The Goddess of Fortune
The Quote 500 rich list

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Abstract

Whoever said money doesn't grow on trees has probably never taken a good look at the Quote 500 rich list. The Quote 500 is a magazine published every year in the fall, that contains lists and rankings of the Netherlands's wealthiest citizens. In this paper the fortunes of the richest are classified as either a inherited fortune or a self-made fortune. Next I investigate how the status of the fortune, self-made or inherited, affects the trend of the fortune. Additionally, I investigate whether the economic sector of origin of the fortune has a significant effect on the trend of the fortune. Lastly I look at whether inherited and self-made fortunes are generally achieved in specific sectors. The models created to perform this research include a two-step linear regression model and a Bayesian stochastic multi-level model. The results indicate that when a fortune is inherited this has a positive effect on the trend of the fortune. Furthermore the sectors Industry, Construction, Transport Storage and Communication and Immovable Property and Rental of Movable Property and Services have a significant negative effect on the trend of the fortune and last we generally find inherited fortunes in the sector Trade and self-made fortunes are most found in the sector Immovable Property and Rental of Movable Property and Services.

***Key words**: Extraordinary Wealth, Fortune Classification, Two-step Linear Regression Model, Bayesian Stochastic Multi-level Model*

Contents

1 Introduction

Great fortune, money beyond imagination, it is something that only happens to a very small amount of people. Some may spend their whole lives trying to accomplish great wealth but just like in a dream, you can see it, and you're running towards it but you never seem to get there. After all, the goddess of fortune, as of justice, is blind. Of course it's not just luck that makes some people billionaires and others not. According to Torgler and Piatti (2013) globalization and the degree of corruption also play a significant part when it comes to extraordinary wealth. In line with Clark (2000) they use the following definition for globalization: 'The process of establishing networks of connections among actors in different countries, mediated through a variety of flow including people, information and ideas, capital and good.'. They find that a country's capacity to create international networks that help open up the flows of information, goods and capital are a key ingredient when it comes to enhancing the accumulation of extraordinary wealth. Next to that however there is also the other side of the coin, as they find that this sort of wealth is also usually accompanied by corrupt activities. The finding that corruption seems to facilitate great wealth is of course not very surprising. The combination of corruption, wealth and power is not an uncommon phenomenon.

In 1917 B.C Forbes, a financial columnist, and his partner Walter Drey, the general manager of the Magazine of Wall Street, founded Forbes magazine or as it was originally named: 'Forbes:Devoted to Doers and Doings'. Over the years Forbes has grown into a well-known American business magazine that appears once every two weeks. Forbes is most famous for its lists and rankings especially the lists regarding the richest Americans and the world's high performing companies. Among other things Forbes magazine keeps track of the number of billionaires across the world. When we examine this list we see that the United States (492), China (152) and Russia (111) hold the leading positions, Forbes (2014). The numbers between brackets denote the number of billionaires in each country. Clearly the US outshines all others countries with a number of billionaires that more than triples the country in second place. Not surprisingly a lot of the most extravagant and luxurious houses ever built are also located in the United States. The most widely discussed house right now is the American version of the Palace of Versailles. Still under construction this house is to become the dream home of the Siegel family. With approximately 90,000 square feet that include a bowling alley, indoor relaxing pools, five kitchens, 23 bathrooms, 13 bedrooms, two elevators, two movie theaters (one for kids and one for adults, each modeled after a French opera theater), 20-car garage and a wine cellar built for 20,000 bottles, this is believed to be the largest private owned American house, The Wall Street Journal (2011). As the Wall Street Journal notes:'Even in the age of excess, Versailles is excessive.'.

As the rankings and lists of Forbes proved to be quite popular, other magazines similar to Forbes have come into existence. These magazines also listed and ranked the wealthiest individuals of a country. More specifically the Dutch version of Forbes is called the Quote 500. This magazine ranks and lists the 500 wealthiest Dutch citizens. They started these publications in 1998 and publish them once a year. The Quote magazine already existed before 1998 as it was founded in 1986 by Maarten van den Biggelaar as a monthly business magazine. Then in 1997 when Jort Kelder became main editor they also started publishing the Quote 500. What is considered the counterpart of the Quote 500 is the Quiet 500 magazine. This magazine has its origin in the city of Tilburg and was founded by Anton Dautzenberg in 2012, (Quiet, 2014). In this magazine you won't read about riches and luxuries, on the contrary it's the exact opposite. Here you will read about people who live in quiet poverty, families who have merely 60 euros a week to come by. Important to mention though is that the Quiet 500 magazine is a gimmick, there is no real list of poverty. It was brought into existence to put the Quote 500 in better perspective.

In this paper I will analyse the Quote 500 data ranging from the years 1998 up to and including 2009. For the fortunes of the wealthiest Dutch individuals I will make the distinction of whether a fortune was gathered by means of inheritance or whether it is a so called self-made fortune. More specifically I will investigate how the status of the fortune (self-made or inherited) affects the trend of the fortune, if it is at all affected. What is meant by *the trend of the fortune* is the general direction of the fortune over time. Additionally, as I have also information regarding in what economic sector a fortune was achieved, I will research whether self-made and inherited fortunes are generally gathered in specific sectors and more importantly whether or not the sector of origin has a significant effect on the trend of the fortune (self-made or inherited).

The rest of this paper is structured as follows: in section two the relevant literature and related work will be discussed, in section three there will be a more detailed description of the data that is available for this research. Next in section four the methodology, the various models used to perform the research will be described, in section five the results will be analyzed and discussed, section six contains the final conclusions of the research and finally in section seven possibilities for potential future research will be discussed.

2 Literature and Related Work

Research regarding the wealthiest people on the globe is not found in abundance. One of the few people who *have* performed quite some extensive research in this particular area is John J. Siegfried et al. One of his first papers on this subject, Siegfried and Roberts (1991), examines the greatest fortunes in Great Britain in 1988. The fortunes were identified from brief descriptions and lists published in Money magazine. The main objectives of the paper were to investigate the sources of wealth of a group of extremely wealthy British citizens and to evaluate the role of competition in accumulating such fortunes. They considered an industry to be competitive if expected long-run equilibrium profits at the margin were negligible. The 200 British fortunes that they researched originated in 74 industries, the most common being land-holding and real estate trading and development. Surprisingly they found that 73% of these fortunes originated in what were essentially competitive industries as judged by a panel of professionals. When they went into more detail and split up the fortunes in either self-made or inherited, they observed that almost all of the 121 self-made fortunes have been accumulated in competitive industries. This in contrast to the inherited fortunes where the majority have been accumulated in imperfectly competitive industries. As explanation they relate back to the thesis of C.D. Harbury and P.C. McMillan who argue that "there are some industries where inherited wealth is necessary in order to amass sufficient capital to begin efficient operations, and other industries that more readily allow for entry of small firms with little initial capital." In others words, for those who don't have family roots in great wealth, creating your own fortune is easier in industries that allow small scale entry.

In 1994 a similar study was performed by Siegfried and Round (1994), this time concerning the wealthiest individuals of Australia. The data was collected from Business Review Weekly (1990) and Australian Business (1990) and consisted of what magazines reported as the 200 wealthiest Australians. Again the goal was to identify the industries from which the largest Australian fortunes originated and to determine the extent to which these industries were competitive when the seeds of wealth were sown. In this paper there were 263 Australian fortunes to be classified. Just like in the previous research, over three quarters of the fortunes (77%) originated in competitive industries as judged by a panel. This also has to do with the fact that the industries where the fortunes were derived from, such as grocery retailing, investing, clothing retailing, sheep stations, automobile dealers, were all rated as competitive industries. Whether the fortune was inherited or self-made, in Australia didn't seem to be related to whether the industry of origin was competitive or not.

In 1997 yet another similar study was performed, this time in New Zealand, Hazledine and Siegfried (1997). 120 fortunes were extracted from the 1996 edition of the NBR's Rich list. For a fortune to be included a minimum size of $ NZ 10 million was required. Again a panel of experts, including industrial organization specialists, competition policy practitioners and economic historians, had to assign the industries, this time, to three different types. Namely competitive, monopolistic or oligopolistic. This paper replicates the results found in the previous studies as there is again a predominance of competitive sourced fortunes (79%). Industrial sectors that seem to have high tendencies to produce millionaires in New Zealand are manufacturing and so called deal-making industries such as insurance, property development, brokerage and banking.

In each of these three studies it is remarkable that the authors find a high prevalence of competitive industries as of being the source of extraordinary wealth. To summarize, the panels rated 73% of the British fortunes, 77% of the Australian fortunes and 79% of the New Zealand fortunes as originating in industries judged to be competitive. How is it then that some people seem to be able to accumulate vast amounts of money when even first year Economics students are taught that markets that render you with extraordinary returns quickly attract attention and entry in a competitive economy, which of course increases supply and decreases the price, so that above normal profit margins erode before accumulation of huge wealth can even begin? The explanation that Siegfried et al. offer in each of their papers comes down to the same thing. Although "..the competitive model predicts normal expected profits on the margin in equilibrium, competitive industries are not immune from risk, are populated by firms with differing costs and probably never reach equilibrium.", as stated in (Hazledine and Siegfried, 1997). Other possible explanations include short-run disequilibrium profits as there might be substantial lags in people recognizing and reacting to changes in demand, so suppliers can earn large amounts of wealth before market adjustment has eroded their advantage. Next to that there is the possibility of infra-marginal rents (price exceeds marginal cost) as a result of keen insight and, of course, luck which is also something that should not be forgotten when trying to determine the origin of a person's great wealth.

Whereas these three studies merely touch upon the subject of classifying fortunes as either self-made or inherited and instead focus on evaluating the role of competition, in this research it *is* one of the main focusses.

When it comes to figuring out the reasons for how some people have been able to accomplish extraordinary wealth, Neumayer (2004) seems to have been the first to research this at a global level using a cross sectional analysis. Using data from the Forbes List of Billionaires Neuymayer performs a quantitative analysis. In his paper he lays down three hypotheses, the first one being that there is a relationship between a high incidence of great wealth and private property. The second one states that great fortunes cannot arise if the economy is subject to intense government intervention. Last he states that a high degree of competition doesn't stop the creation of fortunes. In testing these hypotheses he uses a Tobit model with as dependent variable the number of billionaires in a number of countries. The explanatory variables consist of, among others, fiscal burden, a measure of government intervention and property rights. The results he finds are in favour of the first hypothesis, a greater guarantee of property rights is positively associated with the number of billionaires. The second hypothesis however, is rejected as neither a greater extent of government intervention nor a higher fiscal burden have a negative effect. Then again he does find evidence that a high degree of competition doesn't form a barrier to accumulating great fortunes. In sum super fortunes are not bothered by interventionist governments, don't seem to rely on a low degree of competition in order to flourish but the protection of property rights seems be of utmost importance.

There are not many papers who have analyzed quote 500 data. In fact, maybe the paper by Franses and Vermeer (2012) is the only one. What makes the paper stand out is that they used a new method that involved "..the clustering of the 500 individual ranks into a smaller set of ranks that are associated with approximately similar wealth levels.". More specifically they created six clusters that contained similar quote individuals regarding wealth. An interesting finding is that quote individuals seem to follow a so called power law meaning that there is a connection between the rank on the quote list and the wealth value. The main finding of the paper however is that lagged economic growth seems to increase inequality among the wealthiest citizens of the Netherlands. This is a somewhat surprising finding as the relationship between economic growth and inequality is usually found the other way around, when the economy grows inequality decreases. For this finding they rely on the argument presented in Barro (2000) who argues that this relation is indeed possible if one looks at the richer countries in this world.

3 Data

3.1 Data Description

The data that is available for this research is Quote 500 data ranging from 1998 up to and including 2009. As already stated, each year since 1998 the Quote magazine publishes their 'X-ray' of those who truly control the Dutch economy. The data consists of lists and rankings and corresponding fortunes of the wealthiest individuals. Of course the Royal family has been an ever present figure in the Quote, along with other well-known families like Brenninkmeijer and Heineken.

There is a lot of criticism regarding the validity of the Quote 500 data. There are people who claim that are millionaires on the list who are at least worth twice the amount stated by the Quote. Or that for some billionaires the Quote is just merely guessing. To estimate the fortunes Quote mainly relies on external sources, including the Kamer van Koophandel (Chamber of Commerce), Offices of the land registry and company's annual reports. Then to make their estimates they for example look at publicly traded shares, art auction results, price/earnings ratios to value privately held shares and also marriage notices. This process, as also stated by Siegfried and Round (1994), most likely overstates fortunes of first generation millionaires and understates what can be regarded as old wealth. Siegfried and Round (1994) argue that most first generation wealth is for the most part contained within the company that created their extraordinary wealth. Meaning that, when one values the company, it's a simple matter of multiplying the share price times the number of shares owned. The catch is however that selling such a large amount of shares can't be done without decreasing the share price. Meaning that there is reason to believe that this form of wealth is overstated. Old wealth on the other hand is more likely to be concealed, it can for example be held in trusts, art collections and offshore accounts. This of course makes it more difficult to value these fortunes. Nevertheless the estimates of the Quote do give an indication of how the most fortunate people in the Netherlands fare and how their fortunes mutate.

In table 1 you can find descriptive statistics regarding the fortunes. In the years 2002 and 2003 the Dutch GDP grew with only 0.1% and 0.3% respectively, which is, needless to say, far below average. We also see this in table 1 when we look at the means for these two years (165.316 and 180.524), which are almost half of what we experienced in for example 2001. The maximum wealth value across all individuals and across all years is 24100 million euros in 2008. After 2008 this value most likely started to take quite a down-turn as the credit crunch started to take hold.

Year	Mean	Standard Deviation	Minimum	Maximum
1998	256.381	764.576	35	8500
1999	310.830	1005.332	45	15000
2000	362.500	1075.399	60	15000
2001	362.960	1011.177	75	17000
2002	165.316	462.294	32	8000
2003	180.524	530.499	35	10000
2004	194.850	602.847	41	12000
2005	219.860	642.319	43	12500
2006	241.550	767.987	46	15000
2007	273.558	934.301	48	18500
2008	289.030	1133.854	50	24100
2009	254.012	968.731	45	20500

Table 1: Statistics of the 500 wealthiest in the Netherlands, in millions of euro's

Apart from the rankings and the fortunes there is also information regarding the economic sectors in which the fortunes were achieved. Table 2 gives an overview of all the relevant economic sectors.

SIB code	Economic Sector
1	Agriculture/Fishing
2	Mining and Quarrying
3	Industry
4	Energy and Waterworks
5	Construction
6	Trade
7	Catering Industry
8	Transport, Storage and Communication
9	Banks and Insurance
10	Immovable Property and Rental of Movable Property and Services
11	Public Administration
12	Education
13	Health and Welfare Care
14	Culture, Sports, Recreation and other Services

Table 2: Economic sectors

To give an idea of how the millionaires are distributed across the sectors, tables 3 and 4 show how many millionaires each sector contains in 1998 and in 2009 respectively. When we compare 1998 to 2009 we see that they don't differ much. In both years the sectors Industry, Trade, Banks and Insurance and Immovable Property and Rental of Movable Property and Services hold the vast majority of millionaires. There is one sector however where the number of millionaires has about tripled in 2009 compared to 1998. This is the sector of Mining and Quarrying (sector 2). A possible reason why this sector is so successful could be because of the Global Financial Crisis that hit in 2007-2008. Perhaps people started investing their in money gold and silver as a sort of insurance and so, increasing demand in this sector.

	Top 500	Percentage	Top 100	Percentage
sector 1	12	2.4%	3	3.0%
sector 2	4	0.8%	2	2.0%
sector 3	133	26.6%	19	19.0%
sector 4	0	0.0%	0	0.0%
sector 5	39	7.8%	6	6.0%
sector 6	89	17.8%	22	22.0%
sector 7	6	1.2%	1	1.0%
sector 8	23	4.6%	1	1.0%
sector 9	55	11.0%	17	17.0%
sector 10	99	19.8%	25	25.0%
sector 11	2	0.4%	1	1.0%
sector 12	0	0.0%	0	0.0%
sector 13	0	0,0%	0	0,0%
sector 14	38	7,6%	3	3,0%
		100%		100%

Table 3: Sector Distribution 1998

	Top 500	Percentage	Top 100	Percentage
sector 1	15	3,0%	0	0,0%
sector 2	12	2,4%	8	8,0%
sector 3	108	21,6%	18	18,0%
sector 4	0	0,0%	0	0,0%
sector 5	37	7,4%	4	4,0%
sector 6	97	19,4%	23	23,0%
sector 7	5	1,0%	1	1,0%
sector 8	22	4,4%	3	3,0%
sector 9	63	12,6%	13	13,0%
sector 10	110	22,0%	25	25,0%
sector 11	2	0,4%	1	1,0%
sector 12	0	0,0%	0	0,0%
sector 13	0	0,0%	0	0,0%
sector 14	29	5,8%	4	4,0%
		100%		100%

Table 4: Sector Distribution 2009

Finally I will discuss the type of data that we are dealing with. There are several types of observational data, namely Cross-section data, Time series data and last Panel data. A cross-section dataset consists of observations on variables at a specific point in time. It is basically a snapshot of a certain population. Time series data means that we have repeated observations on variables at a number of points in time T, for the same individual. An example of time series data would be the daily closing value of the AEX. Last we have panel data, also known as longitudinal data. This type of data is obtained by selecting a certain sample, for example S, and then collect observations over a number of time periods. We have for example household panels where there is a dependent variable Y_{it} that equals the income of individual i in year t and a number of independent variables for example age or gender etc. An advantage of panel data is that it can model dynamic relationships. A disadvantage is that your panel could suffer from what is known as 'sample fatigue'. Meaning that your respondents simply stop providing you with responses and your sample becomes unrepresentative.

The Quote 500 data qualify as panel data. It is however an unbalanced panel as people leave and enter the Quote 500 every year. Most likely the issue of sample fatigue does not apply here as even when the millionaires decide not to cooperate, the Quote can make an estimate of their fortune based on information that is public.

3.2 Fortune Classification

In this section I will explain what rules I used to classify a fortune either as inherited or as self-made.

As there are no concrete guidelines on to how to determine whether a fortune is inherited or self-made, I created my own. First, the Quote 500 includes a lot of families and for families I have chosen to in general classify them as inherited unless it is known that the person who originally created the initial wealth is still alive in 2009. I have chosen the year 2009 as an anchor as this year marks the end of the period being analyzed. Choosing any of the other years as an anchor would mean that a fortune would for example be classified as self-made from 1998 to 2001 and as inherited from 2002 to 2009, which of course doesn't make sense.

Second, in general someone is considered self-made if he or she is the founder (or one of the founders) of the company that created his or her fortune. For example Jan Zeeman founded the Zeeman textile stores which also generated his fortune and thus is self-made.

Third, if a son (or daughter) takes over his father's company and the son turns the company into a multi-million euro business, than the son is classified as self-made. For example, the father runs the town's grocery store and his son turns it into a national supermarket. However, if the company is already considered a high performing business when the son takes over, in that case the son's fortune is classified as inherited.

When whether a person is inherited or self-made couldn't be traced this family or person was classified as unknown and left out of the analysis. Using these rules I searched newspaper articles, company websites, magazines and other publicly available databases to track down the millionaires and classify them. In total there were 938 Quote 500 entries over the twelve year period. Of these 938 entries 277 were classified as inherited and 460 were classified as self-made. The remaining 201 entries couldn't be traced as to whether the fortunes was inherited or self-made, which leaves us with 737 classified fortunes

4 Method

In this section the two models to analyse the fortunes will be described.

4.1 Two Step Linear Regression Model

In this section the first model, used to analyse the classified fortunes, is described. To see whether the status of a fortune and the sector in which a fortune has its origin, have an effect on the trend of the fortune, the following two step model was created.

$$Y_{i,t} = \mu_i + \beta_i Trend_t + \epsilon_{i,t} \tag{1}$$

$$\beta_i = \delta_0 + \delta_1 InheritedDummy + \delta_2 sector_1 + ... + \delta_{14} sector_{13} + \eta_i \tag{2}$$

$$\epsilon_{i,t} \sim N(0, {\sigma_1}^2), \quad \eta_i \sim N(0, {\sigma_2}^2) \tag{3}$$

In the first equation we estimate, by means of Ordinary Least Squares (OLS), the trend parameters β for each individual i. It is by means of this trend parameter that we operationalize the trend of each fortune. $Y_{i,t}$ represents the fortune of individual i in year t. $Trend_t$ represents the trend variable in year t, which looks as follows for this twelve year period: $[1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12]$. In the second equation I again apply OLS, this time for all the individual trend parameters that result from the first regression. Sector 14 is left out because if I were to include all sector dummies and a constant term, this would guarantee perfect multicollinearity. Meaning that one independent variable can be linearly predicted from the others which may lead to invalid results about the individual independent variables. By leaving sector 14 out this problem is solved and sector 14 can now be seen as our reference sector. The InheritedDummy represents the dummy variable for whether someone is a inherited or a self-made millionaire (inherited=1, self-made=0). The fourteen sector variables represent the dummy variables for each economic sector. It is assumed that both the error terms $\epsilon_{i,t}$ and η_i are normally distributed with mean zero and variances σ_1^2 and σ_2^2 respectively.

With regard to the first regression there is the condition that each individual i needs to have a sufficient number of observations in order to generate a decent estimate of β. Therefore the millionaires who only show one observation in the Quote 500 list over the measured period, are removed from the analysis as with only one observation you can't make an estimate. The millionaires with two observations are also removed as this would simply estimate a straight line and no standard errors. After cleaning the dataset in this way, I have a total of 576 individuals left for analysis of which 224 are classified as inherited and 352 as self-made. Within this cleaned sample there are no individuals who gathered their fortunes in the sectors 4 and 13 (Energy and Waterworks and Health and Welfare Care) and only one individual in sector 11 (Public Administration) meaning these sectors are also left out of the analysis.

To find the best model a top-down method was used in combination with the Akaike Information Criterium (AIC). The top-down method means that you start with a model that contains all variables and then in each step you remove the variable that is least significant. Subsequently you choose the model where the AIC stops improving, that is the point where the AIC value doesn't decrease any further. The AIC is defined as follows.

$$AIC = 2k - 2log(L) \tag{4}$$

k equals the number of parameters and L equals the likelihood of the model. As the concept 'likelihood' will return later on in the paper, I will give a short description of what it entails. The method known as Maximum Likelihood Estimation (MLE) is another way of estimating the parameters in a model. MLE centers around the so called likelihood function that is set up by the researcher himself and has to fit the given data set as well as possible. It is the likelihood function that contains the parameters to be estimated for example mean and variance. MLE will now provide you with a set values where the model parameters (in this case mean and variance) maximize the likelihood function. This renders you with a set of parameter estimates and the maximum likelihood which can be used in for example the AIC. Notice that here the likelihood is only used to compute the AIC.

4.2 Stochastic Multi Level Model with Hierarchical Bayes

In the two step linear regression model the sector parameters (equation 2) are estimated using the estimates of the trend parameters from the first regression.

The downside of this method is however, the uncertainty that you have in the first regression you again include it in the second regression. The solution for this problem is estimating both equations at once. Bayesian methods offer a way to implement this. First I will discuss how Bayesian inference works and next the used model will be described.

Within the field of statistics Bayesian inference is a particular subset, one that is distinctly different from the more common Frequentist approach. If we consider the simple example of tossing a coin, with y=1 if the coin toss results in heads and 0 otherwise and Pr(y=1)= θ and we assume that this probability is constant for each trial then y is said to have a Bernoulli distribution. By setting up an experiment where we toss the coin n times, yielding the data $y = (y_1, y_2, ..., y_n)$ where y_i denotes the ith coin toss, we can learn about the parameter θ.

If we now look at it from a Frequentist point of view, probability theory tells us something about the distribution of the data given the parameter θ. This is because the data can be regarded as the outcome of a large number of repetitions, (Greenberg, 2012). The parameter θ remains an unknown number, in this example a number between zero and one and is not given a distribution of its own as the parameter is not regarded as the outcome of a repeated experiment. The technique discussed in section 4.1, OLS, is an example of a Frequentist approach. It assumes that there are enough observations to say something meaningful about, in that case, the parameter β.

From the Bayesian point of view the parameter θ is an unknown quantity and as we have uncertainty regarding its value we can see θ as a random variable and assign it a probability distribution, (Greenberg, 2012) . The choice of the probability distribution is based on the knowledge that the researcher has beforehand regarding θ. In Bayesian terms we call this distribution the prior distribution, here $\pi(\theta)$, $0 \leq \theta \leq 1$. Next you use the data you have to update the 'prior belief' to obtain 'posterior belief'. The posterior belief or more accurately the posterior distribution forms the core of Bayesian inference. It is the distribution of the parameter θ conditioned on having observed the data, $\pi(\theta|y)$. One samples from the posterior distribution, using a particular sampling technique, to obtain estimates of for example the posterior median, mode or mean of your parameter. Using Bayes's Rule the posterior is defined as follows:

$$\pi(\theta|y) = \frac{p(y|\theta)\pi(\theta)}{p(y)} \tag{5}$$

Where $p(y|\theta)$ represents the likelihood function of y. $p(y) = \int p(y|\theta)\pi(\theta)d\theta$. Notice that the likelihood function here is not used for any estimation purposes but is merely a stepping stone to achieve your posterior. We divide by p(y) to make the posterior density a normalized distribution, (Greenberg, 2012). However, as p(y) is independent of θ it is common to write the posterior as:

$$\pi(\theta|y) \propto p(y|\theta)\pi(\theta) \tag{6}$$

In other words, the posterior is proportional to the likelihood function times the prior distribution. In this form the right hand side of the equation no longer integrates to one but still has the same shape as $\pi(\theta|y)$.

As for the prior, there are two types of priors that you can specify, proper and improper or uninformative priors. If a researcher has reasonable knowlegde about the data behorehand, he can specify a proper density as prior for the parameters. If the researcher has no prior beliefs regarding the parameters, the idea is to stay close to the frequentist approach and specify priors that are proportional to one. This means that the prior distribution assigns equal likelihood to all possible values of the parameter.

Next I will describe the model that I will be using. The model I use for my analysis is a stochastic multi-level model with hierarchical Bayes. Hierarchical Bayes simply implies that we use a hierarchical prior specification. For example, assume that we have a model with parameter θ, the prior for θ is a distribution which depends on the parameter η, $p(\theta|\eta)$. A hierarchical prior means that we don't specify a value for η but that we specify a prior distribution for η as well. For example a prior that depends on γ, $p(\eta|\gamma)$. You can now set a value for γ

or simply continue on the process of specifying priors.

There are several reasons for why one would adopt hierarchical priors. You can specify a proper prior (one that is not proportional to a constant), but still show your ignorance regarding the locations and scale of the prior distribution,(Paap, 2014). Another reason includes that due to its specific structure hierarchical Bayes priors are especially well suited for panel data models, (Paap, 2014).

To build my stochastic multi-level model I use the hierarchical Bayes framework. Although they are not of interest in this paper, there are also other interpretations of the hierarchical Bayes framework besides multi-level, for example latent (unobserved) variable models and variance components. The multi-level interpretation assumes that there are multiple layers in the model. Namely, the parameters of the stochastic model in the first layer are the dependent variables of the stochastic model in the second layer. Of course you can extend this even further and create a third or maybe even a fourth layer, depending on the model that you want. I created the following model.

$$Y_{i,t} = \mu_i + \beta_i Trend_t + \epsilon_{i,t} \tag{7}$$

with $\epsilon_{i,t} \sim N(0, 1/h_i)$

$$\beta_i = \delta_0 + \delta_1 InheritedDummy + \delta_2 sector_1 + .. + \delta_4 sector_3 + \delta_5 sector_5 + .. + delta_{10} sector_{10} + \delta_{11} sector_{12} + \eta_i \tag{8}$$

with $\eta_i \sim N(0, 1/hb2)$

The prior specification is as follows:

1. $p(\mu_i) \propto 1$
2. $p(h_i) \propto 1/h_i$
3. $p(hb2) \propto 1/hb2$
4. $p(\delta_0, \delta_1, ..., \delta_{11}) \propto 1$

As my knowledge regarding the fortunes is rather limited I have assumed uninformative priors. Needless to say, the equations that are estimated in this model are exactly the same as the equations estimated in the two step linear regression model. For my parameter estimates I rely on the posterior mean which is achieved by sampling from the posterior distribution.

5 Results

In this section I will discuss the results that I obtained for both the two step linear regression model and the stochastic multi level model. For both models, I discuss only the most important and also the most interesting results, that is for each model the results of the second regression (equations 2 and 8). Additionally I will discus the distribution of fortunes across sectors now that the fortunes have been classified.

In table 5 we find sector distribution of the self-made fortunes. The table shows that the sectors 3 and 10, that is Industry and Immovable Property and Rental of Movable Property and Services, contain most of the self-made fortunes. In contrast to the sectors 2, 7 and 12, Mining and Quarrying, Catering Industry and Education respectively, who contain very few self-made fortunes.

Sector 1	1,70%	sector 8	4,83%
Sector 2	0,57%	sector 9	14,20%
Sector 3	20,45%	sector 10	26,99%
Sector 5	4,54%	sector 12	1,14%
sector 6	15,05%	sector 14	9,94%
sector 7	0,57%		

Table 5: Sector Distribution Self-Made Fortunes

In table 6 we find the sector distribution of the inherited fortunes. Compared to how the self-made fortunes are distributed across the sectors, the inherited fortunes have a more balanced distribution. There are however two spiking sectors, namely sectors 3 and 6, that is Industry and Trade who contain respectively 27.03% and 25.23% of the inherited fortunes. Inherited fortunes are not well represented in the sectors 2,7 and 14, that is Mining and Quarrying, Catering Industry and Culture Sports Recreation and other Services.

Sector 1	3,60%	sector7	0,90%
Sector2	2,70%	sector8	7,21%
Sector3	27,03%	sector9	7,21%
Sector5	12,61%	sector10	10,81%
sector6	25,23%	sector14	2,70%

Table 6: Sector Distribution Inherited Fortunes

Apparently sectors 3,6 and 10 are important sectors for inherited and self-made fortunes. If we look a little bit more closely and apply a z-test for the comparison of two percentages it turns out that there is statistical support that sector 6 contains more inherited fortunes than it does self-made fortunes (z-value=3.03, 5%), sector 10 contains more self-made fortunes than it does inherited fortunes (z-value=4.66, 5%) and for sector 3 the percentages for inherited and self-made fortunes are more or less equal (z-value=1.82, 5%).

Subsequently I'll discuss the results of the two step model represented in table 7. Despite the fact that, based on the AIC criterium, this is the best model none of the variables, except for the constant, are significant on a 5% level. The variables InheritedDummy and Sector3 do approach significance on a 10% level, however as we have a reasonably large amount of data points we can't derive any conclusions from this.

Next we move on to the Bayesian model. In table 8 we find the results for the multi level model that includes all of the variables. We find that most of the variables are again insignificant. However if we look at table 9 where the selection of variables for the best two step model was used for the multi level model, we see that all variables are significant on 5%, except for Sector1 which is significant on 10%. This also why this particular model is regarded as ***the final model***. Important to mention is that the coefficients in tables 7 and 9 are very similar, as they should be, however in the multi level model almost all variables are significant because we have less uncertainty in the estimates as the β and δ parameters are estimated at the same time. Whereas in the two step linear regression model you include the uncertainty that you have in the estimates of the first regression in the estimates of the second regression which in this case leads to insignificant variables. A very important result here is the fact that the Inherited Dummmy is indeed significant and has a positive effect of +10.36 on the trend parameter and hence a positive effect on how a fortune develops over time. Note that the Inherited Dummy was already significant in the multi level model that included all sectors. In others words inherited fortunes show to have a positive effect on the trend of the fortune.

As for the origin of a fortune looking at the final model, when a fortune was achieved in the sectors 3, 5, 8 and 10 that is Industry, Construction, Transport Storage and Communication and Immovable Property and Rental of Movable Property and Sevices, this shows to have significant negative effect on the trend of the fortune. Respectively we find the posterior means -14.23, -11.31, -13.03 and -9.69. To give an example of how to interpret these coefficients we take the posterior mean of the Inherited Dummy, 10.36, this means that if someone is a inherited millionaire the trend parameter β_i for this particular individual will increase with 10.36. The trend parameter β_i is interpreted as follows, if an individual has for instance $\beta_i = +5.0$ this means that he/she experiences an average annual increase of 5 million euro's as the fortunes are measured in millions of euro's.

Results 2-step Model

Variable	*Coefficient*	*Standard Error*	*t-statistic*
Constant	11.37	5.458	2.083
Inherited Dummy	10.51	6.565	1.60
Sector1	-13.01	20.528	-0.634
Sector3	-14.78	8.122	-1.819
Sector5	-11.47	12.354	-0.929
Sector8	-13.14	13.864	-0.948
Sector10	-9.82	8.462	-1.161

Table 7: Results 2-step model

Results Multi-level Model All sectors

Variable	*Posterior Mean*	*Posterior Standard Error*
Constant	1.993	3.98
Inherited Dummy	9.132	2.303
sector1	-2.918	7.865
sector2	19.14	10.05
sector3	-4.318	4.495
sector5	-1.178	5.541
sector6	13.21	4.628
sector7	10.79	13.3
sector8	-3.072	5.929
sector9	9.529	4.975
sector10	-0.0616	4.518
sector12	-0.4929	24.97
Hb2 (variance β)	0.001545	3.649E-05

Table 8: Results Multi-level Model All sectors

Results Multi-level Model 2-step sectors

Variable	*Posterior Mean*	*Posterior Standard Error*
Constant	11.37	2.105
Inherited Dummy	10.36	2.265
sector1	-12.76	7.045
sector3	-14.23	2.859
sector5	-11.31	4.295
sector8	-13.03	4.781
sector10	-9.69	2.936
Hb2 (variance β)	0.001543	3.662E-05

Table 9: Results Multi-level Model 2-step sectors

6 Conclusion

We began this research with lists and rankings of people who enjoy (or endure) extraordinary wealth. Some of them who could quite literally, just like Scrooge McDuck, swim in their money. In this paper I analysed 576 fortunes of which 224 were classified as inherited and 352 as self-made. As there are no specific guidelines on how to determine whether someone is a inherited millionaire or a self-made millionaire, a set rules was created to perform this classification. The goal of this research was to see how the trend of a fortune is affected (if at all) by its classification of either being a self-made or inherited fortune. Additionally I investigated whether the sector of origin of the fortune has a significant effect on the trend of the fortune. Finally I also looked at whether inherited fortunes are generally achieved in specific sectors and also if self-made fortunes are achieved in specific sectors.

The findings indicate that the status of the fortune most definitely has an effect on the trend of the fortune. It turns out that when a fortune is inherited this has a positive effect on the trend of the fortune. A possible reason for this could be that with an inherited fortune it usually concerns a family fortune meaning that there is a certain tradition to uphold. Also, these people are most likely more comfortable handling huge amounts of money. Unlike for self-made millionaires, who are perhaps more likely to feel the urge to spend the money now that they finally have it.

Next, I found that there are indeed sectors that have a significant effect on the trend of the fortune. When a fortune was achieved in one of the following sectors: Industry, Construction, Transport Storage and Communication and Immovable Property and Rental of Movable Property and Services this turns out to have a negative effect on how the fortune develops over time. These sectors are known to be quite 'boisterous' in nature, as in they are more sensitive to changes in economy. If the economy is doing well these sectors will also perform well but if the economy is going down-hill or in recession, the people who operate in these sectors will definitely feel it in their wallets. Considering that there has been a global financial crisis, also known as the credit crunch, since 2007-2008, it seems reasonable that if a fortune was achieved in one of these sectors that this has a negative effect on the trend of the fortune.

Finally tables 5 and 6 make clear that both self-made and inherited fortunes are well presented in the sector Industry. Apparently this is a sector that is well suited to accumulate both types of fortunes, people who have roots in old wealth and those who start with little initial capital. The sector Trade seems to be more connected to inherited fortunes. This tells us that the sector Trade used to be a very important sector when it came to achieving extraordinary wealth. Lastly the sector Immovable Property and Rental of Movable Property and Services is with 26.99% the sector that contains most self-made fortunes. This not surprising as this is a sector widely known for the vast amounts of money that you can accumulate in relatively short time span.

Either self-made or inherited, extraordinary wealth will always remain a subject of interest.

Yours sincerely,

Lady Fortuna

7 Future Research

Regarding any future research it might be interesting to compare great wealth across the different countries. Each country is different from the next, different factors that play significant parts, how do they influence the accumulation of great fortune?

8 Appendix

8.1 Appendix A: Prepare Data, Matlab Code

```
load data
A = isnan(Y); % we maken een logical
B =size(Y,1); % aantal rijen dat moet worden afgegaan
for i= B:-1:1

    if sum(A(i,:))==(size(A(i,:),2)-1)|| sum(A(i,:))==(size(A(i,:),2)-2)

    Y(i,:)= [];   % rij verwijderen
    names(i,:) = [];
    status(i,:) = [];
    sector(i,:)=[];
    end
end

Y= Y(1:576,:); % Ik selecteer alleen de mensen die selfmade zijn of inherited
I = size(Y,1);
T = size(Y,2);
vectorY = zeros(I*T,1);

for i = 1:I
    vectorY(((i-1)*T+1):((i-1)*T+T),1) = Y(i,:)';
end
```

8.2 Appendix B : Eviews model

```
!I = 576 'aantal personen
!T = 12 'aantal perioden

'maak series aan waar de data in komt
genr alpha = NA
```

```
genr beta = NA

for !i = 1 to !I 'loop over de personen

     'stel sample in op persoon i
     !startIndex = (!i - 1) * !T + 1
     !eindIndex = (!i - 1) * !T + !T
     smpl !startIndex !eindIndex

     equation eq 'maak lege equation
     eq.ls y c @trend 'voer OLS uit

     'haal gegevens op
     alpha(!i) = eq.c(1) 'sla constante op in alpha
     beta(!i) = eq.c(2) 'sla slope op in beta

next
smpl @first @last 'reset de sample instelling
```

8.3 Appendix C : Openbugs Model

```
model
{
for(i in 1 : N)
{
for (j in 1 : T)
{
fortunes[i,j] ~ dnorm(mu[i,j],hy[i])
mu[i,j] <-beta1[i]+beta2[i]*trend[j]
}
hy[i] ~ dgamma(0,0)
beta1[i] ~ dnorm(0,0.0001)
beta2[i] ~ dnorm(b2[i],hb2)
```

```
b2[i] <- alpha1 +alpha2*inherited[i] + alpha3*sector1[i]
+ alpha5*sector3[i] + alpha6*sector5[i]  + alpha9*sector8[i]
 + alpha11*sector10[i]

#+alpha14*sector14[i] + alpha4*sector2[i] + alpha7*sector6[i]
# + alpha8*sector7[i] +alpha10*sector9[i] +alpha13*sector12[i]
}
hb2 ~ dgamma(0,0)
alpha1 ~ dnorm(0, 0.0001)
alpha2 ~ dnorm(0,0.0001)
alpha3 ~ dnorm(0, 0.0001)
alpha4 ~ dnorm(0, 0.0001)
alpha5 ~ dnorm(0, 0.0001)
alpha6 ~ dnorm(0, 0.0001)
alpha7 ~ dnorm(0,0.0001)
alpha8 ~ dnorm(0,0.0001)
alpha9 ~ dnorm(0,0.0001)
alpha10 ~ dnorm(0,0.0001)
alpha11 ~ dnorm(0,0.0001)
alpha12 ~ dnorm(0,0.0001)
alpha13 ~ dnorm(0,0.0001)
alpha14 ~ dnorm(0,0.0001)
}
```

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