

WDA Forum



University of St.Gallen

The WDA – HSG Discussion Paper Series

on Demographic Issues

A Truly Impossible Equation: The Future of Welfare States in Times of Demographic Ageing

*by Marc Trippel, Dmitry Kulikov, Zlatil Davidov
& Hans Groth*

No. 2011/10



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Universität St.Gallen

Hochschule für Wirtschafts-, Rechts- und Sozialwissenschaften

(HSG)

A Truly Impossible Equation: The Future of Welfare States in Times of Demographic Ageing

The impact of demographic shifts on public debts in Europe, the US, and Japan:

Current situation and evolution until 2030

Demography as a “stress factor” for public budgets

Public indebtedness – scenario analyses

Three proposals for sustainable fiscal development

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1 Executive Summary

The financial crisis that started in mid-2008 continues to disrupt the Euro-zone as well as other OECD countries and has led to an increasingly uncontrolled expansion of public debt. Additionally, the threatening bankruptcy of entire states is currently widely discussed. Governments were forced to increase their gross governmental debt dramatically in order to recapitalize banks. Also, they needed to introduce large stimulus programmes to revive demand. These actions were indispensable in order to ensure the success of the fragile global economic recovery. This, according to the OECD, led to the drastic increase of the industrialized countries' average rate of indebtedness during 2007-2010 – an increase of 25% in terms of gross government debt relative to gross domestic productivity (Debt-to-GDP). Consequently, the bankruptcy of Greece seems only a matter of time while the budgetary situation for Spain, Portugal and Italy as well as Belgium and France turns out to be critical.

Throughout history, there have always been periods of high public indebtedness for industrialized countries. An example is the period after World War II with debt levels of 121% for the United States and 300% for Great Britain. The current situation is different however, due to the unfolding demographic shifts and the resulting unprecedented consequences. The demographic developments for Western Europe, the United States and Japan forecast stagnating or shrinking workforces and fast growing retirement populations. This goes hand in hand with exploding social spending commitments and lower economic growth rates – all in all *“a truly impossible equation”*.

The topic of this paper is to analyze the impact of demographic change, and ageing in particular, on public debt levels for the European Union, the United States and Japan until 2030. An extensive status-quo analysis has been conducted followed by projections for the next 20 years. A *“Demographic Stress Indicator on Governments Budgets”* has been developed in order to measure the demographic burden on public debt. Finally, three different frameworks are suggested which all aim at fighting high and non-sustainable debt levels. They are either on the financial market-, on the policy- or on the civil society level.

- *“ageing bonds” to immediately escape from the “debt-trap” and bankruptcy*
- *a “balanced shift” towards more private financing of health care and retirement schemes and increasing self-responsibility*
- *a “complementary currency” to reduce the financing stress associated with ageing*

Immediate actions are needed and unpleasant trade-offs have to be made!

As the current global fragility shows, the last decades' developments in terms of missing financial sustainability poses a serious threat to national and personal welfare as well as social stability of societies. Especially in the context of the structural changes in our society due to ageing, the proposed approaches open discussions to rethink future sustainable financing of our social systems.

2 Good-Bye Pyramids – Governance of Social Welfare States has to be Reengineered

Throughout the creation of this chapter the Western nations, and in particular the EU, the US and Japan have entered an unprecedented phase of fiscal and economic uncertainty – a phase for which they are surprisingly little prepared, demonstrating no solid plan of action. At first glance this uncertainty is driven by growing instability originating in the financial markets themselves due to endogenous weaknesses of their governance structures. However, at a closer look it turns out that the fundamental source of this growing skepticism is located somewhere else: Governments and their policies represent the true epicenter. They are no longer capable to manage their national budgets in a way that is sustainable both from the fiscal perspective and from the perspective of their voters.

In the past 50 years the developed nations have built up social security-, welfare- and healthcare systems requiring huge amounts of transfer payments to a continuously growing number of ageing citizens. The source of these funds has either been tax money or public debts. In an environment with growing economies and only reasonable numbers of citizens entitled to receive state benefits it was easy to finance such transfer payments. Potential state budget shortcomings could easily be financed through government bonds because investors considered it as risk free to lend money to a state. Policy makers took advantage of this trust and continuously expanded promises to their voters in order to secure their re-election.

However, with the beginning of the 21st century this “business model” is no longer an option. A new all too long unnoticed force – demographic change – appeared. Till the midst of the 20th century population compositions of the Western societies were more or less based on the classical “pyramid” design – a model which had been valid for more than 3000 years. Such a “pyramid”-based population structure made it very easy to promise and subsequently grant generous transfer payments. The justification and rationale behind this was quite simple: The number of those entitled was lower or at least in a fair balance with the number of those who financed these entitlements through taxable income from their hard work. This is why Otto v. Bismarck faced no obstacles when he introduced a state run social security system in 1883. He gave promises to those who never qualified for these entitlements. His rationale couldn't be better summarized than the following quote: *My idea was to bribe the working classes, or shall I say, to win them over, to regard the state as a social institution existing for their sake and interested in their welfare.*¹

However, constant low fertility rates since the 1960s and continuously increasing longevity since more than 150 years² resulted in a novelty in the history of mankind: The “good-bye pyramids”- phenomenon.

¹ „Mein Gedanke war, die arbeitenden Klassen zu gewinnen, oder soll ich sagen zu bestechen, den Staat als soziale Einrichtung anzusehen, die ihretwegen besteht und für ihr Wohl sorgen möchte“
– OTTO VON BISMARCK: Gesammelte Werke (Friedrichsruher Ausgabe) 1924/1935, Band 9, S.195/196

² For example, Switzerland's life expectancy at birth has reached unprecedented > 80 years for both men and women in 2010 for the first time.

Even though there is no escape from this ongoing demographic evolution, civil societies, their governments and their economies have so far been very reluctant to address these developments. The unsolved task is to redesign states, societies, and businesses into a new governance model in which their citizens not only *want* to live, work and retire in but also in which they *can afford* to live, work and retire in.

This ongoing demographic shift is the fundamental driving force for (1) what has become evident in the financial markets and (2) the challenges states are facing today when trying to meet their financial obligations. In the future these obligations can only be fulfilled by confidence and trust based on a solid plan of action on how to manage the demography realities of the 21st century.

Any plan of action is about designing a new civil society with governance models which take a country's demographic pattern – without any short-minded compromises – into account. The new “demographic tree” of the 21st century consists of a slim right-angle with a “Matterhorn”-peak on the top (Figure 1). This new composition is the result of the great achievements in the 19th and 20th century in life sciences, business and society: (1) good health, (2) comfortable living circumstances and (3) the freedom of men and women to make their free choices about their lives and their family planning.

Good-bye Pyramids

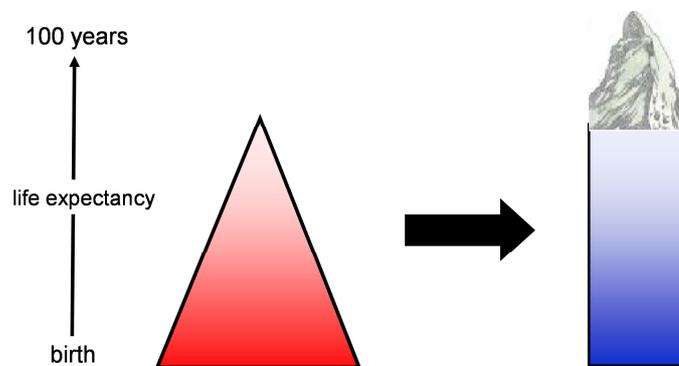


Figure 1: The new “demographic tree” of the 21st century: A slim right-angle with a “Matterhorn”-peak on top.

This WDA Forum discussion paper “*A truly impossible equation: The future of welfare states in times of demographic ageing*” prepared by three engaged HSG Master Students – Marc Trippel, Dmitry Kulikov and Zlatil Davidov – is the final version of many discussions and expert inputs since March 2011. Following a detailed description of the impact of demography on growing public debts in Europe, the US, and Japan, these students have developed – on the basis of thorough demographic analysis – a stress indicator for public budgets. In a second step they describe a scenario analysis of the future of public indebtedness.

Finally, they propose three unique solutions for a sustainable fiscal future – a future which fully reflects the demographic realities until 2030:

- an immediate and bold financial market approach
- an highly sensitive policy or governance approach based on a new balance between self-responsibility and solidarity
- a long-term civil society approach with new roles and responsibilities

There is no doubt: Since the facts are obvious and clear, these three levels are platforms for any actions to be taken by ourselves and the societies we all are part of. The only level not covered in this paper is a fourth and equally critical one: It is the role of innovation.

As such, this paper is a call for action from the engaged young generation which is ready to take responsibility for our and their future. However, any successful implementation of a new civil society contract depends on the capability to redefine solidarity and to design a new contract between generations.

Dr. Hans Groth, November 2011

3 Introduction

The financial crisis that erupted in mid-2008, convulsing the Euro-zone in 2010, striking Greece in particular led to an explosion of public debt nearly everywhere. Governments were forced to increase their gross governmental debt dramatically in order to recapitalize banks (for example UBS in Switzerland, Citigroup in the U.S. and Hypo Real Estate in Germany) and to introduce large national stimulus programmes to revive demand (for example the American Recovery and Reinvestment Act of 2009 with \$ 787b up to date³). These actions were indispensable in order to ensure the stability of the fragile global recovery. Moreover, whole countries found themselves at risk for state bankruptcy. This, according to the OECD, led to the drastic increase of the industrialized countries' average rate of indebtedness during 2008-2010 – an increase of 24% in absolute terms of gross government debt relative to gross domestic productivity (debt-to-GDP). Consequently, the bankruptcy of Greece seems only a matter of time, as the budgetary situation for Spain, Portugal, Italy, and recently also Belgium and France, is increasingly fragile.

In this context, the comparison of indebtedness for private households, enterprises and governments in OECD countries is of particular interest. While private persons and enterprises showed a stable debt ratio since 1997, public indebtedness increased by over 50% until 2007 and exploded further by an additional 51% since 2007 until the end of 2010⁴ (Figure 2). The common rationale of lavish governmental spending policy due to relatively unrestrained control mechanisms is not reflecting the “full truth”, hence the already now occurring demographic effect of population ageing starts to be observed in these countries' social security budgets.

³ Source: www.recovery.gov, Overview of funding

⁴ Source: OECD, Central Government Debt

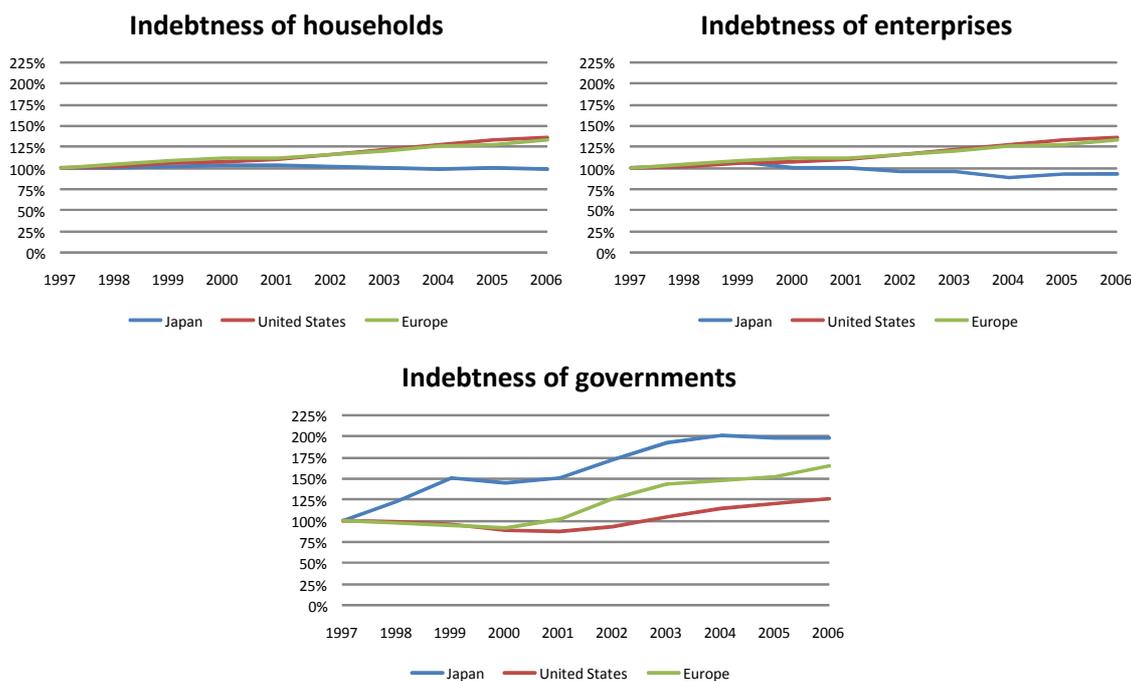


Figure 2: Indebtedness of private households, enterprises and governments 1997 – 2006 (1997 = 100%). Source: OECD, The crisis and beyond, 2010.

Throughout history there have always been periods of high public indebtedness in industrialized countries. An example is the period after World War II with levels of 121% for the United States and 300% for Great Britain. More recently, Japan showed debt rates of 150% and above in the last two decades despite high levels of productivity. Increasing tax revenues from a growing working age population and higher productivity rates due to competitiveness and innovation was in the past the key mechanism for keeping public debts in balance. The current and future situation is different due to the changing demographic situation and its corresponding consequences. Population forecasts for Western Europe, the United States and Japan show stagnating or shrinking workforces and increasing retirement populations. This goes in hand with exploding social welfare spending commitments and lower economic growth rates.

4 Status quo – 2010

The following chapter gives an insight into the global demographic transformation and current public debt situation for countries in Western Europe, the United States, and Japan.

4.1 Demographic Transformation

The world is in a fundamental demographic transformation process where population ageing is a central element. In 2009, an estimated 737 million people worldwide were aged 60+ years of which 56% lived in developing countries. Based on the forecast of the United Nations Population Division (Population Ageing and Development 2009), the amount of elderly people (60+ years) will increase by a factor of 2.7 until 2050 on a global scale; in percent of the world’s total population it will be doubling from 11% in 2009 to 22%.

This is a result of the unprecedented increase in global life expectancy from 48 years in the mid-20th century to 68 years in 2010. By 2030, average life expectancy at birth is to reach 85 years in developed countries. Fertility rates below reproduction levels, particularly in the developed regions, further accelerate the ageing process of those societies. Nevertheless, the extent of ageing differs significantly between within countries. Japan’s population, for example, is the oldest worldwide, with already today over 22% of the population being 65 years or older. Figure 3 shows the development and forecast of ageing in Japan, the European Union and the United States. The forecast of the United Nations Population Division expects an increase of elderly (65 years and older) people until 2030 of 36% for Japan, 52% for the United States and 39% for Europe.

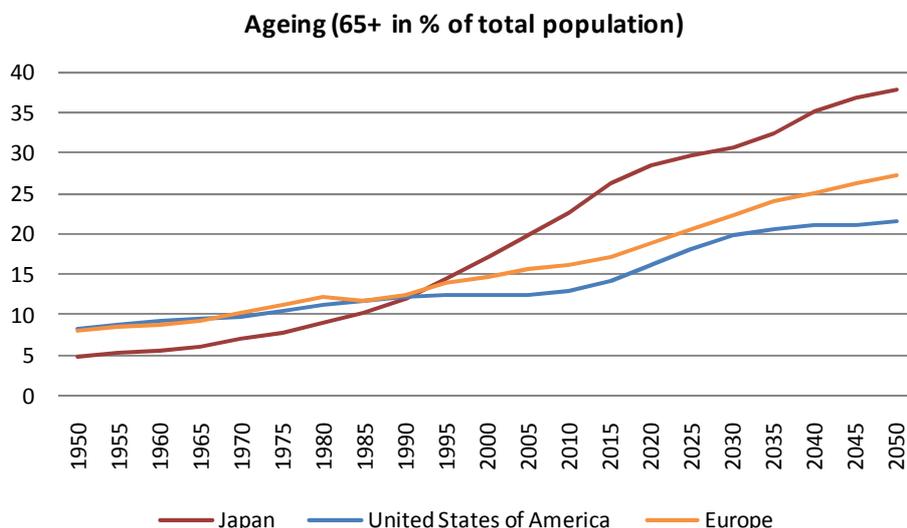


Figure 3: Evolution 1950 -2050 of the percentage of population aged 65 years or older for Japan, the United States and Europe. Source: United Nations, World Population Prospect (2010 Revision).

These demographic changes are taking place within the context of the existing social security framework, institutional structures and benefit programmes. Even though there is a wide variation of the scale and scope of social commitments between countries, demographic

changes already now affect nearly all countries' budgets. Therefore, the high senior-age share will have significant implications for government finances, the financing of health care services and economic security while governments are simultaneously facing a decreasing working population⁵. In the coming two decades, especially developed nations will be massively affected due to the unprecedented high speed of population ageing and ongoing low fertility.

4.2 Demography as “Stress Indicator” on Government Budgets

In order to capture this transformation, we designed a new “demographic stress indicator”. This measure provides an indication of the “budgetary stress” associated with ageing in comparison to other countries. Ageing is a lasting and increasing “modulator” to national economies as well as their governmental budgets and finally, public indebtedness.

Firstly, the comparison of the age dependency ratio until 2030 offers an insight into the impact of ageing among countries. The growth rate of the age dependency ratio – the quotidian of the retirement population with 65 years and older to the working population with 16 to 64 years – is conventionally used to measure the additional “stress” on government budgets from a demographic view until 2030. The rationale: when people are retiring, they are no longer part of the taxable productive age-group within a population.

		2010	2015	2020	2025	2030	2010-30
Europe	Austria	26.0%	7.5%	8.2%	13.7%	18.6%	56.7%
	Belgium	26.5%	10.0%	9.0%	10.6%	10.6%	46.6%
	Finland	26.0%	23.6%	15.4%	9.6%	7.0%	67.2%
	France	25.9%	14.1%	11.6%	8.7%	8.4%	50.0%
	Germany	30.9%	6.4%	9.8%	12.9%	18.2%	55.9%
	Greece	27.8%	6.6%	7.1%	7.7%	8.4%	33.2%
	Ireland	17.4%	14.2%	13.0%	10.8%	10.6%	58.1%
	Italy	31.1%	8.5%	6.6%	7.8%	12.7%	40.6%
	Luxembourg	20.3%	2.7%	6.7%	11.1%	13.3%	37.9%
	Netherlands	22.8%	19.6%	14.1%	13.9%	14.4%	77.8%
	Norway	22.1%	17.3%	9.9%	10.9%	8.9%	55.7%
	Portugal	26.7%	9.7%	9.1%	10.6%	13.4%	50.0%
	Spain	25.0%	8.4%	6.7%	11.0%	14.2%	46.6%
	Sweden	27.9%	14.3%	6.9%	4.7%	6.0%	35.6%
	Switzerland	24.5%	13.5%	11.4%	12.9%	16.6%	66.5%
United Kingdom	25.2%	10.6%	5.7%	6.9%	9.4%	36.6%	
Americas	U.S.	19.6%	13.1%	14.2%	15.2%	12.0%	66.6%
	Brazil	10.4%	13.5%	17.0%	20.7%	20.7%	93.4%
Asia	China	11.3%	15.2%	29.0%	18.0%	20.4%	111.1%
	India	7.6%	8.0%	15.3%	14.8%	12.5%	60.9%
	Japan	35.5%	22.0%	11.3%	4.4%	5.2%	49.1%

Table 1: Change (in %) of age dependency (65+ years to the working population with 16-64 years) for selected countries. Growth rates for each 5 year periods are calculated. . The last column shows the total change in the age dependency ratio from 2010 until 2030. Source: United Nations, World Population Prospects (2010 Revision).

⁵ Bloom, D. & R. McKinnon (2010): *Social Security and the Challenge of Demographic Change*. HSG Discussion Paper Series, No. 2010/9, WDA Forum, University of St. Gallen (HSG), 2010.

Table 1 provides an overview of the demographic stress arising from ageing which is due to the growth rates of retirees in relation to the working population. In Europe, Finland, the Netherlands and Switzerland show the highest growth rates whereas globally China and Brazil are affected the most. Generally, ageing is a transition process which is lagged in time on a global and even regional scale as the example Europe shows. Therefore, the current and future level of society-ageing has to be taken into account in order to provide a meaningful indicator on the “demographic stress” of a given country.

Commonly, three main sources of social costs are associated with ageing: 1. old age pensions, 2. health care provision and 3. long-term care & nursing. Assuming that the cost structure is linear, the public age-related spending behaves in line with the increasing amount of retirees. This might be a valid assumption for old age pensions but doesn't apply to health care and long term care. The changing morbidity patterns in ageing societies with an exponential prevalence growth of non-communicable diseases (NCDs) will challenge this as we possibly underestimate total long term care costs. Of all these NCDs, dementia has the most significant public health impact. No other disease causes such massive and progressive losses on quality of life, personal independence, mobility and mental performance. Moreover, the implications for family and social security systems in terms of financing of care and nursing are immense.⁶

Hence, based on the status quo of the age-related spending, a new “*demographic stress indicator*” has been calculated as the sum product of age-related spending and the 65 plus population in a given country. Additionally, the change in the age dependency ratio is also considered to reflect the loss in productivity. This allows indexing as well as an easy comparison between countries, captures the impact of ageing and provides a forecast of “demographic stress” on public debt.

⁶ Groth, H. & F. Gutzwiller (2011). *The Future of Dementia: Dimensions of midterm challenges for developed nations followed by a closer look at Switzerland*. The WDA-HSG Discussion Paper Series on Demographic Issues. No. 2011/6. WDA Forum, St. Gallen.

		Age-Related Spending of GDP	Age Dep. Ratio	INDICATOR				
		2010	2010	2010	2015	2020	2025	2030
Europe	Austria	21.5%	26.0%	3.8	4.1	4.5	5.1	6.0
	Belgium	21.8%	26.5%	3.8	4.2	4.6	5.0	5.5
	Finland	19.5%	26.0%	3.4	4.2	4.8	5.2	5.6
	France	24.9%	25.9%	4.2	4.8	5.3	5.8	6.3
	Germany	20.0%	30.9%	4.1	4.4	4.8	5.3	6.2
	Greece	18.6%	27.8%	3.5	3.7	4.0	4.3	4.7
	Ireland	12.1%	17.4%	1.4	1.7	2.0	2.4	2.7
	Italy	22.4%	31.1%	4.6	4.9	5.3	5.7	6.3
	Luxembourg	16.5%	20.3%	2.3	2.4	2.6	2.9	3.4
	Netherlands	16.1%	22.8%	2.5	3.1	3.6	4.1	4.7
	Norway	18.2%	22.1%	2.7	3.2	3.6	4.0	4.4
	Portugal	20.8%	26.7%	3.7	4.1	4.6	5.1	5.7
	Spain	16.9%	25.0%	2.9	3.1	3.4	3.8	4.4
	Sweden	21.6%	27.9%	3.9	4.5	4.7	4.9	5.2
Switzerland	16.3%	24.5%	2.7	3.2	3.6	4.0	4.7	
United Kingdom	15.7%	25.2%	2.6	2.9	3.1	3.3	3.7	
Americas	U.S.	10.8%	19.6%	1.4	1.7	2.0	2.5	2.8
	Brazil	13.6%	10.4%	1.0	1.2	1.6	2.2	2.8
Asia	China	4.4%	11.3%	0.4	0.6	1.0	1.4	1.8
	India	2.6%	7.6%	0.1	0.2	0.4	0.6	0.8
	Japan	18.80	35.5%	4.3	5.2	5.7	5.9	6.2

Table 2: "Demographic Stress Indicator on Public Budget": Age-related spending in % of GDP, age dependency ratio (65+ years to the working population (16-64 years)) and the new "Stress Indicator" calculated as age-related spending multiplied with age dependency ratio plus the % change in the dependency ratio over time. Sources: United Nations, World Population Prospects (2010 Revision); Standard & Poor's Global Credit Portal, Global Ageing 2010.

Countries with high age-related spending relative to GDP are exposed to high demographic pressure. Spending levels of 19% and more implicate severe "demographic stress", while at the same time ageing occurs and significant spending cuts remain unlikely. With the baby boomers retiring in this decade as well as continuing below replacement fertility rates, a further budgetary stress seems inevitable. According to our index, highest "demographic stress" is expected in Central Europe (France, Italy, Germany, and Austria) and Japan, but we can also observe the fast changing demographic structure in less developed countries such as China. However, under the given assumptions, China and India are most likely facing less "demographic stress" within the observed period till 2030.

From a demographic point of view, increasing pressure on governmental budgets is a global phenomenon. Countries which currently already face high levels of age-related spending are likely to be challenged most by the evolving demographic shifts and how to finance them⁷.

⁷ Groth & Eberstadt (2010): *Demography and Public Debt: The Crisis Beyond*, Wall Street Journal, 2010.

4.3 The European Union

The development of public debt and budget deficits are a burning issue in literally all Western Europe states nowadays. Recently, one of the most widely discussed topics in political debates is the future course of fiscal policy and the sustainability of public finances⁸. With the financial crisis starting in 2008, the common public debt related indicators such as the gross domestic debt over the gross domestic product (Debt-to-GDP) increased dramatically. Nevertheless, over many decades and in most Western European countries public debt had ratcheted up as a shock absorber – rising in bad times but not really declining in good times⁹. The last rise, however, goes hand in hand with an unprecedented demographic change. As a consequence, working age cohorts will shrink. At the same time, 65+ and 80+ populations in particular will increase dramatically resulting in higher ageing-related state commitments. The inevitable overspending poses a threat for the wealth and stability of future generations due to the open question in financing future liabilities.

Demographics

The life expectancy in Western Europe is among the highest in the world. Leader in Europe is Iceland, followed by Switzerland (80.1 for males and 84.5 for females¹⁰). An increase in life expectancy, alongside with on-going sub-replacement fertility rates is resulting in an accelerated ageing of the population in Western Europe. Depending on the forecast, the retirement group (aged 65 +) is increasing by up to 50% until 2030. If this goes hand in hand with negative population growth such as for example in Germany or Italy, the working age population is not only declining but also has to finance a greater amount of people at the same time. However, some countries (like Switzerland) may be able to keep their working population quite stable due to a strategy of high migration levels.

Debt

The government deficits and debt levels in Europe, in particular Greece, Ireland, Italy, Portugal, and Spain (the “PIIGS”) forced the EU and the IMF to speak a €750 bn rescue package aiming to ensure financial stability and to demand harsh austerity measures¹¹. The Greek bail-out of €110 bn in May 2010 was followed by a €85 bn rescue package for Ireland in November 2010 and a €78 bn bail-out for Portugal in May 2011. Moreover, the outlook for the European Union has never been grimmer due to the omnipresent refinancing problems.

The public debt level of the Euro area is €7.063bn, equal to 78.7% of GDP as of 2009. As a result of the financial and economic crisis, the public deficit as of 2009 increased in this area by €801 bn¹². Figure 4 shows that gross debt to GDP ratios were on high levels already before the crisis, but increased massively since 2007.

⁸ Neck, R. & J. Sturm (2010): *Sustainability of public debt: introduction and overview*. Massachusetts Institute of Technology, Cambridge, 2008.

⁹ IMF staff position paper (2010): *Long-term trends in public finances in the G-7 economies*. International Monetary Fund, Washington.

¹⁰ Bundesamt für Statistik, Bevölkerungsbewegungen – Indikatoren: *Lebenserwartung 2010*.

¹¹ BCC News (2010): *EU Ministers offer 750bn euro plan to support currency*, May 10, 2010.

¹² European Commission, Eurostat: *General government gross debt*, September 2010.

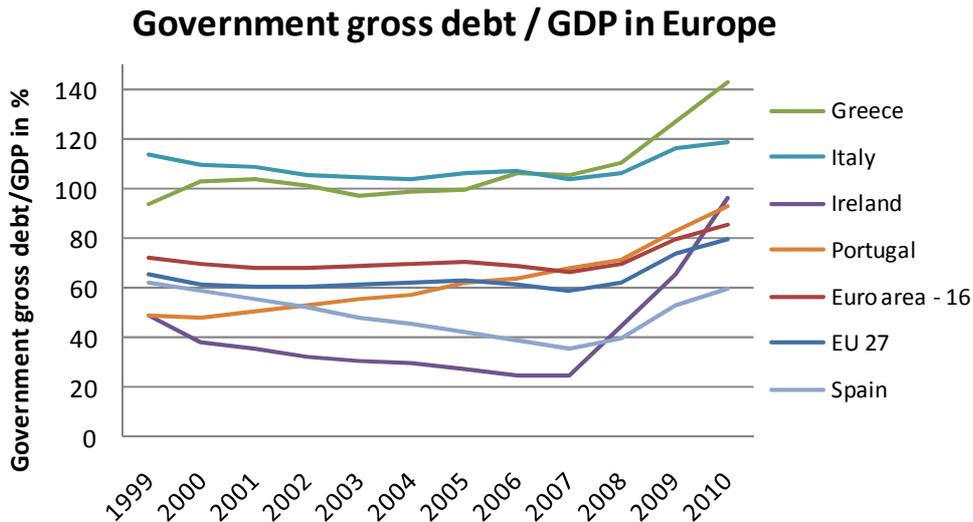


Figure 4: Development of the government debt/GDP ratio for the Euro area and selected countries (PIIGS). Source: Eurostat, General governmental gross debt, 2010.

Governmental bonds are usually called as risk-free¹³. Nevertheless and as depicted in figure 5, the near-default of some countries dramatically increased their bond yield spread and their risk insurance on Credit Default Swaps spread (measures the gap of the observed capital costs to the risk free capital costs, which implicitly is the risk premium)



Figure 5: Credit Default Swaps for Europe, Japan and the United States between 2000 and 2010. Source: Bloomberg, 2010.

The recent and ongoing downgrading of some EU member states' credit ratings highlighted the lack in confidence of the financial markets. Doubts arise that these governments are able to pay back their obligations. For some governments, the conditions to raise their debt level in the future significantly deteriorated. At the same refinancing existing debt becomes more expensive resulting in a "debt trap", implicating that some countries are forced to make new debt in order to pay the current interest of previously issued government bonds. In their global outlook 2010, the IMF stated: "widespread public scare across major advanced economies appears unlikely". However and as of end of 2011, the question how long the "stable" EU

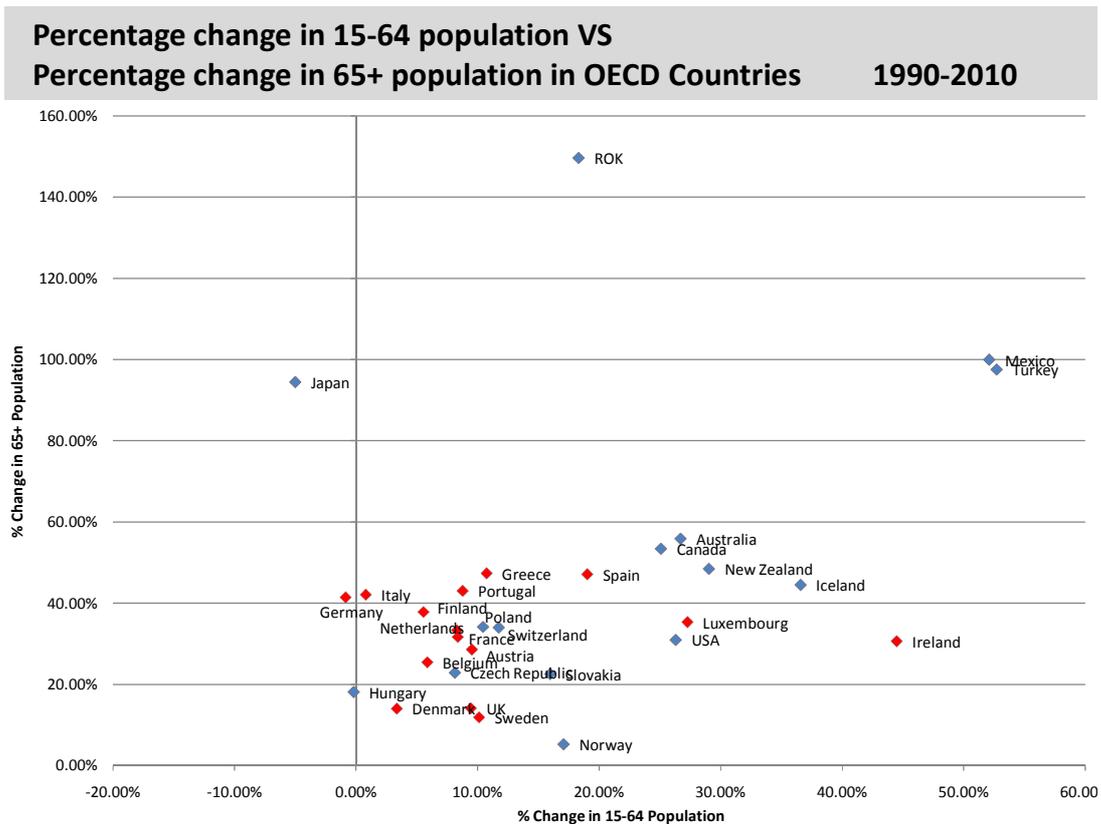
¹³ Bank of International Settlement (2010): *The future of public debt: prospects and implications*, working paper.

member states are going to finance the “PIIGS” in case these fail to reduce their deficits is discussed with increasing intensity. In order to reduce these budget deficits, the Swiss “Schuldenbremse” got attention as a possible austerity measure and numerous countries have discussed how to implement such a tool in their fiscal policy. It is noteworthy to mention that Switzerland is the only developed countries that managed to reduce the budget deficit throughout the crisis.¹⁴

Risk indicator

Demographics are neither the main reason nor the only rationale for the increasing public indebtedness. Nevertheless, the demographic change, especially ageing, is an increasingly important driver to public indebtedness. Therefore, we aim to design a demographic risk indicator in order to quantify the demographic stress on public budgets.

The dependency ratio as the quotient of non-working to working population will increase significantly in literally all European countries within the next two decades. In 1990, the average dependency ratio was around 25%, meaning that four people would work or finance one dependent of the retirement age group. This ratio is constantly worsening and will stabilize at approximately “two working for one” from 2030 on. This implies a need to massively increase productivity and/or adjust social spending.



¹⁴ NZZ am Sonntag (2010): *Schuldenbremse wird zum Exportschlager*, October 10, 2010.

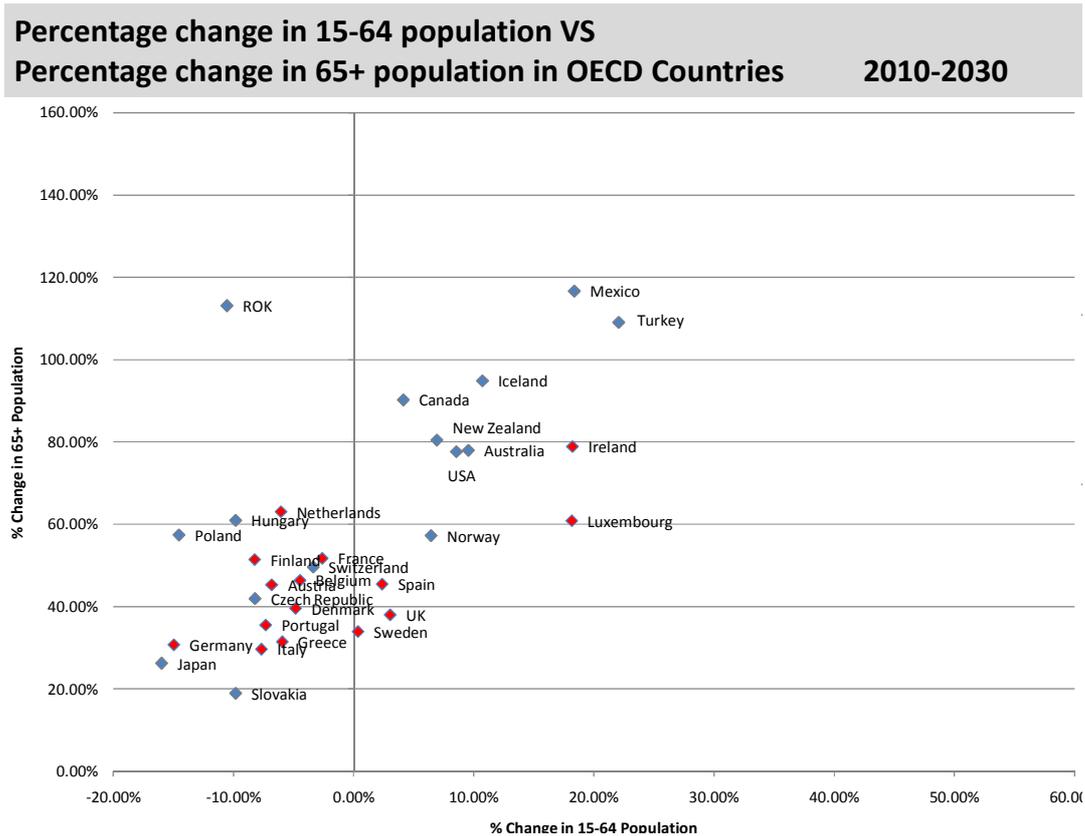


Figure 6: Accelerating increases in elderly cohorts while working age populations stagnate or even decline (OECD 1990 -2010 vs 2010 -2030). Source: H. Groth & N. Eberstadt, 2010.

4.4 United States

US government securities have been considered so far as risk free. Historically the country has never failed to pay its debts. Even during the current crisis, when debt to GDP ratio has increased almost by 30%, the ability of the US to satisfy its creditors was hardly questioned as can be observed in the CDS spread in figure 5. But the upcoming ageing of its population implies new unprecedented dynamics of US government debt.¹⁵

Demographics

Unlike the EU and Japan, the US are in a far more advantageous situation in terms of population dynamics. The country still enjoys relatively high fertility rate of 2.08. The rationale therefore is the ongoing tradition of the US as an immigration country combined with a cultural for higher fertility rate than the Europeans. Per 2010, 1,042,625 people immigrated – receiving a legal permanent resident status – into the US (0.3% of the total population)¹⁶. In other words, the nation is stable in terms of future workforce supply. Aside from that, immigration policy is not as strict as in the EU or particularly Japan, which gives the country a

¹⁵ The most recent downgrading of the U.S. by Standard & Poors as a matter of the U.S. deficit limit discussion shall not question the assumption of risk free government bonds so far, but highlights the financing challenges.

¹⁶ United States, Department of Homeland Security (2010): *Yearbook of Immigration Statistic*. Washington, D.C.: U.S. Department of Homeland Security, Office of Immigration Statistics, 2011.

substantial net inflow of new and mostly young population cohorts. Life expectancy is relatively high (75.8 for men and 80.4 for women as of 2010) and will increase by roughly 4 years till 2030.¹⁷

Even taking into account such a positive forecast, demographic shifts and the resulting health-care spending in particular, stay the most critical source of challenges for the US in the coming 20 years. The working force will increase by roughly 7 percent until 2030. Nevertheless, the share of elderly population will rise by almost 80 percent. As a consequence the age dependency ratio will increase from currently 20% to 33%.¹⁶ The long-term fiscal imbalance in the U.S. can therefore only be tackled by addressing high-cost cases in health care¹⁸.

From the government debt position such dynamics will lead to skyrocketing spending (to provide entitled benefits to old people guaranteed by law), while the revenue inflow will stay almost the same. Therefore, if no changes will be undertaken already in the nearest future, the country will end up with an enormous amount of public debt (a quantitative evaluation of debt to GDP ratio is provided in Chapter 5.3).

Debt

Figure 7 provides the debt distribution of the United States for the next decades.

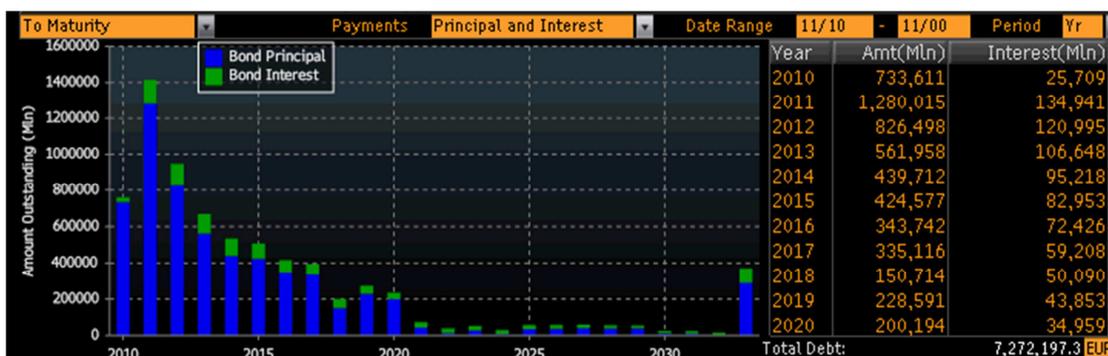


Figure 7: Public debt distribution of the United States by year of maturity. Source: Bloomberg, 2010.

One can easily see the enormous bond blocks maturing in the next 5 years forcing the government to roll the debt into longer maturities with likely less favourable interest rate conditions. Moreover, there are big interest payments occurring within the next years, which additionally cause stress on governmental budgets. Recently, the US government has been recording the largest budget deficits, expressed as a share of the economy, since the end of World War II. As a result of those deficits, the amount of federal debt held by the public has surged. One of the largest rating agencies, Standard & Poors downgraded the United States credit rating from AAA to AA+ on political risks and debt burden as of August 2011¹⁹. At the end of 2008, that debt equalled 70 percent of the nation’s annual economic output (as measured by gross domestic product or GDP), a little above the 20-year average of 63 percent. Since then, large budget deficits have caused debt held by the public to shoot upward; over

¹⁷ Social Security Online (2011): *The 2010 OASDI Trustees Report*.

¹⁸ P. Orszag (2011): *The Risks and Rewards of Health-Care Reform*, Foreign Affairs, July/August 2011.

¹⁹ S&P (2011): *US long-term rating lowered to AA+ due to political risks, rising debt burden*. 5-Aug-2011.

\$15 trillion by June 2011 with a total public debt outstanding of 99% versus GDP, and debt held by the public of at 68% of GDP—the highest percentage since after World War II²⁰. The sharp rise in public debt stems partly from lower tax revenues and higher federal spending related to the recent severe recession and also turmoil in the financial markets. However, the forecasted upward trend in debt to GDP ratio incorporates imbalance between spending and revenues that already existed before the crisis. In the future they will only aggravate.

4.5 Japan

In March 2011, an unpredicted earthquake hit Japan followed by a Tsunami flooding and a nuclear power plant catastrophe and most likely influenced its future development. Since the demographic reference of Japan did not consider such events, it cannot be excluded that some of the fertility and ageing forecasts for Japan might take a different course than described in this paper.

Demographics

The public budget and the economy are increasingly being hit by the growing proportion of elderly people. Japan has the highest ratio of old-age to working-age population of already around 40% in 2010. Consequently, the government has been trying to address the problems associated with its ageing population, and has increased the budgetary allocation by 10% for social welfare since 2000 until 2010. In order to fight the root cause of the problem and not only its symptoms, the government has also implemented policies supporting and encouraging families to have more children. Despite these actions, scientists are drawing a rather dark future for Japan's society and thus, its economy. Komine and Kabe propose that Japan is an example of how the demographic shrinking will affect every other Asian country sooner or later.

Stating that the population in Japan has already begun to decrease leads us to the question of how and where this decrease is going to result in. According to the National Institute of Population and Social Security Research, Japan's population will fall by 11 million to 115 million by 2030 and by a staggering 30 million to 95 million by 2050. This population decrease will obviously have a negative effect on the economy of the country. From the current perspective it is difficult to be assessed, whether or not Japan's economy will be able to sustain its competitive advantage against the other developed countries or against the emerging markets of the region. Having in mind that China already surpassed Japan as the second largest economy in 2010, one might argue that Japan will not be able to maintain its leading position on the global markets.

²⁰ OECD (2010): *Central government debt*. ESDS International, University of Manchester.

Projected population structure and age-related spending

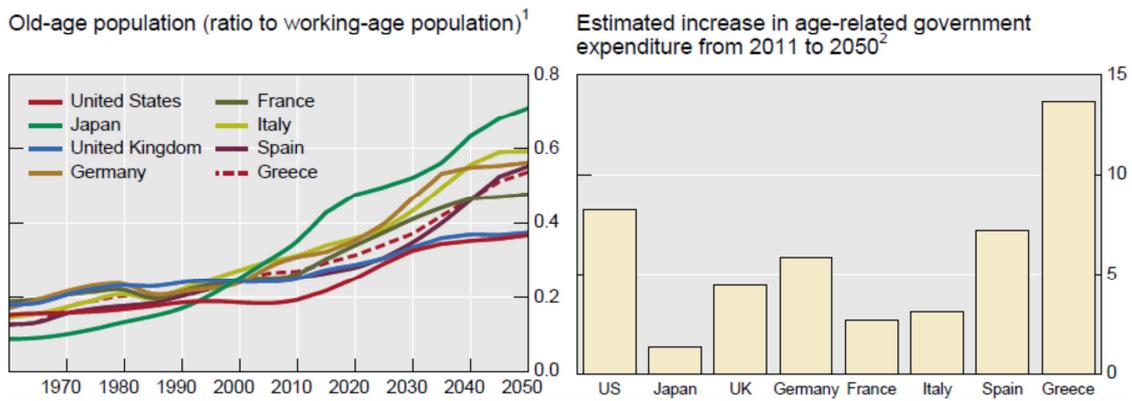


Figure 8: Projected population structures and subsequent age-related spending increases. Source: The future of public debt: prospects and implications by S. G Cecchetti, M. S. Mohanty and F. Zampolli.

Looking at the current situation from a more positive perspective, figure 8 shows that Japan’s estimated increase (from an already high level) in age related government expenditure is the lowest of all developed countries and is very near to zero. This suggests that the government will rather face the challenge of finding the sources to fund the existing high-level of age-related social security spending.

Debt

Figure 9 shows the indebtedness of Japan and the debt distribution of its public debt until 2035. With a staggering EUR 8.145 trillion in outstanding debt, one can observe that it has been well allocated through the future, but that a high amount is to mature in the next 5 years and thus has to be refinanced. Remarkable are further the relatively long maturity of government bonds with a high duration and the continuity of long term debt instruments.

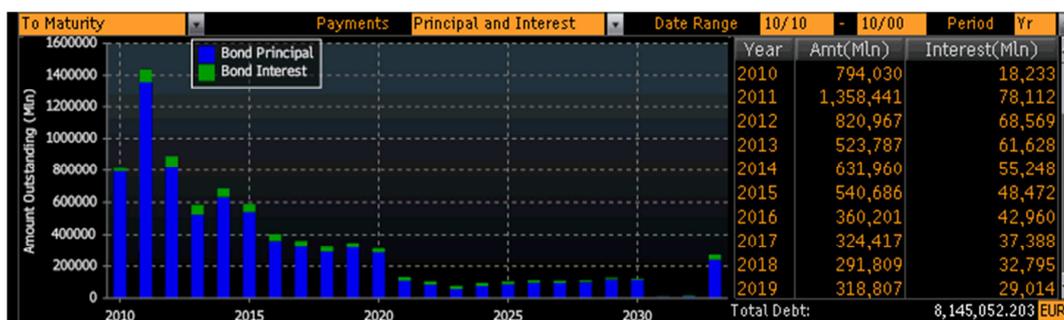


Figure 9: Public debt distribution of Japan by year of maturity. Source: Bloomberg, 2010.

Japan has the highest public debt in GDP ratio percentage from all the developed countries in the world. With a 197% debt to GDP for 2010 and a forecast of more than 200% for 2011 (some analysts argue that the 200% level has already been breached), it might be considered a miracle that Japan has not yet defaulted on its public debt and that the spreads on its bonds are actually that low. A plausible explanation exists, however. A staggering 94% of Japan’s

public debt is owned by Japanese firms or Japanese individuals²¹. The locals are happy to accept the very low returns on Japanese bonds, because they have always considered it to be a risk free investment. Therefore there is only a marginal spread on the government bonds over the official lending rate. As long as Japanese buy their own debt, no foreigners will have a strong word at what the risk premium should be, therefore the government can continue to pay low spreads. On the other hand, due to the “lost decade”, the Bank of Japan has been implementing a Zero Rate policy with the goal to actually keep the economy running and minimize the liquidity problems of the banks in the country. Therefore, a 0% lending rate plus a very low spread means the debt interest costs to the government are close to zero. Currently the financing costs are just below 5% of Japan’s GDP, hence not an issue which Japan is too worried about. Putting it in another way:

“If domestic investors keep purchasing JGBs—whether it is motivated by moral duty, patriotism, lack of other investment opportunities, or for economic profits—the Japanese government does not have to worry extensively about insolvency or increasing the burden for debt financing.” (Myung-koo Kang, 2010)

Therefore, although statistically it looks like Japan is in a bad position from a debt/GDP perspective, its monetary and fiscal policy has helped to keep the country in a fairly stable financial condition. A pure debt-to-GDP comparison is therefore not deep enough to grasp the differences between the interests paid on the debt levels. This can be seen in figure 11 provided by the Ministry of Finance, showing that although government debt has almost doubled in the past decade, the fraction of the GDP used to service the National Debt has actually fallen by 2%.

(7) Ratio of Major Expenditure Items in the General Account

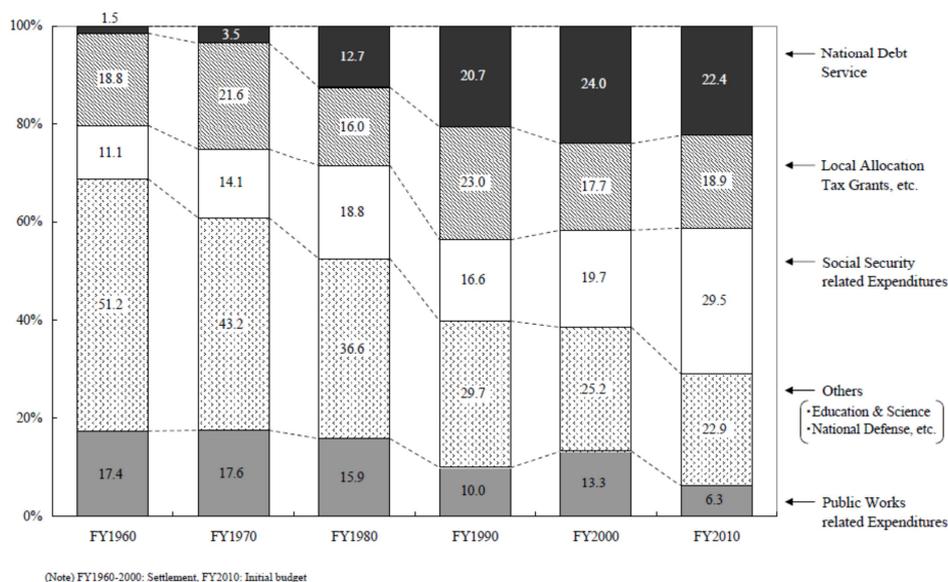


Figure 10: Expenditure categories of Japan’s national budget as percentage of total Budget. Source: Japan Government Budget 2010.

²¹ The Wall Street Journal (2010): Japan looks hard at trimming huge debt. 1-Mar-2010.

Even though the status quo in Japan doesn't look that disturbing today, a glance in the future gives us a rather different perspective.

“If this situation changes in the future, it will be much more difficult for the government to roll over existing debt and to finance new funds at low costs. In short, the absorptive capacity of government debt financing may be constrained in the future, and such a gloomy prospect has intensified political conflicts about the appropriate way to achieve fiscal consolidation in the future.” (Myung-koo Kang, 2010)

5 Forecast – 2030

In the following chapter, we derive and discuss a model to generate the future debt to GDP ratio until 2030. Our results based on three different scenarios are similar to other findings and show the urgent need for sustainable changes in order to absorb the growing fiscal stress of the demographic transmission. In the last part, we improved our model in order to simulate the different parameters such as age-related spending, government revenues and debt levels. This allows us to understand the nature of public indebtedness better and provide an insight into the range of possible outcomes as a basis for the recommendations.

5.1 Methodology and Data

For the forecast of the future public debt to GDP ratio, we use the methodology applied by the Bank for International Settlement²². We use this approach because no strong assumptions on the future path of fiscal policy (which is unlikely to be constant) are necessary. Moreover, the government's total revenues and non-age-related spending remain a constant percentage of GDP in the baseline scenario. This allows us to derive the real effect of ageing populations on public debt, while dividing government spending on elderly and non-elderly related expenditures.

The debt to GDP ratio for a specific year is calculated as the sum of last year's debt plus interest rates plus total government spending minus government revenues (for the detailed budget accounting and debt dynamics consult the annex).

We use the official projections for age-related governmental spending (Congress Budget Office of the United States, European Commission and the Japanese Ministry of Finance) in order to generate a path for total primary government spending and the primary balance until 2030. For the sample period, a) the real interest rates that determine the costs of funding are assumed to remain constant at their long term average (2000 – 2009) and b) real GDP growth will be assumed to be equal to the post-crisis rates. Data is taken from the OECD and IMF data base as of 2009.

We derived three scenarios:

- Baseline case, where government revenues and non-age-related costs remain constant on respective 2009 levels.
- Governments are able to decrease their deficit per GDP according to the official announcements, we assume that overall primary balance improves by 1% of GDP in each year from 2012 to 2017 (the rest is equal to the baseline scenario).
- Cut in spending and higher revenues is the third scenario, assuming that future age-related liabilities are reduced. This might not be very likely at the moment but interesting from a theoretical point of view. Therefore, we expect age-related spending to GDP at the level per 2009 with fiscal improvement according to scenario 2.

²² Bank of International Settlement (2010): *The future of public debt: prospects and implications*, working paper.

5.2 Results

Based on the three different scenarios, we generated the future development of the debt to GDP ratio until 2030 for the EU 25²³, Ireland in particular, the United States and Japan. The following figures show the baseline scenario (blue), primary balance improvement (green) and reduction in age-related spending (purple). Under the assumption that no changes to current policies will be introduced, the debt to GDP ratio will increase to 208% for the European Union by 2030, 260% for Ireland, 440% for Japan and almost 242% for the United States. This massive growth is driven by the increasing costs in age-related spending, which stands in contrast to stagnating governmental revenues.

For the second scenario our model forecasts a moderate increase to 96% for the European Union in terms of debt to GDP ratio, to 186% for Ireland and to an even astonishing 128% for the US. However, for Japan the growth of public indebtedness can only be slowed to 320% which is still a very high level. The effectiveness of this action is interesting for the European Union in particular, enhancing the chances to stabilize debt to GDP in the short run, while working on sustainable programs to strengthen the primary balance despite a shrinking workforce.

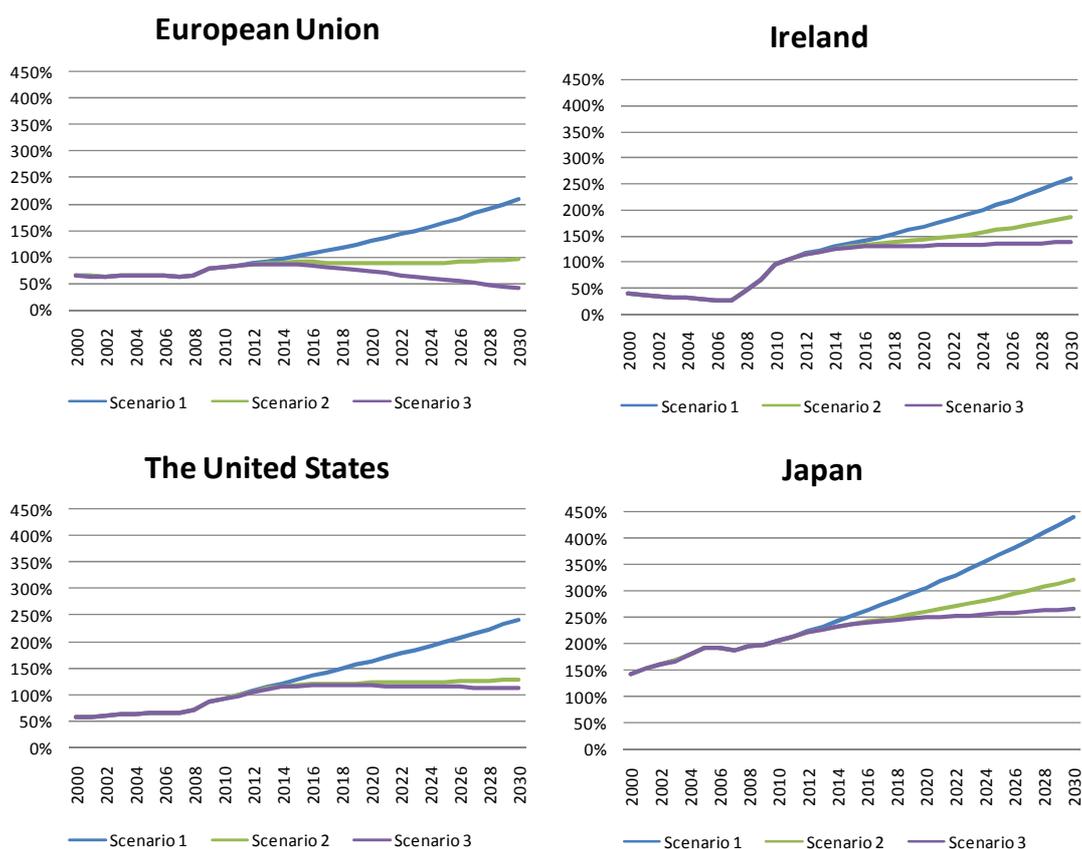


Figure 11: Public debt to GDP projections (in %) for three different scenarios. Source: Own calculations based on Bank of International Settlement data (BIS, 2010).

²³ European Union member states (EU 25): Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom.

Hence, the third scenario reduces debt to GDP by 2030 for approximately additional 50% compared to the scenario 2 for the EU 25, Ireland and Japan. Nevertheless, the effect is quite small (15% only) for the United States due to a relatively high real interest rate (adjusted on real GDP growth) compared to the other investigated countries. In addition, the assumptions of constant revenues assume deficits on the primary balance for the United States.

5.3 Deficit Control – Back to 2007 Levels

The financial and economic crisis severely influenced the indebtedness of all investigated regions and countries. This leads to the question, what level of primary balance would be required in order to bring the debt to GDP ratio back to its pre-crisis level as of 2007. Table 1 shows the average primary surplus required to bring debt ratios back to the 2007 level over different time horizons (until 2015, 2020 and 2030) under scenario 1 (government revenues and non-age-related costs remain constant on respective 2009 levels).

	Over 5years	Over 10years	Over 20years	Forecast 2011
EU-25	6.1%	4.3%	3.8%	-4.8%
Japan	9.1%	7.1%	6.5%	-8.0%
United States	9.7%	6.6%	5.1%	-7.1%
Ireland	19.2%	11.2%	7.6%	-9.3%

Table 3: Average primary balance required to come back to pre-crisis 2007 debt to GDP ratio. Source: own calculation following the Bank of International Settlement (BIS, 2010) and OECD Forecasts.

Aggressive adjustment to achieve this objective within 5 years would require surpluses between 5-6% for the European Union, 8-9% for Japan, 9-10% for the United States and 18-19% for Ireland, depending on the assumed scenario 1 to 3. A more smoothing adjustment policy over 20 years would reduce the target surplus to 4-7.6% per year depending on the country. Nevertheless, the OECD forecast for 2011 with deficits between 5-8% indicate that a short term recurrence to old levels is rather unlikely. Hence, the pressure on the primary balance will further increase in the near future.

Moreover, using our model the authors assess that in order to put public debt on the stable path (i.e. no debt increase in the long-run) governments need to decrease budget deficits by a certain amount in the following years. This refers to the US 9-10% of GDP, to Japan 12%, and to the EU 7%. It means that either spending should be reduced or revenues should be increased by this amount – or more realistically, a combination of these two extremes should be applied.

6 Measurements and Policy Actions

What can be done to deal with the virulent challenge of increasing debt ratios? In this paper we propose three recipes which are independent of each other and have different time frames:

- irredeemable bonds, basically an immediately effective financial market solution
- the transfer of entitlements from public to private in order to resolve the ageing issue through new policies and governance for entitlements from the state
- a complementary currency, basically a civil society approach

6.1 Financial Market Solution

If governmental ageing related expenses continue to rise as predicted by our current analysis, the government deficit widens and the country has to issue new bonds. If the indebtedness of the country rises, investors assess the risk of the entire country going bankrupt as higher, thus they demand higher yields for each new bond issue. At one particular point, the government cannot pay those higher yields anymore and will go bankrupt²⁴. It is important to note that a nation's bankruptcy has been a common phenomenon over mankind but has been heavily ignored within the last decades for industrialized countries. Increasing welfare due to increasing demand (also as a matter of demographics) are no longer valid in the known context, hence the future generation will no longer be capable to pay the debt burden of current and ancient generations. One way to prevent this Greece-like scenario of spreading is the issuance of *Sustainable Ageing Bonds*. They should mainly be offered to domestic retail clients who feel they are fulfilling a morally good and patriotic action by helping their country to finance its budget. Therefore the buyers of the bond demand lower yields than the international investors on the market. Thus the government is still able to finance its projects, but the costs are much lower as opposed to issuing foreign debt.

On the other hand, people will soon remember that post-war debt levels are usually brought down by inflation or even hyperinflation of the domestic currencies, due to the government's unwillingness or inability to repay their debts in any other way. Common sense would therefore suggest that citizens should prefer buying a *Sustainable Ageing Bond* and thus helping their country instead of seeing this same amount of money plus their entire savings being hyper inflated and thus vanishing into thin air.

A similar idea was already implemented during World War II when the governments of the major economies financed their campaigns by issuing the so called "war bonds". Conceptually very similar to the *Sustainable Ageing Bonds*, they were bought by citizens, who wanted to help their country. On March 10, 2011 the Wall Street Journal reported Greece's strategy to issue "diaspora bonds". With such "diaspora bond", Greece hoped to tap into the buyers' national pride. Such bonds will be issued to rich Greek citizens living abroad and Americans of

²⁴ Note that the 2010 near-bankruptcy of Greece was not due to a vast change in its public debt amounts, but to the increased interest costs it had to pay on its re-rolled old public debt. Therefore it is important to state that cutting the interest payments with the help of the irredeemable bonds will ensure that countries do not face the financial difficulties of Greece, while actively fighting their demographic and financial issues.

Greek descent. Research by a World Bank economist and Vanderbilt professor showed that “diaspora bonds” often fetch a “patriotic” discount in borrowing costs. The official government report suggested that the issue is aiming for a yield of less than 5%, while the 10 year yield at the time of the report was 12.2²⁵.

This suggests that countries in financial trouble are able and should use the additional cheap source of money which we call “*Sustainable Ageing Bonds*”.

6.2 Policy approach

As we can see from the conducted analysis, a main reason for increasing deficits in the future are unfunded liabilities linked to pensions, healthcare and increasingly nursing care. If a country enjoys low age dependency ratios these liabilities could be easily covered. Unfortunately in the coming 20 years these ratios are expected to grow substantially, forcing governments to issue new debt while revenues will stay at the present level or even plummet.

The logical conclusion: a way to avoid long-run public debt inconsistency would be a fundamental shift from unfunded (tax) government programs to asset funded pension systems and health care programs including an increasing role of insurers with high ethical standards. The economist Donald Lee states that this shift could be easily implemented by emerging and developing countries, spending a portion of their expected demographic dividend²⁶ on pensions and health care.

However, in developed countries as the EU, the US, and Japan will bear much higher costs given population ageing has already begun for these countries. In such a transition some generations would have to support the elderly part of their population, thus repaying the debt while at the same time saving for their own retirement, thus liberating the young generation of the obligation of supporting them in the future. The same mechanism applies when it comes to switching the funding source of health care programs. These people will still have to pay high taxes to provide benefits for elderly generations and at the same pay insurance premiums, ensuring much lower taxes for next generations.

The challenge for each individual citizen is to start thinking in a self-responsible way about their pensions and health care plans. Let us take this position to the extreme: the best way to get rid of unbalanced public budgets would be to eliminate all social and healthcare taxes while at the same time cancelling all benefits as well as pensions and public healthcare. In such a situation, people would depend on their own savings while governments would no longer be responsible. According to Donald Lee this would also help to prevent dropping saving rates as a result of an aging society. However, such a radical shift would ultimately result in the termination of the social welfare state.

But who can imagine that this can happen without social disruptions and increasing inequalities?

²⁵ Bloomberg (2011): *Greece government bonds*, 14-Mar-2011.

²⁶ The first demographic dividend is a rise in the rate of economic growth due to a rising share of working age people in a population

Moreover, even if society accepts such legislations, the consequences risk being devastating. Explaining to average citizens that if they don't save on their own they will not receive any pension or state support at all, can be a difficult job. As a first step at all one must make sure that people have the necessary literacy for this huge responsibility.

Therefore, in order to insure any progress of the discussed pension and healthcare reforms, governments should manage the expectations of their citizens as a first step and as part of this it is important to improve the financial and wealth creating literacy of their citizens. This has to be done with great sensitivity and caution. The cohesive societal aspects of solidarity should therefore be carefully balanced against self responsibility.

6.3 Civil social approach

The third proposition is the so-called "*Complementary Currency*" – approach which addresses the ageing-driven soaring of public debt at its heart. Bernard Lietaer, the major supporter of this strategy defines it as follows:

"A complementary currency refers to an agreement among a group of people, and/or corporations, to accept a non-traditional currency as a means of payment. They are called complementary because their intent is not to replace the conventional national currency but to perform social functions that the official currency was not designed to fulfil".

The best example of how such a currency can solve the problem of rising socially related costs is the "Fureai Kippu" or the "Caring Relationship Ticket", Japan's widely accepted social care project, starting in 1995 and still running. By simply helping elderly people in their every day needs the volunteers are credited "hours" on their "time accounts". These "hours" can later be transferred to the volunteer's parents who might live far away but might also need social care or they can be used by the volunteers themselves, when they grow old. Some save their hours for future times and some even trade away their hours to people who need them. It works like a matching grant: for every credit hour of service the amount of care provided to society is doubled.

The real fascinating element about this system is not its rather simple mechanism but the effect it has on the society. Undoubtedly, in order to work this system should be introduced in coherent societies or communities where the interactions between people are equally valued. It has been observed if these requisites are fulfilled the volunteers' number and help within the society has greatly increased. Many feel they are helping their own parents by transferring "social hours" to their families. Equally important, elderly prefer this type of payment from an emotional point of view: they do not feel embarrassed to ask for services. According to Lietaer's research, even the quality of the services has improved. Last but not least, this new currency is practically a way in which the government prints money and swaps their future age-related spending with the "Fureai Kippu" currency. Thus, their need to raise new capital in the capital markets in order to fund social care related costs decreases.

7 Conclusion

A “*truly impossible equation*” driven by demography is emerging and becoming increasingly visible for everybody:

- Limited growth in economic output hand in hand with increasing social spending pressure in developed countries

Given the current governance of the social welfare states in many developed countries without any significant reform the trend of increasing public indebtedness will remain and compound significantly until 2030. Particularly the financial crisis puts additional and unprecedented pressure on debt levels and primary balance deficits. Given our assumptions and if nothing happens, the debt to GDP ratio is expected to reach at least 106% for the European Union, 344% for Japan and 216% for the United States by 2030. The logical consequence: The default or near-default of some developed nations can become a reality we have to face.

But what can be done? We propose actions on three different levels in business and society:

- The financial market level
- The policy and governance level
- The civil social level

In particular, the “sustainable aging bonds” proposed by us are capable to improve the growing financing costs of ageing societies in the short and midterm. Once this measure has achieved an urgently needed new level of stability and trust in the financial markets, long term solutions on the political governance and the civil social level such as sensitive shift from public to private and complementary currencies should be considered.

The ongoing demographic shift is unique and unprecedented in mankind’s history. As there is no winner in absolute terms, it calls for transparency as long as we have the ability to take actions with impact. The key prerequisite to sustainable national welfare is financial budgetary stability. The proposed ideas help to reduce debt burden of developed countries in the future. Nevertheless, none of the proposed approaches alone can be stated as the sole solution. A combination of all measures is necessary in order to tackle the demographic shifts of the 21st century to the benefit of everybody involved.

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Annex

A) Demographic Stress Indicator on Government budgets Debt

The demographic stress indicator on public debt is based on the current level of age-related spending multiplied with the percentage of people aged 65 years and older in % of total population plus the change in the age dependency ratio over time:

$$DSI = \prod_t (Spending_{2010; Aged\ 65\ +\ years\ in\ percent}_t) + \left(\frac{Age\ dependency\ ratio_t}{Age\ dependency\ ratio_{2010}} - 1 \right)$$

We derive the forecast based on the percentage change in the future dependency ratios beside of the sum product of age-related spending and people aged 65+ years. Hence, the underlying assumption is that age-related costs behave linear to the change in the age group 65+ years and the age dependency ratio. Moreover, the current age-related spending influences our assessment heavily and finally, no adjustments to outliers are made (especially for developing countries e.g. China and India, the age-related spending might be too low for the coming decade).

B) Budget accounting and debt dynamics

The core equation of our model is the consolidated government sector budget identity:

$$G_t + i_t D_{t-1} = T_t + (D_t - D_{t-1}) + (H_t - H_{t-1}) \quad (1)$$

; where G is the nominal level of primary government expenditure and i is the nominal interest rate paid on nominal public debt D . T stands for taxes, which is the primary source of revenues. Another alternative to finance expenditures is issuing new debt and seigniorage (H). Seigniorage as the possible source of public finance such as central bank liabilities, monetary base respectively, was then excluded from the analysis, because there is no evidence that this instrument is widely used by advanced economies since at least mid-1980s.

Then, dividing both parts of the equation by nominal GDP and rearranging terms we have the following:

$$\begin{aligned} d_t - d_{t-1} &= \tau d_{t-1} + w_t \\ w_t &= g_t - t_t \end{aligned} \quad (2)$$

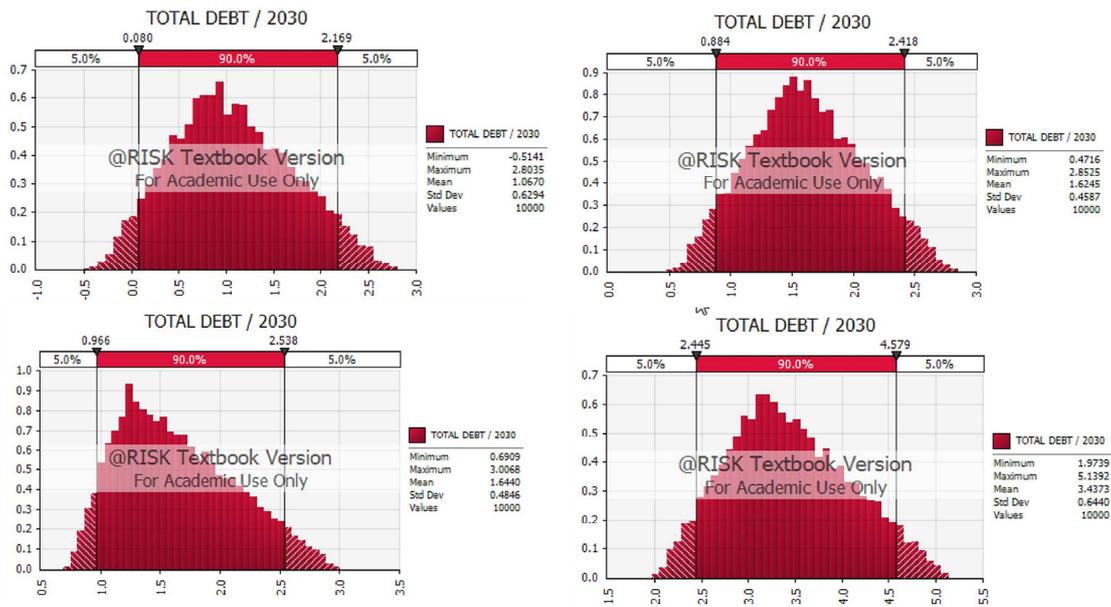
; where the small letters represent ratios of the original variables to GDP. According to (2), the change in the public debt/GDP ratio depends on real interest payments (adjusted for real output growth) and the primary deficit w_t (all expressed as a share of GDP). As it follows from (2), to generate future path of debt to GDP ratio for each country we need forecasted government spending, revenues, real interest rate and real GDP growth.

B) Sensitivity and Probability of outcome

We enhance our model to run a simulation on the different parameters age-related and non-age-related spending, government revenues and debt levels. This allows us to better understand the nature of public indebtedness and provide an insight on the range of possible outcomes.

The baseline scenario is again the starting point of our analysis with effective starting values as of 2009. We then define the possible range of the parameter distribution with min, max and most likely scenario for 2030. The distribution is triangular with a skew according to the most likely value. We run a stochastic simulation with 10,000 iterations on all uncertain parameters such as age-related spending, non-age-related spending, government revenues and previous debt level including actual interest payments with an excel add-in²⁷. For the assumptions and rationale of the parameter distribution in detail, we refer to the appendix.

Figure 10 shows the results for public debt in 2030 according to our simulation. The red range on top of the distribution shows the 90% confidence interval, where the table on the right provides the statistics.



	EU	Ireland	Japan	US
Minimum	-43.6%	49.3%	197.5%	69.1%
Maximum	286.9%	286.8%	515.7%	300.7%
Mean	106.7%	162.5%	343.7%	164.4%
Std Deviation	63.0%	46.0%	64.3%	48.5%
Skewness	0.209	0.133	0.254	0.462
Kurtosis	2.424	2.414	2.405	2.415
Values	10000	10000	10000	10000
5% Perc	8.1%	88.3%	244.3%	96.6%
95% Perc	216.8%	241.8%	457.9%	253.8%

Figure 12: Simulation of public debt to GDP ratios in 2030 for the European Union (top left), Ireland (top right), the United States (bottom left) and Japan (bottom right). Source: Own calculation.

²⁷ @Risk – Academic Version for Excel: Risk Analysis Add-in for Microsoft Excel. Version 5.5.0, Palisade, 2009.

Findings suggest a most likely level of indebtedness of 107% for the European Union, 163% for Ireland, 344% for Japan and 164% for the United States. All distributions are slightly skewed, indicating that a very high level of debt to GDP is statistically unlikely but might occur, especially in the United States. Our findings for the debt to GDP ratio are in between the results of the baseline and the second scenario (primary balance improvement of 1% for 2012 – 2017) debt generation path. Further, it can be stated that small variations in the different parameters do not sustainably impact the debt outcome.

In the next chapter we discuss possible measures how to prevent debt enlargement. Even though it is almost impossible to give any quantitative evaluation of these measures with more or less adequate degree of confidence, we at least know the level of aggregated impact needed to preserve stable public debt. And this can be valuable aid to orientation for the policy makers.

In fact, our projections understate the severity of the long-term budget problem because they do not incorporate the significant negative effects that accumulating substantial amounts of additional federal debt would have on the economy:

- Large budget deficits would reduce national saving, leading to higher interest rates, more borrowing from abroad, and less domestic investment – which in turn would lower income growth in the country.
- Growing debt would also reduce lawmakers' ability to respond to economic downturns and other challenges.
- Over time, higher debt would increase the probability of a fiscal crisis in which investors would lose confidence in the government's ability to manage its budget, and the government would be forced to pay much more to borrow money.

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