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Econometric Project

Determinant of performance of key financial metrics, do a gender diversity and employee education level impact a company's market capitalization and short-term debt?

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SUMMARY

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Section 1: Introduction

I. Research questions

The question here is to explain the determinants of market capitalization and short-term debt using a theoretical and econometric approach. To answer this question, we have a sample of 4000 firms from different sectors observed in 2006 and 2007.

Within firms, there is often a pre-existing belief that social measures such as reducing gender inequality and inherently counterproductive and would therefore harm economic and financial performance.

In addition, certain theoretical currents in economics, notably the theory of human capital developed by Gary Becker and Jacob Mincer, justify gender inequalities in a theoretical manner and legitimize discrimination.

These economists explain that companies prefer to invest less in the training of women and do not entrust them with position of responsibilities because they are less involved in the company and their careers are naturally interrupted by maternity.

In term of the levels of education of the employees, education is also of great importance in the various policies and measures implemented. Today, the degree has never been so important, but does it really impact the performance of companies?

Although diversity can have negative effects in organizations, several research studies have highlighted the positive relationship between female board members and firm's performance and thus market capitalization.

Studies have shown that diversity improves decision-making, allows for the exploration of new opportunities due to different representation systems, adapts to the diversity of clients, promotes creativities and group dynamics (Richard, 2000). For example, it has been proven that women are more cautious borrowers and have a better repayment rate, which would therefore explain that firms whose board of directors is composed of women, would likely to have low levels of debt than those without women.

Not to mention about 80% of consumer product purchasing decision are made by women, which means that companies with women in their ranks often produce better-selling products, largely because they take women's opinions and experiences into account. Thus, reducing discrimination is no longer just a social issue but has also become an economic reason.

Over the past two decades, harnessing knowledge has been recognized as one of the key prerequisites for gaining competitive advantage. This has resulted in the efforts of many Western countries to transform their economic structure toward a knowledge-based economy. The process of acquiring knowledge is achieved through investment in human capital, which in turn depends on education.

The importance of education is exemplified in the global marketplace, where businesses seek to increase their productivity and competitiveness through specialized knowledge or skills. Thus, the exploration of employees with a high level of education proves to be essential for any companies.

II. Evaluation methodology

Given the description of the data, our research, and the results from earlier sections, panel data analysis would be the most appropriate method for this study. This is because the units are observed over two periods, which makes it a dynamic study.

In addition, companies do not share the same qualities at first. However, regression analysis of data collected over time can be used to identify relationships between a dependent variable and independent variables that might not be immediately obvious. This in turn could reduce bias in estimation models that use linear regression.

If we use a simple OLS regression with only one variable, it will limit our analysis. This is because there are other variables (such as profit and investment) that impact both the explanatory variables (number of women on the board and number of qualified employees) and the explained variables (market capitalization and short-term debt). If we do not include these other variables in the regression, it would lead to an endogeneity issue such as omitted variable bias.

Section 2: Presentation of the Data set and main results

I. Presentation of the dataset

In our dataset, we have a sample of 4000 enterprises from different sectors observed from 2006 to 2007. We have identified sector of activity as a grouping observation in our dataset with 10 available sectors for the 4000 firms. Our outcome variables are "Short term debt" and "Market capitalization". The independent variables we've decided to analyze are the proportion of women on the board and the proportion of employees with higher degrees.

The summary statistic outcome variables grouped by sector reveals that for the variable "Short term debt", the sectors can have a small impact on dispersion of the variable; however, the median fluctuates between 21.80 and 22.70. With regards to "Market Capitalization", it appears that sector also impacts this variable, with some notable differences at mean values 131.698 to 141.825 depending on which sector is looked at more closely.

To have a better understanding of the way those variables fluctuate, the graphs annexed relatively shows the dispersion grouped by sector.

II. Main results

Our impact evaluation methodology, as previously explained, is Panel Data Analysis. Our empirical strategy uses graphs to gain a better understanding of the dataset. The following graphical representation tests our two hypotheses using simple OLS (outcome variables over independent variables).

H1: "Other things being equal, increasing board diversity enhances a firm's market capitalization and reduces short-term debt"

Those graphs seemed to indicate a negative correlation between a higher proportion of women in the board and short-term debt and an absence of correlation between the proportion of women in the board and the market capitalization.

H2: "Other things being equal, highly graduated employees increase market capitalization and reduce short-term debt?"

The graphs don't seem to indicate any correlation between a higher proportion of employees with a higher degree and short-term debt and market capitalization.

We decided to include the factors "id", "age" and the variable "profit" as covariates in our model to improve accuracy. This allowed us to control for the impact of the "id" and test the hypothesis that profit can have a positive impact on proportion of women while also having a negative effect on short-

term debt. The simple OLS method did not take the "individual fixed effects" into account. Adding this variable into consideration allows us to consider the fact that companies do not have the same initial amount of debt.

After completing the regressions, we came to two conclusions: There is no correlation between the proportion of employees with higher degrees and short-term debt or market capitalization. We also found that the negative relationship between the proportion of women on boards and short-term debt appears to be limited.

Furthermore, it appears that profit has a negative effect on short-term debt, which is consistent with the theory.

Then, we decided to use the first differences in order to control for potential omitted variables (e.g., firms who have a higher proportion of women on the board do not have the same observables and unobservable characteristics as those with less women), measurement error (not every firm gave their real number of women on the board) or reverse causality (the fact that the amount of short debt is higher for some firms might have alarmed management and led them to change the board composition).

Our first hypothesis posited that, when using the first differences model, the impact of the proportion of women on short-term debt would be significant. However, we found no such causality between a higher proportion of women on boards and short-term debt. The first differences model also showed no impact of the proportion of women on market capitalization.

Our second hypothesis posits that there is no causal relationship between the proportion of highly educated employees and the amount of market capitalization or short-term debt when using a first differences model. This model uses relative quantities instead of absolute ones, which we believe will more accurately control for fixed effects. The regression model with fixed effects has N constant differences, one unit for each variable considered.

We, then, compared in a table those regressions, with the within model, the simple OLS model and the regression with the covariates.

Section 3 : Fixed effects in r : Panel data analysis

I. Our findings

The data in column 1 shows the results of a simple regression. We can see that there is a negative relationship between the number of women on the board and the amount of short-term debt. To improve the regression, we have decided to include other variables that might affect both the number of women on the board and the amount of short-term debt, such as profit, investment, and age. Our data shows that for every 1 million increases in profit, short-term debt decreases by 0.55%.

We've decided to include a fixed effect for id in column 4, because we want our regression to consider the fact that every firm doesn't start with the same level of short debt. By including the variable "id" as a fixed effect, we consider that all firms do not have the same initial amount of debt. This enables us to better appreciate the real effect of our independent variables over the dependent variable.

The new coefficients are quite similar except for the new coefficient on the log of short debt to the amount of investment, which is no longer significant. The age also appears statistically significant, indicating that being one-year older increases short debt by 0.03%.

We have decided to control for potential omitted variables, measurement error or reverse causality by doing first differences. Our dataset is a panel with only two different periods, so we chose to do both FD and FE even though first differences gave the same results as within estimator. Nevertheless, standard errors cannot be expected to be the same because they are optimal under different dynamics of the idiosyncratic error term.

The impact of these variables may differ across states over time. If this is the case, then using fixed effects or first differences estimation methods will not be accurate.

In the case of the effect of the number of women on the amount of short-term debt, the evolution of the debt between two years is compared and explained by the parallel evolution of the level of women in the board. Consequently, the new coefficient on the log of short debt to the number of women in the board is not statistically different from zero. An increase of one million women in the board does not appear to have a negative impact on the level of short debt. The profit remains statistically significant, indicating that an increase of one million decreases the amount of short debt by 0,57%. The within estimator can help to reduce the impact of omitted variables, especially if those variables are fixed over time (e.g. sector) or across units (e.g. age). However, there may still be other omitted variables that are not fixed and will affect estimates of idiosyncratic error.

The data in table 2 suggest four conclusions. Firstly, and perhaps even more surprising, we found out that the utilization of indifferently multiple OLS with ID fixed effect, the first differences or the within estimator lead to the same results, indicating that there are no omitted variables fixed in time that affect our multiple OLS. Secondly, the number of highly educated employees had essentially no effect on the log of market capitalization.

After controlling for individual fixed effects, we found no significant relation between our two variables. This is against our second hypothesis and contradicts the neoclassic theory. However, we did find a statistically significant relation between the amount of profit and the log of market capitalization, which was not entirely unexpected.

We found a positive relation between profit and market capitalization, indicating that an increase in profit by 1 million results in a 0.18% increase in market capitalization. We also found a positive relation between investment and the log of market capitalization, indicating that an increase by 1 million in investment results in a 0.17% increase in market capitalization. To confirm these relations, we've decided to do some robustness checks.

Before moving to conclusion part on the research, have a quick look on another approach of panel data analysis called Random Effect Model. It's interesting that we found very opposite result that is the number women in the board is statistically significant in short-term debt regression, and the number of employees with high degree is significant in market capitalization regression. However, after running the Hausman test, we reject the null hypothesis that the two estimation methods are both OK ($p\text{-value} < 2.2e-16$ for short debt regression and $p\text{-value} < 2.2e-16$ for market capitalization regression). The alternative hypothesis is that the fixed effects estimation is OK, and the random effects estimation is not. This is because the random effects estimator assumes (the random effects are orthogonal to the regressors) that the fixed effects estimator does not. That is, the individual error components are not correlated with each other and are not autocorrelated between units in space (across firm) and in time series (across year).

II. Robustness checks

There are several possible threats to the internal validity of this study. In the appendix, we consider

two potentially important concerns: that the results might be driven by some sectors that have fewer women, and that the results might be due to changes in sectoral composition over time.

The data from Table 1 suggests that the relationship between the number of women on a board and the logarithm of short-term debt is due to omitted variables. This means that, after controlling for fixed effects, there is no statistically significant relation between these two variables. However, we found a negative relation between profit and the logarithm of short-term debt. But can we trust this result?

Our results are verified in every sector and are not related to the presence of women on boards or the amount of short debt. Additionally, we have confirmed that there is a negative relation between profit and short debt, and a positive effect of age over short debt.

The results from table 2 show that the amount of highly educated people does not have a statistically significant effect on market capitalization, controlled for fixed effects. This suggests that the observed effect in column 1 and 3 is due to unobserved variables affecting the regressors. However, we found a positive effect of investment and profit on market capitalization.

III. Discussion Potential Mechanism

Overall, our results show that the presence of women or highly educated people are ineffective in allowing reduced short debt and higher market capitalization. These results raise a hypothetical mechanism: young companies are more gender sensitive (In the group with an above-average proportion of women, the companies are more likely to be 28 years old and the others 30 years old. Additionally, younger companies are more profitable. This provides a mechanism: because younger companies make more profit, they can finance themselves and invest more in women simultaneously. We found a causal effect due to endogeneity issue in the simple OLS- reverse causality suggests that lower debt allows companies to invest more in women.

IV. Conclusions

In opposition to the initial idea, but in agreement with numerous contemporary research studies which compare the presence of women in the board with a business's success through cross-sectional time series, we found no proof that the growth in the number of female board members decreased the amount of short-term debt. Regardless of whether we use simple OLS with or without fixed effects we find that the increase in profit reduced the amount of short debt, which is coherent to the pecking order theory. We uncovered no substantial relationship between the number of highly educated employees and the market capitalization. However, we saw a positive effect of investment and profit on the market capitalization.

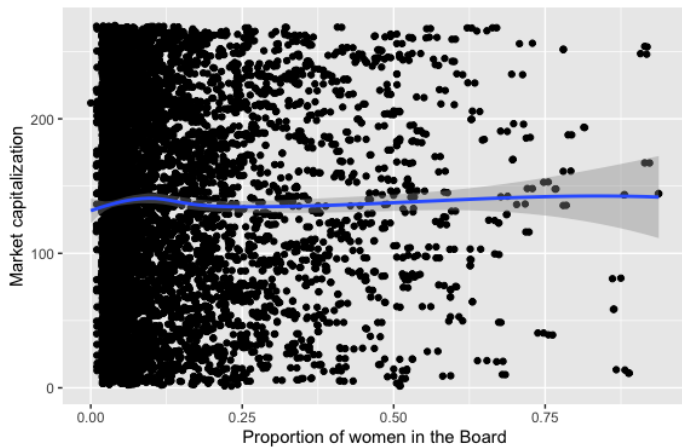
The results of this analysis do not indicate any relationship between the decision-making of a firm and its level of short-term debt or capitalization, which is as expected. However, two variables have been identified as influencing the debt and market capitalization of a company: increasing profits leading to higher market capitalization and reduced short-term debt, and higher investment resulting in increased market capitalization. Nevertheless, we must be careful in the interpretation of these results because the scope of the study was limited to two time periods.

Finally, we contemplate the possibility that the rise in a business' debt could be the cause of fewer female hires, so we must search for a differentiating factor that affects the number of women on the board, but not the debt. Consequently, it leads us to wonder if the results would be consistent across multiple timeframes.

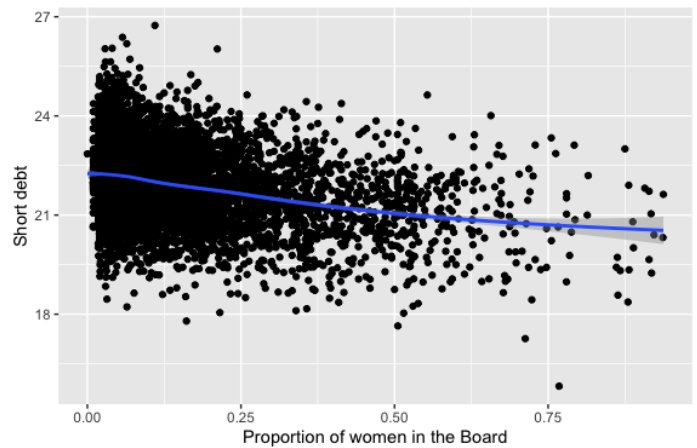
Appendix:

Some representations of variable of interest

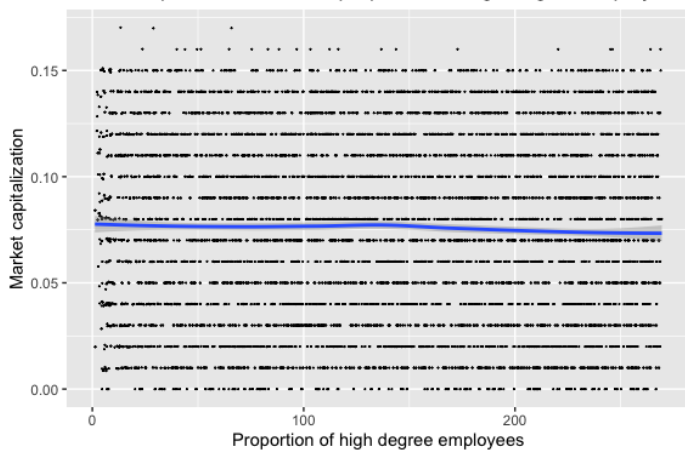
Market capitalization follows proportion of women in the board



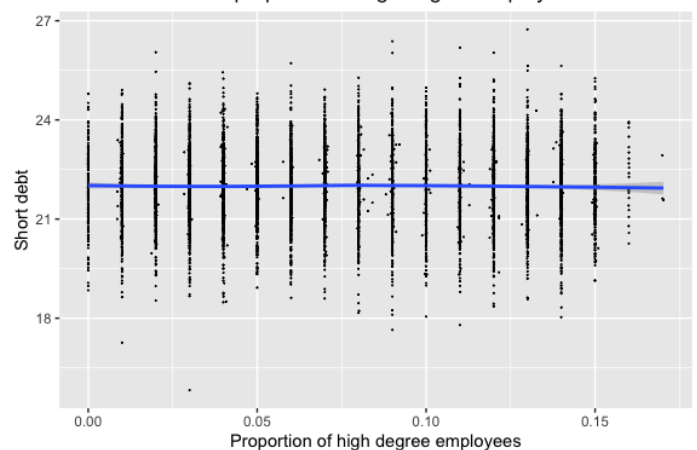
Firm's short debt follows proportion of women in the board



Market capitalization follows proportion of high degree employees



Short debt follows proportion of high degree employees



```
ggplot(asset, aes(x = avrwb, y = mktcap)) +  
  geom_point() +  
  xlab("Proportion of women in the Board") +  
  ylab("Market capitalization") +  
  geom_smooth(method="loess") +  
  ggtitle("Market capitalization follows proportion of women in the board")
```

```
ggplot(asset, aes(x = avrwb, y = shortdebt)) +  
  geom_point() +  
  xlab("Proportion of women in the Board") +  
  ylab("Short debt") +  
  geom_smooth(method="loess") +  
  ggtitle("Firm's short debt follows proportion of women in the board")
```

```
ggplot(asset, aes(x = mktcap, y = highdegree)) +  
  geom_point(size=0) + geom_smooth(method="loess") +  
  xlab("Proportion of high degree employees") +  
  ylab("Market capitalization") +  
  ggtitle("Market capitalization follows proportion of high degree employees")
```

```
ggplot(asset, aes(x = highdegree, y = shortdebt)) +
  geom_point(size=0) + geom_smooth(method="loess") +
  xlab("Proportion of high degree employees") +
  ylab("Short debt") +
  ggtitle("Short debt follows proportion of high degree employees")
```

Summary table with **log(shortdebt)** as dependent variable:

Explanatory variables	Description	Simple OLS	Multiple OLS	Multiple OLS with id fixed	Within Estimator	First difference	Random effect
wboard	Number of women in the board	-1.128e-03 ***	-1.030e-03 ***	1.211e-04	1.2111e-04	0.0001069	-1.0273e-03 ***
Profit	Amount of profit	-	-5.471e-03 ***	-5.786e-03 ***	-5.7855e-03 ***	-	-5.4718e-03 ***
Inv	Amount of investment	-	2.730e-04 ***	5.433e-04	5.4329e-04	-	2.7212e-04 ***
Age	years since incorporation	-	3.021e-04 ***	4.643e-02 ***	4.6435e-02 ***	-	3.2476e-04 ***
Skemp	number of employees with higher degree	4.696e-07	6.584e-07	1.258e-06	1.2580e-06	5.897e-07	6.6085e-07

Summary table with **log(mktcap)** as dependent variable:

Explanatory variables	Description	Simple OLS	Multiple OLS	Multiple OLS with id fixed	Within Estimator	First difference	Random effect
wboard	Number of women in the board	0.0002862	1.218e-04	-1.473e-04	-1.4728e-04	0.0001069	-1.3242e-04
Profit	Amount of profit	-	-8.856e-04	1.843e-03 ***	1.8434e-03 ***	-	1.8215e-03 ***
Inv	Amount of investment	-	1.055e-03	1.684e-03 ***	1.6838e-03 ***	-	1.6907e-03 ***
Age	years since incorporation	-	1.537e-03 *	2.019e-04	2.0195e-04	-	2.1155e-04
Skemp	number of employees with higher degree	4.287e-04 ***	4.286e-04 ***	2.658e-07	2.6580e-07	5.897e-07	4.7977e-06 ***

Codes:

#New transformation

```
lshortdebt<-log(asset$shortdebt)
```

```
lmktcap<-log(asset$mktcap)
```

#Simple OLS shortdebt:

```
lm0<-lm(lshortdebt~wboard, asset)
```



```
summary(lm0)
```

```
lm1<-lm(lshortdebt~skemp, asset)  
summary(lm1)
```

#Multiple OLS shortdebt

```
lm2<-lm(lshortdebt~wboard+skemp+age+inv+profit, asset)  
summary(lm2)
```

#Multiple OLS shortdebt with id fixed

```
lm3<-lm(lshortdebt~wboard+skemp+age+inv+profit+factor(id), asset)  
summary(lm3)
```

#Within estimator shortdebt

```
fixed1<-plm(lshortdebt~wboard++skemp+profit+age+inv, data=asset, index=c("id"), model="within")  
summary(fixed1)
```

#Simple OLS mktcap

```
lm4<-lm(lmktcap~wboard, asset)  
summary(lm4)
```

```
lm5<-lm(lmktcap~skemp, asset)  
summary(lm5)
```

#Multiple OLS mktcap

```
lm6<-lm(lmktcap~wboard+skemp+age+inv+profit, asset)  
summary(lm6)
```

#Multiple OLS mktcap with id fixed

```
lm7<-lm(lmktcap~wboard+skemp+age+inv+profit+factor(id), asset)  
summary(lm7)
```

#Within estimator mktcap

```
fixed2<-plm(lmktcap~wboard+skemp+profit+age+inv, data=asset, index=c("id"), model="within")  
summary(fixed2)
```

#First difference with number of women in the board and short debt

```
asset$lshortdebt<-log(asset$lshortdebt)  
asset$lmktcap<-log(asset$shortdebt)
```

```
asset$dshortdebt<-unlist(by(asset$lshortdebt, list(asset$id), function(i) c(NA,diff(i))))  
asset$dwboard<-unlist(by(asset$wboard, list(asset$id), function(i) c(NA,diff(i))))  
asset  
fd1<-lm(dshortdebt~dwboard, data=asset)  
summary(fd1)
```

#First difference with number of women in the board and market capitalization

```
asset$dlmktcap<-unlist(by(asset$lmktcap, list(asset$id), function(i) c(NA,diff(i))))  
asset$dwboard<-unlist(by(asset$wboard, list(asset$id), function(i) c(NA,diff(i))))  
asset  
fd2<-lm(dlmktcap~dwboard, data=asset)  
summary(fd2)
```

#First difference with proportion of employee with high degree and short debt

```
asset$dlshortdebt<-unlist(by(asset$lshortdebt, list(asset$id), function(i) c(NA,diff(i))))
asset$dskemp<-unlist(by(asset$skemp, list(asset$id), function(i) c(NA,diff(i))))
asset
fd3<-lm(dlshortdebt~dskemp, data=asset)
summary(fd3)
```

#First difference with proportion of employee with high degree and market capitalization

```
asset$dlshortdebt<-unlist(by(asset$lshortdebt, list(asset$id), function(i) c(NA,diff(i))))
asset$dskemp<-unlist(by(asset$skemp, list(asset$id), function(i) c(NA,diff(i))))
asset
fd4<-lm(dlshortdebt~dskemp, data=asset)
summary(fd4)
```

#Random Effet

```
install.packages("plm")
library(plm)
random1<-plm(lshortdebt~wboard+skemp+age+inv+profit,data=asset, index=c("id","year"),
model="random")
summary(random1)

random2<-plm(lmktcap~wboard+skemp+age+inv+profit,data=asset, index=c("id","year"),
model="random")
summary(random2)
```

#Hausmann test

```
phtest(fixed1,random1)
phtest(fixed2,random2)
```

Source on research:

Marjut Falkstedt et Maria Leander. 2021. *Les femmes, clés de la performance des entreprises*.
<https://www.eib.org/fr/stories/women-in-business>

Michel Ferrary. 2010. *Les femmes influencent-elles la performance des entreprises?*
<https://www.cairn.info/revue-travail-genre-et-societes-2010-1-page-181.htm%20>:

Liliana Nicotela S., Stefan Cristian G. 2021. *Does board gender diversity affect firm performance? Empirical evidence from Standard & Poor's 500 Information Technology Sector*. <https://jfin-swufe.springeropen.com/articles/10.1186/s40854-021-00265-x>