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Elite marathon runners: do East Africans utilize different strategies than the rest of the world?

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Abstract

This paper investigates the recent dominance of East African runners at the marathon race distance. Do East Africans utilize different race strategies than runners from other countries? We find that runners who pursue the three strategies of (1) running a negative split, (2) running with the lead pack at the 30 kilometer mark of the marathon, and (3) running faster from 30 kilometers to 35 kilometers than the previous 5 kilometer split (25 kilometers – 30 kilometers) are more likely to win the race and to finish in the top three. We also find that East Africans are more likely to successfully utilize these strategies than runners from other countries.

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1. Introduction

In recent history, East African runners are often among the very best of the elite marathon performers. Note that an East African is defined here as a runner from Kenya, Ethiopia, Uganda, or Eritrea. This appears to be true in both men's and women's marathon races. A significant literature has sought to understand whether the strong performance of East Africans is because of genetic differences, training differences, or geographical differences (see for example, Epstein (2013) and McClusky (2014)). Hill (2014) investigated how race performance could be affected by peer effects. In this paper, we are interested in investigating whether this recent dominance by East African runners at the marathon distance is due, at least in part, to these East African runners successfully following different marathon racing strategies as compared to non-East African runners.

Before examining whether East African runners pursue different racing strategies, it is important to identify race strategies for elite runners, particularly at the marathon distance. One race strategy that is considered by both coaches and runners to be very relevant for elite racing performance is to start the race at a pace that is sustainable for the entire race distance and then speed up over the second half of the race. According to this strategy, runners should try to avoid getting so caught up in the excitement of the race that they start the race at a pace that is too fast for their current level of fitness. This strategy of running the second half of the race faster than the first half of the race is known as running a negative split.

In his book, *Hansons Marathon Method: A renegade path to your fastest marathon*, elite marathon runner and running coach Luke Humphrey points out that "every current world record from 5K to marathon has been set via negative or even splits." In his book with Scott Douglas, *Advanced Marathoning* (2nd ed.), current running coach and former Olympic marathon runner, Pete Pfitzinger agrees. According to Pfitzinger and Douglas, "For the best marathoners in the world, the most effective pacing strategy is to run the second half of the marathon at the same pace as, or even slightly faster than, the first half. Most of the recent world records have followed this model of slightly faster second halves." Pfitzinger and Douglas also provide some examples of negative splits being used successfully in recent world record setting marathon times. "In setting the world best of 2:03:59 at the 2008 Berlin Marathon, Haile Gebrselassie ran the first half in 62:05 and the second half in 61:54. In setting his first world record at this distance, Gebrselassie ran 2:04:26 at the 2007 Berlin Marathon, with half times of 62:29 and 61:57. Similarly, in her first world record, at the 2002 Chicago Marathon, Paula Radcliffe ran 2:17:18 by running the first half in 69:03 and the second half in 68:15. When she set her current world record of 2:15:25 at the 2003 London Marathon, her first half took 68:02, and then she ran the second half in 67:23."

In his book, *Daniels' Running Formula* (3rd ed.), Jack Daniels, who has been coaching and mentoring some of the top collegiate and post-collegiate level distance runners for more than 50 years, summarizes another strategy as follows: "As I tend to feel about all race distances, the race actually starts about two-thirds of the way through that particular event. Up to that two-thirds point, you need to see how relaxed you can be while still sticking with the pace (or competitors) that your plan calls for." Specific to the marathon distance, Pfitzinger and Douglas offer similar advice: "A rule of thumb is to deviate from your goal pace by no more than 8 to 10 seconds per mile during the first 20 miles (32 km) of the race." Pfitzinger and Douglas also point out that "even the best runners in the world pay for it when they start a marathon too quickly."

The previous strategy seems to beg the follow up question of what strategy should then be followed for the end of the race. Coach Jack Daniels provides some guidance for a race strategy recommendation by following up and expanding on his previous strategy recommendation: "Run with your head for the first two-thirds of every race and with your heart for the last third." Pfitzinger and Douglas provide a similar recommendation for the marathon distance: "The key from 20 miles (32 km) to the finish is to push as hard as you can without having disaster strike…"

In addition to the strategies already discussed, Pfitzinger and Douglas also point out that, "If you're racing a marathon in which your specific finishing place is an important consideration (e.g., the Olympic trials), then your pacing strategy will be somewhat determined by the actions of others in the race. If a group of 10 runners breaks away, then you had better go with them, even if it means running faster than planned."

Using the previous discussion of important marathon race strategies as motivation, we argue that a runner's optimal strategy is to be near the lead at the 30 kilometer mark. At this point, the runner should increase his/her speed which will lead to a negative split. For our analysis, we focus on three strategy variables that capture this optimal strategy quite well. These strategy variables are (1) running a negative split, (2) running with the lead pack, which we define as being within three seconds of the leader at the 30 kilometer mark of the marathon (roughly 2/3 of the marathon), and (3) running faster from 30 kilometers to 35 kilometers than the previous 5 kilometer split (25 kilometers – 30 kilometers).

Using data from recent major international marathon races, we investigate whether these three important strategies are successfully followed by elite marathon runners. We also investigate potential differences in strategies among different groups of elite marathon runners. Because of the recent dominance of East African runners (both males and females) at the marathon race distance, a question of particular interest is whether East African runners tend to employ different race tactics (strategies) than elite marathon runners from other countries (like the U.S.). We find that runners who pursue the three strategies described above are more likely to win the race and to finish in the top 3. In addition, for male runners, we find that East Africans are more likely to successfully utilize these three strategies than runners from other countries. In the women's races, we find that East Africans are more likely to be within three seconds of the leader at the 30 kilometer split and are more likely to then speed up in the next 5 kilometers but the proportions of women who run a negative split are statistically equivalent for East Africans and non-East Africans. However, the proportion of Kenyan women who run a negative split is significantly different than both the proportions of Ethiopian and US women who run a negative split.

This study satisfies the University Institutional Review Board requirements for research involving human subjects. The principal concern of this paper is to use race performance data to examine whether elite marathon runners from East African countries are more likely to successfully employ optimal race strategies compared to elite runners from other countries.

2. Data

Data for marathon performance were collected from the websites of four major international marathons: Berlin, Chicago, London, and New York City Marathons. Historical performance data, including split times for each 5 kilometers of the marathon were collected for elite level finishers of the Berlin, Chicago, and London Marathons for the years 2009 through 2014.

Comparable data was also collected for elite finishers of the New York City Marathon for the years 2009, 2010, 2011, and 2013. It is important to point out that the New York Marathon was not held in 2012 because of Hurricane Sandy. Because we focus on elite runners, all data were collected for both the top 10 finishers in the Men's and the Women's Marathon races in each year for a total of 22 races. This data is used to investigate potential differences in competitive strategies employed by East African runners and how this might relate to the recent dominance of distance runners from this geographic region.

Summary statistics are presented in Table 1. As seen, there are 219 elite male runner observations, since one male observation was dropped because there was no information on the runner at multiple points of the race. Of these, nearly 63% of the observations are East African. A closer examination of observations by country shows that nearly 42% are from Kenya, 16.9% from Ethiopia, and 10.5% are from the United States. Male runners run a negative split 12.8% of the time and 44.7% of the male observations are from runners in the lead pack at the 30km point of the race. Finally, 24.7% of the time, male runners run a faster 5k split from 30k to 35k than they did from 25k to 30k, and they finish the race with an average time of 7,743.5 seconds.

Similarly, there are 220 elite female runner observations. Of these, 40.9% of the observations are East African, 16.8% are from Kenya, 24.1% from Ethiopia, and 10.5% are from the United States. Female runners run a negative split 27.3% of the time and 31.4% of the female observations are from runners in the lead pack at the 30km point of the race. Finally, 24.5% of the time, female runners run a faster 5k split from 30k to 35k than they did from 25k to 30k, and female runners finish with an average time of 8,834.7 seconds.

Table 1: Summary statistics

Elite male runners				
Variable	Mean	Std. Dev.	Min	Max
East African	0.626	0.485	0	1
Kenyan	0.416	0.494	0	1
Ethiopian	0.169	0.376	0	1
U.S.	0.105	0.307	0	1
Winner	0.100	0.301	0	1
Top 3 finish	0.297	0.458	0	1
Negative split	0.128	0.335	0	1
In lead pack at 30K	0.447	0.498	0	1
Make a move at 30k	0.247	0.432	0	1
Finishing time (seconds)	7743.511	178.760	7377	8269
Observations	219			
Elite female runners				
Variable	Mean	Std. Dev.	Min	Max
East African	0.409	0.493	0	1
Kenyan	0.168	0.375	0	1
Ethiopian	0.241	0.429	0	1
U.S.	0.105	0.307	0	1
Winner	0.100	0.301	0	1
Top 3 finish	0.300	0.459	0	1
Negative split	0.273	0.446	0	1
In lead pack at 30K	0.314	0.465	0	1
Make a move at 30k	0.245	0.431	0	1
Finishing time (seconds)	8834.673	267.907	8300	9570
Observations	220			

3. Econometric Methodology

The principal concern of this paper is to use race performance data to examine whether elite marathon runners from East African countries are more likely to successfully employ optimal race strategies compared to elite runners from other countries. As discussed in the introduction, we focus our analysis on three strategies often recommended by coaches and used by elite marathoner runners. Our investigation into the use of these three optimal strategies in major marathons proceeds as follows.

In the first step, and to help motivate further analysis, we investigate whether our data supports these optimal strategies as being important in determining the winners in recent major marathons. We begin by examining differences in how frequently the finishers pursue a particular strategy. As seen in Table 2, male winners are more likely to pursue all three strategies relative to non-winners. In addition, males who finish in the top 3 are also more likely to pursue all three strategies relative to those outside the top 3. Similarly, female winners and those who finish in the top 3 are more likely to pursue all 3 strategies relative to non-winners and those outside the top 3.

Table 2: Strategy variables by outcome

	Elite male runners					
	Winners	Non-Winners	Difference	Top 3	Not Top 3	Difference
Variable	(a)	(b)	(a)≠(b)	(c)	(d)	(c)≠(d)
Negative split	0.591	0.076	***	0.400	0.013	***
In lead pack at 30K	0.955	0.391	***	0.815	0.292	***
Make a move at 30k	0.591	0.208	***	0.508	0.136	***
Observations	219					
	Elite female runners					
	Winners	Non-Winners	Difference	Top 3	Not Top 3	Difference
Variable	(a)	(b)	(a)≠(b)	(c)	(d)	(c)≠(d)
Negative split	0.636	0.232	***	0.439	0.201	***
In lead pack at 30K	0.818	0.258	***	0.667	0.162	***
Make a move at 30k	0.409	0.227	*	0.348	0.201	**
Observations	220					

***, **, and * indicates that the strategies are significantly different at the 1%, 5%, and 10% level, respectively.

In the second step of the analysis, and in order to examine the strategies in more detail we then estimate probit models for the probability of winning the marathon using data for all races in our data set. Before continuing, it is important to point out that a potential econometric issue involves the clustering of data. Runners are behaving strategically, so their results are correlated and it is expected that the error terms are correlated across observations within a race. To prevent the standard errors from being incorrectly estimated, the probit models are estimated with standard errors clustered by race and year.

Finally, we proceed with our analysis by testing whether the proportions of elite marathon runners who successfully employ the optimal strategies differ by region of the world. In particular, we are interested in whether East African runners tend to successfully implement these strategies more often than runners from other countries.

4. Results

We begin by noting that for each probit model estimated, our expectations are that all three of these optimal strategies will have a positive effect on the probability of winning. Since men and women may employ different racing strategies we estimate separate models for the men's and women's races. For examples of the substantial literature looking at gender difference in competition, see Emerson and Hill (2014), Croson and Gneezy (2009), Frick (2011), Gneezy and Rustichini (2004), and Niederle and Vesterlund (2007 and 2011). The results of these probit models are reported in Table 3. Since we are focusing our analysis on elite top 10 finishers, we argue that these runners have similar combinations of training and ability going into the race.

Table 3: Probit estimates

	Elite male runners	Elite female runners
Variable	Prob.Win	Prob.Win
Negative split	0.197***	0.083**
	(0.070)	(0.051)
In lead pack at 30K	0.114**	0.182***
	(0.039)	(0.054)
Make a move at 30k	0.052**	0.029
	(0.032)	(0.036)
Observations	219	220

The table displays marginal effects with clustered standard errors. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

For elite male marathon runners, the results match our expectations; all three strategies have a positive and significant effect on the probability of winning. For elite female marathon runners, the results for two of the strategies, running a negative split and being near the lead at the 30 kilometer mark, match our expectations. However, speeding up over the next 5 kilometers after the 30 kilometer mark does not significantly affect the probability of winning in the women's races. Results for probit models for the probability of placing in the top three finishers are very similar and are not reported here.

With the previous results suggesting that the proposed optimal strategies are important for the best runners, we proceed with our analysis by testing whether the proportions of elite marathon runners who successfully employ the optimal strategies differ by region of the world. We begin by examining whether East African runners tend to successfully implement these strategies more often than runners from other countries. To see if there are differences within East African runners, we also separate runners into Kenyan, Ethiopian, U.S., and others, which includes all non-East African and non-United States runners. In our sample of 219 elite male runners, 137 are East African. Of these, 91 are Kenyan, 37 are Ethiopian, and 9 are from other East African countries. In addition, 82 of the elite male observations are not from East Africa, and 23 of these observations are runners from the United States. In our sample of 220 elite female runners, 90 are East African. Of these, 37 are Kenyan and 53 are Ethiopian. There are 130 female observations of runners who are not from East Africa, and 23 of these observations are runners from the United States.

Our focus is on East African runners because of the recent success of East African marathon runners. As seen in Table 4 below, of the 22 male winners of the marathons in our sample, 95.5% of the winners are East African. We also see that 72.7% of the winners are from Kenya, 22.7% are from Ethiopia, and 4.5% are from the U.S. Similarly, of the 65 male runners who finish in the top 3, 90.8% are East African.

The female marathon races have also been dominated by East African runners but by a relatively lesser extent than the male marathon races. Of the 22 female winners, 77.3% are East African, 45.5% are Kenyan, 31.8% are Ethiopian, and 0% are from the US. Of the 66 female runners who finish in the top 3, 62.1% are East African. While there are some differences across genders, it is apparent that recent marathon races have been dominated by East African runners. Our analysis now considers whether these runners pursue the three racing strategies at a higher rate than runners from other areas of the world.

Table 4: Winners and top 3 performers by nationality

	Elite male runners	
Variable	Winners	Top 3
East African	0.955	0.908
Kenyan	0.727	0.631
Ethiopian	0.227	0.277
US	0.045	0.031
Observations	22	65
	Elite female runners	
Variable	Winners	Top 3
East African	0.773	0.621
Kenyan	0.455	0.333
Ethiopian	0.318	0.288
US	0.000	0.030
Observations	22	66

As seen in Table 5, we find that in the men's races, 18.2 percent of the East Africans run a negative split. The proportion of men from other regions of the world who run a negative split (3.7 percent) is significantly different than the proportion of East Africans. In the women's races we see that when comparing East African and non-East African runners, the proportions of women who run a negative split are statistically equivalent (27.8 percent and 26.9 percent respectively). However, if we compare Kenyan women with women from other countries, we see that the proportion of Kenyans who run a negative split is significantly different than both the proportions of Ethiopian and US women who run a negative split.

Table 5: Percent of runners who run a negative split by nationality

	Elite male runners									
	East African (a)	Non-East African (b)	Difference (a)≠(b)	Kenya (c)	Ethiopia (d)	US (e)	Others (f)	Difference (c)≠(d)	Difference (c)≠(e)	Difference (e)≠(f)
Negative Split	18.2	3.7	***	19.8	18.9	4.3	2.9		*	
Obs.	137	82		91	37	23	68			
	Elite female runners									
	East African (a)	Non-East African (b)	Difference (a)≠(b)	Kenya (c)	Ethiopia (d)	US (e)	Others (f)	Difference (c)≠(d)	Difference (c)≠(e)	Difference (e)≠(f)
Negative Split	27.8	26.9		48.6	13.2	21.7	28.0	***	**	
Obs.	90	130		37	53	23	107			

***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively

The proportions of male marathon finishers who were within three seconds of the leader at various 5 kilometer splits of the marathons in our dataset are summarized in Table 6. For the

men's races, it can be seen that the proportions of East African runners who are in the lead pack at different 5K splits in the marathons are consistently higher than the proportions of runners in the lead pack who are not East African. In addition, we also find that these differences in proportions of runners in the lead pack are statistically significant for every split. In particular, at the 30K split, 62.8 percent of East African runners are in the lead pack, but only 14.6 percent of runners who are not East African are in the lead pack at the 30K split. We see very similar results for the women's races. At the 30K split, 52.2 percent of the East African women runners are in the lead pack; however, only 16.9 percent of the women finishers who are not East African are in the lead pack at the 30K point of the races. Tests for equality of these proportions suggest that these differences are statistically significant.

Table 6: Percent of runners in the lead pack by nationality

Elite male runners										
Race Distance	East African (a)	Non-East African (b)	Difference (a)≠(b)	Kenya (c)	Ethiopia (d)	US (e)	Others (f)	Difference (c)≠(d)	Difference (c)≠(e)	Difference (e)≠(f)
5k	83.9	37.8	***	84.6	86.5	39.1	41.2		***	
10k	86.9	31.7	***	86.8	89.2	34.8	36.8		***	
15k	84.7	25.6	***	83.5	89.2	17.4	35.3		***	
20k	76.6	32.9	***	79.1	73.0	34.8	36.8		***	
Half	77.4	24.4	***	79.1	78.4	17.4	30.9		***	
25k	73.7	28	***	78.0	73.0	30.4	27.9		***	
30k	62.8	14.6	***	64.8	67.6	8.7	17.6		***	
35k	32.1	1.2	***	37.4	27.0	4.3	0		***	*
40k	20.4	1.2	***	22.0	21.6	4.3	0		*	*
Finish	15.3	1.2	***	17.6	13.5	4.3	0			*
Obs.	137	82		91	37	23	68			
Elite female runners										
Race Distance	East African (a)	Non-East African (b)	Difference (a)≠(b)	Kenya (c)	Ethiopia (d)	US (e)	Others (f)	Difference (c)≠(d)	Difference (c)≠(e)	Difference (e)≠(f)
5k	71.1	30	***	75.7	67.9	26.1	30.8		***	
10k	64.4	26.9	***	70.3	60.4	26.1	27.1		***	
15k	68.9	27.7	***	75.7	64.2	26.1	28.0		***	
20k	61.1	21.5	***	67.6	56.6	13.0	23.4		***	
Half	70	20.8	***	75.7	66.0	13.0	22.4		***	
25k	54.4	18.5	***	62.2	49.1	13.0	19.6		***	
30k	52.2	16.9	***	67.6	41.5	17.4	16.8	**	***	
35k	38.9	11.5	***	54.1	28.3	4.3	13.1	**	***	
40k	26.7	6.2	***	37.8	18.9	0.0	7.5	**	***	
Finish	18.9	3.8	***	27.0	13.2	0.0	4.7	*	***	
Obs.	90	130		37	53	23	107			

***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively

Table 6 also provides lead pack behavior by specific nationality. For male runners, we see that Kenyans and Ethiopians run in the lead pack at high rates that are statistically similar. Kenyans run in the lead pack at a higher percentage than U.S. runners. For the female runners, we see again that Kenyan and Ethiopian runners run in the lead pack in a statistically similar proportion, but the Kenyans run in the lead pack at a higher proportion that Ethiopian runners

beginning at the 30K point of the race. Finally, Kenyan women run in the lead pack at significantly higher proportions at all points of the race relative to U.S. runners.

Table 7 reports the proportions of men and women finishers who surge (run faster than the previous 5K split) during different 5K splits late in the race. In the men's races, we see that 31.4 percent of the East African runners surge from 30K to 35K, while 13.4 percent of non-East African runners surge at the same point in the race. Further, this difference is statistically significant. The results for the women's races tell a different story than the men's. The proportions of East African runners who surge in later stages of the marathons are statistically equal to the proportions of women who are not East African. In particular, 25.6 percent of the East African women surge from 30K to 35K, while 23.8 percent of non- East African women surge at the same point in the marathon.

Table 7: Percent of runners who surge by nationality

	Elite male runners									
Race Splits	East African (a)	Non-East African (b)	Difference (a)≠(b)	Kenya (c)	Ethiopia (d)	US (e)	Others (f)	Difference (c)≠(d)	Difference (c)≠(e)	Difference (e)≠(f)
25-20k<20-15k	57.7	40.2	**	53.8	59.5	26.1	51.5		**	**
30-25k<25-20k	45.3	45.1		47.3	48.6	65.2	33.8			***
35-30k<30-25k	31.4	13.4	***	35.2	27.0	13.0	13.2		**	
40-35k<35-30k	8.0	9.8		8.8	0.0	8.7	13.2	*		
Obs.	137	82		91	37	23	68			
	Elite female runners									
Race Splits	East African (a)	Non-East African (b)	Difference (a)≠(b)	Kenya (c)	Ethiopia (d)	US (e)	Others (f)	Difference (c)≠(d)	Difference (c)≠(e)	Difference (e)≠(f)
25-20k<20-15k	48.9	43.1		48.6	49.1	43.5	43.0			
30-25k<25-20k	50.0	40.0		64.9	39.6	43.5	39.3	**		
35-30k<30-25k	25.6	23.8		37.8	17.0	17.4	25.2	**	*	
40-35k<35-30k	30.0	33.1		32.4	28.3	17.4	36.5			*
Obs.	90	130		37	53	23	107			

***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively

If we focus on specific nationalities, we see that male Kenyans and Ethiopians surge in the 30K to 35K split at statistically similar proportions. However, we see that Kenyans surge in the 35K to 40K split at a significantly higher proportion. We also see that a lower proportion of U.S. runners surge from 30K to 35K relative to Kenyan runners. For female runners, we find that the proportion of Kenyans who surge in the 30K to 35K split is significantly different than the proportions of both Ethiopian and US women who surge at the same point in the race.

5. Conclusion

Our research question of interest is to determine if elite marathon runners from East African nations tend to successfully utilize optimal racing strategies more often than elite marathon runners from other nations. We find that, in the men's marathons East Africans successfully utilize the three optimal strategies more often than runners who are not East African. Further, our results demonstrate that Kenyan runners successfully employ these strategies more often than runners from the US.

In the women's marathon races, East African runners are more likely to be within three seconds of the leader at the 30K point in the race. However, the proportions of East Africans who run a negative split and who surge during the 30K to 35K split are not significantly different

for women who are not from East African nations. However, when we compare women marathoners from Kenya with women from other nations, we find that the proportions of Kenyan women who successfully use all three optimal strategies are greater than the proportions of US and Ethiopian women.

In our dataset, we find that East African male runners are more likely to win and finish in the top 3 of major marathon races in recent history. East African female runners are also more successful than runners from other countries, but they are relatively less dominant than East African males. Our results indicate that one potential explanation for this is that East African female runners pursue only one of the three optimal strategies at relatively higher rates than female runners from other parts of the world, while East African males pursue all three optimal strategies at higher rates than runners from other parts of the world.

How can these differences in strategic behavior be explained? It seems that there could be several possible explanations, any combination of which could help explain the current relative dominance of East African runners. One possibility is that the fittest runners, in terms of both training and ability, seem to currently come from regions in East Africa. We would expect the fittest runners to be more physically capable of successfully utilizing all three of the optimal strategies. Thus, while many runners enter the race with intentions to follow the optimal strategies, some may not be physically capable of successfully utilizing these strategies.

It is also possible that in some cases the finishing place could be more important than the actual finishing time. Thus, another possible explanation is that some elite runners might focus primarily on running with the leaders as long as possible. Many runners might begin the marathon with the goal of following all three optimal strategies to the best of their abilities but end up sacrificing pursuit of a strategy to optimize finishing place rather than time. For example, a runner might believe that they are maximizing their chance of finishing in the top three or possibly winning by staying with the lead pack as long as possible but doing so might make it more difficult to run a negative split. In this scenario, the behavior of a runner's peers will likely be much more important in determining that runner's strategic choices.

Other possible explanations could involve socio-economic differences between runners from different cultures. For example, are runners from East Africa more likely to work together as a team during the marathon? Is the relative financial incentive of winning a major marathon significantly greater for an East African runner compared to a runner from a wealthier country like the US? Are there fewer alternative professional opportunities in East African nations compared to wealthier regions of the world? These are all possible reasons for runners behaving differently in marathons but our research is not able to assign the differences in strategies to these characteristics.

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