



PRICEWATERHOUSECOOPERS

# **SWISS PRIVATE BANKING, MARKET FORECASTING AND ANALYSIS:**

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## **A SYSTEMS DYNAMICS APPROACH**

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A Thesis Submitted in Partial Fulfilment of the Requirements for the Degrees of  
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## Abstract

The Swiss private banking industry has been always known as one of the leading off-shore private banking centers. During the last five years, however, the market entered a phase of fundamental change. Global economic downturn has notably harmed the industry and the natural recovery was further depressed with the new regulations coming into force. This thesis is an empirical study of the System Dynamics methodology applied to analyze the Swiss private banking industry in its transition phase.

The aim of this thesis is to develop a System Dynamics model that can act as a helpful tool for identifying important structural changes in the industry and assisting in developing industry forecasts. First, this paper provides a review of the relevant literature that proves the adequacy of the chosen methodology for the Swiss private banking case. Then, a detailed description of the development of the industry over time is presented, followed by the hypothesis that suggests that the behavior of the industry has been largely driven by the external factors and the “not-so-invisible-hand” represented by the new regulations. The last section of thesis is devoted to the analysis of the market in the short-midterm future under various scenarios.

The results of the study demonstrate that policies that are being implemented by private banks, directed at cost reduction, are effective only to a very limited extent. It is suggested that only by combining operational efficiency and cutting costs with improved overall service and product quality, Swiss private banks will be able to achieve the positive trend in the profitability of the industry in a midterm future.

The key contribution of this work includes a model that captures the private banking industry in a structured systemic way that includes time delays, feedback cycles, nonlinearities, and stocks and flows. The conclusive added value of this model is its ability to forecast the development of key industry indicators under various scenarios.

**Key words:** Swiss private banking, market forecasting, system dynamics, regulations

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## Abbreviations

|       |  |
|-------|--|
| CHF   | Swiss frank  |
| CIR   | Cost Income Ratio                                      |
| CRMs  | Client relationship managers                           |
| EU    | European Union   |
| EUR   | Euro   |
| FATCA | Foreign Account Tax Compliance Act                     |
| FTA   | Federal Tax Administration                             |
| HR    | Human resources  |
| HWNI  | High-net-worth individuals                             |
| IR    | Investments researchers                                |
| MiFID | Markets in Financial Instruments Directive             |
| MVSS  | Multivariate sensitivity simulation                    |
| OECD  | Organization for Economic Co-operation and Development |
| PB    | Private banking  |
| PwC   | PricewaterhouseCoopers                                 |
| RMSE  | Root Mean Square Error                                 |
| SD    | System Dynamics  |
| SNB   | Swiss National Bank                                    |
| UHNWI | Ultra-high-net-worth individuals                       |
| US    | United States  |
| USD   | United States dollar                                   |

# Chapter 1: Introduction

## 1.1 Introduction and motivation

In the dynamic world of today constant building and reviewing business strategies is essential for successful operation of any business. Assumptions about future demand are crucial for making right business decisions. Companies operating in the fast-paced changing environment have a constant need for scanning industries where they perform. This usually implies not only measuring how an industry performed or will perform, but also understanding underlying forces that shape a market.

For manufacturing firms, knowledge about a market helps to make production planning decisions or plan how much financing will be needed in one or another department in the future. For private banks, knowledge about the market environment can help to define which strategic option to choose (whether to continue the present activities on the stand-alone basis, create a joint venture with another bank or even consider exiting the market), how to position themselves in lights of the changing environment and which policies to implement in order to sustain their businesses.

This paper describes a process and outcomes of a three-month system dynamics project directed to the analysis of structural changes of the private banking industry in Switzerland. Swiss private banking industry has been always known as one of the leading off-shore private banking centers. However, since the last five years the market entered a phase of fundamental change. Global economic downturn has notably harmed the industry and the natural recovery was further depressed with the new regulations coming into force. Patrick Odier, the chairman of the Swiss Bankers Association, starts the annual 2011/2012 banking report with the following words (Swiss Banking Annual Report, 2012a, p.4):

*“In this special centenary year for the Swiss Bankers Association, there is no doubt that our financial centre has rarely faced so many challenges. The situation reminds me of a motorway with road works everywhere: no sooner is one finished than another begins”.*

Dynamic changes in the market environment bring new challenges for the market players<sup>1</sup> and require decision makers to adjust their market strategies. The author of this paper hopes that system dynamics approach to the Swiss private banking problem will help the market

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<sup>1</sup> Market player in this report is used to refer to a private bank or a decision maker in a private bank.

players to make optimal business decisions in light of the changing environment and to implement policies which will help to sustain their businesses.

## **1.2 Client and its motivation**

The research described in this paper was written in partnership with PricewaterhouseCoopers (PwC) in Zurich, Switzerland. PricewaterhouseCoopers is a multinational company which provides various consultancy and auditing services. PwC is the largest of the Big Four<sup>2</sup> accounting firms measured by revenues in (PwC Annual report, 2012a). The company has three main service lines: advisory, tax advisory and assurance services. All service lines in one or another way provide service for private banks in either process consulting, tax advisory or auditing form. Private Banks are important clients for PwC and therefore, it is crucial for PwC experts to have comprehensive understanding of the situation in the industry.

## **1.3 Previous works**

Various methods are being used for market research. Both qualitative and statistical analyses are frequently employed by companies and market research agencies. System dynamics (SD) has been applied to research various markets from its early days and, therefore, was considered to be adequate for researching the Swiss private banking industry. Forrster (1961), Goodman (1989) and Richardson and Pugh (1981) studied how system dynamics can be applied for market analysis and strategy design.

Lynneis (2000) names three arguments for how the proper use of system dynamics models for market forecasting and structural analyses can add value to the clients. Firstly, system dynamics models may generate more reliable forecasts of short- to -mid term trends than statistical models may do and, therefore, lead to better decisions. Secondly, SD models explain the causes of market behavior and define changes in industry structure. Last but not least, system dynamics models allow for the determination and testing of market forecasts under various scenarios to give inputs to strategic decisions and policies.

Over the last decade, various industries have been analyzed using the system dynamics approach. Eskinasi, Rouwette and Vennix (2011) analyzed the dynamics of the Dutch housing market. Liehr, Grossler, Kleinb and Milling (2001) modeled business cycles in the airline

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<sup>2</sup> Big Four refers to four largest international professional services networks in accountancy and other professional services handling the majority of audits for public and private companies.

market. Ghaffarzadegan and Tajrishi (2010) used system dynamics methodology to analyze the economic transition management in a commodity market using the case of the Iranian cement industry.

This research focuses on the analysis of the private banking industry in Switzerland. As far as the author of this paper is aware, this type of the market has not been researched using the system dynamics approach previously. However, certain knowledge can be taken from previous researches on the mentioned industries and from May and Arinaminpathy (2009) who used the system dynamics method to research the banking systems.

#### **1.4 Research objective**

The research objective of the study was to develop a model which can act as a helpful tool for market players to identify important structural changes in the industry over the period of 2006-2011 and to help them make informed business decisions based on the market forecasts for 2012-2018.

The thesis aimed at answering the following research questions:

1. Which forces are driving the industry behavior?
2. What is the effect of new regulations on Swiss private banking?
  - a. How the new regulations effect the revenue side of the industry?
  - b. How the new regulations effect the cost side of the industry?
3. How do policies that market players are employing effect the market?
4. Which policies may help Swiss private banks to increase their profitability?

#### **1.5 Outline of the thesis**

The report outline reflects the chronological order in which this research was conducted. The first chapter provides an introduction to the research and explains the relevance of the topic for the client and gives a brief introduction to the problem. In addition, the author reviews relevant literature and defines the research objective and research questions. The second chapter is dedicated to explaining the research methodology and introducing the reader to the key concepts of the research. Chapter three gives a detailed description of the problem by first describing how the private banking market has developed on a global level and then, presenting how key concepts of Swiss private banking evolved throughout the historic period. Chapter four

gives a description of the model and explains step by step how the model was built. Chapter five presents the analysis of the model and explains the model validation process. Simulation results are also presented in this chapter. Chapter six is devoted to the analysis of the market in the short-midterm future under various scenarios and provides suggestions for possible policies. The last chapter includes the interpretation of the results, the contribution of this study, managerial implications, limitations and directions for further research.

## Chapter 2: Research methodology

### 2.1 Research approach

To understand the processes and forces driving Swiss private banking market behavior a detailed analysis of the context is essential. The study of the private banking industry requires analysis of both qualitative and quantitative data. A case study is defined as “a research strategy which involves the investigation of a particular contemporary topic within its real-life context, using multiple sources of evidence” (Saunders & Lewis, 2012, p. 116). A case study should be used when a detailed understanding of the context is needed and, therefore, was considered to be the best approach for this research.

#### 2.1.1 Process and data collection

The diagram shown in Figure 1 represents the process of the research applied in this paper.

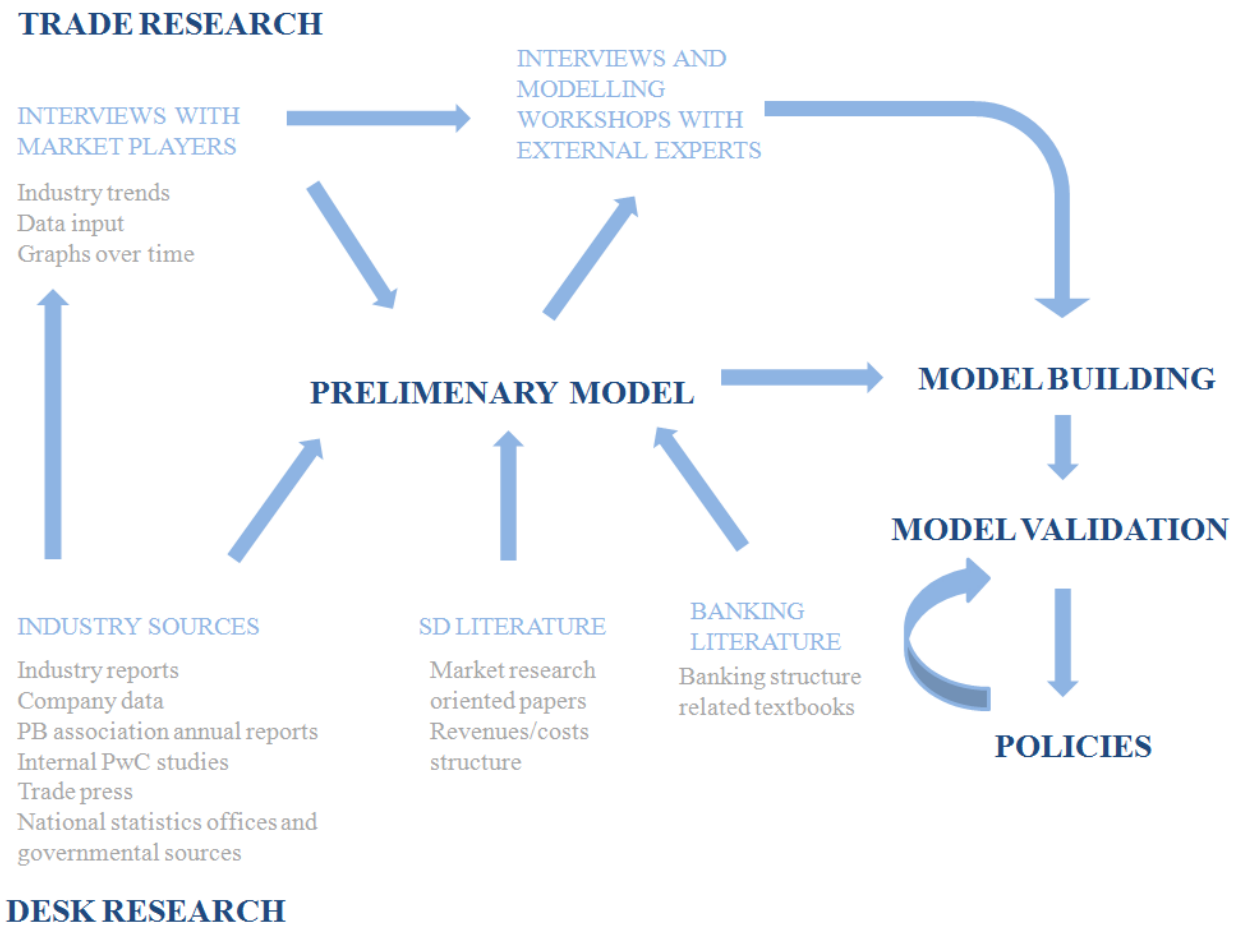


Figure 1: Research process

**Desk research:** the main goal of the desk research was to gather all the information needed for developing an SD model from the published sources so as to lay the groundwork for interviews with market players and industry experts. Three types of sources were used in the desk research: industry related sources, SD literature, and banking related literature. First, relevant SD literature was reviewed in order to prove the adequacy of the methodology for the private banking case. Reviewing the previous studies conducted using the SD approach to investigate markets brought certain knowledge about possible structure for parts of the model (e.g. HR, financial structure, competition). The need to understand how private banking operates also required reviewing various text books on the investment banking, private banking and wealth management. The final and the most time consuming step was reviewing various industry related papers, national and international press, published and unpublished private banking studies. Desk research brought an initial understanding of how private banking market operates and provided a starting point for the preliminary model.

**Trade research:** The main objective of the trade research was to engage in conversation with trade sources (market players and external industry experts<sup>3</sup>) in order to fill the knowledge gap and obtain confirming information about the structure of the model.

*Interviews:* First, representatives of private banks were interviewed. Discussions with market players helped to fill gaps in available published data and evaluate the market players' views on forces driving the market behavior. Knowledge received during those interviews was used to build a preliminary model. Later, several interviews were conducted with external experts. External private banking experts were interviewed in order to obtain confirmation on the estimations provided by market players and enhance an overall understanding of the private banking structure.

*Workshops:* When the preliminary model had been developed, several group modeling workshops took place. The system dynamics literature has highlighted the value of directly involving many participants in the modeling process (Rouwette, Vennix & van Mullekom, 2002). The goal of the workshops was to either obtain confirmation or identify the need for adjustment in the structure of the preliminary model so that it would represent the situation in the industry in coherent and consistent way. Two workshops took place: the first one aimed at validating the causal loop structure and the second at validating the stock and flow structure.

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<sup>3</sup> External experts in this report refers to private banking experts in PwC



After the model had been developed, adjusted and discussed with external industry experts, model validation tests were conducted. The main goal of the model validation was to demonstrate the system's ability to recreate the real situation of Swiss private banking. The final step in the research process was developing and testing policies.

### **2.1.2 Research sample**

The research described in this paper was conducted using a snowball sampling in which every subsequent member of the sample is identified by the earlier sample members (Saunders & Lewis, 2012). All the interview members and participants of the workshop were selected with the help of the partner company. In the literature, a person who “helps to select appropriate people within the organization with whom to work before the workshop, works with the modeling team to plan those pre-workshop meetings, schedules them, and participates in them” is called a gatekeeper (Andersen & Richardson, 1997, p. 109). In this research Joerg Gerigk – a PwC representative and an external thesis advisor – acted as a gatekeeper. With his help, the right people, both the external industry experts and the market players, were selected for the interviews and modeling workshops. The interviewee list included the followings:

- Chief Executive Officer of the Private Bank 1<sup>4</sup>
- Deputy Chief Executive Officer of the Private Bank 2
- Strategic Platform Developer of the Integrated Global Bank
- Senior Manager - Audit Financial Services – External expert
- Financial Services Consultant – External expert
- Head Corporate Finance Financial Services – External expert
- Head of Private Banking – External expert

### **2.1.3 Market research sources**

One of the added values that system dynamics approach can provide is a holistic view of the problem. For developing a comprehensive and coherent representation of Swiss private banking industry this study required collecting data from various sources. Figure 2 shows the list of key sources which were used to research the market.

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<sup>4</sup> The names of the participants are not disclosed.

|                   |  |
|-------------------|--|
| Official sources: | Swiss National Bank  |
|                   | Swiss Bankers Association  |
|                   | Swiss Federal Office   |
| Studies:          | The end of a Golden Age?<br>PwC Private Banking Study  |
|                   | Helvea: Swiss banking secrecy and taxation.<br>Paradise lost?  |
|                   | Capgemini: World Wealth Report 2012  |
|                   | University of Zurich: The International Private<br>Banking Study 2011  |
|                   | Banking in transition – future<br>prospects for banking in Switzerland 2011.<br>A joint study by the Swiss Bankers Association<br>and The Boston<br>Consulting Group on the Swiss banking centre |
|                   | McKinsey Private Banking Survey 2012<br>Finding a new footing  |
|                   | Switzerland – The Future of HNWIs to 2016:<br>Opportunities for Wealth Sector Professionals  |
|                   | KPMG Performance through focus.<br>Seizing the global private banking opportunity  |
| Trade Press:      | OANDA  |
|                   | Swissinfo.ch - International Service of the Swiss<br>Broadcasting Corporation  |

Table 1: Market sources

#### 2.1.4 Data sample

Private Banks are defined as any financial institution or unit within a larger financial institution whose main source of business comes from individuals with at least USD 1 million to invest (McKinsey & Company, 2012). There were 161 institutions<sup>5</sup> at the end of 2011 specializing in stock exchange, securities and private banking services (Swiss National Bank, 2011).

The PwC Private banking study (PricewaterhouseCoopers LLC [PwC], 2013) was the main data source used in the SD model. The PwC private banking study (2013) is based on the 2006 through 2011 annual financial statements of 100 institutions active in the Swiss private

<sup>5</sup> For calculating the total number of private banks, the sum of Foreign-controlled Banks, Commercial Banks and Other Banking Institutions was used. Most banks included in these categories can be regarded as Private Banks.

banking sector. The two big banks, UBS and Credit Suisse, and their private banking activities were included in the benchmarking group of the PwC study. According to the authors of the study, the sample of 100 of the total 161 private banks may be considered representative.

Other sources (listed in Table 1) and interviews with market players and industry experts were used to find the data not available from the PwC study. Where applicable the average parameters for the industry were used (e.g. if the data for the industry states that the average time for a front staff to stay in banking is 8 years, it is considered that the same is true for the average in the sample).

## 2.2 Key terms and definitions

**Assets under Management (AuM)** – assets under management comprise all invested assets held under a discretionary or advisory asset management mandate. The following positions are regarded as assets under management: securities held in client portfolios, fiduciary deposits, amounts due to clients in savings and investment accounts, as well as other amounts due to clients from time deposits (Swiss Bankers Association, 2012).

**Cost Income Ratio (CIR)** – is a ratio of total costs to total income for the year. CIR measures the strategic driver of cost effectiveness in the banking business. It indicates how much of total income is being employed to meet the cost base.

**High Net Worth Individuals (HNWI)** – individuals with investable assets of USD1 million or larger.

**Net new money (NNM)** – is the net amount of AuM brought by new or existing clients over a year less client assets withdrawn. Interest and dividend income as well as market and currency movements on client assets are excluded from net new money results (Swiss Bankers Association, 2009b).

**Off-shore clients** – Swiss private banking clients not domiciled in Switzerland (as oppose to on-shore clients – Swiss private banking clients domiciled in Switzerland).

**Private Banking (PB)** – servicing of High Net Worth Individuals. In this report private banking is used interchangeably with the term “Wealth Management (WM)”.

**Private Banks** – are defined as any financial institution or unit within a larger financial institution whose main source of business comes from individuals with at least USD1 million to invest.

**Ultra High Net Worth Individuals (UHNWI)** – individuals with investable assets of USD30 million or larger.

**Wealth** – refers to financial assets of High Net Worth Individuals, excluding pension assets.

**Withholding tax** – a tax levied on income from securities owned by a non-resident.

## 2.3 Conceptual framework

The final model which will be more thoroughly described in Chapter Three follows the simplified framework illustrated in Figure 2. This framework defines that assets under management held in the private banks are of two types – on-shore assets (assets brought by clients domiciled in Switzerland) and off-shore assets (assets brought by clients not domiciled in Switzerland). In the meanwhile off-shore assets can also be divided into two groups – assets declared and not declared to tax authorities. A small arrow in between declared and non-declared assets represents the flow of the assets from being undeclared to being declared. The value change of assets is being influenced by two major factors – performance and currency effects, and net new money inflow. The SD model will complement the above described framework by an in-depth analysis of net new money and a structure that causes net new money flow.

The majority of private banks revenues are generated through fees and commissions on the assets as shown in the diagram (see Figure 2). Trading and interest income generate only a marginal part of the assets.

Personnel expenses dominate the total costs of private banks, mainly due to the fact that wealth management is a human-capital intensive business (University of Zurich, 2011). Personnel costs depend on the total value of assets under management – the more clients and, consequently, assets a bank manages, the more personnel it would need to manage those clients. Administrative expenses account for the remaining part of PB costs.

The cost to income ratio measures a private bank's efficiency where higher costs result in higher CIR while higher revenues result in lower CIR. Gross profits show the relationship between revenues and costs in absolute terms where higher revenues generate higher gross profits while higher costs decrease the gross profits.

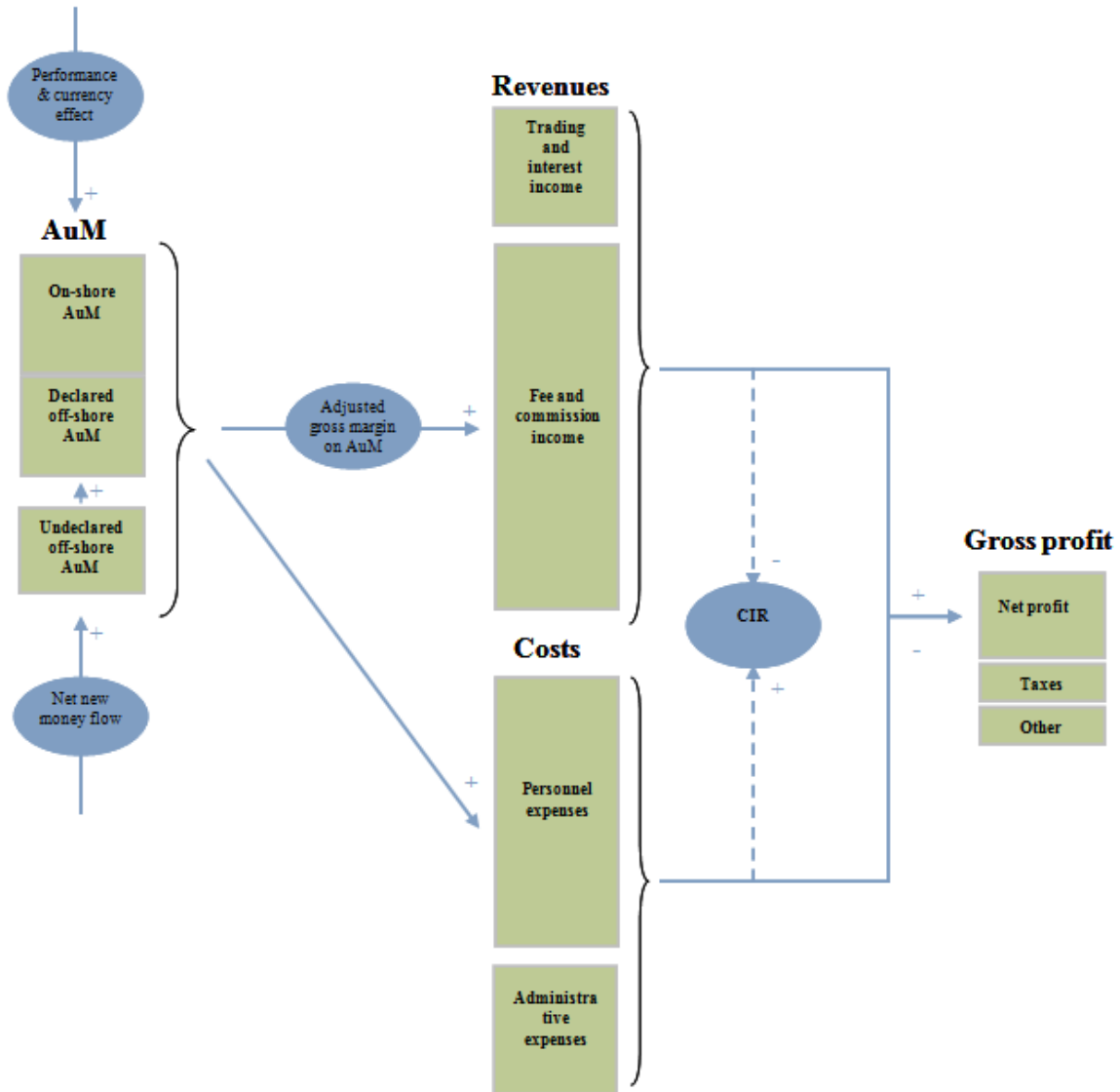


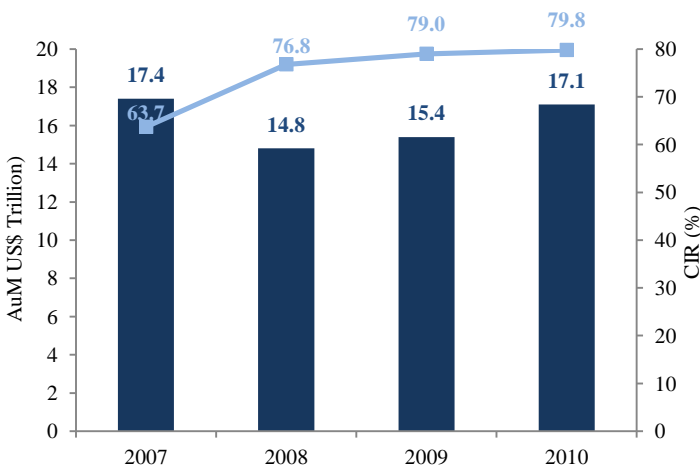
Figure 2: Key concepts

## Chapter 3: Problem description

In order to answer the first research question “Which forces are driving the industry behavior?” it is important to provide an overview of the market situation as it developed over the time period analyzed. The chapter starts with introduction to the situation in the global private banking market. Then, we discuss the situation in the Swiss private banking market.

### 3.1 Global private banking

Private banking can be called one of the most attractive segments within financial services in terms of profitability. Yet from four years of financial turmoil it has not emerged unharmed (McKinsey & Company, 2012). The economic crisis led to significant changes in the global private banking industry. First of all, the economic downturn hit the market by reducing net new money inflows and putting pressure on the margins. But besides a short term effect, this also caused major change in the regulatory environment which will have a much longer-lasting effect on the market situation.



**Figure 3: Global Assets under Management and Cost Income Ratio, %.**

*Source: Capgemini and RBC Wealth Management (2012).*

considerable revenues in the low-interest environment while as investors more often prefer capital-preservation products. On the cost side, rising levels of advisor remuneration make it expensive to acquire and retain client relationship managers who are the private banks' key resources for bringing in and managing their clients. Administrative costs are also high due to

Industry estimates published by Capgemini and RBC Wealth Management (2012) suggest that, although the total of the global assets has increased from 2008 (after a notable decline that year), costs related to managing those assets have risen faster (see Figure 3). The cost income ratio has thus increased by 16 percentage points, rising from 63.7% in 2007 to 79.8% in 2010. Companies are being challenged to generate

high prices for expensive real estate locations and high technology and regulation compliance costs.

According to the study conducted by PwC on global private banking and wealth management (2011), excessive new regulations have become a key concern among global wealth managers. New regulations affect all business models and have profound impacts on all players in the global market. The main idea behind the new regulations has been to reduce systemic risk and protect individual investors. For the market players, new regulations first of all have meant increasing costs – in the form of increased compliance and indirect economic effects (Capgemini and RBC Wealth Management, 2012). Regulations which directly affect the Swiss market will be described in greater detail later in this chapter.

Besides changes in the regulations, the market is being affected by changes in consumer behavior. Findings of the PwC study on the global private banking and wealth management (2011) suggest that clients have become much more demanding. More sophisticated clients demand private wealth products and services which are simpler, more transparent and deliver an evident value.

Structural changes caused by the economic downturn are creating a much more challenging environment for private banks. Initially, many industry experts hoped that the turbulence caused by the crisis is cyclical and the situation would reverse as soon as the market recovered. In later publications (e.g. McKinsey & Company, 2012) it is documented, however, that economic crisis has triggered lasting change. The banking industry has lost the trust of the public, including clients, employees and regulators. Industry experts believe that regulatory pressure will continue accelerating and clients will become even more demanding. Market players can no longer afford to remain static. Changes in the global private banking environment force private banks to adjust their current strategies.

Switzerland was not an exception in terms of being affected by the new regulatory environment. In fact, Switzerland has been hit harder by the new regulations from cross-border business than those banks where West European and North American clients are or were less important (Swiss Bankers Association, 2011b).

### 3.2 Swiss private banking

Switzerland has been always known globally as a leading offshore private banking centre. Swiss private banks have earned a reputation of being “safe haven<sup>6</sup>”. Thanks to its economic clout, Switzerland has been benefiting from a “safe haven” currency<sup>7</sup> (Rinaldo and Söderlind, 2010) and a low level of national debt (PwC, 2013). The political system in Switzerland is based on the principles of direct democracy which in itself has been a guarantee of continuity over the last two centuries. The high average standard of living and the social security system in the country ensures the Swiss reputation for social stability. The business environment is known for little corruption as well as low risk of expropriation.

Another factor behind the success of Switzerland as a private banking center was the secrecy element. Since Swiss Federal Act on Banks and Savings Banks of 8<sup>th</sup> of November 1934 was issued, it has been a criminal offence for bank employees to disclose any information about client’s accounts to any third parties, even tax inspectors (Banking Act, 1934, as cited in Helvea SA, 2009). This implied that all information about accounts and accountholders was considered strictly confidential. This factor has been very appealing to many private banking clients for the reason of preserving their privacy (for instance, celebrities not willing to have their private wealth being discussed in media) or for the more contentious reasons of tax evasion.

Switzerland does not tax non-residents’ assets (Helvea SA (2009)). The EU citizens must either declare their investments to their local tax authorities or pay a withholding tax imposed by EU Savings Tax Directive. US citizens, in the meanwhile, are obliged to notify their local tax authorities about their accounts held in Switzerland. The secrecy that Swiss banks has had to offer and the fact that Switzerland does not impose tax on bank accounts for non-residents has been attracting wealthy individuals from countries with high taxes and caused them to put their investments in Swiss banks. It has been suspected by many that the key reason behind it was the knowledge that money transfers and income from investments will not be disclosed to the local tax authorities and, therefore, will not be taxed. For Swiss private banks many years undeclared money has been an important source of the net new flow. The safe haven reputation combined

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<sup>6</sup> In this report “safe haven” refers to a private banking center with a stable economic, political, legal and social systems where invested assets are expected to retain (or even increase) their value on average and in times of market turbulence.

<sup>7</sup> A “safe haven” currency is a currency that offers hedging value against global risk, both on average and in particular in crisis episodes (Swiss National Bank, 2013b).



with the secrecy which Swiss private banks had to offer, has been a major attraction for wealthy people, encouraging them to choose Switzerland over other private banking centers.

However, after increased international pressure on their offshore business, the Swiss private banking has undergone a major change in its business structure (PwC, 2013). Off-shore models, which are primarily tax-driven are about to lose their attractiveness. Swiss private banks thus lose their off-shore clients, and this has resulted in steadily declining assets under management. The costs, on the contrary, continued to rise. Increasing cost associated with adjustments to new regulations and improving product and service quality pushed the costs of private banks up. As a consequence, the CIR has continuously been increasing over the last few years. Now, the industry experts are questioning whether the “golden age” of Swiss private banking has come to an end (PwC, 2013).

### 3.2.1 Assets under management

Figure 4 shows the development of AuM (included in the analyzed sample) from 2006 to 2011. Assets managed by Swiss private banks peaked in 2007 and then dropped significantly in the course of 2008 economic turmoil. It has been falling further ever since (arrow in the diagram represents the current trend).

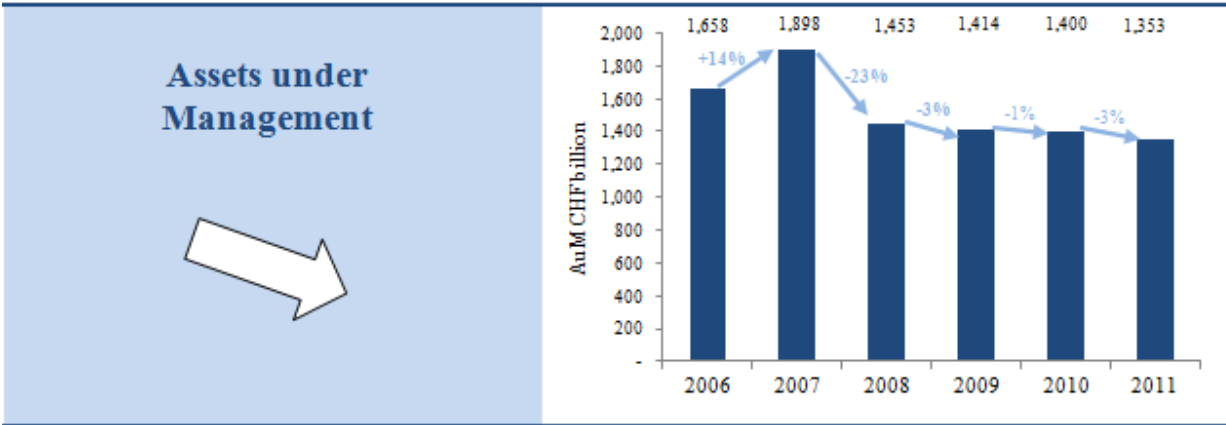


Figure 4: Development of Assets under Management

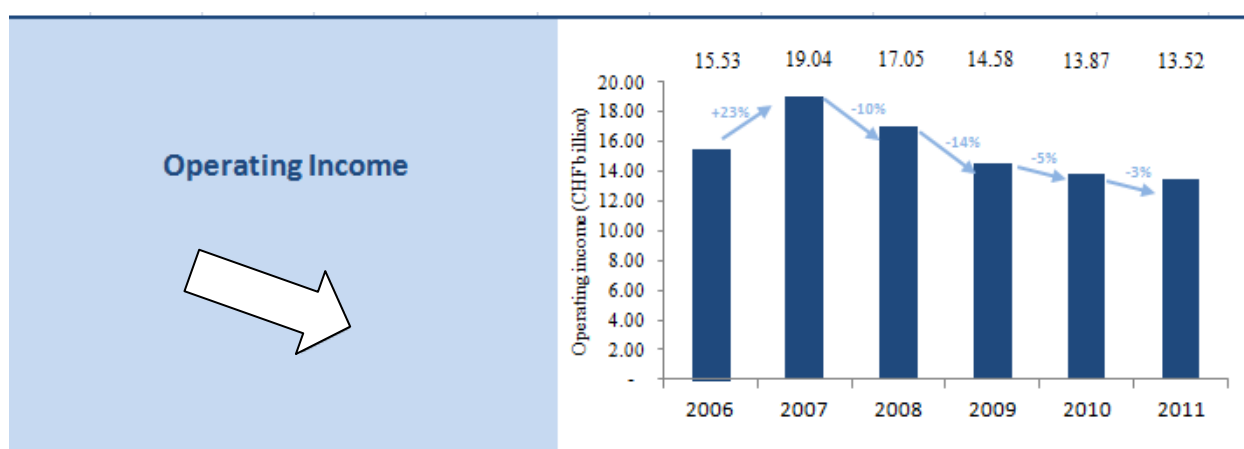
Source: Developed by the author using data from PwC (2013)

According to the study conducted by PwC (2013), Swiss private banks’ AuM has been unfavorably affected by two factors: Firstly, negative performance figures in client portfolios and, second, a stern drop in net new money growth after 2008. Overall, the assets managed by the banks under review have dropped by 29% compared to the peak level at the end of 2007.

While assets under management represent the foundation for revenue generation, the net new money growth rate is an indication of a bank's ability to expand its business organically (University of Zurich, 2011). Despite the drop in net new money growth, actual net new money flow was positive throughout the whole period since 2006. This proves that Swiss private banks still benefit from a safe haven reputation (in particular in times of political, social and economic instability in European Union [EU]) and could offset (so far) the net money outflows caused by the new regulatory environment. Overall, however, the significant drop in net new money has made Swiss private banking industry much more sensitive to external factors, such as share prices or currency effects.

### 3.2.2 Revenues

Figure 5 represents the development of operating income throughout the period analyzed. As it may be seen from the graph, operating income exhibits a similar trend to that of the assets under management. Operating income grew by 23% during a successful year 2007 and has fallen ever since. In 2009 operating income dropped even more significantly than AuM, being additionally impacted by decreasing margins.



**Figure 5: Development of operating income**

*Source: Developed by the author using data from PwC (2013)*

According to the research conducted by PwC (2013), there are several key reasons for the declining revenues. First of all, fees based on the amount of assets under management decreased as a result of the decline in client assets. Moreover, restrained trading activities, high liquidity of the assets under management, a record-low interest rate environment and clients' growing distrust of complex investment products have all decreased the margins on the assets under management. New regulations on the offshore assets have intensified competition from service

providers in clients' countries of origin. Also the intensified price competition among Swiss private banks added to the pressure on margins.

### 3.2.3 Costs

Figure 6 shows the situation on the cost side of the equation. Costs remained relatively stable over the same period as private banks were not able to adjust the costs to the declining revenues. Banks' needs to invest in the know-how of client relationship managers (CRM) and pressure originating from regulations have forced the banks in the industry to maintain the costs on the relatively high level. Another reason for insubstantial cost reduction is the fierce fight for talented staff on the market.

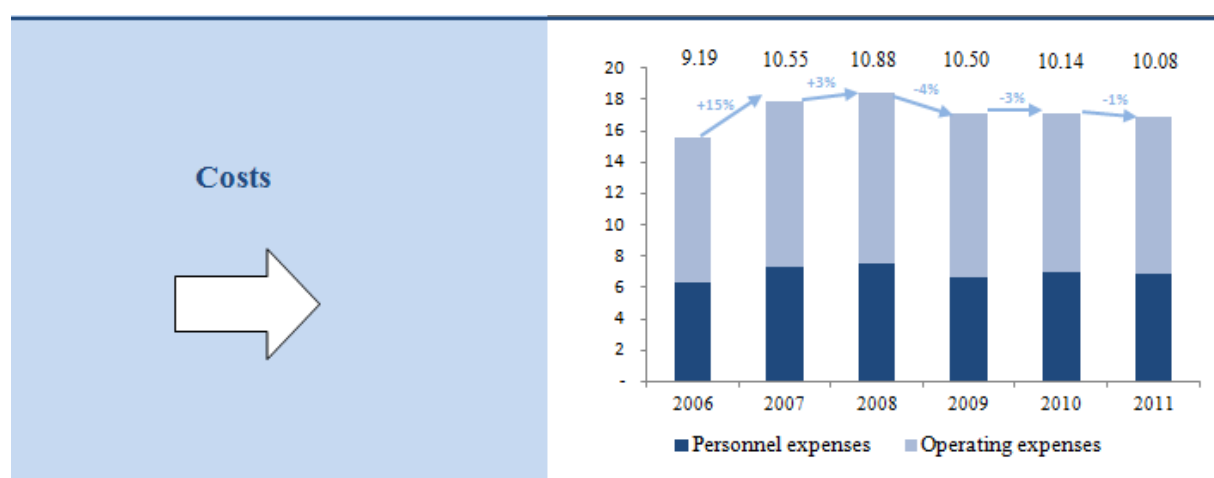


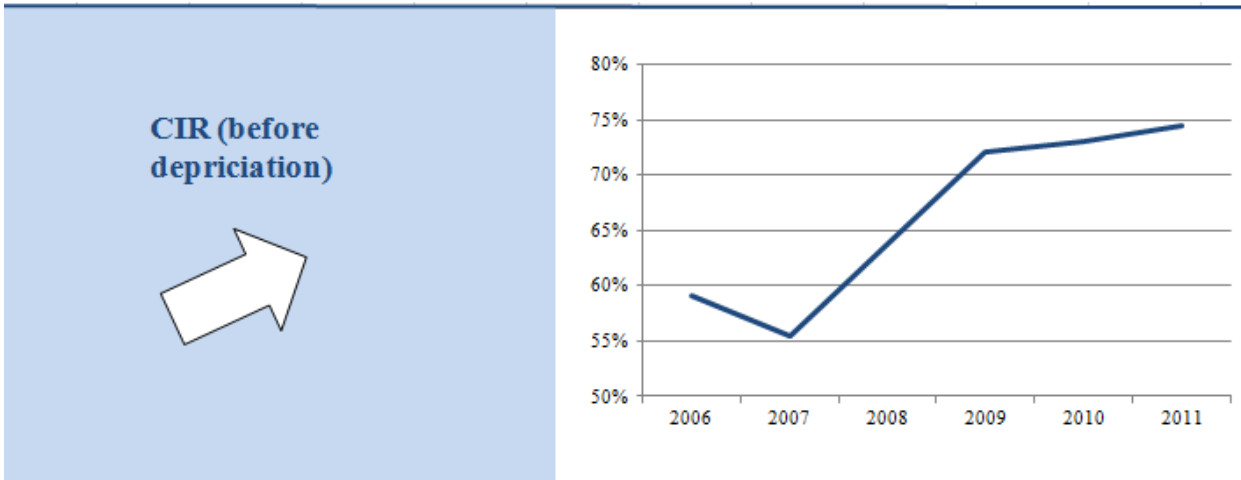
Figure 6: Development of personnel and operating expenses

Source: Developed by the author using data from PwC (2013)

### 3.2.4 Profitability

As a result of declining revenues and costs remaining at the relatively stable level, cost income ratios continuously increased over the period of 2007-2011. As shown in Figure 7, CIR before amortization rose from an average of 59% in 2007 to nearly 75% in 2011. An increase of 26 percentage points is a significant change in just five years.

Such dramatic increase in CIR indicates that Swiss private banks have been becoming increasingly unprofitable. According to the PwC (2013) study, more than 20 out of 100 private banks in the sample had CIR (before depreciation) over 100%, meaning that they were generating negative gross profits before amortization and depreciation.



**Figure 7: Development of the CIR before depreciation**

*Source: Developed by the author using data from PwC (2013)*

This gives a clear indication that conditions in the private banking industry in Switzerland have become very challenging. If the same trend continues some of the banks won't be able to remain sustainable.

### **3.3 Regulatory environment**

In order to answer the second research question: "What is the effect of new regulations on Swiss private banking?" it is important to first describe which new regulations were put into force during the period analyzed.

Changes in the regulatory environment have a substantial impact on the Swiss private banking industry. PwC experts have described it as follows: "It is increasingly the not-so-invisible-hand trimming profitability" (PwC, 2011, p.2), meaning that it is external regulations and not the internal market forces that are now shaping the market behavior.

The economic downturn gave a cause to a series of political and legal actions that directly or indirectly affect the private banking industry in Switzerland. Based on the interviews with the market players, four main regulations which either are impacting or are expected to have a major effect on the industry in a short term were identified: Article 26 of the OECD Model Tax Convention on Income and Capital, Foreign Account Tax Compliance Act, Markets in Financial Instruments Directive II and Basel III. Each of them is discussed separately in the following, focusing on the key points directly related to this study.

### 3.3.1 Article 26 of the OECD Model Tax Convention on Income and Capital

In 2009, Switzerland has come under strong pressure from the United States (US) authorities to ease the rules on banking secrecy and to adopt the OECD standards on administrative assistance in tax matters. This happened after the attempt of the UBS<sup>8</sup> to build up an off-shore business for its US clients transferring their assets to Switzerland (Helvea SA, 2009). Pressure from the US was accelerated by politicians in the EU who joined side with the US.

On 13 March 2009, the Swiss Federal Council announced that Switzerland plans to adopt the OECD standards on administrative assistance in tax matters and will permit the exchange of information with other countries (Helvea SA, 2009). For this study, the Article 26 of the OECD Model Tax Convention on Income and Capital which OECD (2008) is the most important:

*Article 26 creates an obligation to exchange information that is foreseeably relevant to the correct application of a tax convention as well as for purposes of the administration and enforcement of domestic tax laws of the contracting states. Countries are not at liberty to engage in “fishing expeditions”<sup>9</sup> or to request information that is unlikely to be relevant to the tax affairs of a given taxpayer. In formulating their requests, the requesting state should demonstrate the foreseeable relevance of the requested information. In addition, the requesting state should also have pursued all domestic means to access the requested information except those that would give rise to disproportionate difficulties (para. 2).*

The adoption of this standard requires exchange of information on specific cases where there is certain evidence. Moreover, no distinction is made between tax evasion<sup>10</sup> and tax fraud.<sup>11</sup> This is an important point as international administrative assistance was previously only granted by Switzerland in the case of tax fraud. For Swiss banks the automatic exchange of bank data means losing its secrecy privilege and, as a consequence, losing one of its key differentiators.

In 2011, Switzerland negotiated several withholding tax agreements which allow Swiss private banks to protect their clients’ privacy and at the same time ensure the implementation of

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<sup>8</sup> UBS is the biggest bank in Switzerland. Private banking is a part of UBS services.

<sup>9</sup> “Fishing expeditions” here refer to the lists of tax evaders’ names without any evidence supporting them.

<sup>10</sup> Tax evasion “is committed by a person who, as a taxpayer, makes no tax declaration or only an incomplete one (false or non-completion of the tax declaration)” (Swiss Federal Finance Department as cited in Geneva Financial Center, 2011).

<sup>11</sup> Tax fraud is “committed by someone who, for the purpose of tax evasion, uses forged or falsified documents or untrue documents such as account books, balance sheets, profit and loss accounts or wage certificates and other certificates produced by third parties” (Swiss Federal Finance Department as cited in Geneva Financial Center, 2011).

an agreement regarding countries' legitimate tax claims. A withholding tax agreement implies that the final withholding tax is levied by a paying agent (typically a bank) and passed on anonymously to the Federal Tax Administration (FTA). Details of the client's country of domicile are revealed, but the client's name is not. The total tax revenues are then passed on to the relevant country of domicile by the FTA (Federal Department of Finance, 2013).

In autumn 2011, withholding tax agreements were signed with the United Kingdom and Germany. In April 2012, Austria also signed a withholding tax agreement. The agreements with the United Kingdom and Austria entered into force on the 1<sup>st</sup> of January 2013. The agreement with Germany was aborted because of opposition coming from the German Federal council (Federal Department of Finance, 2013).

### **3.3.2 Foreign Account Tax Compliance Act (FATCA)**

While Swiss authorities were in the process of negotiating bilateral tax treaties, a new challenge came from the Foreign Account Tax Compliance Act (FATCA). Final FATCA regulations were issued on January 17, 2013 (KPMG, 2013). FATCA was designed by the US authorities aiming at closing loopholes in existing tax compliancy regulations. FATCA is a highly complex framework that significantly complicates the US clients' tax reporting rules (University of Zurich, 2011).

The new regulation is planned to be put in force in stages with the first stage starting on the January 1, 2014. For Swiss private banks, FATCA will first of all mean a significant increase in reporting rules related to tax information about the US clients and, consequently, further increase in the reporting related costs.

### **3.3.3 Markets in Financial Instruments Directive II (MiFID II)**

Another challenge which Swiss private banks are awaiting is related to the introduction of the Markets in Financial Instruments Directive II (MiFID II). According to PwC (2012b) report MiFID II seeks to enhance investor protection by maximizing transparency and reducing data fragmentation. MiFID II introduces larger regulatory requirements to account for developments in technology and market infrastructure in the financial services industry.

The expected implementation date for MiFID II recently moved from 2012/2013 to 2014/2015. Besides the operational and technological implications, the key implications on Swiss private banks will again be related to an increase in costs. Increase in costs of execution

and infrastructure stem from the move to regulated venues and associated reporting, transparency and conduct requirements will increase notable. Moreover, a wider range of products will be considered “complex” (requiring the development of an advisory model) (PwC, 2012b).

#### **3.3.4 Basel III**

In October 2011, the Swiss legislator published a proposal for the implementation of the new regulatory framework called Basel III. The new capital regime aims at achieving a higher resilience of banks to losses compared to the regime under the Basel II framework (Schellenberg Wittmer, 2012). The key challenge that Basel III brings to private banks is associated with increase of the minimum capital requirement for the key ratio of common equity to risk-weighted assets.

Basel III entered into force in January 2013, with an implementation period expected to last until the end of 2018. Basel III adds another uncertainty to the short term future of private banks in Switzerland.

## Chapter 4: Dynamic Hypothesis

In order to explain causes of the dynamic problem described in the previous chapter and to come up with possible policies, it is important to understand the underlying structure of the system.

In this chapter the structure of Swiss private banking industry will be described. The SD model which represents the structure of private banking market in Switzerland consists of three major sectors: the AuM sector, the personnel sector, and the financial sector. Each of the sectors will be described and explained separately. Table 2 gives a brief introduction to the major sectors.

|                  |  |
|------------------|--|
| AuM sector       | Explains the structure behind the assets managed by private banks. Consists of two subsectors: on-shore AuM and off-shore AuM.   |
| Personnel sector | Gives a simplified representation of the personnel structure. Consists of three subsectors: front office, middle office and back office.   |
| Financial sector | Represents financial structure of the market. Focuses mainly on net income components. Consists of three subsectors: operating income, operating costs and net income statement. |

**Table 2: Introduction to the major sectors**

The simulation time of the model is set for 2006-2018. The simulation starts on the first day of 2006 [01.01.2006]. The period from 2006 to the end of 2011 is a historical period (the model aims at representing the historic data development for this period) and the period from 2012-2018 is a forecast period (the model aims at making reliable predictions for this period).

Figure 8 represents a causal loop diagram that was developed after the desk research was conducted. This causal loop diagram was also confirmed by the market players during the first modeling workshop. Figure 8 represents the main hypothesis which suggests that the behavior of



the industry during the period analyzed has been largely driven by the external factors and the “not-so-invisible-hand” represented by the new regulations.

Variables in dark blue color represent external variables which Swiss private banks cannot affect with their policies. Attractiveness of Swiss private banking for the off-shore clients depends on three main components: Product and service quality, Safe haven reputation and Secrecy. The safe haven reputation and the secrecy are external while the product and service quality could be defined by the market players. Regulatory pressure has a direct affect on secrecy and on costs.

Two loops *B1 Cost pressure* and *B2 Cost pressure* replicate the current policies implemented by the market players in response to the declining profits. *B1* indicates measures directed at reducing administrative costs and *B2* represents measures directed at staff reduction.

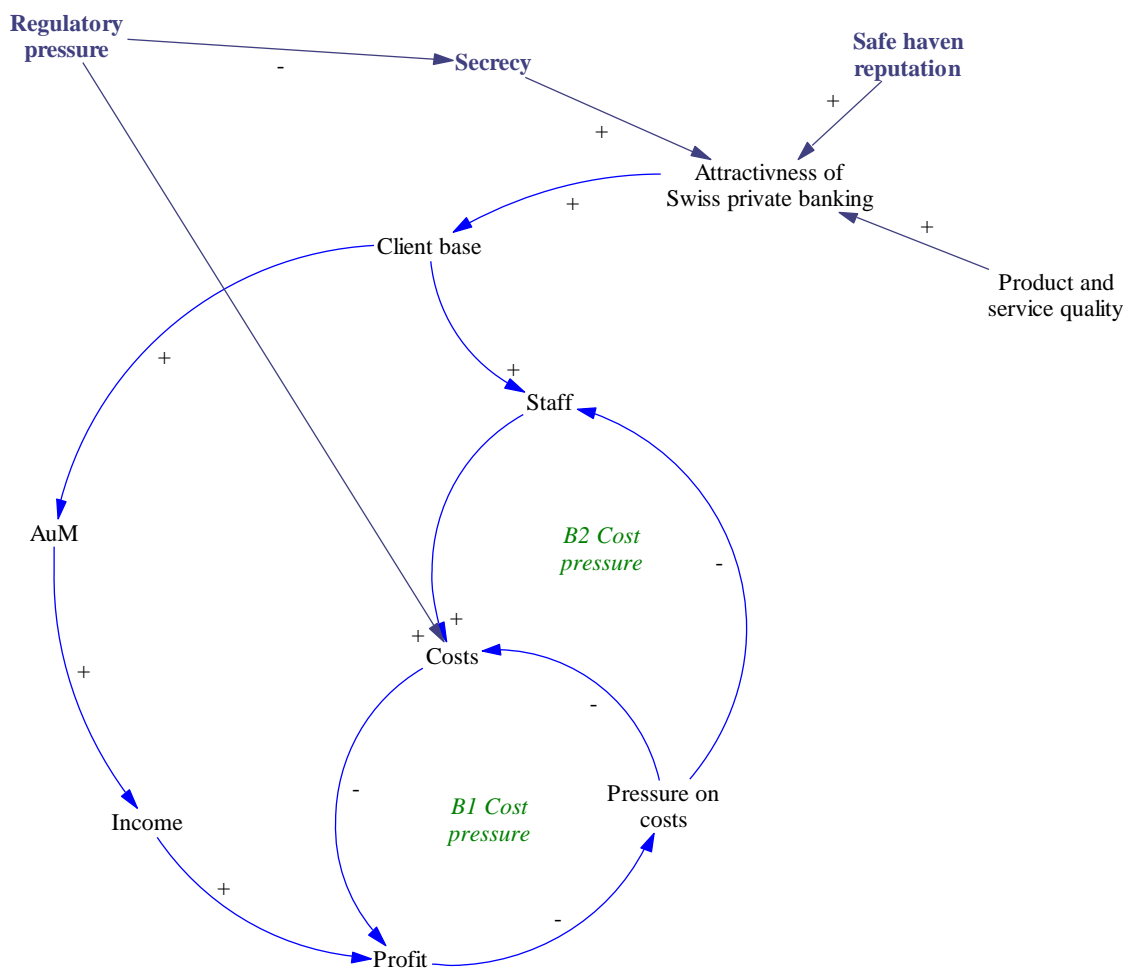


Figure 8: Initial causal loop diagram

## 4.1 Assets under management

AuM is one of the key private banking indicators which shows the amount of all invested assets held under a discretionary or advisory asset management mandate at a certain period of time. The following positions are regarded as assets under management: securities held in client portfolios, fiduciary deposits, amounts due to clients in savings and investment accounts, as well as other amounts due to clients from time deposits (Swiss Bankers Association, 2012). In the market research terms, AuM is an indication of the size of the private banking industry. Therefore, AuM is one of the central elements in the model. Private banks report the level of assets under management as per year ended in Swiss francs (CHF).

AuM in the private banking sector can be segmented in accordance with various parameters, for instance, by type of clientele (HNWI or UHNWI), by type of securities clients are holding or by country/region of client's origin. For the purpose of this study, the key differentiation was made between local and foreign assets – investments made by on-shore and off-shore client, respectively. Off-shore clients refer to Swiss private banking clients not domiciled in Switzerland while on-shore clients refer to private banking clients which are residents of Switzerland.

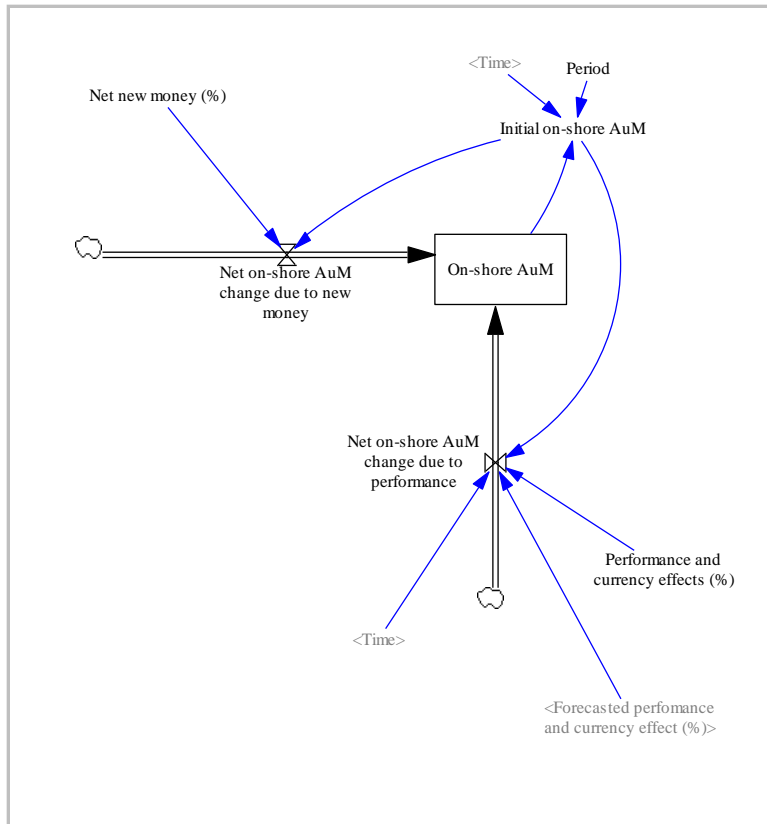
Initially, the structure of AuM was planned to be expanded with a co-structure to simulate clientele. However, private banks do not publish data for the number of people for whom they managing accounts. From the interviews, it was concluded that using the average value that a client invests to calculate the number of clients in the industry would not represent the real situation in the industry. Moreover, during one of the modeling workshops, it was mentioned that an in-depth analysis of the AuM structure rather than the clientele structure would make the SD model easier to understand and follow by the market players. Therefore, it was concluded that AuM should be the main focus area.

### 4.1.1 On-shore assets under management

Figure 9 shows the basic structure of on-shore AuM, where the stock of assets is being influenced by two flows – Net on shore AuM change due to change in net new money and Net on-shore AuM change due to performance and currency effects. Industry reports as well as annual reports of private banks give the change of AuM from the beginning of the year to the end in percent. Therefore, a matching variable was introduced in the model and, the following formula was used to calculate the value of the stock in the beginning of the year:

**"Initial on-shore AuM"**=SAMPLE IF TRUE (MODULO (Time, Period) <1e-006,"On-shore AuM", "On-shore AuM")

Net on-shore AuM change due to new money is a multiplication of the initial value of the on-shore AuM and the percentage change due to net new money. Similarly, the Net on-shore AuM change due to performance is a multiplication of the initial value of the stock and a percentage change due to performance and currency effects.



**Figure 9: On-shore AuM**

Swiss National Bank (as cited in PwC, 2013) reported the proportion of the security holdings attributed to off-shore clients to be around 59% at the beginning of 2006. This value was used as a benchmark to calculate the initial value of the on-shore AuM stock. According to the industry experts, Swiss private banking clientele is very loyal to their local banking services. The share of Swiss to hold their private assets in other than Switzerland private banking centers is very low. Action of the private banks, therefore, do not

cause a change in the on-shore AuM stock on the level of the country (on-shore clients move from one Swiss private bank to another, but this process is not set to be the focus of this research). Net new money is being dependent on the new wealth creation. Performance and currency effects are also purely external.

#### 4.1.2 Off-shore AuM

Off-shore is the other important part of Swiss private banking business. Swiss safe haven reputation in an uncertain world of today, Swiss privilege of banking secrecy and a high quality of banking products and services has led wealthy individuals to place their money in Swiss

private banks' accounts. Secrecy has been more important for some clients than for the others. According to Helvea SA (2009), secrecy was more important for clients coming from Western Europe, notably France, Germany, Italy, Spain and the UK due to the possibility to avoid paying tax. As it was mentioned in the problem description part, EU citizens have an option to either declare their earning to their local tax authorities or pay a withholding tax. However, according to the Helvea SA (2009) study, the scope of the investment income which is actually taxed is very restricted. Helvea SA (2009) estimates that around 80% of EU-sourced money was not declared to local tax authorities in 2009.

Therefore, in the model a distinction between declared off-shore assets and undeclared off-shore assets should be made. Off-shore assets are represented by two stocks – declared off-shore assets (Off-shore DAuM) and undeclared off-shore assets (UAuM). The general structure associated with off-shore stocks is the same as for on-shore assets – the stocks are being influenced by performance and currency effects flows and by the flows of net new money. The key difference for the off-shore structure is the split of the net new money netflow into the new money gain rate and money loss rate as shown in Figure 10. The loss rate is comprised from a sum of assets lost due to wealth loss or spending (for instance, in a case when an account has been inherited by several legatees and as a result of the split new accounts do not total up to USD1 million) and assets loss to competitors (clients taking their assets to other private banking centers).

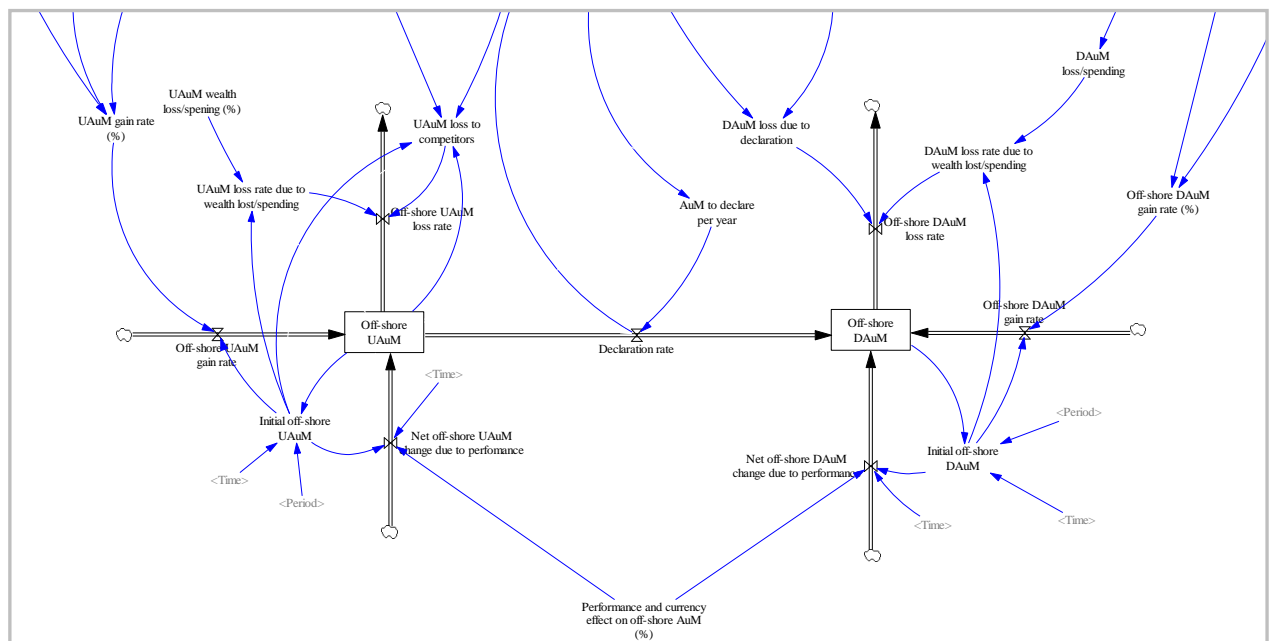
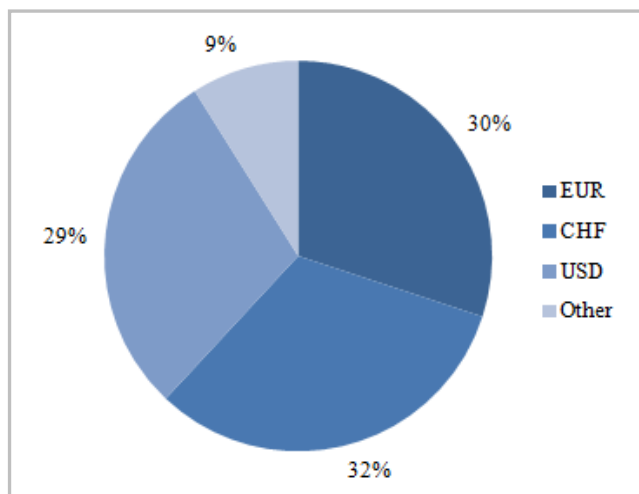


Figure 10: Declared and undeclared off-shore AuM

The flow, which represents the declaration rate, connects declared off-shore assets (Off-shore DAuM) and undeclared off-shore assets (UAuM). The structure follows the basics of one of the diffusion model where off-shore assets are moving from the undeclared to the declared assets stock over time.

To calculate the initial value of the off-shore AuM stocks, data regarding the origins of the accounts was first collected. The SNB (as cited in Helvea SA, 2009) published the data about custody accounts by currency as per end of 2007 (as shown in Figure 10). Following the logic described in the Helvea SA (2009) study it is assumed that all the assets invested in euro came from Europe and most “Other” category covers investments made in British pound. Furthermore, it is being assumed that around 50% of Swiss banks’ off-shore accounts have their origins in the



**Figure 11: Swiss non-resident custody accounts by currency (end-2007)**

*Source: SNB as cited in Helvea SA (2009), replicated by the author.*

European Union. Applying this approach to the sample analyzed, EU-sourced money in the sample equals CHF727 billion at the beginning of the period analyzed. Helvea SA (2009) estimates that around 80% of EU-sourced money was not declared and assuming that the declaration rate between 2006 and 2009 was very low, it was estimated that undeclared EU money in the beginning of 2006 equaled to CHF348 billion. The off-shore declared AuM totaled to CHF480 billion.

Off-shore assets gain rate both of declared and non-declared AuM is being influenced by the attractiveness of Swiss private banking for foreign investors. Even so, factors that define the attractiveness to declared and non-declared clients are not the same. As shown in Figure 10, the attractiveness for declared clients is a function of the safe haven reputation and service and product quality that clients receive in Swiss private banks. The importance of safe haven reputation and product and service is showing the significance of the factors for a client when choosing a private banking center. For undeclared clients, the attractiveness function includes perceived secrecy besides product and service quality and “safe haven” reputation. Secrecy and reputation of safe haven are factors that the industry cannot influence. Therefore they are

exogenous. Product and service quality is being defined by policies that market players implement in order to keep the initial value of the quality or adjust it, therefore, they are endogenous.

The following formulas were used to calculate attractiveness for declared and non-declared clients, respectfully:

$$\text{Attractiveness of Swiss PB for declared client} = \text{Safe haven reputation} (\text{Time}) * \text{Importance of safe haven reputation} + \text{Swiss service and product quality} * (1 - \text{Importance of safe haven reputation})$$

$$\text{Attractiveness of Swiss PB for undeclared clients} = \text{Safe haven reputation} (\text{Time}) * \text{Importance of safe haven reputation} + \text{Perceived secrecy} * \text{Importance of secrecy} + \text{Swiss service and product quality} * (1 - \text{Importance of secrecy} - \text{Importance of safe haven reputation})$$

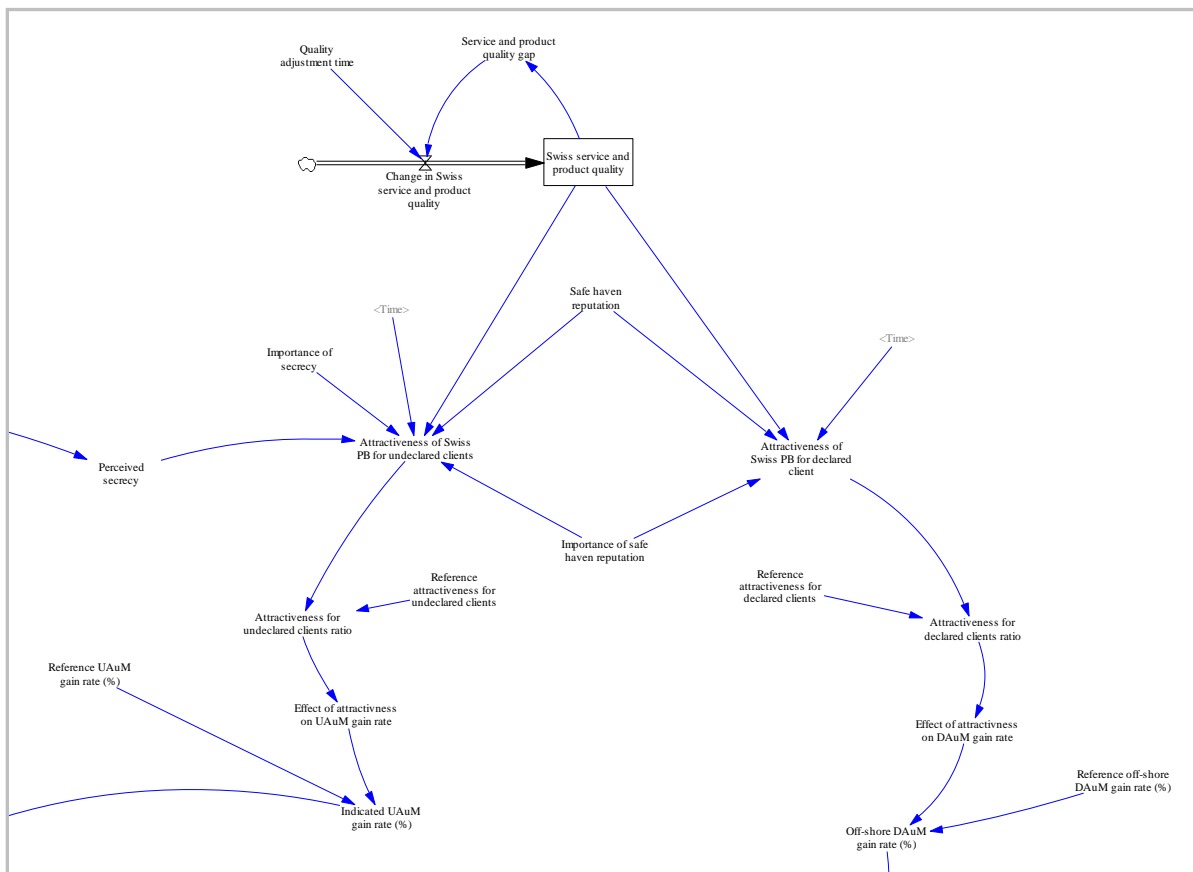


Figure 12: Attractiveness of Swiss private banking for declared and non-declared clients

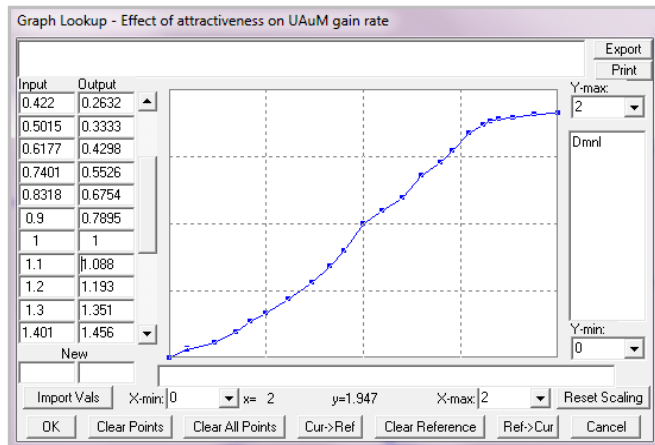
Data for these variables was collected during the interviews with market players. Interviewees were asked to estimate values of qualitative variables on a scale [0-100] and to sketch the behavior of variables over time. Also, market players were asked to assign coefficients to estimate the importance of each factor for clients.

To model the effect of attractiveness on assets gain rate, the actual value of attractiveness is compared to the initial value (in the model called reference attractiveness). When the attractiveness ratio is 1 (the reference attractiveness is equal to actual attractiveness), then the effect on the gain rate will also be 1 (the actual gain rate will be the same as the reference gain rate). As portrayed in Figure 10, the same logic is applied to both declared assets gain and undeclared assets gain. The INITIAL function was used to calculate the reference attractiveness.

**Reference attractiveness for undeclared clients** = INITIAL (Attractiveness of Swiss PB for undeclared clients)

**Reference attractiveness for declared clients** = INITIAL (Attractiveness of Swiss PB for declared clients)

The effect that attractiveness has on the assets gain rate is non-linear, meaning that first a marginal increase in attractiveness leads to corresponding marginal increase in the client gain



rate. The further increase in the attractiveness the less impact it will have as shown in Figure 13. To calculate the actual gain rate, the effect of attractiveness is multiplied by a reference gain rate. The reference values of the gain rate were estimated based on historic data available for the net new money. The same dependence is true for both declared and non-declared assets gain rate.

Figure 13: Non-linear effect of attractiveness on AuM gain rate

### 4.1.3 Effect of new regulations on AuM

The regulations that were put into force after the global financial downturn took place had a major effect on assets managed in Swiss private banks. First of all, Swiss private banking started to lose one of its major differentiators – secrecy.

To demonstrate the effect of new regulations on assets, a variable “Regulatory pressure” has been introduced. The values of the variable are set to be either 0 or 100 as prior to introduction and after, respectfully. The formula used to show regulatory pressure is the following:

$$\text{Regulatory pressure} = \text{IF THEN ELSE} (\text{Time} < 2009, 0, 100)$$

The regulatory pressure had an effect on the perceived secrecy with a certain perception delay. In the model it is represented using SMOOTH function:

$$\text{Perceived secrecy} = \text{SMOOTH} (\text{IF THEN ELSE} (\text{Regulatory pressure} = 0, 100, 0), \text{Regulation perception delay})$$

Besides the effects which regulations had on the secrecy, the new regulations have pushed the private banking industry towards a more compliant business model, meaning that private banks are less inclined to accept the new undeclared money. The implementation was, however, not immediate, but characterized by a certain implementation delay. In the model, the effect of regulation pressure on the new undeclared assets gain rate is represented using the following formula:

$$\text{UAuM gain rate (\%)} = \text{SMOOTH} (\text{IF THEN ELSE} (\text{Regulatory pressure} = 0, \text{Indicated UAuM gain rate}, 0), \text{Declaration implementation delay})$$

What is most important, new regulation have resulted in increased assets outflow. On the one hand, the outflow of undeclared assets increased because some of the clients who had their assets in Switzerland primarily due to the secrecy, decided to move their private wealth to other private banking centers immediately. Therefore, the overall client loss rate to competitors increased. Besides the increased undeclared assets loss rate, regulators have put a pressure on undeclared clients to declare their assets to local tax authorities. The declaration process has also



triggered clients' consideration for moving their assets to their home countries as Switzerland lost its major competitive advantage of secrecy. A retention rate is represented as a fraction of assets which clients decide to keep in Switzerland.

Another important factor which resulted in increase outflow of the assets is the fact that clients tend to withdraw much higher amounts for their spending needed when their assets are declared than undeclared. In the model it means that the fraction AuM loss due to spending is much high for declared assets than for undeclared. Therefore, the higher the declared assets stock gets due to declaration process, the higher actual assets outflow due to spending.

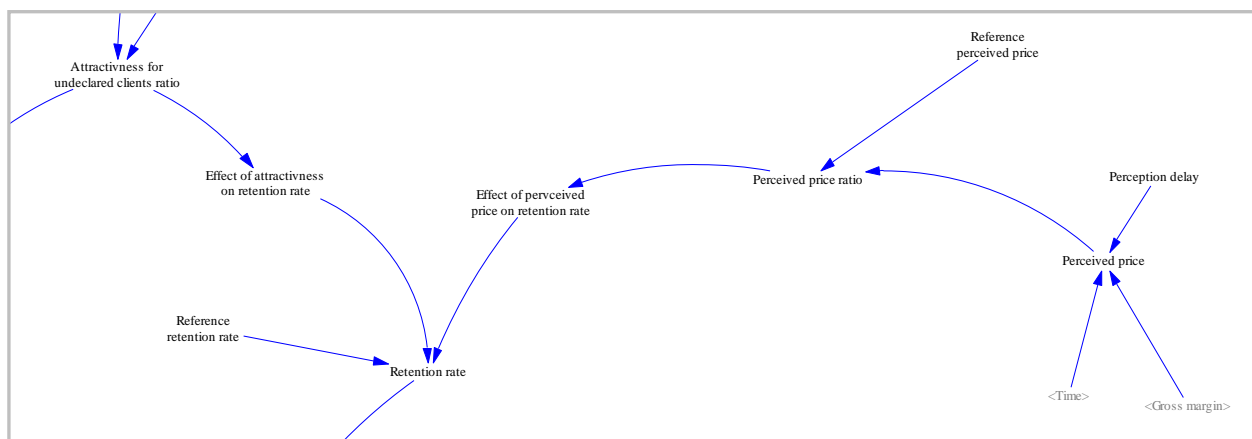


Figure 14: Retention rate

Assets' retention rate is a function of the attractiveness and the perceived price – a price which clients pay for private banking products and services that they are using (see Figure 12). Attractiveness plays a more important role in clients' decision process than perceived price. Therefore, a higher coefficient is applied for attractiveness than for the perceived price in the calculation of retention rate.

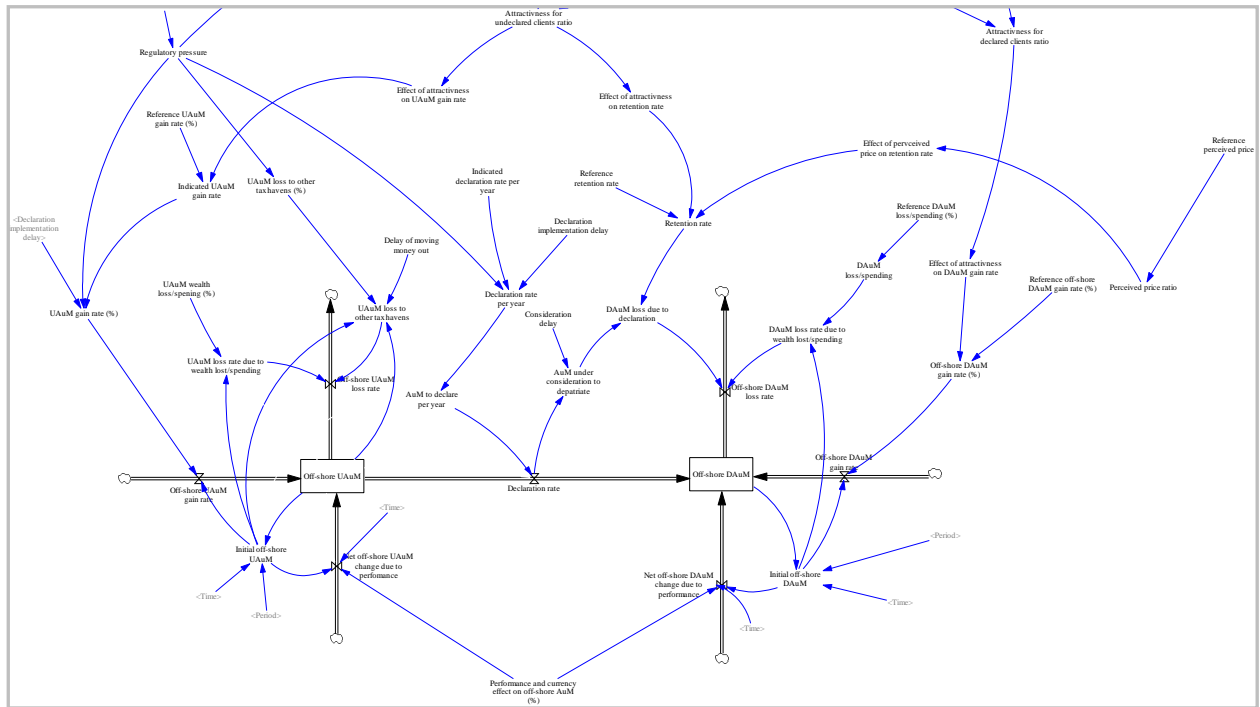
The effect of attractiveness on the retention rate is modeled using a graphical function to portray a non-linear effect of a change in attractiveness on the retention rate. The same structure is used to portray the non-linear effect of a change in price on change in retention rate.

In the model, the indicated declaration rate is assigned a value of 1, which means that new regulations will result in all the money moving from undeclared to being declared. Yet, the actual declaration did not happen immediately after the new regulations were put into force. The declaration implementation delay indicates the time that it will take all undeclared money to become declared. The following formula was used to represent the fraction of the declaration rate:

**Declaration rate (%) = SMOOTH (IF THEN ELSE (Regulatory pressure=0, 0, "Indicated declaration rate (%)" ), Declaration implementation delay)**

The DAuM loss due to declaration shows assets' repatriation process e.g. loss of clients to banking centers in their home countries. Declared AuM loss due to declaration is being calculated by multiplying those assets that clients consider moving out of Switzerland after they were declared by the fraction of assets that was actually moved:

**DAuM loss due to declaration = AuM under consideration to repatriate\*(1-Retention rate)**



**Figure 15: Effect of new regulations on AuM**

Figure 15 shows in which way, the new regulations affect the assets under management structure. A complete stock and flow diagram of the assets under management sectors is presented in the Appendix C1.

In sum, there are three main stocks in the AuM sector: on-shore AuM, undeclared off-shore AuM and declared off-shore AuM. The sum of these three stocks is the total of all assets managed by private banks in Switzerland. Total AuM is an input to the next sector – Personnel.

## 4.2 Personnel

Personnel costs constitute the major driver of the total operating costs of Swiss private banks. Therefore, it is important to include at least a simplified representation of the personnel structure in the model to describe the industry in a coherent way. Personnel in private banks may be categorized as front office, middle office and back office personnel.

### 4.2.1 Front office

Generally Front office is a term which is used to refer to a company's departments that in one or another way come in contact with clients. In private banking, front office is used to refer to client relationship managers (CRMs) and investment research personnel.

Private banking business is very much about personal relationship between a client and his/her CRM. Very often clients are very loyal to one specific client relationship manager. Among private banks poaching individual CRMs or even entire team from competitors' is one of the popular measures of banks' attempts to increase their AuM. However, this is usually the case for private banks within the same country. Therefore, for the Swiss private banking industry model an important conclusion to be drawn is the fact that CRMs besides being one the key cost drivers also constitute one of their key assets.

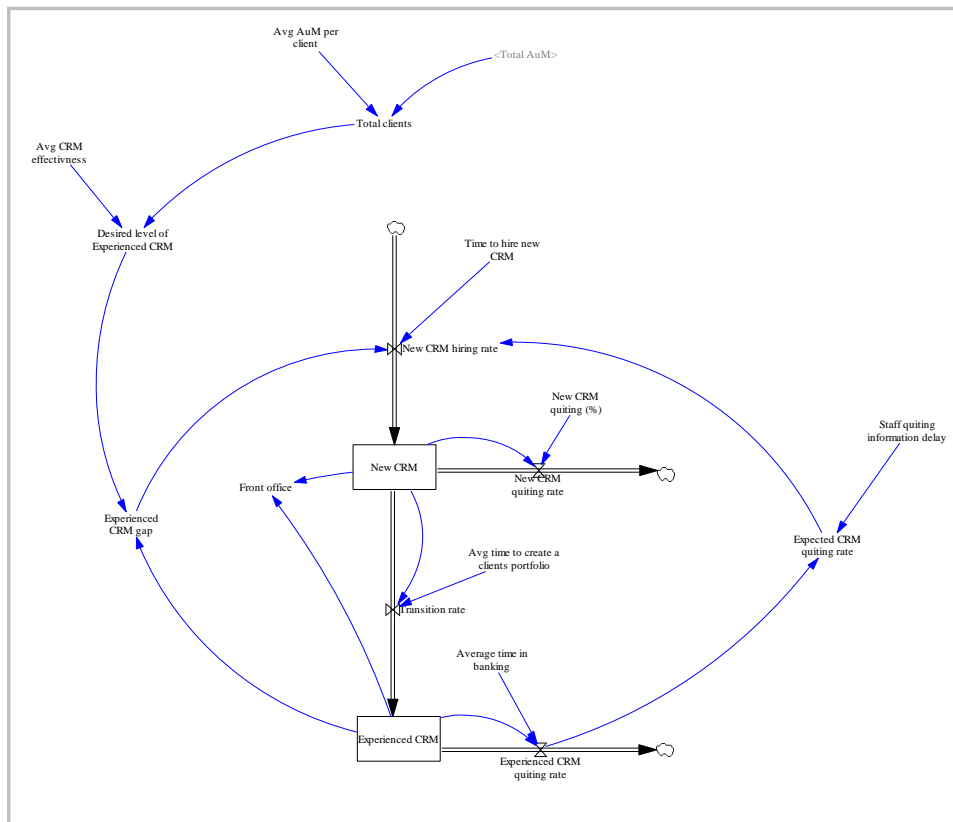


Figure 16: Client relationship managers

Private banks usually set the level of CRMs they need based on the amount of clients they have. If the gap between desired level and current level is positive, they hire more. If, however, there are more CRMs than needed to serve existing clients, CRMs are usually assigned to search for new clients. In reality the process is even more complex. However, for the purpose of this study it is sufficient to assume that the hiring process is based on the gap between the desired level and actual level of CRMs in the banks as shown in Figure 16.

The CRM structure contains two stocks – New CRMs and Experienced CRMs – to represent newly hired CRMs and client relationship managers which have already developed their clients’ portfolios, respectively. This structure is used to capture the industry and, therefore, it shows the movement of CRMs in (e.g. young professionals or experienced investment managers coming from different banking sectors) and out of the industry (e.g. retiring or changing jobs from private banking to another industry). Competition among private banks for CRMs within the industry is not captured in this structure.

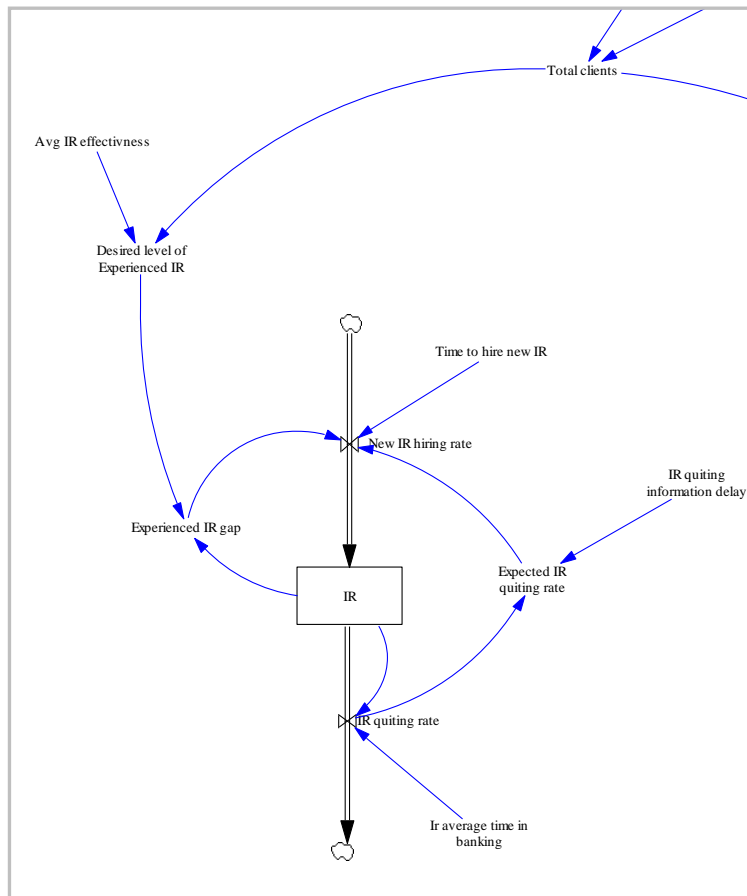
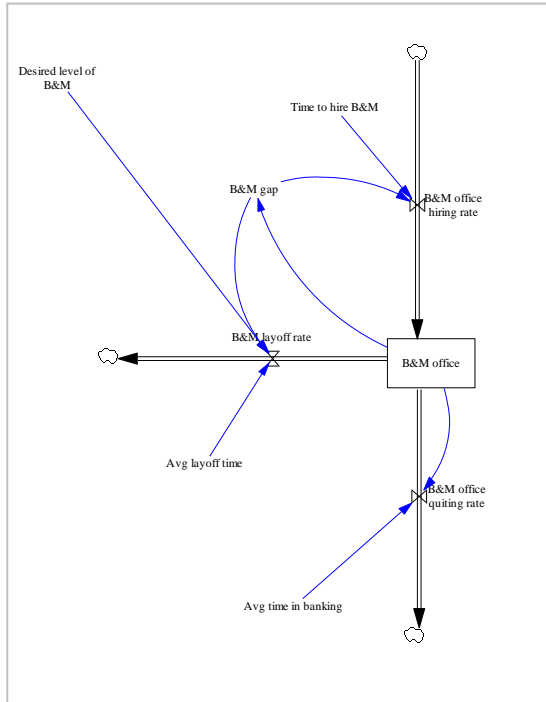


Figure 17: Investments researchers

The desired level of CRM is calculated by dividing total clients in the industry by average CRM effectiveness. The New CRM stock adjusts itself to the desired level of personnel with a first order delay – the time needed to hire personnel. The new CRM hiring rate flow captures, not only the gap between desired and actual state, but also takes the expected CRM quitting rate into account. The rate between new CRMs and experienced CRMs shows the transition rate. Again, with the first order delay – time to create clients’ portfolio – new CRMs are moving from being new to being experienced employees.



**Figure 18: Back and middle office**

New CRMs quitting rate is very low – it is very uncommon among inexperienced relationship managers to move from private banking to another industry. Experienced CRMs quitting rate is governed by first order delay with – average time in banking being the adjustment time.

Investment research refers to investment professionals whose key responsibilities involve managing clients’ portfolios and recommending products. The structure associated with Investment research contains one stock of investments researchers (IR) (see Figure 18). The structure around the stock follows the same modeling logics as described above for the CRMs, just with one stock. Because IRs need less time to become

experienced than CRMs (IRs do not need time to create their clients’ portfolio). The desired level of investment research professionals is also been set by dividing the total level of clients in the industry by the average effectiveness of one investment researcher.

The sum of total CRMs and total IRs shows the total level of front office staff. Considering that the level of front office staff depends on the level of managed assets, it can be concluded that front office expenses can be regarded as variable costs.

#### 4.2.2 Middle and back office

Middle office is comprised of risk management staff, financial personnel and compliance specialists. In contrast, to the front office, the desired level of middle office personnel is not dependent on the amount of assets that private banks are managing and, therefore, can be regarded as fixed costs. Back office staff conducts transactions processing, general operations and IT operations. The level of the back office work force also does not depend on the level of assets managed by bank, but is rather dependent on external factors such as, e.g. regulations. Since the back office and the middle office follow the same structure, the simplified representation of back and middle office will be consolidated in one stock (in the model B&M – Back and Middle – office).

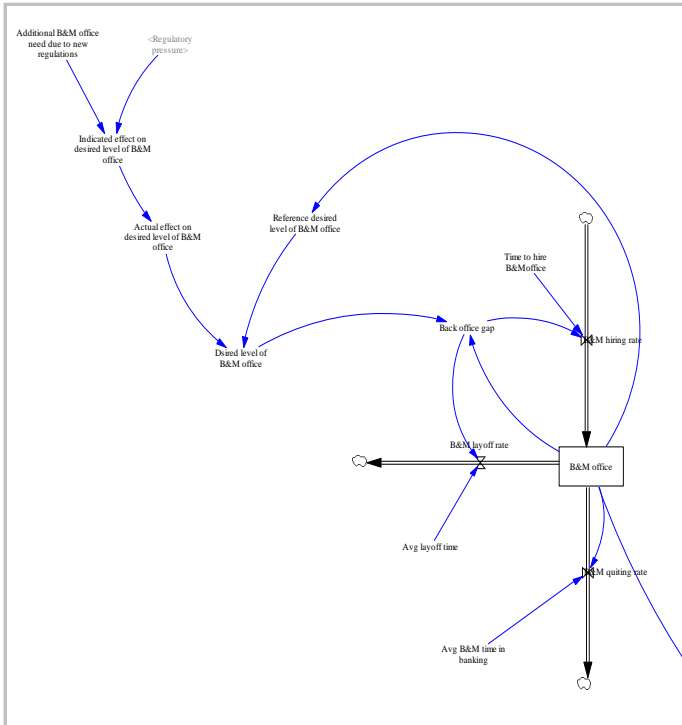


Figure 19: Effect of new regulations on desired level of back and middle office

The basic structure is very similar to the structure of IR (see Figure 19). Key difference is being the fact that the desired level of back office personnel is an external variable. Also, according to the trade interviews, back office staff can be laid off, meaning that when the actual level of back office staff is exceeding the desired level, desired layoff is positive. The layoff rate is being calculated by dividing the gap by the layoff time.

### 4.2.3 Effect of new regulations on personnel

As discussed in Chapter 3, new regulations that were put into force after the economic crisis have had an effect not only on assets and, consequently, on revenues, but also on costs. One of the major implications of new external requirements was an increase in personnel, mainly in compliance and risk management required to run a private banking business.

In the model, additional back and middle office staff, needed due to regulations, represents an additional number of professionals which are needed as a result of the pressure coming from new regulations as shown in Figure 19. The following formula was used to calculate the indicated regulation effect on the desired level of back and middle office personnel:

$$\text{"Indicated effect on desired level of B\&M office"} = \text{IF THEN ELSE (Regulatory pressure} > 0, \text{"Additional B\&M office need due to new regulations"}, 1)$$

Indicated effect is then being added to the reference level of desired back and middle office to calculate the actual desired level of back and middle office staff. The expression “desired level of back and middle office” is used to show the need for personnel. In reality, however, an additional increase in back and middle office staff is not desired for private banks.

Additional increase in back and middle office personnel means additional personnel costs and no added value for the clients and, therefore, no added value for the banks.

Not only have new regulations impacted the back and middle office staff also new regulations have brought a need for front office personnel to do additional tasks related to

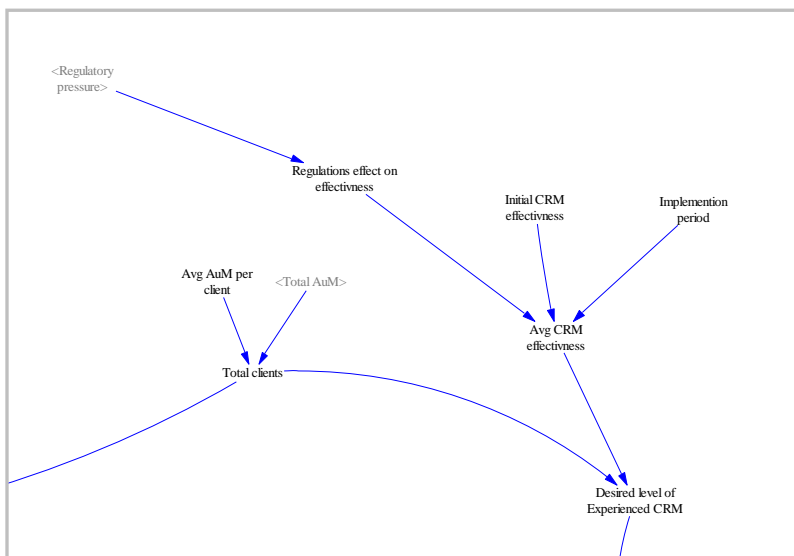


Figure 20: Effect of new regulations on CRM effectiveness

dealing with one client so that that their working efficiency has decreased. In the model this is represented as an effect of regulation on CRM effectiveness as shown in Figure 20.

In sum, the personnel structure is represented using four main stocks: New CRM, Experienced CRM, IR (these three summed together

represent front office), and Back and Middle office stock (which consolidated back and middle office personnel). The sum of the total front staff and back and middle office staff represents the total personnel in the industry. Total personnel is an input to the next sector – Financials. The full stock and flow structure of the Personnel sector is presented in Appendix C2.

### 4.3 Financial sector

Due to the time limits applied on this project, only a simplified representation of the financial sector has been implemented. The basic profit and loss structure is the key focus area whereas the balance sheet structure was left aside.

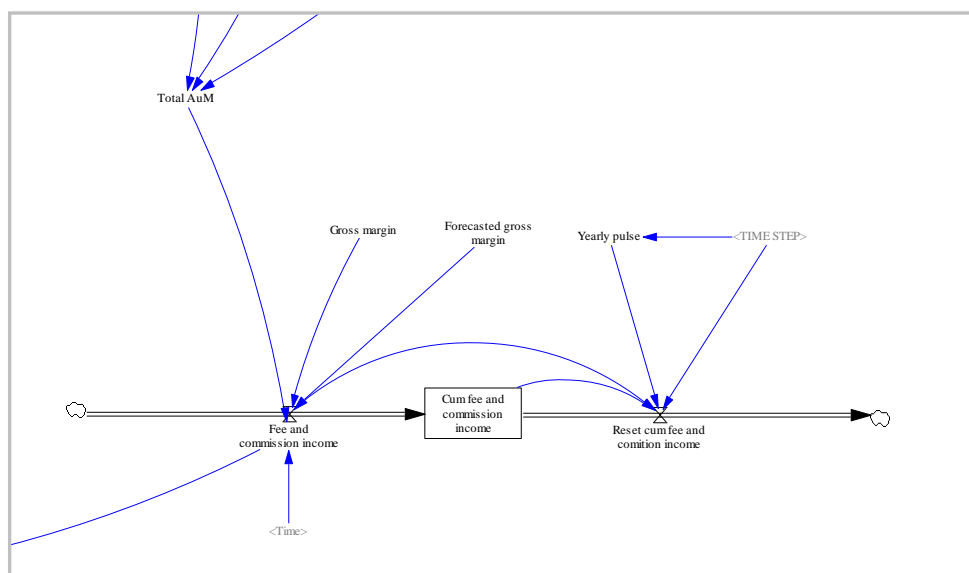
In the model, the financial sector aims at representing the basic structure of income and costs accounts and calculating gross and net profits. Tracking changes in the financial results provides us with an opportunity to track the implications of the model's internal dynamics.

#### 4.3.1 Operating income

Private banks generate income from fees charged to clients for products and services provided. Clients' accounts can be of two types – discretionary (accounts managed

professionally by brokers) and brokerage accounts which allow banks to generate income from initial public offerings (IPOs) or secondary offerings. The fee structure can vary from one bank to another, but generally banks charge a fee on discretionary mandates based on the size of the account, collecting the fee every month or each quarter. Private banks also provide other services, such as estate planning or tax income planning.

Net fee and commission income generate the major part of total operating income of private banks and is, therefore, the focus of this research. Trading and interest income are considered exogenous.



**Figure 21: Fee and commission income**

In the model, fee and commission income is modeled as a flow that accumulates in the “cumulative fee and commission income” stock as shown in Figure 21. The flow of fee and commission income calculates the income generated every TIME STEP (which is set to be equal to roughly one month) by multiplying assets under management using the gross margin. The stock shows how income accumulates over a year. To follow the accounting logic, the cumulative fee and commission income stock accumulates over a year and is being emptied on the last day of every year. To represent this process, the following function was used:

**Reset cum fee and commission income** = IF THEN ELSE (Yearly pulse>0, (Cum fee and commission income/TIME STEP) + Fee and commission income, 0), where

**Yearly pulse** = PULSE TRAIN (2007-TIME STEP, TIME STEP, 1, 2019)



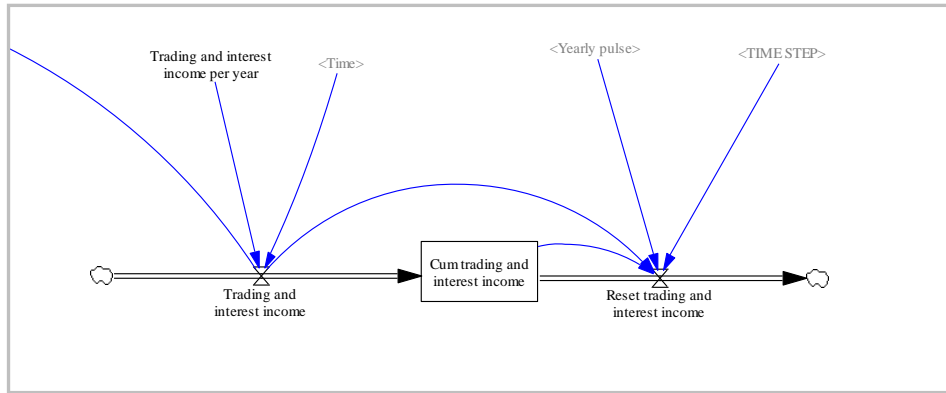


Figure 22: Trading and interest income

Trading and interest income although uses external data as input, following the same basic structure as fee and commission income as shown in Figure 22.

The sum of fee and commission income and trading and the interest income flows is the total operating income. In the same way, the sum of the stocks amounts the cumulative operating income. The full stock and flow structure of income subsector is presented in Appendix C3.

### 4.3.2 Operating expenses

Operating expenses consolidate two key private banks' expenses groups: Personnel expenses and administrative expenses. Personnel expenses generate the major part of total operating expenses of private banks and, therefore, are the focus of this research. Administrative expenses are considered exogenous.

In the model, the structure that represents personnel and administrative expenses is an analog to the operating income structure explained in operating income part.

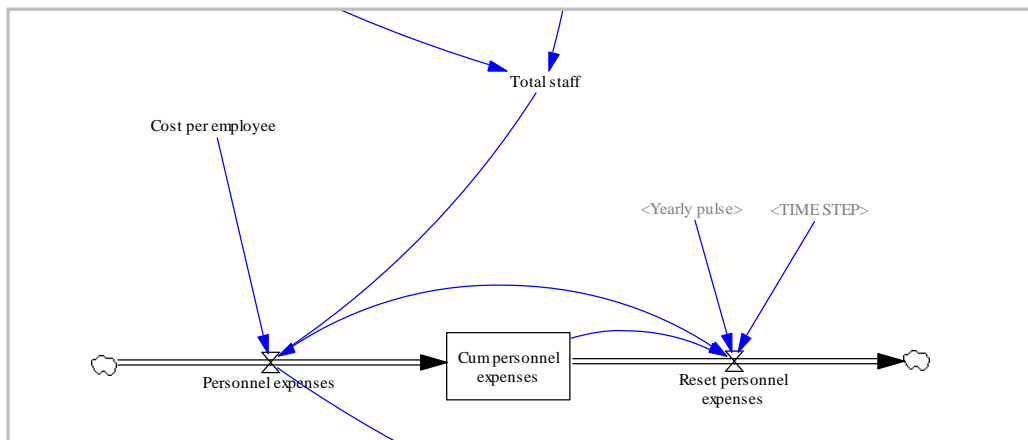


Figure 23: Personnel expenses

As shown in Figure 23, Personnel expenses are modeled as a flow that accumulates in the “cumulative personnel expenses”. The flow of personnel expenses calculates expenses for all personnel in the industry every TIME STEP by multiplying total personnel by cost per employee. Cost per employee is an average value for the industry of the costs experienced by private banks for managing one employee per year. It includes salaries and bonuses (if any). The cumulative personnel expenses stock portrays how personnel related expenses accumulate over a year. To follow basic accountancy logics, the cumulative personnel expenses stock accumulates over a year and is being emptied on the last day of every year. “Reset personnel expenses” represents the same structure as “reset cumulative fee and commission income” described before. Administrative expenses although is governed by an external data as an input follow the same basic structure as personnel expense as shown in Figure 24.

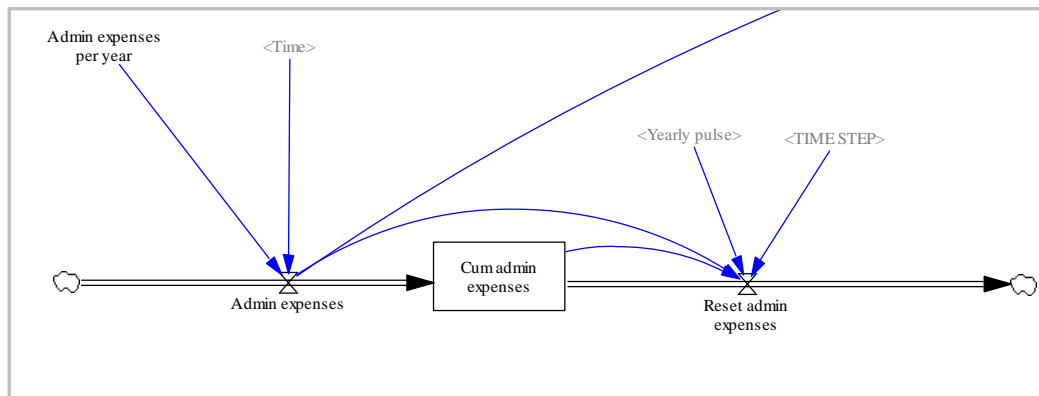


Figure 24: Administrative expenses

Investments are a part of expenses that improve quality of products and services for the clients. “Reference investments” represent a part of costs that private banks have to spend over one year in order to maintain the quality of products and services at its initial value (see Figure 23). “Investments” represent the actual level of investments which has been made over year.





that new regulations have had on the level of assets managed in the industry. New regulations have put a pressure on banks not to accept new undeclared money. This results in decrease inflow of new AuM. Furthermore, new regulations have pressured undeclared clients to declare their assets. The declaration process has had a consequence on client loss rate. Expenses were affected both through an undesired increase in total personnel as well as increase in administrative costs (mainly associated with additional investments in IT systems that, however, do not have any added value for the clients).

#### 4.4 Current policies

In lights of the changing market environment market players have been implementing a number of policies directed at improving the situation. From the interviews with the market players, the key policies being implemented by private banks are:

- Outsourcing (mainly back office services)
- Operational efficiency policies
- Infrastructure consolidation

When considering the industry as a whole, all these policies in one or another way are directed at cost reduction. In the model, it is assumed that the decision makers, based on the unsatisfying financial results, introduce staff reduction policies. For instance outsourcing back office services allows banks to reduce desired level of back office workforce.

To show how negative change in gross profit fosters market players to implement cost reduction policies, we first introduce a variable that represent the ratio between current profits against profits in a former year. To calculate profits in a former year (in the model, Gross profit in the year N-1) the following formula was applied:

**"Gross profit in the year N-1"**= DELAY INFORMATION (Gross profit, Initial gross profit)

The ratio between current gross profits and gross profits in a former year gives an indication to the market players whether profits have increased or decreased over a year. When the gross profits ratio is below 1, the effect of policies on the desired level of back office staff and administrative expenses is activated.

In sum, Chapter 4 aimed at explaining the structure behind the Swiss private banking industry before and after new regulations were introduced. After the analysis of the structure had been made, it was concluded that industry behavior has been largely driven by the external factors that private banks cannot control. Among those: market performance, currency exchange effects, safe haven reputation, the secrecy and the new regulations. Product and service quality is one of the main internal drivers.

## Chapter 5: Model analysis and testing

To make sure that the results of the model described in Chapter 4 can be trusted and used for the market analysis, the model should be analyzed thoroughly. “Validity of the results in a model-based study are crucially dependent on the validity of the model” (Barlas, 1996, p. 183). Before using the model for policy analysis, enough confidence should be built in its validity, coherency and ability to recreate historic behavior for the right reasons. According to Barlas (1996), there are three main categories of system dynamics validation tests: direct structure tests, structure-oriented behavior tests, and behavior pattern tests. Chapter 5 describes the process of model analysis and validation.

### 5.1 Unit consistency

Dimensional consistency is one of the key tests that should be performed to validate the model. A units’ consistency test can reveal important flaws in the structure of the model. Vensim, which has been used to develop the model, has a unit checking feature which checks the model equation for the consistent use of units of measurement. The software units’ checks do not prevent the simulation from having errors, but rather helps to find problems that might otherwise have been overlooked. The unit consistency tests were conducted by checking the model equation-by-equation and conducting the unit consistency tests for each of the equation separately. When a new structure was added to the model, it was immediately tested for face and units’ consistency. Conducting the unit consistency tests brought better understanding of the structure of the model and proved that model does not contain any inconsistencies.

### 5.2 Extreme conditions tests

The literature (Peterson and Eberlein, 1994; Sterman, 2000) emphasizes the importance of a model being robust in extreme conditions. A model should behave in a realistic way no matter how extreme the inputs imposed on it may be. The extreme conditions test can be performed by analyzing the equations used in the model and studying the simulated behavior.

Vensim has a special SyntheSim (for Synthesis of Simulations) feature which allows to synthesize model structure and simulation behavior. The software allows seeing the results of simulations superimposed on the model diagrams. It instantly updates these displays as model constants and lookups are being changed. SyntheSim feature is extremely helpful when conducting extreme conditions tests.

Using SyntheSim function a variety of constants and lookups were tested. The following tests' results are reported below:

- Extreme condition 1: Extremely high performance and currency effect
- Extreme condition 2: Extremely long declaration implementation delay
- Extreme condition 3: Extremely low CRM effectiveness
- Extreme condition 4: Extremely low costs per employee

### 5.2.1 Extreme condition 1: Extremely high performance and currency effect

The first extreme condition test aimed at testing model's behavior when performance and currency effects are set to extremely high value 1 (100%). This means that every year the inflow of AuM due to performance and currency effects would be equal to the value of stock in the end of the last year.

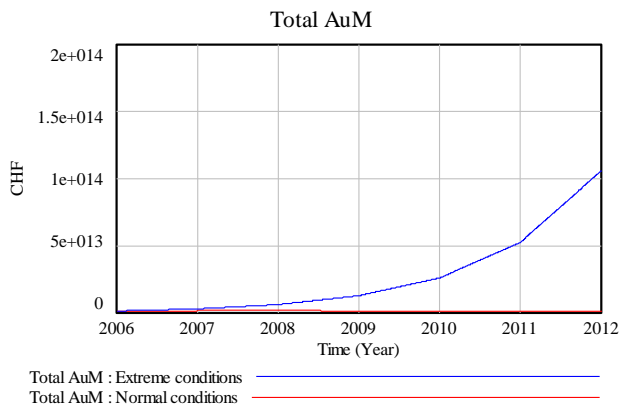


Figure 28: AuM under normal and extremely high performance and currency effect value

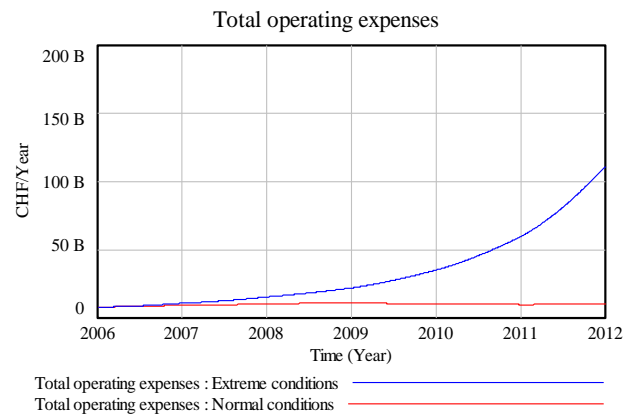


Figure 29: Operating expenses under normal and extremely high performance and currency effect value

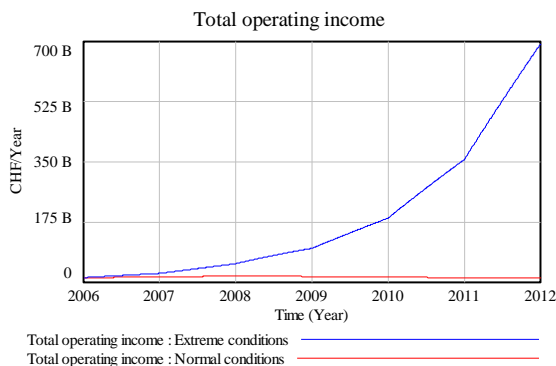


Figure 30: Operating income under normal and extremely high performance and currency effect value

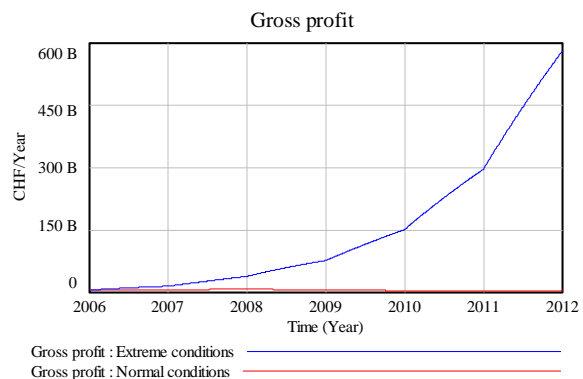


Figure 31: Gross profit under normal and extremely high performance and currency effect value



The results of the first extreme condition test showed (see Figures 28-31) that when performance and currency effect is set to extremely high value, the total assets under management is showing exponential growth because the value of the inflow due to performance will always dominate any other affect that other flows might have. As a result of the exponential growth of AuM, operating income, expenses and profit are also increasing exponentially. This simulation proved that the model shows adequate behavior under this extreme condition.

### 5.2.2 Extreme condition 2: Extremely long declaration implementation delay

The second extreme condition test aimed at examining the behavior of the declared and undeclared assets stocks when the declaration implementation delay is set to an extremely high number. This would mean that although the implementation was put into force in 2009, there was no actual declaration implementation during 2009-2011.

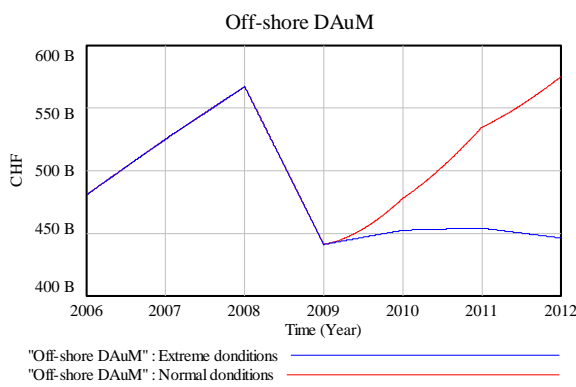


Figure 32: Off-shore DAuM under normal and extremely high declaration implementation delay

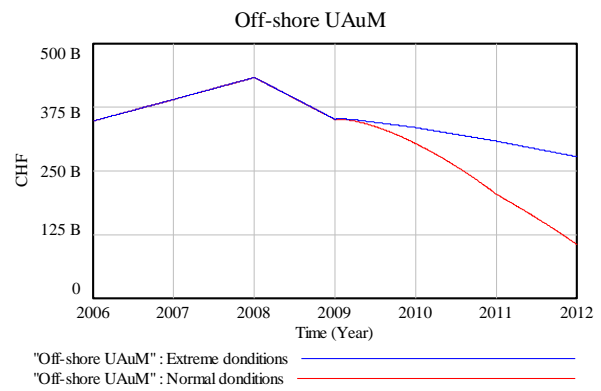


Figure 33: Off-shore UaM under normal and extremely high declaration implementation delay

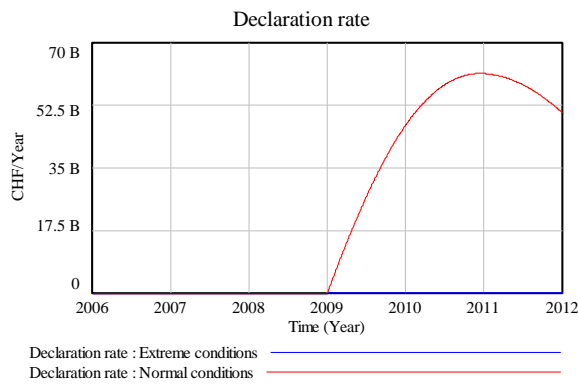


Figure 34: Declaration rate under normal and extremely high declaration implementation delay

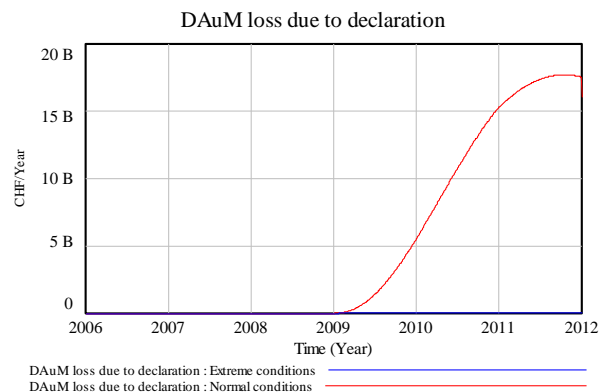


Figure 35: DAuM loss due to declaration under normal and extremely high declaration implementation delay

The results of the test (see Figures 32-35) showed that under extremely high declaration implementation delay there is no AuM moving from UAuM stock to DAuM stock. Declaration rate is equal to 0, and consequently, there is no client loss due to declaration. Results of this simulation also represent the hypothetical situation well.

### 5.2.2 Extreme condition 3: Extremely low CRM effectiveness

The third extreme conditions test was conducted in order to test the behavior of the model when effectiveness of client relationship managers is set to be very low. This would mean that for managing the same amount of clients, a much higher number of CRMs would be needed.

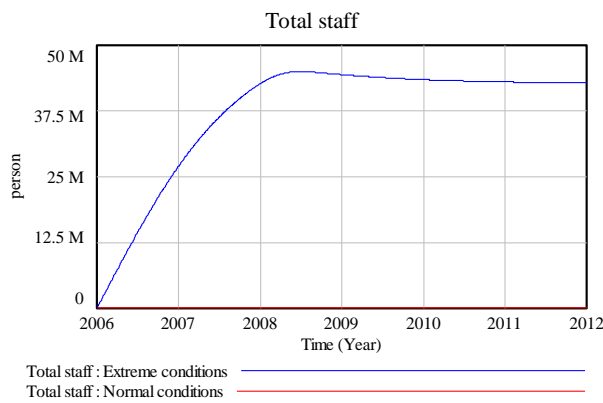


Figure 36: Total staff under normal and extremely low CRM effectiveness

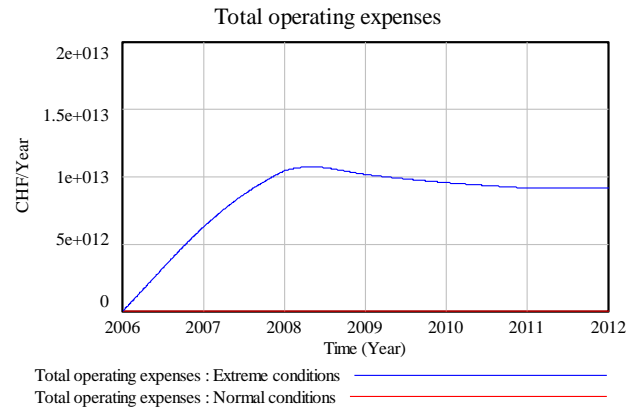


Figure 37: Total operating expenses under normal and extremely low CRM effectiveness

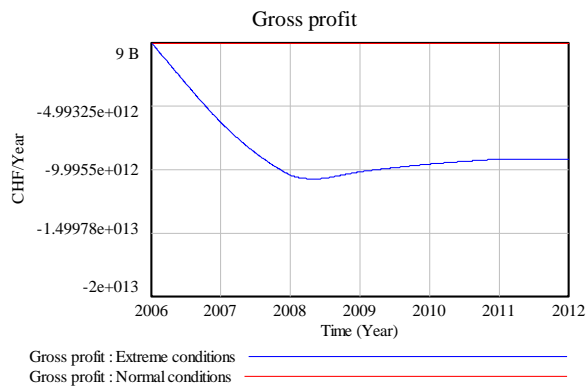


Figure 38: Gross profit under normal and extremely low CRM effectiveness

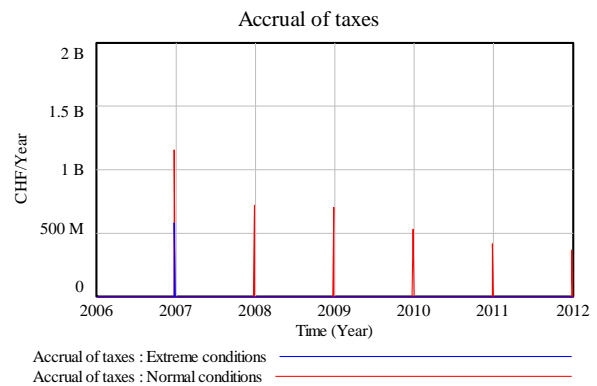


Figure 39: Accrual of taxes under normal and extremely low CRM effectiveness

The test results (see Figures 36-39) showed that when effectiveness of CRMs is very low, the level of personnel increases significantly. Total staff is showing a goal-seeking behavior, where the desired level of personnel is a goal which is set at very high level due to a very low effectiveness of the client relationship managers. Total operating expenses, consequently, also increase significantly.

Gross profits, on the contrary, decay sharply due to very high costs related to personnel. Figure 38 shows that taxes are being accrued only when gross profit is positive. This simulation also produced expected results and did not reveal any flaws.

### 5.2.3 Extreme condition 4: Extremely low costs per employee

The fourth test which was conducted aimed at testing the behavior of the model when costs per employee are set to extremely low value. This would mean that having the same amount of employees would have costed banks very little.

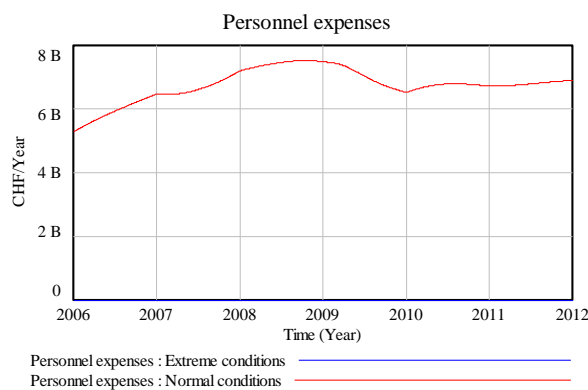


Figure 40: Personnel expenses under normal extremely low costs per employee

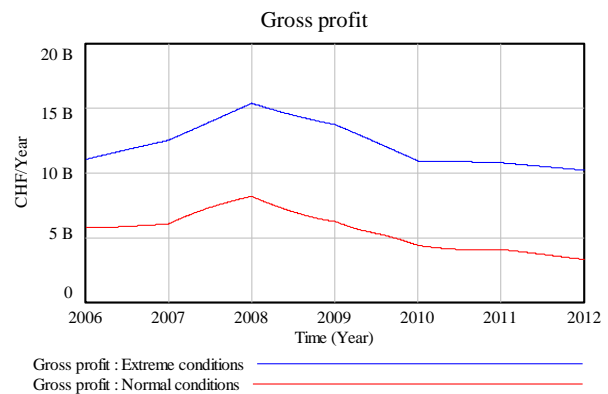


Figure 41: Gross profit under normal extremely low costs per employee

The results of the simulation (as shown in Figures 40-41) show that when costs per employee are set to extremely low value, expenses related to personnel are also extremely low. Consequently, the gross profits showed much higher values than under normal conditions. Simulations results met the predictions and therefore, did not reveal any major inconsistencies.

After performing the extreme conditions tests no major flaws in the equations were discovered. The simulations showed realistic results for the historic period when extreme values were assigned to the parameters.

## 5.3 Behavior pattern tests

To evaluate the accuracy of the model designed, the produced behavior should be compared to the actual data available for the historic period. Behavior pattern tests show if a model reproduces the problem behavior adequately (Sterman, 2000). Conducting behavior pattern tests should give additional confidence in the structure of the model. The test will be completed by comparing the simulated data to the reference data.

### 5.3.1 AuM reference mode test

Figure 42 shows the comparison of the historic development of AuM and the behavior produced by the model. The arrow, just as in the problem description part, indicates the current trend. Total AuM data (red line) represents the reference mode. Blue line shows the simulated behavior. The visual comparison shows a rather good fit between simulated and reference graphs. The calculated correlation coefficient ( $R^2$ ) is equal to 0.99 and RMSE divided by run average is 1.3%. Statistical tests also prove that graphs have a very close fit. A very close correlation between the reference mode and the simulation results during the historic period is due to the fact that key factors driving the behavior are external: performance and currency effects, Safe haven reputation and regulatory pressure.

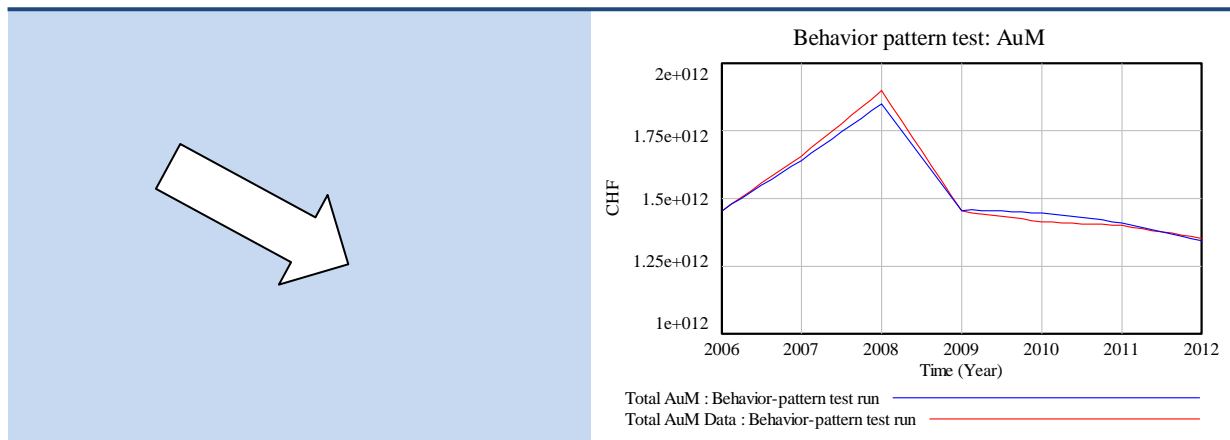


Figure 42: AuM reference mode test

### 5.3.2 Personnel reference mode test

Figure 43 shows the comparison of the historic time series of the total staff in the industry and the behavior produced by the model. Total staff (red line) represents the reference mode. Blue line shows the simulated behavior. The visual comparison shows quite good fit between simulated and reference graphs. The calculated correlation coefficient ( $R^2$ ) is equal to 0.90 and RMSE divided by run average is 2.8%. Statistical tests also prove that graphs have a very close fit.

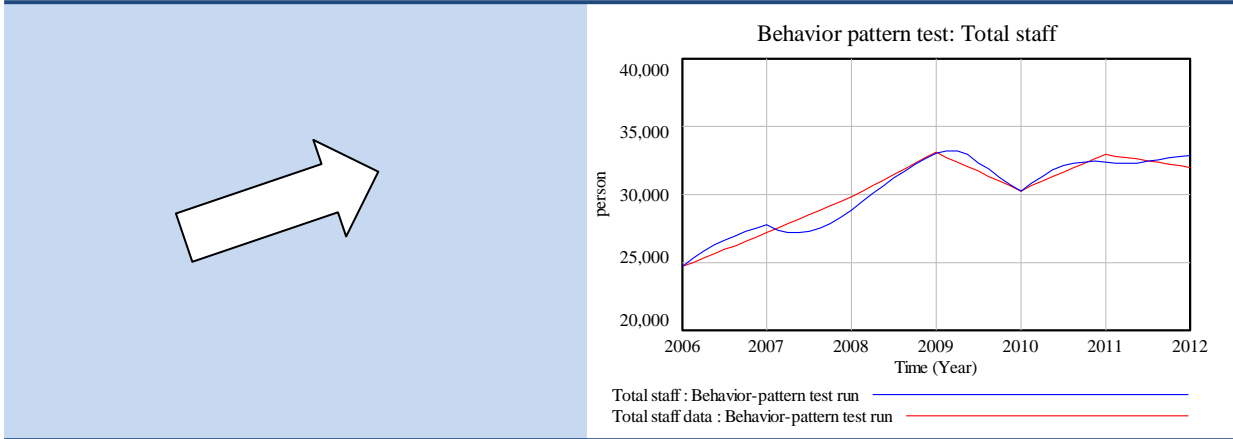


Figure 43: Personnel reference mode test

Slight differences between the reference mode and the simulated behavior are due to the fact that reference data shows the results per year ended while simulated behavior also shows the accumulation process of total staff during the year. The total staff, represented as a stock, is demonstrating a goal seeking behavior. Stock is constantly seeking for the desired level of the staff. The goal changes every year based on the financial results and on the pressure coming from regulations to adjust staff levels. Generally, the fit is close enough to conclude that the model represents the real situation of the personnel development over the historic period well.

### 5.3.3 Financial sector reference mode tests

Figures 44-46 show the comparison of the key financial indicators' data with the simulated behavior. Figures 44-45 show the results of the tests conducted comparing operating income and expenses, respectfully.

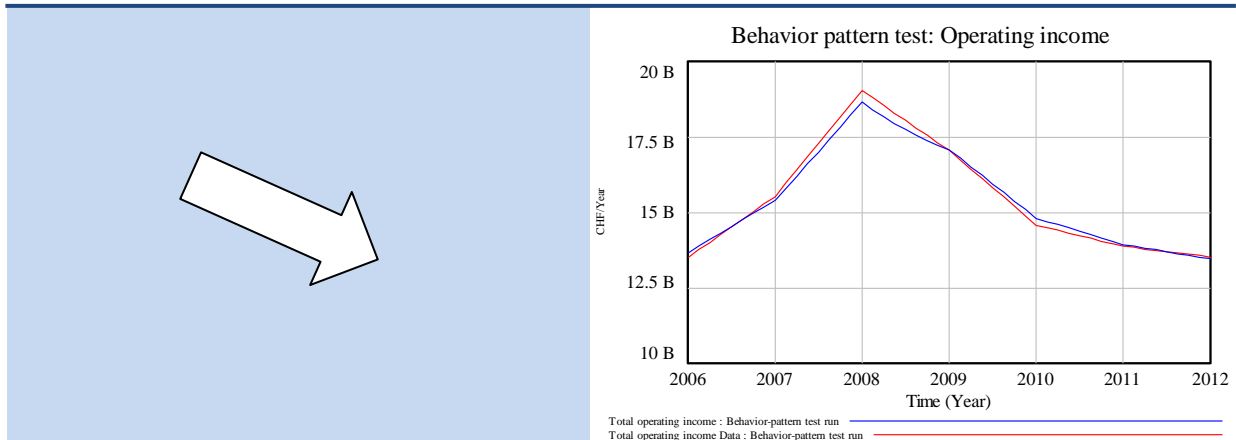


Figure 44: Operating income reference mode test

Red line represents the reference mode while blue line shows the simulated behavior. Both graphs show rather close fit. The calculated correlation coefficient ( $R^2$ ) for operating income simulation against real data is equal to 0.99 and RMSE divided by run average is 1.1%.

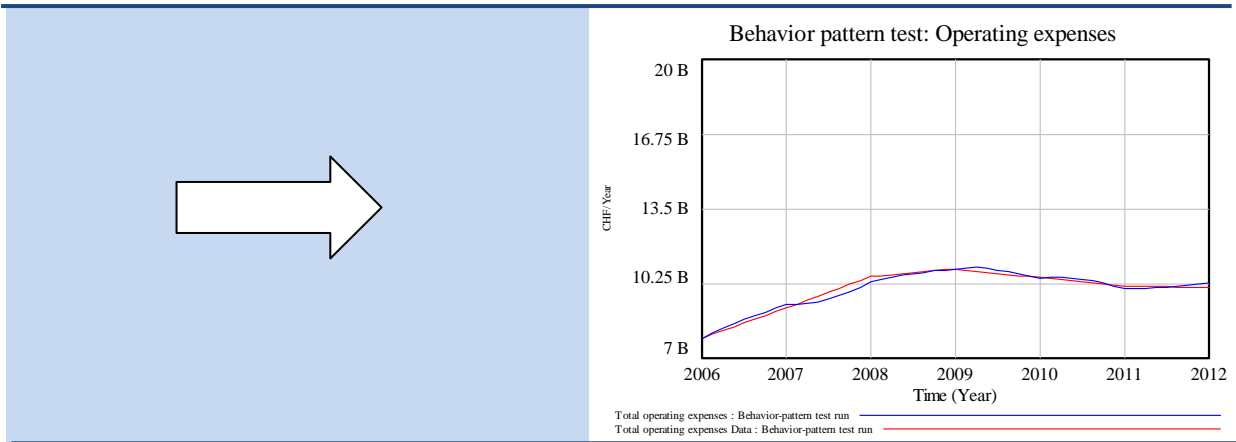


Figure 45: Operating expenses reference mode test

The calculated correlation coefficient ( $R^2$ ) for operating expenses simulation against real data is equal to 0.95 and RMSE divided by run average is 1.9%. Statistical testing, therefore, also proves that both operating income and operating expenses have a close fit.

Figure 46 shows the comparison of the CIR data with the simulated behavior. The final industry indicator also shows rather close fit between the data and the simulation results.

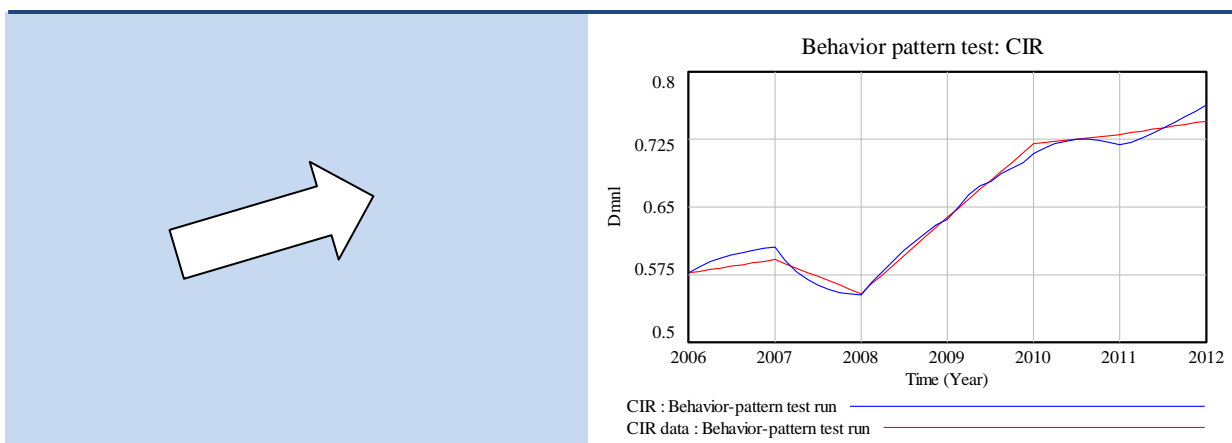


Figure 46: CIR reference mode test

The calculated correlation coefficient ( $R^2$ ) for CIR simulation against real data is equal to 0.98 and RMSE divided by run average is 1.88%.

Table 3 summarizes all the key indicators which were used to test the model against the real historic data.

|                    | R <sup>2</sup> | RMSPE   | Theil's Inequality Statistics |                |                |
|--------------------|----------------|---------|-------------------------------|----------------|----------------|
|                    |                |         | U <sub>m</sub>                | U <sub>s</sub> | U <sub>c</sub> |
| AuM                | 0.99490        | 0.01333 | 0.03482                       | 0.71975        | 0.24543        |
| Total staff        | 0.89651        | 0.02820 | 0.15467                       | 0.05805        | 0.78729        |
| Operating income   | 0.99486        | 0.01105 | 0.04153                       | 0.55635        | 0.40212        |
| Operating expenses | 0.95095        | 0.01930 | 0.16723                       | 0.01137        | 0.82141        |
| CIR                | 0.98110        | 0.01886 | 0.13954                       | 0.38594        | 0.47452        |

**Table 3: Summarized behavior pattern test results<sup>12</sup>**

Additionally to the key correlation indicators (R<sup>2</sup> and RMSE) described above, Theil's inequality statistics were calculated. The Theil inequality statistics (Theil, 1966 as cited in Sterman, 2000 p. 875) provide an “elegant decomposition of the error” by splitting the MSE into three components: bias (U<sup>m</sup>), unequal variation (U<sup>s</sup>), and unequal covariation (U<sup>c</sup>). The tests results show (see Figure 3) that bias error, which is considered to be the most worrisome, is extremely low. The error for most of the tested variables arises from the co-variation (Total staff, operating expenses and CIR) and unequal variation (AuM and operating income). When unequal variation dominates the RMSE, the model simulation and the historic data is highly correlated, but the variation differs around the mean. When unequal covariation dominates mean square error, the variations comes from the point by point comparison. No major concerns regarding the eligibility of the model came from the statistical analysis.

## 5.4 Structure-behavior tests

Gaps in the available data often can mean that it is not possible to evaluate the importance and strength of some key relationships or formulations by statistical means (Sterman 2000). Structure-behavior tests analyze the importance of parts of the structure by examining whether anomalous behavior is being produced when the relationship is cut or modifies. Three structure-behavior tests were conducting: no regulatory pressure test, no current policies and no investments.

### 5.4.1 No regulatory pressure

One of the research questions which this paper aims at answering is “what is the effect of new regulations on Swiss private banking?”, therefore, it was considered important to test how

<sup>12</sup> Formulas used to calculate metrics presented in Table 3 are listed in the Appendix D.

the system would behave if there were no external impulse coming from the governmental regulations. To test this structure, regulatory pressure was set to be equal to 0 for all analyzed period (as appose to regulatory pressure being 0 when time is < 2009 and 100 when time is >2009). The simulation results are presented in the Figures 47-50.

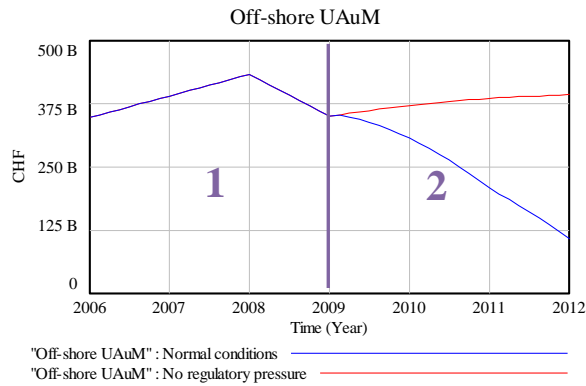


Figure 47: Off-shore UAuM under normal and no regulatory pressure conditions

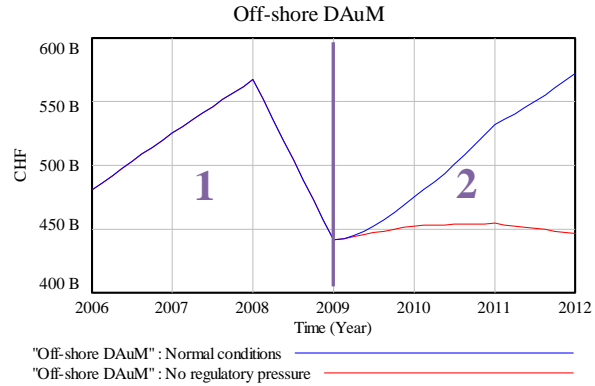


Figure 48: Off-shore DAuM under normal and no regulatory pressure conditions

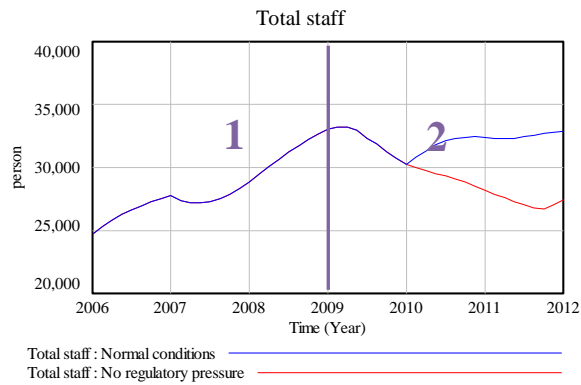


Figure 49: Total staff under normal and no regulatory pressure conditions

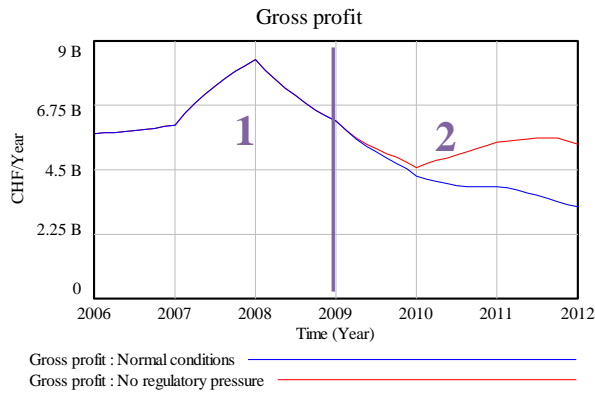


Figure 50: Gross profit under normal and no regulatory pressure conditions

The results of the tests meet the predicted behavior. On the graphs, two periods are shown: 1 – before new regulations were introduced and 2 – after. All graphs show that when testing period 1, graphs are identical. This just provides additional confidence that no errors occur in the structure of the model. The period two shows the difference between model's behavior under normal against no regulatory pressure conditions.

If Swiss private banks would continue accepting undeclared money and no additional outflow due to clientele loss would occur, undeclared off-shore AuM (as shown on Figure 47) would have remained relatively stable with a slightly increasing trend. The declared off-shore



AuM would also remain relatively stable if no additional inflow due to declaration were to happen (as shown in Figure 48).

On the cost side, the total staff level would have decreased almost to its initial level (in the beginning of the analyzed period) as shown in Figure 49. The difference in two graphs which occurs as a result of the regulatory pressure starts in the end of 2009 and not in the beginning of 2009 as in the case of AuM. The effect of the regulatory pressure on personnel is delayed. First of all, there is a perception delay between the time financial results are being compiled by the financial departments and the time needed for decision makers to adjust the desired personnel level. The hiring process is another delay which explains delayed effect. As a result of the lower personnel level, staff related costs would accordingly be at a lesser level.

Figure 51 shows how the new regulations affect the gross profits. The graph shows that if no regulations were introduced, the market would recover from the economic downturn in the beginning of 2010. Starting from that point, profits would have been back to a positive growth trend.

#### 5.4.2 No current policies

To test how the market would behave if the market players did not implement cost reduction policies, B1 and B2 loops will be cut.

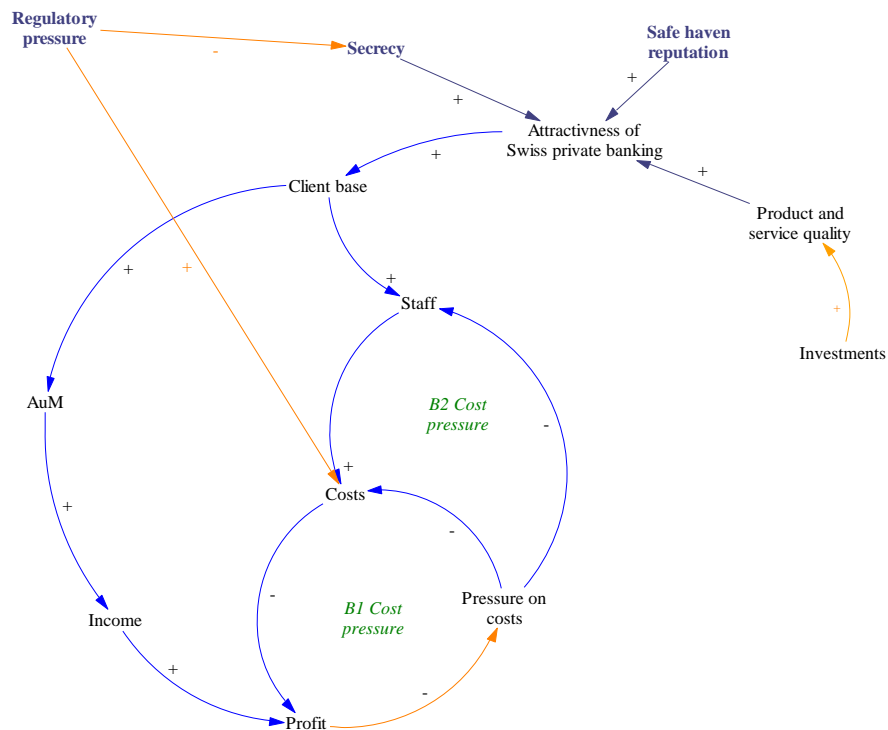
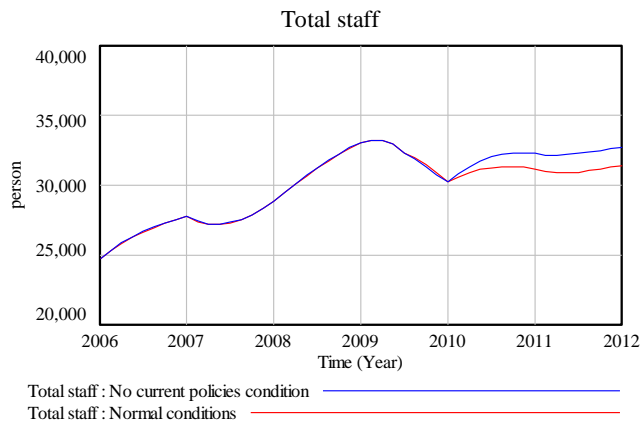
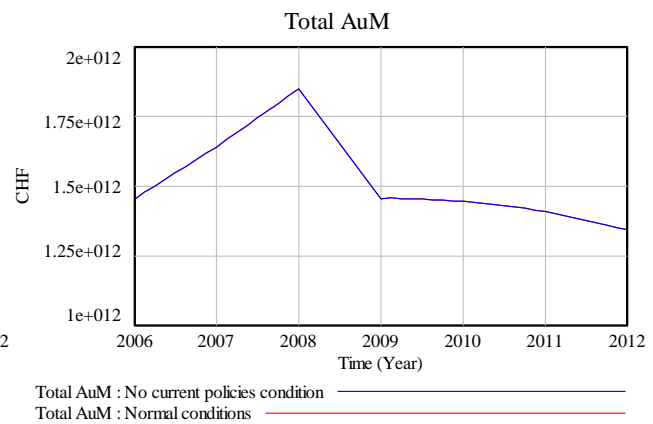


Figure 51: Causal loop diagram with the suggested policies

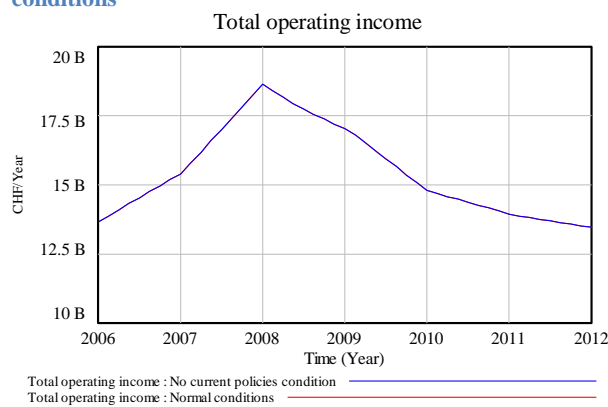
To cut the loops, the effect of perceived profit on desired staff level is set to be equal to 1, which means that there is no effect of profit on the desired level of back office staff or administrative expenses. The results of the simulation are presented in the Figures 52-55.



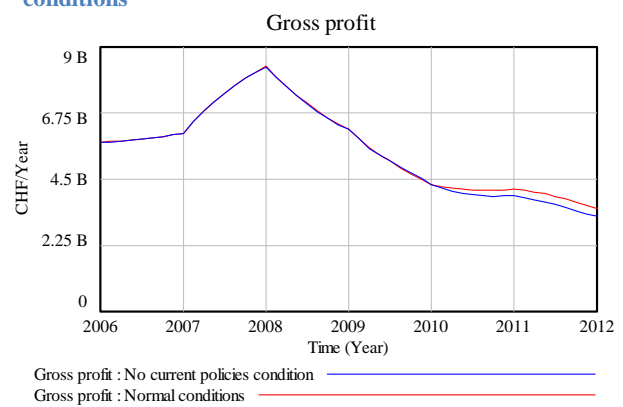
**Figure 52: Total staff under normal and no current policies conditions**



**Figure 53: Total AuM under normal and no current policies conditions**



**Figure 54: Operating income under normal and no current policies conditions**



**Figure 55: Gross profit under normal and no current policies conditions**

The simulation results show that current policies implemented by the market players have had only marginal effect on the overall market performance. The total staff level has been reduced (as shown in Figure 52) as well as personnel related costs. However, cost reduction policies did not have any major effect on the assets under management. This means that although private banks were making certain investments during the analyzed period, the level of investments was only as large as it was required to keep the quality of the products and services at its initial level. The ratio between reference investments and actual investments was equal to one during the historic period. We can conclude that the investments related loops did not have any major influence on the model during the analyzed period.

### 5.4.3 No investments

To test how the model would behave if decision makers had not invested in product and service quality during the analyzed period at all, the link between reference investments and actual investments is cut. This means that there are no additional investments made during 2006-2011. The simulation results are presented in the Figures 56-59.

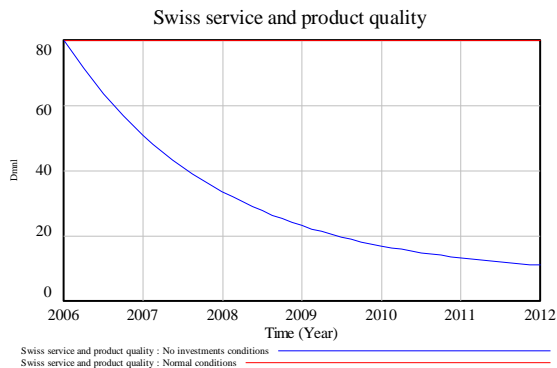


Figure 56: Swiss service and product quality under normal and no investments conditions

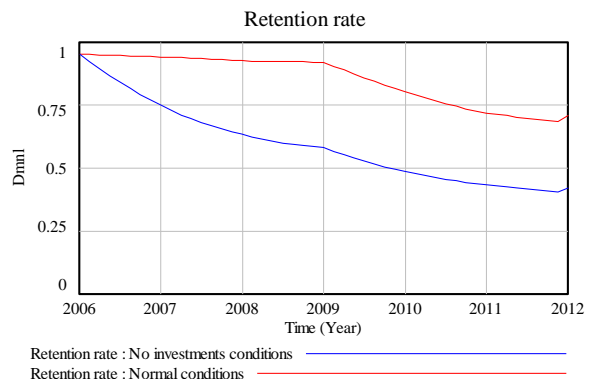


Figure 57: Retention rate under normal and no investments conditions

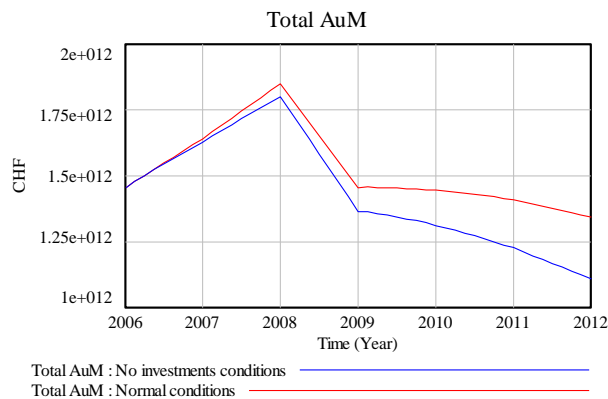


Figure 58: Total AuM under normal and no investments conditions

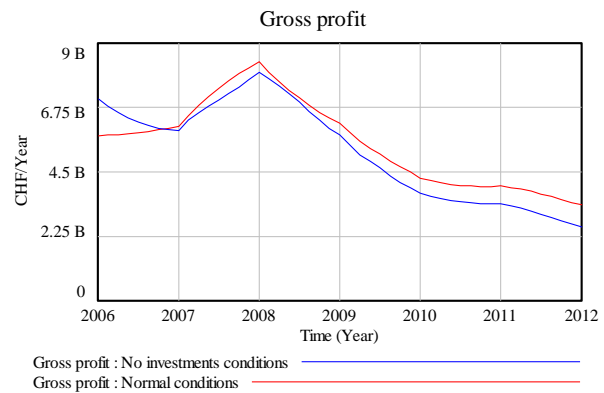


Figure 59: Gross profit under normal and no investments conditions

The simulation shows that if no additional investments in product and service quality were made during the analyzed period, the product service and quality would show a goal-seeking behavior towards 0. The clients' retention rate, consequently, would also be decreasing at a steady pace. Total AuM would be at a lower than under the normal conditions level. And starting from 2009 (when the new regulations come into force and Swiss private banking starts losing clients), the decay of the total AuM would be much steeper than under normal conditions. Gross profits, as a consequence, would also be at a lower level.

## 5.5 Parameter sensitivity tests

According to Barlas (1994 p. 191), “Behavior sensitivity test consists of determining those parameters to which the model is sensitive, and asking whether the real system would exhibit a similar high sensitivity to the corresponding parameter”. In other words, sensitivity testing is the process of changing underlying assumptions about the value of constants in the model and analyzing the resulting output. Manual sensitivity testing involves assigning different values of constants and simulating one by one in order to get a spread of output values. Vensim has a special function which allows conducting sensitivity simulations automatically. In the Monte Carlo simulation or multivariate sensitivity simulation (MVSS) constants can be sampled over a range of values while outputs are stored for later analysis.

In the Swiss private banking model, there are several variables which have an important effect on the market behavior which are external. Therefore, it is important to test the system’s reaction to the change in these variables and compare the simulation results with expectations about how the real market would react to the change in those variables. A number of parameters were tested, however, only the most important results are presented.

### 5.5.1 Sensitivity to performance and currency effect value

Performance and currency effect has an important effect on the size of the market (AuM). It is expected that sensitivity of the market to this parameter is very high. In the model, performance and currency effect was represented as an external variable with historic data being its input. To test the sensitivity of this variable we set it to be a constant in the range of [-0.3 – 0.3]. The results of the simulation are shown in the Figures 60-61.

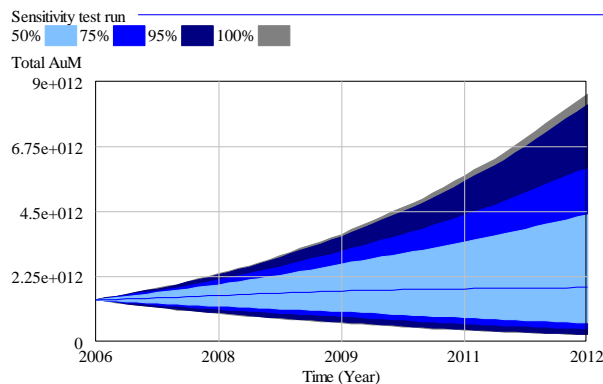


Figure 60: AuM sensitivity to a change in performance and currency effect

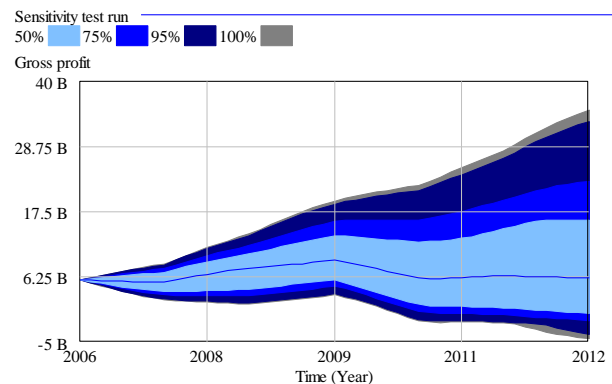


Figure 61: Gross profits sensitivity to a change in performance and currency effect

The simulation results show that the model is very sensitive to the change in performance and currency effect. In the Figure 60 it can be seen that the amplitude between the maximum point of the AuM and the minimum is substantial. In the graphs, colors indicate the confidence bound which are computed at each point in time by ordering and sampling all the simulation runs. It can be seen from the graph that most of the tested simulations would be within the light blue color boundaries. Gross profits show the same trend as AuM with slightly lower sensitivity amplitude.

This sensitivity test shows that both AuM and gross profits react significantly to the values that performance and currency effect takes. The shape of the behavior, however, does not change when different parameter values are taken. This indicates the robustness of the model.

### 5.5.2 Sensitivity to declaration implementation delay

The second sensitivity test examines the sensitivity of the model to declaration implementation delay. In the model the implementation delay is set to be an estimated constant. Therefore, it is important to test the impact of the variation in this variable on the behavior of the model. To test this factor, a list of possible values that an implementation delay can take was created. The values are set to vary between 0.0001 and 10 years. The list of declaration implementation delay values used in this sensitivity test is presented in the Appendix E. The results of the test are presented in Figures 62-65.

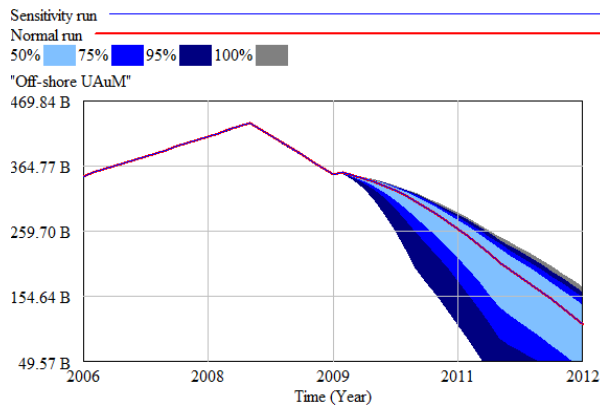


Figure 62: Off-shore UAuM sensitivity to a change in declaration implementation delay

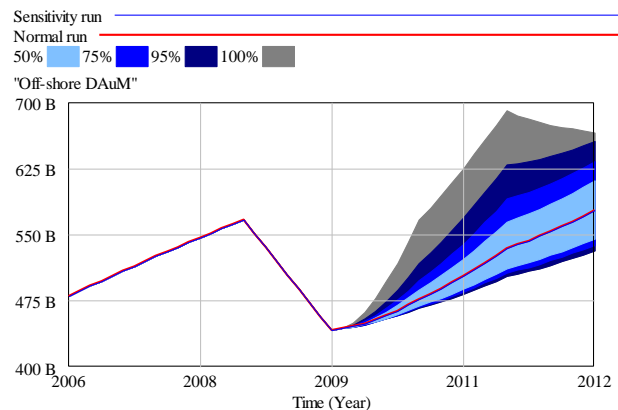
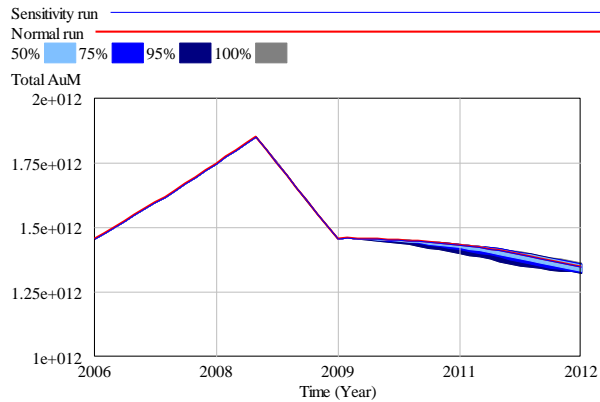
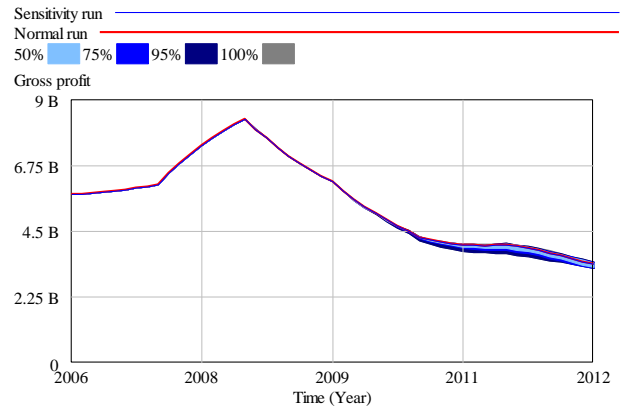


Figure 63: Off-shore DAuM sensitivity to a change in performance and currency effect



**Figure 64: Total AuM sensitivity to a change in declaration implementation delay**

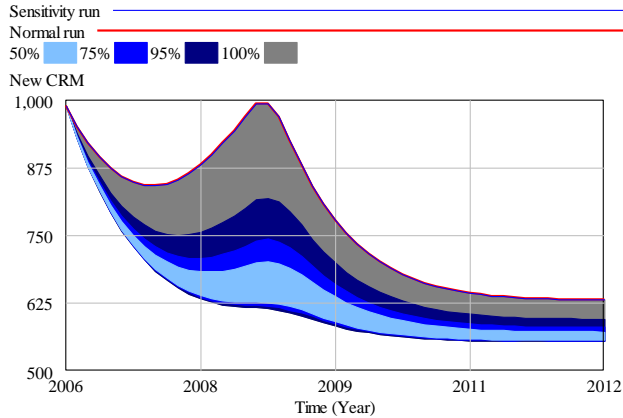


**Figure 65: Gross profit sensitivity to a change in declaration implementation delay**

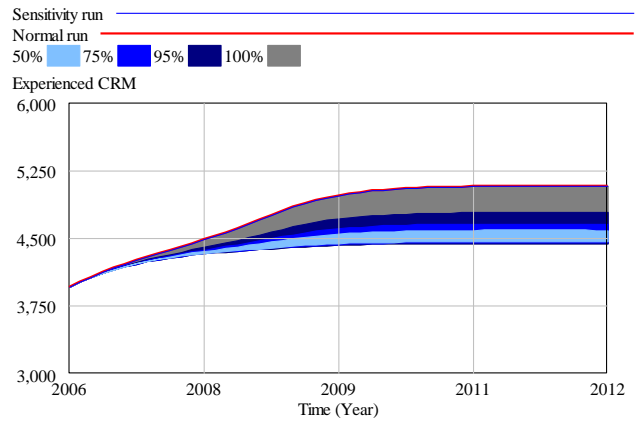
The results of the test show that both, declared and undeclared AuM stocks are very sensitive to the change in the declaration implementation delay time, which means that both off-shore AuM stocks react significantly to the values that the declaration implementation delay takes. The total AuM consolidates not only off-shore DAuM and UAuM, but also on-shore AuM which is not affected by the declaration delay in any way. The sensitivity of the total AuM is lower than of the each off-shore stocks separately. Gross profits profit show even higher robustness to the change in declaration implementation delay. These results also seem to represent the real world situation fairly well.

### 5.5.3 Sensitivity to time to hire new CRMs

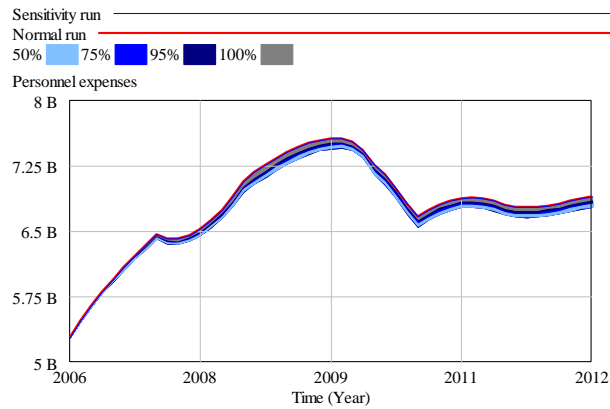
The third sensitivity test aims at testing the model's robustness to a change in time to hire new CRMs. In the model, time to hire new CRMs is a constant which was estimated by the market players during the interviews. To test this factor, a list of possible values that hiring delay can take was created and imported in Vensim using Monte. The list of the inputs tested is presented in Appendix E. The results of the simulation are shown in Figure 66-69.



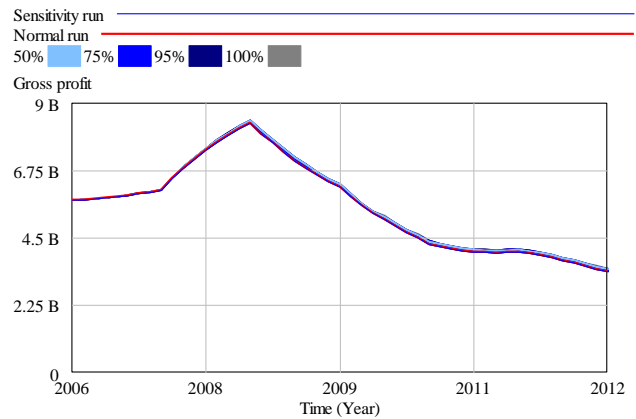
**Figure 66: New CRM sensitivity to a change in time to hire new CRMs**



**Figure 67: Experienced CRM sensitivity to a change in time to hire new CRMs**



**Figure 68: Sensitivity of Personnel expenses to a change in time to hire new CRMs**



**Figure 69: Sensitivity of gross profit to a change in time to hire new CRMs**

The simulation results show that New CRM stock is very sensitive to the variations in the time needed to hire new CRMs. The amplitude of the oscillations increases with the increase in the time to hire and decreases when the time to hire is reduced. The experienced CRMs stock reacts more robustly to the change in the time to hire new CRMs value than the New CRM stock does. The total personnel expenses and gross profit have a rather low sensitivity to the change time to hire new CRMs. From this test it can be concluded that when it comes to the consolidated industry level, increase or decrease in time to hire new CRM has only marginal effect on the profitability of the market

In sum, Chapter 5 aimed at analyzing the model in order to build trust in its structure and prove that the model produces the right behavior for the right reasons. The tests did not reveal any inconsistencies.

## Chapter 6: Scenario analysis and new policies

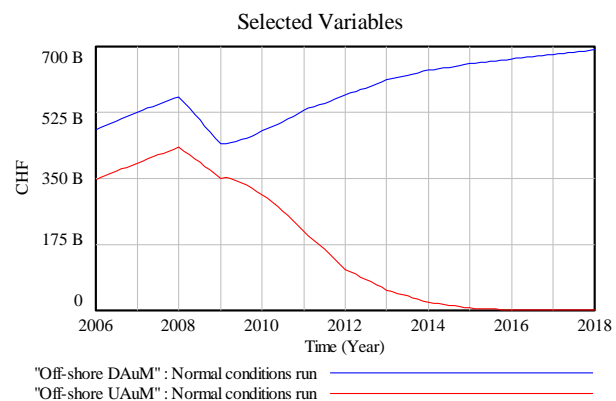
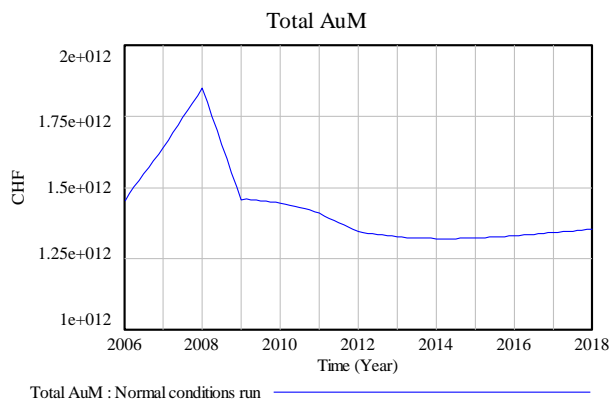
After the model has been tested and no major flaws were revealed, it was concluded that it can act as a tool for the development of the Swiss private banking industry forecasts over the short to mid- term future (2012-2018). For the exogenous variables that are not part of the internal model dynamics, various scenario analyses will be conducted. As it was demonstrated in the Chapter 5, the model is very sensitive to the change in performance and currency effect values. Therefore, the model will be simulated under various scenarios of the performance and currency effects from 2012 to 2018. In this chapter the analysis of the simulation results in a neutral performance and currency environment will be presented. The results of the simulations under favorable and unfavorable performance and currency effect scenarios are presented in the Appendixes F and G, respectfully. Finally, this chapter will suggest policies which could help private banks to increase their profitability in a longer run.

### 6.1 Outlook under neutral performance and currency environment

To examine the net new money flows and the behavior of the market over the forecast period under neutral performance and currency effect conditions, the model is simulated with forecasted performance and currency effect being set to 0.

#### 6.1.1 Assets under management

The simulation results show that assets under management (as shown in Figure 70) after continuous downwards trend during 2009-2013 will stabilize in 2014 and will show a sluggish positive growth from then on.

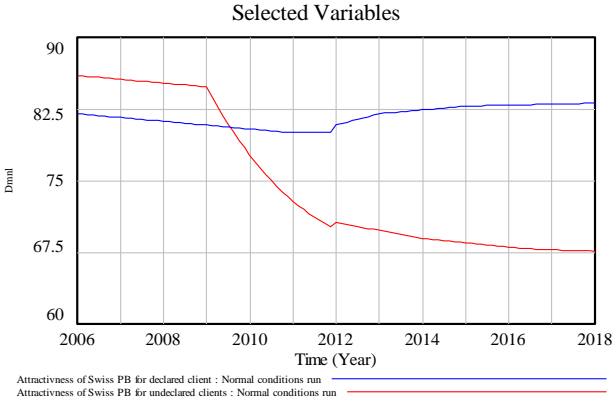


**Figure 70: Forecasted total AuM under neutral performance and currency effect conditions** **Figure 71: Forecasted declared and undeclared AuM under neutral performance and currency effect conditions**

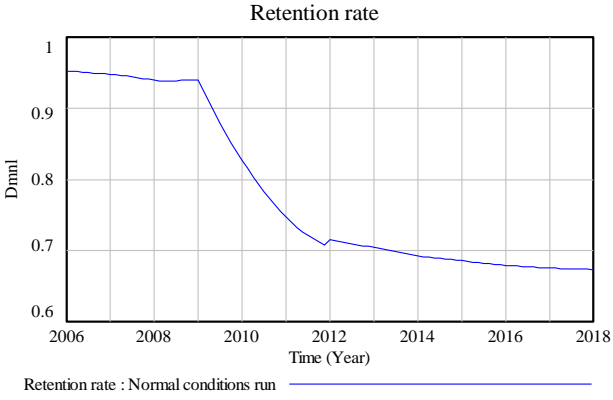


The explanation for this can be found by looking into the behavior of the declared and undeclared AuM stocks. Figure 70 shows that off-shore UAuM will be showing a goal-seeking behavior and approach 0 in 2015. After the Article 26 of the OECD Model Tax Convention on Income and Capital (described in details in chapter 3) was adopted, Swiss private banks were less willing to accept new undeclared assets and, therefore, the inflow of the undeclared AuM is gradually decreasing towards 0. In the meanwhile, the declaration process, which was also the outcome of the new regulatory environment, accelerated and resulted in increased flow of AuM from undeclared to declared assets stock.

The time it takes for all the assets in UAuM stock to move to the DAuM stock depends on the declaration implementation delay. In this simulation it is assumed that the transition process happens gradually. However, the transition process can happen much faster if the pressure from local tax authorities, or clients’ perception of the pressure from tax authorities, would suddenly increase. To test how the model would behave under different declaration implementation delay values a special interface was developed (as shown in Appendix J). Using this interface PwC specialists and the market players may test different scenarios by changing values of the variables which are under uncertainty.



**Figure 72: Forecasted attractiveness of Swiss PB for declared and undeclared clients**



**Figure 73: Forecasted retention rate**

Figure 72 shows the simulated forecast for the development of the attractiveness of Swiss private banking for declared and undeclared clients (undeclared clients here refer to those clients who had their assets initially undeclared in the beginning of the analyzed period). The results of the simulation show that the attractiveness for declared clients is expected to increase over the forecast period. The safe haven reputation, which is one of the key components of the function defining attractiveness, is expected to gain strength in lights of the increasing uncertainty in

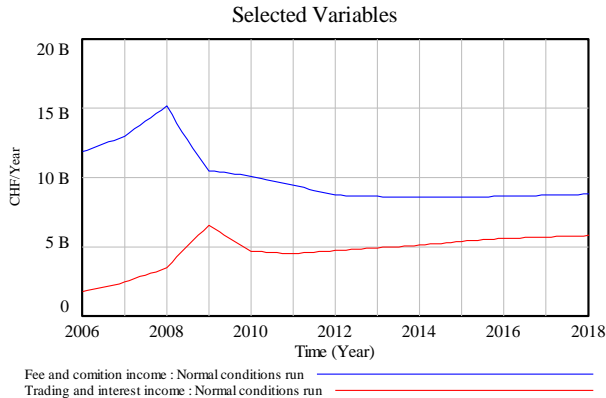
some regions of the world. Uncertainty in the euro zone area, the simmering political tensions in the Middle East and, the recent nationalization of privately owned companies in several Latin American countries is expected to add value to the perception of Switzerland as a safe haven for the off-shore clients (PwC, 2013).

The attractiveness of Swiss private banking for undeclared (also formerly undeclared) clients, however, will continue to fall. The major reason behind the negative trend is the loss of perceived secrecy. Decreasing attractiveness for undeclared clients will continue having a negative effect on the client retention rate as shown in Figure 72. The falling retention rate can be considered one of the major concerns which private banks should address in order to decrease the outflow of the assets to competing private banking centers.

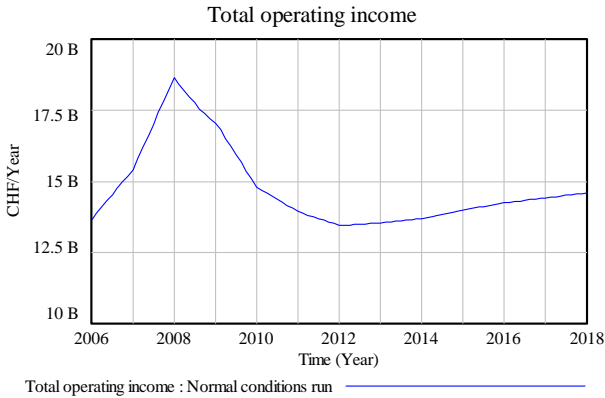
In sum, the new money inflow generated as a result of increasing attractiveness for new declared off-shore clients (in particularly in the areas with political and economic uncertainties) will still outweigh the money outflow. The total level of AuM will reach its bottom when the AuM outflow due to the declaration process will peak. As soon the transition towards compliant business model is over, Swiss private banking industry will be able to recover and produce robust net new money inflows.

**6.1.2 Revenues**

Figures 74-75 show the development of the operating income over the forecast period under the neutral performance and currency effect conditions. First, the model is simulated with stable gross margins.



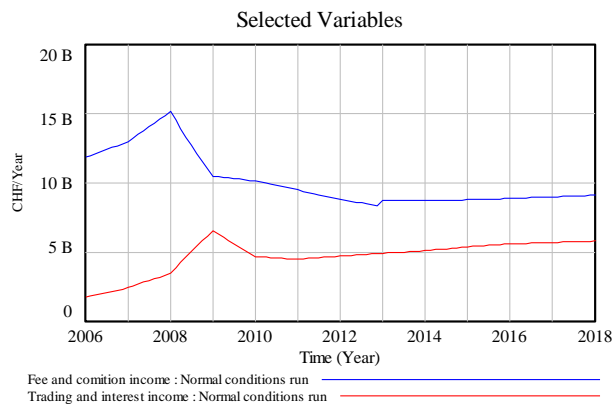
**Figure 74: Forecasted Fee and commission income and trading and interest income under current gross margin conditions**



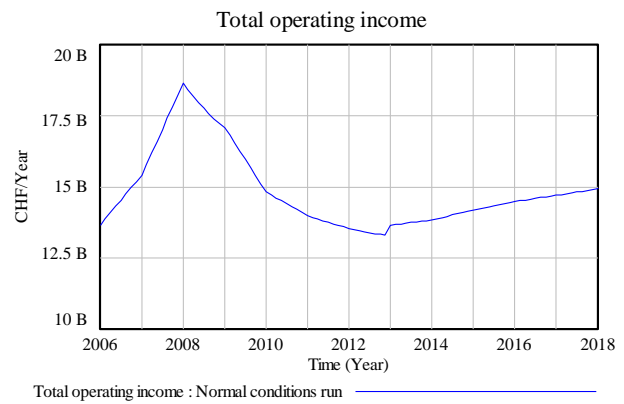
**Figure 75: Forecasted total operating income under current gross margin conditions**

The results of the simulation indicate that fee and commission income are expected to follow the same trend as the AuM. The trading and interest income have external inputs to our model. The current simulation was run under favorable trading and interest income conditions. Different scenarios can be testing using the developed interface in the model.

Industry experts, however, believe that gross margins won't remain unchanged over the forecast period. It is expected that unfortunately for the private banks and, for the industry as a whole, gross margins will decrease in the future. According to PwC (2013), the intensified competition among the banks within the industry as well as increased competition with other off-shore private banking centers and private banking centers in the respective off-shore clients' home countries will continue pressuring the fees. Moreover, on average tax-compliant client assets generate lower margins for banks compared to undeclared assets. Therefore, at the same time to the declaration process, the average margins on AuM will be further pushed down. In light of such an unfavorable forecast for the development of the gross margins, we run the simulation to examine behavior of the operating income under declining gross margins conditions (Figures 76-77).



**Figure 77: Fee and commission income under decreasing margins conditions**



**Figure 76: Total operating income under decreasing margins conditions**

The simulation results show that decreasing fees not necessarily should be considered as unfavorable condition. In fact, the simulation shows that when lower fees are set, the total operating income level in the industry would be even slightly higher than under current conditions. On the one hand, decreased fees means lower gross margins applied on the assets. On the other hand, reduced fees increase client retention rate and, therefore, reduce the AuM outflow. This consequently means the higher level of the total AuM on which margin is applied.

### 6.1.3 Costs

The costs which private banks experience will continue being heavily affected by the regulatory environment. New regulatory requirements such as FATCA, as well as adapting to MiFID II will require private banks to make additional investments in human capital and IT.

Regulatory changes will force Swiss private banks to invest further in the regulatory, legal and compliance areas. This means that banks will be forced to adjust the desired level of back and middle office staff level further up. Adapting to new regulatory standards will require hiring additional staff with specific expertise in compliance, tax and legal matters. Moreover, additional investments will be needed in the education of employees. Overall, adopting new regulations will increase the total level of back office staff and consequently, back office personnel related costs. The total administrative costs will also continue growing due to required investments in IT. Figures 78-79 show the results of the simulation when future costs related to new regulatory environment are taken into account.

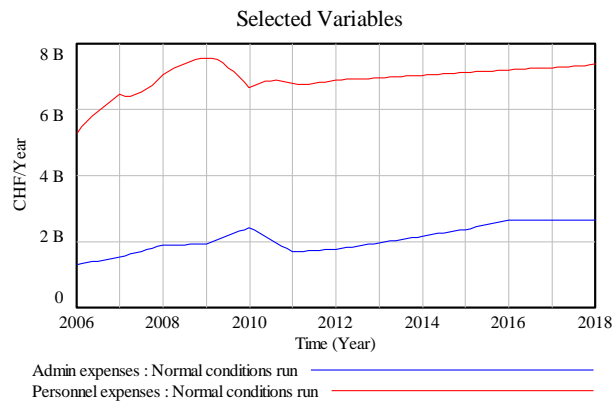


Figure 79: Forecasted administrative and personnel expenses

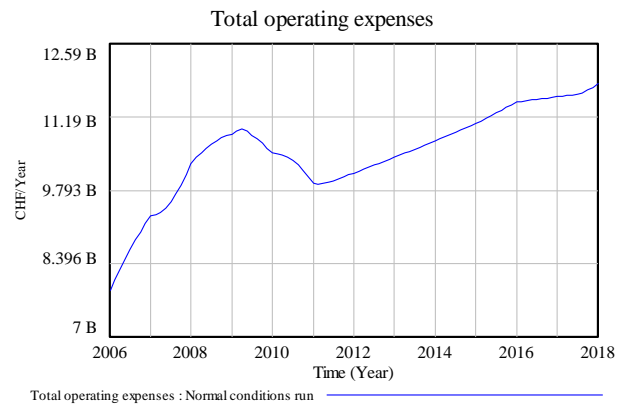


Figure 78: Forecasted total operating expenses

Both, personnel and administrative costs are forecasted to show further increase, mainly, as a result of the additional costs associated with new regulatory environment. Costs related to new regulations do not add any value to the quality of products and services which private banks provide and therefore, do not add to generating additional revenues.

### 6.1.4 Profitability

Figures 80-81 show the simulation results for the development of the profitability of the Swiss private banking industry over the forecast period. The simulation showed that no significant improvement in the profitability of the industry is to be expected in the short-midterm

future. Although the revenues are expected to start recovering in a midterm, the costs related to new regulations will counterbalance the increase in revenues. As a result, the cost income ratio will keep growing and stabilize at the level of 80%. When the value of the expected CIR at the end of the forecast period is compared to its initial value, it can be concluded, that the prospects for the industry are not favorable.

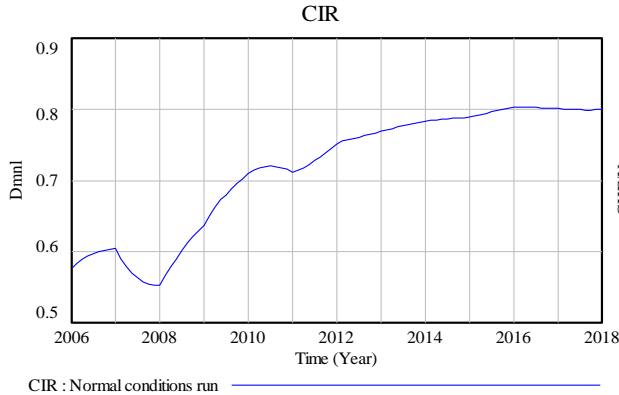


Figure 80: Forecasted CIR

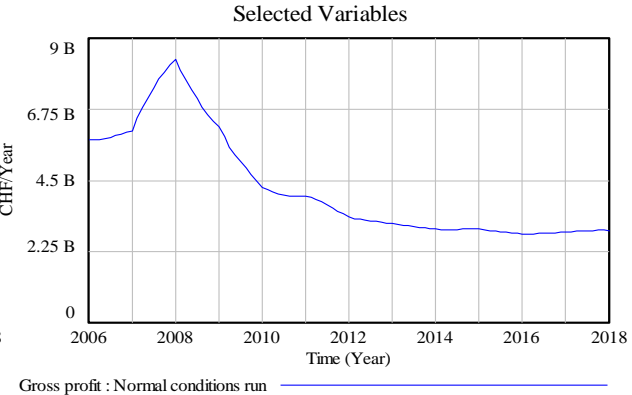


Figure 81: Forecasted gross profit

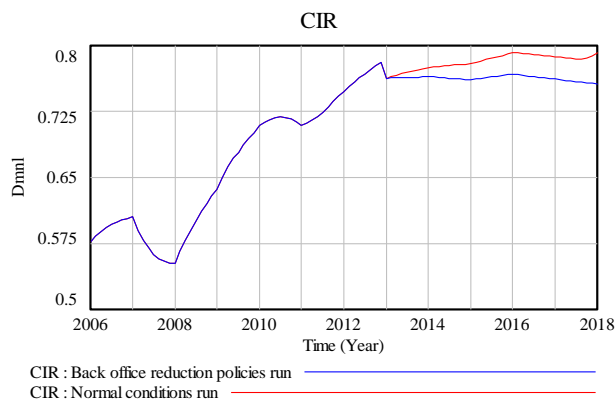
### 6.2 Outlook with the current policies

There are no doubts in saying that under the forecasts discussed, the prospects for private banks may seem challenging. However, as it was concluded in the previous chapter, in response to the declining profits, private banks have been implementing measures directed at streamlining their operational structure and closing down or disposing of non-profitable operations. It is expected that the same trend will continue, and what is more, outsourcing back-office services and infrastructure consolidation policies will be getting even more popular.

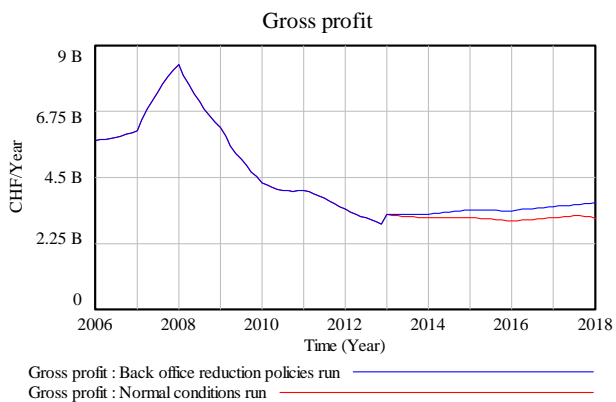
To test how the industry would behave when the market players intensify their cost reduction policies, we run the simulation assuming that new cost-reduction policies allow lowering the level of the back and middle office staff by an average of 6%. Since it would be hard to predict what would be the minimum level of the back and middle office personnel needed, we introduce a variable called new desired level of back and middle office personnel to test the behavior of the model under different policy scenarios. We also add a slider to the control panel which allows testing the behavior of the model under different levels of the staff-reduction policies over the forecast period as shown in Appendix J.

The simulation results (as shown in Figures 82-83) show that when the personnel reduction policies are taken into account, the prospects for the industry look to some extent

brighter. The CIR stabilizes at a lower level than when no staff reduction policies are being implemented. However, the extent to which the cost-reduction policies can be applied without any harm made for the quality of service and products is very limited.



**Figure 83: Forecasted CIR under intense cost reduction policies**



**Figure 82: Forecasted gross profit under intense cost reduction policies**

### 6.3 Outlook with the new policies

Most of the policies which were implemented by the market players in response to the declining profits were directed at cost reduction. The revenue side of the profitability equation has not been addressed previously. Now, we would like to test how the market would react if the market players direct their policies not only at reducing costs, but also at increasing their revenues.

As it was discussed previously in Chapter 4, the attractiveness of the Swiss private banking for off-shore clients depends on the safe haven reputation, secrecy and product and service quality. Both, safe haven reputation and secrecy cannot be controlled by the private banks. Product and service quality, on the other hand, may be internal.

Overall, the level of private banking service in Switzerland has been considered high over the analyzed period (as estimated by private bankers, at around 80 points out of 100). From the trade interviews it was concluded that product and service quality has been always considered to be at a relatively high level and therefore, all the investments were directed at maintaining a constant level. Now, we would like to test if the product and service quality could be a leverage point, which could help Swiss private banks to increase their profitability.

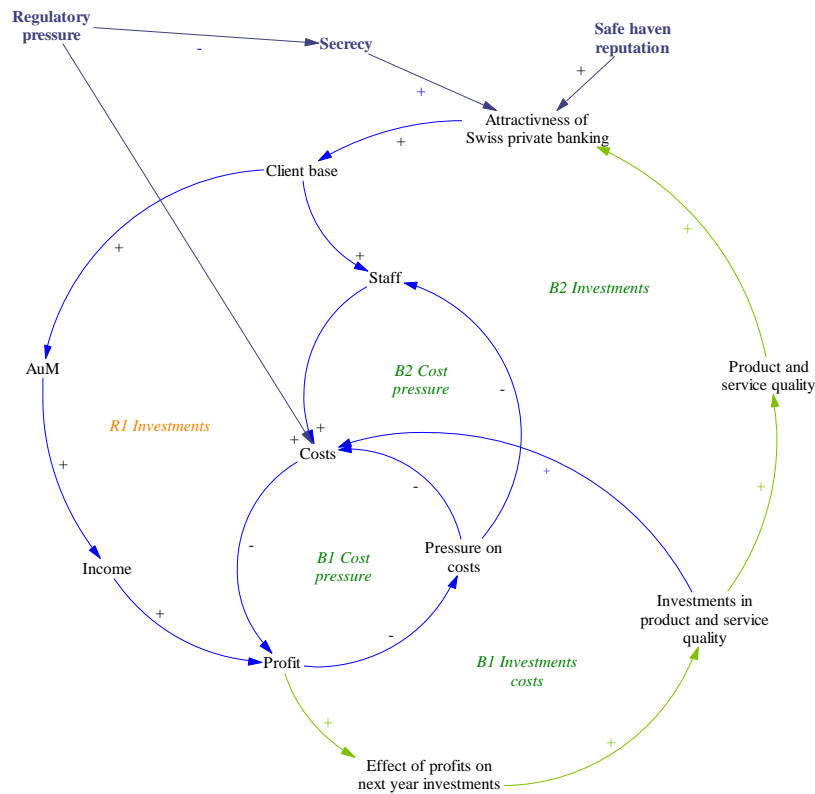
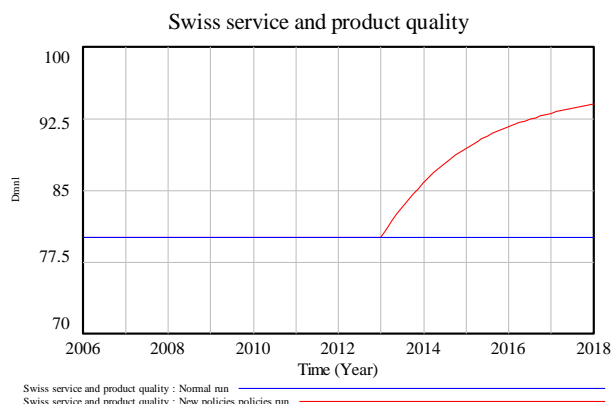


Figure 84: Causal loop diagram with new policies

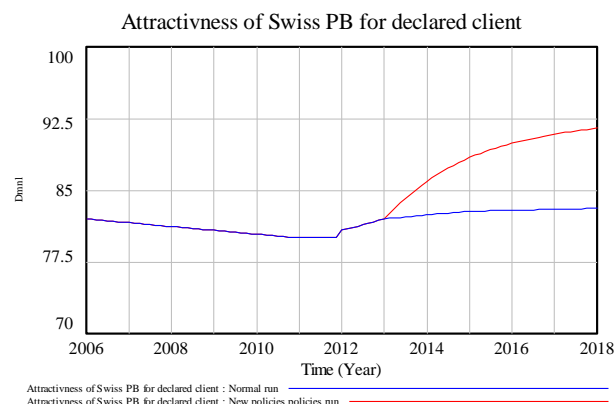
Figure 84 shows that the policies which were used by the market players created a balancing feedback loops structure (*Loops B1 and B2*). The green arrows indicate the suggested new policy. By linking the profits with investments in product and service quality, a reinforcing loop structure is created (*R Investments*). The reinforcing investments loop (*R Investments loop*) represents the reinforcing structure of the investments – the more market players invest in service and products, the higher attractiveness they have on the international market (with a rather long delay) and therefore, the higher revenues and the higher profits they will generate. However, investments first of all, are an immediate cost, which means that the investments are also a part of a balancing *Investments costs loop* structure.

Another balancing loop related to investments (*B Investments*) explains the balancing mechanism related to the demand (AuM). As long as the demand increases due to the increased investments, there will be a need to increase the variable costs which will result in the decreased profits. In the model we introduce a variable which indicates the effect of profits on the indicated investments. After additional structure was added to the model, key tests described in Chapter 5 were repeated in order to obtain confidence in the reliability of the model.

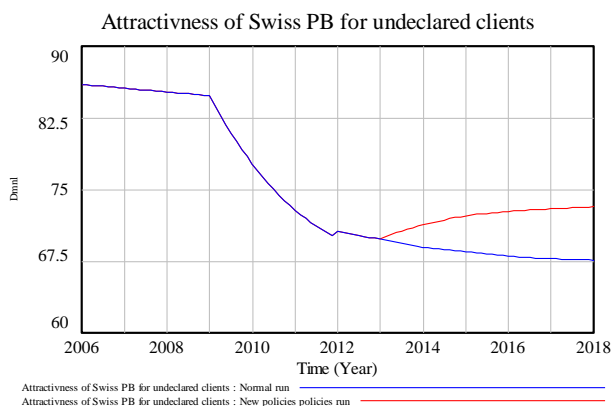
Figures 85-90 show the results of the simulation with the new policy.



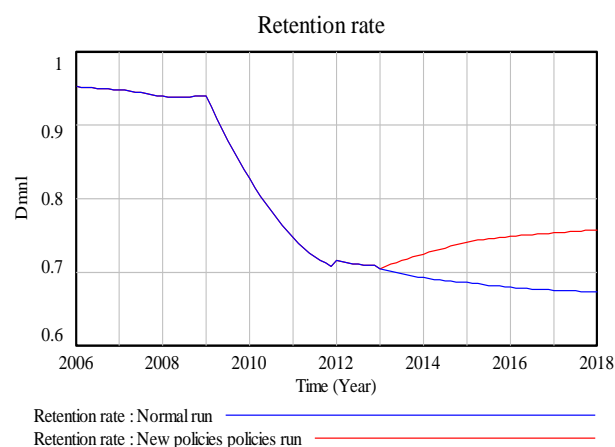
**Figure 86: Service and product quality under normal and new policy conditions**



**Figure 85: Attractiveness for declared clients under normal and new policy conditions**



**Figure 87: Attractiveness for undeclared clients under normal and new policy conditions**



**Figure 88: Retention rate under normal and new policy conditions**

Under the new policy conditions, additional investments result in the increased level of service and product quality. The product and service quality is now showing a goal-seeking behavior, with the new indicated service and product quality being the goal. As a result of increased product and service quality, the attractiveness for both declared and undeclared clients also increases. When the attractiveness of Swiss financial center on the global market enhances, private banks will be able to attract higher share of the new wealth. Increased attractiveness will also imply an improvement in the retention rate. This means that there will be a lower AuM outflow to other financial centers and consequently, higher overall level of the managed assets.

Figure 89 shows that under new policy conditions AuM would be less affected by the new regulations and would recover faster than under no new policy conditions. CIR would also



stabilize at a lower level and ever start showing negative exponential growth behavior in the end of the forecast period.

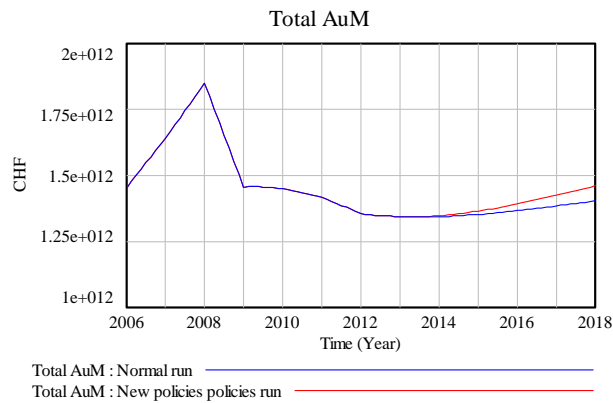


Figure 90: AuM under normal and new policy conditions

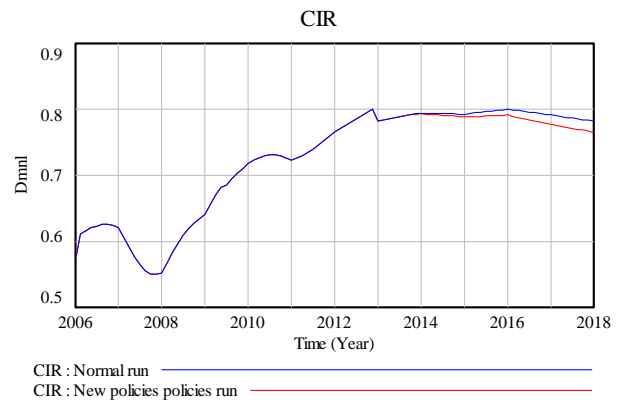


Figure 89: CIR under normal and new policy conditions

In sum, this chapter aimed at looking into the prospects of Swiss private banking under different scenarios for the development of the performance and currency effect and, gross margins. First, the simulation results under no additional policies scenario were analyzed. The prospects for industry when no additional policies are implemented are rather worrisome. However, when the additional policies that are expected to be implemented by the market players are taken into account, the market profitability shows to a certain extent, better results. Finally, after the new policies directed at revenue enlargements were tested, it can be concluded that towards the end of the forecast period the situation of the banks should start improving. After the transition process towards more compliant business model is over, Swiss private banking industry should be able to generate robust net new money inflows.

## **Chapter 7: Conclusion**

The main objective of this thesis was to develop a system dynamics model which could help the market players and PwC experts to analyze the structural changes in the industry and assist in developing the industry forecasts. The SD model was developed in a period of around three month. The process of building the model involved thorough desk research and interactive trade research.

The work aimed at identifying the key forces driving the industry behavior by representing the structure of the industry in a coherent and consistent way. Swiss private banking industry has been always known as a leading off-shore private banking center. However, after the economic downturn, the industry has been going through a phase of fundamental change due to the new regulations which were put into force. Therefore, the effect of new regulations on the market was set to be the main research question. The developed model explains the behavior of the market before to the new regulations were introduced and after. The model passed various model validation tests and proved to be capable to reproduce the behavior of the real system.

The key contribution of this work, besides invaluable experience for the author herself, includes constructing a model that captures the private banking industry in a structured systemic visual representation which includes the time delays, feedback cycles, nonlinearities, stocks and flows. The conclusive added value of the model is its ability to produce forecast for the development of the key industry indicators under various scenarios. The main academic aspiration of the thesis is the proof that system dynamics methodology can be applied for the market analysis and forecasting.

### **7.1 Key findings**

From the course of developing the model several conclusions could be derived:

- 1) First of all, it was concluded that over the period analyzed, the performance of the industry has been largely driven by the external factors that Swiss private banks cannot control, such as, market performance, currency exchange effects, the reputation of Switzerland being a safe haven, changes to banking secrecy and new regulations. The key internal performance driver of the industry is the product and service quality. It has remained constant over the period under review and therefore, did not have major influence on the behavior of the

market. From this, we can conclude that indeed, it is the “not-so-invisible-hand” that is driving the industry performance.

- 2) New regulations have had a very strong effect on the industry, both on revenues and costs of private banks. More rigid tax regulations have resulted in the Swiss private banking industry losing its attractiveness for off-shore clients and, increasing AuM outflows. In addition, new regulations have triggered the transition towards a more tax-compliant business, causing the inflow of undeclared assets to decrease to its minimum. The costs of private banks were being increased, primarily in the form of increased compliance and indirect economic effects.
- 3) Most of the policies the market players have implemented were directed at cost reduction. The simulation results indicate that such policies are effective only to a certain extent and were not able to entirely compensate for the slump in revenues.
- 4) Lastly, it was concluded that by focusing entirely on cost reduction, Swiss private banks will not be able to improve the current situation significantly. It was suggested that by investing in service and product quality, Swiss private banks will be able to reduce AuM outflow related to the declaration process and maintain higher overall level of the managed assets and consequently, higher profitability.

## 7.2 Recommendations

Based on the analysis described in the current paper, several recommendations for private banks can be made.

**Standing still is no longer an option:** Swiss private banking industry has been largely driven by external factors during the period analyzed. For many years factors, such as tax benefits, and the reputation of being safe haven were the key success drivers of the industry. However, external factors do not support the industry anymore; therefore, there is a need for the industry to build on its own strengths. Private banks need to be able to implement effective change in response to the changes in the market environment.

**Making clients “stick”:** The study revealed that client loss to other private banking centers after the declaration process is one of the areas of key concern. Private banks should prepare for this and introduce measures directed at increasing clients’ retention rate. Banks should focus on keeping the current clients and, their wealth, in by creating more intimate, added-value and long-term relationships between CRMs and clients.

**Exceeding clients' expectations:** Although Swiss private banks have the reputation for high quality of products and services, increasing quality further is an area which yields benefits. Only by exceeding clients' expectation in terms of service provided, Swiss private banking industry will be able to make the transition period smoother. One of the ways to enhance clients' wealth management experience is by segmenting clients into groups based on clients' specific needs and characteristics. Accompanying investments should be made in human resource.

**Further tightening the belts:** If possible, Swiss private banks should intensify their cost-reduction policies. Outsourcing back office services, infrastructure consolidation, operational efficiency, and other cost reduction policies which can be implemented without any harm on the overall quality of client experience should be considered. It can be expected that by improving overall service and product quality combined with delivering operational efficiency and cutting costs, Swiss private banks resume the positive trend in the industry's profitability in the midterm future.

### **7.3 Implications**

The suggested policies might face a number of implementation obstacles which should be discussed. In this study, we were looking into the private banking industry as a whole and the size of the banks and their investments capabilities per unit were not taken into account. Therefore, the organizational feasibility of suggested policy can be questioned. Organizational feasibility is defined as the extent to which the proposed policy can be met by an individual organization. It is expected that some of the private banks will not be able to obtain the desired level of cost reduction which will be needed in order to generate the funds needed or investments in the product and service quality. This means that the industry might experience further consolidation processes.

### **7.4 Limitations and further research**

The main limitations to this research were related to the time boundaries given. The private banking industry contains an intimidating degree of dynamic complexity. Given the three to four month time for researching the industry, developing and validating the model and producing the report, there are several areas in which a longer study could lead to significant improvements.

First of all, the model consists of endogenous and exogenous variables. Implications of the new regulations were set to be the key focus of this research, and therefore, a number of variables not directly related to this issue were considered exogenous.

Gross margin was used as an exogenous variable, while it could be modeled endogenously. Also, in the financial sector only the net income structure was taken into account. Including the whole balance sheet and developing more detailed financial structure of the industry would allow more precise testing of investments-related policies. Another area for further research could be in the expanded representation of the personnel structure. For instance in this paper, it was assumed that the labor market is unlimited and there is no lack of experienced employees in the Swiss private banking sector. In reality, there is strong competition for experienced and high quality personnel.

Another limitation which should be mentioned is related to the gaps in available data. Although there are many published studies which analyze Swiss private banking sector, most of them focus only on key indicators. A number of variables had therefore, to be estimated. If similar research would have been conducted for a specific bank, more detailed data would have been available and more precise assumptions could have been made. Furthermore, the study of Helvea SA (2009) was used as a main source for making the split for declared and undeclared off-shore assets. If more recent studies on the declaration process were available, the results of the simulations were more precise.

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<sup>13</sup> Here PwC refers to the network of member firms of PricewaterhouseCoopers International Limited (PwCIL), or, as the context requires, individual member firms of the PwC network.

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## Appendix A: Equation list

| Name  | Equation   | Units    |
|---|--|----------|
| Accrual of gross income                           | Gross profit   | CHF/Year |
| Accrual of taxes                                  | IF THEN ELSE(Yearly pulse <sup>2</sup> >0, (Annual tax on profit*Cum gross income), 0 )  | CHF/Year |
| Actual effect on desired level of B&M office      | DELAY INFORMATION ( "Indicated effect on desired level of B&M office", 1, 1)   | Persons  |
| Admin expenses                                    | Admin expenses per year (Time)   | CHF/Year |
| Admin expenses per year                           | ( [(2006,0)-(2016,3e+009)],(2006,1.2975e+009),(2007,1.53227e+009),(2008,1.88932e+009),(2009,1.92557e+009),(2010,2.43092e+009),(2011,1.68793e+009),(2012,1.7638e+009),(2013,1.964e+009),(2014,2.164e+009),(2015,2.364e+009),(2016,2.664e+009))  | CHF/Year |
| Annual tax on profit                              | 0.1  | 1/Year   |
| Attractiveness for declared clients ratio         | Attractiveness of Swiss PB for declared client/Reference attractiveness for declared clients   | Dmnl     |
| Attractiveness for undeclared clients ratio       | Attractiveness of Swiss PB for undeclared clients/Reference attractiveness for undeclared clients  | Dmnl     |
| Attractiveness of Swiss PB for declared client    | IF THEN ELSE(Time<2012, Importance of safe haven reputation*Safe haven reputation (Time)+(1-Importance of safe haven reputation)*Swiss service and product quality , Importance of safe haven reputation*Forecasted safe haven reputation(Time)+(1-Importance of safe haven reputation)*Swiss service and product quality )  | Dmnl     |
| Attractiveness of Swiss PB for undeclared clients | IF THEN ELSE(Time<2012, Safe haven reputation(Time)*Importance of safe haven reputation+Importance of secrecy*Perceived secrecy + Swiss service and product quality *(1-Importance of secrecy-Importance of safe haven reputation) , Forecasted safe haven reputation(Time)*Importance of safe haven reputation + Importance of secrecy*Perceived secrecy+Swiss service and product quality *(1-Importance of secrecy-Importance of safe haven reputation) ) | Dmnl     |

| Name                                   | Equation  | Units         |
|--|---|---------------|
| AuM to declare per year                | IF THEN ELSE("Off-shore UAuM">0, "Initial off-shore UAuM"*Declaration rate per year, 0 )        | CHF/Year      |
| AuM under consideration to repatriate  | SMOOTH(Declaration rate, Consideration delay)   | CHF/Year      |
| Average time to pay taxes              | 0.5   | Year          |
| Avg AuM per client                     | 5000000   | CHF/Persons   |
| Avg CRM effectiveness                  | (SMOOTH(Regulations effect on effectiveness, Implementation period ))*Initial CRM effectiveness | person/person |
| Avg IR effectiveness                   | 85  | person/person |
| Avg layoff time                        | 0.5   | Year          |
| Avg time of B&M in banking             | 4   | Years         |
| Avg time to create a clients portfolio | 1   | Year          |
| B&M office layoff rate                 | IF THEN ELSE(Back office gap<0, (Back office gap/Avg layoff time) , 0 )                         | person/Year   |
| B&M office quitting rate               | B&M office/"Avg time of B&M in banking"   | person/Year   |
| B&M office                             | INTEG ( "B&M office hiring rate"- "B&M office layoff rate"- "B&M office quitting rate" , 16010) | Persons       |
| B&M reduction policy switch            | 0   | Dmnl          |
| B&M office hiring rate                 | IF THEN ELSE(Back office gap>0, Back office gap/"Time to hire B&M office" , 0 )                 | person/Year   |
| Back office gap                        | Desired level of B&M office-"B&M office"  | person        |

| Name  | Equation  | Units           |
|---|---|-----------------|
| Change in investments                       | Investments gap/TIME STEP   | CHF/Year/Year   |
| Change in reference investments             | Reference investments*"Change in reference investments (%)"   | CHF/Year/Year   |
| Change in reference investments (%)         | 0.02  | Dmnl            |
| Change in Swiss service and product quality | Service and product quality gap/Quality adjustment time   | Dmnl/Year       |
| CIR   | Total operating expenses/Total operating income   | Dmnl            |
| CIR ref                                     | ( [(0,0)-(2012,10)],(2006,0.577),(2007,0.591686),(2008,0.554029),(2009,0.638465),(2010,0.7202),(2011,0.730824),(2012,0.745371)) | Dmnl            |
| CIR ref1                                    | CIR ref (Time)  | Dmnl            |
| Consideration delay                         | 0.5   | Year            |
| Cost per employee                           | ( [(2006,0)-(2018,250000)],(2006,213761),(2007,233000),(2008,245000),(2009,229000),(2010,220000),(2011,213000),(2012,214000))   | CHF/person/Year |
| CRM average time in banking                 | 8   | Years           |
| CRM quitting information delay              | 1   | Year            |
| Cum admin expenses                          | INTEG ( Admin expenses-Reset admin expenses, 0)   | CHF             |
| Cum fee and commission income               | INTEG ( Fee and commission income-Reset cum fee and commission income, 0)   | CHF             |
| Cum gross income                            | INTEG ( Accrual of gross income-Reset earnings before tax, 5.776e+009)  | CHF             |

| Name                                       | Equation   | Units    |
|--|--|----------|
| Cum personnel expenses                     | NTEG ( Personnel expenses-Reset personnel expenses, 0)   | CHF      |
| Cum trading and interest income            | INTEG ( Trading and interest income-Reset trading and interest income, 0)  | CHF      |
| DAuM loss due to declaration               | AuM under consideration to repatriate*(1-Retention rate)   | CHF/Year |
| DAuM loss rate due to wealth lost/spending | Initial off-shore DAuM*"DAuM loss/spending"  | CHF/Year |
| DAuM loss/spending                         | 0.065  | 1/Year   |
| Declaration implementation delay           | 6  | Year     |
| Declaration rate                           | IF THEN ELSE("Off-shore UAuM">0, AuM to declare per year , 0)  | CHF/Year |
| Declaration rate per year                  | SMOOTH(IF THEN ELSE( Regulatory pressure=0, 0 , Indicated declaration rate per year ), Declaration implementation delay)   | 1/Year   |
| Delay of moving money out                  | 0.1  | Year     |
| Desired level of Experienced CRM           | Total clients/Avg CRM effectiveness  | person   |
| Desired level of Experienced IR            | Total clients/Avg IR effectiveness   | person   |
| Desired level of B&M office                | IF THEN ELSE("B&M reduction policy switch"=0, (("Reference desired level of B&M office"*Effect of income ratio on staff reduction policies)+"Actual effect on desired level of B&M office" ), IF THEN ELSE(Time<2013, (("Reference desired level of B&M office"*Effect of income ratio on staff reduction policies )+"Actual effect on desired level of B&M office" ), "New desired level of B&M office (policy measure1)" ) ) | Persons  |
| Effect of attractiveness on DAuM gain rate | WITH LOOKUP ( Attractiveness for declared clients ratio, ((0,0)-(2,2)],(0,0.0964912),(0.0550459,0.114035),(0.152905,0.122807),(0.232416,0.140351),(0.342508,0.210526),(0.415902,0.219298),(0.544343,0.298246),(0.672783,0.447368),(0.801223,0.631579),(0.83792,0.70  | Dmnl     |

| Name   | Equation  | Units |
|--|---|-------|
|  | 1754),(0.905199,0.859649),(1,0.991228),(1.1,1.23684),(1.21101,1.38596),(1.33333,1.55263),(1.40061,1.68421),(1.46177,1.72807),(1.5474,1.77193),(1.61468,1.79825),(1.65749,1.80702),(1.69419,1.83333),(1.7737,1.86842),(1.88379,1.91228),(1.98165,1.91228) )  |       |
| Effect of attractiveness on retention rate                           | WITH LOOKUP ( Attractiveness for undeclared clients ratio, ((0,-0.009)-(2,2)],(0,0),(0.0978593,0.0526798),(0.232416,0.105548),(0.342508,0.184211),(0.422018,0.263158),(0.501529,0.333333),(0.617737,0.429825),(0.740061,0.552632),(0.831804,0.675439),(0.9,0.789474),(1,0.947368),(1.1,1.08772),(1.2,1.19298),(1.3,1.35088),(1.40061,1.45614),(1.46177,1.53509),(1.5474,1.66667),(1.61468,1.73684),(1.65749,1.75439),(1.69419,1.77193),(1.7737,1.78947),(1.88379,1.80702),(2,1.81579) )   | Dmnl  |
| Effect of attractiveness on UAUM gain rate                           | WITH LOOKUP ( Attractiveness for undeclared clients ratio, ((0,0)-(2,2)],(0,0),(0.0978593,0.0526798),(0.232416,0.105548),(0.342508,0.184211),(0.422018,0.263158),(0.501529,0.333333),(0.617737,0.429825),(0.740061,0.552632),(0.831804,0.675439),(0.9,0.789474),(1,0.947368),(1.1,1.08772),(1.2,1.19298),(1.3,1.35088),(1.40061,1.45614),(1.46177,1.53509),(1.5474,1.66667),(1.61468,1.73684),(1.65749,1.75439),(1.69419,1.77193),(1.7737,1.78947),(1.88379,1.80702),(2,1.81579) )  | Dmnl  |
| Effect of gross profit on indicated investments                      | WITH LOOKUP ( IF THEN ELSE(Time>2013, Policy gross profit ratio, 1 ), ((1,0)-(2,2)],(1,1.29825),(1.0948,1.31579),(1.1,1.29825),(1.2,1.34211),(1.3,1.38596),(1.4,1.47368),(1.5,1.62281),(1.6,1.77193),(1.7,1.87719),(1.8,1.94737),(1.9,1.99123),(2,1.99123) )  | Dmnl  |
| Effect of income ratio on staff reduction policies                   | WITH LOOKUP ( Perceived net income ratio, ((0,0)-(2,2)],(0,0.921053),(0.0550459,0.921053),(0.152905,0.921053),(0.232416,0.921053),(0.342508,0.929825),(0.415902,0.921053),(0.544343,0.929825),(0.672783,0.95614),(0.801223,0.964912),(0.83792,0.973684),(0.868502,0.973684),(0.93578,0.982456),(1,0.991228),(1.07645,1.35965),(1.21101,1.66667),(1.33333,1.79825),(1.40061,1.81579),(1.41284,1.85965),(1.46177,1.83333),(1.5474,1.85965),(1.61468,1.88596),(1.65749,1.89474),(1.69419,1.89474),(1.7737,1.89474),(1.88379,1.89474),(1.98165,1.89474) ) | Dmnl  |
| Effect of investments ratio on indicated service and product quality | WITH LOOKUP ( Investments ratio, ((0,0)-(2,1.25)],(0.0978593,0.0964912),(0.232416,0.105263),(0.342508,0.149123),(0.422018,0.210526),(0.501529,0.254386),(0.617737,0.429825),(0.740061,0.640351),(0.831804,0.754386),(0.9,0.868421),(1,1),(1.06422,1.09868),(1.11315,1.125),(1.2,1.15789),(1.3,1.19737),(1.40061,1.22807),(1.46177,1.22807),(1.5474,1.22807) )   | Dmnl  |



| Name   | Equation  | Units           |
|--|---|-----------------|
|  | ), (1.61468, 1.22807), (1.65749, 1.28289), (1.69419, 1.22807), (1.7737, 1.22259), (1.88379, 1.21711), (1.96942, 1.21711) )  |                 |
| Effect of perceived price on retention rate    | WITH LOOKUP ( Perceived price ratio, ((0,0)-(2,2)], (0,1.97368), (0.1,2), (0.2,1.97368), (0.3,1.9386), (0.4,1.74561), (0.5,1.57895), (0.6,1.47368), (0.7,1.32456), (0.8,1.20175), (0.9,1.07895), (1,1), (1.1,0.833333), (1.2,0.649123), (1.3,0.561404), (1.4,0.491228), (1.5,0.350877), (1.6,0.245614), (1.7,0.149123), (1.8,0.0964912), (1.9,0.0614035), (2,0.0526316) ) | Dmnl            |
| Expected CRM quitting rate                     | SMOOTH(Experienced CRM quitting rate, CRM quitting information delay)   | person/Year     |
| Expected IR quitting rate                      | SMOOTH(IR quitting rate, IR quitting information delay)   | person/Year     |
| Experienced CRM                                | INTEG ( Transition rate-Experienced CRM quitting rate, 3952)  | Persons         |
| Experienced CRM gap                            | Desired level of Experienced CRM-Experienced CRM  | Persons         |
| Experienced CRM quitting rate                  | IF THEN ELSE(Experienced CRM>0, Experienced CRM/CRM average time in banking, 0)   | person/Year     |
| Experienced IR gap                             | Desired level of Experienced IR-IR  | Persons         |
| Fee and commission income                      | IF THEN ELSE(Time<2013, Total AuM*Gross margin (Time) , Total AuM*Forecasted gross margin)  | CHF/Year        |
| Fee and commission income ref                  | ((0,0)-(10,10)], (2006,1.2e+010), (2007,1.30946e+010), (2008,1.55616e+010), (2009,1.04643e+010), (2010,9.89988e+009), (2011,9.37899e+009), (2012,8.796e+009))   | CHF/Year        |
| Fee and commission income ref1                 | Fee and commission income ref (Time)*1  | CHF/Year        |
| Forecasted cost per employee                   | 214000  | CHF/person/Year |
| Forecasted gross margin                        | 0.0065  | 1/Year          |
| Forecasted performance and currency effect (%) | 0   | 1/Year          |

| Name  | Equation  | Units    |
|---|---|----------|
| Forecasted safe haven reputation                | $(((2012,0)-(2019,90)),(2012,82),(2013,85),(2014,86),(2015,87),(2019,88))$  | Dmnl     |
| Front office                                    | New CRM + Experienced CRM+IR  | Persons  |
| Gross income in the year N-1                    | DELAY INFORMATION (Gross profit , 1, 5.5e+009)  | CHF/Year |
| Gross margin                                    | $(((2006,0)-(2018,0.009)),(2006,0.00815),(2007,0.0079),(2008,0.0082),(2009,0.0072),(2010,0.007),(2011,0.0067),(2012,0.0065),(2013,0.0062),(2014,0.0061),(2015,0.0059),(2016,0.0058),(2017,0.0057),(2018,0.0053))$   | 1/Year   |
| Gross profit                                    | Total operating income-Total operating expenses   | CHF/Year |
| Gross profit ref                                | $(((0,0)-(2012,9e+009)),(2006,5.776e+009),(2007,6.33915e+009),(2008,8.48973e+009),(2009,6.1627e+009),(2010,4.07849e+009),(2011,3.7337e+009),(2012,3.4421e+009))$  | CHF/Year |
| Gross profit ref1                               | Gross profit ref (Time)*1   | CHF/Year |
| Implementation period                           | 3   |          |
| Importance of safe haven reputation             | 0.4   | Dmnl     |
| Importance of secrecy                           | 0.2   | Dmnl     |
| Income ratio                                    | Gross profit/"Gross income in the year N-1"   | Dmnl     |
| Indicated declaration rate per year             | 1   | Dmnl     |
| Indicated effect on desired level of B&M office | IF THEN ELSE( Regulatory pressure>0, 7000, 1)   | Dmnl     |
| Indicated investments                           | Reference investments*Effect of gross profit on indicated investments   | CHF/Year |
| Indicated service and product quality           | IF THEN ELSE(Investments policy switch=0, Reference service and product quality, IF THEN ELSE(Time<2013, Reference service and product quality , SMOOTH(Reference service and product quality*Effect of investments ratio on indicated service and product quality , Investments implementation delay ) ) ) | Dmnl     |

| Name                             | Equation   | Units       |
|----------------------------------|--|-------------|
| Indicated UAuM gain rate         | Effect of attractiveness on UAuM gain rate*"Reference UAuM gain rate (%)"                        | Dmnl        |
| Initial CRM effectiveness        | 70   | Dmnl        |
| Initial off-shore DAuM           | SAMPLE IF TRUE(<br>MODULO(Time, Period)<1e-006,"Off-shore DAuM", "Off-shore DAuM")               | CHF         |
| Initial off-shore UAuM           | SAMPLE IF TRUE(<br>MODULO(Time, Period)<1e-006,"Off-shore UAuM", "Off-shore UAuM")<br>Units: CHF | CHF         |
| "Initial on-shore AuM            | SAMPLE IF TRUE(<br>MODULO(Time, Period)<1e-006,"On-shore AuM" ,"On-shore AuM")<br>Units: CHF     | CHF         |
| Investments                      | INTEG (<br>Change in investments,<br>Reference investments)                                      | CHF/Year    |
| Investments gap                  | Indicated investments-Investments  | CHF/Year    |
| Investments implementation delay | 3  | Year        |
| Investments policy switch        | 0  | Dmnl        |
| Investments ratio                | Investments/Reference investments  | Dmnl        |
| IR                               | INTEG (<br>New IR hiring rate-IR quitting rate,<br>3750)   | Persons     |
| IR average time in banking       | 8  | Years       |
| IR quitting information delay    | 1  | Year        |
| IR quitting rate                 | IR/IR average time in banking  | person/Year |
| Net new money (%)                | 0.03+STEP(0.01, 2007)+STEP(-0.02, 2008)+STEP(-0.01, 2009)+STEP(0.01,2010)+<br>STEP(-0.02, 2012)  | 1/Year      |

| Name  | Equation   | Units        |
|---|--|--------------|
| Net off-shore DAuM change due to performance      | IF THEN ELSE(Time<2013, ("Initial off-shore DAuM"*"Performance and currency effect on off-shore AuM (%)") , ("Forecasted performance and currency effect (%)"*"Initial off-shore DAuM" ) )   | CHF/Year     |
| Net off-shore UAuM change due to performance      | IF THEN ELSE("Off-shore UAuM">0, (IF THEN ELSE(Time<2013, ("Initial off-shore UAuM"*"Performance and currency effect on off-shore AuM (%)") , ("Forecasted performance and currency effect (%)"*"Initial off-shore UAuM" ) ) ) , 0 ) | CHF/Year     |
| Net on-shore AuM change due to new money          | Net new money (%)*"Initial on-shore AuM"   | CHF/Year     |
| Net on-shore AuM change due to performance        | F THEN ELSE(Time<2013, ("Initial on-shore AuM"*"Performance and currency effects (%)") , ("Forecasted performance and currency effect (%)"*"Initial on-shore AuM" ) )<br>Units: CHF/Year   | CHF/Year     |
| Net profit  | Gross profit-Accrual of taxes  | CHF/Year     |
| New CRM   | INTEG ( New CRM hiring rate-New CRM quitting rate-Transition rate, 988 )   | Persons      |
| New CRM hiring rate                               | F THEN ELSE(New CRM*"New CRM quitting (%) "<0, 0 , New CRM*"New CRM quitting (%)")   | person/Year  |
| New CRM quitting (%)                              | 0.001  | 1/Year       |
| New CRM quitting rate=                            | IF THEN ELSE(New CRM*"New CRM quitting (%) "<0, 0 , New CRM*"New CRM quitting (%)")  | Persons/Year |
| New desired level of B&M office (policy measure1) | 28000  | People       |
| New IR hiring rate                                | Expected IR quitting rate+((IF THEN ELSE(Experienced IR gap>0, Experienced IR gap , 0 ))/Time to hire new IR)  | person/Year  |
| Off-shore DAuM gain rate (%)                      | Reference off-shore DAuM gain rate (%)*Effect of attractiveness on DAuM gain rate  | 1/Year       |

| Name   | Equation  | Units    |
|--|---|----------|
| Off-shore DAuM gain rate                             | Initial off-shore DAuM*"Off-shore DAuM gain rate (%)"   | CHF/Year |
| Off-shore DAuM loss rate                             | DAuM loss rate due to wealth lost/spending + DAuM loss due to declaration   | CHF/Year |
| Off-shore DAuM                                       | INTEG ( Declaration rate+"Net off-shore DAuM change due to performance"+"Off-shore DAuM gain rate" -"Off-shore DAuM loss rate", 4.80686e+011) | CHF      |
| Off-shore UAuM gain rate                             | IF THEN ELSE("Initial off-shore UAuM">0, "Initial off-shore UAuM"*"UAuM gain rate (%)", 0 )   | CHF/Year |
| Off-shore UAuM loss rate                             | UAuM loss to other tax havens+"UAuM loss rate due to wealth lost/spending"  | CHF/Year |
| Off-shore UAuM                                       | INTEG ( "Net off-shore UAuM change due to performance"+"Off-shore UAuM gain rate"-Declaration rate -"Off-shore UAuM loss rate", 3.48083e+011) | CHF      |
| On-shore AuM   | INTEG ( "Net on-shore AuM change due to new money"+"Net on-shore AuM change due to performance", 6.25212e+011)                                | CHF      |
| Perceived net income ratio                           | SMOOTH3( Income ratio, Profit perception delay)   | Dmnl     |
| Perceived price                                      | IF THEN ELSE(Time<2013, SMOOTH(Gross margin (Time), Perception delay ) , SMOOTH (Forecasted gross margin, Perception delay ))                 | Dmnl     |
| Perceived price ratio                                | Perceived price/Reference perceived price   | Dmnl     |
| Perceived secrecy                                    | SMOOTH( IF THEN ELSE( Regulatory pressure=0, 100, 0), Regulation perception delay)  | Dmnl     |
| Perception delay                                     | 0.2   | Year     |
| Performance and currency effect on off-shore AuM (%) | 0.01+STEP(-0.011, 2007)+STEP(-0.3, 2008)+STEP(0.25, 2009)+STEP(-0.02,2010)+STEP(-0.02,2011)+STEP(0.091,2012)                                  | 1/Year   |

| Name  | Equation   | Units    |
|---|--|----------|
| Performance and currency effects (%)            | $0.13 + \text{STEP}(-0.37, 2008) + \text{STEP}(0.23, 2009) + \text{STEP}(-0.02, 2011)$   | 1/Year   |
| Period  | 1  | Years    |
| Personnel expenses Data                         | Personnel expenses ref (Time)*1  | CHF/Year |
| Personnel expenses                              | IF THEN ELSE(Time<2013, Total staff*Cost per employee (Time) , Total staff *Forecasted cost per employee )   | CHF/Year |
| Personnel expenses ref                          | ( [(2006,4e+009)-(2012,8e+009)],(2006,5.28e+009),(2007,6.33172e+009),(2008,7.30875e+009),(2009,7.58167e+009),(2010,6.66334e+009),(2011,7.01709e+009),(2012,6.85121e+009) ) | CHF/Year |
| Policy gross profit ratio                       | Gross profit/Policy reference gross income   | Dmnl     |
| Policy reference gross income                   | 3240000000   | CHF/Year |
| Profit perception delay                         | 1  | Years    |
| Quality adjustment time                         | 2  | Years    |
| Reference attractiveness for declared clients   | INITIAL(Attractiveness of Swiss PB for declared client)  | Dmnl     |
| Reference attractiveness for undeclared clients | INITIAL(Attractiveness of Swiss PB for undeclared clients)   | Dmnl     |
| Reference desired level of B&M office           | DELAY INFORMATION ( "B&M office" , 1, 20000)   | person   |
| Reference investments                           | INTEG ( Change in reference investments, 1.2975e+009 )   | CHF/Year |
|   |  |          |

| Name                                   | Equation   | Units     |
|--|--|-----------|
| Reference off-shore DAuM gain rate (%) | IF THEN ELSE(Time<2012, 0.15 , 0.09 )  | 1/Year    |
| Reference perceived price              | INITIAL( Perceived price )   | Dmnl/Year |
| Reference retention rate               | 1  | Dmnl      |
| Reference service and product quality  | INITIAL(Swiss service and product quality)   | Dmnl      |
| Reference UAuM gain rate (%)           | 0.12   | 1/Year    |
| Regulation perception delay            | 2.5  | Year      |
| Regulations effect on effectiveness    | IF THEN ELSE(Regulatory pressure=0, 1 , 0.8 )  | Dmnl      |
| Regulatory pressure                    | IF THEN ELSE(Time<2013, IF THEN ELSE( Time<2009, 0, 70) , 100 )  | Dmnl      |
| Reset admin expenses                   | IF THEN ELSE(Yearly pulse>0, (Cum admin expenses/TIME STEP)+Admin expenses , 0 )   | CHF/Year  |
| Reset cum fee and commission income    | IF THEN ELSE(Yearly pulse>0, (Cum fee and commission income/TIME STEP)+Fee and commission income , 0 )   | CHF/Year  |
| Reset earnings before tax              | IF THEN ELSE(Yearly pulse2>0, (Cum gross income/TIME STEP)+Accrual of gross income , 0 )   | CHF/Year  |
| Reset personnel expenses               | IF THEN ELSE(Yearly pulse>0, (Cum personnel expenses/TIME STEP)+Personnel expenses , 0 )   | CHF/Year  |
| Reset trading and interest income      | IF THEN ELSE(Yearly pulse>0, (Cum trading and interest income/TIME STEP)+Trading and interest income , 0 )   | CHF/Year  |
| Retention rate                         | 0.9*Reference retention rate*Effect of attractiveness on retention rate+0.1<br>*Reference retention rate*Effect of perceived price on retention rate | Dmnl      |
| Safe haven reputation                  | [(2006,80)-(2011,90)],(2006,85),(2011,80))   | Dmnl      |

| Name                              | Equation   | Units    |
|-----------------------------------|--|----------|
| Service and product quality gap   | Indicated service and product quality-Swiss service and product quality  | Dmnl     |
| Swiss service and product quality | INTEG ( Change in Swiss service and product quality, 80)   | Dmnl     |
| Taxes owed                        | INTEG ( Accrual of taxes-Taxes paid, 3.41e+007)  | CHF      |
| Taxes paid                        | Taxes owed/Average time to pay taxes   | CHF/Year |
| The time step for the simulation. | TIME STEP = 0.125  | Year     |
| Time to hire B&M office           | 1  | Years    |
| Time to hire new CRM              | 1  | Years    |
| Time to hire new IR               | 1  | Year     |
| Total AuM                         | On-shore AuM+"Off-shore UAuM"+"Off-shore DAuM"   | CHF      |
| Total AuM ref                     | [(0,0)-(2012,2e+012)],(2006,1.45398e+012),(2007,1.65754e+012),(2008,1.89775e+012),(2009,1.45338e+012),(2010,1.41427e+012),(2011,1.39985e+012),(2012,1.35323e+012)) | CHF      |
| Total AuM ref1                    | Total AuM ref (Time)*1   | CHF      |
| Total clients                     | Total AuM/Avg AuM per client   | person   |
| Total operating expenses          | Personnel expenses +Admin expenses +Investments  | CHF/Year |
| Total operating expenses ref      | [(0,0)-(2012,2e+010)],(2006,7.875e+009),(2007,9.18603e+009),(2008,1.05468e+010),(2009,1.08832e+010),(2010,1.0498e+010),(2011,1.01371e+010),(2012,1.0076e+010))     | CHF/Year |
| Total operating expenses ref1     | Total operating expenses ref (Time)*1  | CHF/Year |



| Name                                       | Equation   | Units        |
|--|--|--------------|
| Total operating income                     | Fee and commission income+ Trading and interest income   | CHF/Year     |
| Total operating income ref                 | [(0,0)-(10,10)],(2006,1.35e+010),(2007,1.55252e+010),(2008,1.90365e+010),(2009,1.70459e+010),(2010,1.45765e+010),(2011,1.38708e+010),(2012,1.35181e+010))  | CHF/Year     |
| Total operating income ref1                | Total operating income ref (Time)  | CHF/Year     |
| Total staff                                | B&M office+ Front office   | person       |
| Total staff ref                            | [(0,0)-(10,10)],(2006,24704.3),(2007,27174.8),(2008,29831.6),(2009,33107.8),(2010,30287.9),(2011,32944.1),(2012,32015))  | Persons      |
| Total staff ref1                           | Total staff ref (Time)*1   | person       |
| Trading and interest income                | Trading and interest income per year (Time)  | CHF/Year     |
| Trading and interest income per year       | [(2006,0)-(2018,7e+009)],(2006,1.80047e+009),(2007,2.43063e+009),(2008,3.47495e+009),(2009,6.58161e+009),(2010,4.67659e+009),(2011,4.49184e+009),(2012,4.72213e+009),(2013,4.922e+009),(2014,5.1022e+009),(2015,5.402e+009),(2016,5.602e+009),(2017,5.702e+009),(2018,5.80702e+009)) | CHF/Year     |
| Transition rate                            | IF THEN ELSE(New CRM/Avg time to create a clients portfolio<0,0, New CRM/Avg time to create a clients portfolio)   | Persons/Year |
| UAuM gain rate (%)                         | SMOOTH(IF THEN ELSE(Regulatory pressure=0, Indicated UAuM gain rate, 0), Declaration implementation delay)   | 1/Year       |
| UAuM loss rate due to wealth lost/spending | IF THEN ELSE("Off-shore UAuM">0, "Initial off-shore UAuM"*"UAuM wealth loss/spending (%)", 0)  | CHF/Year     |
| UAuM loss to other tax havens              | IF THEN ELSE("Off-shore UAuM">0, (SMOOTH( "UAuM loss to other tax havens (%) "*"Initial off-shore UAuM" , Delay of moving money out)), 0)  | CHF/Year     |
| UAuM loss to other tax havens (%)          | IF THEN ELSE(Regulatory pressure=0, 0.001 , 0.12 )   | 1/Year       |

| Name                          | Equation   | Units  |
|-------------------------------|--|--------|
| UAuM wealth loss/spending (%) | 0.001  | 1/Year |
| Yearly pulse                  | PULSE TRAIN(2007-TIME STEP, TIME STEP , 1 , 2019 )   | Year   |
| Yearly pulse2                 | PULSE TRAIN(2007-2*TIME STEP, TIME STEP , 1 , 2019 ) | Year   |

## Appendix B: Key Vensim functions used in the model

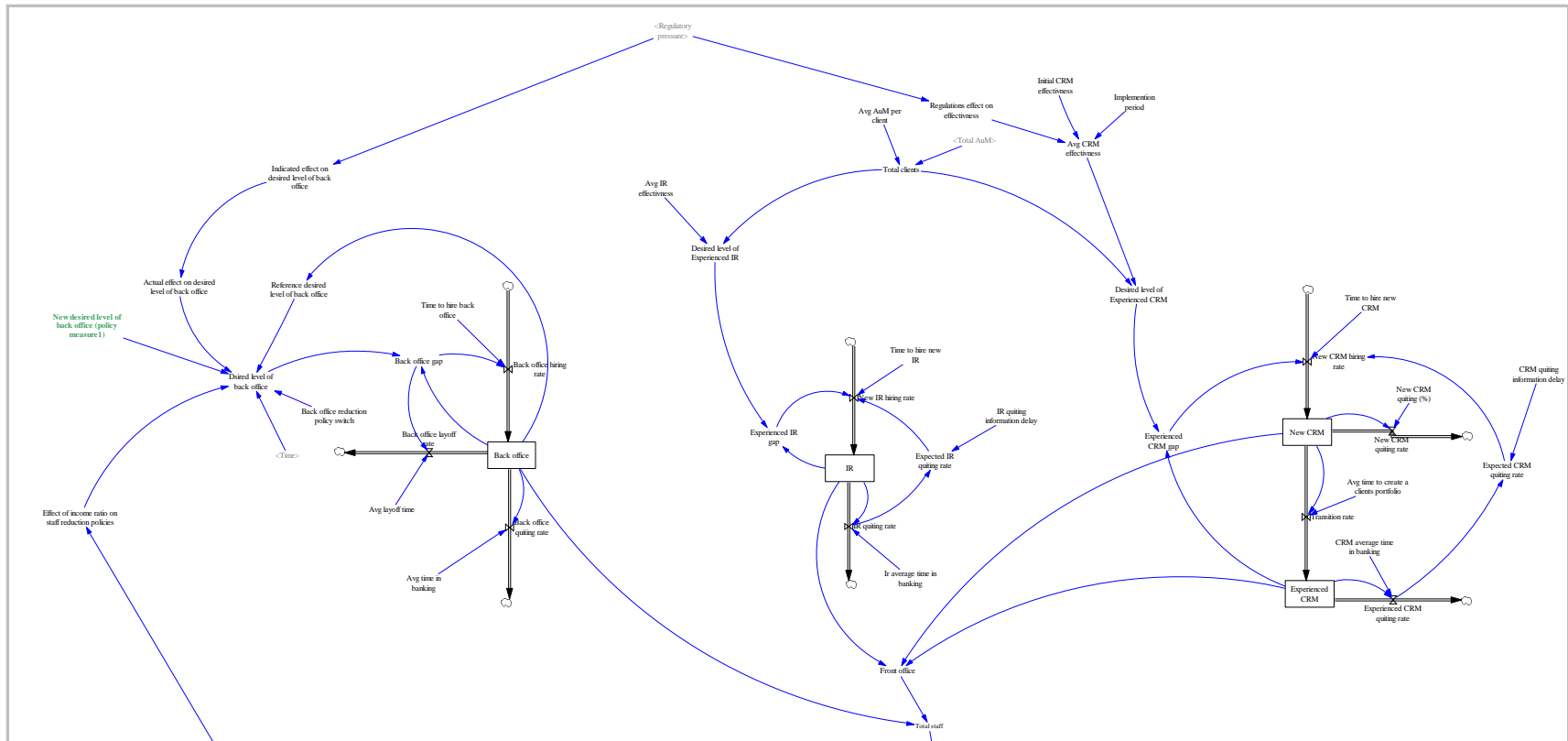
| Function          | Description  | Syntax   |
|-------------------|--|--|
| DELAY INFORMATION | Returns the value of the input delayed by the delay time. Delay time can be a variable. If delay time is decreasing some values of the input will be discarded and replaced by more recent inputs. If delay time is increasing existing values will be held.   | DELAY INFORMATION (input, delay time, initial value)                       |
| IF THEN ELSE      | Returns first value ( <i>tval</i> ) if condition ( <i>cond</i> ) is true and a second value ( <i>fval</i> ) if condition is false. Condition must be a Boolean expression or variable that can be interpreted as Boolean (i.e., taking a value of 0 or 1). Only the value returned is evaluated, so the other value could be an expression that would lead to an error.  | IF THEN ELSE( <i>cond</i> , <i>tval</i> , <i>fval</i> )                    |
| INITIAL           | Returns the value A at initial its initial value and does not change it during a simulation. <i>Initial</i> is used when a variable's starting value is needed.  | INITIAL(A) INITIAL value of variable                                       |
| INTEG             | Returns the integral of the rate. The initial value is the value of the variable on the left-hand side of the equation at the beginning of the simulation.   | INTEG (rate, initial value)  |
| PULSE TRAIN       | Returns 1.0, starting at time ( <i>start</i> ), and lasting for interval ( <i>width</i> ) and then repeats this pattern every ( <i>tbetween</i> ) time. 0.0 is returned at all other times. If the value of <i>tbetween</i> is smaller than <i>width</i> then 1 will be returned between <i>start</i> and <i>end</i> . If <i>width</i> is less than or equal to TIME STEP the pulses will only last one TIME STEP. | PULSE TRAIN ( <i>start</i> , <i>width</i> , <i>tbetween</i> , <i>end</i> ) |
| SAMPLE IF TRUE    | Returns input when condition is  | SAMPLE IF TRUE   |

|             |  |                                   |
|-------------|--|-----------------------------------|
|             | true, otherwise remains constant. The function initially holds constant at the stated initial value. This function is useful for retaining information about a variable's behavior.  | (condition, input, initial value) |
| SMOOTH      | Returns 1 <sup>st</sup> order exponential smooth.  | SMOOTH(input, delay time)         |
| SMOOTH3     | Returns 3rd order exponential smooth. In the model it is used to show more complex information delay than SMOOTH (E.g. before decision makers actually can make strategic decision based on financial results, information about financial results is being delayed several times) | SMOOTH3(input, delay time)        |
| STEP        | Returns 0 until the step time and then returns height.   | STEP(height, step time)           |
| WITH LOOKUP | Specifies a nonlinear relationship between the input $x$ and the output by passing the input through a series of $x,y$ pairs specified as numbers.   | WITH LOOKUP( $x,(l\#)$ )          |

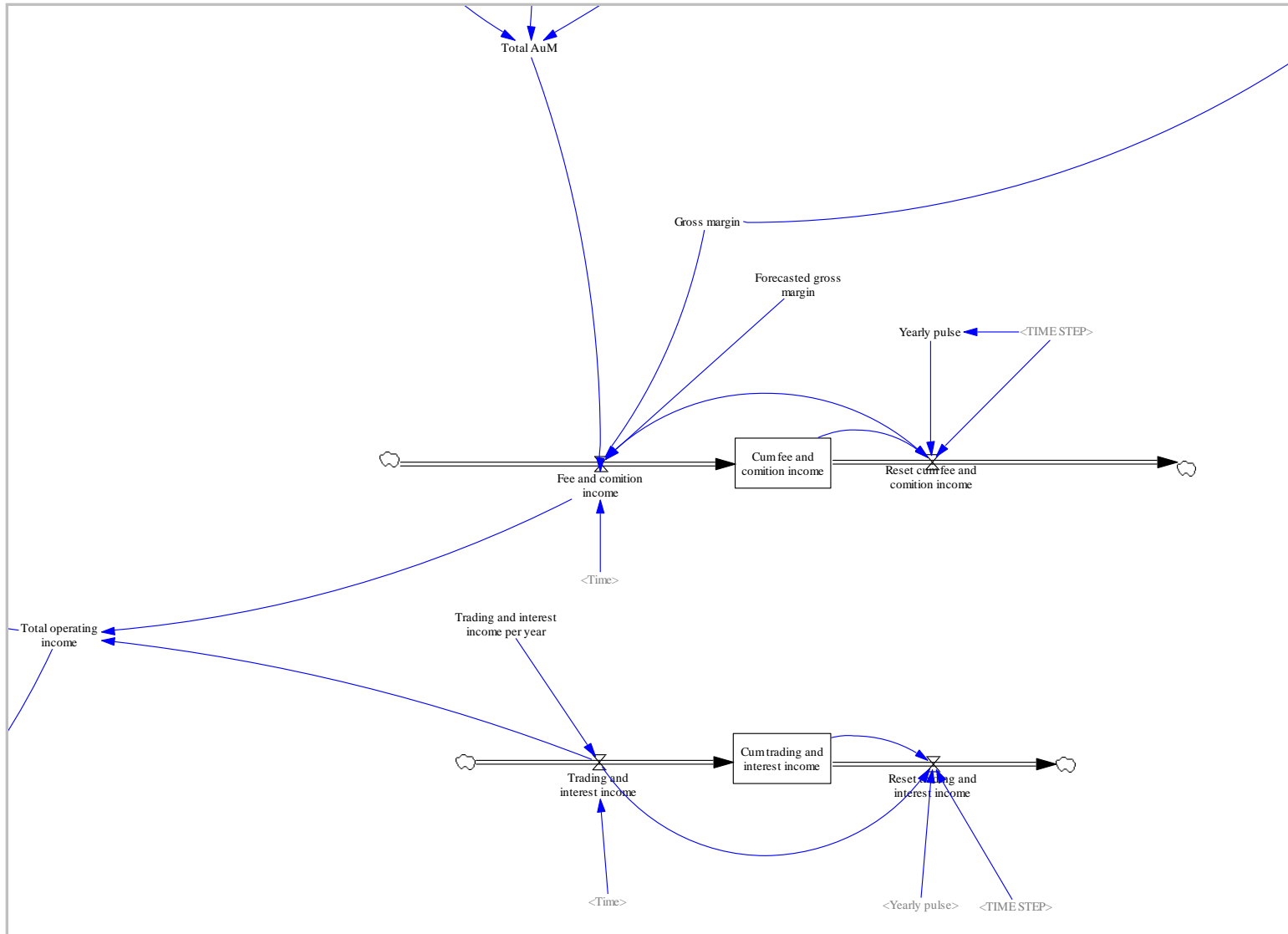
*Source: created by the author using Vensim manual's material.*



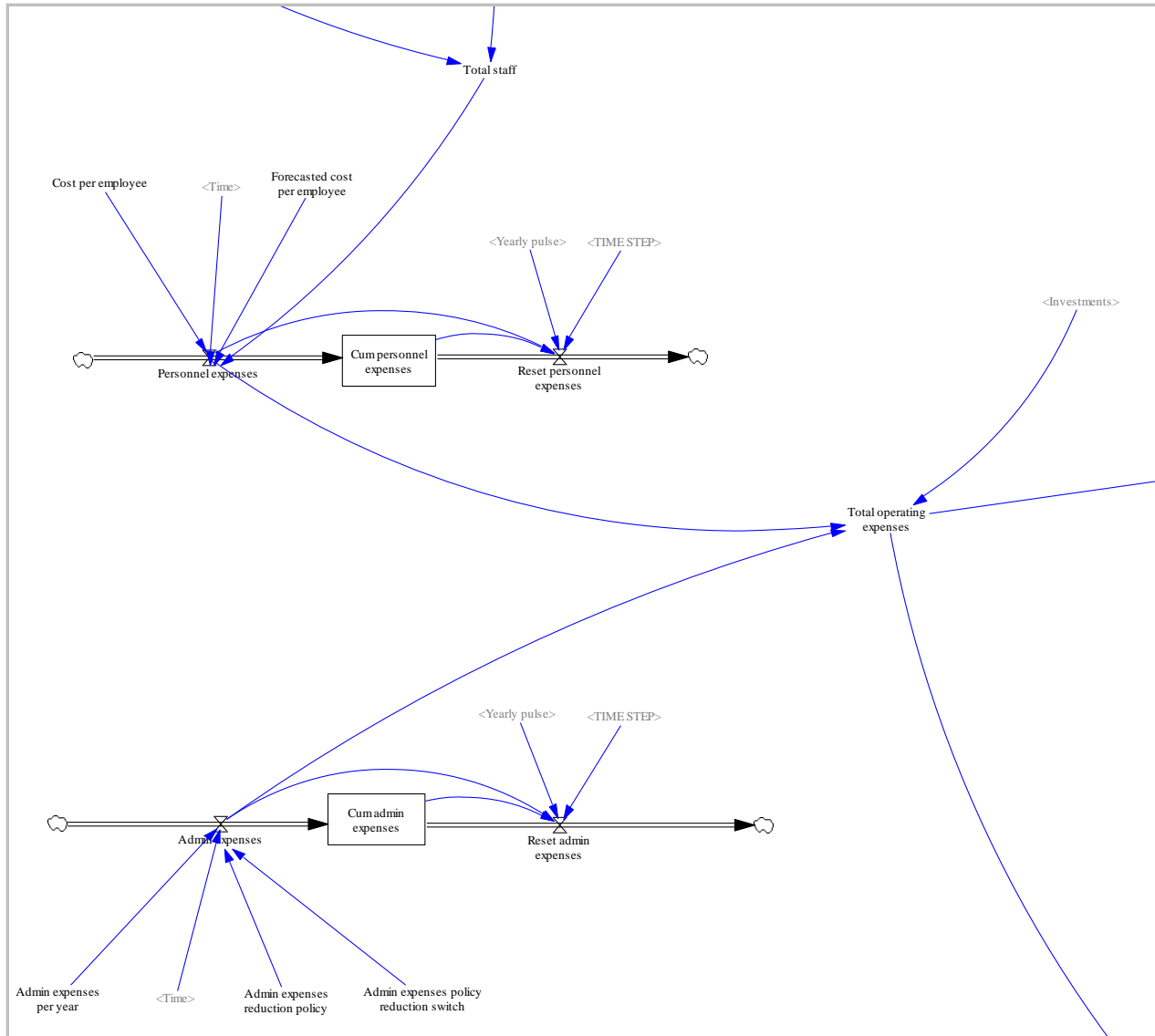
## Appendix C2: Stock and flow diagram of the Personnel sector



## Appendix C3: Stock and flow diagram of the Operating income subsector

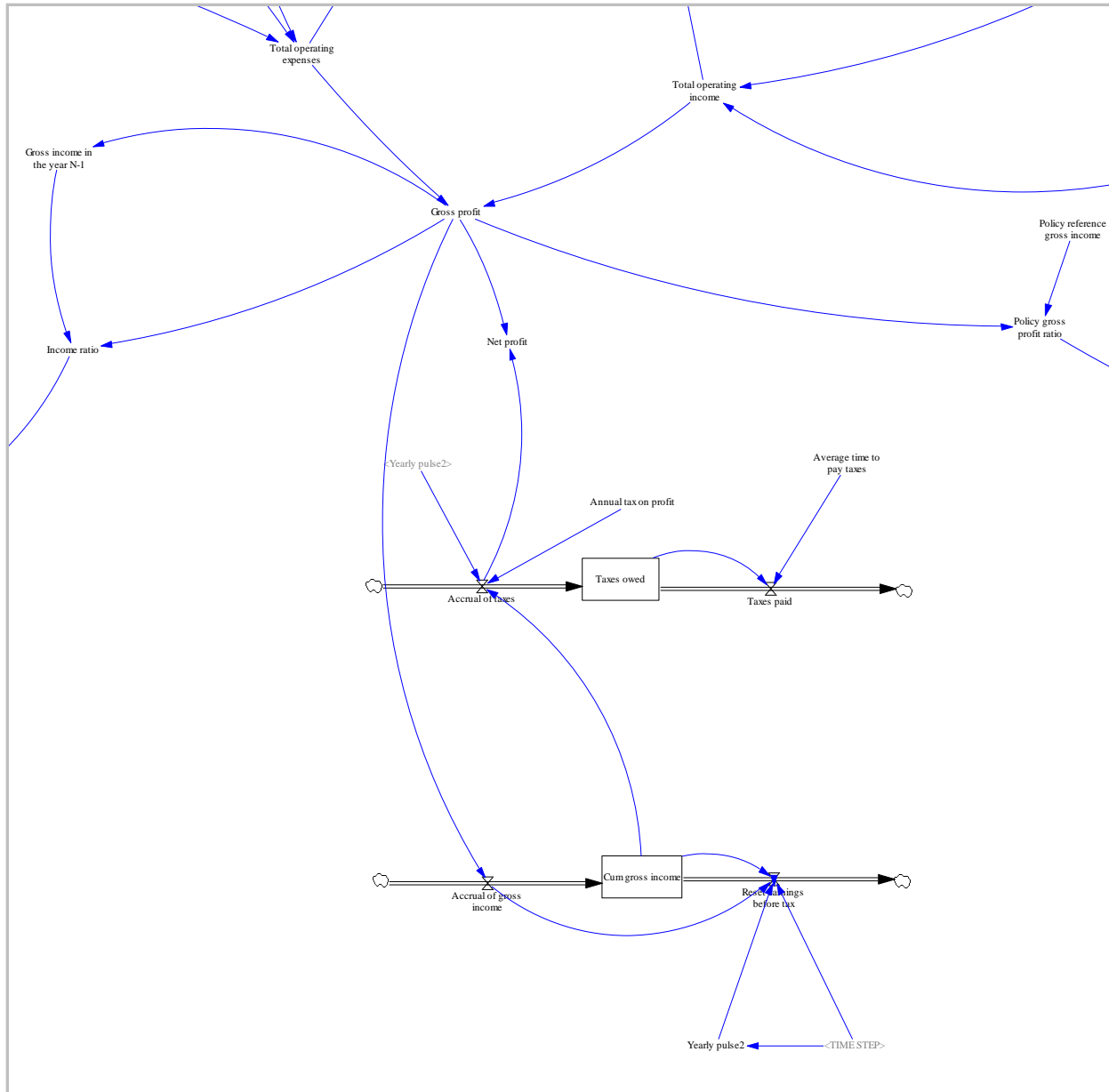


## Appendix C4: Stock and flow diagram of the Operating expenses subsector





## Appendix C5: Stock and flow diagram of the simplified net income statement



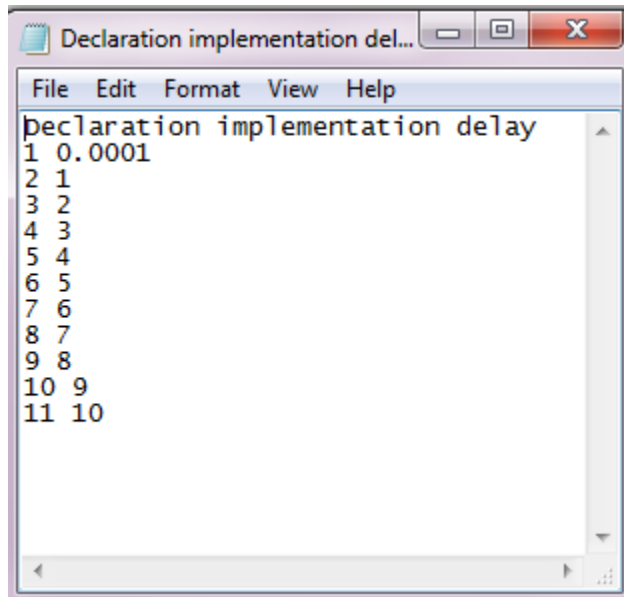
## Appendix D: Formulas used during the behavior pattern tests

| Metric                        | Definition   | Formula  |
|-------------------------------|--|--|
| R <sup>2</sup>                | Coefficient of determination; the fraction of the variance in the data “explained” by the model (dimensionless). r = correlation coefficient between model and data series   | $R^2 = r^2; r = \frac{1}{n} \sum \frac{(X_d - \bar{X}_d)(X_m - \bar{X}_m)}{s_d s_m}$ $\bar{X} = \frac{1}{n} \sum X; s = \sqrt{\frac{1}{n} \sum (X - \bar{X})^2}$ |
| MAE                           | Mean Absolute Error (units)  | $MAE = \frac{1}{n} \sum  X_m - X_d $   |
| MAPE                          | Mean Absolute Percent Error (dimensionless)  | $MAPE = \frac{1}{n} \sum \frac{ X_m - X_d }{X_d}; \text{ (multiply by 100 for \%)}$  |
| MAE/Mean                      | Mean Absolute Error as a fraction of the mean (dimensionless)  | $MAE/Mean = MAE / \bar{X}_d; \text{ (multiply by 100 for \%)}$   |
| (R)MSE                        | (Root) Mean Square Error (RMSE: units; MSE: units <sup>2</sup> )   | $MSE = \frac{1}{n} \sum (X_m - X_d)^2; RMSE = \sqrt{MSE}$  |
| Theil's Inequality Statistics | Decomposes MSE into three components: bias (U <sup>M</sup> ), unequal variation (U <sup>S</sup> ), and unequal covariation (U <sup>C</sup> ) (dimensionless); U <sup>M</sup> + U <sup>S</sup> + U <sup>C</sup> = 1 | $U^M = \frac{\bar{X}_m^2 - \bar{X}_d^2}{MSE}$ $U^S = \frac{s_m^2 - s_d^2}{MSE}$ $U^C = \frac{2(1 - r)s_m s_d}{MSE}$  |

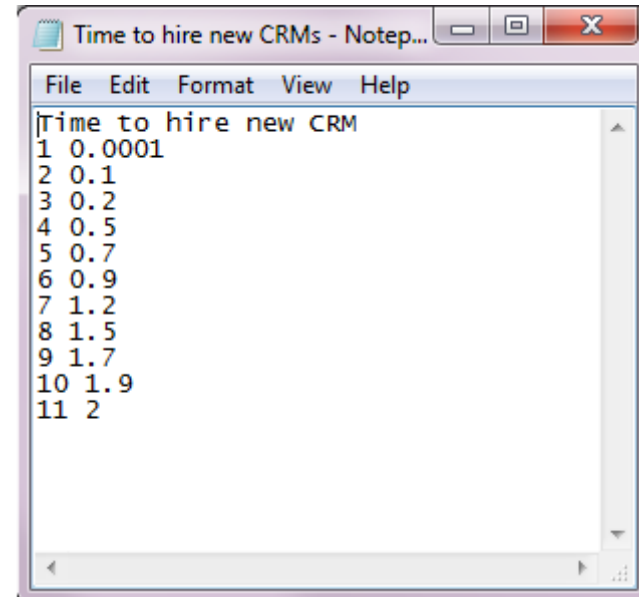
Source: Sterman, 2000

## Appendix E: List of sensitivity test inputs

Sensitivity to declaration implementation delay test inputs:

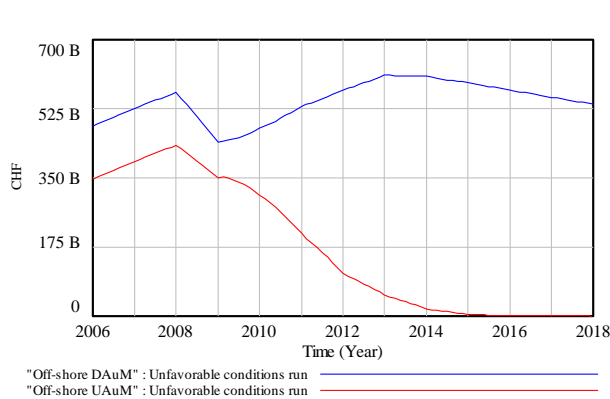


Sensitivity to time to hire new CRM test inputs:

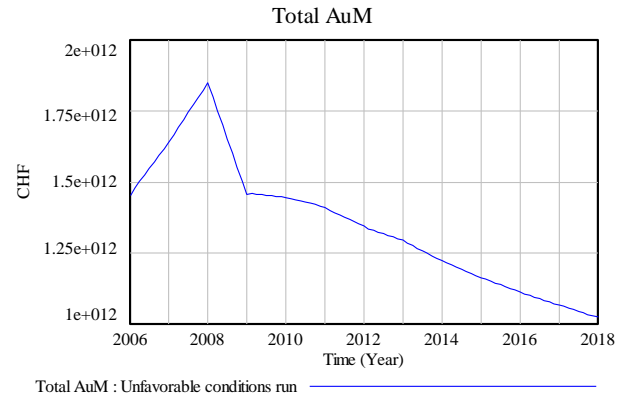


# Appendix F: Simulation results under unfavorable performance and currency conditions

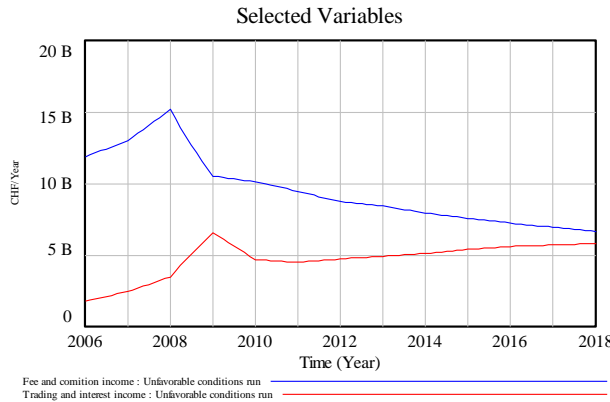
Figures F1-F8 demonstrate the simulation results under unfavorable performance and currency effect conditions. Forecasted performance and currency effect value is set for -5%.



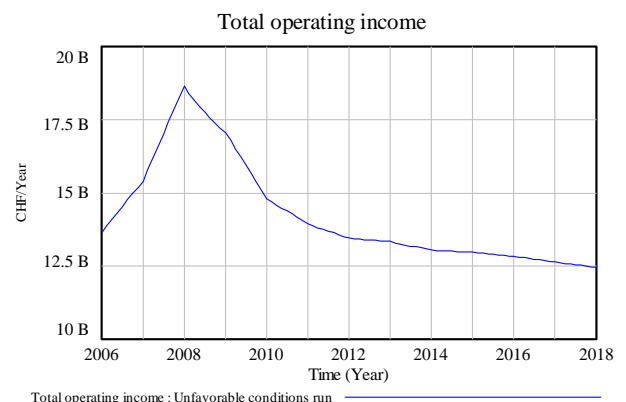
**F 1: Off-shore declared and undeclared AuM under unfavorable performance and currency conditions**



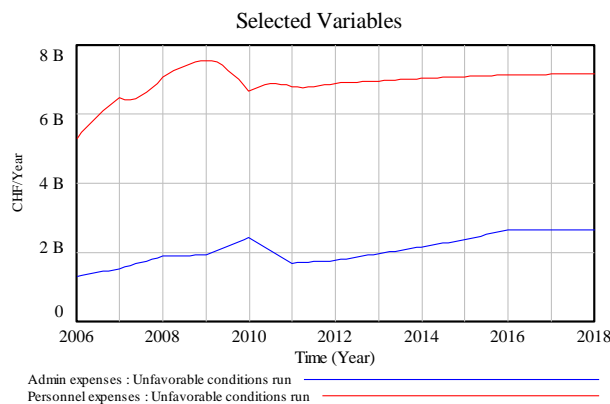
**F 2: Total AuM under unfavorable performance and currency effect conditions**



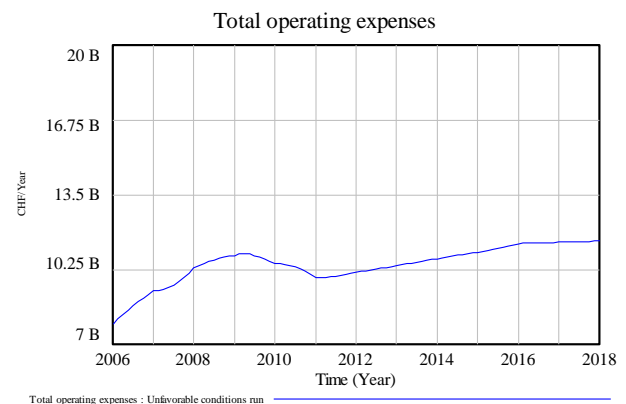
**F 3: Fee and commission and trading and interest income under unfavorable performance and currency conditions**



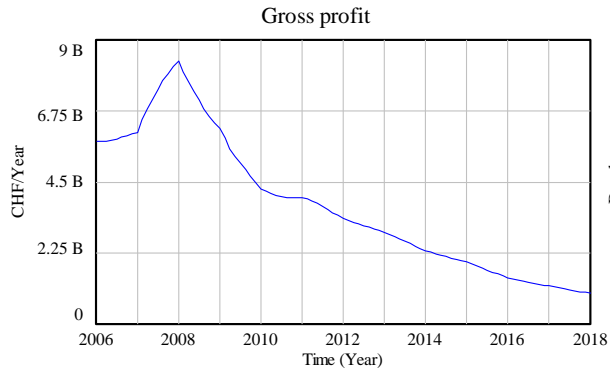
**F 4: Total operating income and unfavorable performance and currency conditions**



**F 5: Administrative and personnel expenses under unfavorable performance and currency effect conditions**

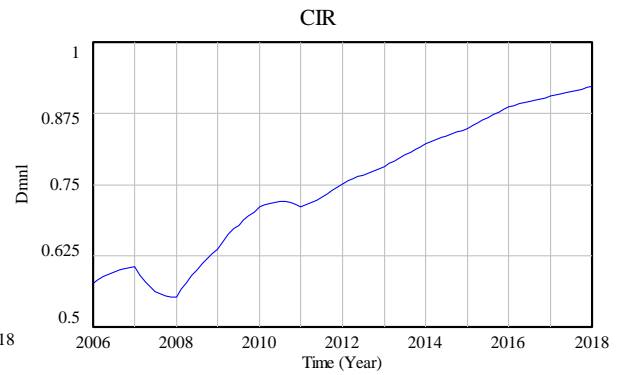


**F 6: Total operating expenses under unfavorable performance and currency effect conditions**



Gross profit : Unfavorable conditions run

**F 8: Gross profit under unfavorable performance and currency effect conditions**

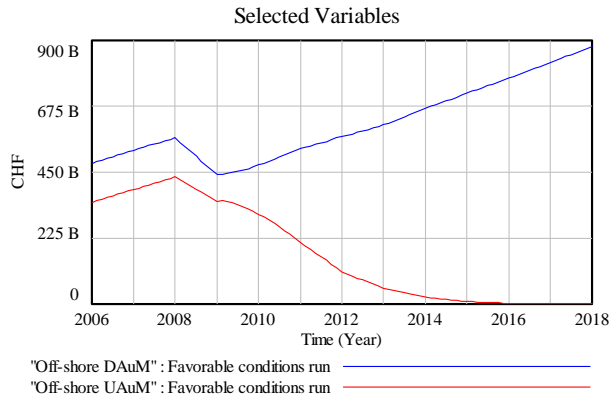


CIR : Unfavorable conditions run

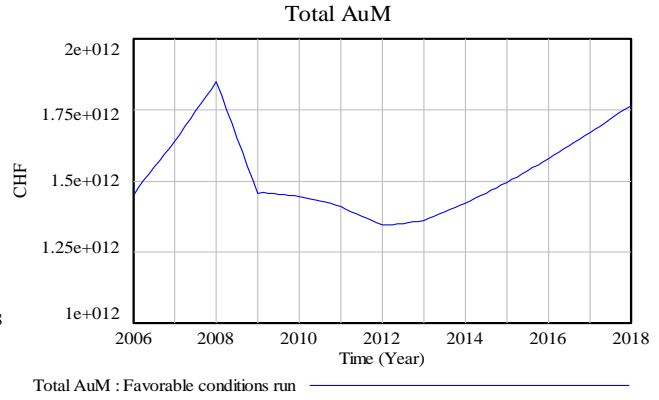
**F 7: CIR under unfavorable performance and currency effect conditions**

# Appendix G: Simulation results under favorable performance and currency conditions

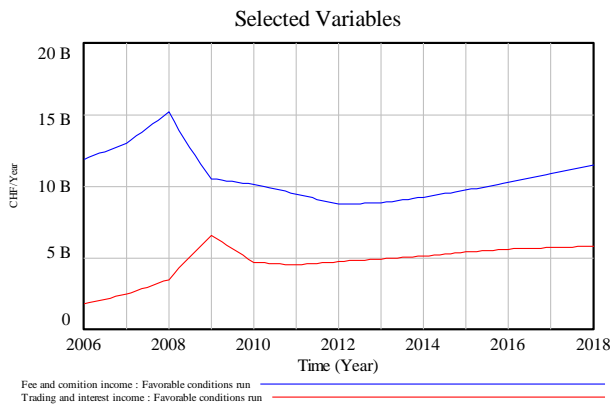
Figures G1-G8 demonstrate the simulation results under favorable performance and currency effect conditions. Forecasted performance and currency effect value is set for 5%.



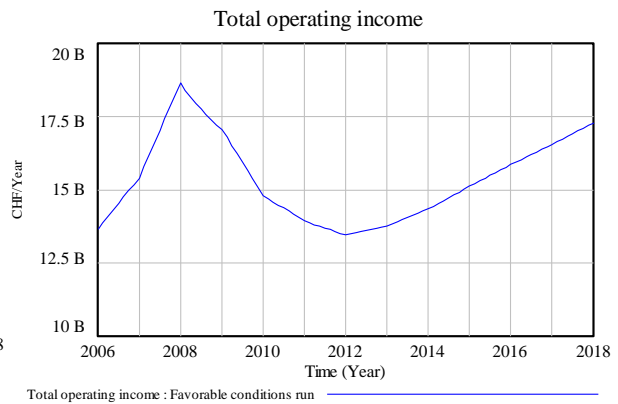
**G 1: Off-shore declared and undeclared AuM under favorable performance and currency conditions**



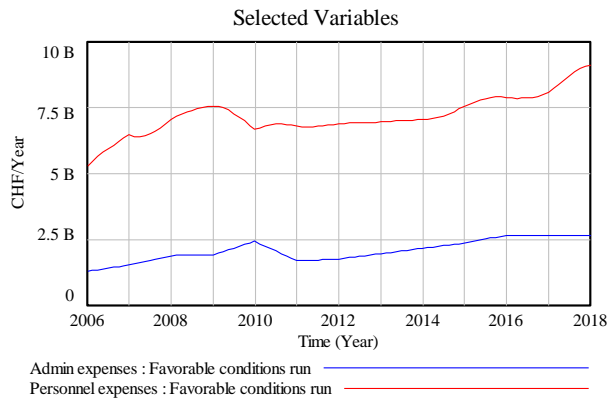
**G 2: Total AuM under favorable performance and currency effect conditions**



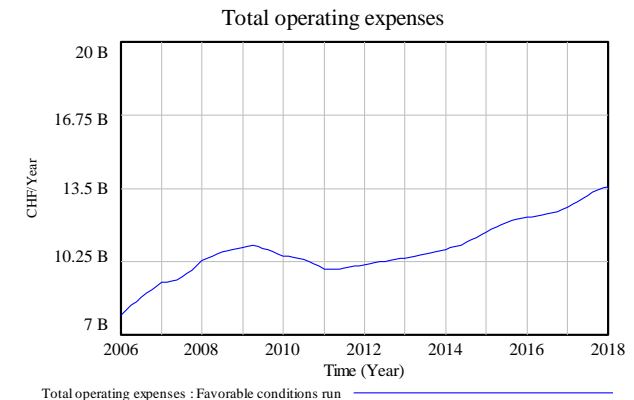
**G 3: Fee and commission and trading and interest income under favorable performance and currency conditions**



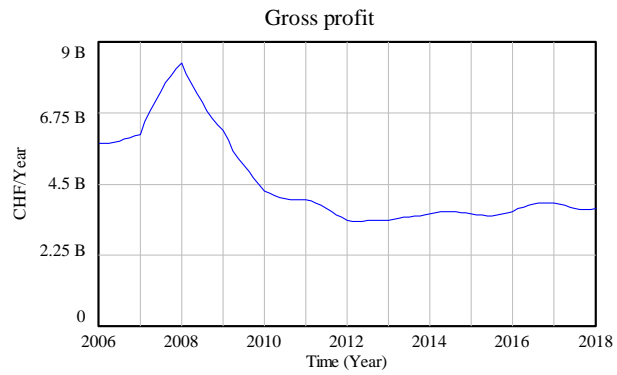
**G 5: Total operating income and unfavorable performance and currency conditions**



**G 6: Administrative and personnel expenses under favorable performance and currency effect conditions**

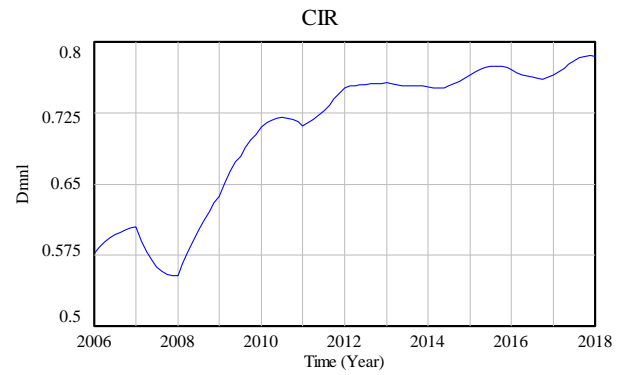


**G 4: Total operating expenses under favorable performance and currency effect conditions**



Gross profit : Favorable conditions run

**G 7: Gross profit under favorable performance and currency effect conditions**



CIR : Favorable conditions run

**G 8: CIR under favorable performance and currency effect conditions**

# Appendix J: Control panel

