# Globalized Market for Talents and Inequality: What Can Be Learnt from European Football?

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# Globalized Market for Talents and Inequality: What Can Be Learnt from European Football? *

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**Abstract**

Complex interactions between high-skilled migration and aggregate performance govern the dynamics of growth and inequality across nations. Due to lack of data, these interdependencies have not been extensively studied in the economics literature. This paper takes advantage of the availability of rich panel data on the mobility of talented football players, and the performances of national leagues and teams to quantify the effect of a "globalization" shock, the 1995 Bosman rule, on global efficiency and cross-country inequality in football. I built a micro-founded model endogenizing migration decisions, inequality and training; I estimated its structural parameters; and I used numerical simulations to compare actual data with a counterfactual no-Bosman trajectory. My analysis reveals that the Bosman shock (i) increased global efficiency in football, (ii) increased inequality across leagues, and (iii) decreased inequality across national teams. I quantify the effect of the Bosman rule on the football hierarchy of UEFA and FIFA. Countries from Africa, South (except Argentina and Brazil) and Central America have produced more talents and benefitted from brain-gain type effects. My results also show that this brain-gain mechanism is the major source of efficiency gains. However, it plays only a minor role in explaining the rising inequality.

**Keywords**: International Migration, Brain Drain, Globalization, Inequality, European Football.

**JEL Codes**: F22, J61

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# 1 Introduction

The effect of the mobility of talented workers (the so-called brain drain) on inequality between nations has attracted a lot of interest in the last couple of decades. Identifying the macroeconomic effects of migration is a complex task because the link between migration and inequality is bi-directional. Income differentials induce migration, and migration affects cross-country inequality because migrants have specific characteristics compared to "stayers" in origin and destination countries (highly skilled workers tend to migrate more often than the less skilled). The lack of availability of long-term longitudinal data on the size and structure of migration and the absence of quantitative data on migration policies make it difficult to disentangle the mechanisms at work.

In parallel, empirical studies have problems disentangling and quantifying the bi-directional links. Economic variables are treated as exogenous in studies of the determinants of migration; and migration shocks are often considered as exogenous in studies predicting their effects on development and inequality. In addition, only a few theoretical or calibrated models have been used to study interactions between brain drain and inequality[1]. These models are calibrated to match the data. However there is no guarantee that the specifications are the most appropriate ones, or that their micro-foundations are supported by empirical studies. Hence, some important issues remain under-explored and/or controversial: To what extent does high-skilled migration increase inequality across nations? Does migration affect the economic hierarchy of nations? Can high-skilled emigration be good for sending countries? Who is benefitting or suffering from high-skilled labor mobility?

In this paper, I take advantage of the availability of rich panel data on European male football (soccer) leagues to investigate these interdependencies. Football has been so far the most globalized labor market [2]. An increasing number of talented players move every year across countries and continents to (re-)join the top European leagues. Consequently, the patterns observed in football can provide some insights into the implications of high-skilled migration in general for the global economy. European football data are quite rich. Existing databases have allowed me to identify the most talented players by country of origin, document their international mobility, and build metrics for the performance of leagues and nations. Another advantage of working on football is that a major policy reform was implemented in 1995, drastically changing the patterns of migration of talented players. This reform, known as the Bosman rule, considerably eased the transfer of players.[3] This shock was unexpected[4]; it has led to sub-

[1] See de la Croix and Docquier, 2012; Mountford, 1997

[2] The database developed in this paper shows that 50 percent of talented players were playing in a foreign league in 2010; the world average emigration rate of college graduates only amount to 6 percent(Docquier, Lohest and Marfouk (2009) ).

[3] The Bosman rule involved (i) the elimination of transfer fees forced small clubs to compete for players with big clubs with enormous budgets, and (ii) a relaxation of constraints on the number of extra-EU players in EU leagues.

[4] "This is an attack on football, it destroys a system which worked perfectly fine for years" "football will get squeezed out because of this judgement or "Euro-Shock-Clubs in Chaos" (Gassmann and Knop, 2004).Those were some of the reactions of football officials or journalist that referred to the Bosman case and the decision of the European Court of Justice (ECJ) on the 15th of December 1995. Also, a re-

stantial increases in migration flows between countries and has reinforced the concentration of talent in the top European leagues.

In this paper, I will study the impact of the Bosman rule and the associated migratory response on European football in different countries. As a general picture we can think of this "quasi-natural experiment" as a liberalization of migration shock, which can be used to quantify the effect of mobility restrictions on efficiency and cross-country inequality.

To study this phenomenon I constructed a structurally discrete location choice model for the decision of football players to migrate to certain countries, with the utility for an individual player depending on his country of residence characteristics and potential moving costs. And I assumed a particular production technology (Cobb Douglas) for the output (UEFA score of a European league and FIFA score of a national team), which depends on the number of players and their average skill level.

The availability of rich panel data allowed me to estimate the structural parameters of this model. To the best of my knowledge this is the first paper to characterize the migration determinants of talented football players. Firstly, I find that while the migration of talented players depends on the usual variables such as income per capita in the countries of origin and destination, geographical distance, and colonial links, the quality of the leagues is of primary importance. The prestige of the destination league is a key pull factor governing the migration decisions of talented players. I further show that the total number of talented players is a key determinant of the average performance of the league; and the total number of talented players weighted by the score of their employment league is a key determinant of national teams' performances.

This structural model also allowed me to quantify the impact of the Bosman liberalization shock on the training and production of talents. I use counterfactual simulations to assess the effect of the Bosman rule on players' mobility, their geographic concentration, and the ranking, efficiency and inequality of leagues and national teams. Firstly, I show that the Bosman liberalization shock has magnified the effect of push and pull factors, increasing the global scale of migration. Secondly, the Bosman liberalization shock has spurred training and the production of talent in poorer regions such as Africa, South- and Central America. The exceptions to this are Argentina, Brazil and the USA - the USA in particular is not usually thought of as a poor country. No such incentive effects were identified in European or Asian countries. This result is similar to the brain-gain theory (Beine et al., 2011; Docquier and Rapoport, 2012), according to which poorer emigration countries have produced more and more talent. Using counterfactual simulations, I find that the Bosman liberalization reform has led to an improvement in football quality in the world as measured by UEFA and FIFA scores. In particular, I show that the efficiency of European football improved by 12 percent in 2010, and the efficiency of national teams by 20 percent. The Bosman rule has increased inequality across European leagues, while

cent article in BBC discusses the revolution and the surprise that Bosman reform had to European football see(http://news.bbc.co.uk/sport2/hi/football/4528732.stm). Consequently, this anecdotal evidence supports the this shock can be considered as exogenous. I also provide a falsification exercise which shows that the Bosman rule was not anticipated.

at the same time decreased the inequality across national teams. The effects are quite large: the Gini index of UEFA scores shows an increase of 25 percent in the inequality between the European leagues between the years 1998 and 2010, whereas the inequality between national teams fell by 70 percent on average over the same period.

My model implies that if the Bosman rule had not been implemented, Brazil and Spain (rather than the Netherlands and Spain would have been the most likely finalists in the World Cup 2010). Also, I observe that Algeria, Chile, Colombia, Egypt, Paraguay and Uruguay would be ranked very differently. For instance, Algeria appears to be 7 positions higher because of the Bosman rule (it is in the 48th position instead of the 55th), while Colombia, Uruguay, Paraguay, Chile and Egypt are in the 18th, 6th, 16th, 10th and 9th positions instead of the 46th, 33th, 44th, 39th, 34th positions respectively.

The remainder of this paper is organized as follows. Section 3 presents the data and stylized facts. Section 4 illustrates the theoretical model and its estimation. Section 5 illustrates a quasi-experiment. Finally, I present my conclusions in Section 6.

## 2 Related Literature

Let me now discuss the similarities between the goal of my paper and recent advances in the traditional literature on brain drain and cross-country inequality. The ingredients of my analysis are in line with three strands of this literature, although here the concepts are transposed to football. In this section I will review the general literature in economics, and summarize the contributions of scholars who have considered football as an interesting case study for illustrating the effects of globalization. The first part of my literature review focuses on the determinants of migration. In the second part, I discuss the analogy between the concepts of income per capita and income per citizen (natural) on the one hand, and concepts of leagues' and national teams' performances on the other. In the third part, I focus on the effects of brain drain on the countries of origin and reception and the inequalities between them.

*Determinants of migration.* The first strand of the literature concerns the determinants of migration. According to Docquier, Lohest and Marfouk (2007) high-skill emigration is not particularly sensitive to geographic variables such as distance; however it increases with the degree of religious fractionation at origin and decreases with the level of development at origin. The size of the country also matters: small countries are more open to immigration than large countries. Docquier et al. (2007) show that these determinants are valid for both developing and developed countries although the magnitude of the coefficients differs. Using aggregate bilateral data, Grogger and Hanson (2010), Rosenzweig (2008), Bï¿½lot and Hatton (2008) show that wages and earnings are two important characteristics of international labor movements. Finally, Beine, Docquier and Ozden (2011) disregard country-specific variables (captured by fixed effects) and focus instead on the effect of networks/diasporas on the size and composition of bilateral migration flows. Allowing for the usual determinants of migration and for potential endogeneity biases, they show that larger diasporas increase the size of migration flows and lower the average educational level of new migrants.

To the best of my knowledge, only Kleven et al. (2010) have transposed these techniques to football and analyzed the determinants of players' mobility in football . They studied the effects of top earnings' tax rates on the international migration of top football players in Europe. They set out a theoretical model of taxation and migration, which they then estimated using data on marginal tax rates at the top of the income distribution. They showed that (i) the overall location elasticity with respect to the net-of-tax rate is positive and large, and (ii) cross-tax effects of foreign players on domestic players (and vice versa) are negative. Many other factors are likely to play a role and have been omitted. In particular, the development level of the destination country and the prestige of the league are expected to act as pull factors. I plan to develop a more comprehensive model accounting for these channels.

*Migration and football team's performance.* Another strand of literature studies the effect of emigration on income per citizen (natural) in the country of origin. Clemens and Pritchett (2008) see income per natural as an important measure of development. They argue that the standard measure of income per capita (i.e. per resident), often used to indicate material welfare or to designate a goal of development, is unsatisfactory for measuring people's welfare when many individuals change their country of residence. Income per natural does not replace income per capita, but it can supplement it as a measure of the well-being of people. They show that positive selection in emigration can be responsible for decreases in income per capita in the origin countries, and increases in income per natural.

Transposed to football, the concept of income per natural is similar to the performance of national teams, while the concept of income per capita refers to the performance of national leagues. Several researchers have analyzed the effects of migration on the performance of national teams. Considering migration as exogenous, Berlinschi et al. (2011) recently used cross-country data and showed that the migration of football players has positive effects on the performance of the national teams of countries of origin. In a similar vein, Milanovic (2005) developed a theoretical model predicting that the liberalization of the market for football players would reduce inequality between national teams due to skill spillover between expatriate and local players. He provides descriptive statistics from the history of the World Cup suggesting that inequality between national teams, as measured by the average goal difference between the winners and the losers, gradually decreased between 1950 and 2002.

Finally, Gelade and Dobson (2007) provided an econometric analysis of the impact of migration on national teams' performance. They estimated the effect of an expatriation index, measured by the percentage of the national team players who were employed abroad, on the comparative strength of the national teams. After controlling for the size of the talent pool, football culture, economic resources and climate, they found a positive and highly significant coefficient for their expatriation index. As already discussed, the national team's performance is not a good indicator of the performance of the local economy: studying national teams is equivalent to studying income per natural. It is also important to study the performance of the league. Indeed, the league's performance affects its attractiveness and the desire of talented players to stay or leave. Endogenizing the performance and linking it to migration decisions are key to understanding how a globalization shock affects the football scene.

*Brain drain and its effects on origin countries.* There are three waves of research analyzing the effects of the brain drain. The first wave of economic papers mainly consists of welfare analyses in standard trade-theoretic frameworks (e.g., Grubel and Scott, 1966; Berry and Solingo,1969). These contributions concluded that the impact of the brain drain on source countries was neutral and emphasized the benefits of free mobility for the world economy. This was explained by the fact that high-skilled emigrants often leave some of their assets in their country of origin, which complements remaining high- and low-skill labor (Berry and Soligo, 1969), as well as sending back remittances to their home country.

The second wave came under the leadership of Jagdish Bhagwati. A number of theoretical models were developed to explore the welfare consequences of the brain drain in various institutional settings. Domestic labor market rigidities, fiscal and other types of externalities (Bhagwati and Hamada, 1974 ; McCulloch and Yellen, 1977) were introduced to emphasize the negative effects of the brain drain for those left behind. The third wave of research demonstrated that high-skilled emigration also induces positive feedback effects for sending countries through several channels, including increased incentives to acquire education due to skill-biased emigration prospects. Beine et al. (2001, 2008) empirically investigated this "brain gain" phenomenon using cross-country data. They found evidence of a positive effect of skilled migration prospects on gross human-capital formation in a cross-section of 127 countries. In a limited number of countries, these benefits outweighed the costs of the brain drain (in other words there was a net brain gain). Causality is hard to establish in a pure cross-sectional framework and the positive association between the brain drain and human capital formation could be driven by external unobserved characteristics or reverse causality.

The similarities between the driving forces of (i) high-skilled workers' mobility and development disparities across nations, and (ii) players' mobility and disparities in football teams' performance is strong. My aim is to use much better and more detailed data on football players' mobility and inequality across leagues to shed light on the effect of a globalization or liberalization shock.

*Brain drain and its effects on destination countries.* There is another strand of economic literature that shows that the concentration of human capital in the most advanced economies can stimulate technological progress across the world and trickle down to less advanced economies (see Grubel and Scott, 1966; Kuhn and McAusland, 2009; Mountford and Rapoport, 2011). In particular, Kuhn and McAusland (2009) show that emigration can benefit not only sending but also receiving countries. Highly-skilled emigrants can design better products and production processes abroad than at home, and they can produce higher-quality goods. As a result, the value of every unit of a good costs less and all the good's consumers benefit, regardless where they live. Furthermore, Mountford and Rapoport (2011) illustrate that the permanent immigration of skilled workers will raise the level of human-capital accumulation and so reduce the fertility rate. They predict faster rates of growth in receiving economies. Hence, even if a net brain gain is at work in poor countries, it is unclear whether it is large enough to match the gains observed in the receiving countries. In other words, the inequality impact of the brain drain is ambiguous even when the economies of the sending countries improve. In this paper, I will study how the concentration of talented football players impacts on the quality of their league of employment.

## 3 Data development and stylized facts

In this section, I describe my database on the location of talent, bilateral migration stocks, and the performance of national leagues and national teams. I first present my data sources and definitions. Then I pin down some remarkable stylized facts on the development of inequality across leagues, the number of talented players in Europe after the Bosman rule came into effect, the geographic concentration of such talents, and the link between migration, inequality, and number of talented players per region.

*Data sources and definitions.* I define a talented player as one who has made at least three appearances in one of the best 65 national teams during a World Cup year[5].In this paper, a "talented player" can be transposed into a high skilled worker for the global economy. Since, I use macro data for my analysis, it is difficult to incorporate the "superstar" phenomenon (see Lucifora and Simons, 2003;Rosen, 1981) as defined in sport literature in the definition of "talented" player. According to this literature, a talent is a high-valued athlete based on the preferences of the team supporters. In this paper, I can assume that each player that participates in his National team is valuable to the supporters of his country.

I focus on the nine World Cup years from 1978 to 2010 (the World Cup takes place every four years). Talented football players make more appearances in these years because (i) trainers use their best players, (ii) more matches are played for the qualification and final stages of the World Cup, and (iii) major nations all play a similar number of games. The selection of the best 65 countries is based on the FIFA ranking 2011. It includes 21 UEFA core countries, 29 non-European countries (mainly from Africa and Latin America), and 15 Eastern European countries. In the latter group, 12 new countries were created after 1990 (3 of them are former countries: ex-USSR (split in 1991); ex-Yugoslavia (split in 1991); and ex-Czechoslovakia (split in 1993)).

My key variables are:

- I denote by $N_{ijt}$ the number of talented players (talents) originating from country $i$, and employed in league $j$ during the World Cup year $t$. The data are provided by Benjamin Starck-Zimmermann and the CIES Football Observatory, [6] which records the names of players appearing in their national team, the number of their appearances, and their club of employment on an annual basis. The total number of talents originating from country

[5]Defining as a talented player with 1 or 2 appearances to his national team would strongly increase the number of talents in the database.Some national teams appear to have almost 60 players.Some of these players stop participating in their national teams over time.Consequently, using 3 appearances per player, I can define players who regularly participate to their national team; with more than 3 appearances some well-known talented players would be exclude but the main results of the paper will not disappear.

[6]See http://www.national-football-teams.com/v2/ national.php..

$i$ is given by $N_{it}^T = \sum_j N_{ijt}$ whereas the total number of talents employed in league $j$ is denoted by $l_{jt} = \sum_i N_{ijt}$.

- I denote by $Q_{it}$ the quality/score of the national team $i$ in year $t$. The data are provided by the official website of FIFA[7]. However the rules did change over the years. To make the results comparable, I standardized scores, dividing the FIFA score of each country in my dataset by the score of Spain[8] in the same year. Spain was chosen because it was the winner of the last World Cup. This normalization makes the variable more stationary and comparable over time.

- I denote by $q_{jt}$[9] the quality/score of league $j$ at year $t$. I measure the quality of the league by its UEFA score [10]. By definition, the UEFA score aggregates points accumulated by the clubs in each league over the last five years in European club competitions. The UEFA coefficient assigned to each country is the sum of the points obtained by all the participating teams from that country divided by the number of teams. However the rules changed over the years.

  Data for the quality index of leagues are only available from 1978 onwards, and data on $q_{jt}$ are only available for European countries. To proxy the score of the non-European leagues I adopted the following procedure: I regressed the scores of the European national teams on the quality/score of their league, and identified a linear relationship. Using this linear equation, I then proxied the quality/score of the league of non-European countries. Hence, I have two samples: the 1978-2010 balanced group of EU-to-EU countries and another group which includes both the balanced group and the 1994-2010 group of All-to-EU countries[11]. The first group contains 3487 observations and the second 7775 observations [12].

I will also use other variables for empirical purposes. Data on geographic distance, colonial links, and linguistic proximity are taken from the CEPII database, described in Clair et al.

[7]See http://fr.fifa.com/worldranking /rankingtable/index.html

[8]if the standardized scores divided the FIFA score of each country in my dataset by the score or Germany, UK or other country of our sample, the results of regressions will not be altered.

[9]The system for gain points in UEFA for each league depends on a number of parameters. It is difficult to be modelled. The system of collecting points of the European Leagues depends on 1) the number of games that teams play regardless of the match result, 2) the qualification of the teams in the next round and 3) the goals that teams score during the matches. Looking these conditions, I can clearly infer that the score of each league given from UEFA is not a zero-sum game. Since, the game between two teams is a random process which it is difficult to be modelled, I can consider a Cobb-Douglas technology for my analysis.

[10]See http://kassiesa.home.xs4all.nl/bert/uefa/data/method4/crank2012.html

[11]EU-to-EU means that the country of origin is in European Union to destination in a country in European Union. On the other hand, All-to-EU represents the country of origin of the player is from all the world with destination to European Union country.

[12]The linear combination between the scores of leagues and national teams is: $q_{i,t} = 0.6397Q_{i,t} - 0.0237$. The regression explains 30 percent the variation of quality/score of league. The average correlation between the score of leagues and national teams between 1994 and 2010 is 0.58, but it has increased gradually across the years. This proxy allows me to increase my sample for the migration equation.

(2004). Wage data are proxied by the level of income per capita in PPP and taken from the World Penn Tables. I will now describe a few major stylized facts.

*Inequality across leagues.* I will first describe the trends in inequality across the 21 European leagues over the 1978-2010 period. For each World Cup year, I compute two standard inequality indices, the Gini and Theil indices, using the league score data, $q_{jt}$. To maximize the comparability of these inequality measures, I interpolated a score for England in 1990. After the Heysel stadium disaster in 1985, UEFA decided to ban all English clubs from European competitions from 1986 to 1991. The score of England thus fell to zero by 1990, and this produced a large variation in the inequality indices. To overcome this problem, I replaced the zero value in 1990 by the average of the scores of England in 1986 to 1994. Figure 1 shows the changes in inequality for the two indices. In particular, it shows that the inequality across leagues fell from 1978 to 1998 and then increased until 2010.

[Insert Figure 1]

A complementary view is provided by Figure 2, which compares the Lorenz curves of the leagues' score in 1994 and 2010. The Lorenz curves intersect at the 12th position. This means that the best 12 leagues have improved since the Bosman reform, while the intermediate leagues declined. It is worth noting that I performed the same comparison between 1978 and 1994 (available upon request), but did not find any meaningful difference between the Lorenz curves in the pre-Bosman period. Again, Figure 2 suggests that the Bosman rule might have increased the gap between the top and bottom leagues, with the most deleterious effect being evident in the intermediate leagues.

[Insert Figure 2]

*Number and concentration of talents in Europe.* the Bosman rule was intended to allow the free mobility of football (soccer) players across the European leagues. To investigate its effects, I present stylized facts on the number of talented players (talents) in Europe and their concentration.

Figure 3 illustrates percentage evolution of talented players in Europe across 1978 and 2010. I observe that there is an increase of the percentage non-European talents in Europe after 1994. In particular, the increase of nonEuropean talents is from 6% to 28% in 1998. In 2010, the 1/3 of talents in Europe is non-EU players. The introduction of the Bosman rule coincided with an increase in the percentage of non-EU talented players in Europe.

[Insert Figure 3]

Second, I constructed the Herfindhal index for the total number of immigrants in the EU. The Herfindhal index is given by:

$$H_t = \sum_{j \in EU} \left( \frac{N_{ij,t}}{N_{EU,t}} \right)^2.$$

After some calculation this formula can be decomposed into the sum of three parts as follows:

$$H_t = H_{EU,t}\sigma^2_{EU,t} + H_{NEU,t}\sigma^2_{NEU,t} + H_{EU,NEU,t} \tag{1}$$

The first part is the Herfindhal index for European players multiplied by the squared ratio of the total number of European players to the total number of players, $\sigma^2_{EU,t}$. The second part is the Herfindhal index for non-European players multiplied by the squared ratio of the total non-European players to the total number of talented players in Europe, $\sigma^2_{NEU,t}$; and the third part is the residual of the Herfindhal index, capturing the correlation between the concentration of EU and non-EU players.

Figure 4 shows the product of the Herfindhal index for non-European players and the proportion of non-European players. Both increased dramatically after the introduction of the Bosman rule, which implies that the concentration of talent in the major leagues also increased substantially. Not only was there an increase in the number of non-European players in Europe, but they also became more concentrated in the major leagues. Like EU players, their Herfindhal index increased but their number as a proportion of the total number of players in Europe decreased, and it was this latter effect which dominated. This is why the contribution of the concentration of European players in the overall Herfindhal index decreased, while the complementary part increased. As a result, the overall Herfindhal index increased between 1978 and 2010, and the pace of the increase was faster 1994: talented players tended to be more concentrated in particular leagues after the Bosman rule.

[Insert Figure 4]

*The migration-inequality nexus.* I also investigated the relationship between migration and inequality. To do this, I built two intra-distribution mobility matrices. Tables 1.a and 1.b illustrate the changes in the ranking of national leagues between the years 1982-1994 and 1994-2010. Each table distinguishes five quintiles, and each cell characterizes the mobility of European leagues in the UEFA ranking, as well as the average probability of transition. I also report the list of countries, and net migration flows from other European countries and from non-European countries. The first element in parenthesis is the net flow of migration from European countries, and the second the net migration from non-European leagues. The main diagonal in Tables 1.a and 1.b. shows the leagues which did not change position in UEFA ranking between the two periods. Countries whose ranking fell lie above the diagonal, and countries that improved lie below it. Thus Table 1.a shows that the ranking of six countries improved and that of five deteriorated between 1982 and 1994.

There is a positive correlation between the ranking and net immigration. The six countries which improved had average positive immigration net flows (1.17, 5.67), and the five countries which deteriorated exhibited negative or low net immigration flows (-0.60, 1.4). Consequently, I can conclude that the improvement or deterioration of countries in the ranking is related to positive and negative net immigration, respectively.

Similar results are found in Table 1.b covering the post-Bosman period. In particular, five countries improved with immigration net flows of (11.80,16.20), and five countries deteriorated with average immigration net flows of (-5.60, 9.20). Obviously, the net migration flows shown in Table 1.b are larger than those in Table 1.a, possibly because of the implementation of the Bosman rule.

These stylized facts show that mobility influenced the ranking of leagues both before and after the implementation of the Bosman rule. Before 1998 (i.e. before Bosman) the trend was for inequality to decrease. Since then, inequality across countries has increased. This suggests the importance of building a theoretical framework and testing it using bilateral data and econometric techniques for obtaining a clearer picture of the relationship between migration and inequality.

[Insert Tables 1.a and 1.b]

*Production of talents (training).* Finally, I investigated whether the introduction of the Bosman rule has had any effect on the production of new talented players (i.e. training). Figure 5 shows the number talented players originating from all the countries in the world from 1978 to 2010. I have separated the countries into different groups, according to the FIFA continental zones (Africa, Asia and Central America, South America and Europe) and a mixed group, BAU, covering Brazil, Argentina and the USA. These countries constitute a separate group since Brazil and Argentina are traditional powers in football, while soccer is less popular in the USA than basketball, baseball or American football.

Figure 5 shows that the number of players from South America and Central America, and Africa has increased since the mid-nineties. On the other hand, Europe, Asia and BAU have had stable growth rates in their talents over the nine World Cup years. Hence, the huge increase in the production of talented players after the implementation of the Bosman rule is only perceptible in poor regions of high emigration. This result is line with the migration-induced incentive mechanism described by Beine et al. (2008),although identifying such a mechanism requires rigorous testing.

[Insert Figure 5]

# 4 The model

To explain changes in the rankings and inequality, and characterize the functioning of the football market, I need to understand (i) the determinants of the migration decisions of talented players, (ii) the determinants of the quality and prestige of leagues and national teams, (iii) the determinants of the production of talents in each country, and (iv) how the Bosman reform has affected these patterns. This section describes the general model used to address these issues. In the next four subsections, I endogenize migration decisions, leagues' and national teams' score, and the production of talented players. Each subsection follows a similar structure, i.e. a presentation of the micro-foundations, a description of the estimation methodology, and a discussion of the results. In the fifth sub-section, I combine all the ingredients, define the intertemporal equilibrium and analyze a two-country version of the model to illustrate the mechanisms at work.

## 4.1 Migration decisions

A large number of studies have investigated the determinants of the size and structure of labor mobility between countries. To endogenize migration decisions, most recent research has been built on a multinomial discrete-choice model without spatial correlation in the unobserved (Belot and Hatton, 2008; Rosenzweig, 2008; Grogger and Hanson, 2011; Beine et al., 2011; Razin and Wahba, 2011). I use similar micro-foundations to analyze the determinants of the mobility of talented players.

*Micro-foundations.* Each country $i$ produces a number $N_{it}^T$ of talented players with heterogeneous preferences. The utility of a player from country $i$ of deciding to play in league $j$ is the sum of a deterministic component depending on the destination league's characteristics and an individual-specific random term. Possible determinants include the average wage level ($w_{jt}$), the prestige of the league (measured by its standardized UEFA score, $q_{jt}$), a vector $a_{jt}$ of amenities (capturing quality of life, taxation, climate, the size of the total diaspora, league rules, quality of stadium and infrastructure, etc.), and mobility costs $c_{ijt}$ if league $j$ differs from country $i$ (with $c_{iit} = 0$ by definition). The deterministic component of utility is assumed to be logarithmic. The random term $\varepsilon_{jt}$ is assumed to follow an iid extreme-value distribution. Player subscripts are omitted for clarity.

The utility of a player from country $i$ and playing in league $i$ at time $t$ is therefore given by:

$$u_{iit} = \theta \ln w_{it} + \delta \ln q_{it} + \rho \ln a_{it} + \varepsilon_{it},$$

where $(\theta, \delta, \rho)$ is a vector of preference parameters.

The utility for the same player of moving to league $j$ at time $t$ accounts for moving costs. These costs capture psychic and integration costs, monetary costs (which can be partly covered by his team of employment) as well as screening costs (the effort of contacting foreign employers and obtaining a visa). Some federations (especially the European leagues) impose restrictions on the employment of foreign players. For instance, a football player must fulfill two conditions to play in the English league: play 75 percent of the matches of his national team, and the rank of his national team must be greater than the 70th FIFA position. In Norway, football clubs need to demonstrate that having a foreign player will improve the level of the league and of the club. The Spanish league does not allow more than three non-European players per club. The utility of moving to league $j$ is given by:

$$u_{ij} = \theta \ln w_{jt} + \delta \ln q_{jt} + \rho \ln a_{jt} + \ln(1 - c_{ijt}) + \varepsilon_{jt}.$$

where $c_{ijt}$ denotes bilateral migration cost, modeled as an "iceberg" cost here.

When the random term follows an iid extreme-value distribution, I applied McFadden's (1974) theorem. The probability that a talented soccer player born in country $i$ chooses to emigrate to league $j$ follows a logit expression:

$$\begin{aligned}\frac{N_{ijt}}{N_{it}^{T}} &= \Pr\left[u_{ijt} = Max_k u_{ikt}\right] \\ &= \frac{\exp\left[\theta \ln w_{jt} + \delta \ln q_{jt} + \rho \ln a_{jt} + \ln(1 - c_{ijt})\right]}{\sum_k \exp\left[\theta \ln w_{kt} + \delta \ln q_{kt} + \rho \ln a_{kt} + \ln(1 - c_{ikt})\right]}\end{aligned}$$

Hence, the ratio of emigrants to stayers is given by the following expression

$$\begin{aligned}\frac{N_{ijt}}{N_{iit}} &= \frac{\exp\left[\theta \ln w_{jt} + \delta \ln q_{jt} + \rho \ln a_{jt} + \ln(1 - c_{ijt})\right]}{\exp\left[\theta \ln w_{it} + \delta \ln q_{it} + \rho \ln a_{it}\right]} \\ &= (1 - c_{ij,t})\left(\frac{w_{jt}}{w_{it}}\right)^{\theta}\left(\frac{q_{jt}}{q_{it}}\right)^{\delta}\left(\frac{a_{jt}}{a_{it}}\right)^{\rho}\end{aligned}$$

For simplicity, consider that $\widehat{c}_{ijt}$ denotes the pre-Bosman level of migration costs and the Bosman ruling multiplies $(1 - c_{ijt})$ by a constant. Hence, we can write $(1 - c_{ijt}) = (1 - \widehat{c}_{ijt}).\exp(\lambda BOS_t)$ where $\lambda$ is a parameter and $BOS_t$ is a variable equal to zero in the pre-Bosman period and to one after the Bosman ruling.We have:

$$\frac{N_{ijt}}{N_{iit}} = (1 - \widehat{c}_{ijt}).\exp(\lambda BOS_t)\left(\frac{w_{jt}}{w_{it}}\right)^{\theta}\left(\frac{q_{jt}}{q_{it}}\right)^{\delta}\left(\frac{a_{jt}}{a_{it}}\right)^{\rho} \quad (2)$$

The bilateral emigration rate (ratio of emigrants to stayers) is a Cobb-Douglas function of differentials in wages, prestige levels, and amenities, net of migration costs.

*Identification strategy.* To estimate the parameters of the structural equation (2), I used data on the bilateral migration of players ($N_{ijt}$), proxied wage levels with GDP per capita of the country ($w_{jt}$), and measured the prestige of the league ($q_{jt}$) by its standardized UEFA score. Amenities and migration costs were not observable. Following the empirical literature on migration, I allowed migration costs to increase with the log of the geographic distance between countries ($d_{ij}$), decrease with linguistic proximity ($l_{ij}$) and with the existence of colonial links between countries ($s_{ij}$). Last but not least, migration costs can be affected by the Bosman rule, $BOS_t$. Since 1995, European football players have been allowed to move without any legal restriction within Europe, and restrictions on non-European players have been attenuated. Hence I included a Bosman dummy ($BOS_t$) in the set of regressors.

Taking the log of (2), I obtained the following pseudo-gravity specification:

$$\begin{aligned}\ln \frac{N_{ijt}}{N_{iit}} &= \theta \ln \frac{w_{jt}}{w_{it}} + \delta \ln \frac{q_{jt}}{q_{it}} + \lambda.BOS_t \\ &\quad + \beta_1 \ln d_{ij} + \beta_2 l_{ij} + \beta_3 s_{ij} + \alpha_i^m + \alpha_j^m + f(t) + \epsilon_{i,t}^m \quad (3)\end{aligned}$$

where $(\lambda, \beta_1, \beta_2, \beta_3)$ are parameters governing the migration cost equation, $\left(\alpha_i^m, \alpha_j^m, \right)$ are fixed effects for origin and destination countries and $f(t)$ is a B-spline function that captures the nonlinear time trend, and $\epsilon_{i,t}^m$ is the error term. The fixed effects, together with the distance and Bosman variables, control for unobserved amenities and migration costs. Our main coefficients of interest are $\delta$ and $\lambda$. Other explanatory variables are time-invariant and exogenous.

I cannot estimate the (3) having both time fixed effects and the Bosman dummy because of multicollinearity. Since, I want to identify the effect of this dummy variable on the migration flows, I provide the following three different ways to estimate the (3): The first two methods are provided for robustness analysis and the third gives me the opportunity to estimate my equation properly. First, I estimate my equation having the Bosman dummy without time fixed effects even if I know that there is omitted variable problem. Second, I estimate my equation only for the years 1994-1998 (the years before and after Bosman rule) to identify the effect of this reform. Third, I assume the nonlinear time trend can be captured by a polynomial of $t$, $f(t)$, and estimate it using B-spline method.

The main data constraint to estimate (3) is that UEFA scores are only available for European countries from 1978 to 2010. Hence, the set of origin and destination leagues must be restricted to European core countries (one 21×21 matrix per year). Because understanding the mobility of non-European players is key to explaining the Bosman effect, I have taken advantage of the high correlation between leagues' and national teams' scores to proxy the prestige of non-European leagues (as explained in the previous section). Hence, I distinguish two samples: the 1978-2010 EU-to-EU countries, and a larger group covering the 1978-1994 EU-to-EU countries and the 1994-2010 All-to-EU countries. The first sample contains 3487 observations and the second 7775 observations.

As far as estimation is concerned, I first used the OLS-FE regression technique. This is likely to yield inconsistent estimates of the coefficients because of the presence of a high proportion of zero values (83%) in bilateral migration stocks ($N_{ijt}$). Estimating the structural model (3) with OLS-FE leads to the exclusion of many country pairs. If the country pairs with zero flows have a different population distribution from pairs with positive flows, this exclusion generates a selection bias. In addition, OLS estimates are not consistent when the variance of the dependent variables is not constant and depends on its covariates. Heteroskedasticity and the presence of zeroes are common problems in pseudo-gravity models. Santos-Silva and Tenreyro (2006) showed that the Poisson pseudo maximum likelihood (PPML) estimator solves these problems and generates unbiased estimators of the parameters (unlike threshold-Tobit or nonlinear estimates). Hence, I also used Poisson regressions, as did other studies on trade and bilateral migration (Beine et al., 2010, 2012; Tenreyro, 2007; Mytiakov et al. ,2010).

Finally, estimation of (3) may also be subject to a reverse causality problem. The reason is that, while migration is likely to depend on the prestige of the league, it also has an impact on the quality of the league. In practice, it is not obvious that this problem is severe. The quality of the league is affected by the total immigration and emigration of players. On average, each bilateral pair accounts for a relatively small fraction of total migration stocks. Nevertheless, I will address the reverse-causality problem by using IV-Poisson and instrumenting the log-ratio of leagues' scores by their lagged value.

#### 4.1.1 *Estimation results.*

Table 2 shows the results of estimating Eq. (3) under different samples and econometric methods. The first five columns illustrate the estimated results with the sample of European countries. The last column also includes non-European leagues of origin. In particular, Columns (1) presents the OLS results where a significant number of observations with zero migration flows are dropped. Columns (2)-(4) and (6) present the Poisson approach and Column (5) reports the results of the IV-Poisson method.

[INSERT TABLE 2]

The coefficients in Table 2 are elasticities such as a 1 percent change corresponds to an equivalent percentage change in the dependent variable equal to the size of the coefficient. For instance a 1 percent rise in the prestige ratio between origin and destination is associated with a positive increase in bilateral migration flows of about 0.3 percent. For the dummy variable such as common language, the corresponding coefficient can again be interpreted as a percentage change only this time for switching the dummy from zero to one.

The majority of the regressions explain more than 60 percent of the variation in the observed migration flows (excepted OLS regressions which are biased). This ensures a very good fit given that the migration rates are very heterogeneous across corridors. The coefficients of the main explanatory variables are significant and have intuitive signs. The coefficients are stable across the estimations and different samples. Higher wage differentials, larger prestige differentials, shared cultural beliefs all beget higher migration flows. Conversely, the larger the geographic distance between origin and destination, the lower are migration flows.

Interestingly, the coefficient of the prestige ratio lies between 0.2 and 0.35 for all the different samples. This means that a 1 percent increase in the prestige ratio will lead to an increase of 0.2 to 0.35 percent in the migration flow between the two countries. Similarly, the coefficient of wage ratio lies between 0.3 and 0.6. This coefficient is close to that estimated by Beine et al. (2012). The elasticity obtained for the distance is ten time bigger than the one estimated by Beine et al. (2011, 2012). This result means that the distance plays very important role in a soccer player's decision about where to immigrate. It is true that soccer players prefer to choose countries close to home country because they sometimes migrate without their family members. At this stage, it is important to mention that the language variable is not significant in some regressions, probably because the soccer industry overcomes linguistic problems. Football teams either hire translators and manage to allow players to communicate in their mother language. Colonial links are also important for the migration of soccer players. The elasticity of this coefficient is slightly larger than that estimated by Beine et al (2011). It means that similarities in culture can really important for the decision to migrate of soccer player.

One of the most important variables is the Bosman dummy. It is significant and positive. The coefficient is 0.5 on average in my regressions. It means that Bosman rule led to drastic increase in migrant flows. The last issue to be explored is the investigation of the existence of reverse causality between the prestige ratio and migration flows. Comparing Poisson and IV-Poisson regressions, the Wald-test shows that there is not significant evidence for reverse causality. In theory, endogeneity exists but it is too small to bias the results. An explanation is that prestige $q_j$ depends on the sum of $N_{ij}$ from 65 countries (as it will be evident in the next sub-section). This means each $N_{ij}$ accounts for 1/65 of this sum on average. Also the $q_i$ depends on the sum of emigration to 21 countries. As a result the $N_{ij}$ represents on average 1/21 of this sum. This endogeneity is too tiny to be detected and the Wald test is not significant.

#### 4.1.2 *Falsification Exercise*

Since there is a concern that Bosman rule was anticipated by the soccer players and the leagues, I try in this section to investigate this issue. In order to address this concern, I follow the strategy of Head et al. (2010) using a falsification exercise. More precisely, I generate random Bosman rule dates between 1986 and 1998. Consequently, I create a false Bosman dummy in the Eq.(3) to investigate if it affects the migration decisions. Table 3 shows the resulting false story of Bosman rule application.

[INSERT TABLE 3]

Column 1 considers that Bosman rule imposed in the year 1986. Also, Column 2 and 3 consider that Bosman rule imposed the years 1990 and 1994 respectively.The Column 4 reports the results of real date of implication of Bosman rule which is also presented in Table 2. In all the Columns of Table 3, the main variables of the Eq.(3) (income differentials, quality differentials, colonian links and distance) are significant and their coefficients are stable. On the other hand, I notice that false Bosman dummy is not significant in Columns 1 to 3. Consequently, I can consider that Bosman rule is an exogenous shock.

### 4.2 Technology

Now, I will define the production functions of leagues and national teams.

*Micro-foundations.* Growth and brain drain theories have emphasized the relationship between human capital, labor productivity and development. I also followed this approach assumed that the performance of leagues and national teams depends on the number and quality of talented players employed. As for leagues' performance, I assume the following Cobb-Douglas technology:

$$q_{jt} = A_{jt} l_{jt}^{\gamma} \tag{4}$$

where $A_{jt}$ is the scale productivity factor in league $j$ at year $t$, $l_{jt} \equiv \sum_i N_{ijt}$ is the total number of talented players employed in the league, and $\gamma$ is the elasticity of the leagues' score to the number of talented players.

Talented players improve their skills when playing in better leagues. For simplicity, the skill of a talented player is assumed to be proportionate to the average quality of the league in which he is employed. I denote by $L_{it} \equiv \sum_j N_{ijt} q_{ijt}$ the total amount of skills available to the national team $i$ at time $t$.[13] A similar index was used by Berlinschi et al. (2011). They weighted each migrant with the ranking of the league where he was employed. On the contrary, I weight all the players that participate in the national team with the performance of their league of employment.[14] The performance of this national team is depicted by the following technology:

$$Q_{jt} = B_{jt} L_{jt}^{\phi} \tag{5}$$

where $B_{jt}$ is the scale productivity factor in country $j$ at year $t$, and $\phi$ is the elasticity of the national teams' scores to the total amount of skills used by the national team.

*Identification strategy.* To estimate the parameters of the production functions (4) and (5), I use standardized data on league and national teams' scores, and data on the distribution of talented players. I model scale productivity factors by using country- and time-fixed effects. Taking the log of (4) and (5), I obtain the following empirical specification:

$$\ln q_{jt} = \alpha_j^q + \alpha_t^q + \gamma \ln l_{jt} + \epsilon_{jt}^q \tag{6a}$$

$$\ln Q_{jt} = \alpha_j^Q + \alpha_t^Q + \phi \ln L_{jt} + \epsilon_{jt}^Q \tag{6b}$$

where $\left(\alpha_j^q, \alpha_t^q\right)$ and $\left(\alpha_j^Q, \alpha_t^Q\right)$ are the vectors of fixed effects, $\epsilon_{jt}^q$ and $\epsilon_{jt}^Q$ are the error terms. These equations are first estimated by OLS-FE. For the same reason as above, OLS might be subject to a reverse-causality bias. Indeed, the quality of the league impacts migration decisions and the total number of immigrants and emigrants. I address this problem by using IV regressions and employ the lagged number of talented players as instruments.

*Estimation results.* Table 4 reports the estimation results of (6a). All the regressions include full sets of country fixed effects and year dummies. Moreover, I controlled for heteroskedasticity, serial correlation[15] and I report the robust standard errors in parentheses. Columns (1) and (2) provide OLS-FE results for two different groups. Column (1) includes only European leagues and Column (2) includes European and non-European leagues. Columns (3)-(5) provide the results of the IV method using different groups. In particular, Column (3) is based on the full group. Column (4) provides the estimation results only with the 21 European leagues excluding Ex-USSR and Ex-Yugoslavia countries. At the end, Column (5) contains all the European leagues. For Columns (3)-(5), I use the 2SLS estimation technique with the first two lags of $\ln l_{jt}$ as instruments.

[13] In the migration data provided by Benjamin Starck-Zimmermann and CIES Football Observatory the team for which each player plays is recorded at the end of the year (i.e. in December). National teams' scores are collected after the end of the World Cup in July. To harmonize measurement periods, I weight each talented player by the performance of his league of the previous year.

[14] At this point, I need to mention that I investigated other specifications for the determinants of the national team. For instance, I consider that the national performance depends on the total number of players and the number of players employed in the top five leagues in the world. The variable for the total number of talented players is significant, but that of the number of talented players employed in the top five leagues is not. The same applies when we use the number of talented players employed in the top three or four leagues.

[15] I cluster the standard errors

The majority of the regressions explain more than 76 percent of the variation in the observed league performance. In all variants, there was a significant and positive impact of the number of talented players on the league's performance. More precisely, if the number of migrants increased by 1 percent, the performance of the league increased by 0.63 percent. Futhermore, the Hausman test shows evidence of endogeneity. Consequently, IV regressions are preferable to OLS-FE. Also, the two necessary conditions for instrumentation are fulfilled in our regressions. Since Gragg-Donald cannot be strictly valid in the presence of heteroskedasticity, I used the "rule of thumb" of an F-stat above 10 to test for the presence of weak instruments. In all the first stage regressions, F-stats were always above 10 (see Staiger and Stock, 1997). In other words my instruments were not weak.

[INSERT TABLE 4]

Table 5 illustrates the results of the estimation of Equation (6b). It shows that the total weight (i.e. the total number of talented players weighted by the performance of the league of employment) is significant and positive. However the coefficient is very low (0.04). This result is presented in Column (1). In Column (2), the regression equation is altered by splitting the variable total weight into two different variables using the properties of the logarithmic function. In particular, this variable can be divided into the total number of players participating in the national team and the average quality of national teams' talented players. I also used 2SLS to solve the endogeneity problem in Equation (6b). The first two lags of $\ln L_{jt}$ were used as instruments to solve the endogeneity problem. The Hausman test shows evidence of endogeneity. Consequently, IV regression is preferable to OLS-FE. The two necessary conditions for instrumentation are thus fulfilled in the regressions. The elasticity in the IV regressions increases to 0.298.

As can be observed, both these variables are significant and positive. In all the regressions, I used all the available country data (European and non-European). Data on the performance of the national teams is available from 1994 onwards on the official FIFA website. Both regressions explain more than 75 percent of the variation in the observed national team performance.

[INSERT TABLE 5]

### 4.3 Training decisions

The Bosman rule has changed the migration patterns of football players, reducing migration hurdles and increasing the "exportability" of talents. The recent literature on brain drain and development has shown that skill-biased migration prospects affect the expected returns to schooling and incentives to acquire education (see Mountford, 1997; Stark et al., 1997; Beine et al., 2001; Stark et al., 1998; Vidal, 1998). When a country's pre-migration human capital stock is endogenous to the prospect of migration, the impact of brain drain on human capital becomes ambiguous: more people invest in education before migration; some of them will leave. A net brain gain can be obtained if the first effect dominates. Beine et al. (2008) have found evidence of a positive effect of skilled migration prospects on gross human-capital formation in a cross-section of 127 countries. They identified a net brain gain for a limited number of developing countries. However causality is hard to establish in a purely cross-sectional framework and they acknowledge that the positive association between brain drain and gross human-capital formation could be driven by external unobserved characteristics or reverse causality (although IV techniques are used in their paper).

My goal is to assess whether the Bosman liberalization shock induced more football players to train hard and become talented. A similar objective was pursued by Chand and Clemens (2008) who studied how an exogenous shock affected the educational investment of Fijians of origin with that of Fijians of Indian ancestry (people of South Asian origin). The shock is the 1987 military coup, which led to strong discrimination against Indo-Fijians. The coup sparked massive emigration among highly skilled Indo-Fijians, and led them to invest heavily in higher education in order to "clear the bar"raised by the Australian (and New Zealand) points system for immigration. While the political situation has stabilized since the mid-1990s, the Indian minority which remains in Fiji is now significantly more migratory and better educated than comparable ethnic Fijians, which was not the case prior to the military coup. Chand and Clemens (2008) interpret this as quasi-experimental evidence of a net brain gain. The advantage of working on football is that there is a single source of the effect of migration costs on training: the Bosman rule is an unexpected globalization shock directly affecting migration prospects. I will assess how it has impacted on training.

*Micro-foundations.*

Many growth models with human capital assume that human capital at period $t+1$ is a Cobb-Douglas function of human capital at time $t$ and investment in schooling at time $t$ (see Lucas, 1998, Azariadis and Drazen, 1990, etc.). In a similar vein, I consider that the production of talents is depicted by the following technology:

$$N_{it+1}^{T} = Z_{it}(N_{it}^{T})^{\sigma} exp(\xi_{it}) \tag{7}$$

where $Z_{it}$ is a scale factor characterizing the training technology of country $i$ at year $t$, $\sigma$ is a technological parameter capturing inertia in the number of talents (one period is 4 years and career lasts longer than 4 years), and $\xi_{it}$ is the proportion of young players (aged say 16 to 20) who train to become talented professional players at time $t+1$ (the exponential form is used for mathematical simplicity).

Becoming a professional football player requires training, but an extra effort $\ln E$ is required to become a talented professional football player. This level of effort is heterogenous across young players and uniformly distributed on $[0, 1]$. Players decide how much effort to put into training without knowing their future migration tastes, i.e the level of individual -specific random term $\epsilon_{jt+1}$, which is extreme value distributed in the ex-post utility function. However, they form expectations about each league-specific utility level ($u_{ijt+1}^{e}$).Based on de Palma and Kilani[16] (2007), we assume that the expected utility function of becoming talented player is given by:

[16]The two authors show that the conditional distribution of maximum utility (MU) coincide (with the uncondi-

$$u^e_{i,t+1} = \mu log \sum_j \left[ e^{lnv_j + ln(1-c_{jt})} \right] - lnE, \tag{8}$$

where $v_j = \theta lnw_{jt} + \delta lnq_{jt} + \rho lna_{jt}$ . The expected utility of a "regular" (non-talented) player is denoted by $v^e_{t+1} = lnv_{ot}$. Regular players are assumed to stay in their home countries. Players decide to train if $ln \sum_j (1 - c_{ij})v_j - lnE > lnv_o$. It becomes straightforward to show that the proportion of players training hard to become talented is given by

$$\xi_{it} = ln \frac{\sum_j [e^{lnv_j + ln(1-c_{ij})}]}{vo} \tag{9}$$

The proportion depends on the magnitude and distribution of bilateral migration costs; as bilateral migration costs decrease, the expected return to training increases and more players invest in training. The intensity of the effect increases with the expected bilateral probability of emigrating, as in the brain-gain literature (Beine et al.,2008;Docquier and Rapoport, 2012). I used the same assumption as they used to derive the empirical specification of the migration equation. This that $\hat{c}_{ijt}$ denotes the pre-Bosman level of migration costs and the Bosman ruling multiplies $(1 - c_{ijt})$ by a constant. As before, I can write $(1 - c_{ijt}) = (1 - \hat{c}_{ijt})exp(\lambda BOS_t)$ where $\lambda$ is a parameter and $BOS_t$ is a variable equal to zero in the pre-Bosman period and equal to one after the Bosman ruling. I obtain

$$\xi_{it} = ln \frac{\sum_j [e^{lnv_j + ln[(1-\hat{c}_{ij})exp(\lambda BOS_t)}]}{vo} \tag{10}$$

Substituting (4.4.7) into (4.4.6) and taking the logs yields

$$ln(N^T_{it+1}) = lnZ_{it} + \sigma lnN^T_{it} + \xi_{it} \tag{11}$$

$$= lnZ_{it} + \sigma lnN^T_{it} + ln \frac{\sum (1 - \hat{c}_{ijt})v_j}{vo} + \lambda BOS_{t+1} \tag{12}$$

where $ln \frac{\sum (1 - \hat{c}_{ijt})v_j}{vo}$ is the utility differential between a talented player moving to country $j$ and a regular player staying put in a pre-Bosman configuration.

*Identification strategy.* In the empirical model, I start from the micro-founded condition (Eq.(9)) to capture $\ln Z_{it} + \sum_j p_{ijt} du_{ijt}$. I assume $\lambda p_{i.t}$ can be proxied by regional dummies, and use a beta-convergence specification, i.e. subtract $\ln N^T_{it}$ from the right-hand and left-hand sides and write $\beta_0 = \sigma - 1$. This convergence regression model is in line with Beine et al.'s

tional one) for a given number of alternatives iff the distribution of error terms are Type I extreme value distributed. Also, they illustrate that the conditional expected MU concide for all the number of alternatives iff the error terms are Type I extreme value distributed. This result is derived by the conclusion of Anas and Feng (1988) who have shown that the conditional and unconditional expected MU concide for the multinomial logit model.

(2008) specification. The regression model is based on the log-change in the total number of country-specific talented players on its lagged value and a Bosman dummy. The Bosman effect is allowed to vary across regions (I distinguish Europe, Africa, Central America, South America and BAU). Unobserved heterogeneity is accounted for by adding a full set of time and country fixed effects:

$$\Delta \ln N_{it}^{T} = \alpha_i^N + \alpha_t^N + \beta_0 \ln N_{it-1}^{T} + \sum_r \varphi_r BOS_t d_{ir} + \epsilon_{it}^N$$

where $\Delta$ is a time difference operator ($\Delta x_t = x_t - x_{t-1}$ ), $\left(\alpha_i^N, \alpha_t^N\right)$ and is the vector of fixed effects, $\beta_0$ is the convergence parameter expected to lie between -1 and 0, $d_{ir}$ is a dummy equal to one if country $i$ belongs to region $r$ and 0 otherwise, and $\varphi_r$ is a coefficient capturing the incentive effect induced by the Bosman rule in region $r$.

As a benchmark, I estimated this equation by OLS-FE. The OLS regression model assumes that all covariates are independent of the error term. Although fixed effects control for possible misspecifications caused by unobserved characteristics, they do not account for other possible sources of endogeneity of the regressors. Endogeneity may arise because of the presence of the lagged term on the right side. The use of fixed effects and AR terms leads to inconsistency of estimates (Nickell,1981). It might be better to use two-stages least squares (2SLS) methods and instruments $\ln N_{i,t-1}$, with their lagged values. Furthermore, as argued by Caselli et al. (1996), empirical studies on convergence are plagued by the incorrect treatment of country fixed effects. It is usually assumed that these effects are uncorrelated with the other right-side variables. The fixed effects $\alpha_i^N$ is used as a determinant of the log-change number of talented players. By construction, it is also a determinant of the lagged term which is the regressor in the equation. Hence, the assumption of uncorrelated fixed effects is violated in panel dynamic regressions. Although fixed effects are used as control variables, it is desirable to correct for this collinearity bias. To solve this problem, I used Arellano and Bond's (1991) approach to developing a generalized method of moments (GMM) estimator using all the moment conditions. This method suggests eliminating country fixed effects using differences. The equation can be rewritten as

$$\Delta \ln N_{it}^{T} = \overline{\alpha}_t^N + (1+\beta_0)\Delta \ln N_{i,t-1} + \sum\nolimits_r \varphi_r \Delta BOS_t d_{ir} + \overline{\epsilon}_{it}^N \tag{13}$$

where $\overline{\alpha}_t^N \equiv \alpha_t^N - \alpha_{t-1}^N$ is the new time fixed effect, $\overline{\epsilon}_{it}^N \equiv \epsilon_{it}^N - \epsilon_{it-1}^N$ is the transformed error term, and $\Delta BOS_t{=}BOS_t - BOS_{t-1}$.

*Estimation results.* Table 6 reports the results of OLS, IV and Arellano-Bond (1991) regressions for the main variables of interest. Columns (1) and (2) show that the lagged level had a significant and negative impact on the rate of growth of the number of talented players. This is in line with Column (3), which shows that the absolute value of $1+\beta_0$ is lower than one. This implies that the training process is stable and predicts monotonic (conditional) convergence of the number of talented players in the long-run. For OLS regression, which is illustrated in Column (1), the speed of convergence is around 0.73. This means that it takes about 1.36 periods (i.e. 5.5 years) to reach the long-run equilibrium. Column (3) shows the Arellano-Bond results. The coefficient of the lagged term, $\Delta \ln N_{i,t-1}$, is around 0.41 and highly significant. This means that the speed of convergence is about 0.59 per period. It takes 1.66 periods (i.e. 6.6 years) to reach the country-specific steady state when the explanatory variables are kept constant.

In all the regressions, the growth rate of the number of talented players in Africa, Central and South America was positively and significantly affected by the Bosman rule. In these regions, the incentives to acquire skills have increased since the globalization shock. On the contrary, no such incentive effect is evident for European and Asian countries. And the incentive effect for the BAU group (Brazil, Argentina and USA) is positive but not significant. The elasticities are robust to the specification and estimation method. The GMM estimation in Column (3) gives the most precise estimated coefficients. As can be seen, the largest incentive effect was in Central American countries (elasticity of 1.68) followed by Africa and South America (both elasticities of 1.05).

As instruments, I use the lags in the number of talented players. The two necessary conditions for instrumentation are fulfilled by the regression in Column (2). Since the Cragg-Donald test is not strictly valid in the presence of heteroskedasticity, I use the "rule of thumb" of an F-stat above 10 to test for the presence of weak instruments. This condition is fulfilled, so the instruments can be considered strong. At the bottom of Column (3) the test of second-order autocorrelation in the residuals shows that there is no evidence of additional serial correlation. Furthermore, the Hansen J-test shows that the over-identification restrictions are not rejected.

From these results, I conclude that the "brain gain" mechanism also applies in football. In particular, I notice that there is a strong incentive for training in developing countries, except in countries with a long footballing tradition (such as Brazil and Argentina). By increasing the expected return to training, migration prospects foster the number of young players investing in training. There is evidence for a positive effect on skill acquisition for countries in Africa, Latin and Central America.

[INSERT TABLE 6]

### 4.4 Intertemporal equilibrium and two-country example

The model described above is dynamic because of the training equation. I can now define an intertemporal equilibrium for my "football economy":

**Definition 1.** *For a given initial distribution of talented players,* $\{N^T_{i1978}\}_{\forall i}$*, and set of exogenous variables,* $\{w_{it}, a_{it}, A_{it}, B_{it}\}_{\forall it}$ *and* $\{c_{ijt}\}_{\forall ijt}$*, an inter-temporal equilibrium is a set of year-specific vectors* $\{N^T_{it}, q_{it}, Q_{it}\}_{\forall it}$ *and matrices* $\{N_{ijt}\}_{\forall ijt}$ *satisfying migration optimality conditions (2), training optimality conditions (9), technological constraints (4) and (5), and aggregation constraints* $l_{it} \equiv \sum_j N_{jit}$ *and* $L_{it} \equiv \sum_j N_{ijt}q_{ijt}$*.*

In my model, static interactions between leagues' quality and migration can be the source of a multiplicity of equilibria because of strategic complementarities in migration decisions: emigration of talented players improves (resp. deteriorates) the quality of the league at destination (resp. at origin). This incites other talented players to emigrate, as demonstrated by de la Croix and Docquier (2012). It is worth noting that national teams' scores, albeit endogenous, have no impact on migration decision; they can be seen as a by-product of the interaction between migration decisions and leagues' performances.

In this section, I use a two-country static version of the model to characterize the equilibrium and investigate the case for multiplicity. I denote countries by $I$ and $E$: $E$ is the country of emigration (lower prestige) and $I$ is the country of immigration (greater prestige). The numbers of talented players are $N_E^T$ and $N_I^T$. Finally, $p \equiv N_{EI}/N_E^T$ gives the emigration probability of players from $E$; zero emigration from country $I$ is assumed. Using (4), the prestige of each league is given by:

$$\begin{aligned} q_I &= A_I[N_I^T + pN_E^T]^\gamma \\ q_E &= A_E[(1-p)N_E^T]^\gamma \end{aligned}$$

Combining these two equations, the inequality between leagues can be expressed as:

$$\Gamma_q(p) = \frac{q_E}{q_I} = \frac{A_E}{A_I}\left[\frac{(1-p)N_E^T}{N_I^T + pN_E^T}\right]^\gamma \tag{14}$$

Thus $\Gamma_q(0) = \frac{A_E}{A_I}\left[\frac{N_E^T}{N_I^T}\right]^\gamma > 0$ (assumed to be lower than one) and $\Gamma_q(1) = 0$. The partial derivative of $\Gamma_q$ with respect to $p$ is negative ($\frac{\partial \Gamma_q}{\partial p} < 0$). As $p$ increases, the relative quality of the emigration league decreases compared to the immigration league. Function $\Gamma_q(p)$ will be referred to as the *Inequality-Setting* equation.

Using (5), the prestige of the national team is given by:

$$\begin{aligned} Q_I &= B_I\left[N_I^T q_I\right]^\phi \\ Q_E &= B_E[N_E^T(1-p)q_E + N_E^T p q_I]^\phi \end{aligned}$$

Hence, the inequality between national teams is governed by:

$$\Gamma_Q(p) = \frac{Q_E}{Q_I} = \frac{B_E}{B_I}\left[\frac{N_E^T}{N_I^T}\right]^\phi \left[(1-p)\Gamma_q + p\right]^\phi . \tag{15}$$

where $\Gamma_Q(0) = \frac{B_E}{B_I}\left[\frac{N_E^T}{N_I^T}\Gamma_q(0)\right]^\phi$ and $\Gamma_Q(1) = \frac{B_E}{B_I}\left[\frac{N_E^T}{N_I^T}\right]^\phi$. Because $\Gamma_q(0) \in [0,1]$, we find $\Gamma_Q(0) < \Gamma_Q(1)$ . This means that as the probability of emigration increases, the inequality between the national teams falls. The derivative of $\Gamma_Q$ with respect to $p$ is given by $\frac{\partial \Gamma_Q}{\partial p} = \frac{B_E N_E^T}{B_I N_I^T}\left[1 - \Gamma_q\left(1 + \gamma\frac{N_I^T + N_E^T}{N_I^T + pN_E^T}\right)\right]$.

If $\Gamma_q\left(1 + \gamma\frac{N_I^T + N_E^T}{N_I^T + pN_E^T}\right)$ is lower than one, the inequality between national teams decreases with migration. This happens when $q_E$ and $\Gamma_q$ are low, i.e. when the relative quality of league $E$ is low.

**Proposition 1**. *Given the Eq. (12), there is a level of fixed characteristics of country of emigration,* $A_E$ *such that:*

1. *if* $A_E < \frac{A_I\left(\frac{N_I}{N_E}\right)^\gamma}{1+\gamma\frac{N_I+N_E}{N_I}}$ *then at any migration level, there is improvement in the level of national team of country of emigration.*

2. *if* $A_E > \frac{A_I\left(\frac{N_I}{N_E}\right)^{\gamma}}{1+\gamma\frac{N_I+N_E}{N_I}}$ *then after a certain level of migration rate,* $\tilde{p}$ *there is an improvement of the national team of country of emigration.*

*Proof.* See Appendix B.1 □

Proposition 1 shows that for some emigration countries only high levels of player drain lead to the improvement of their national teams. This happens when the league characteristics of emigration country are large enough. At low levels of player drain the league performance of the country deteriorates and players staying there have fewer skills. As a result, this negative effect dominates the positive effect of the player drain and the national team's performance falls.

Finally, I use (2) to express the optimal ratio of emigrants to stayers:

$$\frac{p}{1-p} = (1 - c_{EI}) \left(\frac{w_I}{w_E}\right)^{\theta} \left(\frac{q_I}{q_E}\right)^{\delta} \left(\frac{a_I}{a_E}\right)^{\rho}.$$

Inverting this function and denoting $\Gamma_m = \frac{q_E}{q_I}$, we obtain:

$$\Gamma_m(p) = V_{EI} \left(\frac{1-p}{p}\right)^{1/\delta}, \tag{16}$$

where $V_{EI} \equiv (1 - c_{EI})^{1/\delta} \left(\frac{w_I}{w_E}\right)^{\theta/\delta} \left(\frac{a_I}{a_E}\right)^{\rho/\delta}$ is a decreasing function of migration costs, $c_{EI}$. We have $\Gamma_m(0) = \infty$ and $\Gamma_m(1) = 0$. Function $\Gamma_m(p)$ will be referred to below as the *Migration-Setting* equation.

An equilibrium is an intersection between the *Inequality-Setting* curve $\Gamma_q(p)$ (which can be interpreted as the inverted-demand function for migrants) and the *Migration-Setting* curve $\Gamma_m(p)$ (which can be interpreted as the inverted-supply function for migrants)

**Proposition 2** *Given Equations (12) and (13), there are two intersections between* $\Gamma_q(p)$ *and* $\Gamma_m(p)$. *There is a trivial equilibrium at* $p = 1$ *(such that* $\Gamma_m(1) = \Gamma_q(1) = 0$*) and an interior equilibrium at* $p^* \in [0, 1]$ *(such that* $\Gamma_m(p^*) = \Gamma_q(p^*)$*). The interior equilibrium is a trembling-hand perfection equilibrium and the trivial equilibrium is unstable.*

*Proof.* See Appendix B.2 □

Figure 6 plots the inequality-setting against the migration-setting curve. It can be seen that there are two intersections between these two curves. The first is the interior solution ($\Gamma_q^*$,$p^*$) and the second is a corner solution when $p$=1. The interior equilibrium is a trembling-hand perfect Nash equilibrium. The trembling-hand perfection criterion selects Nash equilibria which are robust to the possibility that some players may make a small mistake. To demonstrate this, start from the interior solution and consider that players from the emigration country believe that the prestige of their league is lower than the equilibrium value. They decide to deviate from point ($\Gamma_q^*$,$p^*$). More players emigrate. Then, given the slopes of the curves, they realize that the prestige of their initial league is higher than they anticipated, implying that deviating from the initial solution was a bad decision. A similar reasoning applies to players deviating to the left of the interior solution (i.e. wanting to emigrate less).

For these reasons, the trivial equilibrium is not a trembling-hand perfect. The trivial equilibrium means that all the players of emigration country, $E$ want to move to immigration country $I$. Remember that the error term in the migration equation is considered as to be iid extreme-value distributed. So, the migration tastes of player lies between plus and minus infinity. What matter is the thickness of the tails of the distribution. If we assume iid extreme-value distributed error, the tails are thick. As a result, there will always be a positive proportion of talented players who want to stay in their country.

# 5 Impact of Bosman rule

In this section, I use the calibrated model to simulate the counterfactual trajectory of rankings and migration flows if the Bosman rule had never been implemented, and compare it to the observed trajectory. I analyze the effects of the Bosman rule on efficiency, inequality and the ranking of European leagues and national teams. This section is divided into five subsections. Section 5.1 highlights the mechanisms through which the Bosman rule affects the football market in the two-country stylized model. In Section 5.2, I explain the parameters and the algorithm used to simulate the complete model with large numbers of leagues and national teams. Section 5.3 presents the effects of the Bosman rule on European leagues. Section 5.4 discusses its effects on national teams. Finally, the results of robustness checks are discussed in Section 5.5.

## 5.1 The two-country example

In this section, I analyze the theoretical effects of a liberalization shock on inequality between the leagues and national teams in the two-country setting. Figure 7 illustrates the two effects of the Bosman rule: a change in migration patterns and in incentives to train more in poorer regions.

By reducing migration costs, the Bosman rule shifts the migration-setting curve to the left (black dotted curve in Figure 7). Other things being equal, this leads to an increase in inequality between the two countries and an increase in emigration flows from $E$ to $I$: the equilibrium moves from ($\Gamma_q^1$,$p_1$) to ($\Gamma_q^2$, $p_2$). the Bosman rule thus reinforces agglomeration forces and makes the top leagues better and the bottom leagues weaker. This is the only mechanism at work if the number of talented players is considered as exogenous (or unaffected by the Bosman rule).

However, increasing migration prospects reinforces incentives to train in poorer regions (in my model, I only consider one country of emigration). So soccer players from country $E$ have an incentive to train harder. Consequently, the number of talented players from country $E$ increases and the inequality-setting curve also shifts to the left (grey dotted curve on Figure 7). When such an incentive effect operates, the new equilibrium becomes ($\Gamma_q^3$,$p_3$), rather than ($\Gamma_q^2$,$p_2$), and the global change in leagues' ranking and emigration rates are ambiguous. Figure

7 shows the situation where ($\Gamma_q^3$,$p_3$) is between ($\Gamma_q^1$,$p_1$) and ($\Gamma_q^2$,$p_2$), but another configuration with lower inequality and fewer migrants is possible. What is not ambiguous is the effect on national teams. When incentives effects operate, inequality between national teams falls.

Transposing the two country-model to an $n$-country model makes the analysis more complex for the following reasons: (i) the "brain gain" varies across countries; as demonstrated in Section 3, the Bosman rule did not spur training in the countries of Europe, Asia, Argentina, Brazil and the USA and also the magnitude of the incentive effect varied across the other continents; (ii) most countries are both sending emigrants and receiving immigrants; this is another reason why the effect of the Bosman rule is ambiguous. To identify winners and losers, a numerical analysis is required. I discuss the results of this analysis in the following subsections.

[Insert Figure 7]

### 5.2 Parameters and algorithm

Before delving into the results, I describe the parameters that I used to calibrate my model, and the algorithm used to simulate the $n$-country model.

*Calibration*. The main coefficients of interest for the migration equation are the elasticity of migration to prestige, $\delta$, and the effect of the Bosman dummy, $\lambda$. The estimates for $\delta$ range from 0.2 to 0.35, and that for $\lambda$ from 0.37 to 0.81. I used the average value 0.3 for $\delta$ and a value of 0.5 for $\lambda$. For the leagues' and national teams' production function, I used a value of 0.63 for $\gamma$, the elasticity of leagues' score to the number of talented players (Column 5 in Table 3), and a value of 0.298 for $\phi$, the elasticity of national teams' score to the quantity of skills (Column 3 in Table 4). For the training equation, I took the estimated coefficients from Column 3 in Table 5. In particular, the $1 + \beta_0$ for the lagged number of talented players was set to 0.41 and the region-specific coefficients for the incentive effect, $\varphi$, at 1.05 for Africa, 1.05 for South America, 1.68 for Central America and zero for other regions.

*Simulation Algorithm*. The structure of the algorithm is the following: First, the trajectory of training was simulated as if the Bosman rule had never been implemented. Then the equations for the interdependencies between migration decisions and leagues' score for the years 1998-2010 were solved. To do this I built a Gauss-Seidel "shooting" algorithm: each iteration $I$ started with a set of 309 guesses, $\tilde{q}_{it}^I \; \forall \; i,t$, for the leagues' scores. I plugged these guesses into the migration equation to simulate the counterfactual allocation of talented players across countries. I then used aggregation constraints to obtain the inputs to the production functions and compute the solution for leagues' scores, $\bar{q}_{ij,t}^I$. I iterated these until the solution coincided with the guesses: the next iteration $I+1$ started with a new set of guesses, $\tilde{q}_{it}^{I+1} = \eta\tilde{q}_{it}^I + (1-\eta)\bar{q}_{it}^I$, where $1 - \eta$ is the correction factor. I used $\eta$= 0.7. The algorithm stops when the sum of the errors (in absolute values) falls below a convergence threshold: $\sum_{i,t} |\tilde{q}_{it}^I - \bar{q}_{it}^I| < \epsilon$.

### 5.3 Effect on European leagues

In this section, I analyze the effects of the Bosman rule on the inequality, efficiency, scores and rankings of the European leagues, and compare the trajectory with those obtained from the simulation of the situation in which the Bosman rule had never been applied.

*Efficiency and Inequality.* First, I investigated the overall effect of the Bosman rule on the efficiency and inequality indices computed for the 23 European leagues. Figure 1 showed that the Gini and Theil indices increased around 25 percent and 33 percent respectively from 1998 to 2010. Figure 8 presents the effect of the Bosman rule on inequality (Gini index) and efficiency (average score of European leagues) for the years 1994-2010. I report the difference between the observed and the "no-Bosman" trajectories, as percentages of the no-Bosman values between 1994 to 2010.

[Insert Figure 8].

It shows that the Bosman rule has led to a sharp short-run increase in the Gini index (+24.2 percent in 1998) and a slightly larger long-run effect. In 2010, the Gini index was 32 percent larger than in the no-Bosman case. I conclude that the Bosman rule explains the whole of the rise in inequality observed in European football over the last 15 years. It is also apparent that the Bosman rule has increased efficiency in European football. The effect is progressive. The average score of European leagues increased by 5 percent in 1998 and by 12 percent in 2010. Also, the efficiency in terms of total number of talented players increased by 24.2 percent in 1998 and by 36 percent in 2010. This globalization shock led to improvement in the quality of European football and increased disparities between major and minor leagues.

*Leagues' Score*. These patterns become clearer when looking at the effect on each league. Figures 9 and 10 plot the score of the leagues observed in 1998 and 2010, respectively, and counterfactual scores if the Bosman ruling had never happened. I also present the average score of the Top 5, Bottom 5 and remaining leagues (black circles) and the overall average (white squares). In the majority of cases, the no-Bosman score is below the $45^o$ line, indicating that most leagues improved after the Bosman rule. The exceptions were the bottom leagues. The largest gains are observed in the leading leagues, where scores increased by 22 percent after the Bosman ruling. However there was a drop in the score of the middle-quality leagues. For instance, Denmark, Sweden, Norway and Romania (which send many emigrants abroad) experienced a loss of more than 30 percent. While teams such as Malme or Gotenborg from Sweden, Steaua Bucharest from Romania, or Rosenborg from Norway reached the quarter-finals of the Champions' leagues during the 1980s and at the beginning of the 1990s, they now rarely qualify for the final round of this competition. Among the bottom leagues, Hungary, Ireland and Israel saw their score decrease by 13 percent, while the average for the bottom five leagues only fell by 2 percent.

[Insert Figures 9 and 10].

Similar results emerge from the analysis of 2010 data. The top five leagues increased their score by 25 percent on average. In particular, the English, Spanish and French leagues experienced a gain of 30 percent because of the Bosman rule. The bottom leagues experienced a 14 percent loss in the long-run, compared to 2 percent in the short-run. This explains the rise in inequality: agglomeration forces became stronger after the Bosman ruling and left all the gains for top countries. This is reflected by the presence of new teams in the quarter-finals such Valencia and Coruna for Spain, Manchester United, Arsenal and Chelsea from England, or Schalke 04 and Leverkusen from Germany. Teams like Barcelona and Manchester are more often in the final of Champions League and have won the Champions' league trophy more than twice since 1996. Since the gain for the top leagues is larger than the loss for the bottom five, I conclude that there is a lot of heterogeneity across countries. I have defined a concave production function (league technology) and I expect that the loss for bottom leagues will be larger than the gain for high-rank countries. My efficiency results are due to the fact that top leagues have higher productivity (captured by the fixed effects in my estimates). At the end, I notice that there is a slight decrease in the score of leagues in the middle of the distribution (see Figure 10).

*Ranking of European Leagues*. I now describe how the Bosman rule affected the ranking of the 23 UEFA leagues. In Figures 11 and 12, the X-axis gives the ranking of European leagues with the Bosman rule (observed data) and the Y-axis gives the ranking in the no-Bosman counterfactual scenario. Figure 12 shows the short-run impact in 1998. Neither in the observed nor in the counterfactual data, were the UEFA rankings of the top three leagues (Italy, Germany, Spain) affected. However, the other two countries of the top five, France and England, improved and lost their position in the UEFA ranking respectively. In particular, France is now 4th and would have been in the 7th position without the Bosman rule. Drastic changes are observed for leagues between the sixth and fifteenth positions in the UEFA ranking. Eight countries improved (including Greece, Portugal, the Netherlands and Turkey) and six countries fell (including Norway, Denmark, Sweden, Romania) after the Bosman ruling. This result is in line with the analysis of the scores. Romania, Norway and Denmark lost three, five and six positions, respectively. On the contrary, countries like Belgium, Turkey and Greece rose two, three and four positions, respectively.

Figure 12 illustrates the long-run impact in 2010. In particular, I observe that more countries are above the $45^o$ line than below it (seven countries are above and 5 below the line). In 2010, free mobility had strong effects on countries located between the 10th and the 23rd positions. In particular, Greece, Turkey, Portugal and Switzerland all gained four positions. Scandinavian countries declined and lost more than three ranks each. Again, France is now in the 5th position instead of the 7th if the Bosman rule had never been implemented. Romania lost the opportunity to join the top five and was instead found in the 8th position. In general, Greece, France, Portugal, Turkey and Belgium can be identified as "winners". Examples supporting this result are that Galatasary won the UEFA cup in 2000 for first time in its history. Panathinaikos and Olympiakos were among the best 16 teams of the Champions' league several times after 1996. Porto won the UEFA cup twice and the Champions' league once in 2004. However, countries like Austria, Denmark, Bulgaria, Sweden and Hungary can be identified as "losers".

[Insert Figures 11 and 12].

### 5.4 Effect on national teams

In this section, I present the effects of the Bosman rule on the inequality, efficiency, scores and rankings of national teams.

*Efficiency and Inequality*. The results for efficiency (average score of national teams) and inequality (Gini index) are presented in Figure 13, which shows the effect of the Bosman ruling for the years 1994-2010. The difference between the observed and the no-Bosman trajectories, are given as percentages of the no-Bosman values between 1994 to 2010. Like the leagues, I observe that the efficiency of national teams increased after the Bosman ruling. The rise was sharp in 1998 (+14 percent) and then slower until 2010 (+20 percent over the total period).

[Insert Figure 13].

Contrary to the results obtained for the leagues, the Bosman rule reduced the inequalities between national teams. In 1998, there was a dramatic drop in the Gini index of around 41 percent. The largest effect was observed in 2002. This is reflected in the results of the 2002 World Cup. In the last round of 16, almost half of the teams were non-European: South Korea, Japan, Senegal, Paraguay, Mexico. This is also true for the quarter-final and semi-final stages. It is the first time this phenomenon has appeared in the history of the World Cup. To a lesser extent, non-European countries performed well during the 2010 World Cup in South Africa. *National Teams' Scores.* After analyzing the average impact on efficiency and inequality, I will now examine the effect of the Bosman rule on the scores of each national team. Figure 14 and 15 give the national teams' scores in the observed and counterfactual scenarios for 1998 and 2010, respectively. These figures also present the average score of the top five, bottom five and remaining teams (black circles) and the general average scores (white squares). The low and middle ranked FIFA national teams benefitted from the Bosman rule in the short-run (1998) and in the long-run (2010). For 1998, there was an increase of 12 percent in the average score of low and middle countries. On the contrary, the top five countries only improved by 3 percent. Similarly in 2010, the scores of low and middle-ranking national teams improved by about 9 and 6 percent, respectively. Top five national teams only improved their scores by 4 percent. This decrease in inequality is reflected, for instance, by the fact that Algeria succeeded in raising its score by 26 percent in 1998, and 18 percent in 2010. Another remarkable example is the national team from Chile, which improved its score by 45 percent in 1998, and 27 percent in 2010. Cameroon and Nigeria are another two national teams which performed very well in the 1990 World Cup; they raised their scores by 16 percent and 17 percent in the long-run, respectively.

[Insert Figure 14 and 15].

*National Teams' Ranking*. Figures 16 and 17 show the effect of the Bosman rule on the FIFA ranking of all the national teams in 1998 and in 2010. Like the figures for European leagues' ranking, I compared the observed FIFA-ranking of national teams (X-axis) with the no-Bosman counterfactual value (Y-axis). European national teams between the 5th and 10th positions benefitted from the Bosman ruling. A large number of non-European countries in the middle of FIFA ranking benefitted too.

In 1998, the FIFA rankings of European countries such as Greece, Switzerland, Belgium and Turkey deteriorated. For instance, Switzerland now appears to be in the 53th position instead of the 41st. Belgium fell by 7 positions: it is now 29th, but would be 22nd if the Bosman rule had never been implemented. In many cases, I observe the change in ranking of national teams is negatively correlated with the change in the ranking of their league.

There are, however, exceptions. Strong European national teams like France, Spain, Italy and the Netherlands improved their position by at least two places after the Bosman rule. Algeria, Chile, Colombia, Egypt, Morocco, Paraguay, Tunisia and Uruguay also improved in the global rankings. For instance, Algeria increased its ranking by 7 positions (it is now in 48th instead of 55th place). Colombia is 18th instead of 46th.

By 2010, the majority of non-European countries had moved up the ranking. On the other hand, national teams from Europe fell in the FIFA ranking because of the Bosman rule. For instance, Austria and Belgium are now in the 51st and 48th positions instead of the 38th and 35th, respectively. The performances of Sweden, Romania and Bulgaria deteriorated massively, losing more than 15 positions. The fact that the leagues of these countries deteriorated dominates the effect of skills accumulated abroad by talented emigrant players. This result is in line with Proposition 1.

Among the non-European national teams, the main "winners" were Uruguay, Paraguay and Chile. The Bosman rule and the increased incentives to train led them to gain at least 25 positions. African countries like Algeria, Cameroon and Egypt also succeeded in reaching the top 40 countries in the world after the Bosman ruling. Finally, Brazil would be second (rather than third) in the FIFA ranking if the Bosman rule had never been implemented.

[Insert Figure 16 and 17].

### 5.5 Robustness Analysis

For robustness check my result in my numerical experiment, I consider one alternative model, the benchmark model with an exogenous number of players which I compare with the benchmark model. To examine the results of my simulations, I define two scenarios. The two scenarios are the following:

- Scenario 1: Benchmark Model
- Scenario 2: Benchmark Model with Exogenous number of players, $\varphi$=0 of Equ.(7).

*Efficiency and Inequality of European Leagues.* Figures 18 and 19 present the efficiency and inequality of European Leagues from 1994 to 2010 in the two scenarios defined above. In Figure 19, I notice that inequality and efficiency increases through the years in all the scenarios. The efficiency increases less in Scenario 2 than Scenario 1. Consequently, I infer that the greater production of talents in poor countries and their emigration to Europe are key factors explaining the rise in efficiency/quality in the European Football.

As it concerns the inequality between in the European Leagues, Figure 19 shows that the inequality increases in a similar way in all scenarios.This result shows that the incentives mechanisms play minor role in explaining the rising inequality.

[Insert Figures 18 and 19]

*Ranking of European Leagues.* There are not many differences in UEFA ranking across the two different models in 1998 and 2010. In particular, I notice that England falls and France and Netherlands raise in the UEFA ranking in Scenario 1 (see Figure 11 ). On the other hand, Scenario 2 shows that England improves its position because of the Bosman rule and France and Netherlands remain in the same position as they would have without the globalisation shock (See Figure 20). I infer that France benefits from the training and production of new players in non-European countries,probably because it has many former colonies in Africa and it is the main destination for many talented players from these countries. Also, the two scenarios exhibit minor differences in 2010. France improved in the ranking in Scenario 1 but it remained in the same position whether the Bosman rule happened or not. Ireland also fell in the ranking in Scenario 1, but it remained in the same position in the two trajectories under Scenario 2.

[Insert Figure 20.]

*Efficiency and Inequality of National Teams.* Figures 21 and 22 illustrate the efficiency and inequality across national teams from 1994 to 2010. As for the analysis of European leagues, I compare the efficiency and inequality between the two different scenarios.

The inequality fell at a lower pace in Scenario 2 than in Scenario 1(See Figure 21). I conclude at this point that the incentive to train in poor regions and the migration of these talented players in high quality leagues is the main reason of this sharp decrease of inequality across national teams.

Notice that in all the scenarios shown that there is an increase in efficiency after the introduction the Bosman rule. Taken together, Figures 21 and 22 show that my results and conclusions for inequality and efficiency in the benchmark model are robust.

[Insert Figures 21 and 22].

*National teams' Ranking.*Scenario 2 shows that there are not many differences between the positions of national teams in the trajectory if the Bosman had never happened and in the trajectory that includes the Bosman rule.

## 6 Conclusions

Complex interactions between high-skilled migration and aggregate performance govern the dynamics of growth and inequality across nations. Due to lack of data, these interdependencies have been insufficiently studied in the economics literature. This paper takes advantage of the availability of rich panel data on the mobility of talented football players, leagues' and national teams' performance to quantify the effect of a liberalization shock, the 1995 Bosman rule, on global efficiency and inequality in football. I build a micro-founded model endogenizing migration decisions and inequality, estimate its structural parameters, and compare actual data with a counterfactual no-Bosman trajectory. Transposing the results of this paper to global economy, my analysis reveals that if developed countries relax restrictions on high-skilled immigration, we may expect (i) greater inequality in development level (as measured by GDP per capita) , (ii) lower inequality in income per natural, and (iii) greater efficiency at the world level. Also, my results show that incentives mechanisms are the major source of efficiency gains. However it plays minor role in explaining the rising inequality.

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# Appendices

## A Proof

### A.1 Proposition 1

I derive the Equation (9) and I obtain:

$$\frac{\partial \Gamma_Q}{\partial p} = \frac{B_E N_E^T}{B_I N_I^T}\phi\left[(1-p)\Gamma_q + p\right]^{\phi-1}\left[1 - \Gamma_q\left(1+\gamma\frac{N_I^T+N_E^T}{N_I^T+pN_E^T}\right)\right]$$

I examine this derivative at two points, when $p = 0$ and $p = 1$.Then I can infer more conclusions about the shape of the curve $\Gamma_Q$.

For the point $p = 0$:

$$lim_{p->0}\frac{\partial \Gamma_Q}{\partial p} = \phi\left[\frac{A_E}{A_I}\frac{N_E^T}{N_I^T}\right]\left[1 - \frac{A_E}{A_I}\left(\frac{N_E^T}{N_I^T}\right)^{\gamma}\left(1+\gamma\frac{N_I^T+N_E^T}{N_I^T}\right)\right]$$

and for the point $p = 1$.

$$lim_{p->1}\frac{\partial \Gamma_Q}{\partial p} = \phi > 0$$

To infer more conclusions for the shape of the curve, I need to investigate further the derivative of $\Gamma_Q$ at point 0.

In particular, $\phi\left[\frac{A_E}{A_I}\frac{N_E^T}{N_I^T}\right]$ is greater than zero. Consequently, my analysis focus on the other component of the derivative. Then, I can separate two cases:

- if $1 - \frac{A_E}{A_I}\left(\frac{N_E^T}{N_I^T}\right)^{\gamma}\left(1+\gamma\frac{N_I^T+N_E^T}{N_I^T}\right) < 0$ then $A_E > \frac{A_I\left(\frac{N_I}{N_E}\right)^{\gamma}}{1+\gamma\frac{N_I+N_E}{N_I}}$ . When this condition exists then the $\Gamma_Q$ is decreasing with $p$ at the point $p = 0$ and it is increasing at point $p = 1$. Consequently, the large brain drain is beneficial for the improvement of the national team of country of emigration.

- if $1 - \frac{A_E}{A_I}\left(\frac{N_E^T}{N_I^T}\right)^{\gamma}\left(1+\gamma\frac{N_I^T+N_E^T}{N_I^T}\right) > 0$ then the function is increasing in the interval $[0, 1]$ . As a result, the brain drain is beneficial for the national team of country of emigration.

### A.2 Proposition 2

This proof has three steps:

1. I prove that both functions (migration and league) have one intersection in point $p$=1.

2. I prove that both of them they are decreasing functions.

3. The limit of migration function tending to zero is greater than the limit of league function tending to zero.

So we have to prove the above step by step.

1. Plugging into Equation (17) and (22) $p$=1 then it is easy to find that for both equation we obtain $P_q = 0$.
2. I analyse the derivatives of the migration and league equation with respect to $p$.
   - League equation

$$\frac{\partial P_q}{\partial_p} = \frac{\alpha_e}{\alpha_i}\left[\frac{(1-p)n_e}{n_i + pn_e}\right]^{\alpha-1} \alpha\frac{-n_e n_i - pn_e - (1-p)n_e^2}{(n_i + pn_e)^2} < 0. \quad \text{(A. 1)}$$

   - Migration Equation

$$\frac{\partial P_q}{\partial_p} = \frac{1}{\delta}(-\frac{1}{p^2})(\frac{1-p}{p})^{\frac{1}{\delta}-1}(\frac{w_i}{w_e})^{\theta}\frac{1}{v_o}\frac{B_e}{B_i} < 0 \quad \text{(A. 2)}$$

3. I investigate the limits for both of equations as their functions tend to zero.
   - Migration equation

$$lim_{p->0}(\frac{1-p}{p})^{\frac{1}{\delta}}(\frac{w_i}{w_e})^{\theta}\frac{1}{v_o}\frac{B_e}{B_i} = \infty \quad \text{(A. 3)}$$

   - League equation

$$lim_{p->0}$$
$$\frac{\alpha_e}{\alpha_i}\left[\frac{(1-p)n_e}{n_i + pn_e}\right]^{\alpha} = \frac{\alpha_e}{\alpha_i}\left[\frac{n_e}{n_i}\right]^{\alpha} \quad \text{(A. 4)}$$

From the three steps, I can conclude that since the two equation meet at $p$=1, both are decreasing and the migration equation is above the league equation for values of $p$ close to zero then there is a point that both of them will intersect in the interval $p \in (0, 1)$.

# B Tables

Table 1.a: Intra-distribution mobility matrix 1982-1994 (21 UEFA countries)

| | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 |
|---|---|---|---|---|---|
| Group 1 | Prob=0.50<br>BEL (-4, 3)<br>GER (17, 14) | Prob=0.50<br>NET (-1, 3)<br>UK (16, 9) | Prob=0.00 | Prob=0.00 | Prob=0.00 |
| Group 2 | Prob=0.50<br>FRA (5, 8)<br>ITA (8, 9) | Prob=0.25<br>SPA (18, 3) | Prob=0.00 | Prob=0.00 | Prob=0.25<br>HUN (-3, 0) |
| Group 3 | Prob=0.00 | Prob=0.25<br>POR (-1, 9) | Prob=0.50<br>AUS (-1, 0)<br>SCO (8, 0) | Prob=0.25<br>SWI (-5, -5) | Prob=0.00 |
| Group 4 | Prob=0.00 | Prob=0.00 | Prob=0.25<br>GRE (0, 4) | Prob=0.50<br>SWE (-4, 1)<br>ROM (-9, 1) | Prob=0.25<br>BUL (-10, 0) |
| Group 5 | Prob=0.00 | Prob=0.00 | Prob=0.25<br>TUR (-10, 4) | Prob=0.25<br>DEN (5, 0) | Prob=0.50<br>ISR (-1, 0)<br>IRE (-6, 0)<br>NOR (-8, 1) |

Table 1.b: Intra-distribution mobility matrix 1994-2010 (21 UEFA countries)

| | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 |
|---|---|---|---|---|---|
| Group 1 | Prob=0.50<br>GER (32, 16)<br>ITA (12, 20) | Prob=0.25<br>FRA (-1, 34) | Prob=0.25<br>BEL (-8, 6) | Prob=0.00 | Prob=0.00 |
| Group 2 | Prob=0.50<br>SPA (-1, 22)<br>UK (52, 58) | Prob=0.50<br>POR (-16, -1)<br>NET (18, 8) | Prob=0.00 | Prob=0.00 | Prob=0.00 |
| Group 3 | Prob=0.00 | Prob=0.00 | Prob=0.50<br>GRE (2, 5)<br>TUR (7, 14) | Prob=0.50<br>AUS (-12,0)<br>SCO (-6, 6) | Prob=0.00 |
| Group 4 | Prob=0.00 | Prob=0.25<br>ROM (6, -1) | Prob=0.25<br>SWI (5, 2) | Prob=0.25<br>DEN (-4, 3) | Prob=0.25<br>SWE (-1, 0) |
| Group 5 | Prob=0.00 | Prob=0.00 | Prob=0.00 | Prob=0.25<br>BUL (-3, 0) | Prob=0.75<br>HUN (-9,0)<br>IRE (0, 0)<br>ISR (-6, 0)<br>NOR (5, 3) |

Note: Tables 1.a and 1.b include 21 European leagues. Prob. means the probability of moving from one group to the other. Each country has two values in the paratheses. The first value is the net emigration and the second the net immigration.

Table 2: Determinants of migration in soccer

| | Dependent Variable: Migrants/stayers ratio(logs) | | | | | |
|---|---|---|---|---|---|---|
| | EU x EU sample | | | | | All to EU sample |
| Model : | (1) | (2) | (3) | (4) | (5) | (6) |
| Colonial links | $0.33^{a}$ | $0.66^{a}$ | 0.51 | $0.62^{a}$ | $0.69^{a}$ | $0.54^{a}$ |
| | (0.03) | (0.2) | (0.436) | (0.30) | (0.315) | (0.673) |
| Linguistic proximity | -0.012 | 0.2 | 0.11 | 0.216 | 0.169 | 0.14 |
| | (0.05) | (0.12) | (0.24) | (0.19) | (0.1) | (0.166) |
| Leagues' score ratio(logs) | $0.1^{c}$ | $0.2^{c}$ | $0.35^{c}$ | $0.22^{c}$ | $0.3^{a}$ | $0.35^{b}$ |
| | (0.03) | (0.1) | (0.18) | (0.1) | (0.140) | (0.14) |
| Distance (logs) | $-0.29^{a}$ | $-2.2^{a}$ | $-2.15^{a}$ | $-2.24^{a}$ | $-2.2^{a}$ | $-3.9^{a}$ |
| | (0.015) | (0.08) | (0.20) | (0.08) | (0.13) | (0.13) |
| GDP ratio (logs) | -0.07 | $0.6^{a}$ | $1.39^{c}$ | $0.33^{c}$ | $0.69^{c}$ | $0.3^{b}$ |
| | (0.055) | (0.266) | (0.66) | (0.17) | (0.316) | (0.15) |
| Bosman dummy | $0.12^{a}$ | $0.64^{a}$ | $0.81^{a}$ | $0.42^{a}$ | $0.37^{c}$ | $0.54^{a}$ |
| | (0.06) | (0.079 | (0.17) | (0.15) | (0.16) | (0.26) |
| Constant | $1.95^{a}$ | $10.6^{a}$ | $10.14^{a}$ | $10.63^{a}$ | $9.95^{a}$ | $17.4^{a}$ |
| | (0.09) | (0.599) | (1.07) | (0.707) | (1.11) | (5.29) |
| Destination Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Origin Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Year Fixed Effects | No | No | No | No | No | No |
| Bspline | No | No | No | Yes | Yes | Yes |
| Years | 1978-2010 | 1978-2010 | 1994-1998 | 1978-2010 | 1978-2010 | 1978-2010 |
| Method | OLS | Poisson | Poisson | Poisson | IV-Poisson | Poisson |
| N | 643 | 3487 | 841 | 3487 | 3005 | 7775 |
| $R^2$ | 0.48 | 0.6 | 0.6 | 0.62 | 0.58 | 0.70 |
| Wald test of exogeneity | | | | | 0.75 | |
| P-value of Wald test | | | | | 0.38 | |

Note: Robust Standard errors in parentheses $^{a}$, $^{b}$ and $^{c}$ denoting significance at the 1%, 5% and 10% levels respectively.
For IV-poisson regressions, we use the second lagged variable of the ratio of league score

Table 2: Falsifications tests

| | Dependent Variable: Migrants/stayers ratio(logs) | | | |
|---|---|---|---|---|
| | EU x EU sample | | | |
| Model : | (1) | (2) | (3) | (4) |
| Colonial links | $0.62^a$ | $0.63^a$ | $0.62^a$ | $0.62^a$ |
| | (0.30) | (0.3) | (0.3) | (0.3) |
| Linguistic proximity | 0.215 | $0.216^c$ | 0.215 | $0.216^c$ |
| | (0.19) | (0.11) | (0.19) | (0.19) |
| Leagues' score ratio(logs) | $0.25^a$ | $0.22^a$ | $0.23^a$ | $0.21^c$ |
| | (0.10) | (0.10) | (0.09) | (0.102) |
| Distance (logs) | $-2.24^a$ | $-2.24^a$ | $-2.24^a$ | $-2.24^a$ |
| | (0.127) | (0.13) | (0.13) | (0.085) |
| GDP ratio (logs) | $0.29^c$ | $0.34^c$ | $0.32^b$ | $0.33^c$ |
| | (0.15) | (0.17) | (0.17) | (0.17) |
| Bosman dummy | -0.48 | -0.248 | 0.11 | $0.42^a$ |
| | (0.30) | (0.19) | (0.1) | (0.150) |
| Constant | $10.8^a$ | $10.8^a$ | $10.65^a$ | $10.63^a$ |
| | (0.989) | (0.99) | (1.1) | (0.707) |
| Destination Fixed Effects | Yes | Yes | Yes | Yes |
| Origin Fixed Effects | Yes | Yes | Yes | Yes |
| Bspline | Yes | Yes | Yes | Yes |
| Years of Bosman dummy | 1986-2010 | 1990-2010 | 1994-2010 | 1998-2010 |
| N | 3487 | 3487 | 3487 | 3487 |
| $R^2$ | 0.59 | 0.59 | 0.59 | 0.62 |

Note: Robust Standard errors in parentheses $^a$, $^b$ and $^c$ denoting significance at the 1%, 5% and 10% levels respectively. For IV-poisson regressions, we use the second lagged variable of the ratio of league score

Table 4: Estimation of the production function of leagues

| Model : | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | $\log$ score of league | $\log$ league's score | $\log$ league's score | $\log$ league's score | $\log$ league's score |
| number of talents(logs) | $0.135^{b}$ | $0.111^{a}$ | $0.632^{a}$ | $0.597^{a}$ | $0.623^{a}$ |
| | (0.041) | (0.05) | (0.251) | (0.17244) | (0.153) |
| Constant | -0.252 | -0.3248 | $1.32^{a}$ | $1.28^{a}$ | $1.4^{a}$ |
| | (0.239) | (0.1708) | (0.7) | (0.650) | (0.71) |
| Country fixed Effects | Yes | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes |
| Observations | 174 | 253 | 347 | 166 | 219 |
| R-square | 0.77 | 0.85 | 0.79 | 0.76 | 0.80 |
| Method | OLS | OLS | IV | IV | IV |
| F-test of first regression | | | 13.65 | 14.39 | 13.07 |
| Cragg-Donald test | | | 14 | 13.4 | 11.72 |
| Hausman test | | | 5.97 | 14.61 | 12.44 |
| p-value | | | 0.0152 | 0.0002 | 0.0006 |
| Hansen test | | | 0.3 | 0.29 | 0.42 |

Robust Standard errors in parentheses $^{a}$, $^{b}$ and $^{c}$ denoting significance at the 1%, 5% and 10% levels respectively. The first two lags are used as instruments for the variable number of migrants (logs).

Table 5: Estimation of the production function of national teams

| | (1) | (2) | (3) |
|---|---|---|---|
| | national score (logs) | national score (logs) | national score (logs) |
| Total level of skills (logs) | $0.04^{a}$ | | $0.2977^{b}$ |
| | (0.01627) | | (0.140375) |
| Average skill for talents (logs) | | $0.1655^{c}$ | |
| | | (0.0921) | |
| Number of talents (logs) | | $0.123^{a}$ | |
| | | (0.04701) | |
| constant | $-0.74^{a}$ | $-.89277^{a}$ | $-1.93089^{a}$ |
| | (.11464 ) | ( .17733) | (0.3542) |
| Country fixed Effects | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes |
| Observations | 309 | 284 | 186 |
| R-square | 0.75 | 0.78 | 0.75 |
| F-test of first regression | | | 11.5 |
| Cragg-Donald test | | | 39.5 |
| Hausman test | | | 4.77 |
| p-value | | | 0.0309 |
| Hansen test | | | 0.90 |

Robust Standard errors in parentheses $^{a}$, $^{b}$ and $^{c}$ denoting significance at the 1%, 5% and 10% levels respectively.

The first two lags are used as instruments for the variable Total level of skills (logs)

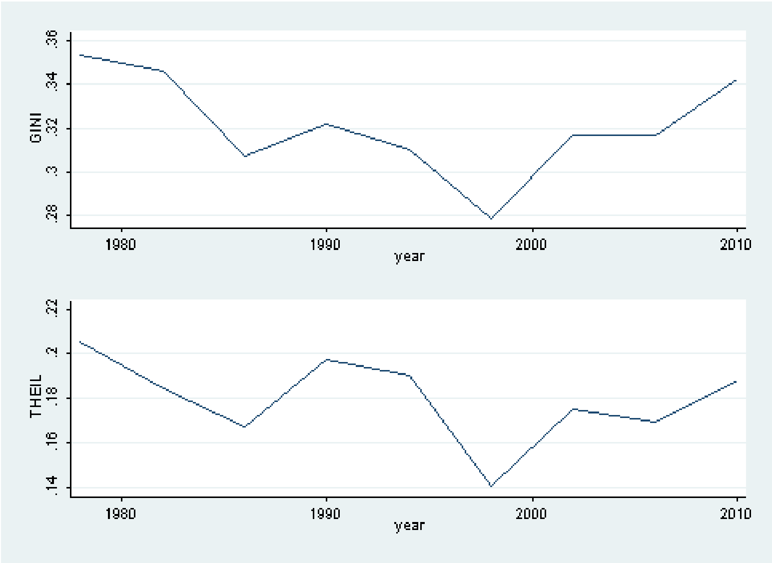
Table 6: Training for soccer players(Dependent :Variation in Number of talented players)

| | (1) | (2) | (3) |
|---|---|---|---|
| Lagged number of talents(logs) | -0.73[a] | -0.96[a] | |
| | (0.079) | (0.2654) | |
| Lagged variation in Number of talents (logs) | | | 0.41[a] |
| | | | (0.02) |
| Bosman x Europe | -0.306 | 0.159 | 0.122 |
| | (0.2202) | (0.1687) | (0.3168) |
| Bosman x Africa | 1.32[a] | 1.6[a] | 1.05[a] |
| | (0.350) | (0.487) | (0.545) |
| Bosman x Asia | 0.17 | 0.48 | 0.32 |
| | (0.366) | (0.318) | (0.889) |
| Bosman x Central America | 1.49[a] | 2[a] | 1.68[a] |
| | (0.384) | (0.399) | (0.61) |
| Bosman x Latin America | 1.06[a] | 1.41[a] | 1.05[b] |
| | (0.4383) | (0.4699) | (0.58) |
| Bosman x B.A.U | -0.1840 | -0.018 | -0.05 |
| | (0.3282) | (0.2283) | (0.12) |
| Constant | 2.37[a] | 2.92[a] | 1.206[a] |
| | (0.379 ) | ( .793) | (0.317) |
| Country fixed Effects | Yes | Yes | No |
| Year fixed effects | Yes | Yes | Yes |
| Observations | 453 | 325 | 389 |
| R-square | 0.46 | 0.52 | |
| F-first reg, | | 11 | |
| Cragg-Donald | | 22.3 | |
| AR(1)p-value | | | 0.008 |
| AR(2)p-value | | | 0.321 |
| Number of groups | | | 64 |
| Number of Instruments | | | 35 |
| Hansen test | | 0.11 | 0.103 |

Robust Standard errors in parentheses [a], [b] and [c] denoting significance at the 1%, 5% and 10% levels respectively. As instruments are used the first two lags of talented players. The number of instruments is 23 and number of groups is 64.

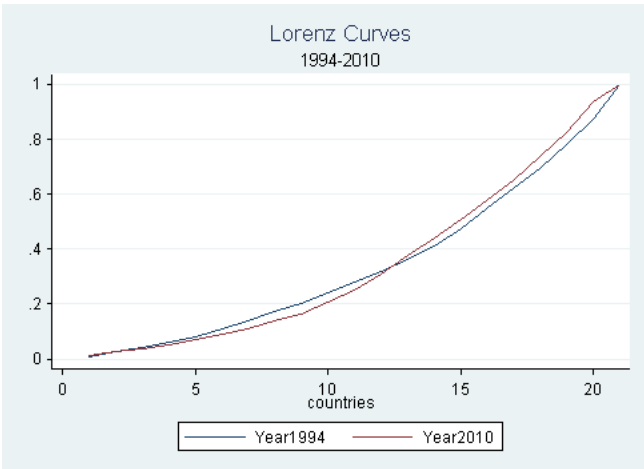
## C Figures

**Figure 1:** Gini and Theil Indices (1978-2010)



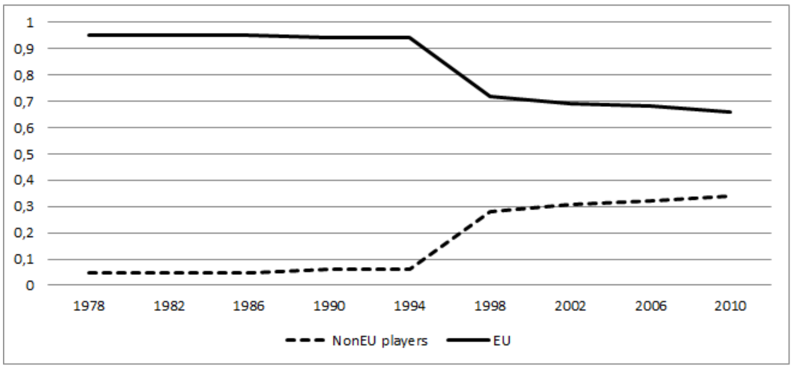

Note: The figures include 21 European leagues. Indices calculated using the standardized UEFA scores.

**Figure 2:** Lorenz curves of leagues' score, 1994-2010



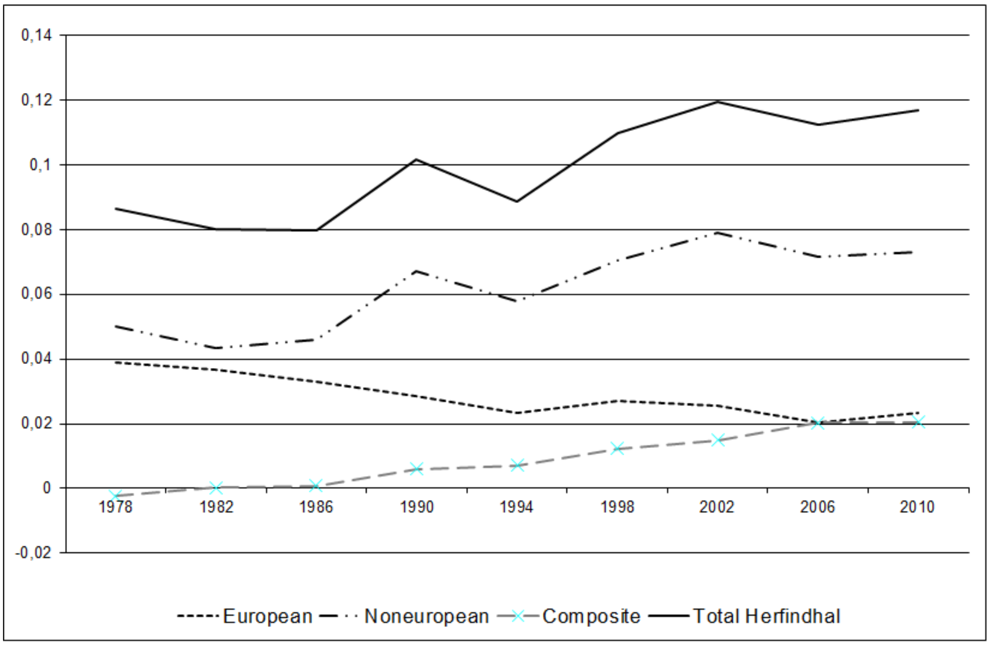

Note: The figure includes 21 European leagues.

**Figure 3:** Talented players in Europe



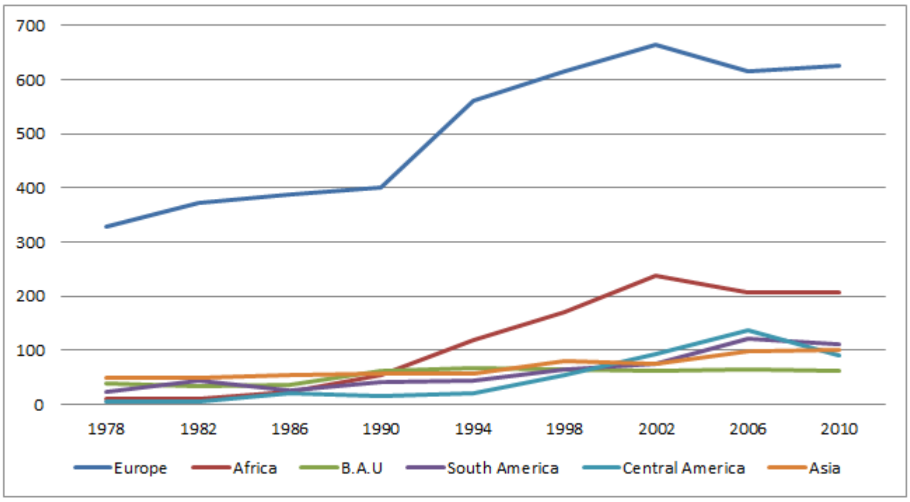

Note: The figure presents the percentage evolution of the number of talents existing in Europe from 1978 to 2010.

**Figure 4:** Geographic concentration of talented players in Europe,1978-2010




Note:The figure includes only EU destination countries and 65 countries of origin.Concentration is manned with Herfindhal index;its decomposition is presented in Eq.(2).

**Figure 5:** Talented soccer players




Note:The figure includes the first 65 countries in the FIFA ranking. Number of talented players defined by regions.

**Figure 6:** Competitive Equilibrium in the two-country case

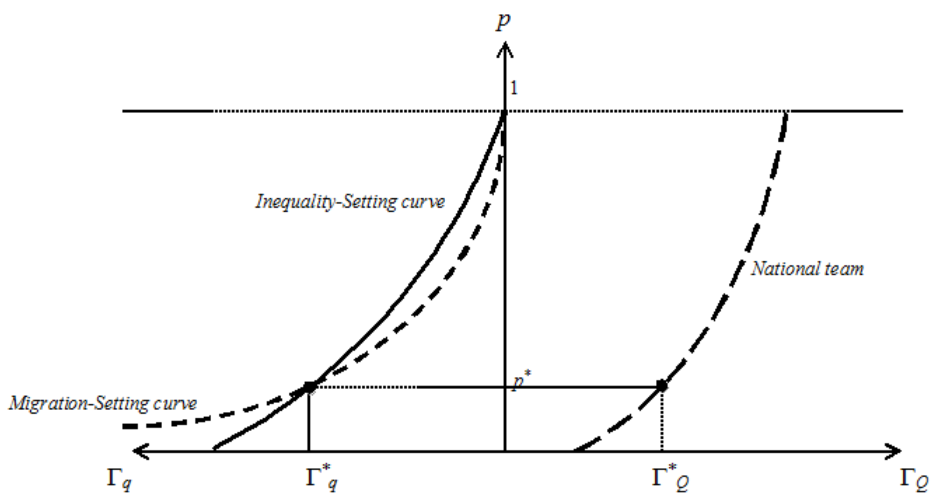


**Figure 7:** Effect of Bosman rule in the two-country case

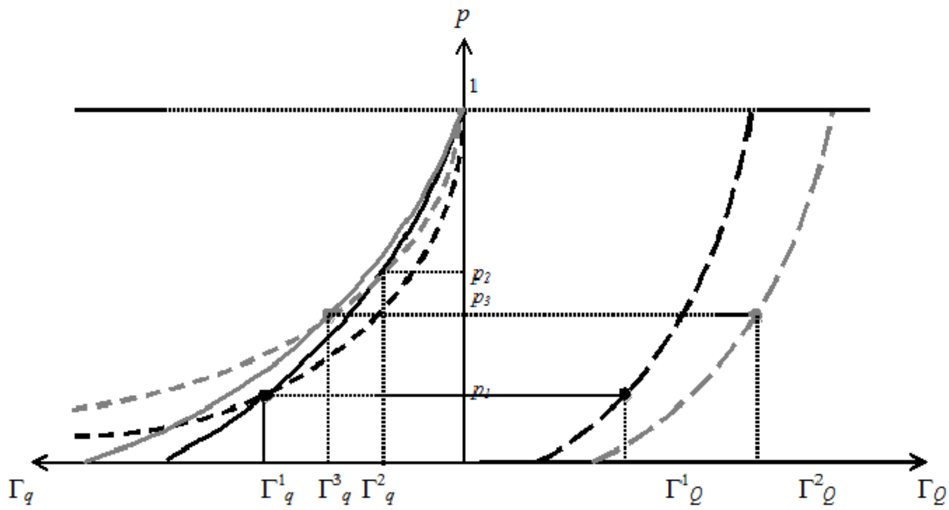
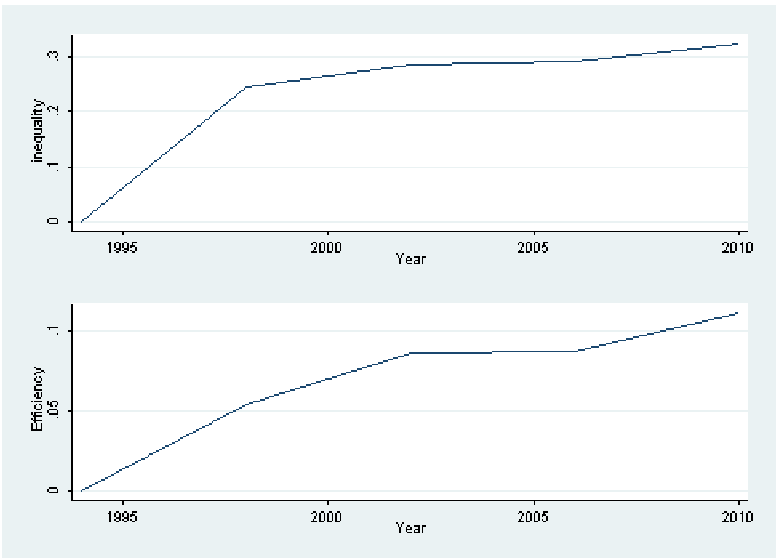
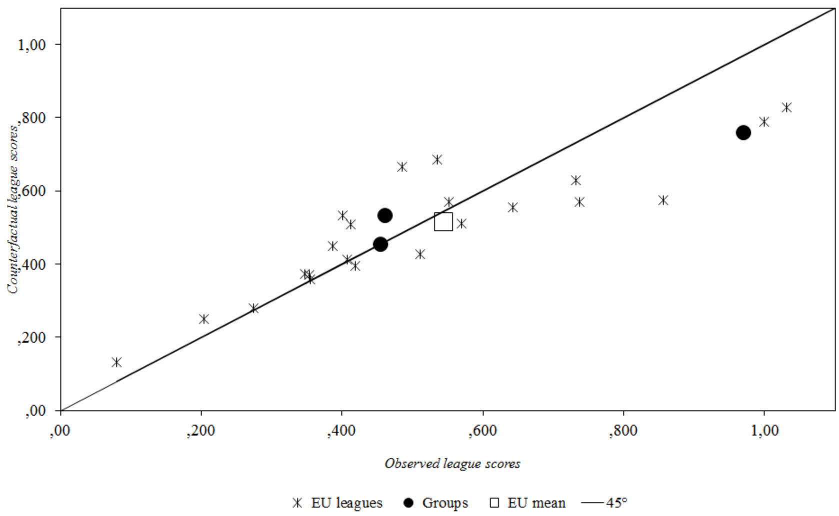



**Figure 8:** Effect of Bosman rule on Inequality and Efficiency among European Leagues



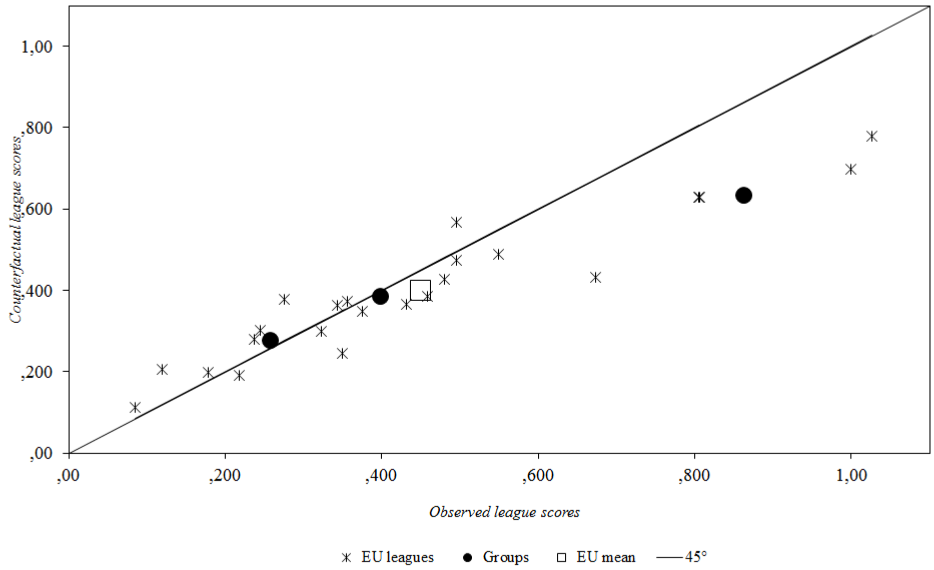

Note: The Figure describes the inequality and the efficiency across the years 1994 to 2010. GINI index and the leagues' score of Bosman tranjectory are compared to those of the trajectory of if Bosman rule had never happened.

**Figure 9:** Impact of Bosman rule on the score of European Leagues in 1998 (short-run)



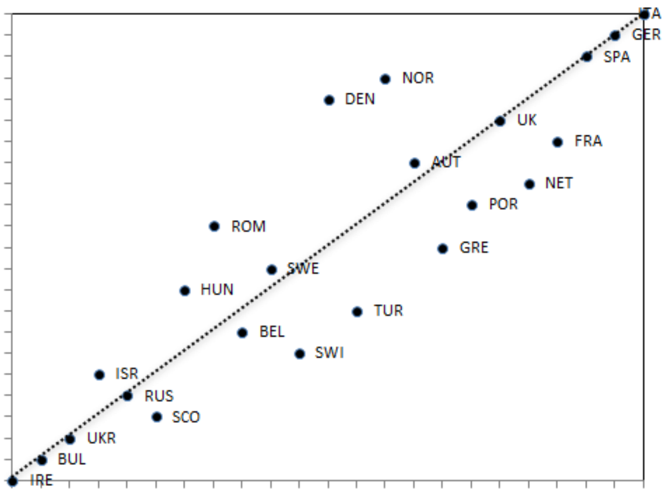

Note:The figure presents the standardised UEFA score of 23 European Leagues in 1998. The distribution of Bosman rule is presented by the observed data and the distribution of no Bosman rule is presented by the counterfactual data. Black circles represent the average scores of top, medium and bottom leagues. White square is the average of all the scores of leagues.

**Figure 10:** Impact of Bosman rule on score of European Leagues in 2010 (long-run)



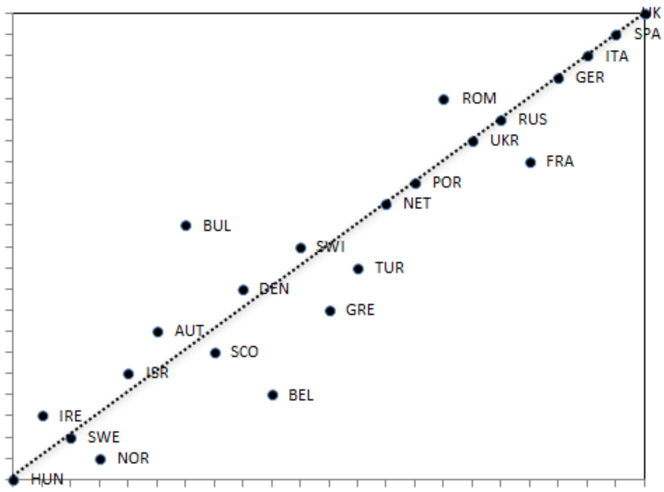

Note:The figure presents the standardised UEFA score of 23 European Leagues in 2010. The distribution of Bosman rule is presented by the observed data and the distribution of no Bosman rule is presented by the counterfactual data. Black circles represent the average scores of top, medium and bottom leagues. White square is the average of all the scores of leagues.

**Figure 11:** Impact of Bosman rule on the Ranking of European Leagues in 1998 (short-run)



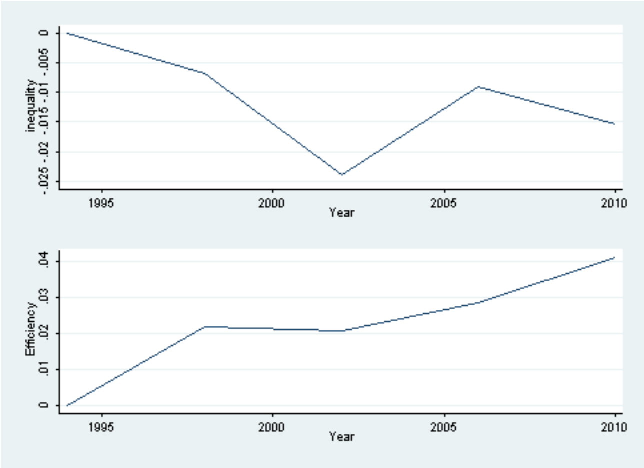

Note:The figure illustrates the ranking of 23 European Leagues in 1998. The X-axis presents the ranking of distribution of Bosman rule and Y-Axis the distribution of no Bosman rule.

**Figure 12:** Impact of Bosman rule on the Ranking of European Leagues in 2010 (long-run)



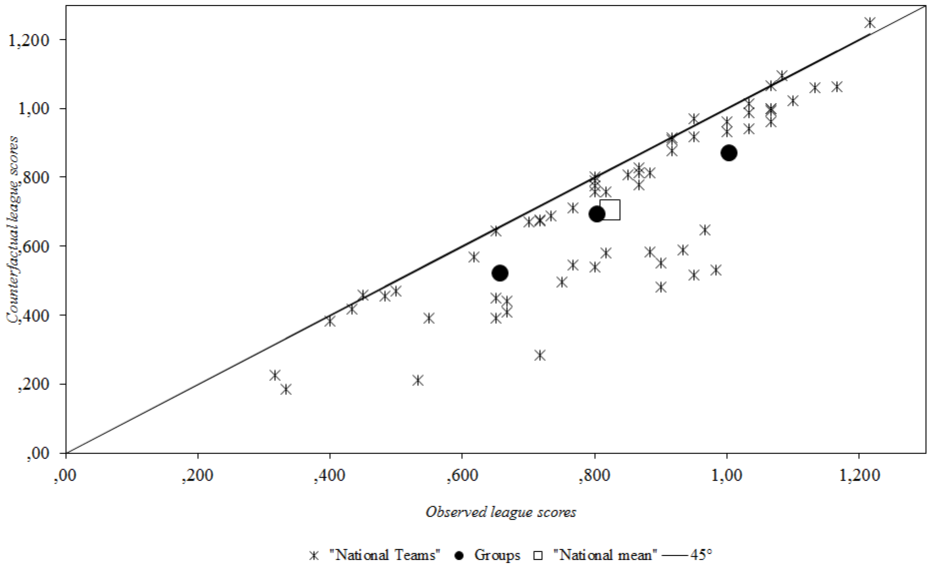

Note: The figure illustrates the ranking of 23 European Leagues in 2010. The X-axis presents the ranking of distribution of Bosman rule and Y-Axis the distribution of no Bosman rule.

**Figure 13:** Effect of Bosman rule on the Inequality and Efficiency of National Teams



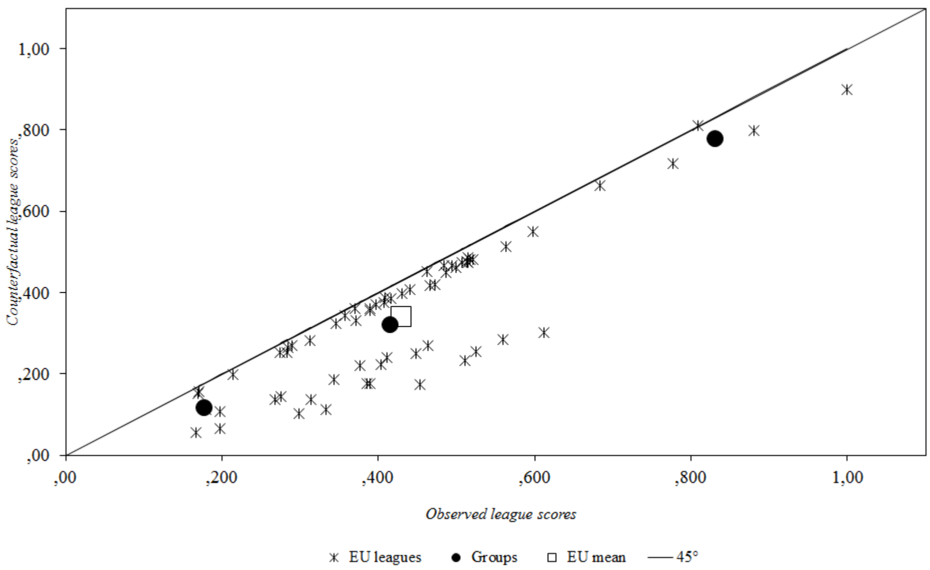

Note: The Figure describes the inequality and the efficiency of all the National teams across the years 1994 to 2010. GINI index and the Leagues' score of Bosman distribution are compared to those of the distribution of no Bosman rule.

**Figure 14:** Impact of Bosman rule on National Teams' score in 1998 (short-run))



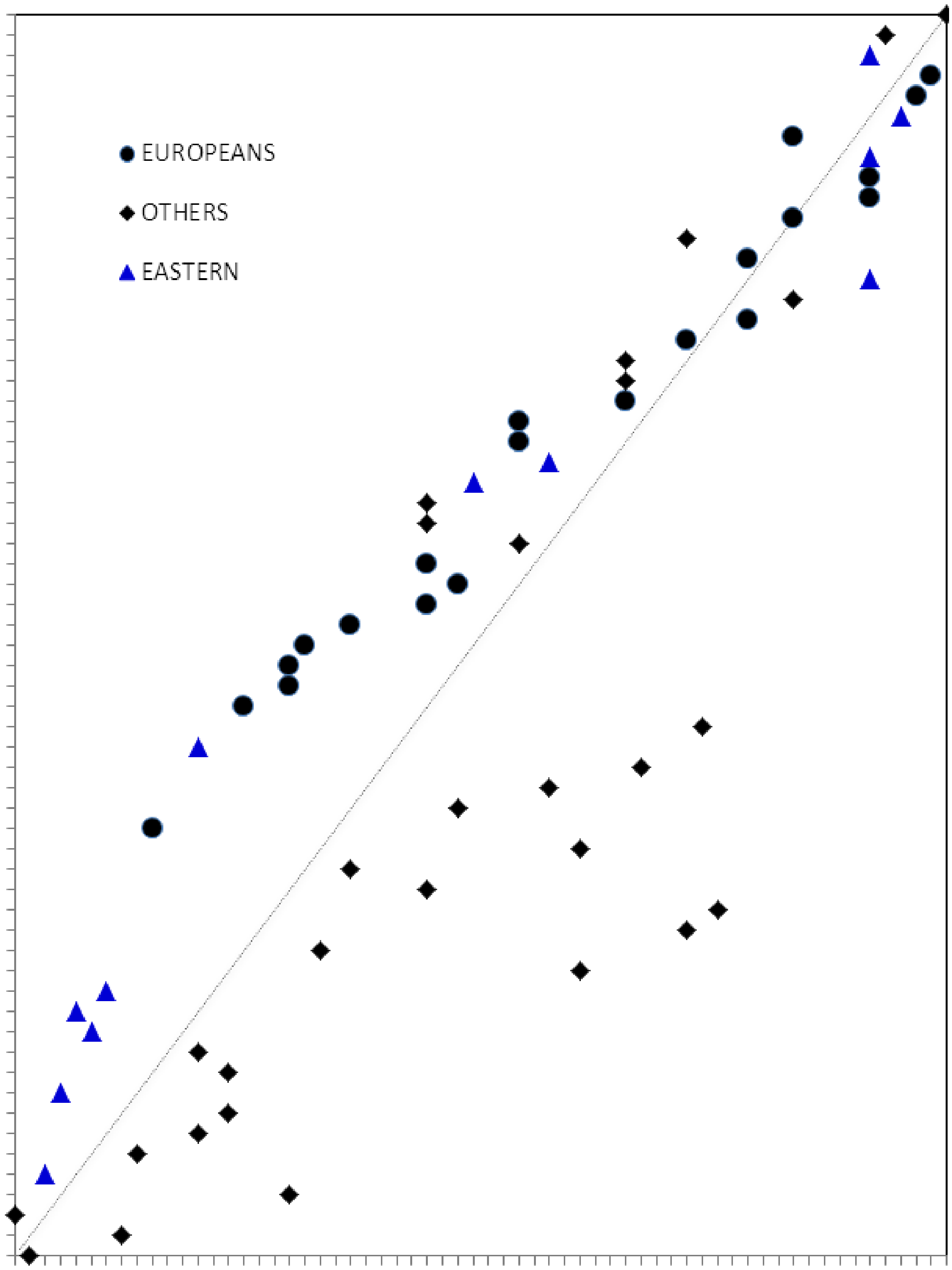

Note:The figure presents the standardised UEFA score of 65 National Teams in 1998. The distribution of Bosman rule is presented by the observed data and the distribution of no Bosman rule is presented by the counterfactual data. Black circles represent the average scores of top, medium and bottom national teams. White square is the average of all the score of national teams.

**Figure 15:** Impact of Bosman rule on National Teams' score in 2010 (long-run))



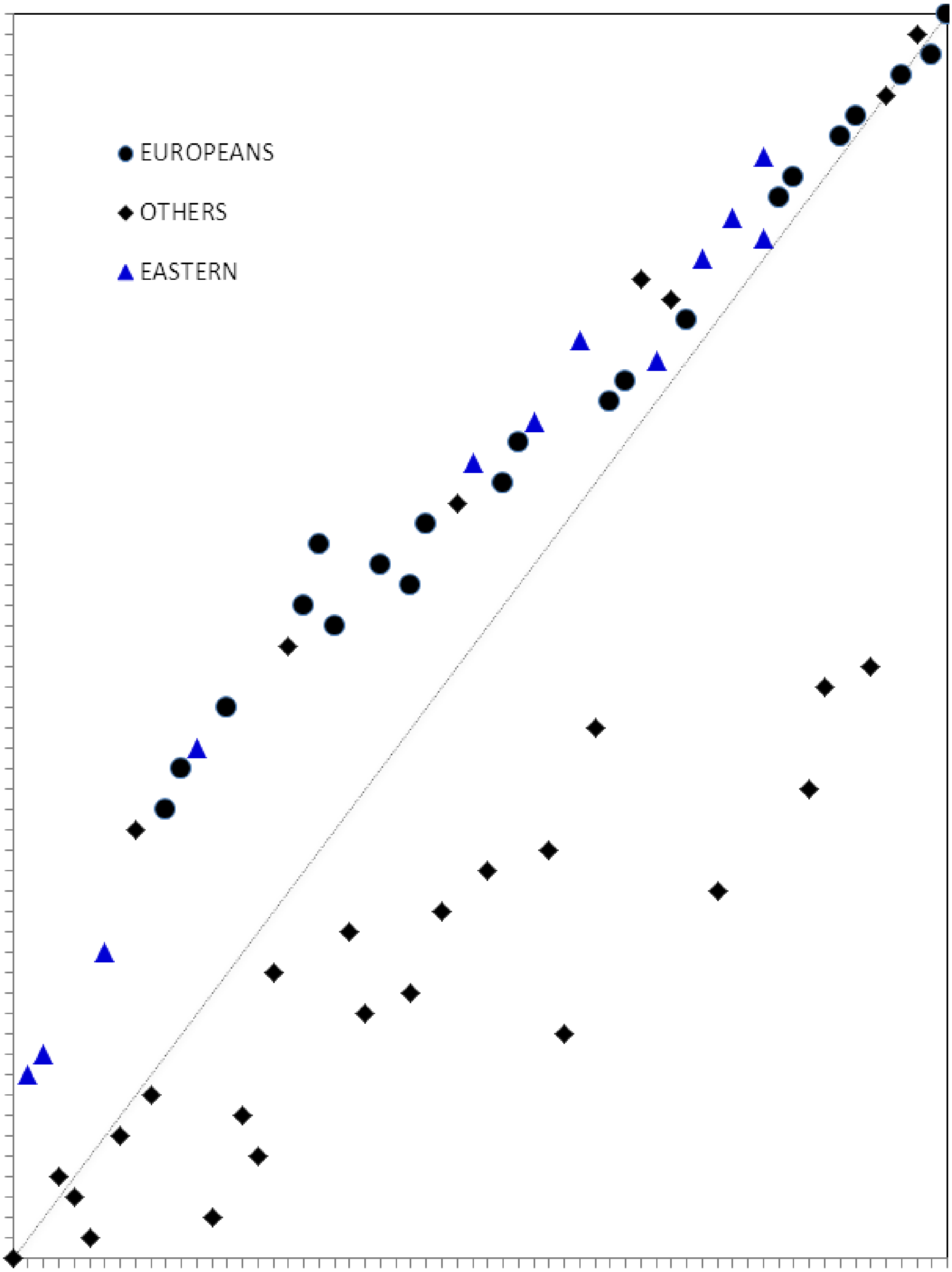

Note:The figure presents the standardised UEFA score of 65 National Teams in 2010. The distribution of Bosman rule is presented by the observed data and the distribution of no Bosman rule is presented by the counterfactual data.Black circles represent the average scores of top, medium and bottom national teams. White square is the average of all the score of national teams.

**Figure 16:** Impact of Bosman rule on National Teams' Ranking in 1998



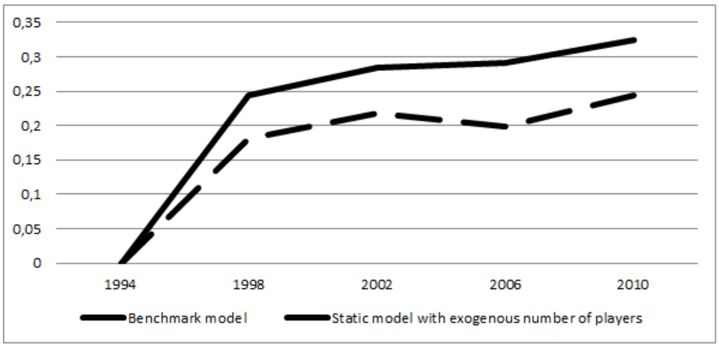

Note:The figure illustrates the ranking of 65 National Teams in 1998. The X-axis presents the ranking of distribution of Bosman rule and Y-Axis the distribution of no Bosman rule.

**Figure 17:** Impact of Bosman rule on National Teams' Ranking in 2010



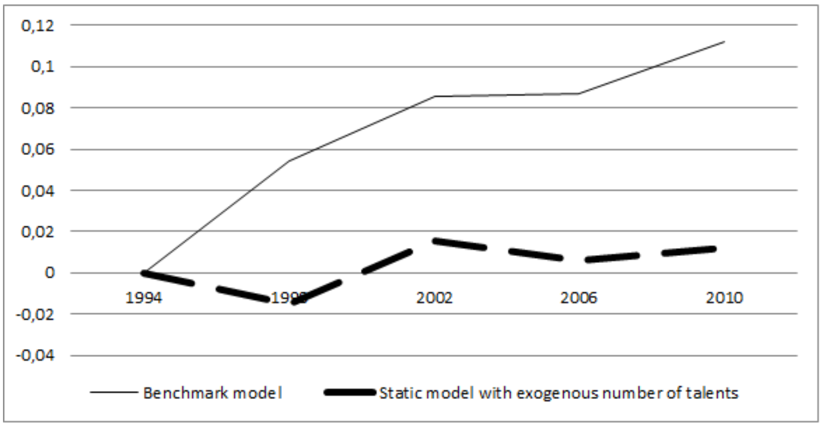

Note:The figure illustrates the ranking of 65 National Teams in 2010. The X-axis presents the ranking of distribution of Bosman rule and Y-Axis the distribution of no Bosman rule.

**Figure 18:** Effects of Bosman rule on Inequality of European Leagues(robustness analysis)



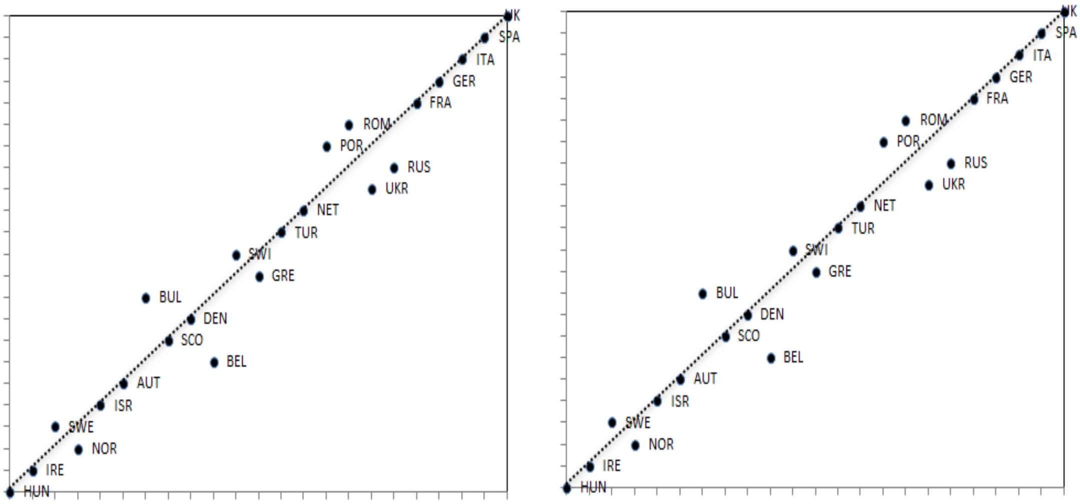

Note:The figure illustrates the inequality of European leagues under two scenarios.Scenario1: benchmark model.Scenario2:Benchmark model with exogenous number of talented players.GINI Index of Bosman distribution is compared to that of the distribution of no Bosman rule.

**Figure 19:** Effects of Bosman rule on Efficiency of European Leagues(robustness analysis)




Note: The figure illustrates the efficiency of European leagues under two scenarios.Scenario1: benchmark model. Scenario2:Benchmark model with exogenous number of talented players.Leagues' score of Bosman distribution is compared to that of the distribution of no Bosman rule.

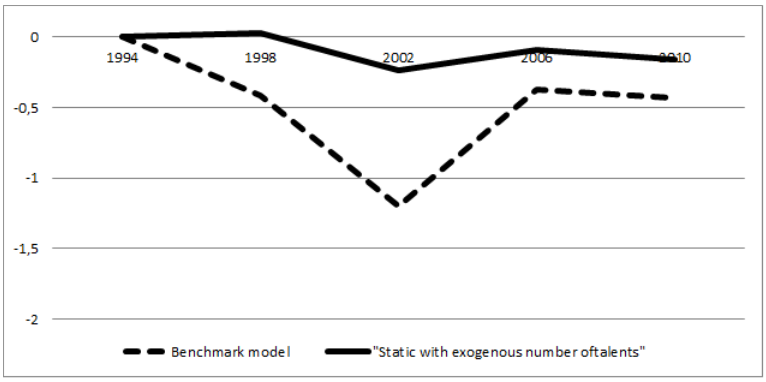
**Figure 20:** Effects of Bosman rule on Ranking for European Leagues in 1998 and 2010




figure(24a) figure(24b)

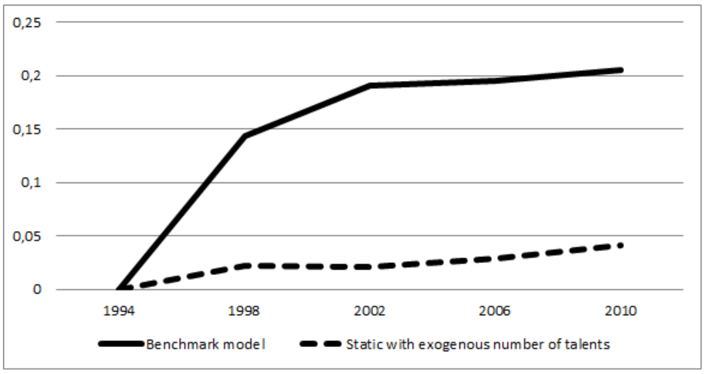
Note: The figures include the ranking of 23 European Leagues in 1998 and 2010. Both of the Figures represent the ranking for the Benchmark model with exogenous number of talented players

**Figure 21:** Effects of Bosman rule on Inequality in National teams




Note:The figure illustrates the inequality of National Teams under two scenarios.Scenario1: benchmark model. Scenario2: Benchmark model with exogenous number of talented players. GINI Index of Bosman distribution is compared to that of the distribution of no Bosman rule.

**Figure 22:** Effects of Bosman rule on Efficiency in National Teams




Note:The figure illustrates the efficiency of European leagues under two scenarios.Scenario1: benchmark model.Scenario2:Benchmark model with exogenous number of talented players.Leagues' score of Bosman distribution is compared to that of the distribution of no Bosman rule.