Assessing the Offensive Productivity of NHL Players Using In-game Win Probabilities

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FEBRUARY 27-28, 2015 BOSTON CONVENTION AND EXHIBITION CENTER
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Imagine that you're an NHL GM.

You want to add some goal scoring talent to your roster.

Two potential acquisitions

24 years old
15 goals in 2014-2015
0.26 goals per game (career)
48.1% Corsi-tied (career)

24 years old
16 goals in 2014-2015
0.30 goals per game (career)
47.6% Corsi-tied (career)

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Which player should you trade for?

The one who scores in high pressure situations.

or

The one who is more clutch

Outline of this talk

An NHL Win Probability Model

Narrative Building using Win Probabilities

Measuring Offensive Productivity with Added Goal Value

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An NHL Win Probability Metric

- Hockey journalists and statisticians currently lack many empirical tools available in other sports

  One such tool is a metric for calculating second-by-second win probabilities

- The metric introduced here:
  - is the only such metric currently available
  - incorporates powerplay information in a novel way
  - provides a flexible framework which can unify the work being done on puck possession, zone starts, spatial data, etc.

Intuition about the metric

$$
\begin{aligned}
P_t(w) \quad = \quad & P_t(w|\delta_t + 1) \cdot \Lambda(\gamma_h \cdot \nu_t) + \\
& P_t(w|\delta_t - 1) \cdot \Lambda(\gamma_a \cdot \nu_t) + \\
& P_t(w|\delta_t)(1 - \Lambda(\gamma_h \cdot \nu_t))(1 - \Lambda(\gamma_a \cdot \nu_t))
\end{aligned}
$$

When the teams are playing at full-strength, the vector ν_t is all zeros. This means that the metric simplifies to:

$$P_t(w) = P_t(w|\delta_t)$$

Intuition about the metric

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If the home team is on a powerplay then:

Intuition about the metric

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If the home team is on a powerplay then:

- $\Lambda(\gamma_h \cdot \nu_t)$ is the probability that the home team scores a PP goal

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If the home team is on a powerplay then:

- $\Lambda(\gamma_h \cdot \nu_t)$ is the probability that the home team scores a PP goal
- $\Lambda(\gamma_a \cdot \nu_t)$ is the probability that the away team scores a SH goal

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If the home team is on a powerplay then:

- $\Lambda(\gamma_h \cdot \nu_t)$ is the probability that the home team scores a PP goal
- $\Lambda(\gamma_a \cdot \nu_t)$ is the probability that the away team scores a SH goal
- $(1 - \Lambda(\gamma_h \cdot \nu_t))(1 - \Lambda(\gamma_a \cdot \nu_t))$ is the probability that neither team scores before they return to even strength

A flexible framework

$$
\begin{aligned}
P_t(w) \quad = \quad & P_t(w|\delta_t+1)\cdot \Lambda(\gamma_h\cdot\nu_t)+ \\
& P_t(w|\delta_t-1)\cdot \Lambda(\gamma_a\cdot\nu_t)+ \\
& P_t(w|\delta_t)(1-\Lambda(\gamma_h\cdot\nu_t))(1-\Lambda(\gamma_a\cdot\nu_t))
\end{aligned}
$$

Everything in red represents the probability that a goal is scored by one team or the other in some period of time.

The framework here allows for any statistics to be included, as long as you have a model that predicts how the stat impacts goal-scoring rates

- Which players are on the ice
- Zone starts
- Corsi and Fenwick stats
- Spatial data

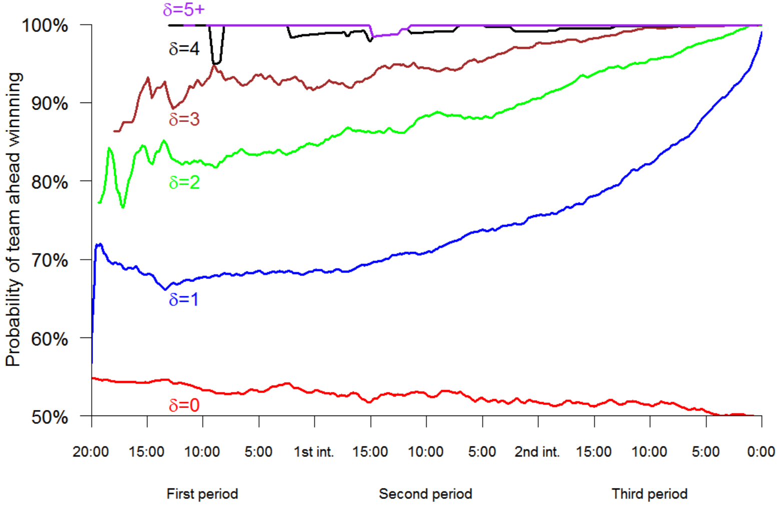
Estimating $P_t(w|\delta_t)$

I used empirical data to estimate $P_t(w|\delta_t)$

- Data from all regular season games from 2005/2006 through 2012/2013
- Over 9000 games

I then used a weak Bayesian prior to smooth out the data

Estimating $P_t(w|\delta_t)$



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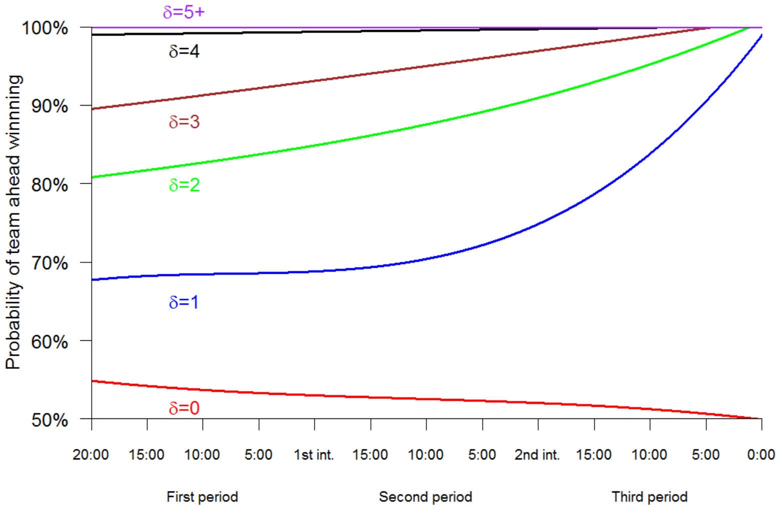
Estimating $P_t(w|\delta_t)$



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Flyers at Stars
Saturday, October 18, 2014

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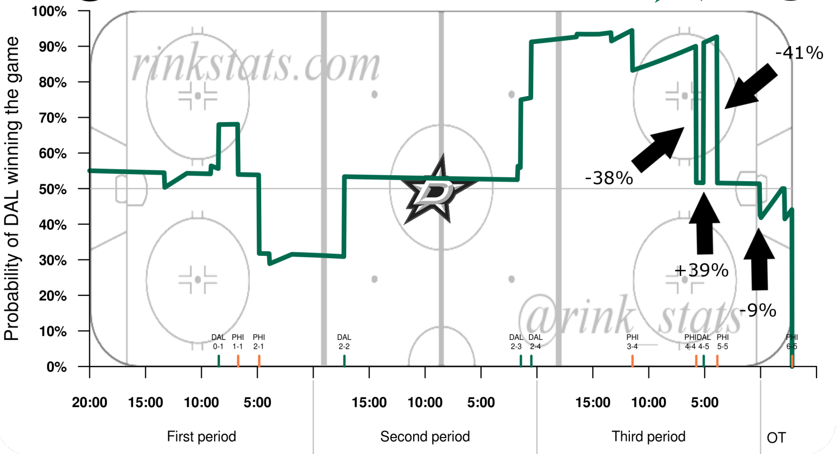
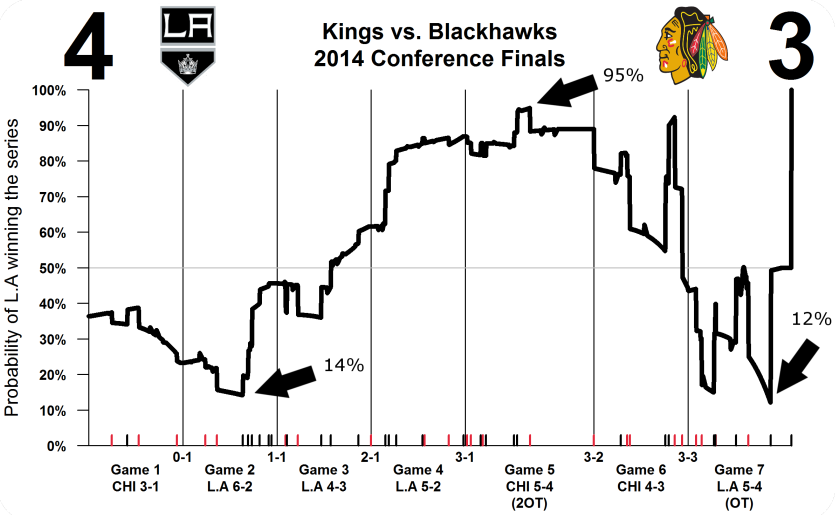
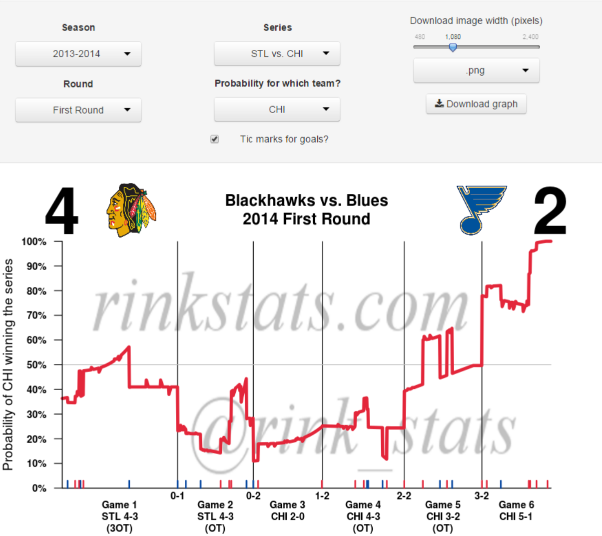




4
3
Kings vs. Blackhawks
2014 Conference Finals
Probability of L.A winning the series
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
95%
14%
12%
0-1
1-1
2-1
3-1
3-2
3-3
Game 1
CHI 3-1
Game 2
L.A 6-2
Game 3
L.A 4-3
Game 4
L.A 5-2
Game 5
CHI 5-4
(2OT)
Game 6
CHI 4-3
Game 7
L.A 5-4
(OT)

Win probability apps



See the apps at:
winprobs.rinkstats.com

Also featured on
war-on-ice.com

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Added Goal Value

Not all goals are created equal.

A 6^{th} goal in a 5-0 game is less valuable to a team than an overtime winner.

Traditional statistics like total goals masks this fact and treats every goal as equally important.

Added Goal Value (AGV) uses win probabilities to measure the significance of each goal. Players with high AGV can be thought of as being more "clutch."

The math behind Added Goal Value

$$AGV_{Crosby} = \sum_{k=1}^{K} \Delta_k - \frac{\sum_{j=1}^{J} \Delta_j}{J} \cdot K$$

$$\begin{aligned} \Delta_k &= P_{t_k+1}(w) - P_{t_k}(w) \\ \Delta_j &= P_{t_j+1}(w) - P_{t_j}(w) \end{aligned}$$

$\Delta_k = P_{t_k+1}(w) - P_{t_k}(w)$: change in win probability from a goal scored by Sidney Crosby

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$\Delta_k = P_{t_k+1}(w) - P_{t_k}(w)$: change in win probability from a goal scored by Sidney Crosby

$\Delta_j = P_{t_j+1}(w) - P_{t_j}(w)$: change in win probability from a goal scored another player

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Understanding Added Goal Value

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$\sum_{k=1}^{K} \Delta_k$: total added win percentage for all goals scored by Crosby

Understanding Added Goal Value

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$\sum_{k=1}^{K} \Delta_k$: total added win percentage for all goals scored by Crosby

$\frac{\sum_{j=1}^{J} \Delta_j}{J}$: average increase in win probability for all goals (about 17%)

Understanding Added Goal Value

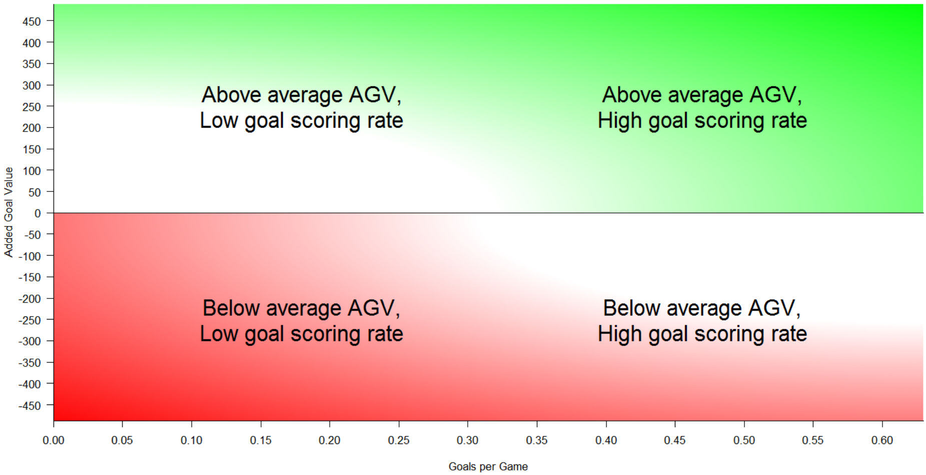
$$AGV_{Crosby} = \sum_{k=1}^{K} \Delta_k - \frac{\sum_{j=1}^{J} \Delta_j}{J} \cdot K$$

$\sum_{k=1}^{K} \Delta_k$: total added win percentage for all goals scored by Crosby

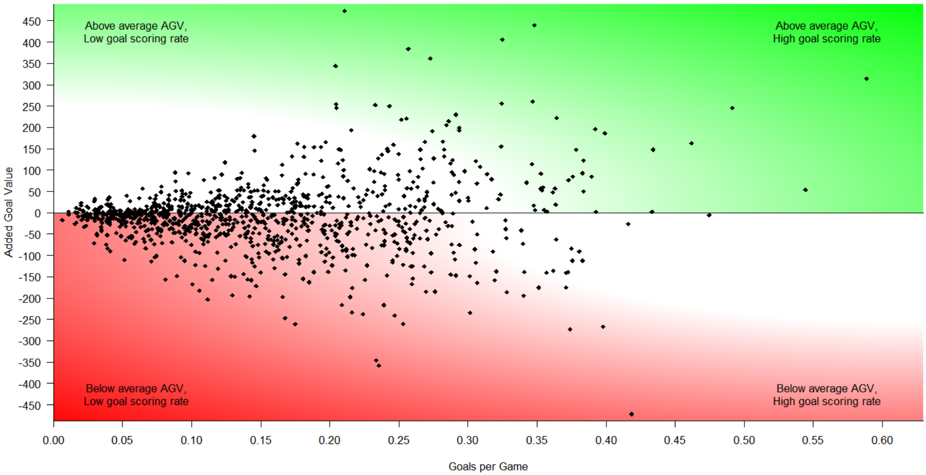
$\frac{\sum_{j=1}^{J} \Delta_j}{J}$: average increase in win probability for all goals (about 17%)

$\frac{\sum_{j=1}^{J} \Delta_j}{J} \cdot K$: expected increase in win probability resulting from the K goals scored by Crosby

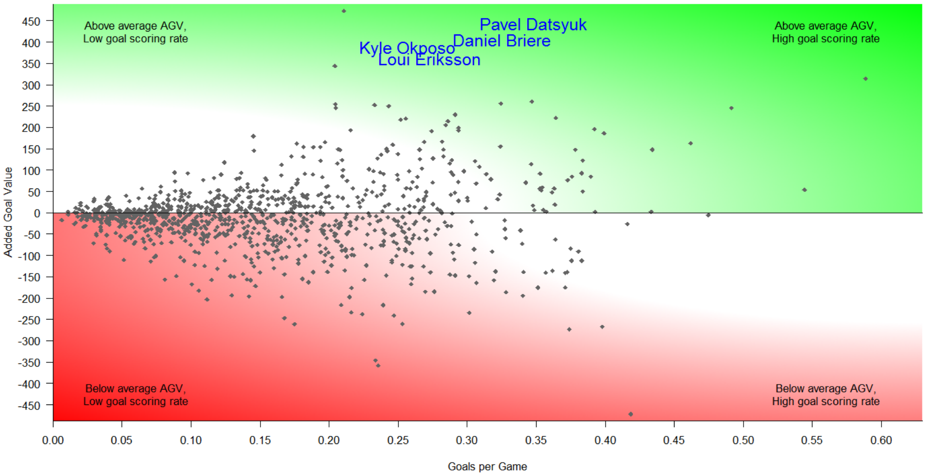
AGV since 2005/2006 season



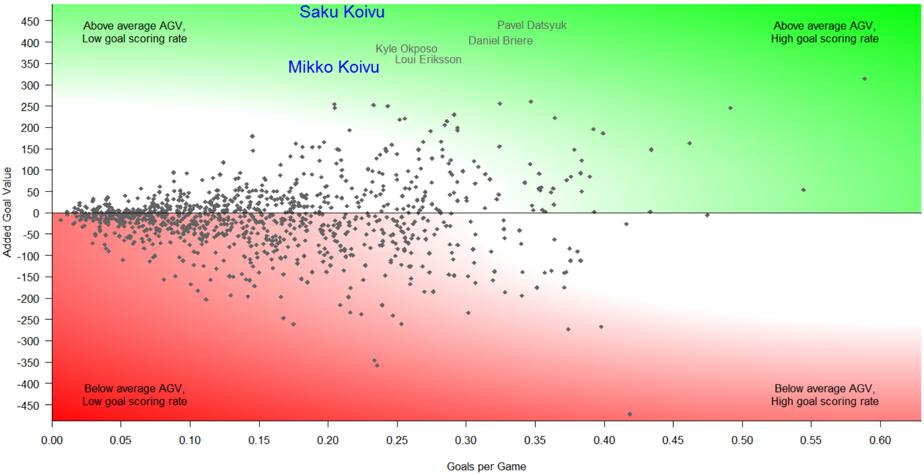
AGV since 2005/2006 season



AGV since 2005/2006 season



AGV since 2005/2006 season



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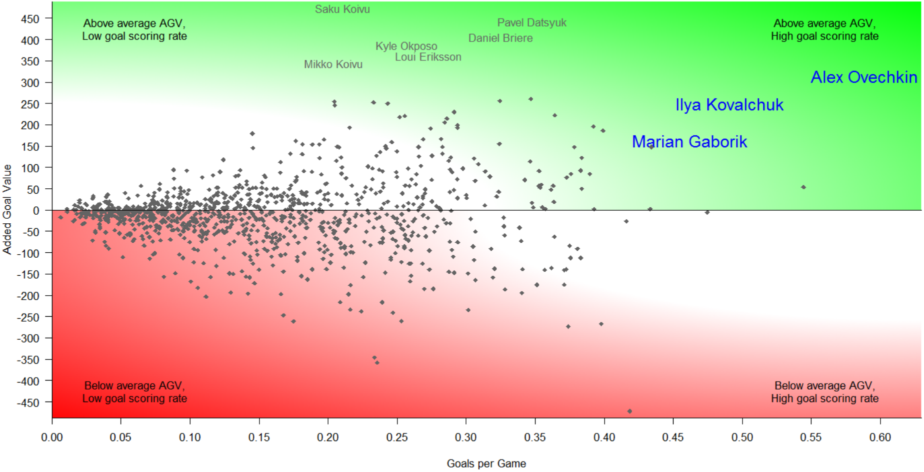

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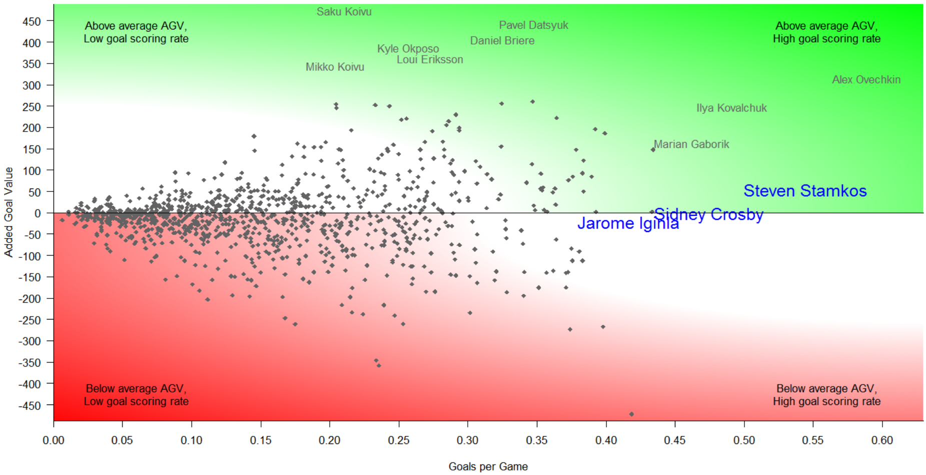
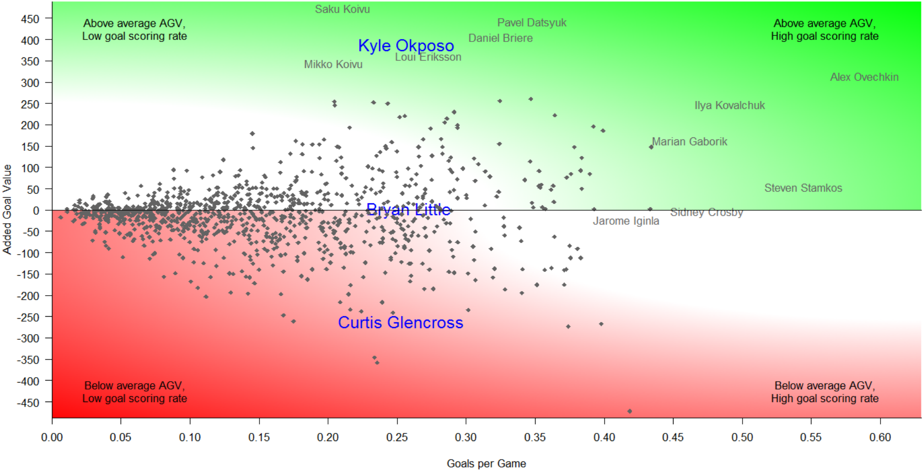
AGV since 2005/2006 season



AGV since 2005/2006 season



Two potential acquisitions

24 years old
15 goals in 2014-2015
0.26 goals per game (career)
48.1% Corsi-tied (career)

24 years old
16 goals in 2014-2015
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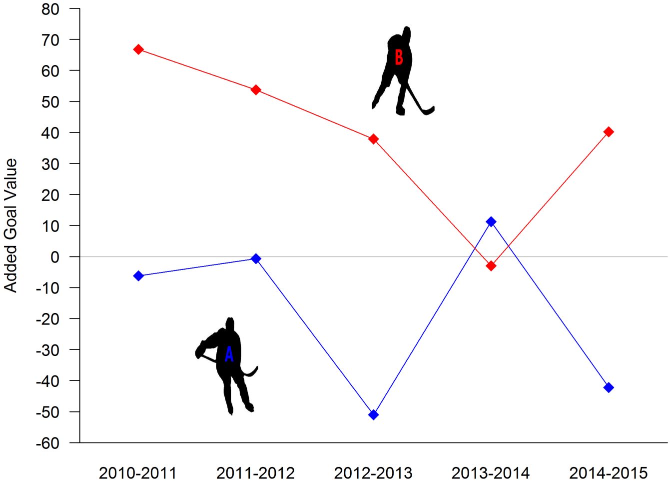
AGV for Players A and B



Who to acquire?

-42.2 AGV (2014-2015)
-88.9 AGV (career)

+40.2 AGV (2014-2015)
+198.9 AGV (career)

Next steps

- Enrich the win probability metric by adding more statistics
- Stanley Cup winning probabilities; playoff qualification probabilities
- Adapt AGV to shootout
- Add assists to AGV metric
- AGV app

Thanks for listening!

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