The Effect of Short Run Workload on Goalie Performance

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2026-01-20

Introduction

In labour economics, one of the main comparative statics asked is how changes in labour input affect worker productivity. If workers are pushed too hard, marginal performance can diminish and as a result, output falls below its potential. While Economists have studied this trade-off, and predict diminishing marginal returns due to fatigue, empirical identification is often challenging due to unobserved heterogeneity and how tasks are assigned often depends on the worker's prior outcomes, creating potential endogeneity. Professional sports such as hockey, however, offer a unique approach to studying this problem, with detailed data and distinct measures of output. This paper will study the causal effect of workload on productivity in the short-run using data from NHL goaltenders in the 2024-2025 season, where labour (input) will be measured by in the number of starts, and output will be observed through save percentage and GAA (goals against average). We will examine how additional starts affect goaltender performance while controlling for individual characteristics, providing evidence on how marginally increasing labour generates diminishing returns in an intense, performance-based labour market.

Guiding Question

Does short-run workload affect goalie performance within a season? When a goalie plays more in the short run, does their performance change?

Model

Save% = b1(workload) + b2(shots against) + individual FE

Controls

- Shots against

Fixed Effects

- Goalie FE (height, weight, age, draft position, goalie coach, experience)

Workload Variables

- back to back
- starts in last 7 days
- days of rest

Standard Errors

- cluster by goalie

Datasets

```
library(readxl)
library(dplyr)
summary <- read_excel("Summary.xlsx", sheet= 1)
summary <- summary %>% select(Player, `Game Date`, GS, GAA, Team, SA, `Sv%`)
days_rest <- read_excel("Days Rest.xlsx", sheet= 1)
days_rest <- days_rest %>% select(Player, `Game Date`, `0 Days Rest`, `1 Days Rest`, `2 Days Rest`, `3 I
                                  `4+ Days Rest`)

goalie <- summary %>% left_join(days_rest, c("Player", "Game Date"))
goalie <- goalie %>% rename(b_to_b= `0 Days Rest`, one_day_rest= `1 Days Rest`, two_days_rest= `2 Days I
```

```
library(plm)
```

```
##
## Attaching package: 'plm'

## The following objects are masked from 'package:dplyr':
##
##     between, lag, lead
```

```
library(stargazer)
```

```
##
## Please cite as:

##  Hlavac, Marek (2022). stargazer: Well-Formatted Regression and Summary Statistics Tables.

##  R package version 5.2.3. https://CRAN.R-project.org/package=stargazer
```

```r
pdat <- pdata.frame(goalie, index=c("player", "game_date"))
pdat <- pdat %>%
  mutate(
    starts= as.numeric(starts),
    save_percentage= as.numeric(save_percentage),
    one_day_rest= as.numeric(one_day_rest),
    two_days_rest= as.numeric(two_days_rest),
    three_days_rest= as.numeric(three_days_rest),
    b_to_b= as.numeric(b_to_b),
    shots_against= as.numeric(shots_against),
    GAA= as.numeric(GAA))
pdat <- pdat %>%
  mutate(rest_days = 1*one_day_rest + 2*two_days_rest + 3*three_days_rest)
```

New Model (Revised Method)

```r
fit <- plm(save_percentage~starts+shots_against, data=pdat, model="within")
stargazer(fit, header=FALSE, float=FALSE)
```

	Dependent variable:
	save_percentage
starts	-0.072^{***}
	(0.007)
shots_against	0.004^{***}
	(0.0002)
Observations	2,762
R^2	0.142
Adjusted R^2	0.109
F Statistic	220.620^{***} (df = 2; 2657)
Note:	*p<0.1; **p<0.05; ***p<0.01

```r
printEqu(fit, stars=TRUE)
```

$$\widehat{save_percentage} = \underset{(0.007134)^{***}}{-0.072272}\ starts + \underset{(0.000193)^{***}}{0.004036}\ shots_against$$

$$n = 2762, \quad R^2 = 0.142420.10885, SSR = 12.91805$$

$$^{*}\text{pv} < 0.1;\ ^{**}\text{pv} < 0.05;\ ^{***}\text{pv} < 0.01$$

```r
fit6 <- plm(GAA~starts+shots_against, data=pdat, model="within")
stargazer(fit6, header=FALSE, float=FALSE)
```

	Dependent variable:
	GAA
starts	1.416***
	(0.233)
shots_against	−0.050***
	(0.006)
Observations	2,762
R^2	0.027
Adjusted R^2	−0.012
F Statistic	36.300*** (df = 2; 2657)
Note:	*p<0.1; **p<0.05; ***p<0.01

```
fit2 <- plm(save_percentage~b_to_b+shots_against, data=pdat, model="within")
stargazer(fit2, header=FALSE, float=FALSE)
```

	Dependent variable:
	save_percentage
b_to_b	0.005
	(0.010)
shots_against	0.003***
	(0.0002)
Observations	2,762
R^2	0.109
Adjusted R^2	0.075
F Statistic	163.150*** (df = 2; 2657)
Note:	*p<0.1; **p<0.05; ***p<0.01

```
fit3 <- plm(GAA~b_to_b+shots_against, data=pdat, model="within")
stargazer(fit3, header=FALSE, float=FALSE)
```

	Dependent variable:
	GAA
b_to_b	−0.053
	(0.313)
shots_against	−0.035***
	(0.006)
Observations	2,762
R^2	0.013
Adjusted R^2	−0.026
F Statistic	17.610*** (df = 2; 2657)
Note:	*p<0.1; **p<0.05; ***p<0.01

```r
fit4 <- plm(save_percentage~rest_days+shots_against, data=pdat, model="within")
stargazer(fit4, header=FALSE, float=FALSE)
```

	Dependent variable:
	save_percentage
rest_days	-0.0002
	(0.001)
shots_against	0.003^{***}
	(0.0002)
Observations	2,762
R^2	0.109
Adjusted R^2	0.074
F Statistic	163.026^{***} (df = 2; 2657)
Note:	*p<0.1; **p<0.05; ***p<0.01

```r
fit5 <- plm(GAA~rest_days+shots_against, data=pdat, model="within")
stargazer(fit5, header=FALSE, float=FALSE)
```

	Dependent variable:
	GAA
rest_days	0.010
	(0.043)
shots_against	-0.035^{***}
	(0.006)
Observations	2,762
R^2	0.013
Adjusted R^2	-0.026
F Statistic	17.620^{***} (df = 2; 2657)
Note:	*p<0.1; **p<0.05; ***p<0.01