Does employees' compensation vary with corporate profit?

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Abstract

We find that from about 1965 to 1983 US employees' compensation, EC, relative to corporate profit, CP, increases in the long run, and from 1984 to 2013 the compensation decreases relative to profit to about half its 1983 value. The first period includes "US peacetime inflation", 1970 -78 and the last period includes "The Great moderation", 1985 – 1997. With the exception of a short period 1998 -2003, the dominant pattern is that corporate profit and employees' compensation increase and decrease in concert, but compensation lags profit with about 10 quarters. From 1965 to present, cycle times for the EC-CP pair generally decreases from about 60 quarters to about 40 quarters.

INTRODUCTION

The present study examines questions related to the development of employees' compensation, EC, corporate profit, CP, and potential factors that might help explain the recent decline in compensation relative to profit.

Corporations could choose to compensate their employees so that their profit is maximized. If so, is there a "natural" ratio between employees' compensation and corporate profit? For example, related to a "natural" rate of unemployment. Since 1983, one can observe that profit has increased, but the ratio between compensation and profit has steadily decreased (Krugman 2013 blog New York Times, Dec 25). To help explain this observation, Paul Krugman, on his blog (2013,) discussed why corporations might not mind moderate depression. A conjecture is that corporations would prefer to have a moderate depression with a slightly lower demand than under a strong economy. This would allow them to pay a

smaller compensation for skilled employees. This option may presumably give them a similar, or higher, profit than under a strong economy.

In the present study, we address the relationship between corporate profit and employees' compensation in a leading – lagging perspective. If corporate profit increases, does employee's compensation follow the increase? And if profit decreases, decreases employees compensation? If so, what are the lag-times between profit and compensation? We hypothesizes that recession periods influences relations between movements in corporate profit and employees' compensation.

Our suggested response to Krugman's observation is that, yes, employees short term (6- 15 years horizon) compensation follow corporate profit for the period 1959 to 1998, but with a lag of about 10 quarters. This holds as an overall pattern, although there are periods where the pattern is more pronounced. For the period 1965 to 1983, employees long term compensation was increasing relative to corporate profit, but after 1983 the compensation has decreased to about half of its 1983 proportion. Several authors address the rationale, or micro foundations, behind growth and employees' compensation, e.g., Holden (1997), Baumol (2007) and Feldstein (2008), and inflation appears to be a potential explanatory variable.

The paper is organized as follows. We first present the data used for this study, thereafter we present the method for calculating leading-lagging relationships and the associated parameters. The method is then applied to the variable pair " corporate profit" and "employees' compensation" 1959 -2013, and finally we discuss and conclude with some policy implications of our results.

DATA

For corporate profit we used Corporate Profits after Tax with Inventory Valuation Adjustment (IVA) and Capital Consumption Adjustment (CCAdj): Billions of Dollars: SAAR. For employees compensation we used Compensation of employees; paid: Gross Domestic Income by Type of Income: Billions of dollars: Seasonally adjusted at annual rates (Quarterly). For inflation we use: Inflation in Consumer Prices at Annual Rates: Percent: CPI-U. All three series from: http://www.economagic.com/. Recessen periodes are from NEBR. This same data for profit and compensation were used in Krugman's blog.

The data for profit and compensation are depicted as original data in Figure 1a, as the ratio between trends in the two variables in Figure 1b) as data detrended in Figure 1c) and as detrended and smoothed in Figure 1d). The smoothed data for inflation are depicted in Figure 1b).

Figure 1 in here

METHOD

We used a method that allows us to calculate running averages of leading and lagging relations, and also running averages of cycle lengths (if identified) and leading or lagging times (if identified). We do not have to stabilize the variance for the variables in this study, because our methods are locally restricted on the full data set. We show the equations used for the quantifying procedures. All calculations are presented in Excel and are available from the author. The method is explained in more detail in Seip and McNown (2007) and Seip (2014)

Detrending and normalizing. The variables are first detrended by fitting a polynomial expression to the data and extracting the residuals. For the corporate profit a third order polynomial function gave good fit, $r = 0.978$, $p = < 0.001$ and for employees' compensation a second order polynomial function gave good fit ($r = 0.996$, $p < 0.001$). We also used an alternative smoothing algorithm for the two series ($f = 0.4$, $p = 2$, see below). We chose not to detrend the data using Hodrick-Prescott filter because its λ – parameter would be difficult to determine. The two trends were compared by setting the ratio between their average values for the period 1959 -61 equal to 1. Krugman (2013) uses 2004 Q4 = 100. Thereafter we smoothed the residuals to eliminate noise using the parameters ($f = 0.2$, $p = 2$), centered the residuals and normalized them to unit standard deviation. Recession periods were coded so that a recession quarter got a score of 1, and all other quarters a score of 0.

Leading and lagging relations. For the paired variables profit and compensation, we depict one variable along the x-axis and the other variable along the y-axes of a phase plot for the two variables. Here corporate profit, CP, is on the x-axis and employees' compensation, EC, is on the y-axis. Figure 1 e) and f) shows the phase plots for detrended and detrended and smoothed data respectively. The two series will form a trajectory in the phase plot. If the trajectory rotate positively (counter-clockwise per definition) then the y-axis variable lags the x-axis variable.

We quantify the rotational patterns in phase plot by[1]:

$$(1) \qquad V = sign(\bar{v}_1 \times \bar{v}_2) \cdot A\cos\left(\frac{\bar{v}_1 \cdot \bar{v}_2}{|\bar{v}_1| \cdot |\bar{v}_2|}\right)$$

where $\bar{v}_1$ and $\bar{v}_2$ are two vectors formed by two sequential trajectories between three sequential points in the phase plots. From these angles, we identify a leading – lagging relation LL. It can be formulated as a function of the number of positive angles to the sum of the absolute value of both positive and negative angles, or as a corresponding expression for the angles themselves over a certain time span, n.

$$(2.1) \quad LL^o = N_{pos} / (N_{pos} + N_{neg}) \; ; \; LL = 2 \times LL^o - 1$$

$$(2.2) \quad LL^o = V_{pos} / (V_{pos} + |V_{neg}|) \; ; \; LL = 2 \times LL^o - 1$$

The variable LL range between -1 (y- variable leads x- variable) to +1 (y-variable lags x- variable). With LL = 0, there is no leading- lagging relationship. Using Monte Carlo technique, we identified 5% confidence interval as LL < - 0.23 or LL > +0.23, the relationships are significant for these values if n > 10. LL is calculated as running averages for three successive observations (quarters in this study, n ≥ 3).

Cycle lengths. Since one full rotation of the trajectories in phase space corresponds to one full cycle, we calculate running averages for cycle lengts, CL (n ≥ 3), by estimating what full rotations would be.

$$(3) \qquad CL = 2\pi n / |\sum v|$$

To find cycle lengths we can also calculate the accumulated V and then truncate the series at multiples of 2 π.

Phase shifts between paired series. Lead or lag times, PS, are estimated from the correlation coefficient, r, for sequences of 5 observations, PS (5). If the two series co-vary exactly, their regression coefficient

[1]With x- coordinates in A1 to A3 and y-coordinates in B1 to B3 the angle is calculated by pasting the following Excel expression into C2: =SIGN((A2-A1)*(B3-B2)-(B2-B1)*(A3-A2))*ACOS(((A2-A1)*(A3-A2) + (B2-B1)*(B3-B2))/(SQRT((A2-A1)^2+(B2-B1)^2)*SQRT((A3-A2)^2+(B3-B2)^2))).

will be 1, and the time lag zero. If they are displaced half a cycle length, the correlation coefficient is r = -1 and the series are counter cyclic. An expression for the phase shift between two cyclic series can then be approximated by:

$$(4) \qquad PS \approx \lambda/2 \times (1- \text{Arcsine } (r))$$

Slopes and volatility. We calculate running averages of slopes as β –coefficients (n = 5) for a regression between the two variables, and volatility for each series as running average of standard deviation (n = 11).

Smoothing. To see the medium term trends for our resulting variables, we smooth the running average values using the 2D smoothing algorithm of SigmaPlot©. The algorithm is a locally weighted polynomial smoothing function. We use the parameter f = 0.2 and f = 0.4 to define local domains (20% and 40 % of the full series respectively) and a second order polynomial function, p = 2.

Principal component analysis, PCA. To obtain a graphic picture of the relationship between our running variables: LL- relationship, cycle length, phase shift, β- coefficient, volatilities and recession periods we use principal component analysis, PCA. The PCA produces two plots, the score plot that shows how samples are related (here observations for each quarter, not to be shown) and the loading plot that shows how variables are related (here our seven variables). Variables that are in the same direction from the origin are associated. Variables that are at a right angel relative to the origin are unrelated, or shifted in time. We use the PCA to obtain an overview of the relationships between variables, but use linear regression to quantify the relationships.

RESULTS

We first present the result for leading and lagging, LL- relationships. Thereafter we present the results for cycle lengths, lag times, β–coefficients (slopes) and long term trends. Finally, we study how the variables relate to each other and to recession periods identified by NEBR by applying PCA to the variables.

Leading -lagging- relationships. LL- relationships are expressed both as bars (quarterly) and as a smoothed line that shows the general trend. We found that the trajectories rotated largely positively, counter - clock-wise by definition, Figure 2a), for the period 1959 to 1998 showing that corporate profit (CP- x-axis) leads employees' compensation (EC- y-axis). After 1998 employees' compensation is leading corporate profit (significantly, 2000-02). After 2002 corporate profit is again leading employees'

compensation. Table 1 shows the periods where LL- relationships were significant, the leading –lagging direction, cycle time and lead- lag times.

Table 1 in here

Cycle length and lead and - lag times. Cycle lengths and lead – lag times are only calculated for periods where LL –relationships are significant, that is when LL < - 0.23 or LL > 0.23. We obtained significant LL-relations for sequences of quarters during 50% of the study period. Open circles show the results for cycle lengths in Figure 2b) and filled circles the results for lead- lag times. Generally, cycle lengths are of the order 50 quarters and lead – lag times of the order 10 quarters. Cycle lengths decrease with time: CL = - 0.145 T+ 58.7, R = 0.455, $p < 0.001$, which is also seen visually in Figure 2b). The dots close to the peaks of the EC curve in Figure 1c) shows the cycle lengths identified by truncating cumulative angles at multiples of 2π.

Figure 2 in here

β- Coefficients. The β- coefficients were calculated as 5 quarters average for the detrended and normalized data (Sequences of 5 quartiles were not normalized). The smoothed curve shows that the slope between two variables with some exceptions is positive, profit and compensation increase and decrease in concert. However, for the period 1995 to 2005 and after 2008, the two variables were counter cyclic Figure 2c).

Long time trends. The trend for the ratio between employees' compensation and corporate profit were shown in Figure 1b). Disregarding the first few years (1959- 65) the trend slopes upward to 1983 Q3 and then turns and slopes downward. This unimodal trend compares well with the trend for inflation if the inflation curve is moved 22 quarters forward in time ($R = 0.912$, $p < 0.001$; not shifted: $R = 0.314$, $p < 0.001$). Defining the trend by smoothing give the same unimodal pattern, but the peak is shifted about 10 quarters forward in time. We have also indicated period characteristics for the time 1970 – 1997, and these characteristics compares well with the trend in inflation.

PCA plot. From the score plot of a principal component analysis, it is possible to see how the variables relate to each other. We made a PCA for the seven variables LL- relation, cycle length, time lag, β – coefficient, volatility in corporate profit, Vol CP, volatility in employees' compensation, Vol EC, and recessions, Figure 2d. We have not estimated confidence bounds for this analysis, but use normal linear regression to verify significance.

Recessions are closely associated with high volatility in both corporate profit, VolCP, and high volatility in employees' compensation, $R_{CP} = 0.242$ and $R_{EC} = 0.346$, $p < 0.001$ for both. Volatilities for the two variables CP and EC is well correlated, $r = 0.810$, $p < 0.001$. The slope between CP and EC, that is, the β – coefficient, and recession is not correlated, but the β –coefficient is correlated with volatility in the variables CP ($r = 0.31$, $p < 0.001$) meaning that there is a tendency for co-variance between CP and EC when volatility in CP is high, that is, the corporations act promptly.

Cycle length and lead lag times are well correlated ($R = 0.687$, $p < 0.001$), but LL-relations and recessions is not correlated ($p > 0.1$).

DISCUSSION

The present study was inspired by Paul Krugman's (2013) blog on corporate profit and employees' compensation. We have not responded directly to his conjecture that corporations might not mind moderate depression, but we have found that corporations most of the time 1959-2013 have compensated employees in concert with their profit, but with a time lag of about 10 quarters. This is the same order of magnitude as the response time for changes in productivity relative to nominal compensation (two lagged years) reported by Feldstein (2008). We first discuss the periods identified in the study more in detail, thereafter we suggest some policy implications and lastly we discuss the method.

Periods in profit and compensation policies. From 1963 to 1983 the increases in compensation with rising profit has been greater than the decrease following decreasing profit. This period corresponds approximately to the US peacetime inflation, 1970 - 78 and to the beginning of Volcker's New Monetary Policy, 1979-85 (De Long 1997; Sims and Zha 2006; McNown and Seip 2011). During the years from 1983 to 2013, decreases in compensation have been less than increases in compensation. The period 1985 to about 1997 is called: "The Great Moderation" (Fang and Miller 2008; Canarella et al. 2009). The verbal characteristics as well as the numerical values for inflation give circumstantial evidence that support inflation as an explanatory variable. It appears that employees restricted, or was restricted, in their

demands for compensation relative to corporate profit. However, Feldstein (2008) shows that from 1970 to 2007 real compensation increased at only a slightly lower rate as output (≤ 0.2-0.4 %; both variables deflated).

During the period 1998 - 2003, corporate profit and employees' compensation were counter -cyclic. During the same period, employees' compensation was a leading variable to corporate profit.

Policy implications. The present results quantify leading and lagging relationships between corporate profit and employees' compensation. The finding that employees' compensation follows corporate profit probably corresponds with what one would formulate as a first hypothesis. However, we found no "natural" proportion for compensation (the range was wide, 0.3 -0.7 as a proportion of profit) suggesting that there are no mechanisms, e.g. bargaining power issues related to corporate profit that could secure unemployment at some "natural" rate, c.f., Krugman (2013) on the issue of bargaining power. However, other factors may play a role. Our results on the increase and then subsequent decrease in employees' compensation may be related to two confounding factors: either inflation or to the less tangible factors associated with changes in production factors or financial incentives.

One potential causal relationship is that high inflation enhances employees' compensation relative to profit. Several authors find effects of inflation on compensations and real wages, but the direction is not clear. Kumar (2008) found that lower inflation rates increases the dispersion of real wages, but it may lower or raise real wages. Cukierman and Lippi (1999) finds that Central bank policies may raise or lower real wages, unemployment and inflation in concert. Among less tangible factors is that labor since the 80'ties may play a lesser role relative to capital in production, (Feldstein 2008) and the requirement for skilled level in the workforce may have changed. Abowd et al. (1999) show that enterprises that hire skilled workers are more productive, but not more profitable. With lower inflation, it may be easier to keep financial resources in monetary units. Our hypothesis, that there would be a relation between the lead - lag relations for corporate profit and employees' compensation and recession periods was not supported.

From this, the policy lesson would be two-fold: first, since employees' compensation follows corporate profit during raise and decline, intuitional mechanism designed to optimize welfare should probably be designed differently during increase and decrease in compensations. Secondly, since inflation may be a potential source for differences in compensation, mechanisms or bargaining frameworks that regulate it should emphasize the non – symmetric effects of increasing and decreasing inflation (rent setting under non-symmetries in inflation and unemployment are discussed in Seip and McNown (2013)).

The method we use to calculate running averages for LL- relationships and the other variables depends on the smoothness of the underlying data sets. The LL- method itself can determine an optimum smoothing, defined as the degree of smoothing that give an optimum LL- value (close to -1 or +1). Here we used the smoothed data and used a smoothing algorithm to identify important trends. However, we obtained almost the same results for unsmoothed data (Figure 2 a,c,d), except that cycle lengths and lead – lag times were smaller, suggesting that there is a lead – lag relationships also at smaller time scales than 2-3 years. Relative to smoothed data, quarters with significant LL- relationships decreases from 50 % to 28%. We believe that our quantification is supported by visual inspection of the graphs. For example, quantifications in Figure 2a (LL- relations) and Figure 2b (cycle length, lead and lag times) are consistent with the patterns that can be found for the two variables in Figure 1 c, d.

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Figures

Figure 1. Data and calculations. a) Corporate profit, CP, and employees compensation, EC, billions of dollars, b) Trends (polynomial fitting) in employees' compensation, EC, as a fraction of corporate profit, CP, with EC/CP = 1 for the period 1959-61. Inflation smoothed. c) Data for corporate profit and employees' compensation detrended. Double arrow shows the period from 2001Q2 to 2006 Q2. d) The data detrended, smoothed and normalized to unit standard deviation ($f = 0.2$, $p = 2$, see text). The black dots shows cycle lengths identified by the "cumulative angel" method (see text). e) phase plot for the series in c) normalized to unit standard deviation. f) phase plot for the series in d). Graphically extreme points are identified with year.

Figure 2 Results. a) Leading - lagging relationships; positive values: corporate profit leads employees' compensation. b) Cycle lengths (open circles) and time lags (filled circles). Shaded columns show recession periods according to NEBR, c) running average of slopes (β – coefficients) when the two detrended variables are regressed. d) PCA loading plot for the variables: Leading-lagging relationship, LL, cycle lengths, CL, time lags, PS, slopes (β – coefficients), volatility in corporate profit, VolCP, volatility in employees' compensation, VolEC, and recession periods, Res

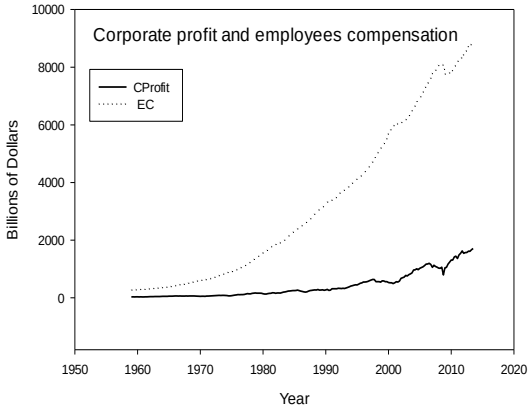
Tables

Table 1 Periods where leading - lagging relationships are significant. 50 % of all quarters show significant LL- relationships (5% level)

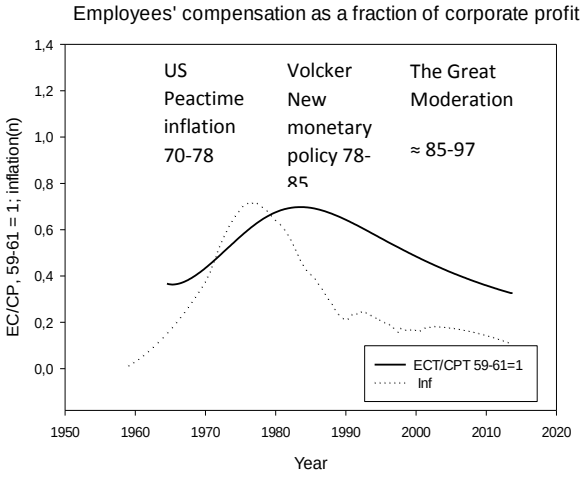
Times	**LL- -direction**	**LL-relation cycle time, Quarters**	**lag- leading time, Quraters**
1972-74	CP → EC	52	17
1976-82	CP → EC	50	8.2
1984-86	CP → EC	27	7.5
1989-97	CP → EC	36	9.8
2000-02	EC → CP	20	6.0
2003-9	CP → EC	38	7.6

Figure 1

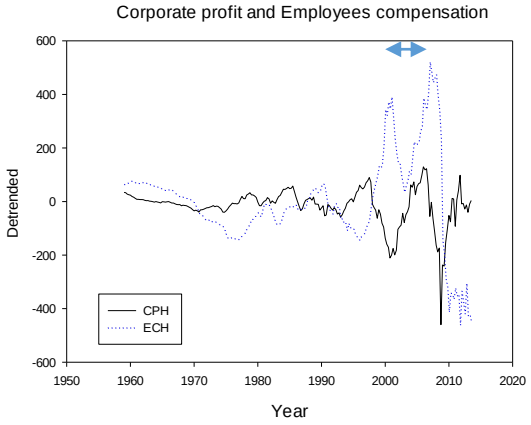
a)



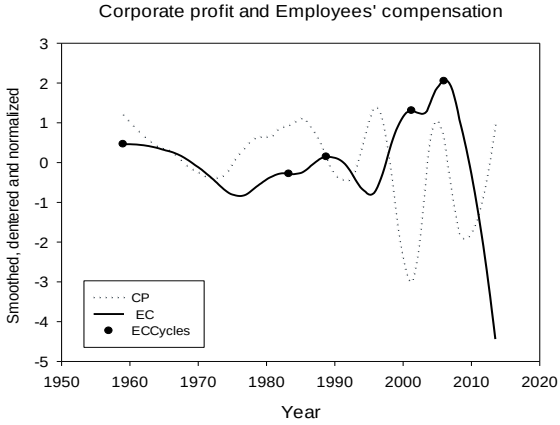
b)



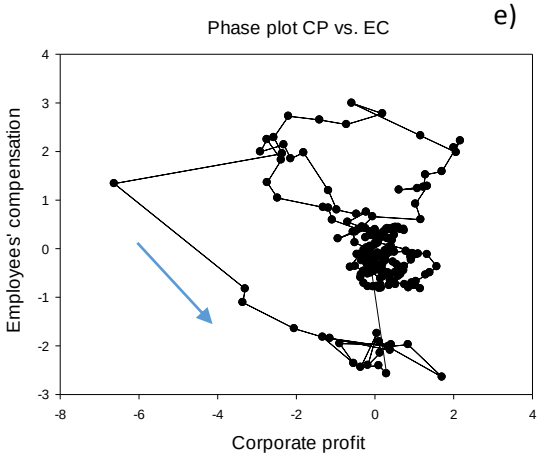
c)



d)



e)



f)

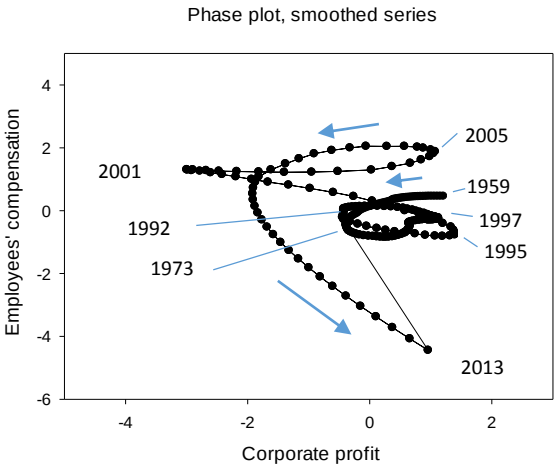
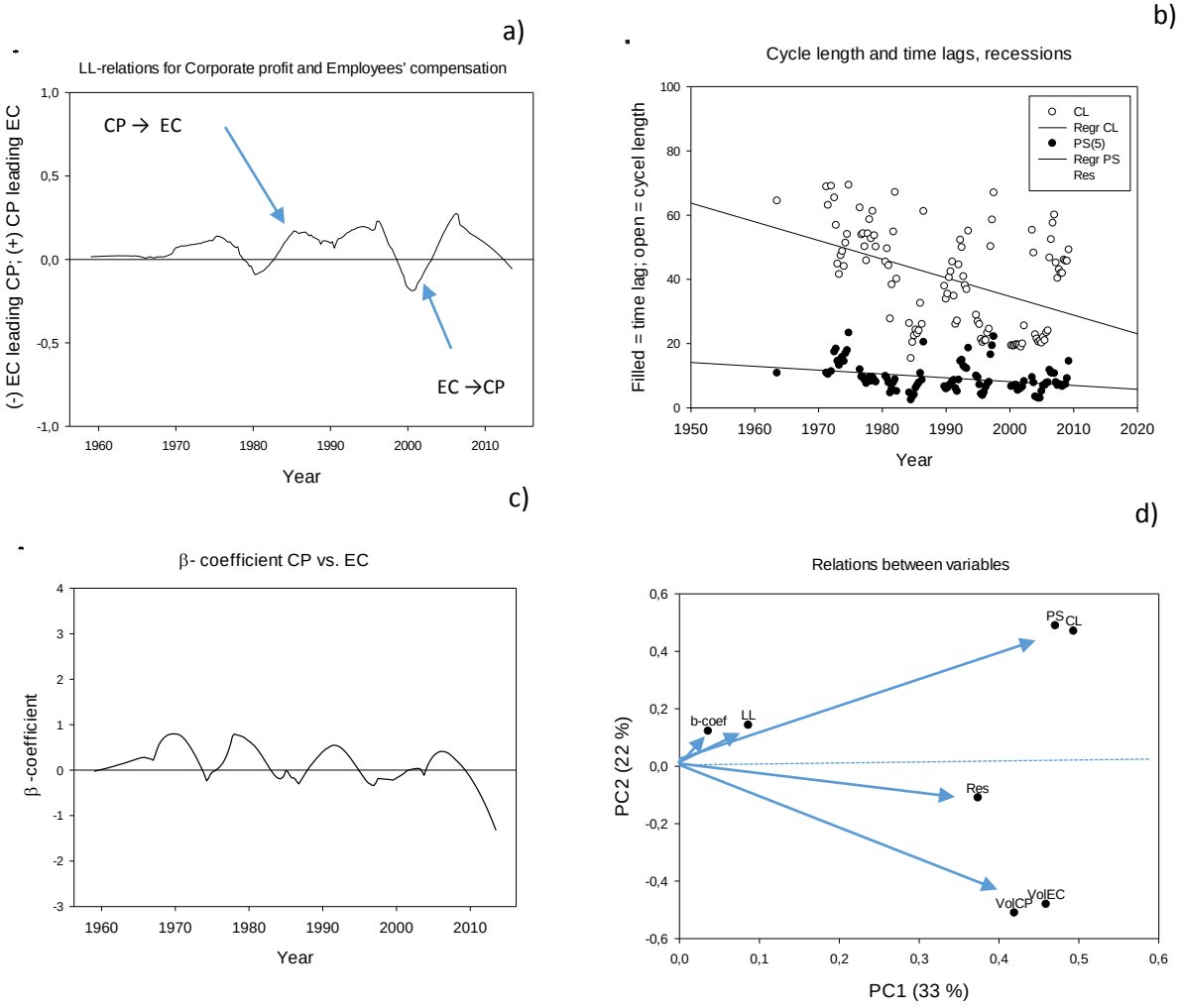


Figure 2


a)
LL-relations for Corporate profit and Employees' compensation
CP → EC
EC →CP
(-) EC leading CP; (+) CP leading EC
Year
b)
Cycel length and time lags, recessions
CL
Regr CL
PS(5)
Regr PS
Res
Filled = time lag; open = cycel length
Year
c)
β- coefficient CP vs. EC
β -coefficient
Year
d)
Relations between variables
PS
CL
b-coef
LL
Res
VolEC
VolCP
PC2 (22 %)
PC1 (33 %)