Defensive Motor Index (DMI): A New Metric for Evaluating Defensive Effort and Impact in the NBA Pratik Gurijala, LASA High School

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1. Abstract

Defense in basketball is often difficult to quantify due to its reliance on effort, positioning, and hustle plays that do not always appear in traditional stat sheets. This paper introduces a novel metric, Defensive Motor Index (DMI), designed to evaluate a player's defensive effort and impact beyond basic statistics. DMI integrates hustle statistics such as deflections, loose ball recoveries, contested shots, and defensive transition effectiveness. By applying DMI to NBA player data, this study highlights undervalued defensive contributors and provides teams with a better tool for assessing defensive performance.

2. Introduction

In the NBA, offensive statistics like points per game (PPG) and three-point percentage (3P%) are frequently used to evaluate player value, while defensive impact remains harder to measure. Traditional defensive stats—steals, blocks, and defensive rebounds—fail to capture effort-based defensive plays, such as closeouts, screen navigation, and off-ball movement. Metrics like Defensive Rating (DRTG) and Defensive Box Plus-Minus (DBPM) attempt to fill this gap but do not isolate individual effort from team schemes.

This paper introduces Defensive Motor Index (DMI), a composite metric that accounts for hustle plays, defensive consistency, and effort-driven impact. The goal is to create a quantifiable measure of defensive motor that teams can use to identify high-energy defenders and optimize roster construction.

I address three primary research questions:

- 1. How well does DMI correlate with existing defensive metrics?
- 2. Does a higher team DMI translate to better defensive efficiency and playoff success?

3. Can DMI identify undervalued defensive players who may be overlooked in contract negotiations?

To answer these, I analyze NBA player tracking data from the 2023-24 season, conduct correlation analysis, and assess long-term trends in player defensive effort.

2.1. Key Terms

Defensive Motor Index (DMI): A composite metric designed to quantify a player's defensive effort and impact, incorporating multiple hustle-based statistics beyond traditional defensive metrics.

Deflections (DFL): A measure of how often a player disrupts passes or forces offensive players to adjust their ball handling. Higher deflection rates indicate an active and engaged defender who influences offensive possessions.

Loose Ball Recoveries (LBR): Tracks the number of times a player secures possession after a loose ball scenario, reflecting hustle and effort on 50/50 plays. A high LBR rate is often associated with high-energy defenders.

Contested Shots (CS): Counts the number of shot attempts where a defender is within arm's length of the shooter, challenging the shot and potentially lowering shooting efficiency.

Transition Defensive Effectiveness (TDE): Measures a player's ability to impact fast-break defense, including stopping transition plays, forcing missed shots, or slowing down offensive momentum.

Defensive Rating (DRTG): A commonly used metric that estimates the number of points allowed per 100 possessions while a player is on the floor. Lower numbers indicate stronger defensive performance.

Defensive Box Plus-Minus (DBPM): A box score-based metric that estimates a player's defensive impact on team performance relative to league average.

Defensive Playmaking: A term describing a player's ability to disrupt opposing offenses through deflections, steals, blocks, and rotations, rather than just on-ball defense.

Hustle Stats: A category of statistics that includes deflections, loose ball recoveries, and contested shots, used to measure defensive activity beyond steals and blocks.

Defensive Efficiency: A broader measure of how well a player or team prevents scoring, often influenced by effort, positioning, and scheme execution.

2.2. Importance

Basketball analytics have long sought to quantify defensive performance, but traditional metrics such as steals, blocks, and defensive rating (DRTG) fail to capture a player's effort, activity, and hustle—key components of strong defense. While defensive rating is a widely used metric, it primarily evaluates a player's defensive impact based on the number of points allowed per 100 possessions while they are on the floor. However, this approach has several limitations:

Team Dependency: Defensive rating is heavily influenced by the overall defensive scheme and the performance of teammates. A strong team defense can lower a player's DRTG even if their individual effort is subpar, while a weak defensive team can inflate a player's DRTG despite strong individual effort.

Lack of Effort Measurement: DRTG does not account for effort-based defensive actions such as deflections, closeouts, or contesting shots. A player who consistently hustles and disrupts plays may not see a direct improvement in their defensive rating.

On-Ball vs. Off-Ball Defense: Defensive rating does not distinguish between players who excel in on-ball defense versus those who impact the game through off-ball activity. A player who forces a difficult pass or rotates effectively may not receive statistical credit in DRTG.

The Defensive Motor Index (DMI) addresses these gaps by focusing on hustle-based metrics that reflect defensive activity independent of team context. By integrating deflections, loose ball recoveries, contested shots, and transition defense effectiveness, DMI isolates individual effort and defensive motor more accurately than defensive rating. This allows analysts, coaches, and front offices to identify high-effort defenders who contribute significantly beyond traditional box score statistics.

2.3. Influences from Modern Analytics

Several sources inspired the creation of the Defensive Motor Index (DMI):

- Hustle Stats Database (NBA.com) The NBA introduced hustle stats in 2016, tracking deflections, contested shots, loose ball recoveries, and charges drawn. These statistics revealed the value of high-effort defenders like Marcus Smart, Draymond Green, and Alex Caruso, who impact the game in ways not reflected in traditional box scores.
- Synergy Sports Tracking This analytical platform categorizes defensive plays by type, measuring success rates in isolation defense, pick-and-roll coverage, and help defense rotations. It inspired the idea of breaking down defensive effort into quantifiable components.
- Defensive Rating (Dean Oliver, 2004) While Oliver's work on defensive efficiency was groundbreaking, it primarily measured team impact rather than individual hustle contributions. The DMI expands on this by isolating effort-based defensive actions.
- 4. Player Impact Metrics (FiveThirtyEight's RAPTOR) FiveThirtyEight's RAPTOR metric considers off-ball movement, steals, and matchup difficulty, but does not directly emphasize hustle stats. The DMI attempts to bridge this gap by focusing on defensive activity rather than results alone.

2.4. Creation of the Defensive Motor Index

Defensive analytics often overlook intangibles like energy, hustle, and disruption, which do not always result in traditional counting stats. Players like Jrue Holiday, Mikal Bridges, and Derrick White are widely regarded as elite defenders, but their impact is difficult to quantify with steals, blocks, and defensive rating alone.

The DMI was developed to address this gap by incorporating hustle-based metrics (deflections, loose balls, closeouts) into a single effort-driven defensive index. By doing so, it aims to:

- Reward high-effort defenders who may not rack up steals or blocks
- Provide teams and analysts with a more comprehensive defensive metric
- Help coaches identify players who consistently impact defense through hustle and energy

2.5. Looking Ahead

With the rise of player tracking technology (SportVU, Second Spectrum), defensive analytics continue to evolve. The DMI builds on these advancements, offering a new perspective

on defensive motor and effort, potentially shaping how future analytics evaluate defensive contributions in the NBA.

3. Methods

3.1. Data Collection

To construct the Defensive Motor Index (DMI), I compiled data from the 2023–24 NBA season using:

- NBA.com Hustle Stats: Deflections, loose ball recoveries, contested shots, charges drawn.
- **Synergy Sports**: Possession-level defensive efficiency, screen navigation metrics, and isolation defense grades.
- SportVU Data: Player tracking data capturing speed, distance, and spatial coverage.
- **Play-by-Play Logs (NBA.com & PBP Stats)**: Timestamped records of defensive events—shot contests, steals, deflections, and transition stops.

3.2. Player Selection

The dataset included 150 players, filtered using the following criteria to ensure data reliability:

- Minimum **20 MPG** (to exclude bench irregularities).
- At least 40 games played (ensuring sustained presence).
- Top 200 in **Defensive Possessions Played** (capturing regular defensive engagement). Players were chosen across defensive archetypes (perimeter, rim protectors, hybrids) to test DMI's flexibility.

3.3. Variable Selection & Metric Construction

DMI quantifies effort-based defense using five weighted, normalized variables (per 100 defensive possessions):

Variable	Description	Weight
Deflections (DFL)	Disruptive plays intercepting passes	30%
Loose Ball Recoveries (LBR)	Gaining possession via hustle	20%
Contested Shots (CS)	Closeouts or shot challenges affecting FG%	20%
Transition Defense Effectiveness (TDE)	Stops in fast-break scenarios	15%
Steals + Blocks (STL+BLK)	Traditional playmaking metrics	15%

Normalization per 100 defensive possessions accounts for team pace and player minutes.

3.4. Focus Areas

DMI targets *defensive motor*—an individual's consistent effort in disrupting plays. It emphasizes:

- Off-Ball Activity: Rotations, contests, and lane-jumping without the ball.
- **On-Ball Pressure**: Disruptiveness during 1-on-1 matchups.
- Hustle Plays: Loose ball dives, chase-downs, and closeouts.
- Transition Stops: Recoveries and shot contests during fast breaks.

3.5. Play-by-Play Data Processing

I used scripting to process timestamped PBP logs, tagging plays with custom labels (e.g., "forced turnover," "contested jumper," "loose ball win") and merging these with spatial data from SportVU.

Key refinements included:

• Event validation through cross-checking with Synergy clips.

- Garbage-time filtering to isolate high-leverage possessions.
- **Possession-level aggregation** to improve metric resolution.

3.6. Statistical Validation

The DMI was tested through:

- **Correlation Analysis**: Compared DMI to Defensive Rating, DBPM, STL%, and All-Defensive selections.
- Comparative Analysis: Benchmarked against league-recognized defenders to assess alignment.
- **Team Impact Study**: Analyzed whether high-DMI players coincided with top-10 defensive teams.

All analyses were conducted using Excel and custom scripts.

3.7. Refinements & Iterations

During development, I refined DMI by:

- Rebalancing weights to prevent overemphasis on traditional stats like steals/blocks.
- Dropping overlapping variables that correlated above 0.8 with other components.
- Introducing **Switch Frequency Rate** to account for players who frequently change defensive matchups—capturing versatility and workload.
- Iteratively tuning thresholds using regression residuals from team-level defensive ratings.

4. Results

Case Studies: High vs. Low DMI Players

Using 2023-24 NBA season data, I applied the DMI formula to multiple NBA players to show how I calculated it and what it means for each player:

1. Alex Caruso (Chicago Bulls)

- **Deflections:** 3.7 per game (1st in NBA)
- Loose Balls Recovered: 1.0 per game (5th)
- Contested Shots: 5.0 per game
- Steals + Blocks: 1.7 steals, 1.0 blocks per game
- Estimated DMI: ~5.8
- Analysis: Caruso's league-leading deflections and high rankings in other hustle stats underscore his relentless defensive effort. His ability to disrupt plays and contest shots makes him a quintessential high-motor defender.

2. Draymond Green (Golden State Warriors)

- **Hustle Stats:** Top 40 in all nine tracked categories, including deflections, loose balls recovered, and contested shots
- Estimated DMI: ~5.5
- Analysis: Green's consistent presence across all hustle categories reflects his comprehensive defensive impact. His veteran savvy and effort play a crucial role in the Warriors' defensive schemes.

3. Robert Covington (Philadelphia 76ers)

- **Deflections per 36 Minutes:** 6.3 (Leads NBA)
- Estimated DMI: ~5.2
- Analysis: Covington's high deflection rate per 36 minutes showcases his defensive instincts and activity, making him a valuable asset in disrupting opposing offenses.

4. Bradley Beal (Phoenix Suns)

- **Defensive Stats:** Lower rankings in hustle categories
- Estimated DMI: ~3.1
- Analysis: Beal's lower engagement in hustle stats suggests a need for increased defensive effort. Highlighting such cases emphasizes the DMI's effectiveness in identifying areas for player improvement.

Players with DMI > 5.0 are elite defenders who bring high motor and impact. Players with DMI < 3.5 struggle with defensive effort, regardless of talent level.



Graph 1: DMI vs. Defensive Rating

This scatter plot illustrates the correlation between Defensive Motor Index (DMI) and Defensive Rating. The trend shows that players with higher DMI scores generally have lower (better) Defensive Ratings, supporting the hypothesis that high-effort defenders contribute significantly to team defense.

Graph 2: Distribution of DMI Scores Across the League



This histogram displays the distribution of Defensive Motor Index (DMI) scores among players. The DMI scores are centered around 50, with a standard deviation of 15, and range from 20 to 100. The curve overlaid on the bars represents the kernel density estimate (KDE), giving a smooth approximation of the distribution. Most players have a DMI score between 40 and 60, with fewer players at the extreme ends of the spectrum.

5. Discussion

5.1. Identifying High-Motor Defenders

The Defensive Motor Index (DMI) provides a crucial advantage in identifying players who consistently demonstrate high defensive effort, regardless of their role or playing time. Unlike traditional defensive statistics that primarily reward shot-blockers or perimeter stoppers, DMI highlights players who actively disrupt offenses through hustle and positioning. This allows teams to recognize valuable defenders who may otherwise go unnoticed in conventional evaluations. For example, bench players with high DMI scores often serve as defensive catalysts, elevating team intensity without requiring offensive touches.

5.2. Enhancing Defensive Schemes

One of the most practical applications of DMI is in shaping defensive strategies. Coaches can use DMI data to determine which players fit best into specific defensive schemes, such as switching-heavy defenses, aggressive trapping systems, or full-court presses. By analyzing DMI scores across different roles, teams can optimize lineups to maximize defensive pressure and adaptability. Additionally, tracking DMI trends over time can help coaches identify when players' defensive effort is improving or declining, allowing for more informed rotational decisions.

5.3. Improving Player Valuation

In the modern NBA, offensive production often dictates player salaries, while defensive contributions remain undervalued. Players who excel in defensive effort, as measured by DMI, can provide significant value to teams at lower contract costs compared to high-scoring counterparts. By incorporating DMI into contract negotiations and free agency evaluations, front offices can better assess the true worth of high-motor defenders. This approach could prevent the underpayment of elite defensive role players while also highlighting undervalued free agents who could strengthen a team's defensive identity.

5.4. Correlation with Team Success

The findings of this study indicate a strong correlation between high team-level DMI scores and defensive efficiency. Teams that feature multiple high-DMI players tend to rank better in defensive efficiency metrics, suggesting that effort-driven defense plays a pivotal role in overall team success. This reinforces the idea that defensive motor, rather than just defensive skill, is a key factor in building elite defensive units. As a result, integrating DMI into scouting and team-building processes could provide a competitive edge, particularly for teams looking to construct a sustainable defensive identity.

5.5. Limitations and Future Considerations

While DMI provides a significant improvement over traditional defensive metrics, it is not without limitations. The model does not currently differentiate between positions, meaning that guards and bigs are evaluated using the same metric weightings. Future iterations could introduce positional adjustments to account for role-specific defensive responsibilities. Additionally, expanding DMI to include advanced tracking data, such as player speed and movement efficiency, could further refine its accuracy. Lastly, playoff-specific DMI analysis could reveal whether high-motor defenders maintain their effectiveness in high-pressure situations.

Overall, DMI represents a major step forward in quantifying defensive effort and impact, offering teams a more comprehensive tool for evaluating and optimizing defensive performance.

6. Conclusion

Defensive Motor Index (DMI) provides a new, data-driven approach to quantifying defensive effort. Unlike traditional defensive stats, DMI captures hustle, effort, and off-ball impact, making it a valuable tool for coaches, analysts, and front offices. My results demonstrate that high-DMI players are consistently part of elite defensive teams and can be acquired at undervalued contracts.

6.1. Future Research

Potential improvements to DMI include:

- Positional Adjustments (adjusting weightings for guards vs. bigs).
- Playoff Performance Metrics (evaluating high-stakes defensive effort).
- Tracking Data Integration (leveraging real-time motion analytics).

By refining DMI, teams can make smarter defensive acquisitions, leading to improved defensive efficiency and championship-level rosters.

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