

# Globalization and CEO Pay: Estimating the Value of Good Leaders in Complex Firms

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**Abstract:** Much attention has been given to increasing income shares of top income earners in many advanced economies, particularly in the U.S. This increase is partly driven by so-called ‘supermanagers’, the chief executive officers (CEOs) of the largest firms. In this paper, we identify CEOs from matched worker-firm data for Denmark for the period 1995-2008 and construct firm complexity measures related to globalization. We document novel stylized facts about globalization and CEO compensation. We show how firm performance evolves around a CEO change, and we examine whether the rise in CEO compensation can be explained by increasing firm-level globalization and find that changes in the export volume correlates with changes in CEO compensation, while firm complexity measures play a minor role. Firm exports are then instrumented with world import demand in order to identify the causal impact of exports on CEO earnings. Our results indicate that if a firm doubles its exports for exogenous reasons, then the earnings of its CEO increases by 18%.

## 1. Introduction

The effects of globalization on the distribution of income have traditionally been at the core of international trade theory. The literature has usually been concerned with the relative pay to different production factors, skill groups, or other aggregate quantities. Recently however, much attention has been given to the very top of the income distribution. The economic significance of this rather narrow group of individuals (the ‘top one percent’ being a notable example) should not be understated: In 2012, the share of total market income (including capital gains, excluding government transfers) earned by individuals in the top percentile of the income distribution in the U.S. was around 22.5 percent (Piketty and Saez, 2003 and Piketty, 2014). Atkinson and Sørensen (2016) report top 1 percent income shares over time for a number of countries including Denmark and show that all countries have exhibited increasing top income shares since the 1980s albeit not with such a dramatic pace as in the U.S.

A large part of these top income earners have been found to consist of the CEOs of the top firms, or ‘supermanagers’. From a market-based perspective, the increase in relative and absolute pay to these individuals must arise from changes in the supply and demand structure in the market for managerial talent. For example Murphy and Zabojnik (2004) argue that general managerial skills have become more important relative to firm-specific managerial skills, which is consistent with improving outside options for CEOs and that CEO openings increasingly are filled through external hires rather than through internal promotions. Since these changes have occurred at the same time as what is normally perceived as a vast increase in globalization, it becomes natural to ask what, if any, connection there may be between these two phenomena.

Using matched worker-firm data for Denmark for the period 1995-2008 we identify CEOs and construct firm complexity measures related to globalization. We document novel stylized facts about globalization and CEO compensation. Among other things, newly hired CEOs broaden the export portfolio and increase the occupational complexity of the firm. We then show that changes in the export volume correlates with changes in CEO compensation, while firm complexity measures play a minor role. This pattern persists when conditioning on firm size. Firm exports are instrumented with world import demand in order to identify the causal impact of exports on CEO earnings. Our results indicate that if a firm doubles its exports for exogenous reasons, then the earnings of its CEO increases by 18%. This increase in earnings is not followed by increases in the relative wages of CEOs. One potential reason may be that the scale and composition of workers in the firm change within the CEO job spell as exports rise.

This paper adds to the literature by exploring a rich dataset on firms and employees in the context of top income earners and firm-level globalization. Data on CEOs and top managers in Danish firms have previously been used for other purposes as in Bennedsen et al. (2007) and Smith et al. (2013), but the link to firm exports and related activities is novel.

Several explanations have been proposed for the rising top income shares with the most prominent being principal-agent mechanisms, rent extraction and market-based explanations.<sup>1</sup> According to the principal-agent view, shareholders of a firm delegate control of a firm to a CEO, where the agency problem is resolved through an incentive contract that relates pay to firm performance. Because CEO compensation increasingly has been linked to firm performance one would expect to see a rise in CEO effort and pay to compensate for the increasing risks taken on. This view has been criticized by several authors. For example, Bertrand and Mullainathan (2001)

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<sup>1</sup> See Edmans and Gabaix (2016) for a survey of the theoretical literature and Bertrand (2009) and Frydman and Jenter (2010) for reviews of empirical findings.

argue that according to the principal-agent theory one should not be able to find a relationship between CEO pay and the components of firm performance that are not related to CEO effort. They document a strong correlation between oil prices and performance of large U.S. oil companies and find that CEO pay is equally sensitive to overall firm performance and the component of firm performance that is purely driven by oil prices. This may be taken as evidence that CEOs are not only paid for effort but also for luck.

The rent extraction view on CEO compensation holds that contracts are not decided by boards or shareholders but instead set by the CEOs themselves to maximize their own rents. Bertrand and Mullainathan (2001) provide some evidence consistent with this view as better governed oil companies pay their CEOs less for luck. On the other hand, the rent extraction view has also been questioned on the grounds that CEOs should have been interested in extracting rents always, so rent extraction is unable to explain the recent surge in CEO compensation (Murphy and Zabojnik, 2004).

As mentioned above, Murphy and Zabojnik (2004) propose a market-based explanation behind the rising top income share relying on increasing importance of general managerial skills. Gabaix and Landier (2008) analyze a competitive assignment model where CEOs are heterogenous in their talents. Talent is more valuable in large firms and so the most talented CEOs are assigned to the largest firms. As a result CEO compensation rises with firm size. Gabaix and Landier (2008) show that increase in CEO pay in the U.S. since 1980 can be fully attributed to the corresponding growth in firm size. However, the Gabaix and Landier (2008) model has also been criticized for not fitting the data well before 1980 and for being sensitive to sample selection and variable definition issues (Bertrand, 2009).

A small number of papers link increased globalization to the market-based explanations behind rising CEO pay. Marin and Verdier (2012) set up a theoretical model to show that increasing international trade leads foreign firms to enter a war for managerial talent, which in turn puts upward pressure on compensation. Cunat and Guadalupe (2009) use data for a panel of U.S. firms and find that import competition increases the sensitivity of pay to performance and that CEOs experience the largest pay increases in the management team. Chakraborty and Raveh (2015) study managerial wages in a developing country, India, and find that input tariff liberalization increases the compensation share of managers via imports-triggered quality upgrading.

Guadalupe and Wulf (2010) consider a sample of 230 large U.S. manufacturing firms and find that trade liberalization and increased import competition induces firms to remove layers between the CEO and division managers, to increase the number of positions that report directly to the CEO, and that the opportunity to sell in more markets may lead to more management layers (although this finding is weaker). Related to this, Caliendo and Rossi-Hansberg (2012) set up a theoretical model assuming that firms are organized in layers and show that trade liberalization leads expanding exporters to add layers if the expansion is large enough. Caliendo, Monte, and Rossi-Hansberg (2015) use French firm level data which allows them to distinguish three layers of management (supervisors, senior staff and CEOs), clerks and production workers. They then find that expanding firms reorganize by adding layers, pay the new top manager more and reduce wages in existing layers. They also find that firms who start exporting are more likely to reorganize than domestic firms, and new exporters that add layers decrease wages in existing layers. These results are broadly consistent with the view that general managerial skills become more valuable due to increased firm complexity when firms expand.

Finally, Ma (2015) builds a Melitz (2003)-type model with individuals heterogeneous in human capital endowments choosing career paths as either workers or CEOs. The human capital of a CEO translates directly into the productivity of the firm. In equilibrium, the most productive individuals become CEOs of the most productive firms. Since these firms are also top exporters, they make the highest profits and subsequently pay their CEOs relatively more than less exporting or domestic-only firms. He then uses a new dataset on U.S. firms covering around half of firms required to report executive compensation to show that the CEO-to-worker pay ratio within exporters is more than 40% higher than in domestic firms. However, once firm size is controlled for, the difference in CEO-to-worker pay ratio between exporters and non-exporters vanishes. Ma (2015) supplements the analysis with a calibration exercise for the U.S. economy to examine influence of globalization on top income shares with simulations. It is found that globalization can potentially explain around half of the observed surge in top income shares in the U.S. between 1988 and 2008.

The literature is still silent about the exact mechanism behind the relationship between firm-level export activity, firm complexity and CEO compensation as no study uses exogenous variation in the data to pin down possible channels at work. We first provide a set of stylized facts for Danish exporters and compensation of their CEOs. We then move on to identify exogenous shocks that lead to increased exports and examine the implication for CEO pay.

The paper is organized as follows. Section 2 describes the matched worker-firm data, how we identify managers and construct our instrument. Section 3 describes some overall patterns for CEO and firm characteristics, and an event study analysis of firm performance around CEO turnover is performed. Section 4 presents stylized facts on globalization and CEO compensation.

Section 5 examines in more detail the relationship between firm-level globalization, complexity and CEO compensation. Section 6 concludes.

## **2. Data**

In this section we explain our data sources, how CEOs are defined and how we construct various firm complexity measures related to globalization. We also define an instrumental variable for firm exports, which we use to estimate the causal impact of exports on CEO compensation.

### **2.1 Data Sources**

The dataset employed covers the universe of Danish firms and the entire population of individuals in Denmark for the years 1995-2008. Data is drawn from administrative registers in Statistics Denmark and combines firm data from the Firm Statistics Register (FirmStat) and worker data from the Integrated Database for Labor Market Research (IDA). We use the so-called FIDA link to match workers to firms using the workers' main employment relationships. From IDA we obtain information on several individual characteristics such as education, occupation and annual labor market income. From FirmStat we use information about industry codes (NACE six digit), number of full time employees and total sales, and from the Account Statistics Register we read the value of the firms' capital stock.

The data on CEOs in Danish firms (PERSBEST) comes from administrative data collected by the Danish Business Authority (Erhvervs- og Selskabsstyrelsen) and requires all firms to report, among other things, which individuals are members of the board or management of the firm. From this file we select all records where the individual is a member of a firm's management and match

them via the person and firm identifier to the matched worker-firm data set. Firms may have several managers, but in our baseline specification we retain only the top manager using the following algorithm: For the first year a firm is observed, we pick the highest earning manager as CEO. The CEO status is retained as long as that individual stays in the firm without breaks, regardless of whether that individual continues to be the top earner or not. If the individual is not observed in a year, the top earner in that year is selected as CEO and retains CEO status in subsequent years unless there is a new break etc. We provide some summary statistics for this in the next section.

As an alternative definition of CEOs we use occupational codes based on the ISCO88 nomenclature. Attention is limited to workers in the occupational category ‘management at the highest level’ (one-digit category 1). Again there may be more than one person with these occupation codes in a firm. If so, we pick the highest earning manager using the same algorithm as above.

Data on firm-level trade flows broken down by eight-digit product codes (CN8) and origin or destination countries comes from the Danish Foreign Trade Statistics Register. These data allow us to define a number of firm-level globalization variables of interest. First, our main variable of interest is the total value of exports of goods across destinations and product categories for each firm-year combination. As a measure for the complexity of the firm we also define variables measuring the number of export markets served by a firm and the number of unique HS8 products exported in a given firm-year combination. Using the matched worker-firm data, we construct a variable measuring number of unique four-digit ISCO88 codes present in a given firm in a given year. Finally, we also follow Caliendo, Monte, and Rossi-Hansberg (2015) and

define five different layers in the organization of the firm (CEOs, senior staff, supervisors, clerks and production workers).<sup>2</sup> We use the number of layers as another firm-level complexity variable.

We restrict the sample to large (in a Danish context) exporting firms in the manufacturing sector for the following reasons: Most of the analysis is concerned with the intensive margin of exporting using within-firm time variation in export volumes and so attention is limited to firms that export at least 5% of their sales. To avoid irregularities associated with small firms, we restrict the sample to firms with more than 50 employees. We implement these restrictions such that once a firm meets the requirements it stays in the sample. After cleaning the data and imposing these restrictions, we are left with a panel of 8,099 CEO-year observations spanning 1,271 firms and 1,989 different CEOs over the 13-year period 1996 to 2008.

## **2.2 Construction of Instrumental Variable**

Examination of the link between firm-level exports and CEO compensation is challenged by the fact that firm-level exports are endogenous. One type of endogeneity relates to the idea that high-ability managers make their firms more productive and raise exports. If high-ability managers also tend to get paid well, this induces a correlation between unobserved manager ability and firm exports. This type of endogeneity is alleviated by including CEO-firm fixed effects in our analysis.

Another type of endogeneity relates to unobserved firm-level shocks more generally affecting both firm exports and CEO pay. Consider for example a shock to prices or technology causing firm costs to go down. This improved competitiveness may cause the firm to expand operations both domestically and abroad, thus raising exports. At the same time, there is now

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<sup>2</sup> Caliendo et al. (2015) use the PCS classification to define layers. We use the concordance from EurOccupations.org Stateof-the-art report (First Reporting Period-D35) to map our ISCO88 codes into PCS codes.

more surplus to bargain over between the firm and the CEO, possibly causing CEO pay to increase as well. To confront such types of endogeneity problems, we pursue an IV identification strategy as in Hummels et al. (2014) and use world import demand (WID) as instrument for firm exports.

The instrument is defined in the following way. We use the COMTRADE database to get the import demand of country  $c$  of product  $k$  at time  $t$  from the rest of the world except Denmark,  $WID_{ckt}$ . We aggregate these product-country specific world import demands to the firm level by weighting with the presample shares of firm  $j$ 's products in the total exports of the firm. That is, the instrument for firm  $j$  at time  $t$  is  $I_{jt} = \sum_{c,k} s_{jck} WID_{ckt}$ , where  $s_{jck}$  is the share of product  $k$  exported to country  $c$  in total exports for firm  $j$  in the pre-sample year, 1995.

This instrument exploits heterogeneity across firms in their initial product-level export mix. Hummels et al. (2014) show that the initial product-country export mix of a firm is fairly stable over time and that Danish firms have only few product-country exports in common. This means that time changes in world import demand at the product-country level will affect firms differently. For example, exogenous changes in an importing country's production costs or consumer demand will be reflected in changing imports from the world as a whole by that country, and so a Danish firm that exports to this country more than others will benefit disproportionately from these changes.

### 3. CEO Characteristics and Firm Characteristics

In this section we provide descriptive statistics for the data on CEOs and their firms. As mentioned in the previous section, some firms have several managers, but of all the firm-year observations, 78% are recorded with only one manager. Unsurprisingly, there is a clear positive relationship between the number of managers and the number of employees. For example the

average size of firms with only one manager is 185 employees, while the average size of firms with 5 managers is 1364 employees. However, among managers in multi-manager firms the difference in annual income of the top earner (the CEO) and other managers is modest. For the median multi-manager firm the CEO earns 20% more than other managers and this premium is fairly stable over time. In the following we restrict attention to CEOs such that we have one observation per firm-year.

The average earnings of the CEOs in the sample is 1.1 million DKK in 2000 prices (corresponding to about 160,000 USD), see Table 1. The annual earnings can be decomposed into labor income, fringe benefits, bonuses and exercised stock options, but labor income evidently account for the major part of total earnings. The average earnings of CEOs amounts to about 3.5 times the income of the average worker in the firm, which is much lower than what is documented in U.S. data. For the largest firms with at least 500 employees, average CEO earnings roughly two million DKK or about 290,000 USD, while this corresponds to 4.8 times the income of the average worker in the firm. Frydman and Saks (2008) report that by 2005 the ratio of top manager pay to that of average worker earnings was as much as 110 times higher, while in the 1970s it was considerably lower at 30 but still much higher than in our data. Several factors may explain these differences. First, low-paid workers earn considerably more in the Danish labor market due to stronger influence by unions in wage formation. As a result, the income of the average worker is higher. Second, the firms are on average smaller in Denmark than in the U.S. economy and CEO pay correlates positively with firm size.

Two thirds of the CEOs in the sample have a college degree, see Table 1. The average CEO is around 50 years of age with 23 years of labor market experience of which almost 8 years have been spent in the current firm. Restricting attention to job spells as a CEO in a given firm, the

duration is shorter. For the 2,656 CEO job spells in the data, 28% last only one year with a median spell duration of three years and an average duration of 3.5 years. Only 1.9% of the CEOs are women, and this rate has been fairly stable over the sample period. This gender composition is roughly in accordance with the female share reported from U.S. firms (Bertrand 2009).

The occupation is observed for most of the CEOs, and as expected most (78%) are assigned the one-digit ISCO88 classification for managers. One reason why 22% are not managers according to the occupation code could be measurement error. It is well known that occupation codes in administrative data may show persistence in the sense that firms tend to report the same code for each employee even if the employee is assigned new tasks. Related to this, 73% of CEOs are promoted internally. The tendency to hire CEOs from internal candidates is interesting in light of the market-based explanation behind rising CEO compensation mentioned in the introduction. Murphy and Zbojnik (2004) report that the 14.9% of newly appointed CEOs of large U.S. firms were recruited from other firms in the 1970, while this rate increased to 17.2% in the 1980s and 26.5% in the 1990s. This can be interpreted as reflecting an increasing importance of general skills versus firm-specific skills. When firm-specific skills decline in importance external candidates increasingly should be considered, and as a result a larger market for CEOs emerge. The number reported from the 1990s in the U.S. data is in line with the 27% of the CEOs being hired from outside in our data. However, there is no clear time trend in the rate of externally hired CEOs from 1995 and onwards in our data.

The firms in the sample are export oriented with 48% of the sales shipped to markets abroad. This rate has increased from 44% in 1995 to 49% in 2008. We are interested in ways to measure firm complexity because more complex firms may be more difficult to manage and require more talented CEOs. To this end, we define two 'international' complexity measures: the

diversity of products exported and the number of export destination markets serviced. The number of products is the total number of unique CN8 product categories exported for each firm-year combination. The number of export destinations is the total number of unique export destinations for each firm-year combination. We also employ three ‘domestic’ complexity measures: the number of four-digit occupations, the number of layers as defined by Caliendo et al. (2015) and the share of workers with a college degree employed for a given firm. The international complexity measures show a clear rising trend over the sample period, see Figure 1. By contrast, the number of occupations in the firms shows a somewhat declining trend, which could be a reflection of the finding in Guadalupe and Wulf (2010), where firms are flattening their organizational structure in response to globalization and increasing product market competition.

To examine whether hiring a new CEO is correlated with changed activities in the firm, we first run the following regressions: We take either a dummy for increasing the number of exported products, a dummy for increasing the number of destination markets, a dummy for increasing the number of layers, or a dummy for increasing the number of occupations in the firm between year  $t-1$  and year  $t$ , year  $t$  and year  $t+1$  or year  $t+1$  and year  $t+2$  and regress on a dummy for hiring a new CEO in year  $t$ , see Table 2. In all cases there is a positive correlation between hiring a new CEO in year  $t$  and adding products, markets, layers or occupations in year  $t+1$ , but only the correlation for destinations is significant. In year  $t+2$ , the correlations turn negative for the number of destinations and the number of occupations. This indicates that firms are undergoing a transformation and that new CEOs manage to add to the export portfolio and to affect the occupational complexity of the firm.

To shed further light on the dynamics around a change of CEO we next run event study regressions along the lines of Jacobson, Lalonde and Sullivan (1993). That is, we estimate

$$Y_{jt} = \alpha_j + \alpha_t + x_{jt}\beta + \sum_{k \geq -m} D_{jt}^k \delta_k + \varepsilon_{jt}, \quad (1)$$

where  $j$  and  $t$  index firms and years. The dependent variable,  $Y_{jt}$ , is an outcome variable of interest,  $\alpha_j$  and  $\alpha_t$  are firm and year fixed effects, and  $x_{jt}$  is a vector of time-varying firm controls. Equation (1) estimates outcome profiles for the two years before and two years after the CEO change in year  $t$ , with five dummy variables,  $D_{jt}^k$ , corresponding to those years.<sup>3</sup> For the firms with CEO change, the five coefficients in the vector  $\delta_k$  show the differences in their outcome relative to the baseline values (i.e. no CEO change) in each of the five years.

The estimation results are displayed in Figure 2. The top right panel confirms the result from Table 2 that new CEOs manage to increase the number of export destinations one year after their hiring. The two middle panels show that the number of occupations and organizational layers drop two years after the new CEO has arrived. Total sales and export sales exhibit a declining trend from year  $t-2$  to  $t+1$  after which there seems to be a recovery. These results appear to be consistent with the view that new CEOs are hired in declining firms and that they manage to bring the firm back on track by reducing the internal complexity of the firm and by adding export destinations.

#### 4. Stylized Facts About Globalization and CEO Compensation

In this section we show some partial correlations between CEO earnings and firm exports and firm complexity measures. We separate our results into two categories based on whether the measure of CEO earnings is in absolute or relative terms. If changes within the firm are believed to be tied to changing ‘economies of superstars’, we would expect to see increases in both absolute

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<sup>3</sup> Some firms have multiple CEO changes in the sample window. We only examine CEO changes, where the new CEO is the only change in the five years from  $t-2$  to  $t+2$ .

and relative CEO pay since the CEO belongs to a particular group of workers. On the other hand, if CEO wages reflect the general wage trend in the firm, we would expect CEO relative to average worker earnings to remain constant while absolute CEO pay is changing. Note that this implicitly assumes a constant number of workers of various wage levels in the firm. If changes in the environment of the firm means that e.g. the lower paid workers are laid off to reduce the total employment in the firm, lower relative CEO earnings may result even with rising absolute CEO wages and constant wages among the remaining employees.

Table 3 displays coefficient estimates from regressions of CEO earnings (the top panel) or CEO earnings relative to the average worker's earnings (the bottom panel) on export and complexity variables. Firms that export more and have more complex exports as measured by the number of exported products and destinations pay their CEOs more as seen from the coefficients in the first column. Likewise, firms with more occupations and a higher share of high skilled workers compensate CEOs better. Some of this may reflect the fact that larger firms pay higher wages. In the second column we control for the number of workers employed by the firm and total firm sales. The correlations are weaker but still significantly positive. In the third column we include CEO-firm fixed effects (but leave out firm size controls) such that only time variation within CEO job spells is used to identify the correlation. In this case, only exports and the number of occupations show a significant positive correlation. In the last column we also include firm size controls but here all correlations are insignificantly different from zero.

To better understand which export and complexity variables drive CEO compensation, we include in Table 4 all variables in fixed effects regressions. The export volume correlates positively with CEO earnings in column (1). This means that even relying only on time variation within CEO-firm job spells and controlling for firm complexity there is a positive correlation between exports

and CEO compensation measured. However, when firm size controls are added this effect vanishes (column 2) suggesting that exports might not be particularly valuable for CEOs.

Note that most of the control variables included in Table 4 capture variation related to both the scale of the firm and the composition of its activities. For example, the number of products sold can be decomposed into total sales and the number of products per dollar sold.<sup>4</sup> To examine which components drive CEO compensation, we group the variables into scale and composition variables and into input and output variables.

In Table 5 we examine variables measuring firm output activities. The first column is a benchmark case, where exports and sales are included. For earnings measured in levels, sales correlate positively while exports again do not appear to matter for CEO earnings. In column (2) we enter the number of products instead of sales and in column (3) we decompose the number of products into sales and the number of products per dollar sold. It is clear that sales is the primary driver of CEO compensation when measured against the number of products exported. In columns (4) and (5) we do the same exercise for the number of export destinations with the same result. In columns (6) and (7) we decompose exports into sales and the export intensity, but again sales appear to be the main driver of CEO compensation. For CEO earnings measured relative to the earnings of the average worker the picture is different as both sales and the export intensity raises relative CEO earnings.

Taken at face value, these results suggest that while CEOs may be hired to manage complex firm output environments and paid accordingly, changes in CEO salary within the current job spell hinges much more on the ability of the CEO to deliver increased firm scale via higher sales,

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<sup>4</sup> This can be easily seen by rewriting the number of products sold,  $N$ , in the following way:  $\log(N) = \log(\text{sales}) + \log(N/\text{sales})$ .

whereas changes in the CEO's 'span of control' through changes in firm scope only does little to affect the payment received within the tenure period.

In Table 6 we examine variables measuring firm input activities. Column (1) has exports and the number of employees in the firm as a benchmark. The top panel shows that only the number of employees boosts earnings of CEOs. In columns (2) and (3) we first enter the number of high skilled workers and then this variable's two components, the total number workers and the share of high skilled workers. It is clear that the important driver behind CEO compensation here is the total number of employees. Columns (4) and (5) decomposes the number of occupations in the firm (column (4)) into its components, the total number of employees and the number of occupations per worker (column (5)). The same picture emerges as the total number of workers appear to be the main driver behind CEO compensation. The bottom panels shows that much the same correlations are found for relative CEO earnings.

To summarize, this section has documented that changes in the export volume correlates with changes in CEO compensation, while firm complexity measures play a minor role. Total sales and the number of employees also correlate with CEO compensation, and when controlling for firm size there appears to be no effect of exports on CEO compensation. This raises the question whether one should control for firm size variables in estimations of the causal impact of exports on CEO earnings. For example, an exogenous rise in exports could increase sales (and other firm-level variables) and therefore CEO earnings. In the following we turn to estimation of the causal impact of exports on CEO earnings with and without firm controls.

## 5. Are CEOs Rewarded for Luck in Export Markets?

So far we have relied on time variation within job spells to estimate correlations between exports, firm activities and CEO compensation. However, these relationships may suffer from endogeneity bias as for example unobserved productivity or demand shocks to firms may drive both exports and CEO earnings. In this section we rely on exogenous shocks to firm-level exports to estimate the causal effect of exports on CEO compensation. We will employ the world import demand instrument described in Section 2.2 in a first stage regression. In the second stage we follow the literature (e.g. Hummels et al. 2014 and Munch and Skaksen 2008) and estimate individual level Mincer earnings regressions of the form

$$\log Y_{ijt} = \beta_1 \log EXP_{jt} + \beta_2 x_{it} + \beta_3 z_{jt} + \varphi_{IND,t} + \alpha_{ij} + \varepsilon_{ijt}, \quad (2)$$

where  $Y_{ijt}$  is the CEO earnings measure of CEO  $i$  in firm  $j$  at time  $t$ . We use either CEO earnings in levels or relative to the average worker in the firm.  $EXP_{jt}$  is firm  $j$ 's total exports at time  $t$ ,  $x_{it}$  captures CEO control variables (labor market experience and experience squared), and  $z_{jt}$  contains firm-level variables. As mentioned above we will estimate versions of equation (2) with and without these firm controls.  $\varphi_{IND,t}$  denotes industry-year fixed effects while  $\alpha_{ij}$  represents CEO-firm fixed effects. Including CEO-firm fixed effects means that we only rely on time variation within CEO job spells to identify the coefficient of interest,  $\beta_1$ .

We report the results from the first stage regressions in Table 7. The first two columns show the specifications fitting exports with and without the firm control variables. As predicted, the world import demand instrument enters in both cases with a positive sign and it explains a

sufficiently large portion of the variation in exports as indicated by the F-statistic. In the third column we directly instrument total sales with the world import demand variable. The idea is that exogenous export shocks ultimately may increase sales. Again, the instrument enters with the predicted sign and an F-statistic suggesting it is not a weak instrument.

Table 8 reports the results from the second stage IV regressions using CEO earnings in levels in the first three columns and CEO relative earnings in the last three columns. Instrumented exports and sales enter with positive signs in all specifications, and they are significant for earnings measured in levels (columns 2 and 3). For example the coefficient estimate of column (2) means that if the firm doubles its exports for exogenous reasons then the earnings of its CEO increases by 18%. If the firm doubles its total sales due to exogenous changes in world import demand, the earnings of its CEO increases by 41%. In previous research it has been documented that exports tends to raise wages of all workers (e.g. Hummels et al. 2014), but columns (4)-(6) shows that CEO wages do not appear to significantly increase by more than the average worker's wage. As pointed out above, this may be due to compositional changes within the firms.

As an extension we next investigate if exports affect CEOs differently depending on whether they are internally promoted or hired from the outside. As mentioned previously, the market based explanation behind rising CEO pay suggests a declining role of firm-specific skills such that candidates increasingly should be hired from outside the firm, where wages better reflect ability and talent. In our context this would mean that externally hired CEOs should be less likely to be rewarded for exogenous changes in exports than internally hired CEOs, since exogenous export shocks are unrelated to CEO ability.

We examine this hypothesis in Table 9 by interacting exports or total sales with a dummy variable taking the value one if the CEO is internally promoted.<sup>5</sup> The first four columns show results for the CEO earnings measured in levels, while the last four columns employ the relative CEO earnings measure. We report results from fixed effects regressions using non-instrumented exports or total sales and from fixed effects regressions using instrumented exports or instrumented total sales.<sup>6</sup> In all cases the promotion interactions enter with positive sign, but they are insignificant.

## 6. Conclusions

Much attention has been given to increasing income shares of top income earners in many advanced economies, particularly in the U.S. This increase is partly driven by so-called ‘supermanagers’, the chief executive officers (CEOs) of the largest firms. In this paper, we identify CEOs from matched worker-firm data for Denmark for the period 1995-2008 and construct firm complexity measures related to globalization. We document some novel stylized facts about globalization and CEO compensation. Among other things, newly hired CEOs generally manage to add to the export portfolio but it seems to go hand in hand with reduced occupational complexity of the firm.

We then investigate whether the rise in CEO compensation can be explained by increasing firm-level globalization. We find that changes in the export volume correlates with changes in CEO compensation, while firm complexity measures play a minor role. Total sales and the number of

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<sup>5</sup> All CEO job spells starting in 1995 are excluded, since we cannot define the promotion dummy in that year.

<sup>6</sup> This implicitly assuming the promotion dummy is exogenous, which may clearly not be the case. Ideally we should also instrument the promotion dummy.

employees also correlate with CEO compensation, and when controlling for firm size there appears to be no effect of exports on CEO compensation.

Firm exports are instrumented with world import demand in order to identify the causal impact of exports on CEO earnings. Our results indicate that if the median firm doubles its exports for exogenous reasons, then the earnings of its CEO increases by 18%. This increase in absolute earnings is not followed by increases in the relative wages of CEOs. One potential reason may be that the scale and composition of workers in the firm change within the CEO job spell as exports rise.

Finally, we relate our results to the idea that an increasing role for general managerial skills at the expense of firm-specific skills should increasingly attract candidates for CEO positions from the outside where wages better reflect ability and talent. This implies that externally hired CEOs should be less likely to be rewarded for exogenous changes in exports than internally hired CEOs, since exogenous export shocks are unrelated to CEO ability. However, we do not find any significantly different effects for internally promoted CEOs.

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## Appendix: Tables and Figures

Table 1, Sample Means, 1996-2008

	No. of obs.	Mean	Std. Dev.
<i>CEO characteristics:</i>			
Age	8,099	49.94	8.114
Female	8,099	0.022	0.147
Experience	8,099	23.581	9.368
Tenure	8,096	8.464	6.980
College degree	8,099	0.65	0.48
Annual income, 1,000 DKK	8,099	1,106	1,193
Labor income, 1,000 DKK	8,099	1,017	1,090
Benefits, 1,000 DKK	8,099	89.15	396.52
Anniversary bonuses, 1000 DKK	8,099	7.81	123.97
Fringes, 1000 DKK	8,099	69.54	40.05
Stock options 1000 DKK	8,099	11.80	372.00
Internally promoted	8,099	0.854	0.353
<i>ISCO one-digit occupations:</i>			
Legislators, senior officials and managers	7,011	0.789	0.408
Professionals	7,011	0.093	0.290
Technicians and associate professionals	7,011	0.068	0.253
Other occupations	7,011	0.050	0.218
<i>Firm Characteristics:</i>			
Employees	8,093	207.30	478.18
Share with college degree	8,095	0.18	0.12
Wage bill, 1,000 DKK	8,089	68300	187000
Occupations	8,099	29.75	18.76
Capital stock, 1,000 DKK	8,089	87500	460000
Total sales, 1,000 DKK	8,096	438000	814000
Exports, 1,000 DKK	8,010	164000	553000
Exports/Total sales	8,004	0.53	0.32
Exported products	8,010	25.02	32.96
Export destinations	8,010	25.77	20.76

Notes: Experience is measured as time spent employed since 1980. Tenure is measured as time spent at the current firm. Annual income is labor income including bonuses, Internally promoted is a dummy indicating if the CEO is hired by the firm before the CEO is registered as a CEO. All nominal variables are measured in year 2000 DKK using the GDP deflator.

Table 2. New CEOs and changes in firm complexity

Add Products in t	0.0155	0.0163
Add Products in t+1	0.0192	0.0183
Add Products in t+2	0.0098	0.0092
Add Destinations in t	-0.0412 **	-0.0405 **
Add Destinations in t+1	0.0493 ***	0.0500 ***
Add Destinations in t+2	-0.0282 *	-0.0285 *
Add Layers in t	0.0038	0.0039
Add Layers in t+1	0.0064	0.0064
Add Layers in t+2	-0.0033	-0.0037
Add Occupations in t	-0.0092	-0.0093
Add Occupations in t+1	0.0174	0.0165
Add Occupations in t+2	-0.0401 ***	-0.0414 ***
Industry and year fixed effects	yes	yes
Firm size controls	no	yes

Notes: Notes: The coefficient estimates are from regressions of dummies for adding products, destinations or occupations in year t, year t+1 or year t+2 on a dummy indicating if year t is the CEO's first year in the firm. Firm fixed effects are included in all regressions. \*\*\* Significant at the 1 percent level, \*\* Significant at the 5 percent level, \* Significant at the 10 percent level.

Table 3. Exports, firm complexity and CEO earnings.

<i>Log CEO Earnings:</i>				
Log Exports	0.1377 ***	0.0053	0.0169 ***	0.0027
Log Products	0.1695 ***	0.0212 ***	-0.0026	-0.0105
Log Destinations	0.2024 ***	0.0495 ***	0.0179	-0.0016
Log Occupations	0.4476 ***	0.0874 ***	0.0528 ***	0.0004
Share of high skilled workers	1.2019 ***	0.7307 ***	-0.0475	0.1512
Layers of Management	0.1722 ***	0.0379 ***	0.0079	-0.0005
<i>Log Relative CEO Earnings:</i>				
Log Exports	0.1133 ***	0.0106 **	0.0167 **	0.0074
Log Products	0.1402 ***	0.0195 ***	-0.0024	-0.0061
Log Destinations	0.1689 ***	0.0460 ***	0.0301 **	0.0051
Log Occupations	0.3949 ***	0.0570 ***	0.0756 ***	-0.0001
Share of high skilled workers	0.4707 ***	0.1641 ***	-0.4568 ***	-0.1039
Layers of Management	0.1442 ***	0.0273 ***	0.0026	-0.0062
Industry and year fixed effects	yes	yes	yes	yes
Firm size controls	no	yes	no	yes
CEO-Firm fixed effects	no	no	yes	yes

Notes: The coefficient estimates are from regressions of CEO earnings or relative CEO earnings on the variables listed in the first column. \*\*\* Significant at the 1 percent level, \*\* Significant at the 5 percent level, \* Significant at the 10 percent level.

Table 4. CEO earnings, exports and firm complexity.

	Log CEO earnings		Log CEO relative earnings	
	(1)	(2)	(3)	(4)
Log Exports	0.0157** (0.0075)	0.0050 (0.0079)	0.0075 (0.0082)	0.0069 (0.0085)
Log Products	-0.0122 (0.0095)	-0.0134 (0.0096)	-0.0119 (0.0104)	-0.0084 (0.0103)
Log Destinations	0.0037 (0.0163)	0.0015 (0.0164)	0.0203 (0.0178)	0.0042 (0.0177)
Log Occupations	0.0360** (0.0165)	-0.0030 (0.0182)	0.0520*** (0.0182)	-0.0112 (0.0196)
Share of high skilled workers	0.1160 (0.1170)	0.2195* (0.1259)	-0.4434*** (0.1319)	-0.1489 (0.1357)
Layers	0.0002 (0.0097)	-0.0021 (0.0097)	-0.0043 (0.0105)	-0.0048 (0.0104)
Log Sales		0.0234 (0.0233)		-0.1941*** (0.0251)
Log Employees		0.0979*** (0.0277)		0.3354*** (0.0298)
Observations	7,968	7,952	7,951	7,948
Number of job spells	2,139	2,136	2,136	2,135
R-squared	0.018	0.023	0.043	0.063

Notes: The coefficient estimates are from regressions of CEO earnings and CEO relative earnings on the variables listed in the first column. Industry, year and job spell fixed effects are included. \*\*\* Significant at the 1 percent level, \*\* Significant at the 5 percent level, \* Significant at the 10 percent level.

Table 5. CEO earnings and firm output activities.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>Log CEO earnings:</i>							
Log Exports	0.0064 (0.0069)	0.0191*** (0.0066)	0.0087 (0.0071)	0.0170** (0.0073)	0.0062 (0.0077)	0.0169*** (0.0063)	
Log Sales	0.0673*** (0.0150)		0.0562*** (0.0171)		0.0680*** (0.0216)		0.0737*** (0.0140)
Log Products		-0.0105 (0.0093)					
Log (Products/Sales)			-0.0123 (0.0093)				
Log Destinations				-0.0002 (0.0158)			
Log (Destinations/Sales)					0.0007 (0.0158)		
Log (Exports/Sales)							0.0064 (0.0069)
Observations	8,004	8,010	8,004	8,010	8,004	8,010	8,004
Number of job spells	2,149	2,150	2,149	2,150	2,149	2,150	2,149
R-squared	0.020	0.017	0.020	0.016	0.020	0.016	0.020
<i>Log CEO relative earnings:</i>							
Log Exports	0.0142* (0.0076)	0.0187** (0.0073)	0.0161** (0.0078)	0.0130 (0.0080)	0.0105 (0.0085)	0.0167** (0.0070)	
Log Sales	0.0143 (0.0183)		0.0052 (0.0204)		0.0306 (0.0249)		0.0284* (0.0168)
Log Products		-0.0098 (0.0101)					
Log (Products/Sales)			-0.0103 (0.0101)				
Log Destinations				0.0165 (0.0173)			
Log (Destinations/Sales)					0.0167 (0.0173)		
Log (Exports/Sales)							0.0142* (0.0076)
Observations	7,989	7,992	7,989	7,992	7,989	7,992	7,989
Number of job spells	2,146	2,147	2,146	2,147	2,146	2,147	2,146
R-squared	0.039	0.039	0.039	0.039	0.039	0.039	0.039

Notes: The coefficient estimates are from regressions of CEO earnings and CEO relative earnings on the variables listed in the first column. Industry, year and job spell fixed effects are included. \*\*\* Significant at the 1 percent level, \*\* Significant at the 5 percent level, \* Significant at the 10 percent level.

Table 6. CEO earnings and firm input activities.

	(1)	(2)	(3)	(4)	(5)	(6)
<i>Log CEO earnings:</i>						
Log Exports	0.0035 (0.0068)	0.0091 (0.0067)	0.0031 (0.0069)	0.0137** (0.0065)	0.0036 (0.0068)	0.0160** (0.0064)
Log Employees	0.0966*** (0.0172)		0.0945*** (0.0185)		0.0938*** (0.0191)	
log High skilled workers		0.0526*** (0.0148)				
Log Share of high skilled workers			0.0068 (0.0191)			
Log Occupations				0.0367** (0.0154)		
Log (Occupations/Employees)					-0.0060 (0.0175)	
Layers						0.0048 (0.0094)
Observations	7,999	7,955	7,955	8,010	7,999	7,968
Number of job spells	2,148	2,144	2,144	2,150	2,148	2,139
R-squared	0.022	0.018	0.021	0.017	0.022	0.017
<i>Log CEO relative earnings:</i>						
Log Exports	-0.0067 (0.0074)	0.0050 (0.0073)	-0.0074 (0.0075)	0.0116 (0.0071)	-0.0066 (0.0074)	0.0151** (0.0070)
Log Employees	0.1888*** (0.0193)		0.1763*** (0.0207)		0.1846*** (0.0215)	
log High skilled workers		0.0779*** (0.0163)				
Log Share of high skilled workers			-0.0207 (0.0207)			
Log Occupations				0.0683*** (0.0172)		
Log (Occupations/Employees)					-0.0084 (0.0191)	
Layers						0.0014 (0.0104)
Observations	7,992	7,948	7,948	7,992	7,992	7,951
Number of job spells	2,147	2,143	2,143	2,147	2,147	2,136
R-squared	0.055	0.041	0.051	0.042	0.055	0.039

Notes: The coefficient estimates are from regressions of CEO earnings and CEO relative earnings on the variables listed in the first column. Industry, year and job spell fixed effects are included. \*\*\* Significant at the 1 percent level, \*\* Significant at the 5 percent level, \*Significant at the 10 percent level.

Table 7. First-stage FE-IV regressions.

	Log Exports		Log Sales
	(1)	(2)	(3)
Log WID	0.1210*** (0.0364)	0.2624*** (0.0444)	0.1201*** (0.0193)
Log Employees	0.1606*** (0.0486)		
Log Sales	0.5949*** (0.0391)		
Log Kapital	-0.0369** (0.0147)		
Log Products	0.1420*** (0.0162)		
Log Destinations	0.8434*** (0.0256)		
Log Occupations	0.0408 (0.0310)		
Share of high skilled workers	-0.3489 (0.2143)		
Layers	-0.0086 (0.0162)		
Experience	0.0091 (0.0147)	0.0015 (0.0152)	0.0142** (0.0062)
Experience squared	0.0184 (0.0168)	0.0589*** (0.0207)	0.0231** (0.0096)
Observations	7,919	8,010	8,093
Number of job spells	2,131	2,150	2,154
R-squared	0.392	0.088	0.135
F-statistics for instrument	11.06	34.90	38.79

Notes: The table shows first stage regressions of log exports or log sales using world import demand (WID) as excluded instruments. All specifications include industry-year fixed effects and CEO-firm fixed effects. \*\*\* Significant at the 1 percent level, \*\* Significant at the 5 percent level, \* Significant at the 10 percent level.

Table 8. CEO earnings regressions.

	Log CEO earnings			Log CEO relative earnings		
	(1)	(2)	(3)	(4)	(5)	(6)
Log Exports	0.2909 (0.1817)	0.1810** (0.0824)		0.1349 (0.1960)	0.0785 (0.0903)	
Log Sales			0.4077** (0.1672)			0.1667 (0.1827)
Log Employees	0.0366 (0.0404)			0.2888*** (0.0436)		
Log Sales	-0.1177 (0.1123)			-0.2511** (0.1211)		
Log Kapital	0.0265** (0.0111)			0.0115 (0.0120)		
Log Products	-0.0471* (0.0277)			-0.0246 (0.0299)		
Log Destinations	-0.2063 (0.1543)			-0.0949 (0.1665)		
Log Occupations	-0.0142 (0.0207)			-0.0187 (0.0223)		
Share of high skilled workers	0.1878 (0.1444)			-0.1630 (0.1558)		
Layers	-0.0032 (0.0099)			-0.0070 (0.0107)		
Experience	0.0498*** (0.0090)	0.0420*** (0.0074)	0.0388*** (0.0068)	0.0508*** (0.0097)	0.0296*** (0.0081)	0.0327*** (0.0074)
Experience squared	-0.0834*** (0.0108)	-0.0870*** (0.0114)	-0.0846*** (0.0108)	-0.0829*** (0.0116)	-0.0821*** (0.0125)	-0.0821*** (0.0118)
Observations	7,919	8,010	8,093	7,916	7,992	8,076
Number of groups	2,131	2,150	2,154	2,130	2,147	2,151
R-squared	0.095	0.087	0.084	0.124	0.104	0.103

Notes: The table shows the results from second-stage CEO-level earnings regressions.. All specifications include industry-year fixed effects and CEO-firm fixed effects. \*\*\* Significant at the 1 percent level, \*\* Significant at the 5 percent level, \* Significant at the 10 percent level.

Table 9. CEO earnings regressions, promotion interactions.

	Log CEO earnings				Log CEO relative earnings			
	FE		FE-IV		FE		FE-IV	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log Exports	0.0158 (0.0138)		0.1616 (0.1285)		0.0180 (0.0158)		0.0129 (0.1412)	
Log Exports * Promoted	0.0067 (0.0156)		0.0049 (0.1368)		0.0061 (0.0176)		0.0839 (0.1502)	
Log Sales		0.0861*** (0.0322)		0.2965* (0.1634)		0.0299 (0.0373)		0.0681 (0.1786)
Log Sales * Promoted		0.0036 (0.0351)		0.1204 (0.1668)		0.0090 (0.0412)		0.1434 (0.1821)
Experience	0.0418*** (0.0074)	0.0426*** (0.0064)	0.0420*** (0.0074)	0.0382*** (0.0070)	0.0295*** (0.0081)	0.0345*** (0.0070)	0.0294*** (0.0081)	0.0320*** (0.0076)
Experience squared	-0.0778*** (0.0101)	-0.0773*** (0.0099)	-0.0870*** (0.0114)	-0.0845*** (0.0108)	-0.0784*** (0.0110)	-0.0788*** (0.0109)	-0.0820*** (0.0125)	-0.0819*** (0.0118)
Observations	8,010	8,093	8,010	8,093	7,992	8,076	7,992	8,076
Number of job spells	2,150	2,154	2,150	2,154	2,147	2,151	2,147	2,151
R-squared	0.088	0.090	0.087	0.084	0.105	0.104	0.104	0.103
First stage F-statistics:								
Log Exports			17.61				17.61	
Log Exports * Promoted			19.75				19.75	
Log Sales				22.61				22.61
Log Sales * Promoted				25.92				25.92

Notes: The table shows the results from CEO-level earnings regressions.. All specifications include industry-year fixed effects and CEO-firm fixed effects. \*\*\* Significant at the 1 percent level, \*\* Significant at the 5 percent level, \* Significant at the 10 percent level.

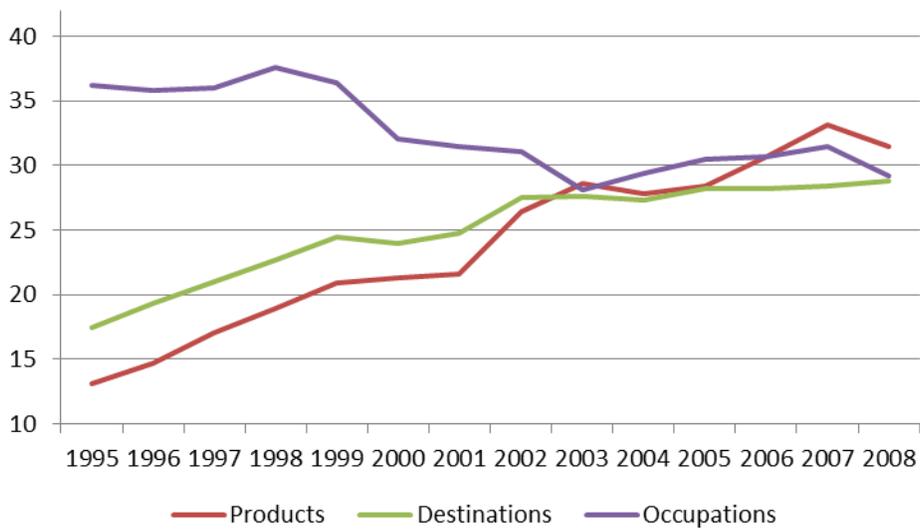


Figure 1. Firm-level average number of products, destinations and occupations.

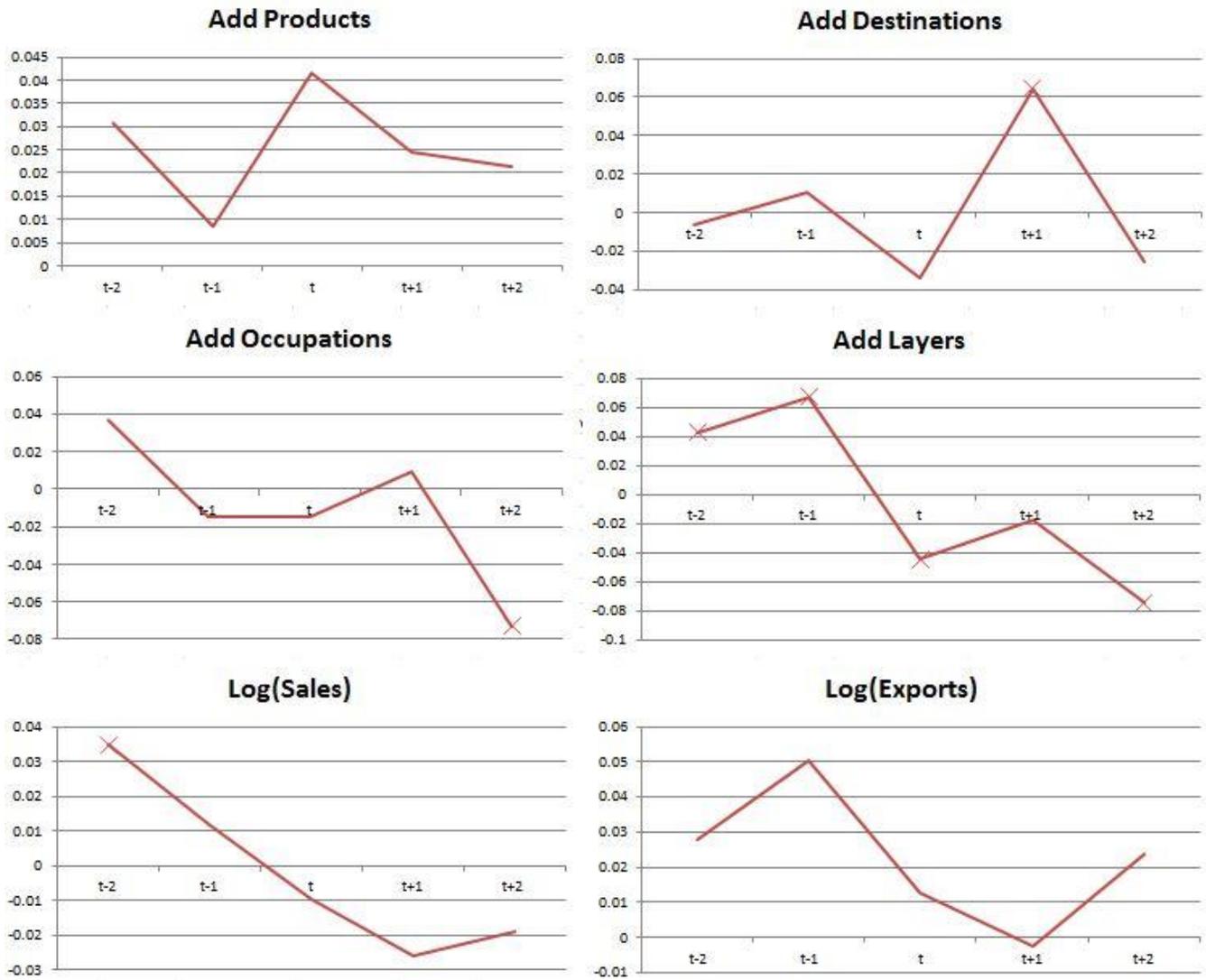


Figure 2. Firm performance and CEO changes.