Player valuations in the Indian Premier League

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The Indian Premier League (IPL) is a new "Twenty20" cricket league which completed its inaugural season in 2008. In a new departure for the cricketing world, players were assigned to teams primarily through an auction, which makes it possible directly to observe the valuations placed on individual players. Using this data, plus information on the previous performance, experience, and other characteristics of individual players, we are able to explore the determinants of valuations and investigate a number of hypotheses related to the design of the auction.

Historically, cricket has been a game played over several days. Test cricket, generally seen as the pinnacle of the game by purists, takes five days, and even then may end in a draw. In response to changing lifestyles and customer demands, the cricket authorities have gradually introduced shorter versions of the game. One day international cricket, which as the name suggests takes a full day, was introduced in the 1970s. And in 2003, the English Cricket Board introduced Twenty20 cricket – an even shorter form of the game taking less than three hours and capable of being played in an evening under floodlights.[2]

Twenty20 cricket was an immediate success in England and was rapidly exported to most parts of the cricket-playing world[3], with the initial exception of India (which had a strong affinity for one-day international cricket). However, this last exception was overcome when India won the inaugural Twenty20 World Cup in South Africa in 2007. This win prompted the founding of the unofficial Indian Cricket League[4]; the response was the founding of the (official) Indian Premier League (IPL).

The IPL created eight franchises assigned to eight of the largest cities in India. In January 2008, an auction was held for ownership of these franchises, with a base price for owning a team for 10 years set at $50m. All the franchises comfortably

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2 The Twenty (and the 20) in Twenty20 refer to the number of overs bowled by each side in each innings. An over is six balls delivered by the same bowler. Each over takes around 4 minutes to bowl, so at 15 overs an hour a Twenty20 game takes around three hours (given time for a short break in between innings). One day internationals typically have 50 overs each side. Test matches aim for 90 overs per day.

3 The cricket playing nations are all Commonwealth countries. The Test-playing nations are England, Australia, South Africa, New Zealand, West Indies, India, Pakistan, Sri Lanka, Bangladesh and (currently suspended) Zimbabwe.

4 "Unofficial" in the sense that it was not sanctioned by the Indian cricket board.

exceeded this amount, with final bids ranging from $67m to $112m.[5] The IPL prospectus outlined financial and marketing benefits to franchise owners, and media rights have been sold for over $1bn.[6]

The new franchises needed to acquire players. With no history for any team, the IPL hit upon a novel way of assigning players to teams – an (English) auction. The auction had several rules, of which the notable rules for the purposes article are as follows:

- Each franchise needs a squad of players, with 11 playing at any one time.
- Only 4 players at any time are allowed to be non-Indian.
- The franchises bid on the basis of the salary they are prepared to offer the player.
- There is an overall salary cap of $5m, while franchises have to spend at least $3.3m.
- Salaries are pro rated if a player is unavailable for part of the season, with the exception that if a player is unavailable for less than 25% of the season, the franchise is still liable for 25% of the salary and 25% of the salary is also counted towards the salary cap.
- The salary offer is valid for three years, although there is the possibility of player transfers in future years.[7]
- Each team must also have four under 22 players.
- Each bid starts with the base fee fixed by the IPL, and there is no upper limit.
- Players were grouped into different bands within the auction based on the expectations of the organisers that they were of similar experience and ability.
- Franchises were allowed to nominate one "icon" player who would have to play for their team – with the promise that they would earn 15% more than the next highest paid player on that team.[8]

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5 The teams are the Bangalore Royal Challengers, the Kolkata Knightriders, the Dehli Daredevils, the Mumbai Indians, the Chennai Super Kings, the Deccan Chargers (from Hyderabad but owned by the Deccan Chronicle media group), the Jaipur Rajasthan Royals, and the Kings XI Punjab (based in Mohali). Owners ranged from construction groups to Bollywood stars. The teams played against each other on a home-and-away basis with seven matches played at home. The top four from this league element went through to contest the semi-finals and the winners met in the final. The inaugural winners were the Rajasthan Royals, who defeated the Chennai Super Kings in a nail-biting finish.

6 http://timesofindia.indiatimes.com/articleshow/msid-2734443,prtpage-1.cms

7 Only the international players and the better known Indian players were auctioned. The remaining slots in the team squads were filled by lesser known Indian players, whose price was fixed at $50,000 per season while under-22 players received $20,000.

8 Since the teams were city-based, this allowed franchises to ensure that their most famous home grown player would play for them (at a price).

LITERATURE REVIEW

The use of sports markets to explore questions of economic interest has a long history. Topics considered include the relationship between wage determination where output is based on the contributions of an individual and the rest of the team, whether there is evidence for racial discrimination in the wages paid to different sports players, and the impact of collective bargaining and salary caps on overall wages, and how this has changed as salary restrictions have been partially lifted.[9]

The majority of this literature analyses US sports, notably American football, basketball, baseball, and ice hockey, whilst there is also a considerable interest in soccer, the leading world sport. This likely reflects two factors: the popularity of these sports and the availability of data. The literature on the economics of cricket is sparse at best. To our knowledge, the Journal of Sports Economics has until now published only one article on cricket, relating to the determinants of attendance at English county cricket.[10] Other cricket literature has looked primarily at the determinants of attendance of other types of matches.[11]

The most relevant literature for our purposes relates to previous attempts to understand the determinants of player wages, as a function of skills, market structure, discrimination by race, and league rules governing salaries. For US sports, relevant articles include Scully (1974), Hill and Spelman (1983), Jones and Walsh (1988), and Bishop et al (1990). There is no directly related paper looking at the valuations of cricket players. The most analogous situation relates to baseball, given the fact that cricket players' contribution to overall team performance can be measured with reasonable accuracy, in a similar way to baseball, in contrast to purer team sports such as American football where assigning contributions to individuals is less straightforward.[12]

RESEARCH QUESTIONS

The novel aspect of the IPL auction from a research perspective is that for the first time exact data is available on valuations for cricket players. In the past cricket authorities who operate central contracting for their star international players have provided some broad indications of the relative value of different indications, this is less than sufficient for accurate indications of the determinants

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9 See for example Fizel, J, Gustafson, E., and Hadley, L. (eds) Baseball Economics: Current Research (1996), Praeger Publishers., and Fizel, J, Gustafson, E., and Hadley, L. (eds.) Sport Economics: Current Research (1999), Praeger Publishers.

10 Paton D. and Cooke, A., Attendance at country cricket: an economic analysis (2005) Journal of Sports Economics, Vol. 6, No. 1, 24-45 (2005).

11 Hynds, M. and Smith, I., The demand for test match cricket (1994) Applied Economics Letters, Volume 1, Number 7, pp. 103-106(4); Schofield, J.A., The demand for cricket: the case of the John Player League (1983), Applied Economics, vol 15, no. 3, pp283-296; Bhattacharya, M. and Smyth, R., "The Game is Not the Same: The Demand for Test Match Cricket in Australia" . Australian Economic Papers, Vol. 42, pp. 77-90, 2003.

12 This does not necessarily mean that the statistics measured are fit for purpose. See Michael Lewis's book "Moneyball".

of those values to be drawn.[13] This is in contrast to the accurate salary data that is available on many US sports, such as American football, basketball, baseball, and ice hockey.[14]

It is also helpful that the rules of the auction are available. Auction theory points to two types of uncertainty which could affect auction outcomes – private value uncertainty and common value uncertainty.[15] Both may be present in this case.

- Private value uncertainty relates to uncertainty over the value that a bidder places on an object due to idiosyncratic factors affecting that bidder alone. In the cricket context, a team might place a greater value on an individual player for a variety of reasons, such as how well that player will fit with the rest of the team, and whether there is a particular marketing benefit associated with that player.
- Common value uncertainty arises when it is clear that the value of an item is approximately the same for all bidders, but that this level is unknown. Bidders each estimate the valuation with uncertainty; the winner will be the highest and hence most over-optimistic bidder. This problem gets worse with the numbers of bidders. Acknowledging this issue, bidders will shade down their bids, leading to lower valuations for the sellers.

The rules of the auction appear to be at least in part a response to these types of uncertainty. In relation to private value uncertainty, we can interpret the "icon player" rule as a means of ensuring that players that are particularly highly associated with a certain team (due to birth) are definitely assigned to that team; so that, for a price, there is no uncertainty about that player definitely playing for that team. However, if there genuinely was a clear sense in which one player was more attractive to a certain team, this rule appears redundant; that team would always outbid a rival. Indeed, this rule may be a means of sustaining the value to the player rather than the certainty gained by the bidder; Bulow et al (1999) demonstrate that if it is certain that one firm has a private value advantage, then others may not bid, leading to a low valuation.[16] If so, it would seem that teams would have an incentive to argue for the removal of this rule in the future, as it results in their paying substantially more for those players.

The rules of the auction also appear designed to minimise common value uncertainty and so the winner's curse, and hence to maximise the valuations placed on players. This provides an interesting possible motivation for the introduction of a salary cap. Various reasons have been explored for understanding the use of salary caps in sports leagues, notably as a mechanism to

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13 See for example http://en.allexperts.com/q/Cricket-1632/players-salaries.htm

14 See for example http://content.usatoday.com/sports/football/nfl/salaries/default.aspx.

15 McAfee, R Preston & McMillan, John (1987) "Auctions and Bidding", Journal of Economic Literature, vol. 25(2), pages 699-738, June.

16 Bulow, Jeremy, Huang, Ming and Klemperer, Paul, "Toeholds and Takeovers". Journal of Political Economy, Vol. 107, No. 3, June 1999.

keep leagues competitive, and as a way of reducing overall wages paid to players.[17]

But here we can consider a salary cap as a means of providing a focal point for teams' bids for players. It is plausible that based on historic performance data teams have a pretty good understanding of the relative merits of different players. The common value uncertainty arises from the fact that the overall value to be gained from any particular player, or players collectively, is unknown (in the sense that there is an uncertainty as to the effect of winning games on ticket sales and marketing benefits). The salary cap provides a focus for bids; if the maximum total wage is $5m across players, then this allows teams to understand the absolute values of each player.[18] The minimum salary cap (which is a novel rule) may also provide a similar focusing benefit, while ensuring that no team spends too little for competitive balance to be maintained.

These issues are not the focus of the paper. Rather, we concentrate on understanding whether teams responded rationally to the rules of the auction. Teams had only a short period of time to prepare for the auction, since the league was set up in a rush. There is always the possibility of a "bidding frenzy" during the auction itself. And there was substantial press and player comment at the time relating to the incomprehensibility of the valuations placed on individuals.[19]

Using the valuations of players, the rules of the auction, and data on player characteristics and performance, we explore the following questions:

- The extent to which player valuations are based on performance, and which performance features matter? We might hypothesise that previous experience and performance of Twenty20 cricket might be the most valuable, while Test Match experience is the least valuable, as it requires largely different skills (notably patience and risk-avoidance by batsmen).
- Whether, and how much, the rules set during the auction affected player valuations? In particular, the rules impose an artificial scarcity of Indian players, in particular young Indian players, through the cap on the number of overseas players and the requirement that there be a certain number of young Indian players in each squad.

To anticipate the conclusions, we find that there is strong evidence for team rationality in both cases, although there are some examples where either teams

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17 These issues are discussed in Ross, S.F., & Szymanski, S. (2005) "The Law & Economics of Optimal Sports League Design", Tanaka Business School Discussion Paper.

18 Imagine for simplicity there were only two players and that one was four times better than the other. In the absence of further information, all that is known is that $V_1 = 4V_2$, which has a multiplicity of solutions. If we also know that $V_1+V_2 = 5$, then the only solution is $V_1 = 4$, $V_2 = 1$.

19 David Hussey, who has never played Test cricket for Australia and has played only a handful of one-day internationals, received a bid of $675,000. His brother Mike Hussey (currently a Top 10 batsman in the international rankings for both Test and one-day cricket) received $350,000. As David Hussey said, "He [Mike Hussey] actually sent me a text message this morning and said, 'I can't believe you're worth double what I am'." See 27th February 2008 quote on Cricinfo: http://content-uk.cricinfo.com/magazine/content/quote/magazine/index.html?skiplimit=380;year=2008#top

were irrational or were employing information outside our model to arrive at valuations (such as on marketing value).

METHODOLOGY

We employ a reduced form model of the following general form:

$$value = f(experience, performance, characteristics) + error$$

The dependent variables employed cover a variety of performance factors (such as batting and bowling averages) in different forms of cricket, experience in different forms of cricket, and characteristics of players (such as age and nationality). This captures the theoretical expectation that players are more valuable to the extent that they increase the chances of winning games, since revenues for firms are increasing in success on the pitch. Note that we cannot capture in the regression the level of benefit gained from using a specific team member in the advertising and marketing of a team, nor of the contribution of that team member in non-quantifiable performance dimensions such as team spirit and fielding. The errors will pick up these factors plus other missing dimensions and measurement errors.

Data on valuations and characteristics was obtained from the IPL website.[20] Data on performance and experience was obtained from Cricinfo's Statsguru website.[21] Full details of the variables employed are contained in the Annex.

We employ standard OLS regression techniques. It is unlikely that any of the dependent variables are endogenous with respect to valuations, since they relate either to exogenous characteristics such as nationality, or to previous experience and performance, hence instrumental variables techniques are not necessary.[22]

We employ a general-to-specific methodology. Having searched a variety of specifications, the optimum specification is as set out in Table 1. The regression has an R-squared of 0.76 and passes the standard statistical tests (heteroskedasticity, omitted variables, and normality).[23] All the relevant variables are statistically significant at the 5% level.[24]

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20 www.iplt20.com

21 http://stats.cricinfo.com/statsguru/engine/current/stats/index.html This is a rich database that could be used to explore many other research questions.

22 Given that players did not know that the IPL was about to be developed, it is unrealistic to think that their career performance statistics would be influenced by possible future IPL valuations (and in any event it is not clear why players would not already have incentives to perform at the peak of their ability).

23 A log-log specification suffered from heteroskedasticity problems and did not provide additional explanatory power compared to the levels regression.

24 There are four variables included which act as controls where there is missing data on certain observations (where a player has never played an international Twenty20 match, for example). These allow us to capture the available data on that player rather than losing the observation. They can be interpreted as the average adjustment that needs to be made for a player that has e.g. never bowled in a one day international. All these variables are statistically insignificant in any event.

Dependent variable: price	Coefficient	Std. Error	t-ratio	P>|t|	95% CI	
					Lower bound	Upper bound
International T20 Matches Played	$11,899	$5,182	2.3	0.024	$1,579	$22,218
ODI Matches Played	$820	$227	3.61	0.001	$368	$1,272
T20_Batting_SR	$1,068	$4,501	2.37	0.02	$171	$1,966
ODI-SR-Bowling	-$1,584	$780	-2.03	0.046	-$3,136	-$31
Top 10 All Rounders Dummy	$194,322	$696,011	2.79	0.007	$55,727	$332,917
Indian 22 or under	$419,450	$663,100	6.33	0	$287,410	$551,491
Indian 23 or over	$240,212	$59,124	4.06	0	$122,480	$357,943
Icon Player	$354,263	$102,314	3.46	0.001	$150,530	$557,997
Dhoni dummy	$852,302	$185,031	4.61	0	$483,858	$1,220,746
Symonds dummy	$798,380	$178,075	4.48	0	$443,787	$1,152,972
Dummy, no international T20 matches played	-$65,174	$621,221	-1.05	0.297	-$188,877	$58,528
Dummy, no T20 matches played	-$29,099	$106,488	-0.27	0.785	-$241,144	$182,946
Dummy, no ODI matches played	$118,370	$110,135	1.07	0.286	-$100,937	$337,676
Dummy, no ODI bowling	-$55,680	$570,201	-0.98	0.332	-$169,223	$57,863
Player acquired outside auction	-$202,810	$602,211	-3.37	0.001	-$322,727	-$82,893
Constant	$114,024	$842,420	1.35	0.18	-$53,724	$281,773
Number of obs.	93					
R-squared	0.7593					
Adj R-squared	0.7124					

Table 1: Regression results

Source: Frontier analysis

A number of tentative conclusions may be drawn from the results.

- **Experience matters.** Players with more experience were more valued in the auction. This is likely to be because experience (especially international experience) reflects underlying ability, although it may also be that experience is valuable for its own sake. The most important experience was in international Twenty20 matches, where valuations were higher by about $12,000 per match. However, experience in ODIs was also valuable, valued at $820 per match.
- **Strike rates matter, for batting and bowling.** The batting strike rate is the number of runs a batsman scores per 100 balls. The bowling strike rate is the number of balls required to take a wicket. Both indicate the speed at which the game progresses – crucial in Twenty20 cricket given its limited duration. We find that each 10 point increase in batting strike rates results in a $11,000 increase in valuations.[25] Each 10 point reduction in bowling strike rates (i.e. fewer balls required to take a wicket) increases valuations by $16,000.
- **All-rounders are valuable.** There is a premium placed on being good at both batting and bowling. The top 10 ODI all-rounders, as measured by the ICC ratings, earned US$194,000 more than would otherwise have been expected on their batting and bowling performances alone. Effectively with these players you get almost "two for one".
- **There is a premium on being Indian.** The rules of the auction, and the nature of the franchises, meant that there was a premium for Indian players. The restriction to four overseas players means that each team needs a large number of Indian players (and there were not that many Indian players with previous international experience). Indian players are also likely to be more marketable in India than non-Indian players, so this is another potential source of premium. Moreover, the requirement that each team had four players of 22 or below meant an even greater premium on younger Indian players. We find the premium for younger Indian players was $419,000, while the premium for older Indian players was still a healthy $240,000.
- **There was an extra premium for "Icon" players.** Unsurprisingly, the five icons – Sachin Tendulkar, Sourav Ganguly, Rahul Dravid, Virender Sehwag, and Yuvraj Singh - earned $354,000 more than would have been expected from their ability and experience alone. This premium is over and above the benefits of being an experienced Indian player and may well have a strong element of marketing benefit. Note that the Icons were not bid for within the auction, but their salaries are derived from the criterion that they be 15% higher than the next highest salary in the side.
- **Special cases.** There are two players whose valuations we cannot properly capture within the regression framework (in the sense that they would cause the failure of the normality test). The highest bid of all was for Mahendra Singh Dhoni, India's ODI and Twenty20 captain. The bid was US$850,000

25 Batting strike rates typically range between 80 and 180 (runs per 100 balls).

more than we would have expected. It is again likely to reflect the huge marketing benefits that would accrue to the team Dhoni played for.[26] The other player that is an outlier is Andrew Symonds, the Australian all-rounder, for whom we find that the bid for Symonds was around $798,000 higher than expected.[27]

- **Bidding frenzy?** There are twelve players for whom we have valuations but who were not part of the auction, but instead were the subject of directly negotiated contracts. It is not clear from theory whether this should make any material difference, since it would be possible for players (or their agents) to create competition between the pool of bidders through successive negotiations. However, we find that players bid for outside the auction went for $203,000 less on average than their skills and experience suggest. Possible explanations for this are that there was a "bidding frenzy" at the time of the auction; alternatively that the players (or their agents) did not search around possible buyers as effectively as they could; or that with most slots filled through the auction, there were only a small number of teams left looking for players.

FACTORS THAT DIDN'T MATTER

In addition to the regression above, we also tested a number of other variables that could in principle have affected the results.

- **Test match experience and performance.** Test match experience and performance did not matter. This may be because the skills required in Test cricket are sufficiently removed from the requirements of Twenty20 cricket. Alternatively, it may be that this is a multicollinearity issue, in that Test match performance, ODI performance and Twenty20 performance are correlated to some extent.[28]
- **Missing games.** A number of players were not able to play for their teams for the full season due to international commitments elsewhere (salaries were in the auction were pro-rated accordingly). This could have affected valuations, but appears not to have made any difference.
- **Percentage of runs in 4s and 6s.** The fans like to see balls hit to the boundary (worth 4 runs), ideally without bouncing (6 runs). We found that there was no extra value placed on a player scoring a high percentage of runs in 4s and 6s, although this may well reflect the fact that this factor will already be taken into account in the batting strike rate.

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26 Mahendra Singh Dhoni might fairly be said to be the David Beckham of Indian cricket.

27 Symonds himself was at a loss to explain his valuation. "If I could tell you why that would probably be quite a good news story, but there is no sort of logical sense to what each player's worth ... I can't see a pattern" (Sydney Morning Herald, February 2008). One possible explanation relates to his notoriety due to being involved in altercations with Indian players in a previous Test series.

28 The correlation between Test and ODI performance, in terms of batting and bowling strike rates, is between 0.2 and 0.3. The correlation between Test and Twenty20 strike rates is lower, at less than 0.1.

In addition, we explored whether there was extra explanatory power from the order in which players were auctioned. We did not find any patterns in the valuations. A regression using just the auction groups explained about 60% of the variation in valuations. However, while this reveals that the organisers of the IPL were good judges of a player's worth, it does not provide any more information about the determinants of that worth.

ACTUAL VALUATIONS VS. OUR PREDICTIONS

The predictions of the regression analysis are plotted in Figure 1 against the actual valuations.

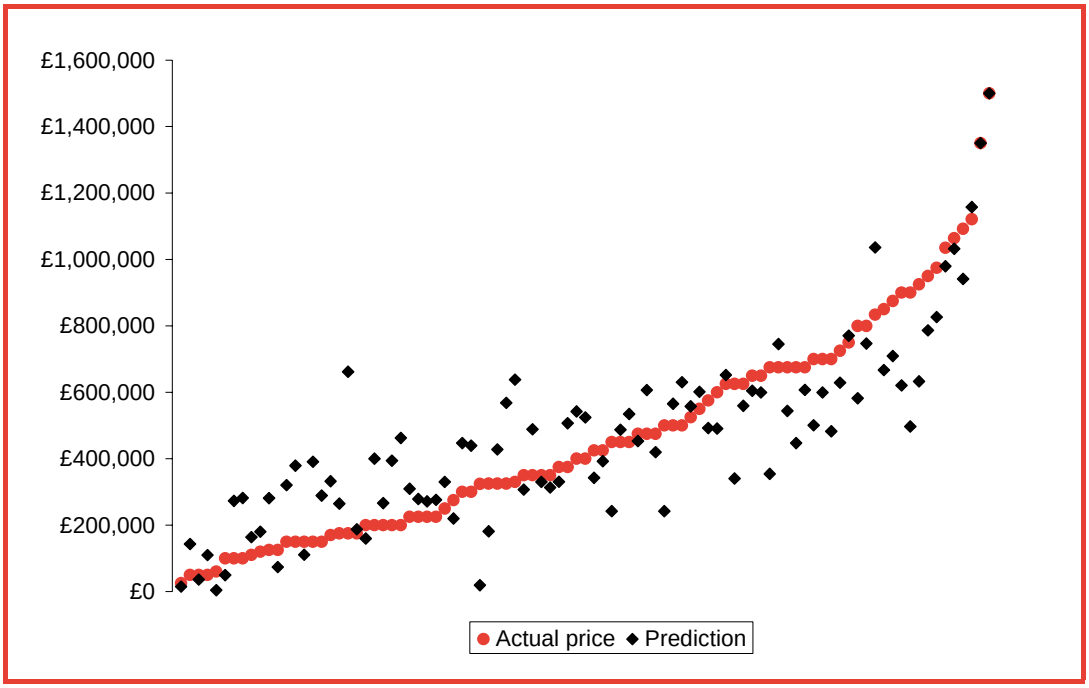

Figure 1: Predictions vs. residuals

Source: Frontier analysis

Overall, the fit is reasonable. If anything, we appear to slightly underestimate the valuations to players that went for higher prices, and similarly overestimate the valuations of players at lower levels. This may well reflect that a player's valuation reflects not just performance and experience (which we capture) but also marketing value and other intangible benefits (which it is not possible to capture).

VALUATIONS FOR ENGLISH PLAYERS

One notable group of absentees from the IPL auctions were the England players. The English season starts at the same time as the IPL and most experienced

England players were centrally contracted to play in the Test and ODI matches against New Zealand.[29]

We can use the regression analysis to predict the valuations of English players, had they been in the auction. Note that, as above. we can only predict valuations based on experience and performance, and under the assumption the bidders would have treated English players in the same fashion as other players. We cannot take account of likely marketing benefits, which may explain why we predict Kevin Pietersen to have gone for around $400,000 per season, while the rumours are that he has been offered a contract for future years of upwards of $1m.

29 Some of New Zealand's players were in the auction and played a handful of games in the IPL prior to flying to England.

	Predicted value based on experience and performance
Paul Collingwood	$652,470
Andrew Flintoff	$607,000
Kevin Pietersen	$410,875
Owais Shah	$351,842
James Anderson	$342,233
Ian Bell	$305,567
Stuart Broad	$298,296
Matt Prior	$281,015
Tim Ambrose	$251,925
Phil Mustard	$232,703
Ryan Sidebottom	$229,065
Steve Harmison	$194,190
Alastair Cook	$184,332
Matthew Hoggard	$161,687
Michael Vaughan	$131,761
Ravi Bopara	$108,670
Monty Panesar	$106,708

Table 2: Predictions for English players

Source: Frontier analysis

CONCLUSIONS

The IPL auction provides a unique opportunity in the cricketing world to understand the factors that drive player valuations. We find that valuations depended to a large extent on measurable performance and experience factors. But the rules of the competition also led to substantial premia for certain players (in particular young Indian players).

The IPL appears likely to be around for many years, providing opportunities for further research. It will be interesting to see how franchises respond to the existence of more data on player performance after the first season – in terms of player transfers and perhaps buying players out of their contracts if performance

has been disappointing. Moreover, there may be changes in the rules, such as a relaxation of the salary cap, which would be expected to boost valuations still further.

Annex – variables considered

The following variables were explored during the analysis.

Variable name	Description	Source
player_id	Player id code	IPL
icon	Player is icon player	IPL
price	Amount bid for player	IPL
nationality	Nationality	IPL
age	Age	IPL
team	Team	IPL
batting_style	Batting style	Cricinfo Statsguru
bowling_style	Bowling style	Cricinfo Statsguru
test_mat	Number of test matches played	Cricinfo Statsguru
test_inns	Number of test innings batted	Cricinfo Statsguru
test_ave	Test batting average	Cricinfo Statsguru
test_sr	Test strike rate	Cricinfo Statsguru
test_inns_bow~d	Number of Test innings bowled	Cricinfo Statsguru
test_ave_per_~t	Test average runs per wicket	Cricinfo Statsguru
test_econ	Test average runs per over	Cricinfo Statsguru
test___boundr~s	Test % of runs in boundaries	Cricinfo Statsguru
test_6s	Test % of runs in 6s	Cricinfo Statsguru
test_sr_bowling	Test bowling strike rate	Cricinfo Statsguru
odi_mat	Number of ODI matches played	Cricinfo Statsguru
odi_inns	Number of ODI innings batted	Cricinfo Statsguru
odi_ave	ODI batting average	Cricinfo Statsguru
odi_sr	ODI batting strike rate	Cricinfo Statsguru
odi_inns_bowled	Number of ODI innings bowled	Cricinfo Statsguru
odi_ave_per_w~t	ODI bowling average	Cricinfo Statsguru

odi_boundries~r	Percentage of ODI runs in boundaries	Cricinfo Statsguru
odi_6s	Percentage of ODI runs in 6s	Cricinfo Statsguru
odi_econ	ODI bowling economy rate	Cricinfo Statsguru
odi_sr_bowling	ODI bowling strike rate	Cricinfo Statsguru
it20_mat	Number of international T20 matches played	Cricinfo Statsguru
it20_inns	Number of international T20 innings batted	Cricinfo Statsguru
it20_ave	International T20 batting average	Cricinfo Statsguru
it20_sr	International T20 batting strike rate	Cricinfo Statsguru
it20_inns_bow~d	Number of international T20 innings bowled	Cricinfo Statsguru
it20_boundries	Percentage of international T20 runs in boundaries	Cricinfo Statsguru
it20_6s_perce~e	Percentage of international T20 runs in 6s	Cricinfo Statsguru
it20_ave_per_~t	International T20 bowling average	Cricinfo Statsguru
it20_econ	International T20 economy rate	Cricinfo Statsguru
it20_sr_bowling	International T20 bowling strike rate	Cricinfo Statsguru
t20_mat	Number of total T20 matches played	Cricinfo Statsguru
t20_inns	Number of total T20 innings batted	Cricinfo Statsguru
t20_ave	Total T20 batting average	Cricinfo Statsguru
t20_sr	Total T20 batting strike rate	Cricinfo Statsguru
t20_inns_bowled	Total T20 innings bowled	Cricinfo Statsguru
t20_boundries	Percentage of total T20 runs in boundaries	Cricinfo Statsguru
t20_6s_percet~e	Percentage of total T20 runs in 6s	Cricinfo Statsguru
t20_ave_per_w~t	Total T20 bowling average	Cricinfo Statsguru
t20_econ	Total T20 economy rate	Cricinfo Statsguru
t20_sr_bowling	Total T20 bowling strike rate	Cricinfo Statsguru

test_ran~nt_bat	Current Test batting ranking	ICC
test_ran~st_bat	Highest Test batting ranking	ICC
test_ra~nt_bowl	Current Test bowling ranking	ICC
test_ra~st_bowl	Highest Test bowling ranking	ICC
odi_ranking_c~t	Current ODI batting ranking	ICC
odi_ranking_h~t	Highest ODI batting ranking	ICC
odi_ranking_c~l	Current ODI bowling ranking	ICC
odi_ranking_h~l	Highest ODI bowling ranking	ICC
auction_order	Auction round 1-8, 0=England, 9	IPL
base_price	Base auction price	IPL
base_price_du~y	Dummy, = 1 if went for base auction price	
top_10_test_a~s	Dummy, = 1 if in Top 10 Test all-rounders list	ICC
top_10_odi_al~s	Dummy, = 1 if in Top 10 ODI all-rounders list	ICC
test_dummy	Dummy, = 1 if not played Test cricket	Derived
odi_dummy	Dummy, = 1 if not played ODI cricket	Derived
it20_dummy	Dummy, = 1 if not played international T20 cricket	Derived
t20_dummy	Dummy, = 1 if not played any T20 cricket	Derived
test_bowled_d~y	Dummy, = 1 if not bowled in Test cricket	Derived
odi_bowled_du~y	Dummy, = 1 if not bowled in ODI cricket	Derived
it20_bowled_d~y	Dummy, = 1 if not bowled in international T20 cricket	Derived
t20_bowled_du~y	Dummy, = 1 if not bowled in T20 cricket	Derived
test_no_wicke~y	Dummy, = 1 if taken a Test wicket	Derived
odi_no_wicket~y	Dummy, = 1 if not taken an ODI wicket	Derived
it20_no_wicke~y	Dummy, = 1 if not taken an international T20 wicket	Derived

t20_no_wicket~y	Dummy, = 1 if not taken a T20 wicket	Derived
india	Dummy, = 1 if player is Indian	Derived
youngest_indian	Dummy, =1 if player is Indian and aged 22 or under	Derived
oldest_indian	Dummy, =1 if player is Indian and aged 23 or over	Derived
australian	Dummy, = 1 if player is Australian	Derived
south_african	Dummy, = 1 if player is South African	Derived
sri_lanka	Dummy, = 1 if player is Sri Lankan	Derived
pakistan	Dummy, = 1 if player is Pakistani	Derived
nz	Dummy, = 1 if player is from New Zealand	Derived
other	Dummy, = 1 if player is from England, West Indies, Bangladesh or Zimbabwe	Derived
dhoni	Dummy, = 1 if Dhoni	Derived
symonds	Dummy, = 1 if Symonds	Derived
england_dummy	Dummy, = 1 if English	Derived
fourorfewer	Player available for four or more games	Derived from IPL data
missedgames	Dummy, player has missed some games	Derived from IPL data
gamesmissed	Number of games missed	Derived from IPL data
gamesavailable	Number of games available	Derived from IPL data
missedgamedummy	Dummy, some games missed	Derived from IPL data
fourorfewerdummy	Dummy, = 1 if available for four or fewer games	Derived from IPL data
outsideauction	Player not bid for in auction	IPL

Table 3: Variables, descriptions and sources

Source: Frontier, IPL website, Cricinfo Statsguru, ICC player rankings (www.icc-cricketrankings.com)