Production hierarchies in Sweden

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HIGHLIGHTS

- Swedish occupation data can be used to construct hierarchies within firms.
- The resulting hierarchies conform to theoretical predictions.
- Firms with more layers are larger in size, in value added, and pay higher wages.
- Firms are hierarchical: higher layers are smaller and have higher mean wages.
- Adding layers correlate with firm size/value added increases and wage decreases.

ARTICLE INFO

ABSTRACT

I study the internal organization of firms using Swedish occupation data. The empirical patterns match the theoretical predictions of Caliendo and Rossi-Hansberg (2012) and are similar to the patterns observed in French data by Caliendo et al. (2012).

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1. Introduction

Caliendo et al. (2012)—henceforth CMRH—describe a method through which data on worker occupations can be used to construct hierarchies within firms. They use data on French production firms to provide support for central theoretical predictions from Caliendo and Rossi-Hansberg (2012)—henceforth CRH.

CRH builds on the idea in Garicano (2000) and Garicano and Rossi-Hansberg (2006) that firms are hierarchies of knowledge. Production inputs are labor and knowledge. Workers solve problems that arrive, and problems they cannot solve they pass up

to managers. Managers use workers because they are time-constrained and workers allow them to focus on the problems only they can solve. Managers pass problems to other managers when they cannot solve them. This generates hierarchies, with less knowledgeable workers further down in the hierarchy. When firms grow, they need to hire more workers and/or add more layers of management because growth means more problems need to be solved. When firms expand by adding a layer, pre-existing layers need less knowledgeable workers. As workers are paid according to their level of knowledge, mean firm-layer wages at pre-existing layers should fall when layers are added and rise when layers are removed.

The contribution of this paper is to show that Swedish occupation data can be used to construct hierarchies as in CMRH, and that the resulting hierarchies support the theoretical predictions in CRH that are as follows.

1. Firms with more layers are larger in size, in value added, and have higher mean wages.

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2. Firms are hierarchical: lower layers have more workers and lower mean wages than higher layers.
3. Adding layers is associated with increases in mean firm size/value added and decreases in mean firm wages at pre-existing layers. The reverse holds for removing layers. This result also holds for layer-by-layer mean layer size and mean layer wages for a majority of pre-existing layers.

Support for prediction three is noisier than in CMRH because the Swedish occupation data for smaller firms is collected through rolling surveys (the data in CMRH covers the universe of workers). As smaller firms are not sampled every year, following hierarchical structures within firms over time substantially reduces the sample size.

2. Data

2.1. The Swedish occupation data

The Swedish Standard Classification of Occupations 1996 (SSYK) is a national version of the International Standard Classification of Occupations (ISCO-88 (COM)). The SSYK data compiled for the Statistics Sweden LISA database comes primarily from two sources. The first is the official wage statistics survey (Lönestrukturstatistiken) which surveys around 11 000 companies each year in the private sector. Companies with more than 500 workers are surveyed every year; the remainder is a random sample of firms. In total occupation data is gathered for around a million workers each year. The second source is a survey sent out by mail to around 30 000–47 000 companies per year in the private sector who are not selected for inclusion in the official wage statistics survey (a total of around 150 000 private sector companies per year). The surveys are sent out on a rolling basis: all 150 000 companies are surveyed at least once over a 4–5 year time span. Most of these companies have between 2 and 19 workers. In total, summing over the period 2001–2008, between 91% and 96% of all workers in Sweden are sampled at least once.

2.2. Data processing

The sample is based on occupation data in the LISA database and firm accounting data from the Swedish Companies Registration Office available in the IFN Corporate Database (IFNCD).[1] Data on occupation codes, firm–worker links, and labor income of workers comes from the LISA database. CMRH work with hourly wages and number of hours worked; however these are not available in my dataset.[2] I proxy the worker's wage with yearly labor income, which is the sum of an individual's before-tax labor income over the whole year, and hours of work with the number of workers. Information on value added for all firms in the manufacturing sector comes from the IFNCD.

To merge the datasets, I start with the firm-level dataset for the years 2001–2007 and drop duplicated firm-year information (because multiple annual accounts can be submitted each year) and drop observations that have value added or size missing or non-positive. A firm is in the manufacturing sector if it has an SNI2002 categorization at the two digit level between 15 and 37 (the SNI2002 corresponds to the NACE classification at the four digit level). There are 139 064 such firm-year observations. Around 66% of the workers have "accurate" occupation data. "Accurate" means that the occupation information for the worker is collected in the relevant year from the firm the worker–firm link refers to.[3] Within a surveyed firm, not all workers have accurate

Table 1
Wage distribution.

PCS	Mean	*p5*	*p10*	*p25*	*p50*	*p75*	*p90*	*p95*
Class 5+6	267.1	122.4	168.4	219.2	262.5	311.4	366.7	409.4
Class 4	348.1	158.7	201.6	255.9	325.3	418.1	529.3	606.5
Class 3	475.3	216.7	263.6	333.3	426.2	554.3	735.2	887.5
Class 2	520.9	156	198.1	261.7	359.7	594.7	999.3	1359.30
Full sample	307.7	132.5	179.5	229.1	279.9	349.7	458.5	557.5

Notes. This table shows the wage distribution across the four PCS classes that form the basis of layers of management in a firm. The table corresponds to Table 1 in CMRH. Wages are in thousands of 2005 SEK.

occupation data. I keep only firm-year observations with more than 75% of all workers having accurate occupation data and trim away firm-year observations with labor income observations above the 99.95th percentile. The final dataset contains 39 343 firm-year observations corresponding to 95% of value added and 68% of employment in the Swedish manufacturing sector.

2.3. Constructing layers of management

I follow CMRH and use the PCS-ESE classification as basis for layers of management. I use a PCS82 to ISCO-88 mapping and an ISCO-88 to SSYK96 mapping to go from PCS codes to SSYK codes.[4] As CMRH, I use the first digit of the PCS classification to group occupations into four classes. PCS Class 2 corresponds to firm owners receiving a wage (CEO and directors), PCS Class 3 to senior staff/top management positions, PCS Class 4 to supervisors and PCS Class 5+6 to qualified and non-qualified clerical workers and blue-collar workers. Table 1 displays the wage distribution across the PCS occupational categories as applied to the Swedish data. As in CMRH, workers in higher occupations (lower classes) tend to have higher mean and median wages in most parts of the wage distribution.[5]

A firm-year observation with c occupational categories will be said to have $L = c - 1$ layers of management. For example, a firm containing two occupation classes will be said to have one layer of management (a firm can have a maximum of three layers of management).

Table 2 displays the number of firms per year as well as the mean value added, size, wage and layers (size refers to the total number of workers). There is room for firms in Sweden to change by adding or dropping layers: the average number of layers in the firm is similar to CMRH (ranging from 1.2 to 1.6 here and 1.50 to 1.59 in CMRH). The sample size, however, varies quite a bit across time as a result of changes in the sampling of occupations of workers in smaller firms.[6]

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[1] See Tåg et al. (2013) for a closer description and summary statistics of the Swedish occupation classifications.

[2] Although not available to me, it is possible to obtain wage and hours' data for a subsample of Swedish workers (those surveyed through "Lönestrukturstatistiken").

[3] For larger firms, the data comes from Lönestrukturstatistiken and is thus "accurate" for every year.

[4] Although the SSYK is based on ISCO-88 (COM), Statistics Sweden note that there are few differences between the ISCO-88 and the ISCO-88 (COM) at the three digit level. The mapping from PCS82 to ISCO-88 comes from EurOccupations.org State-of-the-art report (First Reporting Period-D35) and the ISCO-88 to SSYK96 mapping from Statistics Sweden. When the PCS code corresponds to two or more ISCO-88 codes, I use the highest code (lowest rank) of the ISCO codes for that PCS code.

[5] A difference to CMRH in Table 1 is that Class 2 employees in low percentiles appear to make less money than other classes. A plausible explanation is that CEOs in small Swedish firms are often owners of the firm they work in. CEOs/owners in closely held firms have the option to take out part of their compensation as capital income (through dividends) rather than as labor income (a wage). This is desirable as capital income is taxed at a lower rate than labor income (the "3:12 rules" regulates the portion of income that can be allocated to capital income). The capital income part of the compensation is not reflected in the wage measure in Table 1, so Class 2 employees in low percentiles appear to make less money than other classes.

[6] Firms do not appear to have become flatter over time as in CMRH for France or Rajan and Wulf (2006) for the US. This, however, is likely an artifact of the changes in average size and value added across years because of the sampling of the occupation data.