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A simulation model of the Italian economy

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Abstract

The integration of Europe into one European Union accordingly resulted in the integration of Europe's individual economies. Meaning that the economic development and stability of one country depends to a greater extent on the success of the rest of the European partners. This reliance was heightened by the introduction of the European Monetary Union in 1999 with the Euro as the common currency. Despite the Euro member states having a central bank, it is each country's responsibility to finance its government debt through the emission of governmental bonds. The risk premiums that have to be paid by each country differ through-out the Euro zone. The concern that Italy, with the present state of its economy and development prospects, could introduce future implications of its high government debt to the European Union as a whole (OECD, 2011d). An analysis of the Italian economy will explore this likelihood.

The concern here is to give an analysis of the Italian Economy and development with its future implications of high governmental debt (OECD, 2011d). Economic growth and welfare is measured in the Gross Domestic Product (GDP). The classical macroeconomic models as described in Mankiw (2010, p. 27), with the GDP as a sum of the consumption, investment, government purchases and net exports of a country are classical Keynesian models. The standard estimation approach for a macroeconomic model is to explain endogenous variables through exogenous variables. It considers governmental debt as a decreasing factor, such as payment for interest on bonds, and not the absolute amount of the government debt. This problem will be addressed by applying the econometric model E2012 (Hanappi, 2011) to Italy, which takes the national debt as stock variable into account.

The thesis is structured in a literature review and a macro econometric simulation part. The literature review revealed that Italians are facing credit constraints and high restrictions on mortgage lending which shape the society and its consumption behaviour. The econometric analyses showed that an increase in output per worker in Italy decreases at the same time the number of available job places. This could lead to a higher unemployment rate in the next years linked to an increasing population.

Kurzfassung

Der Integrationsprozess, der nach der Entstehung der Europäischen Union eingeleitet wurde, führte zur Gründung der Währungsunion 1999. Diese Verflechtung führt dazu, dass die wirtschaftliche Entwicklung eines Landes die anderen Mitgliedsstaaten ebenso beeinflusst. Die einheitliche Währung mit einer gemeinsamen Europäischen Zentralbank reduzierte den Druck der Währungsschwankungen, die Refinanzierung der Staaten blieb allerdings die Angelegenheit der Nationalstaaten. Staaten finanzieren die jährlichen Budget-Defizite durch Ausgabe von Staatsanleihen. Der Preis, der für einen Anleihe bezahlt werden muss, ist trotz gemeinsamer Währung unterschiedlich. Italiens hoher Schuldenstand und der aktuelle Zustand der Wirtschaft ist die Basis für eine Analyse und dessen Implikationen für den Rest Europas (OECD, 2011d).

Wirtschaftswachstum und Wohlstand werden als Bruttoinlandsprodukt (BIP) gemessen. Klassische Keynesianische makroökonomische Modelle wie beschrieben in Mankiw (2010, p. 27) ermitteln das BIP als Summe von Konsum, Investitionen, Staatsausgaben und Nettoexporten. Berechnet werden diese Modelle mit ökonometrischen Gleichungen, welche das Verhalten von endogenen Variablen mit dem Verhalten exogener Variablen erklären. Die Höhe der Staatsschuld fließt in die Berechnung als Zinszahlung ein, während die absolute Höhe nicht berücksichtigt wird. Die italienische Wirtschaft wird mit Hilfe des Modell E2012 (Hanappi, 2011) analysiert, welche die nominellen Schulden und Kapitalstöcke berücksichtigt.

Der erste Teil der Arbeit beschäftigt sich mit ökonomischer Literatur über Italien und diskutiert diese. Ein Ergebnis dieser Recherchetätigkeit ist, dass die Italiener einen schwierigeren Zugang zu Krediten haben. Dies hat wiederum einen Einfluss auf die Gesellschaft und das Konsumverhalten. Der zweite Teil beschäftigt sich mit der ökonometrischen Analyse und Simulation. Das Ergebnis der Simulation ist, dass in den nächsten Jahren der Anteil pro Arbeiter am BIP steigen wird, aber gleichzeitig die Anzahl der Arbeitsplätze sinkt. Ebenso ist ein starker Anstieg des Bevölkerungswachstum progonistiziert, welches die Arbeitlosenrate erhöhen kann.

Contents

CHAPTER 1

Introduction

1.1 Motivation

Italy is one of the big and economy influential member states of the European Union. The formation of the European Union created new links between the economies in Europe. A downturn in one country will most likely affect the partners as well. Especially for Austria where Italy is the second most important traiding partner acording to Statistik-Austria (2011).

1.2 Problem Statement

Economics of countries get compared by their so called Key Economic Indicators such as Gross Domestic Product, Gross Capital Formation (Investment) or Saving Ratios. These values represent aggregates of different economic agents. The problem which will be addressed is to differentiate between households, firms, banks and the state and estimate their contribution to the overall economy in Italy with econometric methods. Especially, the stock and flows of money between these agents will be considered. In Italy the government stock variable public debt is very high compared to other European states.

1.3 Aim of the Work

This master thesis aims to get a better understanding of the Italian economy and its development. A possible prediction of the future development of the Italian economy, based on different scenarios, shall show the influence that decisions made today will have on to the future.

1.4 Methodological Approach

The methodological approach consist out of of three dependent steps:

1. **Literature Review.** Background information will be gathered which serves as a theoretical base for extension to the econometric model.

2. **Model Extension.** The extension of the model (Hanappi, 2011) will be based on the country specific evidence obtained by the review and a detailed discussion of the model variables and statistical tests.

3. **Simulation** The model estimation and a simulation of possible scenarios with an economic interpretation of the results will be expressed. Followed by an economic evaluation and interpretation.

1.5 Structure of the Work

Chapter 2 provides literature research about important implications in Italy compared to other European countries.

Chapter 3 describes the marco-econometric model which was used for the simulation and the steps how it was built.

Chapter 4 presents the simulation result of how the model would have performed in the past and a simulation run for the future.

Chapter 5 summarizes all finding and provides an outlook for further investigations.

CHAPTER 2

Macroeconomic modelling

The development of an economy depends on different influences. The Key Economic Indicators are a measure of the effects of these influences on an economy, however for some countries the effects are more apparent. This section will discuss selected literature on the Italian economy. First, the incentive for the Italian people to save, as argued by Kirsanova and Sefton (2007), will be explored. Second, the high premium rates Italy pays to finance its expenditure, as pointed out in Pozzi and Wolswijk (2011), are analysed and compared to other Euro States. This is followed by a review of a survey by Parisi, Schiantarelli, and Sembenelli (2006) who conducted a micro-data analysis of the R & D contribution to the economic performance of Italy. Finally, this section will be closed with a review of the work of Antonelli, Antonietti, and Guidetti (2010) who pointed out the implication of the work place training effects of the Italian work force.

2.1 Saving Rates

The Savings Rate is the percentage of savings to the GDP. According to the Solow Growth Model, as described in Mankiw (2010, p. 218), the Savings Rate has an influence on capital stock and the standard of living. Savings in itself, can generate economic growth but not a sustainable one. It will plateau after a while. Various circumstances, along with the laws and rules made by society, have an influence on the personal decisions of individuals to either save money for the future or to consume it for more immediate purposes. Kirsanova and Sefton (2007) list possible influential factors:

1. **Demography.** Individuals in societies that have a higher workforce, compared to retirees, tend to save more.

2. **The welfare state.** When the government, financed through taxes, provides social security benefits, such as healthcare and pensions, the savings rate is lower. The lack of these securities is an incentive to accumulate a personal buffer for retirement.

3. **Retirement behaviour.** The entrance age to retirement impacts the decision of the height of personal savings for later use. In countries that tend to have a later retirement age, the ratio is lower.

4. **Constraints on borrowing.** Immediate consumption, such as buying a house or living space, that cannot generally be funded with savings require a loan. Tighter risk restrictions on the provided securities or higher required down payments lead to an increase in the savings rate to meet these criteria.

5. **Income distribution over a lifetime.** The imbalance of income may have an effect on the Savings Rate. The funding of the tertiary education system, where tuition fees are based on loans, may influence spending habits.

6. **Income uncertainty.** If the chance of losing steady income is higher, the savings rate will increase in order to insure against the potential losses.

7. **Capital gains.** According to the definition of national accounts[1], gains on assets are not considered as income. This affects countries where the average individual has direct investment in corporate equity[2], opposed to countries where the investments are explicit accounted. With a higher net measured investment the savings ratio will be lower.

2.1.1 The Framework by Kirsanova and Sefton (2007)

Kirsanova and Sefton (2007) used a micro-data analysis to work out the different savings behaviour patterns between countries. Their work focused on comparing the Saving Rate in the United Kingdom, the United States of America and Italy. Their main goal was to derive a better understanding of the individual behaviours that have the most influence on the national rate of saving. In addition, Kirsanova and Sefton focused on investigating the way of private sector financing. They defined the National Saving Rate(SR_t) as

$$SR_t = \frac{Y_t - C_t - G_t}{Y_t} \tag{2.1}$$

[1]National accounts is an abbreviation for system of national accounts by the United Nations (Council, 2009).

[2]As noted in Mankiw (2010, p. 69) large companies listed on the Stock Exchange have two important avenues to raise funds. Through issuing bonds and stocks. The terms are defined by Mankiw (2010, p. 69): *"Raising investment funds by issuing bonds is called debt finance, and raising funds by issuing stock is called equity finance."*

Y represents the national income and market prices, C the consumption of households and G considers the government purchases. To investigate the household saving decisions at the micro-level, a life-cycle model was used. This allows the rate to be expressed as a combination of different environmental influences (Kirsanova & Sefton, 2007).

Gourinchas and Parker (2002) also used a life-cycle model to investigate the household-saving behaviour. They used a dynamic, stochastic model to derive behaviour out of exogenous uncertainty influences. Their findings showed that younger households save to protect themselves from income loss. More established households tend to focus their savings with the prospect of a comfortable retirement.

The life-cycle model used by Kirsanova and Sefton (2007) is based on the fact that cohort consumption has a proportional relation from the present value to the end of life. The consumption $c_{a,t}$, where a stands for the age of an individual and t for the time period, is

$$c_{a,t} = \alpha_a \cdot (h_{a,t} + w_{a,t}). \tag{2.2}$$

α_a is defined as *"the average propensity to consume(APC) out of a resource on an individual aged a*"(Kirsanova & Sefton, 2007, p. 2004). The available resources which could be consumed is a sum of $h_{a,t}$,which represents the current value of the total non-capital income ($y^{NC}_{a,t}$), and $w_{a,t}$, which refers to the asset holdings. The non-capital income $y^{NC}_{a,t}$ is

$$y^{NC}_{a,t} = y^{L}_{a,t} + y^{P}_{a,t} + y^{T}_{a,t} + y^{K}_{a,t}. \tag{2.3}$$

It sets together the labour earnings $y^{L}_{a,t}$, retirement funding $y^{P}_{a,t}$ (private and public pensions), direct money transfer from the government $y^{T}_{a,t}$ and benefits of any kind $y^{K}_{a,t}$. In addition the total income $y_{a,t}$ is defined as

$$y_{a,t} = y^{NC}_{a,t} + y^{C}_{a,t}, \tag{2.4}$$

where $y^{C}_{a,t}$ is the capital income based on returns of net wealth (Kirsanova & Sefton, 2007).

When aggregating the behaviour of individuals there is the assumption that an individual's present value of contribution remains constant over time. These resources will grow with the productivity growth rate g which leads to a future value at time $t + s$ of the total income as

$$y_{a+s,t+s} = (1 + g)^s \cdot y_{a+s,t}. \tag{2.5}$$

Furthermore, the future mortality rates need to be adjusted. To derive the present total value of non-capital income, under these assumptions, a discount factor based on the life expectancy of a generation must first be calculated such that

$$\prod_{s=0}^{u-a} \mu_{a+s} \frac{1}{1+r_{t+s}}$$

μ_{a+s} is the probability to survive another year with the age of $s-1$. The probability value will decrease over time so that it may be more likely that a person who is 30 will live for another year than a person who is 80. It serves as a weight of reduction. The term r_s represents the real interest rate which could be different each year according to the discount factor. Overall this implies the assumption that a younger person can benefit more from the current total non-capital income than an older person. This leads to a net present value calculation as

$$h_{a,t} = \sum_{u=a}^{100} \left(\prod_{s=0}^{u-a} \mu_{a+s} \frac{1}{1+r_{t+s}} \right) y_{u,t+u-a}^{NC} = \sum_{u=a}^{100} \left(\prod_{s=0}^{u-a} \frac{\mu_{a+s}}{1+r_{t+s}} \right) (1+g)^{u-a} y_{u,t}^{NC}. \tag{2.6}$$

At last, for calculating the savings rate, the consumption at time t is needed. This is calculated by summing up all consumption over the generations($c_{a,t}$) and population($n_{a,t}$) by

$$C_t = \sum_a c_{a,t} n_{a,t} \tag{2.7}$$

and total resources as

$$R_t = \sum_a (h_{a,t} + w_{a,t}) n_{a,t}. \tag{2.8}$$

Combining the equations so far and applying them to the national savings rate leads to the framework

$$SR_t = 1 - \frac{G_t}{Y_t} - \left(\sum_a \alpha_a \frac{h_{a,t} + w_{a,t}}{\frac{R_t}{N_t}} \frac{n_{a,t}}{N_t} \right) \frac{R_t}{Y_t}. \tag{2.9}$$

For comparing factors between countries additional notions are introduced, such as the distribution of population

$$p_{a,t} = \frac{n_{a,t}}{N_t},$$

the distribution of non capital resources

$$\psi_{a,t} = \frac{h_{a,t} N_t}{R_t},$$

distribution of capital resources

$$\omega_{a,t} = \frac{w_{a,t}N_t}{R_t},$$

resource to income ratio

$$\rho_{a,t} = \frac{R_t}{Y_t}$$

and the share of government consumption

$$\gamma_t = \frac{G_t}{Y_t}.$$

For the data set in the micro-data analysis, the consumption by children was distributed to their parents. Therefore the benefits B_t need to be subtracted and so the generation term a begins at the age of 19. As before for country comparisons the ratio of benefits is defined as

$$\beta_t = \frac{B_t}{Y_t}$$

This leads to the final framework equation

$$SR_t = 1 - \frac{G_t}{Y_t} - \frac{B_t}{Y_t} - \left(\sum_{a=19}^{100} \alpha_a \frac{h_{a,t} + w_{a,t}}{\frac{R_t}{N_t}} \frac{n_{a,t}}{N_t}\right) \frac{R_t}{Y_t} \tag{2.10}$$

$$= 1 - \gamma_t - \beta_t - \left(\sum_{a=19}^{100} \alpha_a (\psi_{a,t} + \omega_{a,t}) p_{a,t}\right) \rho_t \tag{2.11}$$

Equation 2.11 can now be used to compare the average propensity to consume $\alpha_{a,t}$, demographic factors $p_{a,t}$, total resources($\rho_t, \psi_{a,t}, y^L_{a,t}, y^P_{a,t}, y^T_{a,t}, y^K_{a,t}, \omega_{a,t}$), government expenditures γ_t and the benefits contributed to children β_t (Kirsanova & Sefton, 2007).

2.1.2 Average propensity to consume

Kirsanova and Sefton (2007) report that in the comparison between the UK, the USA and Italy, Italy showed the lowest Average propensity to consume (APC) according to the micro data of 1997. They argue, that this is due to the credit restraints on mortgages. The law makes it difficult for mortgage companies to get hold of a collateral when the credit taker cannot pay back his loan.

On the average it takes between 60 to 84 months to repossess a house in Italy. In other OCED countries like the UK the process takes 8 to 12 months, Finland with only 2 to 3 months, is even sooner (Price, Girouard, Catte, & André, 2005).

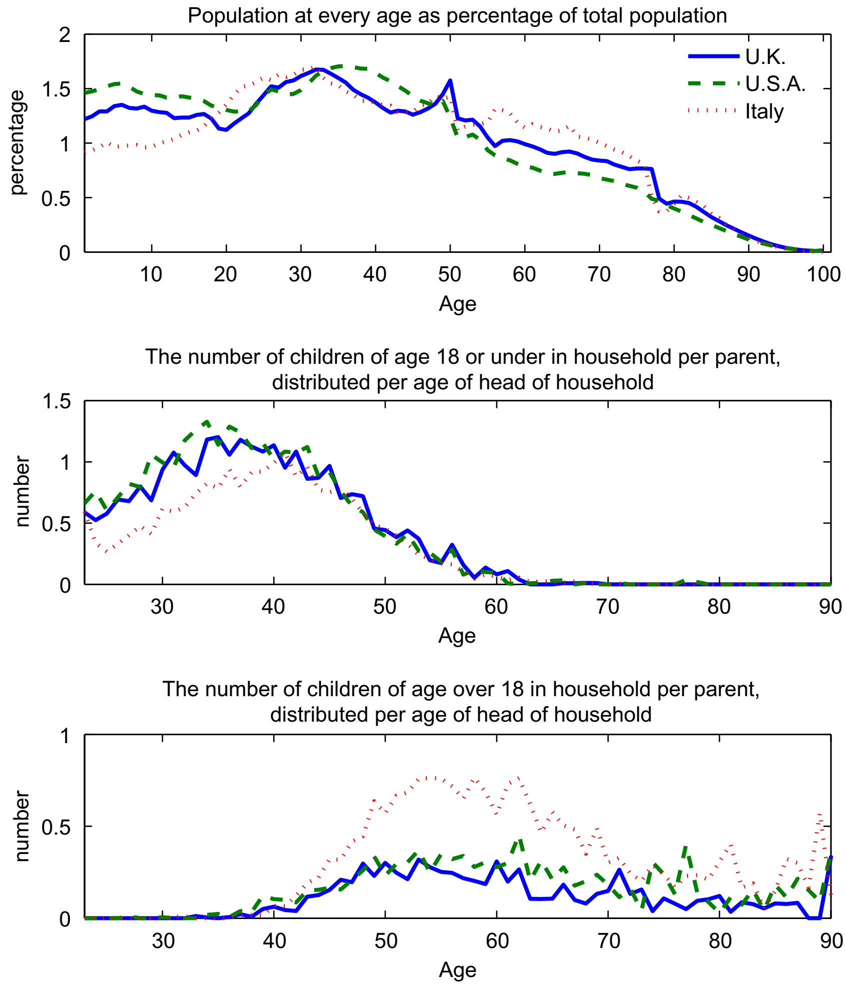

Figure 2.1: Distribution of age taken from Kirsanova and Sefton (2007, p. 2007)

This restraint implies that lenders prefer customers with a lower likelihood of payment default and therefore request higher down payments to secure themselves. These constraints result in a decrease in the APC, in comparison to other countries, particularly for younger generations. The effect can be even more hindering if there is a high income uncertainty in a country. When people lose their steady income loans could ease the temporal drawback. In the absence of this option the effect will increase savings and decrease the APC (Kirsanova & Sefton, 2007).

Young peoples decision about when to leave their parents' household has an influence on their consumer behaviour. The option of moving out is usually possible once the state of financial autonomy is reached. In Italy, young people tend to stay longer in their parents' home compared to the USA and the UK. Figure 2.1 displays this distribution. The reason for this is, again, the ability to provide the down payment that is required to finance their home. More people are living in the same housing space is more economical than multiple single households.

This leads to a shift in spending because the younger generation is sharing with the older one (Kirsanova & Sefton, 2007).

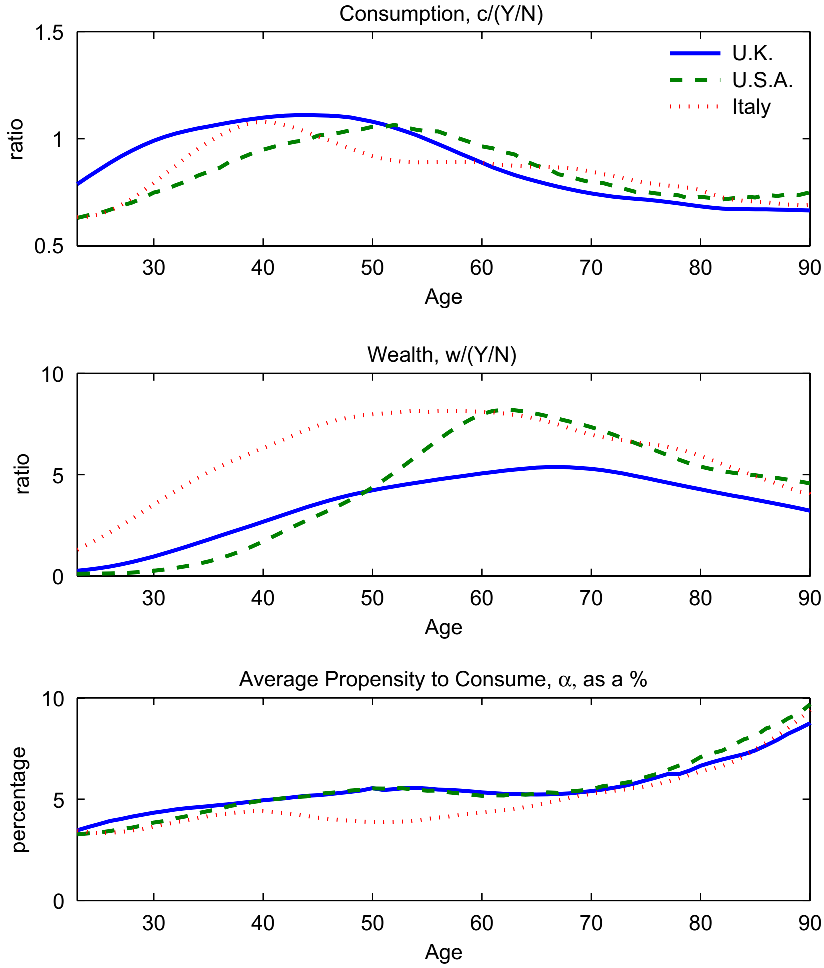

Figure 2.2: Consumption, Wealth, APC taken from Kirsanova and Sefton (2007, p. 2014)

Figure 2.2 displays the consumption profile for the US, UK and Italy. Between the ages of 30-45 and from 65 years consumption patterns of Italians deviate from the other countries. It can be argued that this is an effect of not being responsible for supporting children in the same household, which makes a higher consumption possible. In terms of wealth, Italians start saving earlier compared to the US and the UK (Kirsanova & Sefton, 2007).

Kirsanova and Sefton (2007) argue that wealth declines after retirement age. People from the US tend to retire later and therefore acquire less wealth to live off. The relation between a lower savings rate with a later retirement age was also analysed by Kerdrain, Koske, and Wanner (2010). They argued that a cut in pension benefits and the increased uncertainty of retirement increases the saving propensity. The same argument is brought up by OECD (2011b) which conclude that pension reforms reducing the payments increase the saving. On the other hand, when the age of transition into retirement is increased, saving declines. The last segment of figure 2.2 displays the APC over a lifetime.

2.1.3 Demographic factors

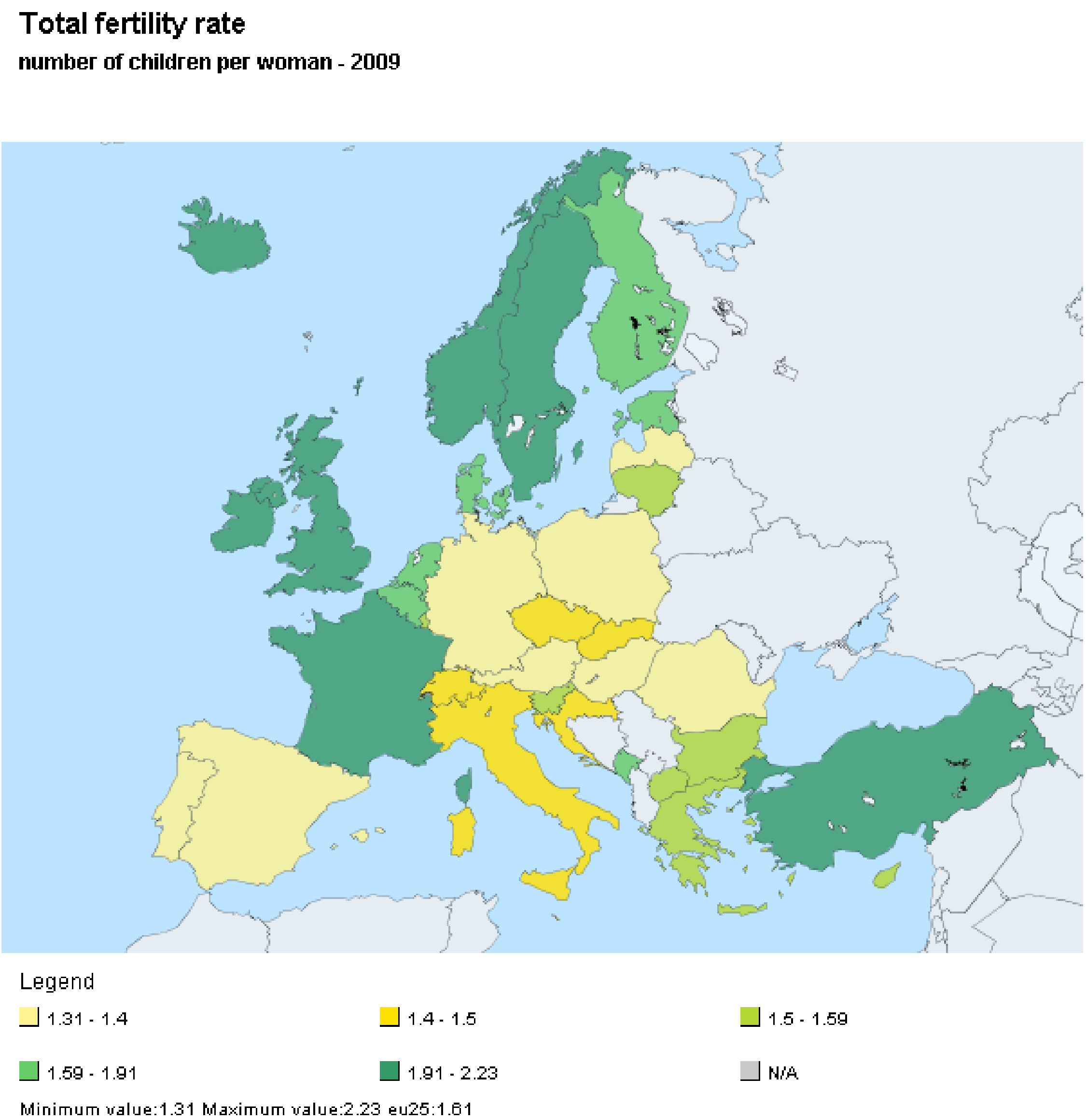

Figure 2.3: The fertility rate in the year 2009 generated with the Eurostat Data Explorer (Eurostat, 2011)

The fertility rate of Italy is lower than in many other European countries, as shown in figure 2.3. The total fertility rate can also be seen as an indication of replacement level according to Eurostat (2011), stating that a value above 2.1 can be seen as a sufficient replacement level.

Italy's fertility rate falls in the same category as Switzerland and the Czech Republic, which are 1.4 to 1.5 respectively. In Italian households it is more likely that parents aged 45 to 60 have children living with them, as opposed to the US and the UK. In contrast to the people in the UK and the US, Italians above the age of 45 are supporting their children while in the other countries this generation is still receiving support from older generations (Kirsanova & Sefton, 2007).

2.1.4 Saving Rate compared to other OECD countries

The table 2.1 compares the net household savings rate in OECD countries. It is visible that the proportion of personal income used for saving has been decreasing between 1994 and 2010 for many countries, while for others it stayed fairly at the same level.

In Italy the Savings Rate is one of the highest compared to other OECD countries. As of 1994 South Korea has had the highest Rate of Savings followed by Italy with 21,8% and 18,1% respectively. The Savings Rate of Italy dropped in 1999 to around 10% and stayed in a band between 8% and 10% for the next years. In 2009, the Savings Rate declined from the band to 6,5%.

In contrast to these high saving countries there are those which experienced a negative rate. New Zealand, Estonia and Denmark are among them. The lowest rate was recorded in 2004 for Estonia with -12.8%.

Finally, there are countries which have a higher Saving Rate but only a small fluctuation of their saving behaviours, examples are Switzerland, Germany, Belgium and Austria. All these countries reside in a spectrum between 8 to 12%.

2.1.5 Summary & Conclusion

To summarize, this section took a closer look at the savings behaviour and the rationale behind it. For Italy the saving behaviour was relatively high for many years because of the credit constraints Italians faced. It is rather difficult for a bank to repossess a house and therefore the process can take up to 6 years. This leads to a higher required security requirement for a house and also affects the overall granting of credit loans. To compare the savings behaviour between countries a close examination of the households is necessary. Different decisions such as, when children leave the household of their parents or when people retire, can increase or decrease the rate in comparison to other countries. As it was shown, the saving restraints and the higher saving rate cause also a shift in consumption for the parents to a later time in life, if their children leave the household later.

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Australia	7,3	6,6	7,3	6,2	3,4	2,5	2,6	3,1	-0,3	-0,6	-0,6	-0,1	2,1	3,2	5,5	9,8	9,3
Austria	12,5	12,8	9,8	8,0	8,6	10,0	9,4	7,7	8,0	8,8	9,2	9,7	10,4	11,7	11,5	10,7	8,3
Belgium	15,7	16,4	14,4	13,3	12,8	13,2	12,5	13,8	13,1	12,3	10,9	10,1	10,8	11,4	11,7	13,7	11,2
Canada	9,5	9,2	7,0	4,9	4,9	4,0	4,7	5,2	3,5	2,6	3,2	2,1	3,5	2,8	3,9	4,6	4,8
Czech Republic	-1,5	8,1	6,4	6,8	5,0	4,7	5,8	5,2	5,2	4,1	2,9	4,8	6,1	5,7	4,8	6,1	5,7
Denmark	-2,7	0,2	-0,2	-2,8	-1,2	-5,6	-4,0	2,1	2,1	2,4	-1,3	-4,2	-2,3	-4,0	-3,3	-0,5	-1,7
Estonia	..	4,2	2,0	-0,1	-2,8	-5,4	-3,0	-4,0	-6,4	-7,1	-12,8	-10,8	-13,1	-8,2	-2,6	5,7	3,7
Finland	1,4	4,2	0,7	2,6	0,6	2,4	0,5	0,4	0,5	1,4	2,7	0,9	-1,1	-0,9	0,0	4,5	4,3
Germany	11,6	11,2	10,8	10,3	10,3	9,6	9,4	9,5	10,1	10,4	10,6	10,7	10,8	11,0	11,7	11,1	11,3
Hungary	..	14,4	13,6	12,5	11,7	7,8	6,2	6,7	5,3	2,9	5,4	6,7	7,2	3,3	2,7	4,5	2,5
Ireland	..	..	..	..	..	..	..	..	-2,2	-0,6	0,9	1,7	-0,9	-0,1	5,5	10,1	8,9
Italy	**18,1**	**17,0**	**17,9**	**15,1**	**11,4**	**10,2**	**8,4**	**10,5**	**11,2**	**10,3**	**10,2**	**9,9**	**9,1**	**8,4**	**8,0**	**6,5**	**5,0**
Japan	13,3	12,6	10,5	10,3	11,4	10,0	8,7	5,1	5,0	3,9	3,6	3,9	3,8	2,4	2,2	5,0	6,2
Korea	21,8	18,5	18,1	16,1	23,2	16,1	9,3	5,2	0,4	5,2	9,2	7,2	5,2	2,9	2,9	4,6	4,3
Netherlands	14,4	14,3	12,7	13,3	12,2	9,0	6,9	9,7	8,7	7,6	7,4	6,4	6,1	6,9	5,9	6,4	3,9
New Zealand	-3,2	-3,5	-3,7	-3,5	-3,2	1,1	-4,7	-3,6	-9,5	-7,4	-6,0	-8,3	-8,9	-4,0	-4,5	-2,2	0,2
Norway	5,4	4,8	2,6	3,0	5,7	4,7	4,3	3,1	8,2	8,9	7,2	10,1	0,1	1,5	3,7	7,3	7,4
Poland	..	14,6	11,7	11,7	12,1	10,5	10,0	11,9	8,3	7,7	7,0	7,3	7,5	6,1	0,8	7,8	9,0
Slovak Republic	..	5,3	8,3	8,7	7,4	6,6	6,5	4,0	3,6	1,3	0,2	1,3	0,9	3,0	2,2	3,4	3,1
Sweden	8,1	8,3	6,3	3,4	2,8	2,8	4,3	8,4	8,2	7,2	6,1	5,5	6,6	8,8	11,2	12,9	10,7
Switzerland	12,4	12,7	10,9	10,7	10,7	10,8	11,7	11,9	10,7	9,4	9,0	10,1	11,4	12,6	11,7	12,0	10,7
United States	5,2	5,2	4,9	4,6	5,3	3,1	2,9	2,7	3,5	3,5	3,6	1,5	2,6	2,4	5,4	5,1	5,3

Table 2.1: Household net saving rates taken and modified from (OECD, 2011c)

2.2 Governmental bond market integration in Europe

National governments finance their expenditure in excess of their income by issuing governmental bonds. With the introduction of the Euro as the common currency different risk premiums were needed to be paid in the Euro zone. This section will focus on the work Pozzi and Wolswijk (2011) that analysed the different price premiums each country and the integration between those markets. To quote from Pozzi and Wolswijk (2011, p. 2):

“we define full financial integration as the situation where bond risk premiums are solely and equally affected by common risk factors.“

This definition has to be seen in the context of the classical financial theory. As described in Fama (1970) a capital market reflects capital ownership and the price in the market matches the allocation of resources. Complete information is available for everyone and this is reflected in the price. Each investor bases his decision on a rational assumption and expectations. A price change is a response to a variation in the available information for all investors.

A model in the classical expectation theory is the Capital Asset Pricing Model (CAPM). The CAPM assumes a market in equilibrium, a normal distribution of returns and no opportunity for arbitrage trading. These axioms have been challenged to be only valid in ideal markets. The model distinguishes between systematic risk (“betas“) and idiosyncratic risk, where idiosyncratic risks can be minimized. The systematic risk is based on the overall market while the idiosyncratic risk is based on the underlying asset (Jorion & Risk Professionals, 2007).

The integration definition leads to two implications. The country-specific factors, such as the idiosyncratic risk, vanish and the risk premium decreases. The main influences for idiosyncratic risk are the liquidity risk and the country-specific risk. Liquidity risk is associated with the local bond market and the demand for buying and selling these bonds. The country-specific risk is associated with country fundamentals such as government debt. The second implication from the integration definition is that common international risk influences the bond prices and are the same in all integrated markets (Pozzi & Wolswijk, 2011).

2.2.1 The analysis

Pozzi and Wolswijk (2011) use an International Capital Asset Pricing Model (ICAPM) with the implication that the risk is at any time affected by international risk following their integration definition. The assumption is that the idiosyncratic risk, the country specific factors, converge to zero. In addition the common international factors (the “betas‘) are equalised in the case of integration. The countries Belgium, France, Germany, Italy and the Netherlands were analysed.

The time frame for the analysis was from 1995-2009. Because of the probability of exchange-rate risk, which could be reflected in the values before the introduction of the Euro, the periods between 1995-2000 (before Euro), 2001-2006 (before the crisis) and 2007-2009 (after the crisis) were analysed separately. The means and standard deviation of excess returns on government bonds show a higher risk premium for Italy. The price premium for the full investigation period was 0.6% higher than for Germany. Nevertheless a decrease in the average risk premiums of all countries was noticeable in the period after the Euro was introduced. An increase in the standard deviation of the excess returns was noticeable within the sample after the crisis (Pozzi & Wolswijk, 2011).

Comparing the correlation of the excess returns shows a change after the introduction of the Euro. The correlation increased significantly in the period 2001-2006. In the following period of 2007-2009 the correlation decreased again. The comparison of the mean, standard deviation and correlation can be seen as an indication that the idiosyncratic influences decreased after the Euro and increased again with the start of the crisis (Pozzi & Wolswijk, 2011).

Multi-factor models can be used to compare different risk premium influences over time as shown by Barucci (2003). Barucci argues that discrete time period models are much easier to estimate compared to continuous ones. Continuous models also do not provide additional economic insight compared to fixed time period calculation.

Pozzi and Wolswijk (2011) assume a representative international investor who invests in different countries' bond market, a risk-free asset and an international portfolio. The country-specific risk which arises from investing in a bond is denoted as α. The common internal risk which affects all country investments is written as β. Five different assumptions are tested in their model for convergence. The first model tests if either α or β experience convergence effects which means the markets are not integrated in any way. The second model tests the convergence of only α and model three tests only for β. The fourth model tests that α and β are subject to convergence effects. Model 5 tests if α and β are affected by identical convergence effects.

Comparing the models revealed that model 3 was the most appropriate choice for matching historical data over the whole time frame. Model 4 performed the best during the period between 2001 and 2006. Model 3 assumed a convergence effect in the overall common international risk and this is apparent over the whole period. This can be seen as an indication that the Euro zone reduced the risk premium for all members of the Monetary Union. The different idiosyncratic risk factors of the countries became less important after the introduction of the Euro and led to an integration of the European market as shown with model 4. Figure 2.4 displays the result of model 3: comparing the idiosyncratic risk and risk premiums between the countries. For all countries the volatility of the idiosyncratic risk decreased with the Euro, Italy was the exception where its volatility was still prominent. When the crisis started, the country-specific factors gained importance again, especially for Italy. It is also notable that Italy is suffering from a higher volatility compared to the other countries (Pozzi & Wolswijk,

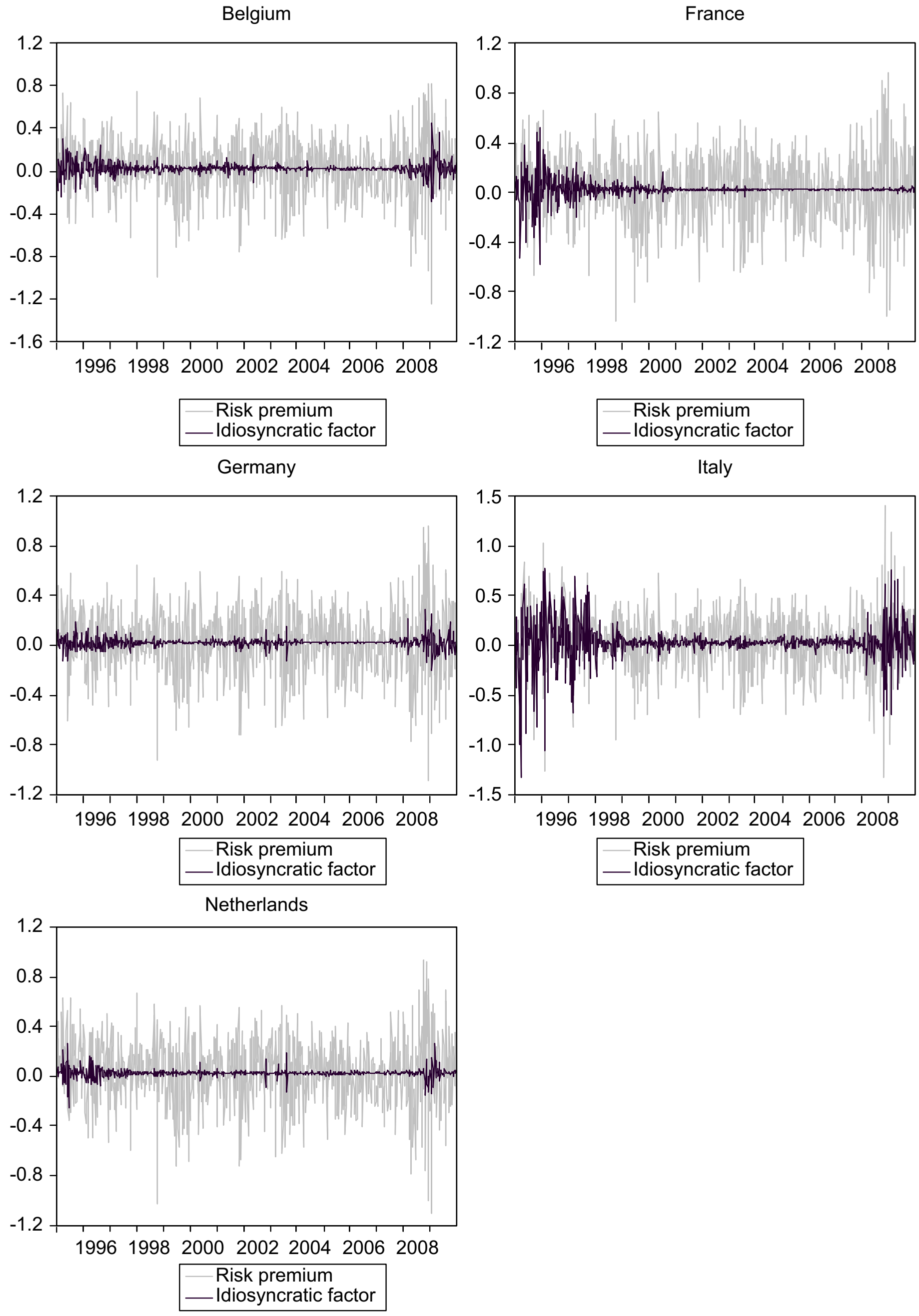

Figure 2.4: Country Specific influences on the risk premium taken from Pozzi and Wolswijk (2011, p. 9)

2011).

Pozzi and Wolswijk (2011) argue that the higher volatility for Italy has to do with the high governmental debt which inclines investors to be more risk-averse. With the start of the Monetary Union the decrease in volatility lagged in Italy compared to the other countries. Nevertheless, it appears that the creation of the common currency resulted in a structural change within the markets. This change existed when the financial crisis started and was not undone. In the years from 1995-1998 the exchange risk contributed to the risk premiums. This risk diminished after 1999.

2.2.2 Interest rates on government bonds

The figure 2.5 illustrates the different yields that the governments had to pay prior to the Euro in Europe. All percentage values before 1999 for the Euro member states or ERM II would also include the exchange risk in their price. The much higher spread prior to 1999 gives an indication for the independent risk factors.

The highest interest rate had to be paid by Greece before it joined the Euro in 2001. The yield dropped from 25% to around 5% and followed the Euro Zone rate for the next years. The second highest rate had to be paid by Italy with below 15% in 1990. As the Euro introduction came closer all rates converged to the same price band.

With the start of the financial crisis in the years after 2007 the price premiums rose again. Especially for Greece and Ireland, while for Ireland the steep rise stopped 2011. In the last year, as evident in the diagram, Italy had higher yields compared to the other Euro states: around 7% with the exception of Greece and Ireland still paying more.

2.2.3 EMU and European markets compared

In a country comparison between members and non-members of the European Monetary Union different influences on the world risk could be found in Abad, Chuliá, and Gómez-Puig (2010). An empirical analysis was conducted concerning 10 year government bond yields comparing the EU-15 (excluding Luxembourg and Greece) with members of the EU without the Euro. The authors were particular interested in the influence of the world risk from 1999-2009. The US yield was used to represent the world risk of default.

Countries which are not members of the monetary union are more exposed to international risk (Abad et al., 2010). They tend to be more vulnerable if they do not share a common monetary policy. Denmark, on the other hand, is not part of the Euro but it is a member of the Exchange Rate Mechanism II (ERM) and its currency is bound by a $\pm 2.5\%$ fluctuation band to the Euro. Denmark is less influenced by global risk factors than Sweden and the UK which are not part of the ERM.

Abad et al. (2010) argue that the European bond market is not fully integrated. In contrast to the work by Pozzi and Wolswijk (2011), in Abad et al. (2010) the authors did not differentiate between periods of financial situations. Therefore, over the average of 10 years they found that the Euro states, compared to the German market, are partially integrated. They argue that the

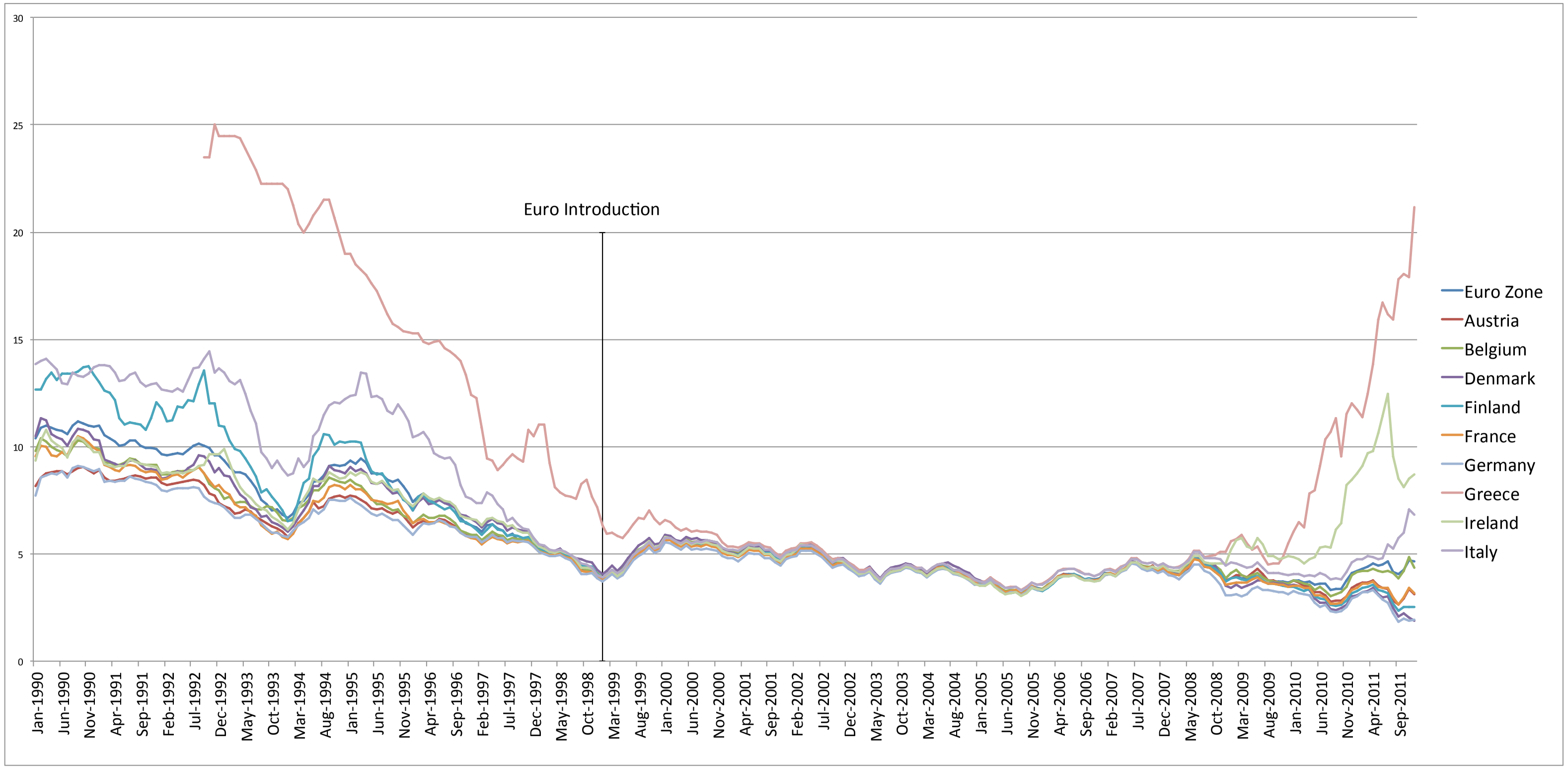

Figure 2.5: Long term government bond yields average according to Maastricht definition (Source: Datastream)

European government bonds are imperfect substitutes and this still allows risk diversification within the Euro zone.

2.2.4 Summary & Conclusion

To summarize, this section focused on the European governmental bond market and its implications for Italy. The introduction of the Euro currency helped to decrease the risk premiums in the Euro zone and any country-specific factors of the premium became less important. For Italy it was noticeable that this effect occurred with a delay of a few years. Even then, the idiosyncratic risk in Italy was more important than in other countries such as Germany or France. With the start of the crisis the European integration of the debt market was reversed but some structural benefits still persisted. Over the average of 10 years, from 1999 to 2009, the European government bond market showed only partial integration.

2.3 The effects of R & D on the manufacturing firm level

The increase in capital and labour alone does not produce economic growth as argued by Solow (1957). Technological change and innovation contribute to economic growth. Process innovation optimizes internal flows within firms and allows cost reduction. Product innovation can provide new products and increase the overall performance of a firm. This section will focus on the work of Parisi et al. (2006) who investigated the effects of product and process innovation on productivity for Italian firms on a local level. In addition they analysed the contribution of research and development (R&D) of increasing the possibility to generate innovation. They used data from 1992-1994 and 1995-1997 from micro surveys in Italy to allow for a better differentiation of causes.

Nearly half of the firms in Italy do not conduct research and development at all. In the sample period 1992-1994 49.3% and in the time frame 1995-1997 61.1% of the firms did not emphasize innovation. Additional descriptive statistic results show that process innovation is conducted by two thirds of the firms while product innovation is performed only by half. It is also noticeable that the introduction of process innovation leads to product innovation within the same manufacturer. This has to do with the fact that a new product most likely needs a new process of production steps. In general R&D activities increase the probability of product and process innovation such as 83.64% for process and 66.82% for product. This activity does not necessarily mean new invention within the firms. R&D activities are also associated with absorbing new technologies available and integrating them into the company. All these measures are taken over the full sample size. When the sample is divided, depending on the company size, different results emerge. Of the manufacturers with over 500 employees

68.25% engage in R&D and 80.95% of them were able to introduce a process innovation. It seems bigger firms can spend more of their resources to optimize the manufacturing process compared to smaller firms (Parisi et al., 2006).

When companies decide to invest money into research and development they tend to be persistent with their choice. In the study, 67.74% of the companies who conducted research in the period 1992-1994 continued with it in the period 1995-1997. Companies who did not engage in research in the first period ($78.\%8$) had no engagement in the second period. A differentiation of the product and process innovation is noticeable. Product innovations are more persistent when conducted in the first period. This could have to do with the economic circumstances of Italy during the first data set. Italy was in a time of economic recession and in the second period the economy was expanding again (Parisi et al., 2006).

2.3.1 Empirical estimation model

Parisi et al. (2006) use a Cobb Douglas production function and a Tornquist index[3] of growth to analyse the effects of R&D. The production output Y_t is measured as the sum of all Sales and Inventory deflated by a Production Price Index for Italy. t represents the time year and i a manufacturer. The Cobb Dougles function is specified as

$$lnY_{i,t} = ln\, A_{i,t} + \theta\, ln\, M_{it} + \beta\, ln\, K_{it-1} + \alpha\, ln\, L_{it-1} + \lambda_i + \epsilon_{it} + \eta_t. \tag{2.12}$$

The function is a combination of technology $A_{i,t}$, materials M_{it} calculated as Tornquist index of deflated aggregating services and materials, the fixed capital stock K_{it-1} and the labour input with a year lag. To specify different possible stochastic shocks which could have been influential the manufacture additional terms are added. λ_i for firm specific, ϵ_{it} as idiosyncratic shock at point in time and η_t for a common shock in a year. They introduced a dummy variable D_{itj} to be able to measure the effect of innovation. The dummy variable is 1 when an innovation has been introduced in the last 3 years. They assume that it takes three years until an innovation has a measurable effect. j represents process innovation, production innovation or both types. Furthermore the change in technological progress is written as

$$\Delta A_{i,t} = \phi + \psi D_{itj}. \tag{2.13}$$

[3]It is defined by IMF (2004) as: *"A price index defined as the weighted geometric average of the current-to base period-price relatives in which the weights are the simple unweighted arithmetic averages of the value shares in the two periods"*

With assumption of constant return to scale and taking the difference with Δ_3 as the difference t and t-3 leads to

$$\Delta_3 ln\frac{Y_{i,t}}{L_{it-1}} = \phi + \psi D_{itj} + \theta\Delta_3 \; ln\,\frac{M_{it}}{L_{it-1}} + \beta\Delta_3 \; ln\,\frac{K_{it-1}}{L_{it-1}} + \Delta_3\epsilon_{it} + \Delta_3\eta_t. \tag{2.14}$$

The difference eliminates the firm-specific shock and eliminates a possible firm specific bias in the survey.

The problem which arises with equation (2.14) is called identification problem as laid out in Baltagi (2011). The variables for input choice and new products or process are endogenous. Because there are no structural equations which would explain these endogenous variables in the model, the variables are correlated with the error term. This causes a violation of the ordinary least square condition resulting in a biased and inconsistent estimator. This can be solved by replacing the endogenous variables with highly correlated variables, which are not correlated to the error term. Parisi et al. (2006) overcame the instrumental problem by making use of the structure of the survey data. They estimate the different ratios using the data set from 1992-1993 as instrumental values.

2.3.2 The results

Estimating the system with use of $\Delta_3 ln\frac{Y_{97}}{L_{96}}$ as a dependent variable provides a statistical significance in only some cases. The constant return to scale of the Cobb Dougles function can not be rejected in all variation of the dummy variables. The instrumental variable estimation showed a 14% increase of the productivity when process innovation was introduced in the past. In addition, the overall effect of R&D is an increase by 4%. Other combinations, such as influence of product innovation, were not statistical significant (Parisi et al., 2006).

Using the constructed Tonquist index as dependent variable for estimations, the effect of product innovation is almost statistically significant. The use of product innovation alone increases the productivity by 13% (only with 10% significance). The overall effect of R&D is again 4%, but when estimated with the process innovation dummy, the process innovation dominates (Parisi et al., 2006).

Parisi et al. (2006) argue that the problem with the product innovation results from measurement problems in product markets. Imperfect markets create different prices but only the overall average price can be observed. Therefore, using the product price in the production function can bias the effect. In addition, the innovation activities might not be equally distributed between product and process innovation within the company. The distribution can also be different depending on the industry sector the company is operating. A low technology company might have different innovation goals as a high technology manufacturer.

To address the problem of undifferentiated results Parisi et al. (2006) used probability models to derive a better understanding. Additional information such as size of the manufacturer, the average research and development intensity, group membership and geographical location was added. Logit, random effects logit and conditional logit models were the chosen models. The models showed that an increase in the firm size increases the chance for a product innovation significantly. The intensity of R&D was positively correlated with product innovation. The likelihood increased by 5.19% (logit) or 6.03% (random logit) when increasing the intensity from zero to the sample average.

The process innovation results using the probability model presented contrasting results. The increase of the firm size had again an effect of the degree of process innovation. On the other hand the R&D intensity showed no significance in all three models as it had before for product innovation. The interaction term between R&D and investment was statistically significant. This serves as an indication that process innovation can also absorb available innovations of the market by buying it as capital good. An example would be new machines for automatic assembly lines (Parisi et al., 2006).

2.3.3 Financing of innovation

The process of innovation needs to be financed. Benfratello, Schiantarelli, and Sembenelli (2008) investigate the effect of bank development on product and process innovation on the Italian manufacturer firm level. They used as data source the same called "Indagine sulle Imprese Manifatturiere" by Capitalia's Observatory over small and medium enterprises. This is the same source as used by Parisi et al. (2006). In addition Benfratello et al. (2008) also added an 8th survey which present the results for 1998-2000.

The distance between a firm and a bank matters for small manufacturers. In rural areas with a low bank density the innovation is noticeably less prominent compared to urban areas. The development is especially important for entrepreneurs that are seeking to invest. Younger and smaller banks tend to be more willing to lend money to high risk and high profit projects. These high risk project are also more costly for the borrower which allows the bank to increase its financial base. Larger banks tend to lend money to bigger companies which offer a decreased risk of default. Especially big high technology firms that need larger amounts of credit to fund their investment into project or process innovation. Each of these lending activities needs monitoring activities by the bank which are cost intensive. Therefore banks being located close by reduces the monitoring costs and decreases the charged interest, especially for smaller companies. The use of the stock market as source for funding for big manufacturers is less important in Italy (Benfratello et al., 2008).

Benfratello et al. (2008) developed a logit model to investigate the probability of introducing innovation depending on the state of the banking system in an area. They used dummy variables to differentiate between impacts such as industry, region, firm related and company legal form. The results showed a significant positive relation between banking development and innovation fostering. The branch density has an affect on product and process innovation. Concerning the age of a manufacturer, their findings showed an increase of the probability of introducing a product until 57 years. After that barrier, a decline was found. A differentiation between high technology and low technology sectors showed that high technology sectors are more dependent on external funding for process innovation. Even more it could be laid out that bigger manufacturers can benefit from bank development for product innovation. Smaller companies tend to get less support for product innovation.

Benfratello et al. (2008) suggest that the different funding of product and process innovation has to do with the risk factor. Product innovation is more risky and it seems banks prefer more secure business models. They also mention that process innovation requires less human resources in validating the investment plan. For product investment plans it is more difficult to decide if such ideas are worth fostering.

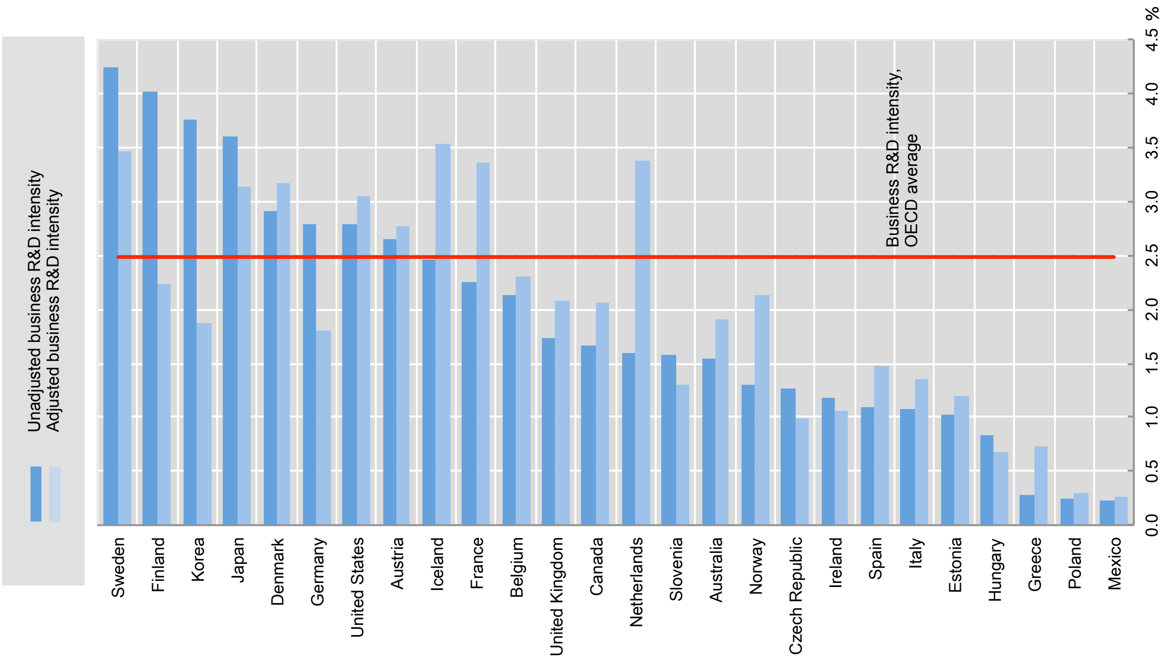

Figure 2.6: Business R&D intensity adjusted for industrial structure 2008 taken and modified from OECD (2011a)

2.3.4 Italians R&D compared to OECD Countries

In comparison to other OECD member states the Italian business research spending intensity is below the average as reported by OECD (2011e). The OECD provided an adjusted industry average which takes the different industry structure into account. The adjusted values are reported as if all the countries which were compared have the same structure. Figure 2.6 displays the countries with their adjusted and unadjusted business R&D intensity. For Italy the adjusted value is 1.36% which is below the OECD average of 2.49%. The unadjusted value is 1.08%. In contrast to Finland, Germany and Korea the adjusted values are lower than the unadjusted. OECD (2011e) emphasize that these three countries have specialised high technology industries which shifts the result from an overall high level to below the OECD average. Industries in these countries which are very resource intensive would be the auto mobile industry or the communication technology sector.

2.3.5 Summary & Conclusion

To recap, this section analysed the implication of research and development on the manufacturing level. Over the half of the Italian firms do not conduct R&D at all. Those who do, have a significant relation between investing and innovation which increases the productivity. The investments are positivity correlated with the introduction of process and product innovation. When both effects are measured at the same time the process innovation dominates the product innovation. This has to do with the fact that for many product innovations the process needs to be upgraded as well to support the new product. R&D does not only generate new products, it also allows it to absorb innovation from external firms. The financing on investments depends, to a degree, on the development of the local banking system. Especially for smaller companies the physical distance to the next bank matters. Banks tend to finance more process innovation projects because they are less risky than product innovation and easier to understand. Especially in high technology industries the external financing for process innovation is high. Product innovation generates more sustainable growth but lower growth rate than process innovation. The credit restraints in Italy cause companies, which are depended on external funding, to focus more on short term productivity increases than on long term improvements.

2.4 Increasing the value of human capital

Another important factor for manufactures is the skill-base of their workers: the human capital. New employees bring their skills from their previous workplace or from the secondary or tertiary education system. Already employed persons require training to keep up with new technology and developments. This section will focus on the work by Antonelli et al. (2010) who investigates the influence of organisational change and work-based training on human capital. This work focused on Italian manufacturers between 2001 and 2005.

Human Capital is a term that generates an analogy between physical goods, such as machines and resources, and knowledge such as input for production. The term can represent the knowledge of an individual or a whole group of people. The improvement on human capital can be seen as an investment in the same way as companies spend money on new machines. All-though the motivation for a worker who undertakes training might depend on a personal, cultural, background or personal desires to be more knowledgeable or qualified (Burton-Jones & Spender, 2011, p. 49,50).

The term capital has a different implication when referring to human capital than to physical. Physical capital can be seen as input in the production process that is used. It can be measured, such as land and machines, used up and owned. On the other hand human capital is fixed with a human individual and cannot be transferred. Therefore the personal knowledge of employees contributes differently to the overall productivity of a company. In general, the demand of knowledge by a company for the productivity is provided by hiring new personnel or training to achieve new skills (Burton-Jones & Spender, 2011, p.51,52).

Antonelli et al. (2010) developed a theoretical framework that focuses on the demand side of labour. In contrast to studies that focus on the supply, like tertiary education or schooling, they analysed the input within a firm which fills the demand through work-based training. In their empirical study they distinguished between four different sources, such as technological and organizational innovation, internationalization activities, outsourcing and hiring.

Antonelli et al. (2010, p. 215) define work based training (WBT) as:

"all the training activities accomplished by the employees and performed after the end of the schooling period under the (total or partial) responsibility of firm management."

All theses training activities are further separated by the training mode. If it takes place within the firm then it is called in-house training, if it is provided by an external provider it is called outside training. Finally, when external professional staff join the working team to teach workers it is called coaching. Coaching can also be done by internal staff who have more inside knowledge and transfers it by working side by side to a college.

2.4.1 The descriptive analysis

Various sources of data were merged for the survey. Companies with at least 11 employees were considered. After merging the different data sources 1545 manufacturing firms remained. The companies were split into three groups. First, small firms with 11-49 employees make up 20% of the sample size. Second, the highest margin are the medium firms with 50-249 employees and a share of 54 %. Finally, the third group are the big firms with 250 employees and more which make up 26% of all the manufacturers in the sample. Overall 66% of the manufacturers are located in the north compared to the centre and the south, 15% and 8% respectively (Antonelli et al., 2010).

Table 2.2: Labour Demand by Firm Size and Level of Education Required in Firm Predictions (Year 2006) taken from Antonelli et al. (2010, p.220).

Size	Education required	No.	%	Cumulated %
Large	Primary education	191	12.5	12.5
	Regional vocational training	36	2,3	14,8
	Vocational training	151	9,8	24,7
	Secondary school	565	36,9	61,5
	College degree	590	38,5	100
	Total	1533	100	
Medium	Primary education	298	22,2	22,2
	Regional vocational training	65	4,9	27,1
	Vocational training	193	14,4	41,5
	Secondary school	558	41,6	83,1
	College degree	226	16,9	100
	Total	1340	100	
Small	Primary education	53	34,9	34,9
	Regional vocational training	9	5,9	40,8
	Vocational training	25	16,4	57,2
	Secondary school	55	36,2	93,4
	College degree	10	6,6	100
	Total	152	100	

The size of a firm has an influence on the type of employees which are needed in the respect to persons with graduate or primal education as illustrated in Table 2.2. University graduates are demanded by 38.5% by large firms as medium-sized firms are mainly interested in workers with a secondary school degree with 41.6%. The demand for people with higher education decreases even further with small manufacturers. Their main interest are workers who have finished secondary school or a vocational training programme, 36.2% and 22.3% respectively. On the other hand, the demand for inexperienced workers is vice versa. Small companies demand 33.6% of workers without experience compared to large firms with 19.5% (Antonelli et al., 2010) .

The affinity to train workers increases with the company size and export orientation. Large companies in 2005 trained 79% of their labour force while medium companies trained 43%. The lowest proportion of training was done by the small companies with only 26.5%. Furthermore, manufacturers who focus on exporting their products train a higher proportion of their workers than companies who focus only on the domestic market (Antonelli et al., 2010).

Finally, the mode of training can also be linked to the company size. In-house training is the preferred choice for large and medium-sized firms. Small companies, which might not have the resources to finance in-house training, choose external training sites. The training method coaching is mainly used by large firms(Antonelli et al., 2010).

2.4.2 Empirical estimation model

Antonelli et al. (2010) use a different approach to measure the human capital. They measure it by the amount of training a firm provides to their workforce, representing the labour demand side. There is particularly a focus on technological and organisational change, internationalization and market-oriented activities like out-sourcing. The dependent variable represents the choice to provide training in the year 2004. The data for the explanatory variables have a time frame of 2001 to 2003. This enables to take into consideration the process of hiring in the past years to acquire new knowledge. As an estimation function a logit model is used because the dependent variable is either 1, if training was provided, or 0 otherwise.

Different regressors are used to explain the propensity to train. The three locations of training, such as in-house, outside and coaching, are taken into account. Additionally, the type of employment such as manager or plant operators are considered as well. Furthermore geographical dummies, industry-specific factors and sources of funding, such as public or private, are added (Antonelli et al., 2010).

The second estimation focuses on the training intensity done by the Italian manufacturers. As a dependent variable Antonelli et al. (2010) constructed an ordered index which accumulated all different ways of training, such as no training or in-house and coaching. They rely on the idea that the gap between the knowledge that a worker has and the knowledge which would be required for the duties, is closed through training and therefore measurable in the intensity of training. An ordered logit model is used for estimation. The use of an ordinary least square would be a problem because an increase in the index does not mean a double increase in intensity (Antonelli et al., 2010).

2.4.3 The results

The empirical model shows again the relation between firm size and work-based training activities. On the average, 1% more workers result in a probability increase of 15% more training activities. Available funding can explain the education training by 24%. A closer examination of the implications of funding showed that when the funding is differentiated between public and private sources the impact is different. Public funding seem to have no noticeable effect on motivating companies to train their work force even more. Acquiring services from abroad cause an increase in the training. New technology requires new training of the workers to cope with the introduction of new technology. The case of out-sourcing of a portion of production activities causes firms to specialise more on their services, which raises the propensity to train (Antonelli et al., 2010).

The chosen training place depends on the skill level of the workers. If operations are conducted which already require a high level of education, in-house training is the favourite choice. On the other hand, in cases with a less trained work-force the training is conducted externally. The acquiring of new production lines and machines requires the workers to satisfy the demand for knowledge on how to operate the new technology equipment. The third option, the coaching seems to be used most when new personnel is hired; in an attempt to adapt new employees as quickly as possible to the new environment (Antonelli et al., 2010).

Organisational changes within the firm result in an increase in the training activities. Particularly when the reason for the change was a new product or new process technology. It leads to an increase by 12% of activities. Larger organizations also tend to train their managers more than their operators. If the size of a manufacturer increases the supervisory tasks get more complex and require more training (Antonelli et al., 2010).

2.4.4 Summary & Conclusion

Summing up, this section focused on the educational development of the manufacturing workers in Italy. The previous section focused on the impacts of R&D activities. These activities depend, to a greater extent, on the skill of the researchers and the overall workers to implement them. Innovation is an important reason for training activities for the labour force especially when the organization structure changed. The intensity of the training increases with the size of the firm. The size also impacts the way the training is conducted. Small firms tend to prefer external training while large companies train their labour force through in-house training. The training method of coaching is used mainly for new personnel to encourage the quickest adaptation to the working environment as possible. Finally, operations which require high technology development or are difficult for the organisation, such as outsourcing, increase the propensity to train even more.

CHAPTER 3

Extension of a macroeconomic model for Italy

The macroeconomic model Hanappi (2011) will be used for analysing the Italian economy from 1995 to 2010 and a simulation to predict future development. The model differentiates between the state, banks, firms and households as separate economic agents. Employees are also included and serve as a representation for the population. It is a stock and flow model which considers debt and saving as stock. Each agent represents a sector of an economy such as general government(state), non-financial corporation's (firms), financial corporations (banks) and households. First, the different stock values and their corresponding behavioural equations values will be described. Second, the added structural equations will be listed. Finally the used data will be discussed.

3.1 The stocks

3.1.1 The debt

The highest debt is held by the Italian firms compared to the households and the state as shown in figure 3.1. Starting in 1995 the firms' debt grew at a faster pace than the others. Households and the state share approximately the same growth rate.

In 2010, firms' liabilities have more than doubled since 1995. They rose from about €1.3 trillion to €3.4 trillion. This contrasts the increases for the state and households with a gain from 1.1 to 1.8 and 0.2 to 0.9 respectively. The agent bank is left out on purpose, because the liabilities of a bank are the savings of firms and households. In addition, it was not possible to differentiate between foreign and residential banks.

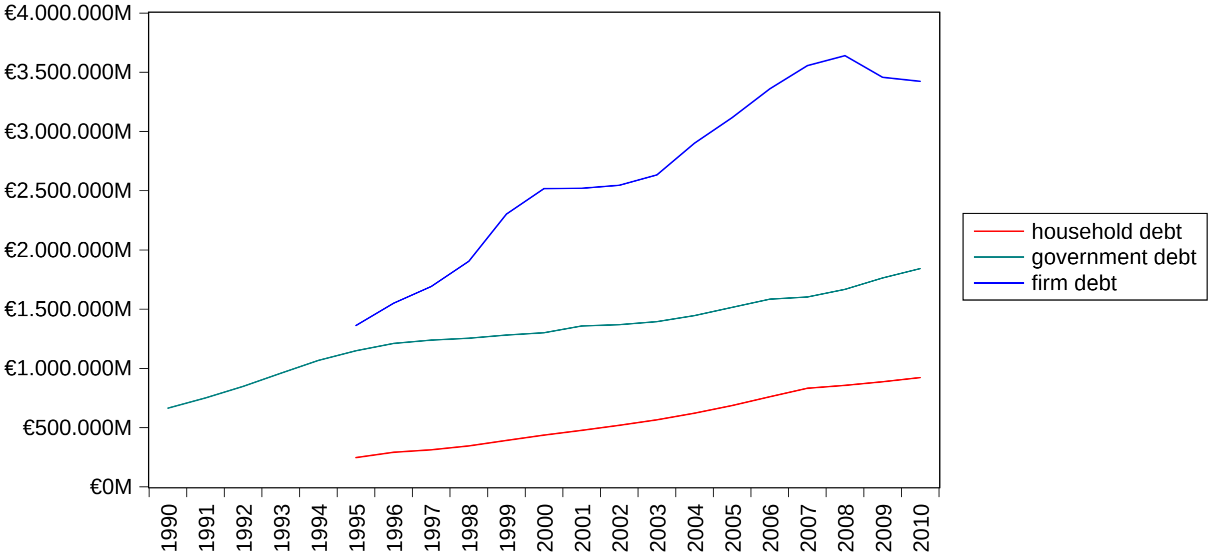

Figure 3.1: The value of the debt in million Euro in Italy

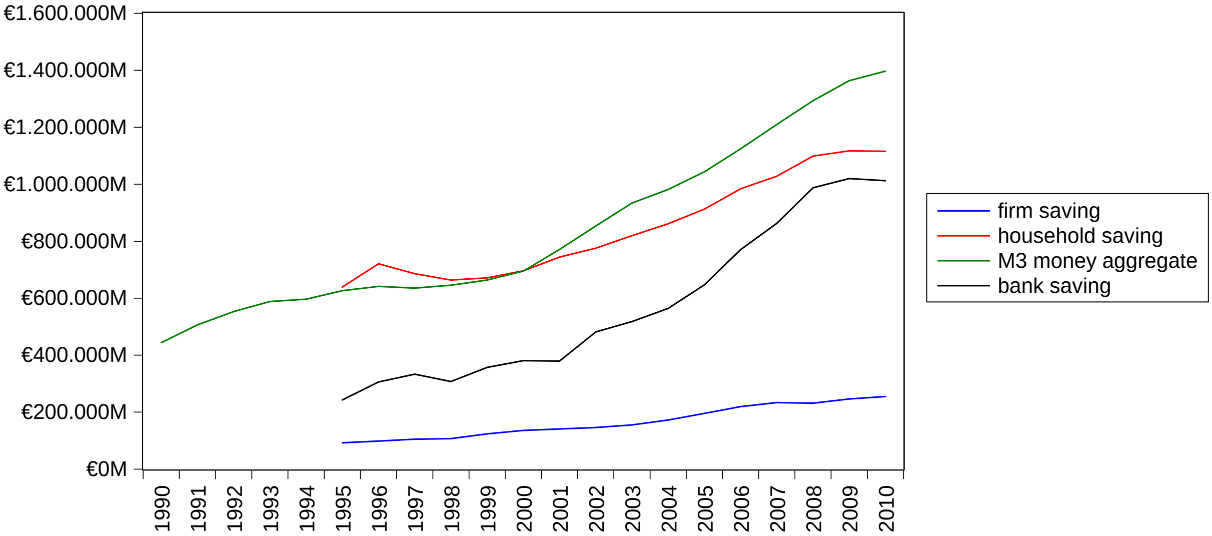

Figure 3.2: The value of the saving in million Euro in Italy

3.1.2 The Savings

The overall deposits in Italy are less than the debt as illustrated by figure 3.2. The money aggregate M3 represents the money and deposits which reside in Italy according to the ECB definition (ECB, n.d.). It includes the deposits with a maturity of up to 2 years. The other saving lines represent all other savings, also with high majorities.

A comparison of figure 3.1 and 3.2 shows a similar rise in the debt of firms and the savings of banks. The two time-series are correlated with 0.91 and one lag autocorrelation of 0.83. This can be explained by the requirement of banks to have a regulatory ratio of their outstanding debt versus their savings. The deposits of the banks show the fastest pace compared to the others.

The savings of the households and firms roughly doubled between 1995 and 2010. On the other hand, for the banks, the savings rose from €0.4 trillion to €1 trillion.

3.1.3 Capital Stock

The different capital stock of the firms, the state and the banks are displayed in figure 3.3 in a logarithmic scale. The highest physical resource is owned by the firms, followed by the state and bank. The financial crises in 2007 caused a dip in the capital stock for the banks and firms. The state was not affected by the financial troubles to his capital stock directly. It can be argued that the states' capital stock mostly consists of infrastructure and therefore is less affected by financial fluctuations.

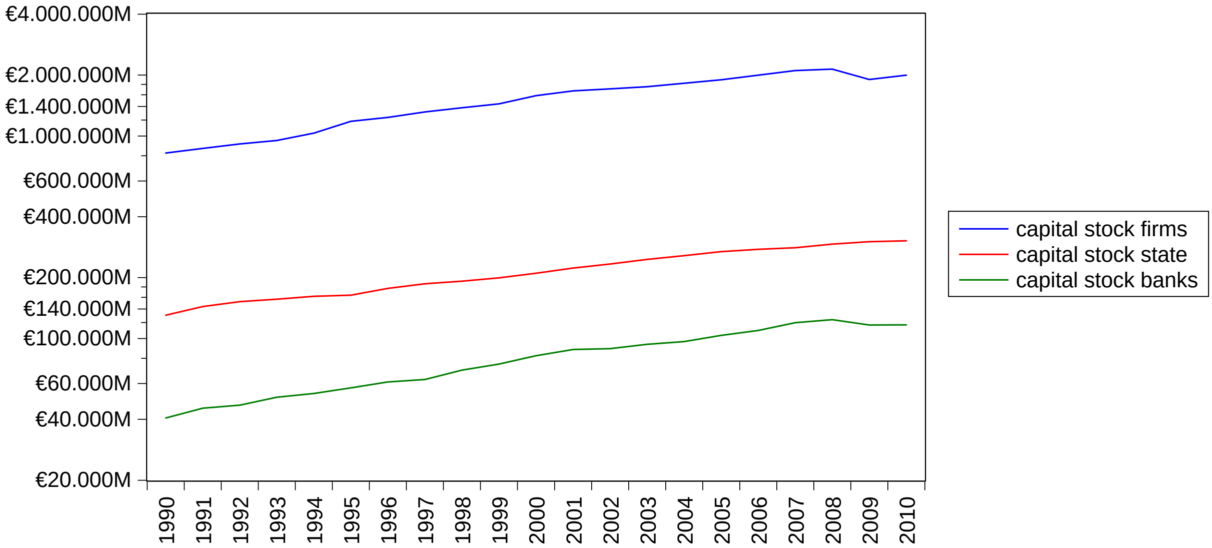

Figure 3.3: Capital stock in Italy logarithmic scale in million of Euro

3.2 Corresponding Equations

3.2.1 The state

For the state, the stock variable is the government debt. Each unbalanced budget a year requires the state to receive additional credit. In addition, each year the state has to pay interest r_t^{cr} for its borrowed money which is given by

$$r_t^{cr} \cdot D_{t-1}^{st}.$$

The added additional net credit Cr_t^{st} is added and leads to the model equation as

$$D_t^{st} = D_{t-1}^{st} + Cr_t^{st}. \tag{3.1}$$

This formula was modified from the original (D_{t-1}^{st}) to represent the steps in the simulation equation rather than the calculation (Hanappi, 2011).

As structural equations for estimation, the following equation was assumed after experiments and following the idea of Hall and Papell (2005, p. 369):

$$Cr_t^{st} = \alpha_1 + \beta_1 \cdot T_t + \beta_2 \cdot str_t^{st} + \beta_3 \cdot (r_t^{cr} \cdot D_{t-1}^{st}) \tag{3.2}$$

The assumption is that the additional credit needed for the state is decreased by the taxes T_t that the state receives as income, increased by social contribution and benefits str_t^{st} and increased by the approximated debt interest payment. Because of the likely correlation of T_t and str_t^{st} with the error term, the equation is estimated with a two-stage least-square and instrument variables. As instruments the lagged variables $(r_{t-1}^{cr} \cdot D_{t-2}^{st})$, T_{t-1}, str_{t-1}^{st}, the government consumption $GFCE_{t-1}$ and the state investment inv_{t-1}^{st} were chosen. To get more stable instruments an adoption of the concept used in Gandolfo and Padoan (1984) for linearisation is applied. They approximated the differential equation system by using the logarithmic ratios of the variables to their steady state. For the simulation this will be assumed with the mean of the variables which results in the final instruments being set as $(r_{t-1}^{cr} \cdot D_{t-2}^{st})$, $log(\frac{T_{t-1}}{\overline{T}})$, $log(\frac{GFCE_{t-1}}{\overline{GFCE}})$, $log(\frac{str_{t-1}^{st}}{\overline{str}^{st}})$ and $log(\frac{inv_{t-1}^{st}}{\overline{inv}^{st}})$

The results are shown in table 3.1. The taxes and social contributions are more significant than the interest paid. The Durbin Watson test statistic requires the test value to be between $d_U = 1,75$ and $4 - d_L = 4 - 0.81 = 3.19$ to accept the assumption of no autocorrelation (Komlos & Süssmuth, 2010).

On average, an increase in income for taxes decreases the refinancing needs, while an increase in government expenditures increase the propensity to take additional credit.

3.2.2 Firms

In contrast to the state, the savings of firms play a role in their stock variable. The agent of firms represents all firms in Italy and aggregates all business activities into one. In analogy to the state the expenditure for credit interest is given by

$$r_t^{cr} \cdot D_{t-1}^{f}$$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
α_1	-28294.37	105475.60	-0.2683	0.7935
$\beta_1(T_t)$	-1.3031	0.5306	-2.4560	0.0319
$\beta_2(str_t^{st})$	1.3570	0.4525	2.9990	0.0121
$\beta_3(r_t^{cr} \cdot D_{t-1}^{st})$	0.6300	0.5141	1.2255	0.2460
R-squared	0.53	Mean dependent var		46466.94
Adjusted R-squared	0.40	S.D. dependent var		27428.21
S.E. of regression	21249.51	Sum squared resid		4.97E+09
F-statistic	3.76	Durbin-Watson stat		2.17
Prob(F-statistic)	0.04			

Table 3.1: Increasing sate debt equation 3.2 estimate

which has to be paid to banks for financing the debt. In this model, firms can also save and therefore additional net credit is added to their debt variable

$$Debt_t^f = Debt_{t-1}^f + Cr_t^f. \tag{3.3}$$

Again the modification to follow the simulation steps in respect to sequential time (Hanappi, 2011).

Each investment Inv_t^f by a firm is assumed to be financed through additional credit. In addition, occurred profit O_t^f in the current year and the debt is assumed to be influential. As shown in figure 3.1 Italian firms have, by far, the most financial liabilities and need to pay the most interest in comparison to the other agents per year. Experiments showed that the interest payments$(r_{t-1}^{cr} \cdot Debt_{t-2}^f)$ of the previous year increases the significance of estimating the debt fluctuation time-series. It is estimated with

$$Cr_t^f = Inv_t^f + \beta_4 \cdot O_t^f + \beta_5 \cdot (r_{t-1}^{cr} \cdot Debt_{t-2}^f) \tag{3.4}$$

The stock variable for the firm is the difference of the debts and savings of a year

$$D_t^f = Debt_t^f - S_t^f. \tag{3.5}$$

To approximate a firm's saving time-series, a regressive form is assumed and estimated by

$$log(S_t^f) = log(S_{t-1}^f) + s_f \cdot log(O_t^f). \tag{3.6}$$

Both equations are estimated using ordinary least-square.

There was not much success in finding results that would be more statistically significant than what is displayed for the increase in firm debt in table 3.2 (R-squared). The Durbin-Watson

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$\beta_4(O_t^f)$	2.8331	0.8750	3.2378	0.0071
$\beta_5(r_{t-1}^{cr} \cdot Debt_{t-2}^f)$	-2.9745	0.8856	-3.3586	0.0057
R-squared	0.43	Mean dependent var		133790.3
Adjusted R-squared	0.38	S.D. dependent var		148222.7
S.E. of regression	116252.20	Durbin-Watson stat		0.99
Sum squared resid	1.62E+11			

Table 3.2: Increasing firm debt equation 3.4 estimate

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$s_f(log(O_t^f))$	0.0056	0.0009	6.1781	0.0000
R-squared	0.98	Mean dependent var		171027.50
Adjusted R-squared	0.98	S.D. dependent var		54845.89
S.E. of regression	7351.12	Durbin-Watson stat		1.53
Sum squared resid	7.57E+08			

Table 3.3: Propensity to save for firms equation 3.6 estimate

statistic is inconclusive. For 14 observations (2 period lag) and 2 coefficients the interval for inconclusiveness is 0.95 and 1.5 (Komlos & Süssmuth, 2010). For the simulation this value will be accepted due to the lack of determinable better alternatives.

The leading signs for a firm's debt increase are different in comparison to the state's debt increase. An individual firm is usually not allowed to refinance its debt by another debt loan, this is not the case for the state. This leads to the situation that a high interest payment for past received funding decreases on the average the acquisition of new external funds. On the other hand, an increase in profits increases the possibility to collect new sources of funding.

The statistical test for the firm's saving propensity is acceptable. The Durbin-Watson statistic for 1 coefficient and 15 is between $d_U = 1,36$ and $4 - d_L = 4 - 1.077 = 2.92$, and therefore accepted (Komlos & Süssmuth, 2010). An increase of operating profit by 1% increases the savings on average by 0.0056%.

3.2.3 Households

Households receive their income through wages, operating surplus of firms and banks and through other social transfers. The original model (Hanappi, 2011) would differentiate between income groups, such as top 10% or lowest 10%, but there was no continuous statistical data found for the period between 1995 and 2010. The stock variable of households is again the debt, minus the savings. In contrast to the state and the firms, the stock is negative because the savings are higher than debt. The debt stock is given by

$$Debt_t^{HH} = Debt_{t-1}^{HH} + Cr_t^{HH}. \tag{3.7}$$

Households have different incentives than firms or the state to acquire new debt. An additional credit is used for financing consumption, such as buying real estate. As reported in the previous chapter, Italian households are confronted with high down-payments which require an already acquired savings stock in the past. The increase in credits for the Italian households is approximated by

$$Cr_t^{HH} = \alpha_2 + \beta_6 \cdot \Delta log(S_t^{HH}) + \beta_7 \cdot log(r_t^{cr}) \tag{3.8}$$

Δ stands for the difference of the variable of the previous year. The credit rate changes in a much smaller scale than the saving stock S_t^{HH}. To overcome this problem the logarithmic function is used for down-scaling. The saving propensity of households is estimated by the change of household income W_t^{HH} as

$$\Delta log(S_t^{HH}) = \alpha_3 + \beta_8 \cdot \Delta log(W_t^{HH}). \tag{3.9}$$

Both equations are estimated individually using ordinary least-squares. The household stock variable is then calculated by

$$D_t^{HH} = Debt_t^{HH} - S_t^{HH} \tag{3.10}$$

This stock variable becomes negative where the savings exceed credits.

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
α_2	-26303.3800	26401.2400	-0.9963	0.3388
$\beta_6(\Delta log(S_t^{HH}))$	213027.9000	73325.3600	2.9052	0.0132
$\beta_7(log(r_{t-1}^{cr}))$	-21552.1700	9996.6900	-2.1559	0.0521
R-squared	0.55	Mean dependent var		45012.69
Adjusted R-squared	0.488	S.D. dependent var		16059.86
S.E. of regression	11593.64	F-statistic		7.43
Sum squared resid	1.61E+09	Prob(F-statistic)		0.0079
Durbin-Watson stat	1.53			

Table 3.4: Increase of household debt equation 3.8 estimate

Table 3.4 presents the estimation results for the credit increase. A positive change of the saving stock increases the credits, while an increase in credit interest rates has the reverse effect.In the Durbin-Watson statistic for 2 coefficients and 15 observation the bandwidth for

Variable	Coefficient	Std. Error	t-Statistic	Prob.
α_3	0.0134	0.0125	1.0655	0.3061
$\beta_8(\Delta log(W_t^{HH}))$	0.7230	0.2595	2.7860	0.0154
R-squared	0.37	Mean dependent var		0.0371
Adjusted R-squared	0.33	S.D. dependent var		0.0434
S.E. of regression	0.0356	F-statistic		7.7617
Sum squared resid	0.0165	Prob(F-statistic)		0.0154
Durbin-Watson stat	1.08			

Table 3.5: Saving propensity of Italian household equation 3.9 estimate

an inconclusive test is 0.976 and 1.543, which is the case (Komlos & Süssmuth, 2010). The coefficients could have been more meaningful if applied to the logarithmic form of Cr_t^{HH}, but because of possible negative values a lin-log model was used.

An increase in the growth of the income by 1% increases on average, the saving stock by 0,7$\%$. The Durbin-Watson test statistic value is inconclusive for 15 observations and 1 coefficient (range from 1,077 and 1,361) (Komlos & Süssmuth, 2010). A better understanding of the propensity to save could be derived by differentiating between the income groups.

3.2.4 Banks

The standard way of banks to earn money is through the profit they make through lending money as they receive deposits from customers as credit. For credits they charge the credit rate and for deposits they have to pay the interest saving rate r_t^s. The credit rate is higher than the saving rate and the difference is the profit. For the simulation, the agent bank represents all banks in Italy and beyond. It was not possible to derive any economically significant results for differentiating the debt and saving between Italy and the rest of the world (Hanappi, 2011).

Granting a credit loan to firm owners can also be seen as an investment to the discovery of promising entrepreneurs. An entrepreneur presents his new idea to a bank and promises higher returns in the future. When banks lend money they provides the opportunity to increase productivity and higher returns, especially in the case of a successful enterprise. An increase in welfare is linked with the profit increase of banks. For the simulation a theoretical bank profit will be calculated by

$$\pi_t = r_t^{cr} \cdot (Debt_t^f + D_t^{st} + Debt_t^{HH}) - r_t^s \cdot (S_t^{HH} + S_t^f) \quad (3.11)$$

This formula is a modified form of the original so as to allow the savings of firm owners and the debt of households to be considered separately. (Hanappi, 2011).

3.3 The economic output

3.3.1 Investment

The investment behaviour undertaken by firms, the state and banks are assumed for firms with

$$Inv_t^f = \alpha_4 + v_{f1} \cdot Cap_{t-1}^f + v_{f2} \cdot \Delta C_t + v_{f3} \cdot \Delta CapC_t^f, \tag{3.12}$$

and the instruments: Cap_{t-2}^f, Cap_{t-3}^f, Δstr_t^{st}, $\Delta Wcomp_t$, $CapC_t^f$, $\Delta Wcomp_t^f$. The state with

$$Inv_t^{st} = \alpha_5 + v_{st1} \cdot Cap_{t-1}^{st} + v_{st2} \cdot \Delta C_{t-1} + v_{st3} \cdot \Delta CapC_{t-1}^{st}, \tag{3.13}$$

and the instruments: Cap_{t-2}^{st}, Cap_{t-3}^{st}, $\Delta CapC_{t-2}^{st}$, ΔInv_{t-1}, $\Delta Wcomp_t$, ΔX_t, $\Delta Wcomp_t^{st}$, Δstr_{t-1}^{st}, and finally the banks with

$$log(Inv_t^b) = v_{b1} \cdot log(Cap_{t-1}^b) + v_{b2} \cdot \Delta log(C_t) + v_{b3} \cdot \Delta log(CapC_t^b) + v_{b4} \cdot Dummy_t^b \tag{3.14}$$

and the instruments: $log(Cap_{t-2}^b)$, $log(Cap_{t-3}^b)$, $\Delta log(str_{t-1}^{st})$, $\Delta log(Wcomp_t)$, $Dummy_t^b$. The first regressor represents the replacement investment of the different capital stocks Cap_t. The difference in the consumption reflects the expected demand, also called the accelerator principle. Experiments showed that for the firm and banks, significant results can only be derived by including the most recent changes in consumption. It could be interpreted that as banks and firms react faster to investment demand in opposite of the state. In general the state may have different goals while investing than the others, such as infrastructure development rather than the possibility to increase profits (Hanappi, 2011).

The change of the overall investments in Italy have been replaced by the fixed capital consumption of the agents. The change in investment was also highly correlated with the change of consumption and can therefore be seen as an indication of a linear combination between them (Baltagi, 2011). Consumption of fixed capital is defined by Council (2009, p. 167) as:

"Consumption of fixed capital (K.1) represents the amount of fixed assets used up, during the period under consideration, as a result of normal wear and tear and foreseeable obsolescence, including a provision for losses of fixed assets as a result of accidental damage which can be insured against."

This means that the first regressor represents the replacement investment because of degradation while the third reduces the investment because of the need to restock.

The increase of the consumption of fixed capital is assumed to follow a trend and is given by

$$log(CapC_t^f) = \alpha_6 + \beta_9 \cdot log\left(\frac{CapC_{t-1}^f}{\overline{CapC}^f}\right), \tag{3.15}$$

$$log(CapC_t^{st}) = \alpha_7 + \beta_{10} \cdot log\left(\frac{CapC_{t-1}^{st}}{\overline{CapC}^{st}}\right) and \tag{3.16}$$

$$log(CapC_t^b) = \alpha_8 + \beta_{11} \cdot log\left(\frac{CapC_{t-1}^b}{\overline{CapC}^b})\right). \tag{3.17}$$

Table 3.6 displays the two stage least-square estimates for the investment function. An increase in the difference of consumption by 1 million Euro increases on the average the investment by 1.08 million, while the consumption of fixed capital reduces the investment. The upkeep of the fixed physical assets requires, on average, an investment increase of 0.1 when the stock increases by 1 million Euro. The Durbin-Watson statistic is again inconclusive, but a test for autocorrelation and partial autocorrelation of the residuals showed no indication for it and is therefore acceptable. The state is less affected by the change of consumption compared to the

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
α_4	-32688.56	20748.17	-1.5754	0.1411
$v_{f1}(Cap_{t-1}^f)$	0.1029	0.0131	7.8419	0
$v_{f2}(\Delta C_t)$	1.0806	0.4769	2.2656	0.0428
$v_{f3}(\Delta CapC_t^f)$	-5.9715	3.1139	-1.9177	0.0793
R-squared	0.90	Mean dependent var		136819.4
Adjusted R-squared	0.88	S.D. dependent var		28401.26
S.E. of regression	9830.21	Sum squared resid		1.16E+09
Durbin-Watson stat	1.32			

Table 3.6: Investment undertaken by firms equation 3.12 estimate

investment of firms and banks as presented in table 3.7. An increase of consumption results in an increase of 0.18 per unit. The Durbin-Watson test shows no sign for autocorrelation.

The investment equation for banks also has a dummy variable included. The investment time-series increased by more than 2 times in year 2002 compared to 2001. In 2003 the value had more or less the same level as the previous year, before 2001. Therefore to get an estimate for the investment function the dummy $Dummy_t^b$ was included with a value of 1 in each year, except for 2002 where it is 0. In contrast to the other investment equation, a log-log model was assumed for scaling purposes.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
α_5	-7303.25	5827.3790	-1.2533	0.2340
$v_{st1}(Cap^{st}_{t-1})$	0.1659	0.0293	5.6702	0.0001
$v_{st2}(\Delta C_{t-1})$	0.1842	0.0843	2.1850	0.0495
$v_{st3} \cdot \Delta CapC^{st}_{t-1}$,	-5.9208	3.2700	-1.8106	0.0953
R-squared	0.86	Mean dependent var		29549.06
Adjusted R-squared	0.82	S.D. dependent var		6101.99
S.E. of regression	2577.45	Sum squared resid		79719082
F-statistic	23.84	Durbin-Watson stat		1.94
Prob(F-statistic)	0.00			

Table 3.7: Investment undertaken by the state equation 3.13

An increase of the consumption by 1% increases the investment of banks by about 9%. Again as before, the fixed capital consumption decreases the investment and the Durbin-Watson statistic shows no sign for autocorrelation.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$v_{b1}(log(Cap^{b}_{t-1}))$	0.8057	0.0228	35.2993	0.0000
$v_{b2}(\Delta log(C_t))$	9.1381	2.9599	3.0873	0.0094
$v_{b3}(\Delta CapC^{b}_{t})$	-2.4500	0.9444	-2.5944	0.0235
$v_{b4}(Dummy^{b}_{t})$	-1.2308	0.2816	-4.3710	0.0009
R-squared	0.51	Mean dependent var		8.32
Adjusted R-squared	0.39	S.D. dependent var		0.33
S.E. of regression	0.26	Sum squared resid		0.79
Durbin-Watson stat	2.14			

Table 3.8: Investment undertaken by banks equation 3.14

Table 3.9, 3.10 and 3.11 display the ordinary least-square results for the trend estimation of the fixed capital consumption of the firms, the state and the bank respectively. The Durbin-Watson statistics shows no autocorrelation for the firms and the state (15 observations, 1 coefficient) and is inconclusive for banks.

3.3.2 Population and employment

The population of workers and unemployed represent the physical side of the economic process. The population L_t growth is estimated by the auto regressive form

$$L_t = \alpha_9 + \beta_{12} \cdot L_{t-1}. \tag{3.18}$$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
α_6	11.6442	0.0099	1175.9780	0.0000
$\beta_9(log(\frac{CapC^f_{t-1}}{CapC^f})),$	0.9659	0.0417	23.1815	0.0000
R-squared	0.97	Mean dependent var		11.5789
Adjusted R-squared	0.97	S.D. dependent var		0.2302
S.E. of regression	0.0380	Sum squared resid		0.0202
Durbin-Watson stat	2.11			

Table 3.9: Fixed capital consumption firms estimate

Variable	Coefficient	Std. Error	t-Statistic	Prob.
α_7	10.0687	0.0093	1077.8600	0.0000
$\beta_{10}(log(\frac{CapC^{st}_{t-1}}{CapC^{st}}))$	0.9875	0.0362	27.2616	0.0000
R-squared	0.98	Mean dependent var		9.9918
Adjusted R-squared	0.98	S.D. dependent var		0.2531
S.E. of regression	0.04	Sum squared resid		0.0178
Durbin-Watson stat	2.17			

Table 3.10: Fixed capital consumption state estimate

Variable	Coefficient	Std. Error	t-Statistic	Prob.
α_8	8.2536	0.0282	292.2838	0.0000
$\beta_{11}(log(\frac{CapC^b_{t-1}}{CapC^b})))$	0.7019	0.1969	3.5643	0.0009
R-squared	0.48	Mean dependent var		8.2440
Adjusted R-squared	0.44	S.D. dependent var		0.1500
S.E. of regression	0.1124	Sum squared resid		0.1770
Durbin-Watson stat	1.02			

Table 3.11: Fixed capital consumption banks estimate

The overall labour supply puts together the currently employed workers L_t^S and the unemployed U_t as

$$L_t^S = L_t^D + U_t.$$

The number of workers in a country who are taking part in the working process, compared to the total population, make up the participation rate:

$$\frac{L_t^S}{L_t} = \alpha_{10} + \beta_{13} \cdot \frac{L_{t-1}^S}{L_{t-1}}. \tag{3.19}$$

With the given labour demand, the unemployment rate can be computed (Hanappi, 2011). Equation 3.19 is estimated numerically therefore the participation rate is substituted with

$$P_t = \frac{L_t^S}{L_t}.$$

This allows the calculation of the number of unemployed people by

$$U_t = P_t \cdot L_t - L_t^D. \tag{3.20}$$

In addition, to calculate the unemployment rate for a better comparison:

$$Up_t = \frac{U_t}{U_t + L_t^D} \tag{3.21}$$

is used. Tables 3.12 and 3.13 display the econometric results for population growth and the growth of the participation rate respectively. Population growth shows a positive autocorrelation in the residuals and violates the ordinary least-square conditions while the participation rate shows no sign for autocorrelation. The form of the model will be assumed to be correct and different steps will be used to obtain statistical relevant results.

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
α_9	-6109.353	2075.083	-2.9441	0.0107
$\beta_{12}(L_{t-1})$	1.1096	0.035884	30.9223	0.0000
R-squared	0.99	Mean dependent var		58044.18
Adjusted R-squared	0.98	S.D. dependent var		1335.29
S.E. of regression	166.03	Durbin-Watson stat		0.49
Sum squared resid	385934.7			

Table 3.12: Population growth in Italy equation 3.18 estimate with bias

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
α_{10}	0.0686	0.0401	1.7095	0.1094
$\beta_{13}(P_{t-1})$	0.8459	0.0915	9.2499	0.0000
R-squared	0.86	Mean dependent var		0.4397
Adjusted R-squared	0.85	S.D. dependent var		0.0093
S.E. of regression	0.0036	F-statistic		85.5602
Sum squared resid	0.0002	Prob(F-statistic)		0.0000
Durbin-Watson stat	1.36			

Table 3.13: Labor participation growth rate equation 3.19 estimate

To follow the procedure as described in Komlos and Süssmuth (2010, p. 90) a lagged model of the population growth will be estimated. The original model with the error term ϵ_t as

$$L_t = \alpha_9 + \beta_{12} \cdot L_{t-1} + \epsilon_t$$

and the lagged version

$$L_{t-1} = \alpha_{11} + \beta_{14} \cdot L_{t-2} + \epsilon_{t-1}.$$

The next step is to calculate the autocorrelations coefficient p from the auto regressive equation

$$\epsilon_t = p \cdot \epsilon_{t-1} + u_t,$$

where ϵ_t and ϵ_{t-1} are calculated with the residual from the ordinary least-square estimates. The estimated coefficient $\hat{p}$ is then multiplied with the lagged model which leads to

$$\hat{p} \cdot L_{t-1} = \hat{p} \cdot \alpha_1 1 + \hat{p} \cdot \beta_{14} \cdot L_{t-2} + \hat{p} \cdot \epsilon_{t-1}.$$

Subtracting the assumed model form the lagged model leads to

$$L_t - \hat{p} \cdot L_{t-1} = \alpha_9(1 - \hat{p}) + \beta_{12} \cdot (L_{t-1} - \hat{p} \cdot L_{t-2}) - \epsilon_t - \hat{p} \cdot \epsilon_{t-1}$$

The α_9 and β_{12} now present the unbiased results for the population growth estimate. Calculating the numerical results of the brackets and then estimating it with ordinary least-square leads to the results as shown in table 3.14 with no sign for autocorrelation.

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
α_9	1586.3070	4595.4050	0.3452	0.7351
β_{12}	0.9788	0.0777	12.5909	0.0000
R-squared	0.92	Mean dependent var		8513.86
Adjusted R-squared	0.91	S.D. dependent var		342.10
S.E. of regression	100.87	Durbin-Watson stat		1.1221
Sum squared resid	142448.40			

Table 3.14: Population growth in Italy equation 3.18 estimate without bias

3.3.3 Economic production

The economic output(GDP) X_t is calculating by using an inverted Cobb Douglas production function given by

$$log(X_t) = log(\delta_1) + \delta_2 \cdot log(Cap_t^{st}) + \delta_3 \cdot log(Cap_t^{f}) + \delta_4 \cdot log(Cap_t^{b}) + \delta_5 \cdot log(L_t^{D}) \quad (3.22)$$

with the corresponding physical capital stock state, banks and firms respectively:

$$Cap_t^{st} = Cap_{t-1}^{st} + \alpha_{st} \cdot Inv_t^{st} \tag{3.23}$$

$$Cap_t^{f} = Cap_{t-1}^{f} + \alpha_{f} \cdot Inv_t^{f} \tag{3.24}$$

$$Cap_t^{b} = Cap_{t-1}^{b} + \alpha_{b} \cdot Inv_t^{b} \tag{3.25}$$

All four equations are estimated using seemingly unrelated estimation as described in Moss (2011). This allows an additional calculation of the labour demand after estimation with

$$log(L_t^D) = \frac{log(X_t) - log(\delta_1) - \delta_2 \cdot log(Cap_t^{st}) - \delta_3 \cdot log(Cap_t^{f}) - \delta_4 \cdot log(Cap_t^{b})}{\delta_5} \tag{3.26}$$

The fist coefficient δ_1 represents the technological process while the others demonstrate the elastic relation between the output and the capital stock as input (Hanappi, 2011).

The estimation results are presented in table 3.15. The capital stock equation indicates autocorrelation which is accepted because of the lack of more appropriate solutions. On average, the output increase by 0.38%, 0.42% and 0.12% when the capital stock of the state, firms and the human capital stock increases by 1% respectively. The coefficient for the increase of the capital stock of banks is estimated close to zero and the statistical test also indicates a low significance. This might have to do with the fact that there is no direct impact between the capital stock of banks and the output. Rather there is an indirect relation between supporting firms and the state with credits for investment.

	Coefficient	**Std. Error**	**t-Statistic**	**Prob.**
$\alpha_f(Inv_t^f)$	0.2340	0.1407	1.6636	0.1022
$\alpha_b(Inv_t^b)$	0.5581	0.2217	2.5169	0.0150
$\alpha_{st}(Inv_t^{st})$	0.2969	0.0309	9.6228	0.0000
δ_1	6.4404	3.5083	1.8357	0.0721
$\delta_2(log(Cap_t^{st}))$	0.3876	0.0354	10.9473	0.0000
$\delta_3(log(Cap_t^{f}))$	0.4255	0.0479	8.8861	0.0000
$\delta_4(log(Cap_t^{b}))$	0.0028	0.0428	0.0649	0.9485
$\delta_5(log(L_t^D))$	0.1279	0.0964	1.3271	0.1903
Observations: 15				
Equation: Cap_t^f				
R-squared	0.90	Mean dependent var		1730813
Adjusted R-squared	0.90	S.D. dependent var		288581.9

S.E. of regression	89212.98	Sum squared resid	1.11E+11
Durbin-Watson stat	1.81		
Equation: Cap_t^b			
R-squared	0.95	Mean dependent var	94015.3
Adjusted R-squared	0.95	S.D. dependent var	20955.51
S.E. of regression	4684.40	Sum squared resid	3.07E+08
Durbin-Watson stat	1.41		
Equation: Cap_t^{st}			
R-squared	0.99	Mean dependent var	243219.6
Adjusted R-squared	0.99	S.D. dependent var	43508.89
S.E. of regression	3812.89	Sum squared resid	2.04E+08
Durbin-Watson stat	0.83		
Equation: $log(X_t)$			
R-squared	0.99	Mean dependent var	14.08803
Adjusted R-squared	0.99	S.D. dependent var	0.152938
S.E. of regression	0.01	Sum squared resid	0.000298
Durbin-Watson stat	1.95		

Table 3.15: Productions equation estimates

3.4 The Final Model

Substituting all coefficients and adding all identity equation the final model is:

$$log(X_t) = log(6.44) + 0.39 \cdot log(Cap_t^{st}) + 0.43 \cdot log(Cap_t^f) + 0.003 \cdot log(Cap_t^b) + 0.18 \cdot log(L_t^D)$$

$$log(L_t^D) = \frac{log(X_t) - log(6.44) - 0.39 \cdot log(Cap_t^{st}) - 0.43 \cdot log(Cap_t^f) - 0.003 \cdot log(Cap_t^b)}{0.18}$$

$$Cap_t^{st} = Cap_{t-1}^{st} + 0.30 \cdot Inv_t^{st}$$

$$Cap_t^f = Cap_{t-1}^f + 0.23 \cdot Inv_t^f$$

$$Cap_t^b = Cap_{t-1}^b + 0.56 \cdot Inv_t^b$$

$$Inv_t^{st} = -7303.25 + 0.17 \cdot Cap_{t-1}^{st} + 0.18 \cdot \Delta C_{t-1} - 5.92 \cdot \Delta CapC_{t-1}^{st}$$

$$Inv_t^f = -32688.56 + 0.10 \cdot Cap_{t-1}^f + 1.08 \cdot \Delta C_t - 5.97 \cdot \Delta CapC_t^f$$

$$log(Inv_t^b) = 0.80 \cdot log(Cap_{t-1}^b) + 9.14 \cdot \Delta log(C_t) - 2.45 \cdot \Delta log(CapC_t^b) - 1.23 \cdot Dummy_t^b$$

$$log(CapC_t^{st}) = 10.07 + 0.99 \cdot log\left(\frac{CapC_{t-1}^{st}}{\overline{CapC}^{st}}\right)$$

$$log(CapC_t^f) = 11.64 + 0.97 \cdot log\left(\frac{CapC_{t-1}^f}{\overline{CapC}^f}\right)$$

$$log(CapC_t^b) = 8.25 + 0.70 \cdot log\left(\frac{CapC_{t-1}^b}{\overline{CapC}^b})\right)$$

$$L_t = 1586.30 + 0.99 \cdot L_{t-1}$$

$$P_t = 0.07 + 0.85 P_{t-1}$$

$$U_t = P_t \cdot L_t - L_t^D$$

$$Up_t = \frac{U_t}{U_t + L_t^D}$$

$$D_t^{st} = D_{t-1}^{st} + Cr_t^{st}.$$

$$Cr_t^{st} = -28294.37 - 1.30 \cdot T_t + 1.36 \cdot str_t^{st} + 0.63 \cdot (r_t^{cr} \cdot D_{t-1}^{st})$$

$$Debt_t^f = Debt_{t-1}^f + Cr_t^f$$

$$D_t^f = Debt_t^f - S_t^f$$

$$Cr_t^f = Inv_t^f + 2.83 \cdot O_t^f - 2.97 \cdot (r_{t-1}^{cr} \cdot Debt_{t-2}^f)$$

$$log(S_t^f) = log(S_{t-1}^f) + 0.0056 \cdot log(O_t^f).$$

$$Debt_t^{HH} = Debt_{t-1}^{HH} + Cr_t^{HH}$$

$$D_t^{HH} = Debt_t^{HH} - S_t^{HH}$$

$$Cr_t^{HH} = -26303.38 + 213027.9 \cdot \Delta log(S_t^{HH}) - 21552.17 \cdot log(r_t^{cr})$$

$$\Delta log(S_t^{HH}) = 0.01 + 0.72 \cdot \Delta log(W_t^{HH})$$

$$\pi_t = r_t^{cr} \cdot (Debt_t^f + D_t^{st} + Debt_t^{HH}) - r_t^s \cdot (S_t^{HH} + S_t^f)$$

3.5 The Data

All money values are calculated in Euro millions and current prices.

Table 3.16: Model variables data sources

Model Variable	Source	Comment
C_t Consumption	Eurostat	Consumption of households.
Cap_t^{st} Capital stock state	ISTAT	Total resources of the general government.
Cap_t^f Capital stock firms	ISTAT	Total resources of non-financial corporations.
Cap_t^b Capital stock banks	ISTAT	Total resources of financial corporations.
$CapC_t^{st}$ Consumption of fixed capital state	Eurostat	Consumption of fixed capital of the general government.

Continued on next page

Table 3.16 – continued from previous page

Model Variable	Source	Comment
$CapC_t^f$ Consumption of fixed capital firms	Eurostat	Consumption of fixed capital of non-financial corporations.
$CapC_t^b$ Consumption of fixed capital banks	Eurostat	Consumption of fixed capital of financial corporations.
Cr_t^f Additional credit firms	Calculated	Calculated by the change of $Debt_t^f$.
Cr_t^{HH} Additional credit households	Calculated	Calculated by the change of $Debt_t^{HH}$.
$Cr_t^s t$ Additional credit state	Calculated	Calculated by the change of D_t^f.
D_t^{st} Debt state	Datastream	Italy general government debt in current prices.
$Debt_t^f$ Debt firms	Eurostat	Financial liabilities of non-financial corporations.
$Debt_t^H$ Debt state	Datastream	Financial liabilities of households.
$GFCE_t$ State Consumption	Eurostat	Final consumption expenditure of the general government.
inv_t^{st} Investment state	Eurostat	Gross fixed capital formation of the general government.
inv_t^f Investment firms	Eurostat	Gross fixed capital formation of non-financial corporations.
inv_t^b Investment banks	Eurostat	Gross fixed capital formation of financial corporations.
inv_t Total Investment	Eurostat	Total investment of total economy.
L_t Total population	Eurostat	Total population in 1000 of persons.
L_t^D Total employment	Eurostat	Total employment national concept in 1000 of persons.
O_t^f Operating profit firms	Eurostat	Net operating surplus and net mixed income of non-financial corporations.
r_t^s Saving Interest	Datastream	Euro one year syntactic datastream offered rate daily to yearly average; converted daily to year value by average
r_t^{cr} Credit Interest	WorldBankWDI	The average lending rate for a year was used as approximation for the the credit interest rate.

Continued on next page

Table 3.16 – continued from previous page

Model Variable	Source	Comment
S_t^{HH} Saving households	Eurostat	Currency and deposits of households.
S_t^f Saving firms	Eurostat	Currency and deposits of non-financial corporations.
str_t^{st} Social transfer	Eurostat	Social contributions and benefits paid by the general government of any kind.
T_t Taxes	Eurostat	Taxes received by the general government in a year.
U_t Total unemployment	Eurostat	Total unemployment national concept in 1000 of persons.
W_t^{HH} Wages	Eurostat	Net disposable income received by all households.
$Wcomp_t$ Compensation of employees	Eurostat	Compensation of employees of the total economy
$Wcomp_t^{st}$ Compensation of state employees	Eurostat	Compensation of employees of the state.
X_t Output	Eurostat	Gross domestic product Italy.

CHAPTER 4

Simulation and Scenarios

The econometric model presented in the previous chapter will now also be used to solve past and future values. Solving the model for past values derives the possibility to compare the performance of the model with the actual values which can be observed. Nevertheless, it is only an indication because the model was built with the already obtained future values. Firstly, the Gauss-Seidel and the Newton algorithm will be described. The latter was used to solve the model. Secondly, the historic performance, the back testing, will be presented. Finally, the results of future values will be interpreted with an economic perspective.

4.1 Computational Economics Methodology

This section will describe how the Gauss-Seidel and the Newton algorithms, used by Eviews to solve the system of non-linear equations. The system that will be solved is a set of equations F as

$$F(x_t, z_t) = 0, \tag{4.1}$$

where x_t is a vector of endogenous variables which are explained by z_t a vector of exogenous variables. For each year of available observations, this system will be solved. At first the equations are split into blocks of dependent equations. If there are equations which simultaneously depend on each other, these equations will be solvable by the Gauss-Seidel or Newton method. Otherwise the result may also be calculated individually (Quantitative, 2004).

In general, there is a system of the form

$$
\begin{aligned}
x_1 &= f_1(x_1, x_2, .., x_N, z) \\
x_2 &= f_2(x_1, x_2, .., x_N, z) \\
&\;... \\
x_N &= f_N(x_1, x_2, .., x_N, z)
\end{aligned}
$$

where the problem is to determine a fixed point $x = f(x, z)$. The Gauss-Seidel starts with an initial guess and iterates over the equation updating it to $x^{k+1} = f(x^k, z)$ until the change between the steps converge to meet the tolerance level. The problem is solved by calculating the root. A pseudo-code representation taken and adapted from (Pauletto, 1997, p. 37) is:

for $k = 0, 1, 2, ..until\, convergence$ **do**
  for $i = 1, ..n$ **do**
    $Solve\, for\, x_i$
    $f_i(x_1^{k+1}, ..., x_{i-1}^{k+1}, x_i, x_{i+1}^k, ..., x_n^k, z) = 0$
    $and\, set\, x_t^{k+1} = x_i$
  end for
end for

This means that the latest guess of a variable is always used for calculating the next step. All equations are sequentially calculated, just as they appear in the system and therefore a change in the order of the equations has an effect.

The Newton algorithm uses derivatives to calculate a linear approximation of the system, again initially through guesses. The partial derivatives of the system $F(x*)$ forms the so called Jacobian matrix $DF(x^k)$. The previous guess is then used to solve a linear equation system which is solved for s^k:

$$DF(x^k)s^k = -F(x^k)$$

the s^k is then added to the guess and leads to an alternate guess as

$$x^{k+1} = x^k + s^k$$

These steps are repeated until the change between the steps converges to a tolerance level. In contrast to the Gauss-Seidel method, the ordering of the equation does not matter (Pauletto, 1997, p.30).

4.2 Scenarios

This section describes the performance of the model how it performs by solving the model for the endogenous variables. The future values of the exogenous variables, the consumption of households, the net disposable income of households, taxes and social contributions by the state were generated by using Holt-Winters exponential smoothing. The interest rates for credit and savings were predicted by using the ICAP brokers's Swap quotation of 3 month Euribor interest rate swaps retrieved using the Datastream database. For the savings additional 50 basis point were added. The credit rate in Italy was in the past years 300 basis points higher than the saving rate and therefore the future lending values where derived by adding 300 basis points to the savings rate. The dummy variable stayed at "1" until 2015. The operating surplus of the firms dropped in 2010 to the level of 1996. The values from 1996 until 2000 were used for the prediction of the values of 2011 to 2015, assuming the same rise in profits.

4.2.1 Back testing

Figure 4.2.1 presents the result when the model was used to predict the values from 2006 to 2010. The drop in the capital stocks of the state, the firms and the banks was not anticipated. The equations assume an increase in the capital stocks by the corresponding investments. Therefore when the crisis started 2007 consumption decreased, the respective investment dropped as shown in figure 4.2.1. This dip would then be passed on to the capital stock equations and finally to the output. Because of the model structure the decline in investment only decreases the growth of the capital stocks but not the absolute volume.

The number of workplaces could be predicted quite well. The slower increase in capital stocks decreased the output of jobs. This can be interpreted that there is, on average, a trend in Italy that the output per worker of the GDP increases.

The related unemployment rate was overestimated by the model because the labour participation rate was predicted to be slowly decreasing as shown in figure 4.2.1. The increasing population paired with an increasing participation rate, while the labour demand decreased, caused a surge of the unemployment.

The capital side of the model was quite accurate in its ability to predict except regarding households as illustrated in figure 4.3 and 4.4. The saving behaviour was overestimated while the additional net credits were overestimated. This caused an increase in the households' stock variable.

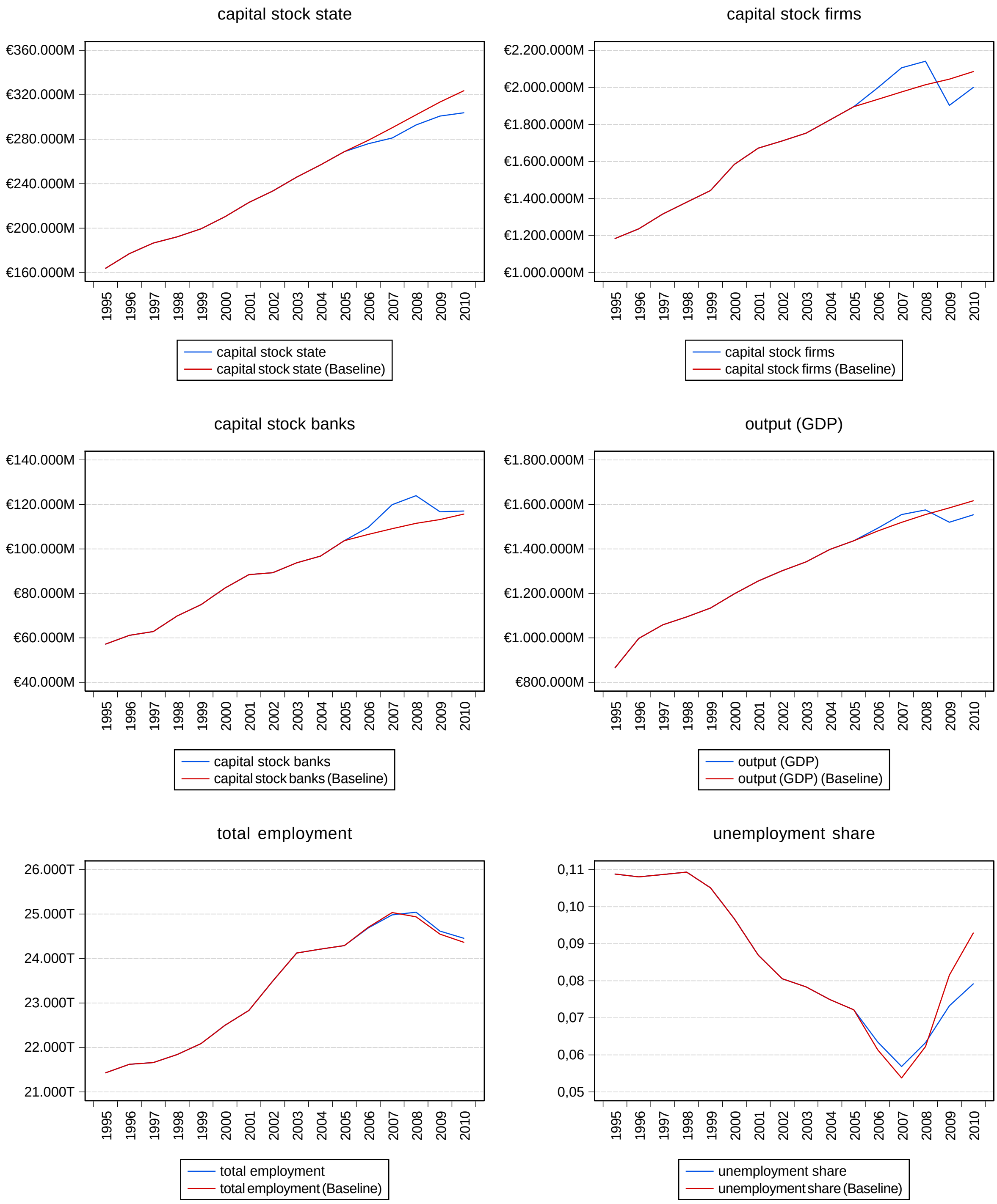

Figure 4.1: Historical performance output

Figure 4.2: Historical performance investment

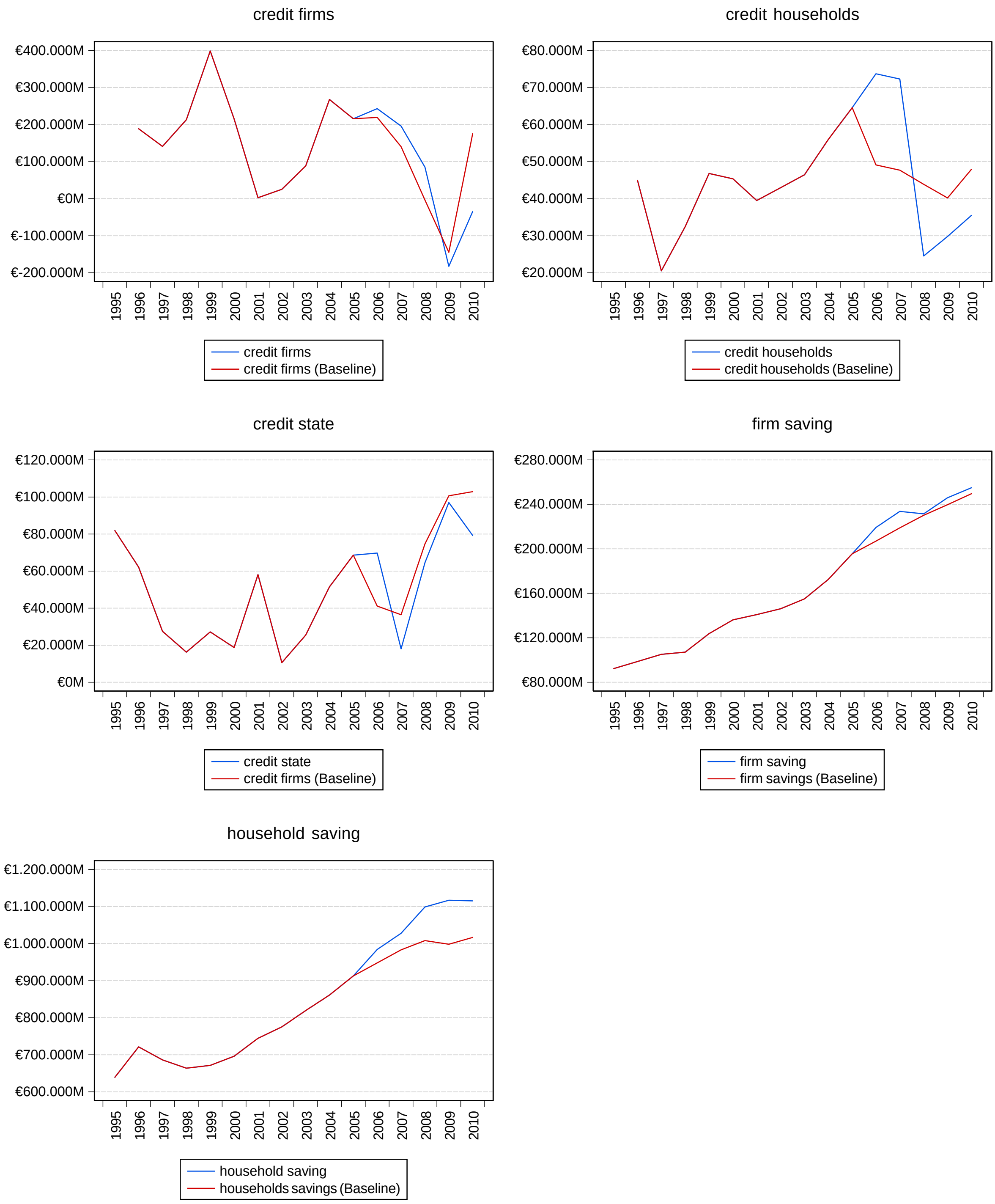

Figure 4.3: Historical performance credit and saving

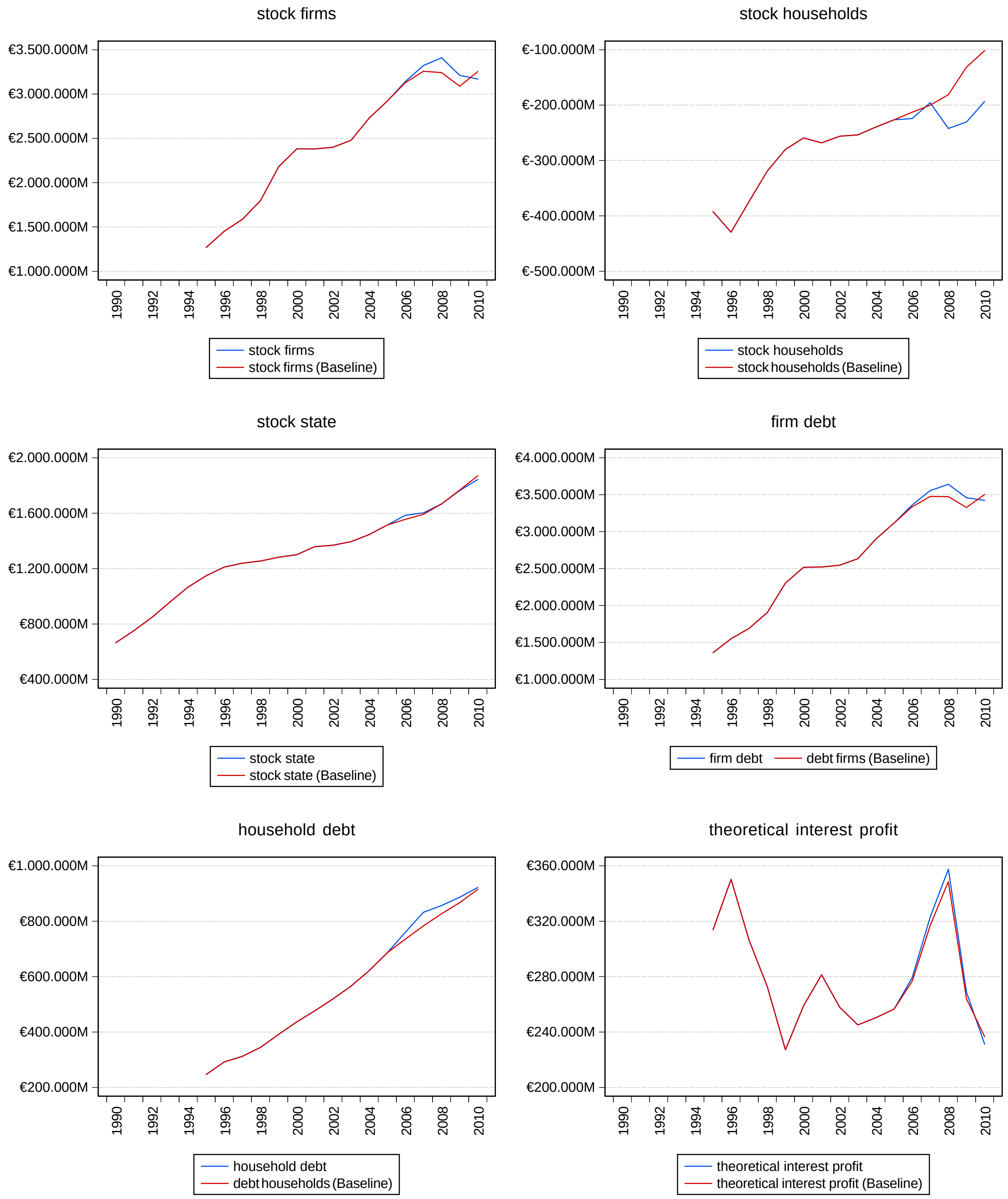

Figure 4.4: Historical performance stocks

4.2.2 Results & Economic Interpretation

The main result of the forecast is that under the assumption of continuous economic growth the unemployment rate will increase while the output increases. Italy has experienced a surge in its population since 2002 as shown in figure 4.6. The model does not differentiate between population growth and birth. Using the information obtained in section 2.1.3 about reproduction, the largest contributor of the population increase must result from immigration to Italy. Furthermore, comparing the employment by gender, using the Eurostat database (Table lfsa_egan), since 2003 on average there is a ratio of 60:40 of male to females workers. On the viewpoint of the participation rate, an increase of females working will increase the demand for available work vacancies even more.

As noted in (Hall & Papell, 2005, p. 111), for the United States, there has been a shift observed starting from 1961 to 2000 which showed a decrease of importance of labour growth. Especially after 1995 the major source of growth shifted to technological advancement rather than labour output. Comparing this to the results of figure 4.5 a shift from human capital stock to resources is noticeable.

A theoretical solution to solve the problem of rising unemployment is to limit the hours worked per week. Assuming a 40 hour working week and adding a discount factor h_t to equation 3.20 as

$$U_t = P_t \cdot L_t - L_t^D \cdot \frac{40}{h_t} \tag{4.2}$$

The model can now be solved again using the EViews function ”Solve control for target” and setting the unemployment share to the lowest level observed in 2007 constant. On average a decrease to 38.36 hours, under the assumption of no additional worked overtime, would keep the unemployment rate constant from 2011 to 2015.

Nevertheless it has to be noticed that $delta_1$ of the production function accounts for all growth effect of the GDP which can not be explained by a change in the capital stocks. Influences are the difference in imports/exports, technical progress and so on. For the forecast simulation, this factor is kept constant. In the next step this factor could be split into more distinct parts to derive more differentiated results.

The model has no feedback behaviour from the capital side of the model to the physical side. Figure 4.7 illustrates a decrease in additional credit for firms in the following years. The credit interest rise causes a push back of credits, which will reduce the possibility of firm investment. In reality this credit restraint could cause troubles especially for small manufacturers which are dependent on the local banking system, as described in section 2.3.3. An increase of the prime lending rate of the European Central Bank in the next years, to target inflation, could create even more problems for the physical side of the economy which is currently not reflected in the model.

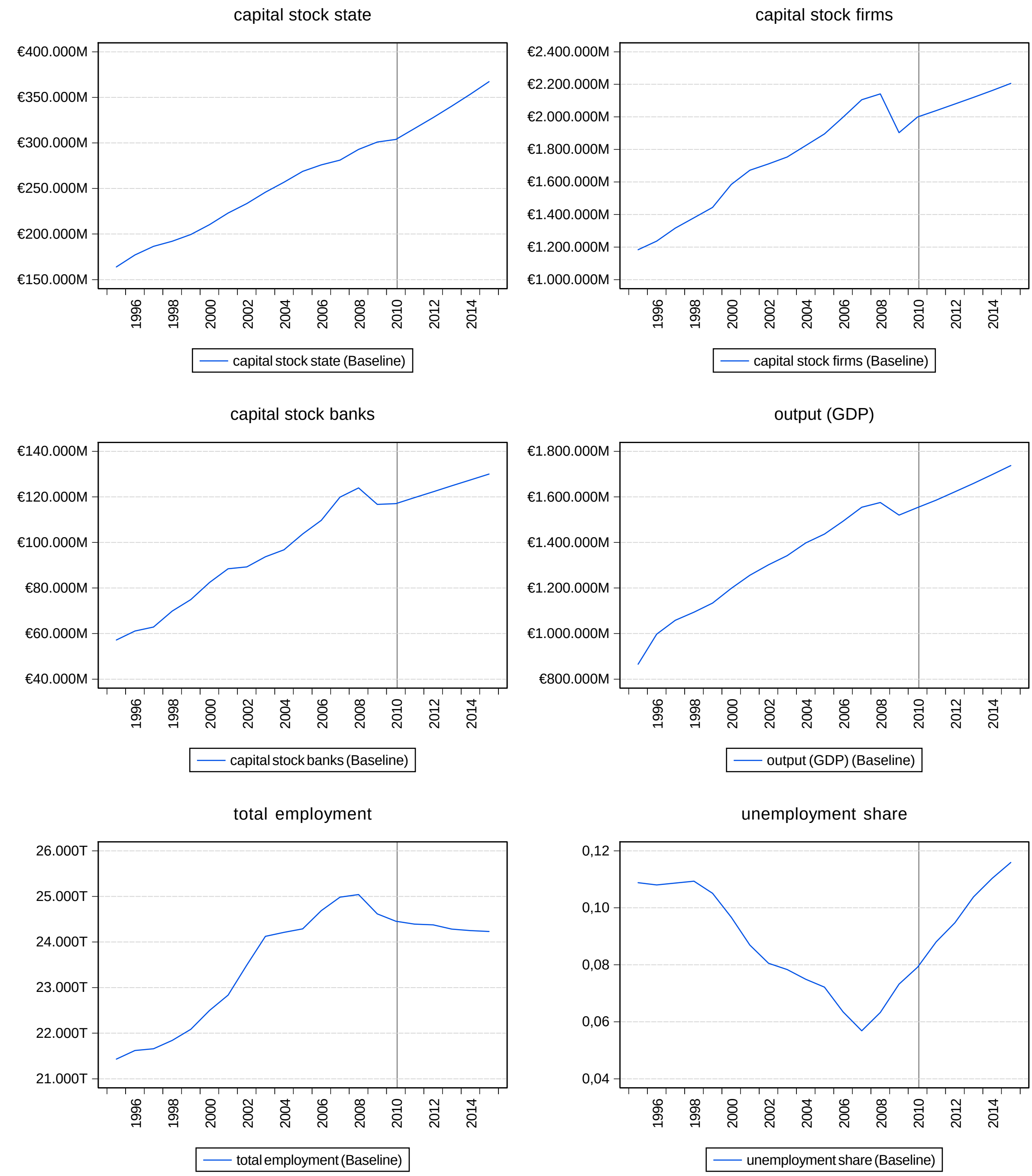

Figure 4.5: Continuous growth output

Figure 4.6: Continuous growth investment

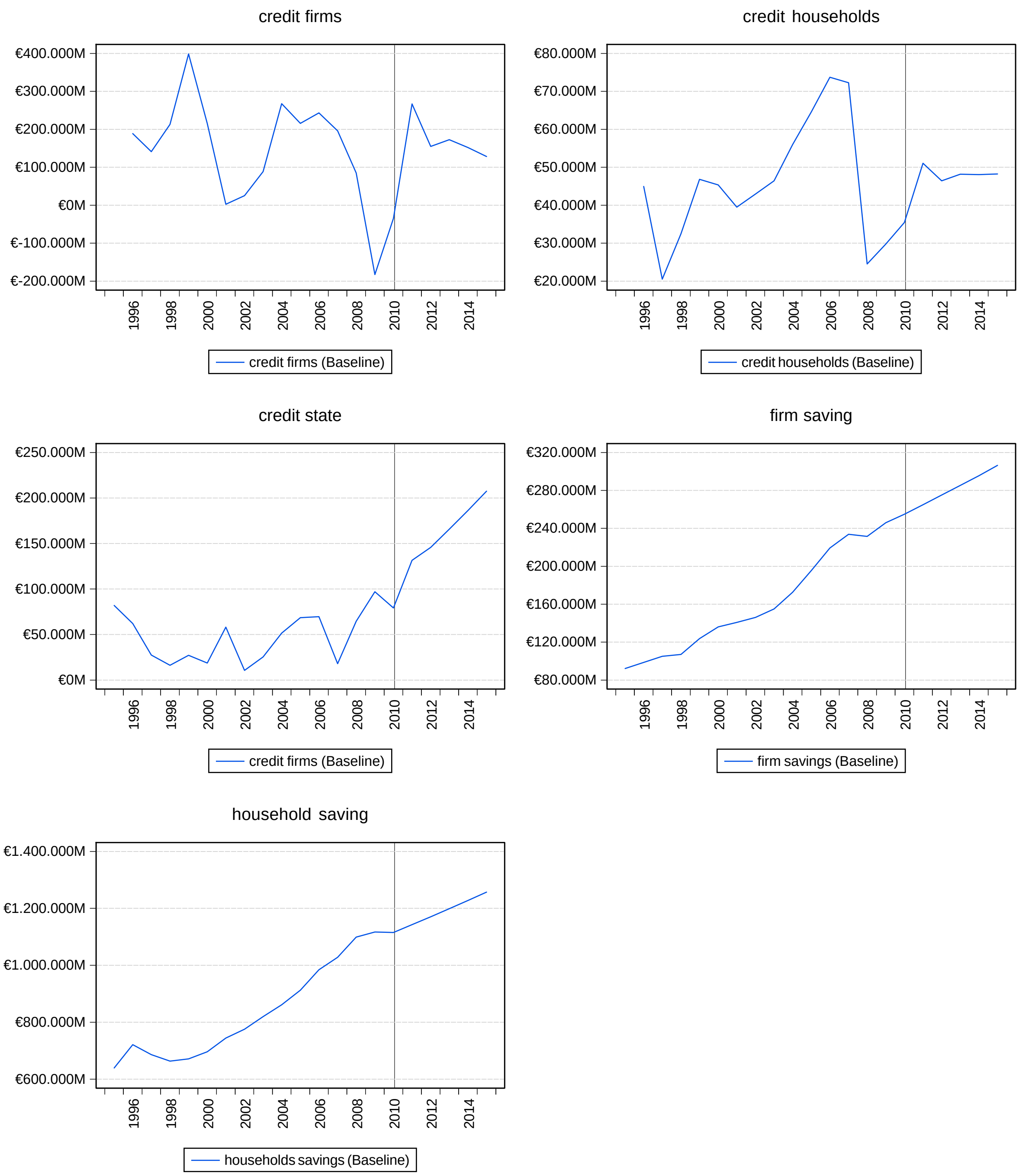

Figure 4.7: Continuous growth credit and saving

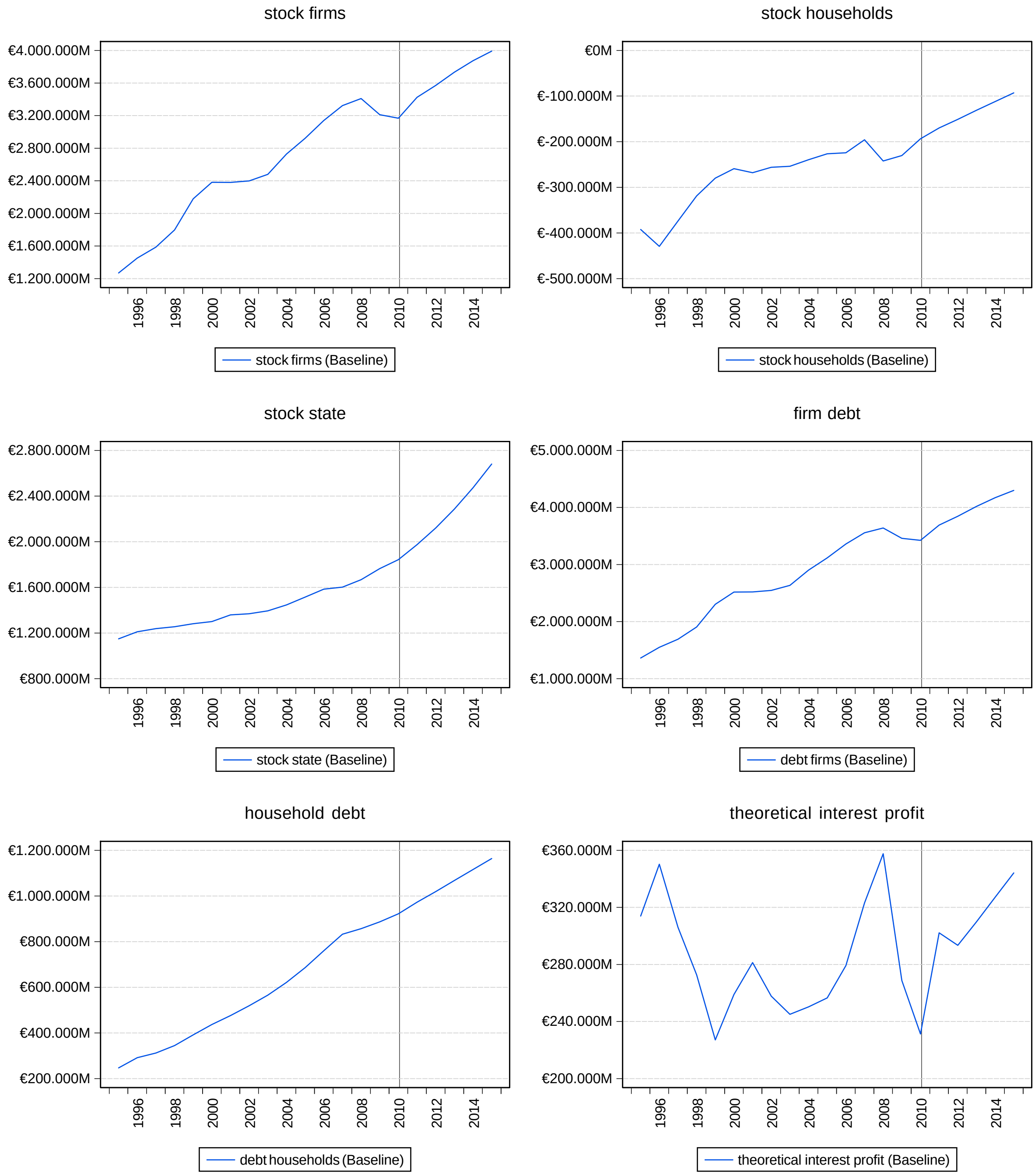

Figure 4.8: Continuous growth stocks

CHAPTER 5

Summary and Conclusion

The general objective of this thesis has been to discuss key aspects of the Italian economy and to analyse possible implications for the future. Italian people have been facing credit constraints for consumption which increased the saving rate compared to other OECD member countries. The difficult process for banks to repossess a house, if the loan defaults, increases the down payments for customer as protection. This is also has an effect on the social society level that young Italian people stay longer at home with their parents until they can afford to leave. The next implication is that a shift in consumption of the parents is noticeable. The older generations spend more money for their own consumption when they are older because before they are still supporting their children.

The credit restraints also affect a firm's decision to invest in research and development. In general, if a manufacturer conducts in-house R & D, which is done by a half of the manufacturers, a statistical significant increase of productivity can be observed. Investment into research activities mainly focuses on product innovation and process innovation, the latter is often required to make the production of new products possible. Another aspect of R & D is that it helps companies absorb newly emerged technologies and integrate them into their production process. On the financing side, for small companies the development of the local banking system has an impact. Banks monitor their credit takers and prefer financing of less risky projects such as fostering of process innovation rather than product innovation where the outcome is unknown. Nevertheless, some industries require capital intensive investment, such as high technology companies, and therefore external financing is important. Overall, there is a tendency to finance short term growth projects rather than long term, the later which could increase the long run productivity more.

All research activities undertaken by firms depend on the persons behind them, the human capital stock. The training intensity increases with the size of the firm,in particular the training method changes. Small companies prefer external training facilities while larger companies conduct in-house training. It gets even more important when high technology has to be used or the supervisor's task gets more complicated in the case of outsourcing.

The amount of credit interest firms and household pay is influenced, to some degree, by how much the governments pay for their debt. The introduction of the Euro in 1999 lets the government prices converge to the same level. For Italy this effect was delayed by a few years. During the period of 1999 to 2007 the European government market showed signs of integration with the exception of Italy. The integration got reversed to some extent when the financial crisis started in 2007. It is worth noting, that countries which did not introduce the Euro, such as Denmark, but which are members of the European exchange rate mechanism also profited from the stability of a common currency.

The model that was used for the simulation is mainly based on Hanappi (2011) and with some extension from Hall and Papell (2005) and Gandolfo and Padoan (1984). It considers stocks and flows and how they have been growing over the past years and their influence was analysed. The firm's debt is the highest in Italy, followed by the state and then the households. The model itself does not differentiate between foreign debt and saving and therefore in a future extension this should be considered to get a much clearer picture of Italy. The firm agent could also be split up into industry sectors to differentiate their contribution to economic growth. A more detailed data set, which contains the quarterly data, could also improve the model even further. Unfortunately it was not possible to obtain more detail information data to investigate these assumptions.

The forecast simulation under the assumption of continuous growth showed that Italy could face unemployment issues in the next years. The productivity is increasing but the number of needed workers is decreasing, paired with a high population growth rate mitigation action might get necessary. A theoretical solution would be decreasing the number of allowed working time by 2 hours which might not be very likely in reality. The model at the moment assumes constant technical progress and in a future version this could help to find alternative solutions for the unemployment rate which is right now out of the simulation's scope.

CHAPTER 6

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