes are found to vary that with different socio-economic and demographic factors.

2.4: Testing for the validity of the model for the MENA region

As assumed above, medical doctors study medicine in their countries of origin but have to make decisions to emigrate by the end of their studies or later.

The theoretical aggregate level of human capital that stays in the country is derived from the model with the introduction of the values of the parameter related to education γ and the values of β_D and β_S with the observed "m" for each country. These parameters are discussed in the above two sections. Different values of the relative risk aversion coefficient are used including the one related to risk neutrality. The calculations provide the theoretical values of the relative net human capital that are given by the theoretical model.

The observed relative human capital is obtained from the database considering the lowest value of m as corresponding to H_0 with H as related to the other values of the emigration rates. This allows for the computation of the observed H/H_0. Given that there are at least 14 values for the theoretical human capital and 13 remaining cases for the observed relative human capital, the mean and standard deviation are computed for each country.

These allow for the conduct of a t-test from comparing the means of the theoretical and observed relative human capital in each country.

The following table introduces the results of comparisons between observed and theoretical relative human capital per country in the sending MENA countries.

The test described above has provided the following results for each country and for the overall sample of economies from the MENA region.

Table 5: t-statistic from comparing theoretical and observed relative net human capital

	Risk neutrality	**Risk Aversion with α=0.75**
Algeria	-2.73**	
Egypt	0.03**	
Morocco	-0.30**	
Syria	3.48**	
Tunisia	2.01**	
Turkey	-1.30**	
Yemen	0.28**	
Jordan	-0.03**	
Libya		-3.03**

** Significant at 99% probability level

Except for Libya, where the test is validated under risk aversion, all the other countries appear to support the model under risk neutrality. But, even for Libya, the constant risk aversion coefficient is 0.75 meaning that is not distant from 1. Details related to the options of calculations with the implied results are included in the appendix.

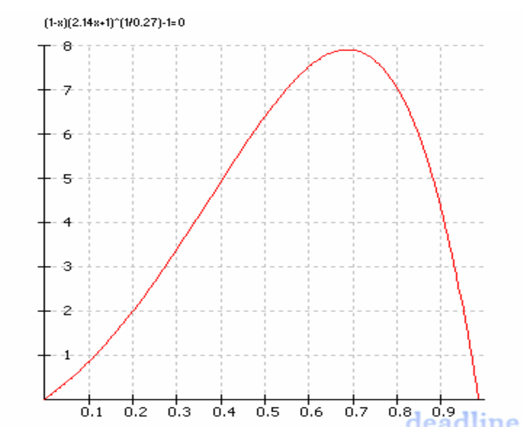
Given these results, it can be inferred that the theoretical model used in this research does reproduce the data observed about the annual rates of emigration of medical doctors in the region as they are given by the database used. This is in favor of using the theoretical model selected to discuss the cases of each country and also the situation and trends in the overall MENA region.

IV. Discussion of the Findings

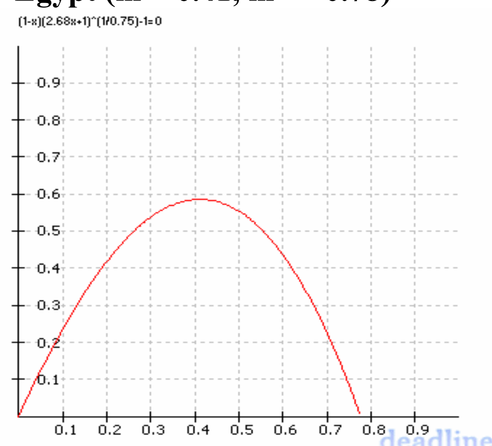
Based on the results attained (table 5) and given the level of emigration rate observed over the period 1991-2004 (table 2), all countries included in this analysis appear to be benefiting from brain gains in the area of medical doctors. This means that domestic medical education is operating such that economies can still support the emigration of medical doctors at the current ratio of medical doctors per capita (table 1). Different results might be attained if the current staffing rates are further increased above the current observed trends (table 1). Under the current domestic educational system and with the current conditions of staffing, the countries under study appear to be enjoying brain gains. But, there are major variations expressed by the countries. The following set of graphs shows how Syria, Morocco, Tunisia, Egypt and Turkey and Libya with low maxima for domestic human capital (0.29, 0.36, 0.37, 0.41, 0.41 and 0.54 respectively) can enter easily the brain drain region under increases in emigration or reduction in education capacity. Countries such as Yemen, Jordan and Algeria appear to be in different situation with relatively higher maximal values for prospective emigration rates of medical doctors (0.69, 0.63 and 0.69 respectively). These results are confirmed with the information on m^{**} that shows lower values for the first set of countries and almost the value of 1 for the second set of countries. Also, the maximal levels of domestic human capital exhibits variations with the largest values shown by Algeria and Yemen (8.00), intermediate values for Jordan (2.75) and Libya (1.45) and lower figures for the remaining countries (Syria: 0.15; Morocco and Tunisia: 0.35; Turkey: 0.55 and Egypt: 0.6). Under the current trends of emigration (1991-2004) of medical doctors, maintaining the current capacity for training of medical doctors can lead to net brain drain especially for the countries with low m* and low maximal values of the domestic human capital. The enhancement of the training capacity is a prospect that would account for these results and for the observed emigration trends. This requirement is not as instantaneous as it can appear for the set of countries with higher m* and higher values of the relative domestic human capital. These latters could have adjusted their training capacity earlier but needs to renew these adjustments through the enlargement of their training capacity.

Net Domestic Human Capital and Emigration of Medical Doctors per country

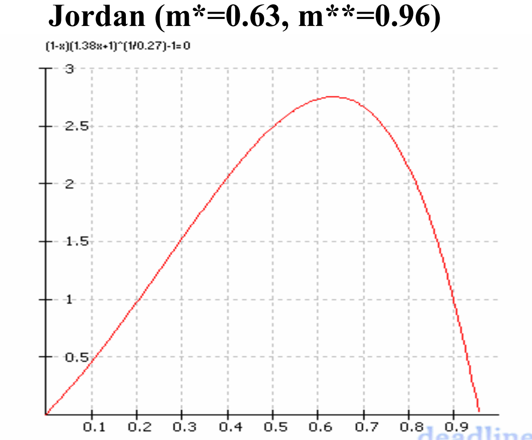
Algeria (m*=0.69, m=0.98)**



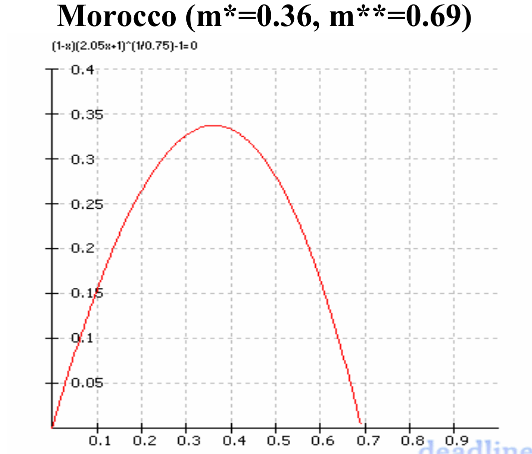
Egypt (m*=0.41, m=0.78)**



Jordan (m*=0.63, m=0.96)**

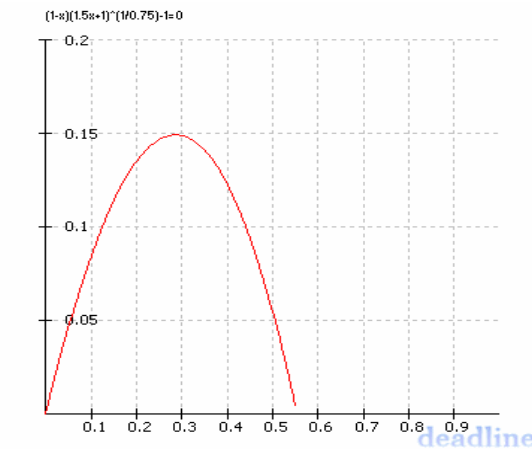


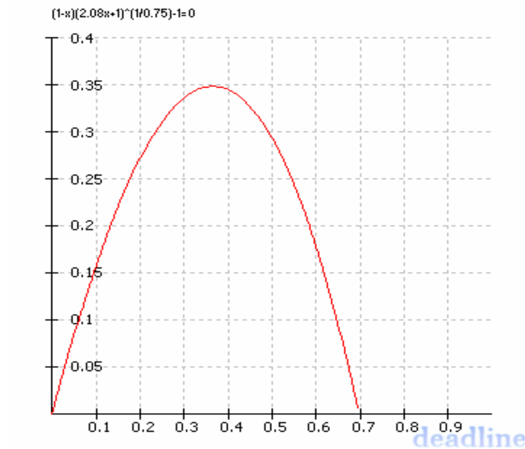
Morocco (m*=0.36, m=0.69)**



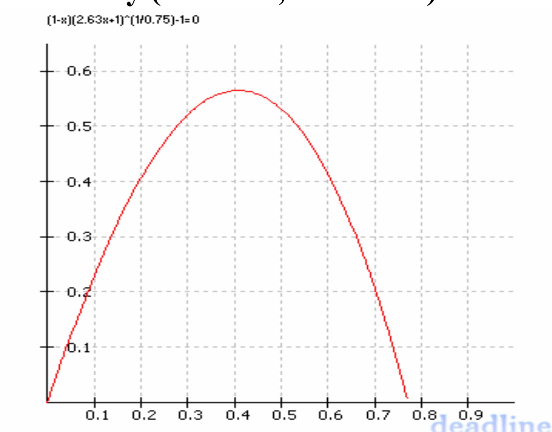
Syria (m*=0.29, m=0.55)**

Tunisia (m*=0.37, m=0.7)**

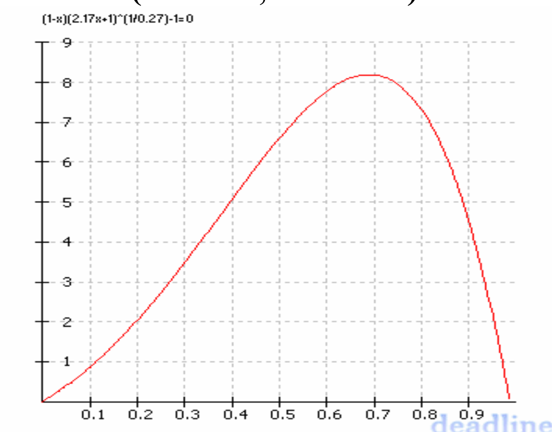




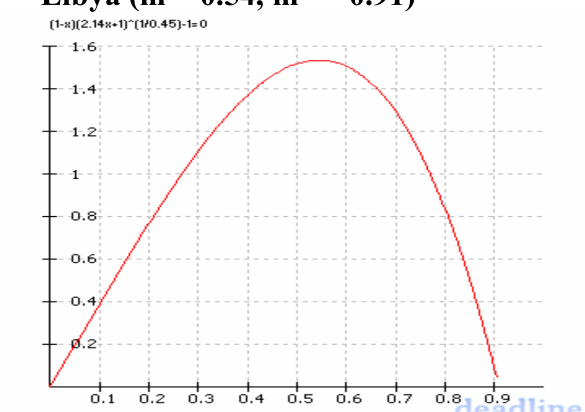
Turkey (m*=0.41, m=0.77)**



Yemen (m*=0.69, m=0.99)**



Libya (m*=0.54, m=0.91)**



Conclusion

Under a theoretical model derived from Stark's et al. (2005) with the introduction of risk aversion (Driouchi et al., 2009), applications to most sending countries in the MENA region appears to be promising. The test of convergence between the observed values based on Docquier et al. (2010) data and the theoretical values obtained from the model is statistically conclusive. Parameters and indices are then derived from the domestic relative human capital for each country. They all show that these economies are enjoying globally brain gains in relation to the emigration of medical doctors. While risk neutrality applies to most countries, Libya has shown moderate risk aversion. The gains attained appear to exhibit low values and lower levels of the maximum level of emigration rates that would sustain these benefits. These countries are Syria, Morocco, Tunisia, Egypt and Turkey with low maxima for domestic human capital. The remaining countries show higher prospects in relation to these gains. This means that the economies under lower gains can enhance their capacity of education of medical doctors as means of enhancing their overall benefits. The other economies can still enjoy the gains for relatively longer periods but should be concerned about the linkages between emigration, education and related economic policies.

The results attained under this research could benefit from further availability of more accurate databases on emigration, wages, and estimates of risk aversion and valuation of education. The results could also be better if microeconomic data were available for each country. These are major directions for future improvements.

References

Assal, M. (2010). Highly-skilled Sudanese migrants: gain or drain? CARIM Analytic and Synthetic Notes 2010/13 Highly-Skilled Migration Series. Retrieved from http://cadmus.eui.eu/dspace/handle/1814/13450

Beine, M., Docquier, F. & Rapoport, H. (2001). Brain Drain and Economic Growth: Theory and Evidence. Journal of Development Economics, 64(1), 275-89.

Beine M., Docquier, F. & Rapoport, H. (2003). Brain Drain and LDCs' Growth: Winners and Losers, IZA Discussion Paper n. 819, IZA, Bonn.

Beine, M., Docquier, F. & Rapoport, H. (2009. On the Robustness of Brain Gain Estimates. IZA Discussion Papers 4293, Institute for the Study of Labor.

Beine, M., Defoort, C. & Docquier, F. (2007). A Panel Data Analysis of the Brain Gain. Université catholique de Louvain.

Beine, M., Docquier, F. & Ozden, C. (2009). Diasporas. *Policy Research Working Paper Series* 4984, The World Bank.

Beine, M., Docquier, F. & Rapoport, H. (2007). Measuring International Skilled Migration: New Estimates Controlling for Age of Entry. *The World Bank Economic Review*, 21(2), 249-254,

Bel Haj Zekri, A. (2010). Le cadre sociopolitique de la migration hautement qualifiée en Tunisie. CARIM Analytic and Synthetic Notes 2010/38, Highly-Skilled Migration Series. Retrieved from http://cadmus.eui.eu/dspace/handle/1814/13863

Bhargava, A., Docquier, F. & Moullan, Y. (2010). Modeling the Effect of Physician Emigration on Human Development. Retrieved from http://ssrn.com/abstract=1555775

Belguendouz, A. (2010). Compétences marocaines expatriées : Quelles politiques de mobilisation suivies pour le développement du Maroc ? Du TOKTEN au FINCOME. CARIM Analytic and Synthetic Notes 2010/21. Highly-Skilled Migration Series. Retrieved from http://cadmus.eui.eu/dspace/handle/1814/13675

Bouklia Hassan, R. (2010). La migration hautement qualifiée de, vers et à travers les paysde l'Est et du Sud de la Méditerranée et d`Afrique subsaharienne. Recherche Transversale. CARIM Analytic and Synthetic Notes 2010/33 Highly-Skilled Migration Series. Retrieved from http://cadmus.eui.eu/dspace/handle/1814/13687

Chakraborty, B. S. (2006). Brain Drain: An Alternative Theorization. *Journal of* International Trade & Economic Development, 15(3), 293-309.

Chetty, R. (2003). A New Method of Estimating Risk Aversion. *National Bureau of Economic Research,* Working paper 9988.

Cicchetti, C.J. & Dubin, J. A. (1994). A Microeconometric Analysis of Risk Aversion and the Decision to Self-Insure. *Journal of Political Economy*, University of Chicago Press, 102(1), 169-86.

Cohen D. & Soto, M. (2001). Growth and Human Capital: Good Data, Good Results, *OECD Development Centre,* working paper WP n°179.

Commander, S., Kangasniemi, M. & Winters, L.A. (2003). The brain drain: Curse or Boon? IZA Working Discussion Paper 809.

Cooper, C., Hanemann, M. & Signorello, G. (2002). One-and-One-Half-Bound Dichotomous Choice Contingent Valuation. *The Review of Economics and Statistics*, 84(4), 742-750.

De la Croix, D. & Docquier, F. (2010). Do Brain Drain and Poverty Result from Coordination Failures? CReAM Discussion Paper Series 1009, Centre for Research and Analysis of Migration (CReAM), Department of Economics, University College London.

Docquier, F. & Marfouk, F. (2006). International Migration by Education Attainment, in Caglar Ozden and Maurice Schiff (eds.), International Migration, Remittances & the Brain Drain. Washington: World Bank and Palgrave Macmillan, 2006.

Docquier, F. & Rapoport, H. (2003). Ethnic Discrimination and the Migration of Skilled Labor. *Journal of Development Economics*, 70(1), 159-72.

Docquier, F. & Rapoport, H. (2005). How Does Skilled Emigration Affect Developing Countries? Facts, Theory and Policy." Paper prepared for presentation at the G-20 workshop on "Demographic challenges and migration", Sydney.

Docquier, F., Lohest, O. & Marfouk, A. (2005). Brain Drain in Developing Region (1990-2000). IZA DP No. 1668.

Docquier, F. & Sekkat, K. (2006). The Brain Drain: What Do We Know? Agence Française de Développement, working paper 31.

Docquier, F., Lowell, L. & Marfouk, A. (2007). A Gendered Assessment of the Brain Drain. Université catholique de Louvain.

Docquier, F. & Rapoport, H. (2007). Skilled migration: The Perspective of Developing Countries." Université catholique de Louvain.

Docquier, F., Lohest, O. & Marfouk, A. (2007). Brain Drain in Developing Countries. *The World Bank Economic Review*, 1–26.

Docquier, F. & Rapoport, H. (2009). Documenting the Brain Drain of «la Crème de la Crème»: Three Case-Studies on International Migration at the Upper Tail of the Education Distribution. Discussion Papers (IRES - Institut de Recherches Economiques et Sociales) 2009031, Université catholique de Louvain, Institut de Recherches Economiques et Sociales (IRES).

Driouchi, A., Baudassé, T., Zouag, N. & Boboc, C. (2009). New Economics of Skilled Labor Migration with Risk Aversion: A Theory and Preliminary Empirical Evidence. *International Journal of Economics*, 3(1).

Expenditure per student, tertiary (2005), WDI Time Series Indicators, The World Bank.

Fullenkamp, C., Tenorio, R. & Battalio, R. (2003). Assessing Individual Risk Attitudes using Field Data from Lottery Games. *Review of Economics and Statistics*, 85(1), 218-26.

Ghoneim, A. F. (2010). Labour Migration for Decent Work, Economic Growth and Development in Egypt. International Migration Papers No. 106. Retrieved from http://www.ilo.org/public/english/protection/migrant/download/imp/imp106.pdf

Halek, M. & Eisenhauer, J. G. (2001). Demography of Risk Aversion. *The Journal of Risk and Insurance*, 68(1), 1-24.

Harris, B., Floud, R., Fogel, R. & Chul Hong, S. (2010). Diet, Health and Work Intensity in England and Wales, 1700-1914. *NBER Working Papers* 15875, National Bureau of Economic Research.

Harrison, G. W., Lau, M.I. & Rutström, E. E. (2007). Estimating Risk Attitudes in Denmark: A Field Experiment. *Scandinavian Journal of Economics*, Blackwell Publishing, 109(2), 341-368.

Hartley, R., Lanot, G. & Walker, I. (2005). Who Really Wants to be a Millionaire: Estimates of Risk Aversion from Game Show Data. *Working Paper*, Department of Economics, University of Warwick.

Human Development Report (2005). International cooperation at a crossroads- Aid, trade and security in an unequal world. United Nations Development Programs (UNDP).

Jouni, H. (2010). La Migration hautement qualifiée au Liban. CARIM Analytic and Synthetic Notes 2010/23, Highly-Skilled Migration Series. Retrieved from http://cadmus.eui.eu/dspace/handle/1814/13677

Khachani, M. (2010). La migration des personnes hautement qualifiées : le cas du Maroc. CARIM Analytic and Synthetic Notes 2010/37, Highly-Skilled Migration Series. Retrieved from http://cadmus.eui.eu/dspace/handle/1814/13689

Khawaja, M.(2010). Highly-skilled migration into, through and from the southern and eastern Mediterranean and sub Saharan Africa. The case of Palestine. CARIM Analytic and Synthetic Notes 2010/30 Highly-Skilled Migration Series. Retrieved from http://cadmus.eui.eu/dspace/handle/1814/13684

Kiwan, F. (2008). La migration de transit au Liban. CARIM-RR 2009/05. Retrieved from http://cadmus.eui.eu/dspace/handle/1814/10791

Labdelaoui, H. (2010). Les dimensions socio-politiques de la migration hautement qualifiée en Algérie CARIM Analytic and Synthetic Notes 2010/24, Highly-Skilled Migration Series. Retrieved from http://cadmus.eui.eu/dspace/handle/1814/13678

Labor productivity and unit labor costs (2006). Key indicators of the labor market. International Labor Organization.

Laschinger, H.K.S., & Finegan, J. (2005). Using Empowerment to Build Trust and Respect in the Workplace: A Strategy for Addressing the Nursing Shortage. *Nursing Economics*, 23(1), 6-13.

Lodigiani, E. (2009). Diaspora Externalities as a Cornerstone of the New Brain Drain Literature. CREA Discussion Paper Series 09-03, Center for Research in Economic Analysis, University of Luxembourg.

Maghur, A. (2010). Highly-skilled Migration (Libya): Legal aspects. CARIM Analytic and Synthetic Notes 2010/31, Highly-Skilled Migration Series. Retrieved from http://cadmus.eui.eu/dspace/handle/1814/13685

Marzouk, M. (2010). L'émigration syrienne hautement qualifiée : les enjeux sociopolitiques. CARIM Analytic and Synthetic Notes 2010/25, Highly-Skilled Migration Series. Retrieved from http://cadmus.eui.eu/dspace/handle/1814/13679

McNeely, C. L. & Camacho, E. (2010). Conceptualizing STEM Workforce Migration in the Modern World Polity. GMU School of Public Policy Research Paper No. 2010-10.

Mountford, A. (1997). Can a Brain Drain be Good for Growth in the Source Economy*? Journal of Development Economics*, Elsevier, 53(2), 287-303.

Nasser, H. (2010). Migration of Skills: The Egyptian Case. CARIM Analytic and Synthetic Notes 2010/29, Highly-Skilled Migration Series. Retrieved from http://cadmus.eui.eu/dspace/handle/1814/13683

Nevidjon, B. & Erickson, J.I. (2006). The nursing shortage: Solutions for the short and long term in: Andrist, L.C., Nicholas, P.K., & Wolf (2006). *A History of Nursing Ideas.* Boston: Jones and Bartlett Publishers.

Nguyen, D.T. (2004). Heterogenous Talent and Optimal Emigration," paper presented at the *Conference on Growth, Development, and Macroeconomic Policy*, Dec 17-18, Delhi,
India.

Olwan, M.Y. (2010). High-Skilled Migration to and from Jordan. CARIM Analytic and Synthetic Notes 2010/05 Highly-Skilled Migration Series. Retrieved from http://cadmus.eui.eu/dspace/handle/1814/13440

Qian, Y. (1994). A Theory of Shortage in Socialist Economies Based on the 'Soft Budget Constraint'. *American Economic Review, 84*(1), pp. 145-156.

Rabin, M. & Thaler, R. H. (2001). Anomalies: Risk aversion. *Journal of Economic Perspectives* 15 (1), 219-232.

Rabin, M. (2000). Risk Aversion and Expected-Utility Theory: A Calibration Theorem. *Econometrica* 68 (5), 1281-1292

Schiff, M. (2005). Brain Gain: Claims About its Size and Impact on Welfare and Growth are Greatly Exaggerated. *IZA DP* No. 1599.

Schechter, L. (2007). Traditional Trust Measurement and the Risk Confound: An Experiment in Rural Paraguay. *Journal of Economic Behavior and Organization*, 62(2), 72-292.

Sika, N. (2010). Highly-Skilled Migration Patterns and Development: The Case of Egypt. CARIM Analytic and Synthetic Notes 2010/17, Highly-Skilled Migration Series. Retrieved from
http://cadmus.eui.eu/dspace/handle/1814/13454

Stark, O. (1991), The Migration of Labour, Basil Blackwell, Cambridge.

Stark, O. & Bloom, D. (1985). The New Economics of Labor Migration", *American Economic Review*, 75(2), 173-178.

Stark, O. & Fan, C. S. (2007). Rural-to-Urban Migration, Human Capital, and Agglomeration. Center of Migration Research, No. 27/86.

Stark, O., Casarico, A., Devillanova, C. & Uebelmesser, S. (2005). The New Economics of the Brain Drain: Mapping the Gains. Retrieved from: http://www.socialpolitik.de/tagungshps/2005/Papers/Casarico.pdf

Szipiro, G. (1986). Measuring Risk Aversion: An alternative Approach. *Review of Economics and Statistics*, 68 (1): 156-159.

Vidal, J. P. (1998). The Effect of Emigration on Human Capital Formation. *Journal of Population Economics*, 11(4), 589-600.

World Bank Database, 2007.

World Bank Institute Database, 2007.

Yazji-Yakoub, A. (2010). La migration hautement qualifiée en Syrie. Aspects juridiques. CARIM Analytic and Synthetic Notes 2010/20, Highly-Skilled Migration Series. Retrieved from
http://cadmus.eui.eu/dspace/handle/1814/13674

Appendix I

Appendix I provides the proofs to support different sections in the theoretical part. These proofs are given for the general case of risk aversion as risk neutrality is a particular case (α=1).

Demo 1: Signs of the first and second derivatives of H

$$H = (1-m)N\left[\frac{c}{\gamma a^{\alpha}\left[m(\beta_D^{\alpha}-\beta_S^{\alpha})+\beta_S^{\alpha}\right]}\right]^{\frac{1}{\gamma\alpha-1}}$$

$$\frac{\partial H}{\partial m} = N\left[\frac{c}{\gamma a^{\alpha}}\right]^{\frac{1}{\gamma\alpha-1}}\left\{\frac{1-m}{1-\gamma\alpha}(\beta_D^{\alpha}-\beta_S^{\alpha})\left[m(\beta_D^{\alpha}-\beta_S^{\alpha})+\beta_S^{\alpha}\right]^{\frac{1}{1-\gamma\alpha}-1}-\left[m(\beta_D^{\alpha}-\beta_S^{\alpha})+\beta_S^{\alpha}\right]^{\frac{1}{1-\gamma\alpha}}\right\}$$

$$\frac{\partial H}{\partial m} = N(1-m)\left[\frac{c}{\gamma a^{\alpha}}\right]^{\frac{1}{\gamma\alpha-1}}\left[m(\beta_D^{\alpha}-\beta_S^{\alpha})+\beta_S^{\alpha}\right]^{\frac{1}{1-\gamma\alpha}}\left\{\frac{\beta_D^{\alpha}-\beta_S^{\alpha}}{1-\gamma\alpha}\left[m(\beta_D^{\alpha}-\beta_S^{\alpha})+\beta_S^{\alpha}\right]^{-1}-\frac{1}{1-m}\right\}$$

$$\frac{\partial H}{\partial m} = H\left\{\frac{\beta_D^{\alpha}-\beta_S^{\alpha}}{(1-\gamma\alpha)\left[m(\beta_D^{\alpha}-\beta_S^{\alpha})+\beta_S^{\alpha}\right]}-\frac{1}{1-m}\right\}$$

Let $A = \frac{\beta_D^{\alpha}-\beta_S^{\alpha}}{(1-\gamma\alpha)\left[m(\beta_D^{\alpha}-\beta_S^{\alpha})+\beta_S^{\alpha}\right]}-\frac{1}{1-m}$

So, $\frac{\partial H}{\partial m} = H.A$

$$\frac{\partial^2 H}{\partial m^2} = H^{'}A + HA^{'} = H\left(A\right)^2 + HA^{'} = H\left(A^2 + A^{'}\right)$$

$$A^2 = \frac{\left(\beta_D^{\alpha}-\beta_S^{\alpha}\right)^2}{(1-\gamma\alpha)^2\left[m(\beta_D^{\alpha}-\beta_S^{\alpha})+\beta_S^{\alpha}\right]^2}+\frac{1}{(1-m)^2}-\frac{2\left(\beta_D^{\alpha}-\beta_S^{\alpha}\right)}{(1-m)(1-\gamma\alpha)\left[m(\beta_D^{\alpha}-\beta_S^{\alpha})+\beta_S^{\alpha}\right]}$$

$$A^{'} = -\frac{\left(\beta_D^\alpha - \beta_S^\alpha\right)^2}{(1-\gamma\alpha)\left[m(\beta_D^\alpha - \beta_S^\alpha) + \beta_S^\alpha\right]^2} - \frac{1}{(1-m)^2}$$

$$A^2 + A^{'} = \frac{(1-m)\left(\beta_D^\alpha - \beta_S^\alpha\right)^2 - 2\left(\beta_D^\alpha - \beta_S^\alpha\right)(1-\gamma\alpha)\left[m(\beta_D^\alpha - \beta_S^\alpha) + \beta_S^\alpha\right] - (1-m)(1-\gamma\alpha)\left(\beta_D^\alpha - \beta_S^\alpha\right)^2}{(1-m)(1-\gamma\alpha)^2\left[m(\beta_D^\alpha - \beta_S^\alpha) + \beta_S^\alpha\right]^2}$$

$$\frac{\partial^2 H}{\partial m^2} = H\left(\beta_D^\alpha - \beta_S^\alpha\right)\left\{\frac{(1-m)\left(\beta_D^\alpha - \beta_S^\alpha\right) - (1-m)(1-\gamma\alpha)\left(\beta_D^\alpha - \beta_S^\alpha\right) - 2(1-\gamma\alpha)\left[m(\beta_D^\alpha - \beta_S^\alpha) + \beta_S^\alpha\right]}{(1-m)(1-\gamma\alpha)^2\left[m(\beta_D^\alpha - \beta_S^\alpha) + \beta_S^\alpha\right]^2}\right\}$$

$$\frac{\partial^2 H}{\partial m^2} = H\left(\beta_D^\alpha - \beta_S^\alpha\right)\left\{\frac{\gamma\alpha(1-m)\left(\beta_D^\alpha - \beta_S^\alpha\right) - 2(1-\gamma\alpha)\left[m(\beta_D^\alpha - \beta_S^\alpha) + \beta_S^\alpha\right]}{(1-m)(1-\gamma\alpha)^2\left[m(\beta_D^\alpha - \beta_S^\alpha) + \beta_S^\alpha\right]^2}\right\}$$

Sign of $\frac{\partial^2 H}{\partial m^2} =$ Sign of $\left\{\gamma\alpha(1-m)(\beta_D^\alpha - \beta_S^\alpha) - 2(1-\gamma\alpha)\left[m(\beta_D^\alpha - \beta_S^\alpha) + \beta_S^\alpha\right]\right\}$

So, this sign depends on the following conditions:

If $\frac{\beta_D^\alpha}{\beta_S^\alpha} < \frac{(2-\gamma\alpha)(1-m)}{\left[\gamma\alpha - m(2-\gamma\alpha)\right]}$ then $\frac{\partial^2 H}{\partial m^2} > 0$

If $\frac{\beta_D^\alpha}{\beta_S^\alpha} > \frac{(2-\gamma\alpha)(1-m)}{\left[\gamma\alpha - m(2-\gamma\alpha)\right]}$ then $\frac{\partial^2 H}{\partial m^2} < 0$

If $\frac{\beta_D^\alpha}{\beta_S^\alpha} = \frac{(2-\gamma\alpha)(1-m)}{\left[\gamma\alpha - m(2-\gamma\alpha)\right]}$ or if $m = \frac{\left[\gamma\alpha\beta_D^\alpha + (\gamma\alpha - 2)\beta_S^\alpha\right]}{\left(\beta_D^\alpha - \beta_S^\alpha\right)(3\gamma\alpha - 2)}$ then $\frac{\partial^2 H}{\partial m^2} = 0$

Demo 2: Conditions related to the sign of $H^{''}$

$0 < \gamma < 1$

$\alpha \le 1$

$\gamma\alpha < 1$

$-\gamma\alpha > -1$

$2 - \gamma\alpha > 1$

$-\mathrm{m}(2-\gamma\alpha) < -\mathrm{m}$

$\gamma\alpha - \mathrm{m}(2-\gamma\alpha) < 1 - \mathrm{m}(2-\gamma\alpha) < 1 - \mathrm{m}$

Then, $\gamma\alpha - \mathrm{m}(2-\gamma\alpha)$ is either positive or negative.

When $\left[\gamma\alpha - \mathrm{m}(2-\gamma\alpha)\right] > 0$, then $\frac{1-\mathrm{m}}{\gamma\alpha - \mathrm{m}(2-\gamma\alpha)} > 1$

$\frac{(1-\mathrm{m})}{\left[\gamma\alpha - \mathrm{m}(2-\gamma\alpha)\right]} > 1$ means that $\frac{(2-\gamma\alpha)(1-\mathrm{m})}{\left[\gamma\alpha - \mathrm{m}(2-\gamma\alpha)\right]} > (2-\gamma\alpha)$

So if $\frac{\beta_D^\alpha}{\beta_S^\alpha} > \frac{(2-\gamma\alpha)(1-m)}{[\gamma\alpha - m(2-\gamma\alpha)]}$, then: $\frac{\beta_D^\alpha}{\beta_S^\alpha} > (2-\alpha\gamma)$ which is always true since $m^* > 0$ always holds.

However, when $[\gamma\alpha - m(2-\gamma\alpha)] < 0$, then $\frac{(1-m)}{[\gamma\alpha - m(2-\gamma\alpha)]} < 0 < 1$ meaning that:
$\frac{(2-\gamma\alpha)(1-m)}{[\gamma\alpha - m(2-\gamma\alpha)]} < 0 < (2-\alpha\gamma)$.
So, condition $\frac{\beta_D^\alpha}{\beta_S^\alpha} > \frac{(2-\gamma\alpha)(1-m)}{[\gamma\alpha - m(2-\gamma\alpha)]}$ is always true since we have:
$\frac{(2-\gamma\alpha)(1-m)}{[\gamma\alpha - m(2-\gamma\alpha)]} < 0 < \frac{\beta_D^\alpha}{\beta_S^\alpha}$.

So, the results depend on whether $[\gamma\alpha - m(2-\gamma\alpha)]$ is positive or negative. The necessary condition to have $[\gamma\alpha - m(2-\gamma\alpha)] > 0$ is $m < \frac{\gamma\alpha}{(2-\gamma\alpha)}$ since $(2-\gamma\alpha) > 0$.

Demo 3: Optimal emigration rate under risk neutrality

$$H_{RN} = (1-m)N\left[\frac{c}{\gamma a\left[m(\beta_D - \beta_S) + \beta_S\right]}\right]^{\frac{1}{\gamma-1}}$$

$$\frac{\partial H_{RN}}{\partial m} = H_{RN}\left[\frac{(\beta_D - \beta_S)}{(1-\gamma)\left[m(\beta_D - \beta_S) + \beta_S\right]} - \frac{1}{(1-m)}\right]$$

When $\frac{\partial H_{RN}}{\partial m} = 0$, $\frac{(\beta_D - \beta_S)}{(1-\gamma)\left[m(\beta_D - \beta_S) + \beta_S\right]} = \frac{1}{(1-m)}$

So, $m_{RN}^* = \frac{\left[\beta_D - (2-\gamma)\beta_S\right]}{(2-\gamma)(\beta_D - \beta_S)}$

Appendix II: Calculations and tests related to the validation of the model

Risk Neutral Model

Country	Years	m	Relative wage	H/H0 Theoretical gamma 0.73	H/H0 Theoretical gamma 0.25	H/H0 Observed
Algeria	1991	0.0094	3.14	1.0666	1.0173	
	1992	0.0099	3.14	1.0702	1.0182	
	1993	0.0104	3.14	1.0736	1.0191	
	1994	0.0103	3.14	1.0728	1.0189	
	1995	0.0105	3.14	1.0746	1.0193	1.0286
	1996	0.0097	3.14	1.0689	1.0179	1.1511
	1997	0.0097	3.14	1.0686	1.0178	1.2208
	1998	0.0160	3.14	1.1147	1.0292	1.2785
	1999	0.0222	3.14	1.1608	1.0401	1.2977
	2000	0.0281	3.14	1.2066	1.0506	1.3166
	2001	0.0337	3.14	1.2509	1.0604	1.3361
	2002	0.0390	3.14	1.2931	1.0694	1.3571
	2003	0.0405	3.14	1.3057	1.0720	1.3793
	2004	0.0418	3.14	1.3157	1.0741	1.3793
	Mean			1.1531	1.0374	1.2745
	Stand.dev.			0.1003	0.0230	0.1123
	t-stat (theoretical and observed H/H0)			-2.7295	-6.5780	
Egypt	1991	0.0901	3.68	2.0254	1.2136	
	1992	0.0798	3.68	1.8843	1.1911	
	1993	0.0719	3.68	1.7803	1.1734	
	1994	0.0565	3.68	1.5888	1.1382	
	1995	0.0554	3.68	1.5760	1.1358	
	1996	0.0527	3.68	1.5439	1.1294	
	1997	0.0640	3.68	1.6805	1.1555	
	1998	0.0619	3.68	1.6543	1.1507	
	1999	0.0567	3.68	1.5917	1.1388	1.0485
	2000	0.0544	3.68	1.5639	1.1334	1.1316
	2001	0.0552	3.68	1.5741	1.1354	1.1529
	2002	0.0554	3.68	1.5767	1.1359	1.1740
	2003	0.0552	3.68	1.5735	1.1353	1.1950
	2004	0.0562	3.68	1.5853	1.1376	1.1950
	Mean			1.6570	1.1503	1.1495
	Stand.dev.			0.1429	0.0252	0.0553
	t-stat (theoretical and observed H/H0)			11.4420	0.0327	
Jordan	1991	0.0796	2.38	1.3554	1.0580	
	1992	0.0838	2.38	1.3755	1.0605	
	1993	0.0826	2.38	1.3696	1.0598	
	1994	0.0795	2.38	1.3546	1.0579	
	1995	0.0828	2.38	1.3706	1.0599	1.0330
	1996	0.0850	2.38	1.3812	1.0612	1.0651
	1997	0.0872	2.38	1.3920	1.0625	1.1214
	1998	0.0862	2.38	1.3871	1.0619	1.2537

	1999	0.0806	2.38	1.3600	1.0586	1.4361
	2000	0.0824	2.38	1.3687	1.0597	1.4807
	2001	0.0858	2.38	1.3850	1.0617	1.5622
	2002	0.0880	2.38	1.3958	1.0630	1.6058
	2003	0.0921	2.38	1.4156	1.0653	1.6482
	2004	0.0983	2.38	1.4460	1.0688	1.6482
	Mean			1.3826	1.0614	1.3854
	Stand.dev.			0.0248	0.0030	0.2457
	t-stat (theoretical and observed H/H0)			-0.0357	-4.1703	
Libya	1991	0.0559	3.13	1.4322	1.0969	
	1992	0.0569	3.13	1.4413	1.0986	1.1048
	1993	0.0583	3.13	1.4529	1.1008	1.2478
	1994	0.0650	3.13	1.5122	1.1116	1.1915
	1995	0.0711	3.13	1.5663	1.1211	1.1701
	1996	0.0784	3.13	1.6336	1.1325	1.1933
	1997	0.0868	3.13	1.7122	1.1451	1.2075
	1998	0.0950	3.13	1.7916	1.1572	1.2312
	1999	0.1012	3.13	1.8526	1.1661	1.2554
	2000	0.1059	3.13	1.8993	1.1727	1.2799
	2001	0.1148	3.13	1.9905	1.1851	1.3053
	2002	0.1201	3.13	2.0462	1.1923	1.3315
	2003	0.1253	3.13	2.1011	1.1992	1.3587
	2004	0.1315	3.13	2.1685	1.2073	1.3587
	Mean			1.7572	1.1490	1.2489
	Stand.dev.			0.2584	0.0393	0.0766
	t-stat (theoretical and observed H/H0)			7.0356	-4.2113	
Morocco	1991	0.0862	3.05	1.6673	1.1347	
	1992	0.0874	3.05	1.6776	1.1363	
	1993	0.0826	3.05	1.6353	1.1296	
	1994	0.0511	3.05	1.3710	1.0833	
	1995	0.0477	3.05	1.3441	1.0781	
	1996	0.0479	3.05	1.3455	1.0784	
	1997	0.0423	3.05	1.3024	1.0698	
	1998	0.0442	3.05	1.3168	1.0727	1.0170
	1999	0.0461	3.05	1.3314	1.0756	1.0340
	2000	0.0472	3.05	1.3405	1.0774	1.0511
	2001	0.0471	3.05	1.3399	1.0773	1.1218
	2002	0.0490	3.05	1.3545	1.0801	1.1399
	2003	0.0498	3.05	1.3608	1.0814	1.1581
	2004	0.0511	3.05	1.3710	1.0833	1.1581
	Mean			1.4113	1.0899	1.0971
	Stand.dev.			0.1364	0.0240	0.0611
	t-stat (theoretical and observed H/H0)			7.2820	-0.3038	
Syria	1991	0.1760	2.50	1.9644	1.1265	
	1992	0.1807	2.50	1.9939	1.1285	
	1993	0.1781	2.50	1.9776	1.1274	
	1994	0.1738	2.50	1.9505	1.1256	

	1995	0.1703	2.50	1.9287	1.1241	
	1996	0.1648	2.50	1.8944	1.1216	
	1997	0.1636	2.50	1.8872	1.1211	
	1998	0.1384	2.50	1.7338	1.1083	
	1999	0.1545	2.50	1.8311	1.1167	
	2000	0.1536	2.50	1.8257	1.1163	
	2001	0.1547	2.50	1.8327	1.1168	1.0465
	2002	0.1583	2.50	1.8545	1.1186	1.0722
	2003	0.1615	2.50	1.8745	1.1201	1.0974
	2004	0.1675	2.50	1.9111	1.1228	1.0974
	Mean			1.8900	1.1210	1.0783
	Stand.dev.			0.0715	0.0055	0.0243
	t-stat (theoretical and observed H/H0)			35.8294	3.4817	
Tunisia	1991	0.0390	3.08	1.2832	1.0664	
	1992	0.0326	3.08	1.2336	1.0559	
	1993	0.0328	3.08	1.2349	1.0562	
	1994	0.0376	3.08	1.2720	1.0641	
	1995	0.0317	3.08	1.2272	1.0545	
	1996	0.0267	3.08	1.1890	1.0460	
	1997	0.0298	3.08	1.2128	1.0513	
	1998	0.0298	3.08	1.2122	1.0512	
	1999	0.0312	3.08	1.2234	1.0537	1.0131
	2000	0.0321	3.08	1.2297	1.0550	1.0247
	2001	0.0330	3.08	1.2372	1.0567	1.0365
	2002	0.0345	3.08	1.2483	1.0591	1.0480
	2003	0.0349	3.08	1.2517	1.0598	1.0602
	2004	0.0357	3.08	1.2573	1.0610	1.0602
	Mean			1.2366	1.0565	1.0404
	Stand.dev.			0.0248	0.0053	0.0192
	t-stat (theoretical and observed H/H0)			19.1090	2.0113	
Turkey	1991	0.0368	3.63	1.3556	1.0893	
	1992	0.0371	3.63	1.3594	1.0902	
	1993	0.0377	3.63	1.3650	1.0914	
	1994	0.0345	3.63	1.3321	1.0841	
	1995	0.0346	3.63	1.3326	1.0842	
	1996	0.0560	3.63	1.5694	1.1336	
	1997	0.0295	3.63	1.2797	1.0721	
	1998	0.0326	3.63	1.3115	1.0794	1.0178
	1999	0.0324	3.63	1.3100	1.0791	1.0521
	2000	0.0316	3.63	1.3013	1.0771	1.0941
	2001	0.0319	3.63	1.3039	1.0777	1.1070
	2002	0.0308	3.63	1.2926	1.0751	1.1783
	2003	0.0309	3.63	1.2936	1.0753	1.1967
	2004	0.0311	3.63	1.2960	1.0759	1.1967
	Mean			1.3359	1.0846	1.1204
	Stand.dev.			0.0724	0.0154	0.0719
	t-stat (theoretical and observed H/H0)			6.4576	-1.3011	

Yemen	1991	0.0219	3.17	1.1618	1.0406	
	1992	0.0151	3.17	1.1103	1.0283	
	1993	0.0115	3.17	1.0829	1.0215	
	1994	0.0119	3.17	1.0860	1.0223	
	1995	0.0097	3.17	1.0701	1.0183	
	1996	0.0109	3.17	1.0785	1.0204	
	1997	0.0126	3.17	1.0916	1.0237	
	1998	0.0125	3.17	1.0904	1.0234	
	1999	0.0126	3.17	1.0911	1.0236	
	2000	0.0131	3.17	1.0952	1.0246	
	2001	0.0120	3.17	1.0871	1.0226	1.0514
	2002	0.0134	3.17	1.0974	1.0251	1.0838
	2003	0.0139	3.17	1.1010	1.0260	1.1171
	2004	0.0157	3.17	1.1145	1.0293	1.1171
	Mean			1.0970	1.0250	1.0924
	Stand.dev.			0.0220	0.0054	0.0315
	t-stat (theoretical and observed H/H0)			0.2758	-4.2616	

Risk neutral summary table

Country	Statistics	H/H0 Theoretical gamma 0.73	H/H0 Theoretical gamma 0.25	H/H0 Observed
Algeria	Mean	1.1531	1.0374	1.2745
	Stand.dev.	0.1003	0.0230	0.1123
	t-stat	-2.7295	-6.5780	
	Stand.dev.	0.0329	0.0030	0.2206
	t-stat	-5.5113	-6.1636	
Egypt	Mean	1.6570	1.1503	1.1495
	Stand.dev.	0.1429	0.0252	0.0553
	t-stat	11.4420	0.0327	
	Stand.dev.	1.0354	0.1060	0.0242
	t-stat	5.7173	7.6250	
	Stand.dev.	0.4818	0.0447	0.0502
	t-stat	13.8425	9.6749	
Jordan	Mean	1.3826	1.0614	1.3854
	Stand.dev.	0.0248	0.0030	0.2457
	t-stat	-0.0357	-4.1703	
	Stand.dev.	0.0334	0.0017	0.0221
	t-stat	4.1789	-3.2897	
	Stand.dev.	0.3367	0.0115	0.0074
	t-stat	15.8235	26.9164	
Libya	Mean	1.7572	1.1490	1.2489
	Stand.dev.	0.2584	0.0393	0.0766
	t-stat	7.0356	-4.2113	
Morocco	Mean	1.4113	1.0899	1.0971

	Stand.dev.	0.1364	0.0240	0.0611
	t-stat	7.2820	-0.3038	
	Stand.dev.	0.0238	0.0065	0.6975
	t-stat	-3.5022	-3.7402	
	Stand.dev.	0.0051	0.0003	0.5282
	t-stat	-8.2383	-8.2749	
	Stand.dev.	0.0038	0.0002	0.1361
	t-stat	-5.7748	-6.4037	
Syria	Mean	1.8900	1.1210	1.0783
	Stand.dev.	0.0715	0.0055	0.0243
	t-stat	35.8294	3.4817	
Tunisia	Mean	1.2366	1.0565	1.0404
	Stand.dev.	0.0248	0.0053	0.0192
	t-stat	19.1090	2.0113	
Turkey	Mean	1.3359	1.0846	1.1204
	Stand.dev.	0.0724	0.0154	0.0719
	t-stat	6.4576	-1.3011	
	Stand.dev.	0.0609	0.0037	0.0828
	t-stat	-0.9586	-4.3423	
Yemen	Mean	1.0970	1.0250	1.0924
	Stand.dev.	0.0220	0.0054	0.0315
	t-stat	0.2758	-4.2616	

Risk aversion model

Country	years	m	Relative wage	H/H0 Theoretical alpha=0.33	H/H0 alpha=0.5	H/H0 Theoretical alpha=0.75	H/H0 Observed
Algeria	1991	0.0094	3.14	0.9962	1.0019	1.0188	
	1992	0.0099	3.14	0.9960	1.0020	1.0198	
	1993	0.0104	3.14	0.9958	1.0021	1.0208	
	1994	0.0103	3.14	0.9959	1.0021	1.0205	
	1995	0.0105	3.14	0.9958	1.0022	1.0210	1.0286
	1996	0.0097	3.14	0.9961	1.0020	1.0195	1.1511
	1997	0.0097	3.14	0.9961	1.0020	1.0194	1.2208
	1998	0.0160	3.14	0.9935	1.0032	1.0319	1.2785
	1999	0.0222	3.14	0.9910	1.0043	1.0441	1.2977
	2000	0.0281	3.14	0.9884	1.0053	1.0558	1.3166
	2001	0.0337	3.14	0.9860	1.0062	1.0669	1.3361
	2002	0.0390	3.14	0.9837	1.0070	1.0772	1.3571
	2003	0.0405	3.14	0.9830	1.0072	1.0802	1.3793
	2004	0.0418	3.14	0.9825	1.0073	1.0825	1.3793
	Mean			0.9914	1.0039	1.0413	1.2745
	Stand.dev.			0.0055	0.0022	0.0258	0.1123
	t-stat (theoretical and observed H/H0)			-7.9648	-7.6190	-6.4468	
Egypt	1991	0.0901	3.68	0.9683	1.0311	1.2371	
	1992	0.0798	3.68	0.9725	1.0285	1.2103	

	1993	0.0719	3.68	0.9756	1.0263	1.1897	
	1994	0.0565	3.68	0.9814	1.0216	1.1494	
	1995	0.0554	3.68	0.9818	1.0213	1.1466	
	1996	0.0527	3.68	0.9828	1.0204	1.1395	
	1997	0.0640	3.68	0.9786	1.0240	1.1691	
	1998	0.0619	3.68	0.9794	1.0233	1.1636	
	1999	0.0567	3.68	0.9813	1.0217	1.1501	1.0485
	2000	0.0544	3.68	0.9821	1.0210	1.1440	1.1316
	2001	0.0552	3.68	0.9818	1.0212	1.1462	1.1529
	2002	0.0554	3.68	0.9817	1.0213	1.1468	1.1740
	2003	0.0552	3.68	0.9818	1.0212	1.1461	1.1950
	2004	0.0562	3.68	0.9815	1.0215	1.1487	1.1950
	Mean			0.9793	1.0232	1.1634	1.1495
	Stand.dev.			0.0043	0.0032	0.0292	0.0553
	t-stat (theoretical and observed H/H0)			-7.5338	-5.5960	0.5799	
Jordan	1991	0.0796	2.38	0.9526	0.9839	1.0757	
	1992	0.0838	2.38	0.9499	0.9828	1.0793	
	1993	0.0826	2.38	0.9507	0.9831	1.0783	
	1994	0.0795	2.38	0.9527	0.9840	1.0756	
	1995	0.0828	2.38	0.9506	0.9831	1.0785	1.0330
	1996	0.0850	2.38	0.9492	0.9825	1.0803	1.0651
	1997	0.0872	2.38	0.9478	0.9819	1.0822	1.1214
	1998	0.0862	2.38	0.9484	0.9822	1.0814	1.2537
	1999	0.0806	2.38	0.9520	0.9837	1.0765	1.4361
	2000	0.0824	2.38	0.9508	0.9832	1.0781	1.4807
	2001	0.0858	2.38	0.9487	0.9823	1.0810	1.5622
	2002	0.0880	2.38	0.9473	0.9817	1.0829	1.6058
	2003	0.0921	2.38	0.9447	0.9806	1.0863	1.6482
	2004	0.0983	2.38	0.9407	0.9788	1.0915	1.6482
	Mean			0.9490	0.9824	1.0805	1.3854
	Stand.dev.			0.0033	0.0014	0.0043	0.2457
	t-stat (theoretical and observed H/H0)			-5.6163	-5.1864	-3.9231	
Libya	1991	0.0559	3.13	0.9760	1.0088	1.1092	
	1992	0.0569	3.13	0.9755	1.0089	1.1112	1.1048
	1993	0.0583	3.13	0.9749	1.0091	1.1138	1.2478
	1994	0.0650	3.13	0.9718	1.0097	1.1267	1.1915
	1995	0.0711	3.13	0.9689	1.0102	1.1381	1.1701
	1996	0.0784	3.13	0.9654	1.0107	1.1518	1.1933
	1997	0.0868	3.13	0.9613	1.0111	1.1673	1.2075
	1998	0.0950	3.13	0.9571	1.0113	1.1824	1.2312
	1999	0.1012	3.13	0.9540	1.0115	1.1937	1.2554
	2000	0.1059	3.13	0.9516	1.0115	1.2021	1.2799
	2001	0.1148	3.13	0.9470	1.0114	1.2180	1.3053
	2002	0.1201	3.13	0.9441	1.0113	1.2275	1.3315
	2003	0.1253	3.13	0.9414	1.0111	1.2366	1.3587
	2004	0.1315	3.13	0.9380	1.0109	1.2474	1.3587
	Mean			0.9591	1.0105	1.1733	1.2489

	Stand.dev.			0.0134	0.0010	0.0490	0.0766
	t-stat (theoretical and observed H/H0)			-13.4453	-11.2121	-3.0288	
Morocco	1991	0.0862	3.05	0.9602	1.0079	1.1566	
	1992	0.0874	3.05	0.9596	1.0079	1.1586	
	1993	0.0826	3.05	0.9620	1.0079	1.1503	
	1994	0.0511	3.05	0.9774	1.0064	1.0944	
	1995	0.0477	3.05	0.9790	1.0061	1.0882	
	1996	0.0479	3.05	0.9789	1.0061	1.0886	
	1997	0.0423	3.05	0.9815	1.0057	1.0785	
	1998	0.0442	3.05	0.9806	1.0058	1.0819	1.0170
	1999	0.0461	3.05	0.9797	1.0060	1.0853	1.0340
	2000	0.0472	3.05	0.9792	1.0061	1.0874	1.0511
	2001	0.0471	3.05	0.9792	1.0061	1.0873	1.1218
	2002	0.0490	3.05	0.9784	1.0062	1.0906	1.1399
	2003	0.0498	3.05	0.9780	1.0063	1.0921	1.1581
	2004	0.0511	3.05	0.9774	1.0064	1.0944	1.1581
	Mean			0.9751	1.0065	1.1024	1.0971
	Stand.dev.			0.0079	0.0008	0.0289	0.0611
	t-stat (theoretical and observed H/H0)			-5.2650	-3.9253	0.2179	
Syria	1991	0.1760	2.50	0.8921	0.9607	1.1749	
	1992	0.1807	2.50	0.8889	0.9589	1.1784	
	1993	0.1781	2.50	0.8907	0.9599	1.1765	
	1994	0.1738	2.50	0.8937	0.9615	1.1732	
	1995	0.1703	2.50	0.8961	0.9628	1.1705	
	1996	0.1648	2.50	0.8999	0.9647	1.1661	
	1997	0.1636	2.50	0.9007	0.9651	1.1652	
	1998	0.1384	2.50	0.9176	0.9734	1.1441	
	1999	0.1545	2.50	0.9069	0.9682	1.1577	
	2000	0.1536	2.50	0.9075	0.9685	1.1570	
	2001	0.1547	2.50	0.9067	0.9681	1.1580	1.0465
	2002	0.1583	2.50	0.9043	0.9670	1.1609	1.0722
	2003	0.1615	2.50	0.9021	0.9658	1.1635	1.0974
	2004	0.1675	2.50	0.8980	0.9638	1.1682	1.0974
	Mean			0.9004	0.9649	1.1653	1.0783
	Stand.dev.			0.0079	0.0040	0.0094	0.0243
	t-stat (theoretical and observed H/H0)			-14.4100	-9.2860	6.9975	
Tunisia	1991	0.0390	3.08	0.9833	1.0060	1.0743	
	1992	0.0326	3.08	0.9861	1.0052	1.0622	
	1993	0.0328	3.08	0.9861	1.0052	1.0625	
	1994	0.0376	3.08	0.9839	1.0058	1.0716	
	1995	0.0317	3.08	0.9865	1.0051	1.0606	
	1996	0.0267	3.08	0.9887	1.0044	1.0510	
	1997	0.0298	3.08	0.9873	1.0048	1.0570	
	1998	0.0298	3.08	0.9874	1.0048	1.0569	
	1999	0.0312	3.08	0.9867	1.0050	1.0597	1.0131
	2000	0.0321	3.08	0.9864	1.0051	1.0612	1.0247
	2001	0.0330	3.08	0.9859	1.0052	1.0631	1.0365

	2002	0.0345	3.08	0.9853	1.0054	1.0658	1.0480
	2003	0.0349	3.08	0.9851	1.0055	1.0666	1.0602
	2004	0.0357	3.08	0.9848	1.0056	1.0680	1.0602
	Mean			0.9860	1.0052	1.0629	1.0404
	Stand.dev.			0.0014	0.0004	0.0061	0.0192
	t-stat (theoretical and observed H/H0)			-6.9319	-4.4864	2.8021	
Turkey	1991	0.0368	3.63	0.9880	1.0142	1.0954	
	1992	0.0371	3.63	0.9879	1.0143	1.0963	
	1993	0.0377	3.63	0.9877	1.0145	1.0976	
	1994	0.0345	3.63	0.9888	1.0134	1.0896	
	1995	0.0346	3.63	0.9888	1.0134	1.0897	
	1996	0.0560	3.63	0.9811	1.0204	1.1448	
	1997	0.0295	3.63	0.9905	1.0116	1.0766	
	1998	0.0326	3.63	0.9895	1.0127	1.0845	1.0178
	1999	0.0324	3.63	0.9895	1.0127	1.0842	1.0521
	2000	0.0316	3.63	0.9898	1.0124	1.0820	1.0941
	2001	0.0319	3.63	0.9897	1.0124	1.0827	1.1070
	2002	0.0308	3.63	0.9901	1.0121	1.0798	1.1783
	2003	0.0309	3.63	0.9901	1.0121	1.0801	1.1967
	2004	0.0311	3.63	0.9900	1.0122	1.0807	1.1967
	Mean			0.9887	1.0134	1.0903	1.1204
	Stand.dev.			0.0024	0.0022	0.0170	0.0719
	t-stat (theoretical and observed H/H0)			-4.8420	-3.9317	-1.0915	
Yemen	1991	0.0219	3.17	0.9912	1.0046	1.0445	
	1992	0.0151	3.17	0.9940	1.0033	1.0308	
	1993	0.0115	3.17	0.9955	1.0025	1.0234	
	1994	0.0119	3.17	0.9953	1.0026	1.0242	
	1995	0.0097	3.17	0.9962	1.0022	1.0198	
	1996	0.0109	3.17	0.9957	1.0024	1.0222	
	1997	0.0126	3.17	0.9950	1.0028	1.0258	
	1998	0.0125	3.17	0.9951	1.0027	1.0254	
	1999	0.0126	3.17	0.9950	1.0027	1.0256	
	2000	0.0131	3.17	0.9948	1.0029	1.0267	
	2001	0.0120	3.17	0.9952	1.0026	1.0245	1.0514
	2002	0.0134	3.17	0.9947	1.0029	1.0273	1.0838
	2003	0.0139	3.17	0.9945	1.0030	1.0283	1.1171
	2004	0.0157	3.17	0.9938	1.0034	1.0320	1.1171
	Mean			0.9947	1.0029	1.0272	1.0924
	Stand.dev.			0.0012	0.0006	0.0059	0.0315
	t-stat (theoretical and observed H/H0)			-6.2007	-5.6813	-4.1187	

Risk aversion model summary table

Country	Statistics	H/H0 Theoretical alpha=0.33	H/H0 alpha=0.5	H/H0 Theoretical alpha=0.75	H/H0 Observed
Algeria	Mean	0.9914	1.0039	1.0413	1.2745
	Stand.dev.	0.0055	0.0022	0.0258	0.1123
	t-stat	-7.9648	-7.6190	-6.4468	
	Stand.dev.	0.0086	0.0049	0.0053	0.2206
	t-stat	-6.4092	-6.3323	-6.1161	
Egypt	Mean	0.9793	1.0232	1.1634	1.1495
	Stand.dev.	0.0043	0.0032	0.0292	0.0553
	t-stat	-7.5338	-5.5960	0.5799	
	Stand.dev.	0.0175	0.0015	0.0631	0.0502
	t-stat	-13.6650	-7.2897	10.9278	
Jordan	Mean	0.9490	0.9824	1.0805	1.3854
	Stand.dev.	0.0033	0.0014	0.0043	0.2457
	t-stat	-5.6163	-5.1864	-3.9231	
	Stand.dev.	0.0338	0.0210	0.0291	0.0074
	t-stat	-16.4892	-10.8167	24.0007	
Libya	Mean	0.9591	1.0105	1.1733	1.2489
	Stand.dev.	0.0134	0.0010	0.0490	0.0766
	t-stat	-13.4453	-11.2121	-3.0288	
Morocco	Mean	0.9751	1.0065	1.1024	1.0971
	Stand.dev.	0.0079	0.0008	0.0289	0.0611
	t-stat	-5.2650	-3.9253	0.2179	
	Stand.dev.	0.0016	0.0010	0.0007	0.5282
	t-stat	-8.2898	-8.2850	-8.2720	
	Stand.dev.	0.0012	0.0007	0.0005	0.1361
	t-stat	-6.6596	-6.5773	-6.3540	
Syria	Mean	0.9004	0.9649	1.1653	1.0783
	Stand.dev.	0.0079	0.0040	0.0094	0.0243
	t-stat	-14.4100	-9.2860	6.9975	
Tunisia	Mean	0.9860	1.0052	1.0629	1.0404
	Stand.dev.	0.0014	0.0004	0.0061	0.0192
	t-stat	-6.9319	-4.4864	2.8021	
Turkey	Mean	0.9887	1.0134	1.0903	1.1204
	Stand.dev.	0.0024	0.0022	0.0170	0.0719
	t-stat	-4.8420	-3.9317	-1.0915	
	Stand.dev.	0.0153	0.0093	0.0080	0.0828
	t-stat	-5.5620	-5.1866	-4.0918	
Yemen	Mean	0.9947	1.0029	1.0272	1.0924
	Stand.dev.	0.0012	0.0006	0.0059	0.0315
	t-stat	-6.2007	-5.6813	-4.1187	