Market power and investment
The case of technology adoption in the Norwegian grocery industry

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Draft – preliminary slides
Motivation and research questions

- **Empirical fact:** Increased market power across all sectors of the economy
  - How does the *competitiveness* of markets affect efficiency and distribution?

- **Investment decisions** – cost-reducing technology
  - Theoretical predictions of the effect of competition on technology adoption are ambiguous:
    - Reduced costs may intensify price competition (negative effect).
    - Cost-reductions may yield a competitive advantage (positive effect).
  - Are firms with more market power more or less likely to invest in new technology?
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What we do – ”zooming in” on one industry
- Industry: Norwegian grocery stores
- Technology: Self-checkout machines
⇒ Does market power affect technology adoption?
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- **What we do** – ”zooming in” on one industry
  - Industry: Norwegian grocery stores
  - Technology: Self-checkout machines
  ⇒ *Does market power affect technology adoption?*

- **What we find** – Preliminary results:
  - More market power leads to more investments in laborsaving technology
  - Results robust to different measures of ”competitiveness”/market power
Outline

1 Some relevant literature

2 Data and the Norwegian grocery industry
   - The Norwegian grocery industry
   - Investments in technology – Self-checkout machines
   - The Scanner Data
   - Linking the scanner data to other sources

3 Identification Strategy

4 Descriptives – Preliminary slides (to be updated)

5 Preliminary results – Preliminary slides (to be updated)
Some relevant literature

- Tougher competition $\Rightarrow$ **more investment**:
  - Theory:
    Vives (JIE, 2008), Bester & Petrakis (IJIO, 1993) (tougher competition $=$ closer substitutes), Götz (RAND, 1999) (monopolistic competition)

U-shaped relationship:
- Theory:
  Sacco & Schmutzler (IJIO, 2011)

Inverted U-shaped relationship:
- Empirical evidence:
  Aghion et al. – Patents (QJE, 2005)
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The Norwegian grocery industry

- Large number of store brands

*Total revenue in the Norwegian grocery industry (2017)*
*Source: Dagligvarerapporten 2018 (Nielsen)*
The Norwegian grocery industry

- Large number of store brands
- But only three integrated firms

Data includes the following firms (covering 99.9% of the market): Coop, NorgesGruppen, Bunnpris, Rema 1000

Data on technology adoption for Coop (NG)

Merker & Moxnes (UiO)

Total revenue in the Norwegian grocery industry (2017)
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  - Rema 1000

- Data on technology adoption for Coop (& NG)

*Total revenue in the Norwegian grocery industry (2017)*
Source: Dagligvarerapporten 2018 (Nielsen)
The Norwegian grocery industry

Competition from Swedish grocery stores

- Due to import tolls and different tax systems, a number of groceries are significantly cheaper in Sweden, e.g.:
  - Meat
  - Dairy products
  - Candy and soft drinks
  - Alcohol
  - Tobacco and cigarettes

- In 2016, the revenue leakage in the grocery sector exceeded the revenue of Bunnpris (Virke)

- In 2018, Norwegian households made, on average, 3.49 shopping trips to Sweden (SSB)
Investments in technology – Self-checkout machines

- First introduced in retail stores in 2008 (IKEA)
  - Bunnpris Blindern first grocery store with self-checkout machines only in 2011
  - In 2018, 17% of COOP grocery stores in our sample from Norway had new technology
  - With the exception of four stores, grocery stores have only partially adopted the new technology

Source: Scanpix/tv2.no
Investments in technology – Self-checkout machines

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  - In 2018, 17 % of COOP grocery stores in our sample from Norway had new technology
  - With the exception of four stores, grocery stores have only *partially* adopted the new technology

- Cost- and labor-saving technology
  - Norwegian grocery industry employs approx. 37 % of workers in retail sector (SSB, 2017)
  - Share of employment expected to drop 10 % by 2030, mainly due to self-checkout machines (Samfunnsøkonomisk analyse/ Virke 2017).

*Source: Scanpix/tv2.no*
The Scanner Data – *Timespan*

- Coop: Nov2017-Dec2018
- NorgesGruppen: Sep2017-Jan2019
- Bunnpris: Manually registered (not yet known)
- Rema1000: May2018-Dec2018

- Preliminary results: based on data for one chain (COOP)

<table>
<thead>
<tr>
<th>Year</th>
<th>Coop</th>
<th>NorgesGruppen</th>
<th>Rema1000</th>
<th>Bunnpris</th>
</tr>
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<tbody>
<tr>
<td>2017</td>
<td></td>
<td></td>
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<td>2018</td>
<td></td>
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<tr>
<td>2019</td>
<td></td>
<td></td>
<td></td>
<td></td>
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Contents of the XML-files
The Scanner Data

Contents of the XML-files

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  <BatchId>45841</BatchId>
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    <Revision>9</Revision>
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</POSFlag>
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<?xml version="1.0"?>
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  <BatchId>14865</BatchId>
  <Transaction TrainingModeFlag="false" CancelFlag="false">
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    </BusinessUnit>
  </Transaction>
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  <Revision>9</Revision>
  <RetailTransaction TypeCode="Cashier" TransactionStatus="Finished" Version="2.2">
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    <BeginDateTime>2018-07-20T12:00:35.7435132+02:00</BeginDateTime>
    <EndDateTime>2018-07-20T12:00:56.5699137+02:00</EndDateTime>
    <Sale NonSale="0" Bonus="true" ItemTypes="Stock">
      <POSIdentity POSSiteID="700019500891" POSSiteID />
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  <SequenceNumber>1</SequenceNumber>
  <BeginDateTime>2018-07-30T12:00:39.1911795+02:00</BeginDateTime>
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```

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  </Sale>
</LineItem>
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Scanner data

Contents of data

- **Transaction level**
  - Unique ID of retail store
  - Transaction/receipt ID
  - Transaction time and date
  - [COOP:] TypeCode (Cashier/ShopAndGoTerminal)
  - Tender Type: Cash/CreditDebit
  - Workstation, Operator, and Associate IDs
  - Total number of items
  - Total sales amount (NOK)
  - Transaction Amount

- **Product level**
  - Item ID (GTIN/SKU)
  - Description (text)
  - Unit price (Price paid, regular price and discounted amount)
  - Quantity and unit of measurement (EA/KG)
  - Product category: MerchandiseHierarchy (Number)
  - Discount (NOK)
  - Time of scan (YYY-MM-DD HH:MM:SS)
  - EntryMethod (Scanned/Keyed)
  - Time for item registration (amount of seconds after previous item)
Scanner data

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  - Time for item registration (amount of seconds after previous item)
Linking the scanner data to other sources

Store brand and location

![Image of GS1 Norway search interface]

**Lokasjonsnummer:**
7080001346034

**Navn:**

**Adresse:**

**Poststed:**

**Organisasjonsnr.:**

**Telefon:**

**NB!** Du kan bruke * når du søker etter navn, adresse, poststed.
Linking the scanner data to other sources

Store brand and location

**Søk**

<table>
<thead>
<tr>
<th>Lokasjonsnummer:</th>
<th>7080001346034</th>
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<tbody>
<tr>
<td>Navn:</td>
<td></td>
</tr>
<tr>
<td>Adresse:</td>
<td></td>
</tr>
<tr>
<td>Poststed:</td>
<td></td>
</tr>
<tr>
<td>Organisasjonsnr.:</td>
<td></td>
</tr>
<tr>
<td>Telefon:</td>
<td></td>
</tr>
<tr>
<td>NBI! Du kan bruke * når du</td>
<td></td>
</tr>
</tbody>
</table>

**Søkeresultat**

<table>
<thead>
<tr>
<th>Navn</th>
<th>Adresse</th>
<th>Sted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Velg</td>
<td>BUNNPRIIS BLINDERN</td>
<td>PROBLEM 11</td>
</tr>
</tbody>
</table>
Linking the scanner data to other sources

Store brand and location
Linking the scanner data to other sources

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Store brand and location
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5. Preliminary results – Preliminary slides (to be updated)
Identification Strategy

Potential IV for competition

- Cross-sectional data on technology adoption status
- Need to disentangle competition and technology adoption (binary variable):
  \[ I_{Technology,i} = \beta_0 + \beta Competition_i + \gamma X_i + u_i \]
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- IV for competition/market power: Proximity to Swedish border (border crossings)
  - Assuming no direct effect of proximity to Swedish border on technology adoption (likely reasonable assumption)
  - Proximity to Swedish border likely correlated with competitive pressure
IV for competition/market power

Distance to closest border crossing
Identification Strategy

Measures of competition

- Cross-sectional data on technology adoption status
- Need to disentangle competition and technology adoption (binary variable):
  \[ I_{Technology, i} = \beta_0 + \beta \hat{Competition}_i + \gamma X_i + u_i \]

- Potential measures of competition/competitive pressure:
  - Store-fixed effects (matching-model for store-product pairs):
    \[ \ln(p_{ij}) = \psi_i + \theta_j + \omega_{ij} \]
  - Average prices (index)
  - Extent and size of discounts
Identification Strategy

Control variables

- Cross-sectional data on technology adoption status

- Need to disentangle competition and technology adoption (binary variable):

  \[ I_{Technology, i} = \beta_0 + \beta Competition_i + \gamma X_i + u_i \]

- Potential control variables: Weaker exogeneity assumption, \( Cov(Z_i, u_i|X_i) = 0 \)
  - Latitude (regional effects)
  - Sociodemographic characteristics of local markets (e.g. population density, share of young people, etc.)
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## Summary statistics

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<tr>
<th>Store information</th>
<th>Old technology</th>
<th>New technology</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Store fixed effects (log unit price)</td>
<td>0.03</td>
<td>-0.03</td>
<td>0.02</td>
</tr>
<tr>
<td>Distance to border crossing (km)</td>
<td>152.84</td>
<td>162.12</td>
<td>154.62</td>
</tr>
<tr>
<td>Revenue (NOK)</td>
<td>3 262 969</td>
<td>9 804 603</td>
<td>4 518 372</td>
</tr>
<tr>
<td>Average discount across products, in %</td>
<td>3.62</td>
<td>5.25</td>
<td>3.94</td>
</tr>
<tr>
<td>Num. of prod. w/discount given to ≥ 1 customer</td>
<td>1 623</td>
<td>3 341</td>
<td>1 961</td>
</tr>
<tr>
<td>Avg. share of receipts w/discounts</td>
<td>0.11</td>
<td>0.16</td>
<td>0.12</td>
</tr>
<tr>
<td>Share of products w/discount given to ≥ 1 customer</td>
<td>0.37</td>
<td>0.46</td>
<td>0.39</td>
</tr>
<tr>
<td>Price index for goods sold in all stores</td>
<td>24.19</td>
<td>23.39</td>
<td>24.03</td>
</tr>
<tr>
<td>Price index for goods sold in 98% of stores</td>
<td>50.62</td>
<td>49.23</td>
<td>50.30</td>
</tr>
<tr>
<td>Number of products in store</td>
<td>4 105</td>
<td>7 043</td>
<td>4 684</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sociodemographics</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Num. of households</td>
<td>32 837</td>
<td>51 056</td>
<td>36 333</td>
</tr>
<tr>
<td>Income (med.)</td>
<td>658 396</td>
<td>675 926</td>
<td>661 760</td>
</tr>
<tr>
<td>Income after tax (med.)</td>
<td>521 887</td>
<td>532 113</td>
<td>523 849</td>
</tr>
<tr>
<td>Population (sum)</td>
<td>632</td>
<td>785</td>
<td>661</td>
</tr>
<tr>
<td>Population (density)</td>
<td>1 433</td>
<td>2 043</td>
<td>1 550</td>
</tr>
<tr>
<td>Share young</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
</tr>
<tr>
<td>Share Middle</td>
<td>0.37</td>
<td>0.38</td>
<td>0.37</td>
</tr>
<tr>
<td>Share old</td>
<td>0.28</td>
<td>0.27</td>
<td>0.28</td>
</tr>
</tbody>
</table>

| Observations                               | 859            | 204            | 1 063     |

Note: Includes data for stores brands: Extra, Marked, Matkroken, Mega, and Prix.
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First stage and reduced form

(1) First stage

(2) Reduced form
OLS and second stage

(3) OLS

(4) Second stage
## Preliminary results

### Table: Regression Results

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>1st stage</th>
<th>Reduced form</th>
<th>OLS</th>
<th>2SLS</th>
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<tbody>
<tr>
<td></td>
<td>Store FE</td>
<td>adopt</td>
<td>adopt</td>
<td>adopt</td>
</tr>
<tr>
<td>Distance border (log km)</td>
<td>0.00724***</td>
<td>0.0312*</td>
<td>0.0427</td>
<td>4.300*</td>
</tr>
<tr>
<td></td>
<td>(0.00166)</td>
<td>(0.0130)</td>
<td>(0.264)</td>
<td>(1.999)</td>
</tr>
<tr>
<td>Store fixed effects (log unit price)</td>
<td>-0.0445***</td>
<td>0.250***</td>
<td>0.257***</td>
<td>0.447***</td>
</tr>
<tr>
<td></td>
<td>(0.00196)</td>
<td>(0.0145)</td>
<td>(0.0192)</td>
<td>(0.0925)</td>
</tr>
<tr>
<td>Revenue (log NOK)</td>
<td>0.121***</td>
<td>1.473***</td>
<td>1.394***</td>
<td>0.971**</td>
</tr>
<tr>
<td></td>
<td>(0.0294)</td>
<td>(0.256)</td>
<td>(0.263)</td>
<td>(0.368)</td>
</tr>
<tr>
<td>Young pop. (share)</td>
<td>0.0100</td>
<td>-0.0397</td>
<td>0.000937</td>
<td>0.0236</td>
</tr>
<tr>
<td></td>
<td>(0.0235)</td>
<td>(0.161)</td>
<td>(0.166)</td>
<td>(0.181)</td>
</tr>
<tr>
<td>Middle-aged pop. (share)</td>
<td>-0.0411</td>
<td>0.113</td>
<td>0.116</td>
<td>0.297</td>
</tr>
<tr>
<td></td>
<td>(0.0325)</td>
<td>(0.240)</td>
<td>(0.243)</td>
<td>(0.283)</td>
</tr>
<tr>
<td>Female population (share)</td>
<td>-0.00601</td>
<td>-0.216</td>
<td>-0.254</td>
<td>-0.192</td>
</tr>
<tr>
<td></td>
<td>(0.0472)</td>
<td>(0.317)</td>
<td>(0.320)</td>
<td>(0.359)</td>
</tr>
<tr>
<td>Pop. sum (log)</td>
<td>-0.00332</td>
<td>-0.0129</td>
<td>-0.0140</td>
<td>-0.00124</td>
</tr>
<tr>
<td></td>
<td>(0.00234)</td>
<td>(0.0158)</td>
<td>(0.0163)</td>
<td>(0.0191)</td>
</tr>
<tr>
<td>Pop. density (log)</td>
<td>-0.00969***</td>
<td>0.0115*</td>
<td>0.00955</td>
<td>0.0528*</td>
</tr>
<tr>
<td></td>
<td>(0.000758)</td>
<td>(0.00544)</td>
<td>(0.00668)</td>
<td>(0.0214)</td>
</tr>
<tr>
<td>Income after tax (log)</td>
<td>-0.0469**</td>
<td>0.295*</td>
<td>0.373**</td>
<td>0.496**</td>
</tr>
<tr>
<td></td>
<td>(0.0178)</td>
<td>(0.141)</td>
<td>(0.138)</td>
<td>(0.156)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.867**</td>
<td>-13.57***</td>
<td>-14.21***</td>
<td>-17.45***</td>
</tr>
<tr>
<td></td>
<td>(0.278)</td>
<td>(2.278)</td>
<td>(2.294)</td>
<td>(2.894)</td>
</tr>
<tr>
<td>Observations</td>
<td>1004</td>
<td>1016</td>
<td>1004</td>
<td>1004</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Thank you for your attention!