Modelling the retirement timing of Canadian nurses using a panel survey

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Background

- 40% nurses is expected to retire in the next 15 years\(^1\)
- Nurses withdraw from the labour force early\(^2\)
  - Generous retirement packages
  - Wage profile is flat
- Anticipated increase in the demand for nurses
- A shortage of nurses impacts the quality of care that patients receive\(^3\)\(^-\)\(^5\)
Gaps in the literature

- A theoretical framework
- Intent vs actual retirement
- Causal studies
- Effect of health status on nurses’ retirement timing
  - Issues: endogeneity and justification bias
  - Poor health, health limitations and health shocks increases the probability of (early) retirement\(^6-8\)
  - Having poor health may be the principal cause of retirement\(^9-10\)
Research objectives

- To determine the impact of health on nurses’ retirement timing.

- To ascertain the impact of job characteristics on retirement timing.
  - Working in the hospital sector
  - Shift type: regular days/night or irregular shifts
  - Public employment
  - Unionization
  - Having employer-based pension
Rationale

- A shortage of nurses impacts the quality of care that patients receive\textsuperscript{3-5}.
- Understaffing causes job burnout and dissatisfaction amongst nurses.
- Findings can be used to inform:
  - Programs and policies aimed at retaining late career nurses in the labour force
  - Nursing forecasting models
Theoretical framework

Galama and colleagues (2013)

\[ \int_0^R U_w[C(t), H(t)] e^{-\beta t} dt + \int_R^T U_R[C(t), H(t)] e^{-\beta t} dt^{13} \]

- \( U_w \) = Utility derived while working
- \( U_R \) = Utility derived while retired
- \( 0 \) = Age nurse starts working
- \( R \) = Retirement age
- \( R \) = Retirement age
- \( T \) = Age at death
- \( C \) = Consumption
- \( H \) = Health
- \( B \) = Discount factor
Theoretical framework

- Time derivatives of constraints:
  - $H(t) = \mu(t)m(t) - d(t)H(t)$ if $0 \leq t \leq T$
  - $A(t) = \delta A(t) + Y[H(t)] - C(t) - p(t)m(t)$ if $0 \leq t \leq T$
  - $Y[H(t)] = \begin{cases} w_0(t) + \varphi(t)H(t) & \text{if } 0 \leq t \leq R \\ b & \text{if } R \leq t \leq T \end{cases}$

$H =$ health; $\mu =$ efficiency of $m$; $m =$ health investments; $d =$ natural deterioration of health
$A =$ assets; $\delta =$ interest rate; $Y[H(t)] =$ earnings; $C =$ consumption; $p =$ price of $m$
$w_0 =$ base wage; $\varphi =$ marginal production of health; $b =$ pension benefits

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05/06/2015

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Methodology: Covariates

<table>
<thead>
<tr>
<th>Labour force participation model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Individual characteristics</strong></td>
</tr>
<tr>
<td>age, married,</td>
</tr>
<tr>
<td>sah_poor, sah_fair, sah_good, sah_vgood, disability</td>
</tr>
<tr>
<td><strong>Human capital variables</strong></td>
</tr>
<tr>
<td>lpn, diploma, uni, exp, exp2</td>
</tr>
<tr>
<td><strong>Household and financial variables</strong></td>
</tr>
<tr>
<td>prtnr_unemp, hhsize, n_schoolage, earners Earnings_hat, hhincome, CPP, OASGI, PRIVPEN, wRRSP</td>
</tr>
<tr>
<td><strong>Job characteristics</strong></td>
</tr>
<tr>
<td>hospital, days, evenings, public, union, pplan</td>
</tr>
<tr>
<td><strong>Control variables</strong></td>
</tr>
<tr>
<td>a55, 160, a65, MR_lifted east, west, year groups</td>
</tr>
</tbody>
</table>
Data source & Data prep

- **Survey of Labour, Income & Dynamics (SLID)**
  - Nationally representative
  - Panel data
  - Follows respondents for 6 years

- **Inclusion & exclusion criteria**
  - RNs & LPNs
  - At least 50 years of age
  - Health status and two years lagged health status are not missing (1996 – 2010)
  - Exclude: did not participate in the labour force while surveyed
Methodology: Pooled 2 Stage Residual Inclusion (2SRI) + FE

First stage: Ordered probit regression
- Dependent variable: Self assessed health (poor, fair, good, very good, excellent)
- Instrument: Lagged (2 years) self-assessed health
- N=1,520 nurses

Second stage: Multinomial logit regression
- Dependent variable: Labour force activity (working fulltime, part-time, retired)
- Residuals from the first stage as an added explanatory variable
- N=1,520 nurses
## Results: RETIREMENT – Part-time vs Full-time

<table>
<thead>
<tr>
<th>Variable</th>
<th>2SRI + FE Coefficients</th>
<th>2SRI + FE dy/dx</th>
<th>Variable</th>
<th>2SRI + FE Coefficients</th>
<th>2SRI + FE dy/dx</th>
</tr>
</thead>
<tbody>
<tr>
<td>sah_poor</td>
<td>-0.87 (1.2711)</td>
<td>-0.16</td>
<td>earnings_hat (10k)</td>
<td>0.025 (0.4270)</td>
<td>0.058</td>
</tr>
<tr>
<td>sah_fair</td>
<td>-0.56 (0.7202)</td>
<td>-0.09</td>
<td>hhincome (10k)</td>
<td>-0.041 (0.0377)</td>
<td>-0.0091</td>
</tr>
<tr>
<td>sah_good</td>
<td>-0.43 (0.4493)</td>
<td>-0.06</td>
<td>CPP (10k)</td>
<td>0.17 (0.1196)</td>
<td>0</td>
</tr>
<tr>
<td>sah_vgood</td>
<td>-0.10 (0.3011)</td>
<td>-0.01</td>
<td>OASGI (1k)</td>
<td>-1.52** (0.3466)</td>
<td>-0.2***</td>
</tr>
<tr>
<td>disability</td>
<td>0.44* (0.2241)</td>
<td>0.06</td>
<td>PRIVPEN (1k)</td>
<td>0.069* (0.0366)</td>
<td>0.0086*</td>
</tr>
<tr>
<td>hospital</td>
<td>0.68 (0.8779)</td>
<td>0.04</td>
<td>wRRSP (1k)</td>
<td>-0.019 (0.0119)</td>
<td>0</td>
</tr>
<tr>
<td>days</td>
<td>-0.74*** (0.2306)</td>
<td>-0.11***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>evenings</td>
<td>-0.14 (0.4159)</td>
<td>-0.03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>public</td>
<td>0.26 (0.9191)</td>
<td>0.12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>union</td>
<td>0.31 (0.3607)</td>
<td>0.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pplan</td>
<td>-1.43*** (0.2919)</td>
<td>-0.22***</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* (p<0.10)  ** (p<0.05)  *** (p<0.01)

Base case: A registered nurse with excellent health, who works irregular shifts in central Canada.
### Results: RETIREMENT – Retired vs Full-time

<table>
<thead>
<tr>
<th>Variable</th>
<th>2SRI + FE Coefficients</th>
<th>2SRI + FE dy/dx</th>
<th>Variable</th>
<th>2SRI + FE Coefficients</th>
<th>2SRI + FE dy/dx</th>
</tr>
</thead>
<tbody>
<tr>
<td>sah_poor</td>
<td>1.88 (2.3651)</td>
<td>0.06</td>
<td>earnings_hat (10k)</td>
<td>-1.22** (0.6087)</td>
<td>-0.0033**</td>
</tr>
<tr>
<td>sah_fair</td>
<td>0.41 (0.17492)</td>
<td>0.02</td>
<td>hhincome (10k)</td>
<td>0.18*** (0.0607)</td>
<td>0.0048***</td>
</tr>
<tr>
<td>sah_good</td>
<td>-0.65 (1.1842)</td>
<td>-0.01</td>
<td>CPP (1k)</td>
<td>0.45*** (0.0142)</td>
<td>0.0077***</td>
</tr>
<tr>
<td>sah_vgood</td>
<td>-0.09 (0.8848)</td>
<td>-0.0005</td>
<td>OASGI (1k)</td>
<td>-0.64 (0.3960)</td>
<td>0.0094</td>
</tr>
<tr>
<td>disability</td>
<td>0.71 (0.5225)</td>
<td>0.01</td>
<td>PRIVPEN (1k)</td>
<td>0.13*** (0.0442)</td>
<td>0.0019**</td>
</tr>
<tr>
<td>hospital</td>
<td>3.87*** (1.2524)</td>
<td>0.09***</td>
<td>wRRSP (1k)</td>
<td>-0.053 (0.0628)</td>
<td>-0.0092</td>
</tr>
<tr>
<td>days</td>
<td>-0.40 (0.3737)</td>
<td>0.003</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>evenings</td>
<td>0.37 (0.6288)</td>
<td>0.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>public</td>
<td>-4.80*** (1.6966)</td>
<td>-0.12***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>union</td>
<td>0.008 (1.0731)</td>
<td>-0.005</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pplan</td>
<td>0.09 (0.5790)</td>
<td>0.02**</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Base case: A registered nurse with excellent health, who works irregular shifts in central Canada*
Limitations & Next steps

Limitations of the study:
• Issues related to using lagged variable as an instrument $^{14-15}$
• Labour force status of nurse’s partner is taken as exogenous
• Standard errors in the retirement model have not been adjusted

Next steps:
• Bootstrap standard errors $^{13}$
• Different specifications of “retired” and fulltime worker
• Calculating accumulated pension benefits and yearly accrued benefit
• Raw vs. standardized residuals
Conclusion

- Importance in accounting for unobserved heterogeneity
- Health does not appear to be significant in retirement timing
  - Statistically significant in the earning’s selection model
- Financial resources appear to matter more in nurses’ decision to retire
Thank you!

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Adrian Rohit Dass
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References

Institutional features: Nursing in Canada

- Regulated nurses
  - Registered Nurses (including Nurse Practitioners)
  - Registered Psychiatric Nurses
  - Licensed Practical Nurses

- Requirements to practice
  - Fulfill educational requirements
  - Pass the entry-level exam
  - Registered with a provincial/territorial nursing regulatory body
    - Ongoing registration: Practicing at least 1,125 hours in the last 3-5 years
    - Non-working & retired class
Institutional features: Mandatory retirement in Canada

- Year MR was lifted:
  - 1983: Manitoba & Quebec
  - 2006: Ontario
  - 2007: Newfoundland & Labrador, Saskatchewan
  - 2008: British Columbia
  - 2009: Nova Scotia

- Never implemented MR:
  - Alberta, Northwestern Territories, Nunavut, Prince Edward Island & Yukon

- New Brunswick: companies are allowed to enforce MR if employers offer a retirement or pension plan
Institutional features: Retirement finances

- Canadian/Quebec Pension Plan (C/QPP)
- Old Age Security (OAS)\(^{11}\)
## Institutional features: Retirement funds

<table>
<thead>
<tr>
<th></th>
<th>Eligibility</th>
<th>Age &amp; Collection</th>
<th>Amount</th>
<th>Additional benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>C/QPP</strong></td>
<td>• Contributed at least once</td>
<td>• 60-64.92: Reduced rate</td>
<td>• Dependent on contributions made</td>
<td>• Long term disability benefit</td>
</tr>
<tr>
<td></td>
<td>• Residential req.</td>
<td>• 65.08-70: Premium</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>OAS</strong></td>
<td>• Canadian citizen or legal resident</td>
<td>• At least 65</td>
<td>• Proportional to years of Canadian residence and annual income</td>
<td>• Guaranteed Income Supplement</td>
</tr>
<tr>
<td></td>
<td>• Residential req.</td>
<td>• Shifting to 67</td>
<td></td>
<td>• Allowance</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Allowance for Survivor(^{11})</td>
</tr>
</tbody>
</table>
Hypotheses

Hastens retirement:
- Increase in:
  - Initial assets
  - Pension benefits
  - Portion of wages saved towards retirement
  - Initial health
  - Efficiency of health investments

Delays retirement:
- Increase in:
  - Earnings
  - Health deterioration
  - Price of health investments
Institutional features: Retirement finances

- Canadian/Quebec Pension Plan (C/QPP)
- Old Age Security (OAS)\(^{11}\)
- Private pension
  - Personal savings
    - Non-registered (e.g. chequing & savings accounts, mutual bonds, stocks & bonds)
    - Registered savings plans (RRSPs & TFSAs)
  - Employer-Based Pension (EBP) plans
    - Defined contribution
    - Defined benefit\(^{12}\)
Data Source: Survey of Labour, Income & Dynamics (SLID)

- Panel data collected by Statistics Canada (1993 - present)
- Nationally representative, excluding 3% of the Canadian population
- Stratified multi-stage design using probability sampling
- A panel consists of ~17,000 households; followed for 6 years
- Has variables related to individual’s socio-demographic characteristics, family structure, labour force activity and financial status over time
Data source

Inclusion criteria
- RN & LPN
- At least 50 years of age
- Health status and two years lagged health status are not missing (1996 – 2010)
- Must have made the decision to retire while surveyed

Data prep:
- Added indicator variables for:
  - Years mandatory retirement was eliminated
  - Age nurses are eligible to apply for EBP, CPP & OAS
- Adjust money variables for inflation using CPI
## Methodology: Covariates

<table>
<thead>
<tr>
<th></th>
<th>Earnings selection model (participation)</th>
<th>Earnings model (earnings)</th>
<th>Ordered probit for SAH (sahealth)</th>
<th>Labour force participation model (LFS_30)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Individual characteristics</strong></td>
<td>male, married, age, age2, poor_fair</td>
<td>male, married, age, age2, poor_fair</td>
<td>sahealth_lag2, age, married, Sah_poor, sah_fair, sah_good, sah_vgood, disability</td>
<td>age, married, Sah_poor, sah_fair, sah_good, sah_vgood, disability</td>
</tr>
<tr>
<td><strong>Human capital variables</strong></td>
<td>lpn, diploma, bachelor, graduate, exp, exp2</td>
<td>lpn, diploma, bachelor, graduate, exp, exp2</td>
<td>lpn, diploma, uni, exp, exp2</td>
<td>lpn, diploma, uni, exp, exp2</td>
</tr>
<tr>
<td><strong>Household and financial variables</strong></td>
<td>hhincome, prtnr_unemp, hhsise, childless18, n_preschool, n_schoolage, earners</td>
<td>hhincome</td>
<td>prtnr_unemp, hhsise, n_schoolage, earners Earnings_hat, hhincome, CPP, OASGI, PRIVPEN, wRRSP</td>
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<td><strong>Job characteristics</strong></td>
<td></td>
<td></td>
<td>hospital, days, evenings, public, union, pplan</td>
<td>hospital, days, evenings, public, union, pplan</td>
</tr>
<tr>
<td><strong>Control variables</strong></td>
<td>province of residence &amp; year</td>
<td>province of residence &amp; year</td>
<td>a55, 160, a65, MR_lifted east, west, year groups</td>
<td>a55, 160, a65, MR_lifted east, west, year groups</td>
</tr>
</tbody>
</table>
Methodology: Empirical approach

- Estimate nurses’ retirement timing

**Issues:**

- Self-assessed health as an explanatory variable
  - Non-comparability
  - Justification bias
  - Incentives in reporting poor health\(^\text{15}\)
- Earnings are only available for nurses who continue to work
Methodology: Empirical approach

1. Estimate nurses’ annual earnings

   **Issues:**
   - Sample selection

2. Estimate nurses’ retirement timing

   **Issues:**
   - Issues related to health as an explanatory variable
     - Non-comparability
     - Justification bias
     - Financial incentives in reporting poor health\(^{15}\)
   - Earnings are only available for nurses who continue to work
Methodology: Wooldridge’s test & correction for sample selection in panel data

- **First stage: Pooled probit regression**
  - Dependent variable: Labour force participation
  - Instrument: partner’s labour force participation, household size, number of preschool and school-aged children & number of earners in the family
  - N=8,960 nurses

- **Second stage: Pooled linear regression**
  - Dependent variable: Nurses’ annual earnings
  - Includes lambda from the first stage as an explanatory variable
  - Bootstrapped SE
  - N=8,814 nurses
### Results: EARNINGS

<table>
<thead>
<tr>
<th>Variable</th>
<th>Naïve Pooled model</th>
<th>Naïve RE</th>
<th>Naïve FE</th>
<th>FE + Sample selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>male</td>
<td>4,503.78*** (639.33)</td>
<td>3,606.86*** (1,039.57)</td>
<td>4,305.9781*** (1,041.80)</td>
<td>4,600.08*** (719.42)</td>
</tr>
<tr>
<td>married</td>
<td>-4,480.39*** (586.71)</td>
<td>-2,075.20*** (718.35)</td>
<td>-881.50 (986.59)</td>
<td>-667.64 (1,642.03)</td>
</tr>
<tr>
<td>age</td>
<td>2,122.42*** (148.88)</td>
<td>2,501.67*** (206.62)</td>
<td>2,253.97*** (733.48)</td>
<td>3,194.87*** (1,121.58)</td>
</tr>
<tr>
<td>age2</td>
<td>-26.91*** (1.74)</td>
<td>-31.73*** (2.44)</td>
<td>-40.39*** (7.68)</td>
<td>-34.51*** (10.01)</td>
</tr>
<tr>
<td>poor_fair</td>
<td>-3,645.88*** (725.28)</td>
<td>-1,763.86*** (675.66)</td>
<td>-1,081.58 (767.92)</td>
<td>-1,208.04 (1,110.78)</td>
</tr>
<tr>
<td>lpn</td>
<td>-8,515.48*** (424.28)</td>
<td>-7,930.68*** (616.68)</td>
<td>-3,825.27** (1,501.93)</td>
<td>-4,236.37* (2,216.65)</td>
</tr>
<tr>
<td>diploma</td>
<td>4,653.51*** (611.14)</td>
<td>6,339.07*** (1,088.35)</td>
<td>4,896.19** (2,021.39)</td>
<td>2,946.10 (2,233.73)</td>
</tr>
<tr>
<td>bachelor</td>
<td>9,591.87*** (734.78)</td>
<td>12,025.03*** (1,306.99)</td>
<td>11,392.55*** (1,285.06)</td>
<td>8,633.38*** (763.63)</td>
</tr>
<tr>
<td>graduate</td>
<td>16,800.18*** (1,748.13)</td>
<td>17,998.69*** (3139.39)</td>
<td>24,849.92** (11,489.309)</td>
<td>18,479.64 (11,896.72)</td>
</tr>
<tr>
<td>exp</td>
<td>656.84*** (60.56)</td>
<td>824.64*** (91.82)</td>
<td>2,773.10*** (462.70)</td>
<td>1,390.43* (11896.72)</td>
</tr>
<tr>
<td>exp2</td>
<td>-6.10*** (1.63)</td>
<td>-9.01*** (2.45)</td>
<td>-18.18** (7.41)</td>
<td>-17.82* (796.45)</td>
</tr>
<tr>
<td>hhincome</td>
<td>0.11*** (0.02)</td>
<td>0.070*** (0.02)</td>
<td>0.04*** (0.02)</td>
<td>0.04 (0.02)</td>
</tr>
</tbody>
</table>
## Results: EARNINGS- Selection model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Instrument</th>
<th>Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>male</td>
<td>0.06</td>
<td>prtnr_unemp</td>
<td>0.3009 (0.3053)</td>
</tr>
<tr>
<td>married</td>
<td>-0.32</td>
<td>hhsiz</td>
<td>-0.56096*** (0.1505)</td>
</tr>
<tr>
<td>age</td>
<td>-1.2725*** (0.2762)</td>
<td>childless18</td>
<td>-0.2622 (0.4682)</td>
</tr>
<tr>
<td>age2</td>
<td>0.0004 (0.0020)</td>
<td>n_preschool</td>
<td>-0.2136 (0.3384)</td>
</tr>
<tr>
<td>poor_fair</td>
<td>0.3124** (0.1567)</td>
<td>n_schoolage</td>
<td>0.3236 (0.4093)</td>
</tr>
<tr>
<td>lpn</td>
<td>0.2345 (0.5458)</td>
<td>earners</td>
<td>0.7492*** (0.1802)</td>
</tr>
<tr>
<td>diploma</td>
<td>0.4750** (0.2256)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>bachelor</td>
<td>0.3865** (0.1833)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>graduate</td>
<td>-3.5967*** (0.8547)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>exp</td>
<td>1.3176*** (0.1855)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>exp2</td>
<td>-0.0043** (0.0019)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>hhincome</td>
<td>0.0816* (0.0474)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p<0.10  ** p<0.05  *** p<0.01
<table>
<thead>
<tr>
<th></th>
<th>Part-time</th>
<th>Retired</th>
</tr>
</thead>
<tbody>
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