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## **Internationalization, competitiveness and performance in athletics (1984–2006)**

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This study examines whether a process of internationalization has affected the level of athletic performance amongst high-level athletes competing on the world stage. Top 100 International Association of Athletics Federations (IAAF) rankings were compared at two time points: 1984 and 2006, by event and by gender. We identified internationalization as a determinant of the level of athletic performances. This level increased more in events that witnessed more important shifts in market shares (dynamic internationalization or competitiveness) and where dominance by a subset of countries (static internationalization) decreased. This internationalization clearly affects performances in men's athletics (as the performance has clearly gone up since 1984), but not in women's athletics. Here the general level of women's athletics has actually decreased.

As witnessed by the increasing participation in major events like the world championships and the Olympic Games, athletics has become more international over the past decades.<sup>1</sup> Successful athletes today come from a more diverse set of countries than was previously the case. As such, the evolution of elite athletics mirrors a general tendency in sports, and even in society as a whole, in which human activity is characterized by the process of globalization. The global spread of sports is similar to the spread of other elements of popular culture, like fashion, fast food, pop music and TV soap operas. However, with regard to modern sports, there is a difference; whereas these other cultural forms lend themselves to endless variation and all kinds of hybridization, modern sports are highly standardized, and bound by fixed and common rules.<sup>2</sup> Also, sports are characterized by competition and hierarchy formation; the aim of the game is to identify a winner.<sup>3,4</sup> The number of winners is predetermined and in some sports internationalization has raised to a maximum the number of nations competing for a fixed supply of medals. Consequently, the 'market' adjusts by raising 'the price of success'.<sup>5</sup> In the economic sphere, increasing international trade, relocation of corporate activities and higher labour mobility result in higher competitive pressure and increased productivity. As in economic life, internationalization in athletics may be expected to intensify competition and increase performance. Therefore, it may have become harder for athletes to become world class leaders in their discipline than was the case heretofore.

The aim of this article is to analyse whether internationalization has indeed affected the level of athletic performance. A number of authors have studied the effects of

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globalization on sports,<sup>6–10</sup> but to our knowledge the impact of internationalization on sport performances has not been systematically analysed. According to Du Bois and Heyndels,<sup>11</sup> internationalization offers opportunities for and, at the same time, creates threats to the sports federations. For obvious reasons, the mere fact that athletes from ever more countries compete makes it harder for any given individual or nation to excel. As such, internationalization is a determinant of competitiveness and thus performance. Still, the competitiveness and internationalization of a sport will also depend on its very nature. In economic terms, some sports will have higher barriers to entry than other. A simple example, the likelihood that an innately talented skier born in Central Africa, Nepal or India will be successful in this sport is low. Although mountains and climate may be available, financial and other economic barriers are at work. Long-distance running, by contrast, has relatively low barriers to entry and a relatively low cost to practise the sport.<sup>12</sup> It therefore allows any nation and culture to compete. Consequently, the probability of a talented athlete becoming successful irrespective of the context s/he lives in is much greater in sports with lower entry barriers. Financial, political and cultural barriers to entry may thus make some sports less competitive than others. This is reflected in a lower degree of internationalization because it will be more difficult for ‘these new’ countries to enter the market. In that sense, competitiveness induced by the absence of sport-specific barriers to entry *drives* internationalization (and thus performance). In summary, two forces are at work. First, internationalization leads to a more competitive field in general because talent is recruited from a larger pool of athletes. Second, sport-specific characteristics foster or hamper the entry of athletes from ‘new’ nations. In both cases, internationalization will be positively related to athletic performance.

Using the notions of static and dynamic internationalization, the article begins by outlining the extent to which athletics has become internationalized. We briefly discuss different notions of internationalization of the ‘athletic market’. We then document internationalization in athletics using data drawn from the official International Association of Athletics Federations (IAAF) (top 100) rankings since 1984. Our focus is on differences that can be observed between athletic events and according to gender. A second observation also surrounds the rate at which performance levels have changed over time and how this differs across events/gender. Our central research question boils down to investigating whether differences in internationalization across athletic events correlate with the observed changes in performance level. The hypothesis to be tested is that athletic performance has increased more (decreased less) in events that witnessed a higher degree of internationalization. The concluding section discusses the managerial implications of our findings for both the national and international sports federations.

### **Data: the athletics market**

The relevant market that we analyse is defined by the IAAF top 100 rankings that are published on an annual basis. Only Olympic events are considered, because these are truly global and the International Olympic Committee (IOC) is a global organization that saw its membership increase to 201 nations in 2008. We collected data on the nationality of all athletes (to assess internationalization tendencies) and on performances (to assess performance evolution). Data from 1984 are compared with data from 2006. Because the issue under consideration implies the identification of a long-term evolution, the period chosen was as large as possible, subject to data availability. The decision to consider only Olympic events was not only a pragmatic one. Olympic events are, as a rule, ‘more important’ for athletes, federations and the public alike. So we expect competition to be

fiercer in Olympic events than might otherwise be the case. Because the list of events at the Olympics has changed over the years (notably for women), we have in effect three types of events: (1) those that were at the Olympic games in both 1984 and 2004; (2) those that were either Olympic in 1984 or 2004 and were officially part of the IAAF programme in the other year; and finally (3) those that were Olympic in one of the years and were *not* on the IAAF programme in the other year. The second category contains women's long-distance running events. Whereas in 1984 the 3000 m was the only long-distance event for women, this event disappeared from the Games to be replaced by 5000 m, 10,000 m and marathon events. The third category set is composed of women's 3000 m steeplechase, triple jump, pole vaulting, hammer throwing and 20 km race walking. They were all added to the list of IAAF events and to the Olympic programme after 1984. Considering Olympic events – or rather events that were Olympic either in 1984 and/or in 2006 – means that we have a total of 39 (42) events for 1984 (2006). This amounts to 3852 (4185) performances in total.<sup>13</sup>

For the analysis contained within the main body of this article, events are grouped into one of seven sets: sprinting and hurdling, middle-distance running, long-distance running and steeplechase, throwing events, jumping events, heptathlon and decathlon, and race walking. Results by event are provided in the Appendix (Tables A1 and A2).

To measure the international character of the athletics market – as discussed below – we compare market shares of individual countries, i.e. their share of athletes in the top 100 competitors for each event. Given the long-term perspective of our analysis and the drastic political changes that have occurred during the period under consideration, we account for the fact that some countries ceased to exist while others were created. Our calculations control for the changes in the 'identity' of countries following the fall of the Berlin Wall and the resulting dissolution of the Soviet Union, Yugoslavia and Czechoslovakia (into no fewer than 23 nations), on the one hand, and the reunification of East and West Germany, on the other hand. The data in the tables are calculated on a theoretical set of 'aggregate countries'. In practical terms, this means that for 1984 East and West Germany are considered as distinct countries. For 2006, the 15, 6 and 2 countries from the former Soviet Union, Yugoslavia and Czechoslovakia, respectively, are regrouped.

### **Internationalization in athletics**

We consider the elite athletics market – defined above – as divided between participating countries. Each country has a market share ranging between 0 and 100%. Internationalization is a process referring to changes in the international character of the market. The latter is defined in terms of the market shares of individual countries; a market is said to be more international if more countries are involved and if market shares are more equally distributed. Athletics is probably one of the most international sports in the world, next to Association football. This is well illustrated at the Olympic Games where almost every nation is represented in the athletics competitions (196 of 204 National Olympic Committees).

Following Du Bois and Heyndels,<sup>14</sup> two notions of internationalization are used: static internationalization and dynamic internationalization. Static internationalization compares the market of elite athletics at two points in time (in our case, 1984 and 2006) and answers the questions whether and to what extent elite athletics has become more international. The second notion – dynamic internationalization – explicitly captures the changes in market fragmentation themselves. As documented further, this accounts for the fact that a market that is equally international in 1984 and 2006 may have undergone important changes (or not), thus reflecting the underlying competitiveness of the market.

Indicators for both types of internationalization are borrowed from industrial economics and are discussed below.

### *Static internationalization in athletics*

Indicators for static internationalization measure how the international character has changed over time. The international character of athletics at any point in time is measured in terms of the degree of concentration or dominance in the market. If all top 100 athletes emerge from a single country the market is fully concentrated (or monopolistic). If each of the top 100 athletes emerge from different countries, then the market could be regarded as being fully fragmented, that is highly international. The most straightforward indicator of static internationalization is the change in the number of countries ( $N$ ) having at least one athlete in the top 100. Reporting this indicator, Table 1 provides clear evidence of static internationalization. The number of countries having at least one athlete in the IAAF rankings has increased from 73 to 128 over the period 1984–2006.

Another indicator for static internationalization is the change in the cumulated market share of the ‘market leaders’. Following tradition in industrial economics where market shares of corporate firms are analysed, it is most common to focus on the market shares of the *four* largest firms/countries (or market leaders).<sup>15,16</sup> For our purposes, the concentration ratio CR4 gives the share of athletes coming from the four countries with the largest market share. Larger values for the concentration ratio reflect a more modest international character of the athletics market. The maximum value equals 1, meaning that all athletes in the IAAF rankings come from within the same set of four countries. Comparing two points in time, evidence on static internationalization would imply that the concentration ratio has decreased. Results, again in Table 1, confirm the considerable static internationalization. The four market leaders in 1984 were the Soviet Union, USA, Germany and Great Britain. No fewer than 57% of all IAAF-ranked athletes came from one of these four nations. By 2006, the share of the four leading countries was reduced to 36%. Also the identity of the market leaders changed (USA, former Soviet Union, Kenya and China).

Table 2 summarizes the changes in concentration ratio ( $\Delta$ CR4) and in the number of countries with ranked athletes ( $\Delta$ N) by event category (data by event are in Table A1).

Table 2 reveals important differences by event category. The general pattern – the market share of the top-four countries has fallen and the number of countries having at least one athlete in the IAAF-rankings has increased – is found in all categories but one. Indeed, while static internationalization is clearly present in each of the other event categories, this is not the case for men’s long-distance running. Here, the field has become less international. Compared with 1984, the number of countries with one or more ranked athletes has fallen by six. The market share of the four most dominant countries in men’s long-distance running has increased by 19%. This unique situation reflects the well-known entry of ‘new’ countries Kenya and Ethiopia. This entry has been so convincing that these countries have actually overtaken the market. Whereas in 1984, Kenya (values for Ethiopia in parentheses) had market shares of 4% (1.8%), 4.5% (2%) and 1.5% (1.5%) in

Table 1. Static internationalization in athletics 1984–2006.

	1984	2006	$\Delta$ 1984–2006
CR4	0.57	0.36	– 0.21
N	73	128	+55

Note: CR4, concentration ratio; N, number of countries with ranked athletes.

Table 2. Static internationalization in men's and women's athletics  $\Delta$ 1984–2006 per group of events ('aggregated countries')

	$\Delta$ CR4		$\Delta N$	
	Men	Women	Men	Women
Sprinting & hurdling	-0.14	-0.07	+18	+29
Middle distance	-0.07	-0.28	+5	+18
Long distance & steeple	+0.19	-0.16	-6	+11
Throwing events	-0.10	-0.13	+13	+25
Jumping events	-0.23	-0.23	+20	+25
Heptathlon & decathlon	-0.16	-0.14	+8	+6
Race walking	-0.17	-	+10	-

Note:  $\Delta$ CR4, change in concentration ratio;  $N$ , number of countries with ranked athletes.

the 5000 m, 10,000 m and marathon, these shares increased to 33.5% (12%), 25.5% (6%) and 37.5% (7.5%) in 2006, thus crowding out many other countries.

It is clear, however, that the evolution in male long-distance running is exceptional. In all other event categories, there is clear evidence of static internationalization. Concentrating on the change in the number of countries with IAAF-ranked athletes ( $\Delta N$ ), we observe that as a rule the internationalization is more explicit in women's athletics. Only for the heptathlon/decathlon is the number of 'new' countries larger for men. Crucially, however, the observed static internationalization appears to be event specific. Sprinting and hurdling, throwing events and jumping events witnessed the most explicit internationalization for both women and men. Looking at the share of the top-four countries ( $\Delta$ CR4), the gender difference is less obvious. Still, some 'event similarity' is present too; for women, the share of the four market leaders decreased most for middle-distance running and jumping events. For men's athletics the share decreased most for jumping events and decathlon. In 2006, these events were thus less dominated by a limited number of countries than they used to be 22 years previously.

### *Dynamic internationalization in athletics*

Whereas 'static internationalization' compares two points in time and reveals the extent to which the market for elite athletics has become more international, changes in the athletics' market may be of a different nature. An example will serve to clarify this point; suppose that at a given point in time  $t = 1$  all athletes come from one of two countries, with country A having 80% and the remaining market share of 20% going to country B. The market is highly concentrated (with  $CR4 = 100\%$  and  $N = 2$ ). Suppose now that by  $t = 2$ , country A has lost so much market share to its competitor that the situation has been reversed: A has 20% of the market, B has 80%. Obviously, there has been a huge change in the market reflecting the underlying competitiveness. But the value of the CR4, as well as  $N$ , will not have changed and no static internationalization will be observed. It should be clear that even though the athletics market is equally international at both  $t = 1$  and  $t = 2$ , there has been strong shifts in market shares. Such shifts reveal – just as for corporate firms – that the market is highly competitive.

Shifts in market shares over time are labelled dynamic internationalization.<sup>17</sup> Such internationalization is an *ex post* indicator of market competitiveness (reflecting low barriers to entry). The situation in the athletics market is similar to the situation in the corporate sector. There, competitive markets are characterized by considerable entry and

exit of new firms. More generally, competitive markets are characterized by considerable shifts in market shares among participating firms. In our context, the participants are countries and the market is the market for athletic success. In a competitive market, countries find it hard to keep their market share as competitors (entrants) systematically threaten their position. Formally, dynamic internationalization can be measured by a Hymer and Pashigian<sup>18</sup> (1962) volatility index (*HP*) that is defined as:

$$HP_{1984-2006} = \frac{1}{2} \sum_{i=1}^n |s_{i,2006} - s_{i,1984}|$$

where  $s_{i,t}$  gives the market share of country  $i$  in year  $t$  (1984 or 2006). The *HP* index ranges from 0 to 1. Higher values of the index refer to stronger dynamic internationalization. A value of  $HP = 0$  implies that market shares have not changed over time; each country has the same share of the athletic market in 2006 as it had 22 years earlier. The maximum value of *HP* is reached if every country that had athletes in the IAAF rankings 1984 does *not* appear anymore in the 2006 rankings.

It should be clear that dynamic internationalization is a necessary condition for static internationalization to occur. Indeed, if the *HP* value takes a value of zero over a given period, this means that the concentration ratio and  $N$  values remain unchanged. If, however,  $HP > 0$ , this reveals that dynamic internationalization has occurred. In that case, the indicators of static internationalization will shed light on the precise nature of the process. Depending on the underlying forces a positive value for *HP* is compatible with decreasing (smaller values for CR4, higher values for  $N$ ) as well as increasing market concentration. To sum up, dynamic internationalization reflects the presence of competitive forces that shift market shares. Static internationalization gives information on the actual nature of these changes.

Analysing IAAF rankings for 1984–2006, Table 3 reveals considerable dynamic internationalization;  $HP = 0.32$ .<sup>19</sup> This reflects a highly competitive market in athletics. Indeed, the *HP* value indicates that over the period under consideration the group of countries that increased their market share took one third (32%) of the market from those countries that were on the ‘losing side’.

Interestingly, the general picture seems to suggest that competitiveness does not differ markedly according to gender; events that are more competitive for men tend to be more competitive for women, with the exception of throwing events. Furthermore, Table 3 reveals that dynamic internationalization, or competitiveness, differs between events. The most pronounced dynamic internationalization is observed for long-distance running

Table 3. Dynamic internationalization (Hymer and Pashigian index) in men’s and women’s athletics  $\Delta$ 1984–2006 per group of events (‘aggregated countries’).

	Men	Women
Sprinting & hurdling	0.34	0.38
Middle distance	0.44	0.46
Long distance & steeple	0.58	0.56
Throwing events	0.23	0.40
Jumping events	0.35	0.32
Heptathlon & decathlon	0.36	0.28
Race walking	0.50	–
Total		0.32

(including steeplechase). The Hymer and Pashigian<sup>20</sup> indicator takes a value of 54 and 58% for women and men, respectively. This is almost twice the average overall HP value, indicating that the countries that increased their market share actually took more than half of the market from the countries whose market share decreased. Also, road walking (for men) and middle-distance running turn out to be highly competitive. Throwing events for men and heptathlon for women have the lowest dynamic internationalization.

### Evolution of athletic performance 1984–2006

Many methods can be used to assess the long-term evolution in athletic performance. One could analyse how world records evolved over time and compare the progress made in given athletic events.<sup>21</sup> To take a view on long-term trends in athletic performances this is certainly a valid methodology. However, to compare the *general* level of performance in any given year or period looking at the prevailing world records would provide a biased view. The reason is that world records are – from a statistical perspective – almost by definition ‘outliers’. To compare 1984 and 2006 performance levels we therefore compare IAAF rankings by gender and discipline and see what 2006 ranking would have been reached with a performance that led to a specified 1984 ranking. We investigate what ranking would have been obtained in 2006 by the athlete who was ranked  $x$ th in 1984. To get a general view and to avoid the outlier-problem we set  $x = 1, 3, 5$  and 10, respectively.

In principle, all Olympic events are considered in 1984 and 2006. However, as discussed above, the set of Olympic events in women athletics has changed over the years. Comparison is therefore possible only for those events that that were at the Olympic games in both 1984 and 2004 or were either Olympic in 1984 or 2004 and officially part of the IAAF programme in the other year. Comparison is further complicated because the IAAF has changed the technical characteristics of the javelin, deliberately aiming to lower the distances that athletes could throw. Because javelin throwing is one of the events in the heptathlon and decathlon, comparison of this event would also be biased. Thus, evolution of performances is analysed for the remaining events. This involves 15 events for women’s athletics and 20 for men’s athletics. An overview of these events and performances is provided in Table A2.

We proceed by first analysing performance evolution at the aggregate level (considering all athletic events) for both men and women. As a second step we investigate whether differences can be observed among (sets of) events.

### The general picture

Table 4 gives an overview of the evolution in the absolute level of performance for men’s and women’s athletics (in general). The table gives the median ranking that would have been obtained in 2006 by the athlete ranked, respectively, first, third, fifth and tenth in 1984. It immediately becomes clear that there has been a drastic change in the level of performances. However, it is impossible – when accounting for gender differences – to

Table 4. Hypothetical 2006 rankings for 1984 performances, median over all events.

	1st in 1984	3rd in 1984	5th in 1984	10th in 1984
Women	1	3	4	7
Men	4	8	12.5	18.5

speak about a single 'general pattern'. Indeed, there is a marked difference in performance evolution between both sexes; while we observe a clear increase in the level of athletic performances for men, the general level of women's athletics has actually decreased<sup>22</sup>.

As is apparent from Table 4, the performance of the best female athlete in 1984 is, as a rule, sufficient to be first ranked athlete in 2006. A performance resulting in a tenth place in the 1984 IAAF ranking for women would even be sufficient to reach a seventh place in the 2006 ranking. So the same performance leads to a better world-ranking. Thus it can be concluded that the general level of female athletics in 2006 was below the 1984 level. It should be noted that if only those events were considered that were on the Olympic programme in *both* 1984 and 2004, the situation is even more extreme; the athlete ranking tenth in 1984 would have a fifth place in the 2006 rankings.

The situation for men's athletics is clearly different. The general level of performance has increased considerably since 1984. A season's best performance in 1984 is, 22 years later, as a rule sufficient to rank fourth. A performance resulting in a tenth rank in 1984 led to a median rank of 18.5 (in half of the events the 10th ranked athlete would reach a rank of 18 or better, in the other half of the events the corresponding rank would be nineteenth or worse).

### *Analysis by event category*

The general picture in Table 4 does not reflect underlying differences in the evolution of athletic performances across events. Therefore, data have to be further disaggregated. Hypothetical 2006 rankings for the 1984 athletes have to be considered. To avoid overloading the analysis, we concentrate on the tenth ranked 1984 performance. This best captures the general evolution of the performance level (as, of course, it minimizes the outlier-bias discussed earlier). As revealed in Table 4, the median ranking of these athletes would be 7 and 18.5 in 2006 for women and men respectively. Figures 1 (for women) and 2 (for men) clearly reveal important differences between sets of events. In the graphic events are grouped in five categories for women and six for men. The rankings in the figure are averages over the respective subdisciplines. Table A2 gives a detailed overview for all events.

### *Women*

Figure 1 clearly reveals a drop in performance within female athletics in three sets of events; the 2006 level of performances in women's middle-distance running, jumping events and throwing events is significantly below the performance level in 1984. The most remarkable decrease is observed for the throwing events. A performance that resulted in a tenth place in 1984 corresponds to a second rank in women's shot put in 2006. For discus throwing, it is even the case that the 10th place in 1984 outperforms the world leading performance in 2006. This clearly reflects drastic changes in throwing competitions. It might be hypothesized that the relative success of anti-drug policies could hardly be better demonstrated. The fact that performances in jumping and middle-distance running have also declined – albeit in a much less spectacular way than in throwing events – does not have such obvious explanations. Anti-drug policies may explain part of the evolution, but probably there is more at hand to explain this trend. For middle-distance running, it may be hypothesized that the relative deterioration in women's levels of performance may be attributed to the IOC recognition of women's *long*-distance running. It is not unthinkable that prior to such recognition a number of talented long-distance runners specialized in

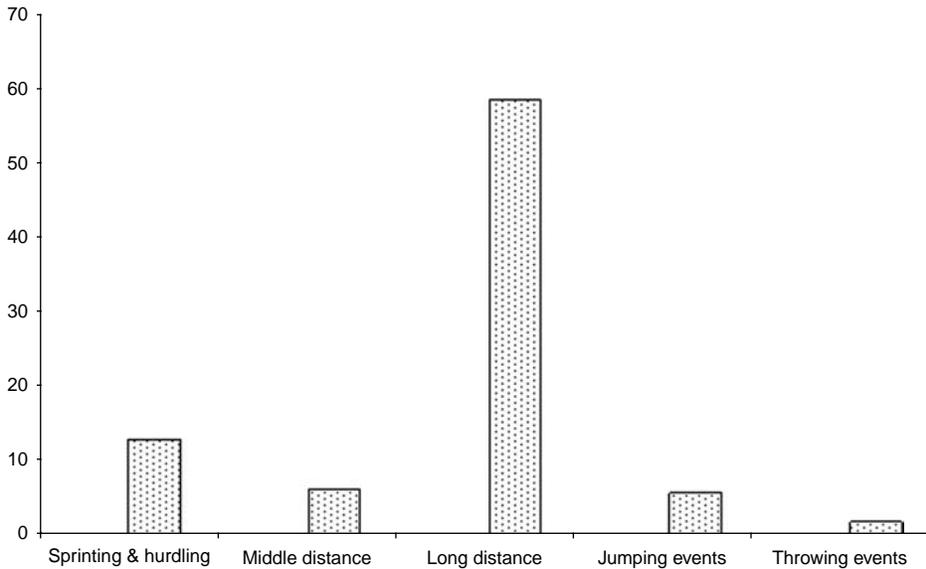


Figure 1. Hypothetical 2006 ranking for the 10th ranked 1984 athlete: women.

middle-distance running. The IOC recognition may then have served as an incentive for a number of middle-distance runners to take up long-distance running. Given the data at our disposal and the focus of our research this question, although certainly valid, lies beyond the scope of the present article.

### *Men*

As already indicated, the general picture for men's athletics is different from that for women, in the sense that there has been a clear improvement in athletic performance over time. As for women, we find important differences in the evolutions across event categories (Figure 2). Again the performance increase is most apparent for long-distance running. The 10th ranked athlete in 1984 would have ranked only 42nd in 2006. While less spectacular than for women (the corresponding ranking was 58th) this is still enormous, especially when compared with the evolution in the other events. More generally, we see an increase in athletic performances for men for all events except in throwing events. For the latter an athlete ranked tenth in 1984 would have been ranked on average eighth in 2006 (fourth in shot put, eighth in discus and eleventh in hammer throwing).

In conclusion, we observe a general tendency for women's performances to decrease and for men's performances to increase. The analysis by event reveals interesting similarities; for both sexes increases in performances are most pronounced for long-distance running. Second strongest increase in performance level for both men and women is observed for middle-distance running, followed by jumping events. For both sexes, throwing events have been characterized by a (strong) fall in performance level.

### **Internationalization and athletic performance**

To analyse how internationalization tendencies help in explaining the observed changes in athletic performance over the period 1984–2006, we calculate a Spearman rank

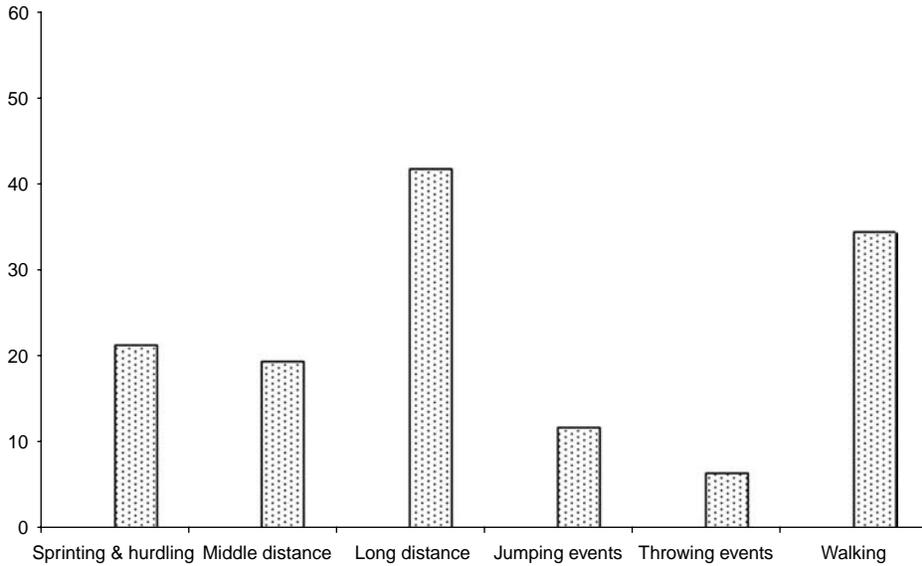


Figure 2. Hypothetical 2006 ranking for the 10th ranked 1984 athlete: men.

correlation between our indicator of performance and the indicators of both static and dynamic internationalization on the other. Data at the event level (see Tables A1 and A2) are used. The results are listed in Table 5. Because the previous section revealed a clear structural difference in the evolution of athletic performance by gender we calculate correlations for athletics in general but also for women's and men's events separately.

As can be seen from Table 5, the evolution in athletic performance correlates significantly with both static and dynamic internationalization. The overall picture in the first column reveals a statistically significant correlation between the level of performance and dynamic, as well as static, internationalization. The Spearman rank correlation for the HP value is 0.52. This indicates that higher competitiveness of an athletics event (higher values for HP) is associated with stronger increases in the performance level. Dynamic internationalization is thus identified as a significant determinant of the increase in athletic performance.

The correlation between *static* internationalization and performance evolution is less straightforward in column 1 ( $-0.43$ ). Indeed, when considering all athletes (male and female), we find a negative correlation between the changes in the concentration ratio CR4 and in the performance level. Events in which the dominance by the four market leaders decreased most (CR4 decreased more) witnessed a stronger increase in the

Table 5. Performance evolution and internationalization: Spearman rank order correlation ( $z$ -values in parentheses).

	All athletes	Men	Women
$\Delta$ CR4 (static)	$-0.43$ ( $-2.51$ )	$-0.64$ ( $-2.87$ )	$-0.29$ ( $-1.14$ )
$\Delta N$	$-0.73$ ( $-4.29$ )	$-0.65$ ( $-2.91$ )	$-0.70$ ( $-2.73$ )
HP (dynamic)	$0.52$ ( $3.10$ )	$0.68$ ( $3.05$ )	$0.38$ ( $1.48$ )

Note:  $\Delta$ CR4, change in concentration ratio; HP, Hymer and Pashigian;  $N$ , number of countries with ranked athletes.

performance level. So, static internationalization correlates positively with athletic performance. This is in line with the expectation that performances have increased more (decreased less) in those athletic events where the dominating countries lost most of their market share.

A different picture emerges from the correlation between  $\Delta N$  (change in the number of countries in the top 100) and performance. This correlation is negative. This means that athletic events in which the number of countries with top 100 athletes increased, witnessed a stronger *decrease* (or weaker increase) in athletic performance. So, static internationalization measured through an increase in the number of countries in elite athletics, correlates negatively with performances. In this respect, it is clear that the actual nature of the competitive forces (revealed through the index of dynamic internationalization) plays a role. Du Bois and Heyndels<sup>23</sup> argue that the most competitive athletic events in the last decades (long-distance running) actually display – at the start of the twenty-first century – all characteristics of a natural monopoly. This nicely illustrates how the competitiveness of the market may change in a globalizing world. In the 1980s and 1990s low barriers to entry have allowed athletes from ever more countries to enter the long-distance running market. This entry has been so successful for some countries (notably Kenya and Ethiopia) that they actually overtook the market. So, while barriers to entry are low as such, it appears that talent is not distributed homogeneously between all countries. The result is an athletic event that is dominated by a small subset of countries. As such, the presence of natural resources (athletic talent) in a limited number of countries gives these a natural monopoly for athletic success.

As discussed above, the evolution of athletic performance reveals a marked difference between men's and women's events. Whereas we found clear evidence of a strong increase in the level of athletic performances for men, in the women's events we actually observed a structural decrease of the level of performance. Therefore, Table 5 also gives correlation coefficients by gender. The correlations for both sexes mimic the aggregated results, although the significance remains only for the male athletes (only the negative correlation between the  $\Delta N$  index and performance remains significant for the female athletes). The positive correlation between dynamic internationalization and performance is not significant for the female athletes. For the male, however, it is highly significant ( $= 0.68$ ). This indicates that performances among male athletes have been driven by internationalization. For women, this is less apparent. Performance evolution in women's athletics may have been affected by internationalization (indeed, the increase in participating countries is larger for women than for men) but the effect on performance has been dominated by other forces. Although identification of these lies beyond the scope of this article, successful anti-drug policies in combination with the fall of the Berlin Wall are prominent candidates. In a sense, the central planning in former Communist countries allowed for a most effective drug use as (medical) knowledge reaches athletes more easily. Moreover, centrally planned sports policies tend to generate more athletic success in less competitive sports and events. Women's athletics is as a rule less competitive than men's, so success can more easily be 'made'.

## Conclusion and discussion

Athletics has witnessed a remarkable transformation over the past decades. The countries that traditionally dominated the field have lost market share and new countries have entered and taken their place. High competitiveness is reflected by considerable shifts in market shares (dynamic internationalization); over the period 1984–2006, the 'winning'

countries took no less than 32% of the market from the 'losing' countries. The market share of the top four nations (static internationalization) decreased from 57% in 1984 to 36% in 2006. These shifts reveal the underlying competitiveness of the 'market', much like shifts in market shares by corporate firms. As a consequence of these competitive forces, elite athletics has become more international in most events. The number of countries with top 100 athletes has increased in most events. Identification of the precise sources of this internationalization lies beyond the scope of this article. Still, a straightforward candidate presents itself; the growth in the world population. Indeed, in the period under consideration this increased with 40%, from 4.8 billion in 1984 to 6.7 billion in 2006.<sup>24</sup> Such an increase has most likely increased the pool of talent worldwide and may as such have been responsible for a considerable increase in the general level of athletic performance. However, it should be noted that such an increase in the world's population has no unambiguous effect on the level of internationalization. If the pools of talent in all countries increase at the same rate, then the effect on top 100 performances from any given country will be nonexistent (unless the growth in population helps crossing some minimal-scale levels in some countries). In practice, however, the population has *not* increased at the same pace everywhere. For example, the population in countries like Kenya and Ethiopia has grown more rapidly (>400% in a period of 50 years). In these specific cases, this population growth may in part explain these countries' increased marked shares.

It was concluded from the analysis that a competitive environment leads to better performance. Indeed, we observe that the level of performance has increased most (decreased least) in those events that were characterized by high dynamic internationalization. Splitting by gender reveals that the effect of internationalization on performance is only significant for men's athletics. For women's athletics, we find a positive relation between internationalization and performance evolution, but it is not significant.

A number of policy lessons can be drawn. Our general finding is self-evident; the more athletes participate, the more competitive the event/sport becomes and the harder it is for any individual athlete to be successful. From the perspective of sports federations, investing in athletic success becomes more costly as the search for the exceptionally talented athlete has to be intensified. This is further evidence that systems of talent detection and recruitment become more important.<sup>25,26</sup>

Crucially, however, we find that competitiveness is event specific. Events that demand higher technical skills, long-term athletic education and early talent detection are as a rule less competitive. We find that competitiveness (measured as dynamic internationalization) is lowest in sprinting and hurdling, throwing and jumping events for both women and men. This reveals the presence of 'technical barriers to entry'. Developing talent in these is a much more time-consuming and long-term process (than in long-distance running, for example). It presupposes a well-organized structure of the sports. Lack of the organizational structure to develop athletic skills may form a serious barrier to entry in the more technical events. The presence, detection and recruitment of talented athletes in a country is no longer sufficient to be successful. Talent development is necessary too. From the perspective of sports federation this may offer opportunities. Indeed, a well-organized federation will be able to develop its athletes and thus generate more athletic success given its pool of talent. Because setting up and running organization with such long-term perspective is rather costly, wealthier countries have a comparative advantage. From a policy perspective it is thus rational for them to specialize in those events (and more generally those sports) that have higher barriers to entry.

## Notes

- <sup>1</sup> De Bosscher *et al.*, *A Global Sporting Arms Race*.
- <sup>2</sup> Van Bottenburg, *Global Games*.
- <sup>3</sup> *Ibid.*
- <sup>4</sup> Dejonghe, *Sport in de Wereld*.
- <sup>5</sup> Shibli and Bingham, 'An Evaluation of Medal-Based Measures of Performance'.
- <sup>6</sup> Van Bottenburg, *Global Games*.
- <sup>7</sup> Dejonghe, *Sport in de Wereld*.
- <sup>8</sup> Guttmann, *Games and Empires*.
- <sup>9</sup> Giulianotti and Robertson, *Globalization and Sport*.
- <sup>10</sup> Maguire, *Global Sport*.
- <sup>11</sup> Du Bois and Heyndels, 'Internationalization in Athletics'.
- <sup>12</sup> Chamerois, 'The Globalisation of the Olympic Games'.
- <sup>13</sup> The number includes both male and female events and does not include the relays. The number of performances falls short of the number of events  $\times$  100 because in a number of instances the IAAF ranking did not give 100 athletes.
- <sup>14</sup> Du Bois and Heyndels, 'Internationalization in Athletics'.
- <sup>15</sup> Clarke and Davies, 'Aggregate Concentration'.
- <sup>16</sup> Deutsch and Silber, 'Static Versus Dynamic Measures of Aggregate Concentration'.
- <sup>17</sup> Du Bois and Heyndels, 'Internationalization in Athletics'.
- <sup>18</sup> Hymer and Pashigian, 'Turnover of Firms as Measure of Market Behaviour'.
- <sup>19</sup> *Ibid.*
- <sup>20</sup> *Ibid.*
- <sup>21</sup> Gembris, Taylor, and Suter, 'Evolution of Athletic Records'.
- <sup>22</sup> It may be argued that athletic performances in 1984 were at a higher level because this was an Olympic year and the Games act as an incentive for individual athletes. Although the organization of the Games may indeed have a positive effect on performances, it can certainly not explain the findings in Table 4. Comparison of first ranked athletes in 1984 with IAAF rankings of 2004 (which was an Olympic year) gives similar results as those found. Indeed, in the 12 (comparable) events which were Olympic in both 1984 and 2004 we find that in 10 cases the best 1984 performance is better than the 2004 season's best. Only for hurdling (both 100 m and 400 m) was the best 2004 performance better than 20 years earlier. So, it can be concluded that the general level of elite athletic performance for women is at best stagnating over the period considered.
- <sup>23</sup> Du Bois and Heyndels, 'Internationalization in Athletics'.
- <sup>24</sup> United Nations.
- <sup>25</sup> De Bosscher *et al.*, *A Global Sporting Arms Race*.
- <sup>26</sup> De Bosscher, 'Sports Policy Factors Leading to International Sporting Success'.

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## Appendix

Table A1. Static and dynamic internationalization 1984–2006 by event.

	HP		N		CR4	
	Men	Women	Men	Women	Men	Women
100 m	-0.03	0.05	4	6	0.36	0.43
200 m	-0.05	0.01	10	14	0.41	0.44
400 m	-0.14	0.01	5	9	0.44	0.40
800 m	-0.08	-0.26	3	14	0.41	0.44
1500 m	0.01	-0.35	2	12	0.54	0.48
3000 m	-	-	-	-18	-	-
5000 m	0.16	0.03	-5	4	0.71	0.64
10,000 m	0.25	-0.09	-8	6	0.62	0.64
Marathon	0.37	-0.04	-12	-2	0.72	0.70
3000 m steeplechase	0.03	-	-2	34	0.51	-
100 m hurdles	-	-0.20	-	11	-	0.46
110 m hurdles	-0.29	-	11	-	0.41	-
400 m hurdles	-0.08	-0.13	1	11	0.42	0.42
High jump	-0.31	-0.27	12	7	0.37	0.26
Pole vault	-0.20	-	5	28	0.32	-
Long jump	-0.38	-0.26	12	17	0.48	0.40
Triple jump	-0.24	-	9	29	0.52	-
Shot put	-0.23	-0.17	9	14	0.25	0.58
Discus	-0.21	-0.10	7	10	0.25	0.48
Javelin	-0.24	-0.19	2	10	0.33	0.28
Hammer	-0.3	-	9	29	0.34	-
Heptathlon	-	-	-	6	-	0.28
Decathlon	-0.37	-	8	-	0.36	-
20 km race walking	-0.12	-	5	-	0.57	-
50 km race walking	-0.41	-	7	-	0.45	-

Note: CR4, concentration ratio; HP, Hymer and Pashigian; N, number of countries with ranked athletes.

Table A2. Performance evolution 1984–2006: rank that would be obtained in 2006 with performance ranked 10th in 1984, illustrated by event.

	Men	Women
100 m	31	15
200 m	19	7
400 m	13	5
800 m	10	5
1500 m	29	7
3000 m		8
5000 m	58	92
10,000 m	26	75
Marathon	58	56
3000 m steeple	26	
100 m hurdles		15
110 m hurdles	31	
400 m hurdles	13	21
High jump	5	7
Pole vault	18	
Long jump	12	4
Triple jump	12	
Shot put	4	2
Discus	8	1
Javelin	3 <sup>a</sup>	2 <sup>a</sup>
Hammer	11	
Heptathlon		2 <sup>a</sup>
Decathlon	2 <sup>a</sup>	
20 km race walking	50	
50 km race walking	19	

Note: <sup>a</sup> Performance not comparable as the technical characteristics of javelin changed.