

# CEO compensation

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ENAC - Minor PREV

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# Story of our project



- CEO's compensation is often criticized. Sometimes it reach 300 times the base salary in the company.
- Is there model that we could build to explain CEOs compensation?
- Does it depend on company's profits ? Or only on CEO's influence and charisma ?

# Data gathering

- Based on the ranking of the 500 companies who has the biggest revenue in the world in 2017 (Fortune 500)
- $N=100$  randomly extract from this ranking
- Mostly from USA and Europe (Information about chinese companies can't be found anywhere).
- Sources: Wikipedia, Bloomberg (give a good total calculated compensation), Salary.com, Press articles

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# Choice of the variables

Variable	Details
EMPLOYEE	Number of employees
REVENUE	2017 company's revenues (\$M)
PROFIT	2017 company's profits (\$M)
AGE	Age of the CEO (Years)
GENDER	1=Male, 0=female
NATIONALITY	1=same as company, 0 stranger
EXPER	Work Experience of the CEO (Year)
EXPERCEO	Was he CEO before ? (1=Yes, 0=No)
BASECOMP	2017 Base compensation of the CEO (\$M)
TOTALCOMP	2017 Total compensation of the CEO (\$M)
FOUNDER	Founder of the company (1=Yes, 0=No)
DUALITY	1=Also the chairman of the supervisory board

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K=12

# Observations

## Compensation

Total compensation include a fixed part (Base compensation), but also a variable part (Stock options, Short and Long term compensations,...).

Complex and policy about CEO compensation can be very different. The total compensation given by Bloomberg (most of the time), gives us a correct value to use.

May be biased with a few CEO due to non-actual or false values.



# Company's infos

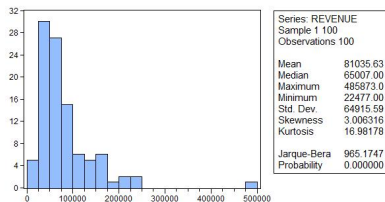


Figure: Companies's revenues

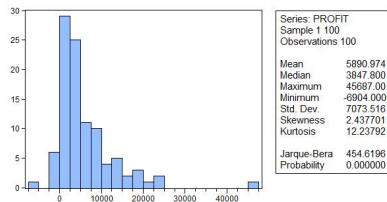


Figure: Companies's profits

## Observations

Revenue: 99% between [0\$,250 000\$M], mode at 50 000\$M

Profit: 99% between [-7000\$M,\$,25 000\$M], mode at 2 500\$M

Profit mean is around 9%

# CEO Characteristics

## Gender

94% of CEOs are mens → estimated coefficient may be biased

## Nationality

82% of CEOs have the same nationality than their company

## Founder

Only 7% of CEOs have founded the company they lead → may be biased

# CEO Characteristics

## Experience as a CEO before

30% of CEOs were CEO in an other company before

## Duality

48% of CEOs are also Chairman of the supervisory board (often the case with french companies)

# CEO Characteristics - Age and Experience

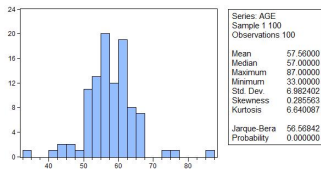


Figure: CEO Age

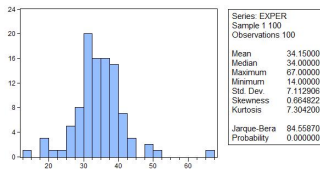


Figure: CEO Work experience

## Observations

**Age:** 33 years old (Mark Zuckerberg), 87 years (Warren Buffet).

**Work experience:** Grouped between 30 and 40 years.

We can expect a **high correlation** between the two variable

Mean age (57) - High school degree (18) - Master's degree (5) = Mean work experience (34)

# Compensations

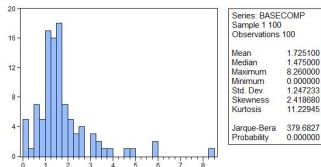


Figure: CEO base compensation

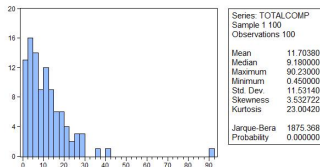


Figure: CEO total compensation

## Observations

**Base:** Min: One-dollar salary (Mark Zuckerberg, Larry Page). Big mode between 1\$M and 2\$M.

**Total:** Nearly linear decrease up to 30\$M, Min: 0.45\$M (french public companies) Max: Larry Page (90\$M)

## What will be our dependant variable ?

- The aim of the study is to see the dependence of all our variables on **CEO compensation**
- Is total compensation more relevant than base compensation ?
- 2 regressions

## Expected signs of marginal effects

Variable	Expected marginal effect
EMPLOYEE	?
REVENUE	+
PROFIT	++
AGE	+
GENDER	+
NATIONALITY	?
EXPER	+
EXPERCEO	+
FOUNDER	+
DUALITY	+

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# First complete model on total compensation

Dependent Variable: TOTALCOMP  
Method: Least Squares  
Date: 04/09/18 Time: 16:27  
Sample: 1 100  
Included observations: 100

	Coefficient	Std. Error	t-Statistic	Prob.
C	16.00817	12.48829	1.281855	0.2032
AGE	0.094749	0.381315	0.248479	0.8043
DUALITY	-1.553076	2.338726	-0.664069	0.5084
EMPLOYEE	1.58E-06	6.23E-06	0.253909	0.8002
EXPER	-0.247641	0.374688	-0.660925	0.5104
EXPERCEO	2.785426	2.412456	1.154602	0.2513
FOUNDER	9.109844	4.328198	2.104766	0.0381
GENDER	-7.124936	4.530001	-1.572833	0.1193
NATIONALITY	-0.047423	2.895045	-0.016381	0.9870
PROFIT	0.000728	0.000173	4.212594	0.0001
REVENUE	1.88E-06	2.53E-05	0.074249	0.9410
R-squared	0.265972	Mean dependent var	11.70380	
Adjusted R-squared	0.183497	S.D. dependent var	11.53140	
S.E. of regression	10.41984	Akaike info criterion	7.628766	
Sum squared resid	9662.999	Schwarz criterion	7.915335	
Log likelihood	-370.4383	Hannan-Quinn criter.	7.744746	
F-statistic	3.224873	Durbin-Watson stat	2.163994	
Prob(F-statistic)	0.001387			

## Interpretations

Only PROFIT and FOUNDER relevant at a 95% level.

$R^2$  not so bad for the first model.

*Proba(FStatistic)*: Our model explains something.

## Improvements

We want to increase significance of variables.

Figure: Equation 01 - Total compensation against all variables

## How to increase our model ?

### Correlation study

Correlation matrix: In general we had lows values, excepted:  
EMPLOYEE - REVENUE = 68% (logical, but maybe because high revenue/number of employee of Walmart)  
AGE - EXPER = 91% (Mean age (57) - High school degree (18) - Masters degree (5) = Mean work experience (34))

### Summary

Removal of **EXPER** and **EMPLOYEE**.

## How to increase our model ?

### Tests of nullity

We tested the nullity of coefficients related to NATIONALITY, REVENUE, EMPLOYEE:

$$F = 0.06 \leq F(3, 89) = 2.70$$

The null hypothesis is not rejected for the 3 variables, so the estimated marginal effects are insignificant.

### Summary

Removal of **NATIONALITY, REVENUE, EMPLOYEE.**

## Corrected model

Dependent Variable: TOTALCOMP  
 Method: Least Squares  
 Date: 04/09/18 Time: 16:52  
 Sample: 1 100  
 Included observations: 100

	Coefficient	Std. Error	t-Statistic	Prob.
C	21.43417	9.455151	2.266931	0.0257
AGE	-0.135630	0.153158	-0.885556	0.3781
DUALITY	-1.733440	2.172536	-0.797888	0.4270
EXPERCEO	2.900249	2.317583	1.251412	0.2139
FOUNDER	8.650323	4.197339	2.060906	0.0421
GENDER	-7.348109	4.420777	-1.662176	0.0998
PROFIT	0.000747	0.000146	5.106171	0.0000
R-squared	0.261408	Mean dependent var	11.70380	
Adjusted R-squared	0.213757	S.D. dependent var	11.53140	
S.E. of regression	10.22493	Akaike info criterion	7.554964	
Sum squared resid	9723.072	Schwarz criterion	7.737326	
Log likelihood	-370.7482	Hannan-Quinn criter.	7.628769	
F-statistic	5.485885	Durbin-Watson stat	2.173528	
Prob(F-statistic)	0.000067			

### Interpretations

Probabilities improved but they remain individually insignificant.  $R^2$  decreased a little bit.

### Improvements

We will test the classical assumptions (**Heteroskedasticity** and **normality of errors**).

Figure: Equation 02 - Total compensation on remaining variables

## Test of classical assumptions

### Tests of homoskedasticity

We performed a White's  $nR^2$  test:

$$nR^2 = 28.97 \geq \chi^2(6) = 12.59$$

We reject homoskedasticity, so there's heteroskedasticity of unknown form.

### Test of normality of errors

We performed a Jarque-Bera test: Eviews gave us a  $JB_E = 662.3$

$$JB_{corrected} = 615.97 \geq \chi^2(2) = 4.61$$

So we reject normality of errors.

# Heteroskedastic consistent model of EQ02

Dependent Variable: TOTALCOMP

Method: Least Squares

Date: 04/09/18 Time: 17:28

Sample: 1 100

Included observations: 100

White Heteroskedasticity-Consistent Standard Errors &amp; Covariance

	Coefficient	Std. Error	t-Statistic	Prob.
C	21.43417	13.27289	1.614883	0.1097
AGE	-0.135630	0.212435	-0.638452	0.5247
DUALITY	-1.733440	2.570579	-0.674338	0.5018
EXPERCEO	2.900249	2.006076	1.445732	0.1516
FOUNDER	8.650323	10.16981	0.850588	0.3972
GENDER	-7.348109	3.898639	-1.884788	0.0626
PROFIT	0.000747	0.000315	2.371558	0.0198
R-squared	0.261408	Mean dependent var	11.70380	
Adjusted R-squared	0.213757	S.D. dependent var	11.53140	
S.E. of regression	10.22493	Akaike info criterion	7.554964	
Sum squared resid	9723.072	Schwarz criterion	7.737326	
Log likelihood	-370.7482	Hannan-Quinn criter.	7.628769	
F-statistic	5.485885	Durbin-Watson stat	2.173528	
Prob(F-statistic)	0.000067			

## Interpretations

Probabilities increased, so probably Heteroskedasticity is not the problem here.

We will use EQ02 to interpret marginal effects.

**Figure:** Equation 03 - Total compensation against remaining variables

## Final regression

Dependent Variable: TOTALCOMP  
 Method: Least Squares  
 Date: 04/09/18 Time: 16:52  
 Sample: 1 100  
 Included observations: 100

	Coefficient	Std. Error	t-Statistic	Prob.
C	21.43417	9.455151	2.266931	0.0257
AGE	-0.135630	0.153158	-0.885556	0.3781
DUALITY	-1.733440	2.172536	-0.797888	0.4270
EXPERCEO	2.900249	2.317583	1.251412	0.2139
FOUNDER	8.650323	4.197339	2.060906	0.0421
GENDER	-7.348109	4.420777	-1.662176	0.0998
PROFIT	0.000747	0.000146	5.106171	0.0000
R-squared	0.261408	Mean dependent var		11.70380
Adjusted R-squared	0.213757	S.D. dependent var		11.53140
S.E. of regression	10.22493	Akaike info criterion		7.554964
Sum squared resid	9723.072	Schwarz criterion		7.737326
Log likelihood	-370.7482	Hannan-Quinn criter.		7.628769
F-statistic	5.485885	Durbin-Watson stat		2.173528
Prob(F-statistic)	0.000067			

Figure: Equation 02 - Total compensation

# Interpretations

## Significance

Estimated marginal effects of **FOUNDER, GENDER, PROFIT** are individually significant at the usual levels.

## FOUNDER

Estimated M.E. is positive, as expected, and high. It means that if a CEO is the original founder of the company, his total compensation will approximately be 8.6M\$ higher than a non-founder.



## Interpretations

### GENDER

Estimated M.E. is negative (-7.3), not as predicted. It means that the total compensation of a men CEO will approximately be 7,3M\$ lower than a woman CEO.

6 women in the sample, ranked 250 under 500, so data probably biased the model.

More linked with company's profits.

### PROFIT

Estimated M.E. is positive, as expected and high. If the company's profit increases by 100 M\$ (2% of the average profit), the total compensation of the CEO will approximately increase by 0.7M\$ .

## Conclusion on total compensation

In our final regression on total compensation, even if half of the variables are individually significant, CEO compensation remains hard to explain, and we can't conclude on interesting variables such as DUALITY.

So we will study base compensation.

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## Model of base compensation against all variables

Dependent Variable: BASECOMP  
 Method: Least Squares  
 Date: 04/09/18 Time: 16:28  
 Sample: 1 100  
 Included observations: 100

	Coefficient	Std. Error	t-Statistic	Prob.
C	2.081801	1.440597	1.445096	0.1519
AGE	0.001930	0.043987	0.043886	0.9651
DUALITY	-0.213336	0.269786	-0.790762	0.4312
EMPLOYEE	-1.93E-06	7.18E-07	-2.687988	0.0086
EXPER	-0.026899	0.043222	-0.622342	0.5353
EXPERCEO	-0.192014	0.278291	-0.689976	0.4920
FOUNDER	-0.252904	0.499283	-0.506534	0.6137
GENDER	0.153258	0.522562	0.293281	0.7700
NATIONALITY	0.266336	0.333960	0.797507	0.4273
PROFIT	-2.96E-05	1.99E-05	-1.484072	0.1413
REVENUE	1.03E-05	2.92E-06	3.510147	0.0007
R-squared	0.165049	Mean dependent var	1.725100	
Adjusted R-squared	0.071235	S.D. dependent var	1.247233	
S.E. of regression	1.201990	Akaike info criterion	3.309299	
Sum squared resid	128.5853	Schwarz criterion	3.595868	
Log likelihood	-154.4650	Hannan-Quinn criter.	3.425279	
F-statistic	1.759313	Durbin-Watson stat	2.131287	
Prob(F-statistic)	0.079917			

### Model

Fixed part of a CEO remuneration, without stock options, etc. Some CEO: 1\$ a year base comp, but tens of million dollars total compensation (Larry Page, Zuckerberg)

Figure: Equation 05 - Base compensation against all variables

# Model on base compensation

## Interpretations

Estimated M.E. of EMPLOYEE and REVENUE are individually significant at the usual levels, but very low.

It means that they have statistically no impact on base compensation.

## Conclusion

Base compensation is even harder to explain than total compensation, we found no variable that could influence the base compensation of CEOs of the 500 companies who makes the more revenue in the world in 2017.

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## Conclusion

We have models which explain something but it's not fully satisfactory. Maybe we should have tried to model CEO compensation on a bigger range of companies (Small and Medium size Business, startup, ...), to see if there are more rules and commonalities.

We could try to find other relevant variables (average workers compensation, national laws, ...).

The limited size of data could also biased the results.