



# Review of Business and Economics Studies

## *EDITOR-IN-CHIEF*

**Prof. Alexander Ilyinsky**  
Dean, International Finance Faculty,  
Financial University, Moscow, Russia  
ailyinsky@fa.ru

## *EXECUTIVE EDITOR*

**Dr. Alexander Kaffka**

## *EDITORIAL BOARD*

### **Dr. Mark Aleksanyan**

Adam Smith Business School,  
The Business School, University  
of Glasgow, UK

### **Prof. Edoardo Croci**

Research Director, IEFCE Centre for  
Research on Energy and Environmental  
Economics and Policy, Università  
Bocconi, Italy

### **Prof. Moorad Choudhry**

Dept. of Mathematical Sciences, Brunel  
University, UK

### **Prof. David Dickinson**

Department of Economics, Birmingham  
Business School, University of  
Birmingham, UK

### **Prof. Chien-Te Fan**

Institute of Law for Science and  
Technology, National Tsing Hua  
University, Taiwan

### **Prof. Wing M. Fok**

Director, Asia Business Studies, College  
of Business, Loyola University New  
Orleans, USA

### **Prof. Konstantin P. Gluschenko**

Faculty of Economics, Novosibirsk State  
University, Russia

### **Prof. George E. Halkos**

Associate Editor in Environment and  
Development Economics, Cambridge  
University Press; Director of Operations  
Research Laboratory, University of  
Thessaly, Greece

### **Dr. Christopher A. Hartwell**

President, CASE - Center for Social and  
Economic Research, Warsaw, Poland

### **Prof. S. Jaimungal**

Associate Chair of Graduate  
Studies, Dept. Statistical Sciences  
& Mathematical Finance Program,  
University of Toronto, Canada

### **Prof. Bartłomiej Kaminski**

University of Maryland, USA;

Rzeszow University of Information  
Technology and Management,  
Poland

### **Prof. Vladimir Kvint**

Chair of Financial Strategy, Moscow  
School of Economics, Moscow State  
University, Russia

### **Prof. Alexander Melnikov**

Department of Mathematical and  
Statistical Sciences, University of  
Alberta, Canada

### **Prof. George Kleiner**

Deputy Director, Central Economics and  
Mathematics Institute, Russian Academy  
of Sciences, Russia

### **Prof. Kwok Kwong**

Director, Asian Pacific Business  
Institute, California State University, Los  
Angeles, USA

### **Prof. Dimitrios Mavarakis**

Director, Energy Policy and  
Development Centre, National and  
Kapodistrian University of Athens,  
Greece

### **Prof. Steve McGuire**

Director, Entrepreneurship Institute,  
California State University, Los Angeles,  
USA

### **Prof. Rustem Nureev**

Head of the Department of  
Macroeconomics, Financial University,  
Russia

### **Dr. Oleg V. Pavlov**

Associate Professor of Economics and  
System Dynamics, Department of Social  
Science and Policy Studies, Worcester  
Polytechnic Institute, USA

### **Prof. Boris Porfiriev**

Deputy Director, Institute of Economic  
Forecasting, Russian Academy of  
Sciences, Russia

### **Prof. Svetlozar T. Rachev**

Professor of Finance, College of  
Business, Stony Brook University, USA

### **Prof. Boris Rubtsov**

Chair of Financial Markets and  
Financial Engineering, Financial  
University, Russia

### **Dr. Minghao Shen**

Dean, Center for Cantonese Merchants  
Research, Guangdong University of  
Foreign Studies, China

### **Prof. Dmitry Sorokin**

Deputy Rector for Research, Financial  
University, Russia

### **Prof. Robert L. Tang**

Vice Chancellor for Academic, De La  
Salle College of Saint Benilde, Manila,  
The Philippines

### **Dr. Dimitrios Tsomocos**

Saïd Business School, Fellow in  
Management, University of Oxford;  
Senior Research Associate, Financial  
Markets Group, London School  
of Economics, UK

### **Prof. Sun Xiaoqin**

Dean, Graduate School of Business,  
Guangdong University of Foreign  
Studies, China

## *REVIEW OF BUSINESS AND ECONOMICS STUDIES*

(*ROBES*) is the quarterly peer-  
reviewed scholarly journal published  
by the Financial University under  
the Government of Russian  
Federation, Moscow. Journal's  
mission is to provide scientific  
perspective on wide range of topical  
economic and business subjects.

## *CONTACT INFORMATION*

Financial University  
Leningradskiy Av. 51 Building 3,  
125993 Moscow  
Russian Federation  
Telephone: +7(499) 943-95-23  
Website: [www.rob.es/fa.ru](http://www.rob.es/fa.ru)

## *AUTHOR INQUIRIES*

Inquiries relating to the  
submission of articles can be sent  
by electronic mail to [rob.es@fa.ru](mailto:rob.es@fa.ru).

## *COPYRIGHT AND PHOTOCOPYING*

© 2014 Review of Business and  
Economics Studies. All rights  
reserved. No part of this publication  
may be reproduced, stored  
or transmitted in any form or by any  
means without the prior permission  
in writing from the copyright holder.  
Single photocopies of articles may  
be made for personal use as allowed  
by national copyright laws.  
ISSN 2308-944X



# Вестник исследований бизнеса и экономики

## ГЛАВНЫЙ РЕДАКТОР

**А.И. Ильинский**, профессор, декан  
Международного финансового фа-  
культета Финансового университета

## ВЫПУСКАЮЩИЙ РЕДАКТОР

**А.В. Каффа**

## РЕДАКЦИОННЫЙ СОВЕТ

**М. М. Алексанян**, профессор Бизнес-  
школы им. Адама Смита, Университет  
Глазго (Великобритания)

**К. Вонг**, профессор, директор Инсти-  
тута азиатско-тихоокеанского бизнеса  
Университета штата Калифорния,  
Лос-Анджелес (США)

**К. П. Глуценко**, профессор Экономи-  
ческого факультета Новосибирского  
государственного университета

**С. Джеимангал**, профессор Депар-  
тамента статистики и математиче-  
ских финансов Университета Торонто  
(Канада)

**Д. Дикинсон**, профессор Департамен-  
та экономики Бирмингемской бизнес-  
школы, Бирмингемский университет  
(Великобритания)

**Б. Каминский**, профессор,  
Мэрилендский университет (США);  
Университет информационных  
технологий и менеджмента в Жешове  
(Польша)

**В. Л. Квинт**, заведующий кафедрой  
финансовой стратегии Московской  
школы экономики МГУ, профессор  
Школы бизнеса Лассальского универ-  
ситета (США)

**Г. Б. Клейнер**, профессор, член-кор-  
респондент РАН, заместитель дирек-  
тора Центрального экономико-мате-  
матического института РАН

**Э. Крочи**, профессор, директор по  
научной работе Центра исследований  
в области энергетики и экономики  
окружающей среды Университета  
Боккони (Италия)

**Д. Мавракис**, профессор,  
директор Центра политики  
и развития энергетики  
Национального университета  
Афин (Греция)

**С. Макгвайр**, профессор, дирек-  
тор Института предпринимательства  
Университета штата Калифорния,  
Лос-Анджелес (США)

**А. Мельников**, профессор  
Департамента математических  
и статистических исследований  
Университета провинции Альберта  
(Канада)

**Р. М. Нуреев**, профессор, заведую-  
щий кафедрой “Макроэкономика”  
Финансового университета

**О. В. Павлов**, профессор  
Департамента политологии  
и политических исследований  
Ворчестерского политехнического  
института (США)

**Б. Н. Порфирьев**, профессор,  
член-корреспондент РАН, заме-  
ститель директора Института  
народнохозяйственного прогнози-  
рования РАН

**С. Рачев**, профессор Бизнес-кол-  
леджа Университета Стони Брук  
(США)

**Б. Б. Рубцов**, профессор, заведую-  
щий кафедрой “Финансовые рынки  
и финансовый инжиниринг” Финан-  
сового университета

**Д. Е. Сорокин**, профессор, член-  
корреспондент РАН, проректор  
Финансового университета  
по научной работе

**Р. Тан**, профессор, проректор  
Колледжа Де Ла Саль Св. Бенильды  
(Филиппины)

**Д. Тсомокос**, Оксфордский универ-  
ситет, старший научный сотрудник  
Лондонской школы экономики (Ве-  
ликобритания)

**Ч. Т. Фан**, профессор, Институт  
права в области науки и технологии,  
национальный университет Цин Хуа  
(Тайвань)

**В. Фок**, профессор, директор по  
исследованиям азиатского бизнеса  
Бизнес-колледжа Университета Лой-  
ола (США)

**Д. Е. Халкос**, профессор, Универси-  
тет Фессалии (Греция)

**К. А. Хартвелл**, президент Центра  
социальных и экономических иссле-  
дований CASE (Польша)

**М. Чудри**, профессор, Университет  
Брунеля (Великобритания)

**Сун Цяокин**, профессор, декан Выс-  
шей школы бизнеса Гуандунского  
университета зарубежных исследова-  
ний (КНР)

**М. Шен**, декан Центра кантонских  
рыночных исследований Гуандунско-  
го университета (КНР)

Издательство Финансового  
университета  
125993, Москва, ГСП-3,  
Ленинградский проспект, 51,  
корп. 3, к. 104.  
Тел. 8 (499) 943-95-23.  
Интернет: [www.robess.fu.ru](http://www.robess.fu.ru).

Журнал “Review of Business and  
Economics Studies” (“Вестник  
исследований бизнеса и эко-  
номики”) зарегистрирован  
в Федеральной службе по над-  
зору в сфере связи, информаци-  
онных технологий и массовых  
коммуникаций 9 июля 2013 г.  
Свидетельство о регистрации  
ПИ № ФС77-54658.

Подписано в печать: 25.12.2014.  
Формат 60 × 84 1/8.  
Заказ № 713 от 26.12.2014.  
Отпечатано в ООП Издательства  
Финансового университета  
(Ленинградский проспект, д. 49).  
16+



# Review of Business and Economics Studies

Volume 2, Number 4, 2014

## CONTENTS

<b>Post Reunification Economic Fluctuations in Germany: A Real Business Cycle Interpretation</b>	
<i>Michael A. Flor</i> .....	5
<b>The Informal Economy and the Constraints That It Imposes On Pension Contributions in Latin America</b>	
<i>David Tuesta Cárdenas</i> .....	18
<b>Study of Informational Requirements to Identify Reputational Risks</b>	
<i>Taisiya Iznova</i> .....	51
<b>Stakeholder Approach to Identification and Analysis of Value Creation Drivers</b>	
<i>Olga Efimova</i> .....	62
<b>National Intellectual Capital (NIC) – New Metrics</b>	
<i>Piotr Wiśniewski, Anna Wildowicz-Giegiel</i> .....	71
<b>Key Insurers Indicators in the Reports of Insurance Companies: Russian and Italian Experience</b>	
<i>Nadezda Kirillova, Andrea Bellucci</i> .....	80
<b>Default Risk and Its Effect for a Bond Required Yield and Volatility</b>	
<i>Pavel Zhukov</i> .....	87



# Вестник исследований бизнеса и экономики

№ 4, 2014

## СОДЕРЖАНИЕ

- Флуктуации германской экономики после воссоединения с точки зрения теории реального цикла деловой активности**  
*Михаэль А. Флор* .....5
- Теневая экономика и пенсионные взносы: опыт стран Латинской Америки**  
*Давид Туэста Карденас* .....18
- Исследование информационных требований в целях идентификации репутационных рисков**  
*Таусия Изнова* .....51
- Стейкхолдерский подход к выявлению и анализу факторов создания стоимости**  
*Ольга Ефимова, Вероника Самохина* .....62
- Новые параметры измерения национального интеллектуального капитала**  
*Петр Вишневецкий, Анна Вилдович-Гегел* .....71
- Основные показатели финансового состояния в отчетах страховых компаний: российский и итальянский опыт**  
*Надежда Кириллова, Андреа Беллуччи* .....80
- Риск дефолта и его влияние на требуемую доходность облигаций и волатильность**  
*Павел Жуков* .....87

# Post Reunification Economic Fluctuations in Germany: A Real Business Cycle Interpretation\*

Michael A. FLOR

University of Augsburg, Department of Economics, Germany  
michael.flor@wiwi.uni-augsburg.de

**Abstract.** We consider the cyclical properties of the German economy prior and after reunification in 1990 from the perspective of a real business cycle model. The model provides the framework for the selection and consistent measurement of the variables whose time series properties characterize the cycle. Simulations of the calibrated model reveal the model's potential to interpret the data. Major findings are that: *i*) the volatility of most aggregate time series has not changed significantly between the two time periods, *ii*) despite many conceptual differences between the European and the U.S. accounting systems, the calibrated parameter values for the German economy are within the range of values usually employed in the real business cycle literature, *iii*) the model is closer to the data for the time period prior to reunification.

**Аннотация.** В статье рассматривается цикличность германской экономики до и после воссоединения 1990 года с точки зрения модели реального цикла деловой активности. Модель обеспечивает рамки для выбора и последовательного измерения переменных, характеризующих цикл. Использование калиброванной модели раскрывает ее потенциал для интерпретации данных. Основные выводы заключаются в следующем: *i*) неустойчивость большинства статистических временных рядов существенно не изменилось по сравнению с периодом до воссоединения, *ii*) Несмотря на многие концептуальные различия между европейской и американской системами бухгалтерской отчетности, калиброванные значения параметров немецкой экономики находятся в диапазоне значений, которые обычно используются в литературе по реальному циклу деловой активности, *iii*) модель ближе к данным периода до воссоединения.

**Key words:** Macroeconomic data, measurement and data on national income and product accounts, economic fluctuations, real business cycles.

## 1. INTRODUCTION AND MOTIVATION

Since the seminal papers of Kydland and Prescott (1982), Long and Plosser (1983), and Prescott (1986), among others, it has become standard praxis to consider business cycles (BC's) within the framework of dynamic stochastic general equilibrium (DSGE) models. This class of models shares the basic ingredients of the first-generation models, namely intertemporal optimization and rational expectations, but also allows for many frictions as, e.g., real or nominal price stickiness, limited participation in financial markets, or obstacles in the allocation of labor.<sup>1</sup> Recent models, e.g. the model of Smets and Wouters (2003), a replacement of the Area Wide Model (AWM)

of the European Central Bank (ECB), can replicate NK effects in the short-run (determined by aggregate demand) and neoclassical effects in the long-run (determined by aggregate supply). Medium scale DSGE models are useful for economic policy evaluation. Their increased complexity vis-a-vis the first-generation models, however, makes them less suited for studying elementary driving forces of the BC. However, as has been widely documented in the empirical literature, the stylized facts of the BC have remained relatively stable over time and region.<sup>2</sup> This suggests that elementary economic mechanisms shape the cycle more than many institutional details. For this reason we will employ a first-generation real business cycle (RBC) model to organize ideas about eco-

<sup>1</sup> Such models are known as New Keynesian (NK) models, which were widely established by Mankiw (1989), Mankiw and Romer (1991), as well as Cho and Cooley (1995), among others.

<sup>2</sup> See for instance Cooley and Prescott (1995), pp. 29–33, for a description of the U.S. BC facts.

\* Флуктуации германской экономики после воссоединения с точки зрения теории реального цикла деловой активности.

economic fluctuations prior and after the territorial status of the Federal Republic of Germany of October 03, 1990, where the entire considered time period covers the first quarter of 1970 until the last quarter of 2012.

The motivation is twofold. First, we want to ask whether the nature of the German BC has changed. As a reference we take the West German economy, West Berlin included, over the period 1970: I-1991: IV. The split of the period 1970: I-2012: IV into two subsamples is not only marked by the German reunification but also by a major change in the German National Income and Product Accounts (GNIPA). As a data base we employ data provided by the German Federal Statistical Office (GFSO), which rests on the European System of Accounts (ESA). Only recently the GFSO finished the revision of data prior to 1991 on the occasion of the great revision in 2005, so that a set of comparable data is available.<sup>3</sup> The second motivation is to explore to what extent the new GNIPA data allows to consistently calibrate an RBC model that can be used to interpret the data. This endeavor is similar to the work of Cooley and Prescott (1995) and Gomme and Rupert (2007) for the U.S. economy. There are, however, conceptual differences between the NIPA System in the U.S. and in Europe that necessitate deviations from the work of these authors. As a result of this work, we have gathered a data base suitable for calibrating DSGE models to German data.<sup>4</sup>

The main findings are: *i*) with respect to the volatility of major macroeconomic aggregates the BC has not changed significantly,<sup>5</sup> *ii*) despite several differences in data and methodology we find parameter values within the range of those estimated for the U.S. economy, and *iii*) taking into account the uncertainty in the estimated second moments, the model is closer to the data for the period 1970: I-1991: IV.

The next section describes the theoretical model. This model provides the framework for the selection and definition of variables employed to calibrate the model and to characterize the BC in section 3. Section 4 provides the results, and section 5 concludes.

## 2. THEORETICAL FRAMEWORK

As a framework for (1) the selection of data that characterize the BC, (2) the consistent calibration, and (3) the interpretation of the empirical findings we employ the RBC model of Heer and Maußner (2009), chapter 1.5. This model abstracts from population growth, but is oth-

erwise similar to the model of Cooley and Prescott (1995). Thus, we exclude home production and investment-specific shocks as in Gomme and Rupert (2007), because these authors already argue on p. 489 that “removing home production from the model has little effect on the model’s predicted business cycle moments” and because their results indicate that adding such an investment-specific shock only leads to more volatility of almost every considered macroeconomic series and brings the model more at odds with the real data.

The economy is populated by a representative firm and a representative household. Time  $t$  is discrete.

**The Firm.** A representative firm produces output,  $Y_t$ , according to the constant returns to scale production function

$$Y_t = Z_t F(A_t N_t, K_t), \quad (2.1)$$

where the firm employs labor and capital services,  $N_t$  and  $K_t$ . Total factor productivity (TFP),  $Z_t$ , is governed by the covariance-stationary, stochastic process

$$\ln Z_t = \rho \ln Z_{t-1} + \sigma \varepsilon_t, \quad \varepsilon_t \sim \mathcal{N}(0,1), \rho \in (0,1). \quad (2.2)$$

Labor augmenting technical progress,  $A_t$ , grows deterministically at the gross rate  $a \geq 1$ :

$$A_{t+1} = a A_t. \quad (2.3)$$

The firm takes the real wage,  $W_t$ , and the rental rate of capital,  $r_t$ , as given and maximizes its current-period profits

$$\Pi_t = Y_t - W_t N_t - r_t K_t. \quad (2.4)$$

This provides two conditions that will hold in the equilibrium of the labor market and the market for capital services:<sup>6</sup>

$$\frac{W_t}{A_t} = Z_t F_N(A_t N_t, K_t), \quad (2.5a)$$

$$r_t = Z_t F_K(A_t N_t, K_t). \quad (2.5b)$$

**The Household.** A representative household supplies labor and capital services to the firm, consumes, and accumulates capital. Capital depreciates at a rate  $\delta \in (0,1]$ , so that

<sup>3</sup> See Braakmann *et al.* (2005) and also the Subject-matter series 18, S.27. For the comparability of time series between the period 1970–1991 and 1991–2004, see also R ath *et al.* (2006).

<sup>4</sup> An Excel sheet with the regarding pre-adjusted time series is available upon request.

<sup>5</sup> As it is also reported by Buch *et al.* (2004).

<sup>6</sup> We denote the partial derivatives of a function  $F$  with respect to its argument  $x \in \{N, K\}$  by a subscript.

$$K_{t+1} = (1 - \delta)K_t + I_t \quad (2.6)$$

is the law of motion of the capital stock, where  $I_t$

denotes gross fixed investments. The household's period-to-period budget constraint, thus, reads:

$$W_t N_t + r_t K_t \geq C_t + I_t. \quad (2.7)$$

The household values consumption,  $C_t$ , and leisure,  $1 - N_t$ , according to the current-period utility function  $u(C_t, 1 - N_t)$ . This function is strictly increasing in consumption and leisure and strictly concave. The household discounts future utility  $t + s$  at the rate  $\beta^s$ ,  $\beta \in (0, 1)$ , and maximizes his expected life-time utility

$$U_t = \mathbb{E}_t \sum_{s=0}^{\infty} \beta^s u(C_{t+s}, 1 - N_{t+s}),$$

subject to the budget constraint (2.7) and a given stock of capital,  $K_t \geq 0$ . Expectations,  $\mathbb{E}_t$ , are conditional on information available at time  $t$ .<sup>7</sup>

In addition to the budget constraint, which holds at equality in equilibrium, and the law of motion of the capital stock two further equations characterize the household's optimal plan:<sup>8</sup>

$$W_t = \frac{u_{1-N}(C_t, 1 - N_t)}{u_C(C_t, 1 - N_t)}, \quad (2.8a)$$

$$\begin{aligned} u_C(C_t, 1 - N_t) &= \\ &= \beta \mathbb{E}_t u_C(C_{t+1}, 1 - N_{t+1})(1 - \delta_t + r_{t+1}). \end{aligned} \quad (2.8b)$$

The first condition determines the household's labor supply. It equates the real wage to the marginal rate of substitution between leisure and consumption. The second condition is the Euler equation for capital accumulation. It equates the disutility from savings with the discounted expected future reward.

**Equilibrium.** In equilibrium factor markets clear so that the household's budget constraint reduces to

$$Y_t = C_t + I_t. \quad (2.9)$$

Equations (2.1), (2.5), (2.6), (2.8a), (2.8b), (2.9), and (2.2) fully describe the dynamics of the model. Due to (2.3) the economy will grow over time and exhibit fluctuations around its balanced-growth path which are driven by the covariance-stationary shocks to TFP,  $Z_t$ .

**Parameterization.** Except for a few special cases, DSGE models as the one presented in the previous

paragraphs do not have an analytical solution. The rules describing the household's choice of consumption and leisure must be approximated with the help of numerical methods. Among the most popular methods are perturbation methods that yield a polynomial approximation at the stationary solution of the non-stochastic version of the model. To apply these methods the researcher must specify the functional form of the production function  $F$  and the utility function  $u$  and transform the model to a stationary one.

On the firms side we follow Heer and Maufßner (2009) as well as Cooley and Prescott (1995) and employ a Cobb-Douglas production function

$$F(A_t N_t, K_t) = (A_t N_t)^{1-\alpha} K_t^\alpha, \quad \alpha \in (0, 1) \quad (2.10)$$

with capital share parameter  $\alpha$ .

Since the model depicts a growing economy, the household's preferences must be chosen so that conditions (2.8) are consistent with a constant supply of hours and a constant growth rate of consumption. The function

$$\begin{aligned} u(C_t, 1 - N_t) &= \frac{1}{1-\eta} [C_t^{1-\eta} (1 - N_t)^{\eta(1-\eta)} - 1], \\ \eta &> \frac{\theta}{1+\theta} \end{aligned} \quad (2.11)$$

has this property and is strictly concave in consumption and leisure, as mentioned before. The parameter  $\eta$  equals the coefficient of relative risk aversion and its inverse is the elasticity of intertemporal substitution.  $\theta$  is the share parameter for leisure in the composite commodity.

Given these parameterizations it is easy to see that scaling all growing variables by the level of labor augmenting technical progress,  $A_t$ , transforms the model to a stationary one. We will use lower case letters to refer to these scaled variables.

**Stationary Solution.** The stationary solution of the non-stochastic model can be computed in the following steps: (1) set  $Z_t \equiv 1 \forall t$ . This is the long-run value of  $Z_t$  implied by the process (2.2) if  $\sigma = 0$ . (2) scale growing variables by  $A_t$ . (3) assume that the dynamics has ceased so that  $x_{t+1} = x_t = x$  for all variables of the model.

Applying this procedure to equations (2.1), (2.5), (2.6), (2.8a), (2.8b), and (2.9) yields the following equations:

$$\frac{y}{k} = \frac{a^n - \beta(1 - \delta)}{\alpha \beta}, \quad (2.12a)$$

$$y = N^{1-\alpha} k^\alpha, \quad (2.12b)$$

$$y = c + i, \quad (2.12c)$$

<sup>7</sup> For this, see also Maufßner (2013b), pp. 59–60.

<sup>8</sup> We denote the partial derivatives of a function  $u$  with respect to its argument  $x \in \{C, 1 - N\}$  by a subscript.

$$\theta \frac{c}{y} = (1 - \alpha) \frac{1 - N}{N}. \quad (2.12d)$$

Equation (2.12a) follows from equation (2.5b) and the Euler condition (2.8b). Equation (2.12b) is the production function for  $Z \equiv 1$ , written in stationary variables  $y = Y / A$  and  $k = K / A$ . Equation (2.12c) is the resource constraint (2.9), also written in stationary variables  $c = C / A$  and  $i = I / A$ . And equation (2.12d) follows from (2.5a) and the labor supply condition (2.8a). We will return to these equations when we discuss the results from the calibration procedure for the simulation of the model in subsection 4.1.

### 3 EMPIRICAL FRAMEWORK

#### 3.1 TREND AND CYCLE

The model laid out in the previous section predicts the short- and long-run behavior of the observable variables

- output  $Y$ ,
- consumption  $C$ ,
- investments  $I$ ,
- hours  $N$ , and
- real wage  $W$ .

We will use this set of variables to characterize the BC.

**Seasonal Adjustment.** Quarterly economic data contains a seasonal and a calendar component, which are not explained by the model. Thus, the researcher must use seasonal- and calendar-adjusted time series. The GFSO employs an indirect approach to remove the seasonal and calendar component from a time series. It computes seasonal- and calendar-adjusted aggregates as the sum of seasonal- and calendar-adjusted subaggregates.<sup>9</sup> For the adjustment either the Berlin Method (currently Version 4.1) or the Census X-12-ARIMA method is employed.<sup>10</sup> Since more time series adjusted with the latter method are available, we will use the Census X-12-ARIMA method throughout.

**Trend Removal.** To achieve stationarity of the time series, its trend must be removed. To isolate the cyclical component in a time series, the popular filter by Hodrick and Prescott (1997), the HP-Filter, is used.<sup>11</sup> In detail, detrending occurs by filtering the log of the time series. For quarterly data it is customary to choose the smoothing parameter by  $\lambda = 1600$ , because of the normally as-

sumed BC fluctuation frequencies from about three to five years.<sup>12</sup>

**Second Moments.** A standard tool to evaluate DSGE models is to compare the second moments of simulated time series with those of the respective macroeconomic aggregates. Therefore the set of the following second moments of the variables introduced above will be used to uncover the properties of the RBC model and to characterize the cycle:

- standard deviation,
- standard deviation relative to standard deviation of output,
- cross-correlation with output,
- cross-correlation with hours, and
- first-order autocorrelation.

#### 3.2 PRICE ADJUSTMENT

The variables output, consumption, investments, and the real wage are measured in units of the final good. The data collected in the GNIPA is based on nominal aggregates and need to be deflated by some measure of the price level. Before the revision in 2005, real variables were defined with respect to the price system of a particular base year. The advantage of this concept is that real magnitudes, such as consumption, investments, and net exports add up to GDP. The disadvantage is that changes in relative prices, which induce changes in the composition of subaggregates, cannot be taken into account. Thus, constant price aggregates are intertemporally not really comparable. Since 2005, the real time series of the GFSO are reported as chain indices, which include a kind of non-linearity and therefore face the problematic characteristic of non-additivity.<sup>13</sup> The deflators of the main aggregates, such as GDP, consumption expenditures, and gross investments, are meanwhile also constructed from chained indices, so that the real aggregates are intertemporally comparable, but the subaggregates do no longer add up without a residual. This residual is greater, the greater the relative prices have changed, and this effect is known as “substitution bias”.<sup>14</sup>

<sup>12</sup> See for instance Cooley and Prescott (1995), pp. 27–29.

<sup>13</sup> See Mayer (2001), Braakmann *et al.* (2005), and also the Subject-matter series 18, S.24. For a more sophisticated contemplation of the properties of chain indices and the possibilities for the computation of chained and unchained real aggregates, see the Appendix, which is available upon request. See also von der Lippe (2000) for critical comments on chain indices in general. And for a detailed dispute with U.S. chain aggregated NIPA data, see Whelan (2002).

<sup>14</sup> Between 1991 and 2004 the GDP residual (difference between the directly determined chained real GDP and the sum of the chained real GDP components) differ at most 0.4% in relation to real GDP, as Nierhaus (2005) mentions. Residuals arise naturally also in spatial units, such as between real GDP at the federal level and the accumulated GDP of the 16 states in Germany. For this, see Nierhaus (2001), Nierhaus (2004a), Nierhaus (2004b), and again

<sup>9</sup> For example, see the Subject-matter series 18, S.23 and especially for the time period 1970 till 1991 the Subject-matter series 18, S.28

<sup>10</sup> See <https://www.destatis.de/DE/Methoden/Zeitreihen/Zeitreihenanalyse.html> for a detailed description and the regarding differences of these two methods. See also <http://www.census.gov/srd/www/x13as/> for the X-13ARIMA-SEATS Seasonal Adjustment Program, which is the successor of the Census X-12-ARIMA.

<sup>11</sup> For different methods concerning detrending in general and their different implications on the considered time series, see Canova (1998).

To tackle the problem of structural inconsistency of the computable chained real aggregates in a certain frame, we follow Gomme and Rupert (2007) in line with Greenwood *et al.* (1997). The former authors mention on p. 484 that “a common price deflator should be used when converting nominal NIPA data into real terms and that a natural choice is the price deflator for non-durable goods and nonhousing services”, and designate their weighted average deflator out of the two just mentioned price deflators simply as the consumption deflator. Greenwood *et al.* (1997), pp. 347–348, mention that such a choice is natural because they want “to avoid the issue of the accounting for quality improvement in consumer durables”. In our context such a weighted price index (PI) corresponds with the consumer PI (CPI) for Germany, since this is also the average price development of all goods and services purchased by households for consumption by purpose.<sup>15</sup> But since the above described model framework and the data pre-adjustments for a consistent measurement also include the net exports, the GDP-deflator is the corresponding or rather adequate PI, following Reich (2003) and Balk and Reich (2008) as well, who argue that a GDP-deflator should be used because this implies a measure of inflation and growth. Therefore all four nominal main aggregates will be deflated by one common PI, which is the GDP-deflator, to guarantee a data and model consistent fashion. Since the chain indices for the subsample 1991: I till 2012: IV are reported with the reference year 2005, where the average of this year is set to 100, first there has to be made a rebasing to the year 1991, to achieve that the two subsamples are comparable.<sup>16</sup>

### 3.3 CONSISTENT MEASUREMENT

**Definitions and Constructions.** Given that the data availability in Germany is different to the data availability in the U.S.,<sup>17</sup> the following considerations focus on the German case.<sup>18</sup>

Nierhaus (2005). Gomme and Rupert (2007) also mention that already in the late 1990s the U.S. BEA pointed out that it is not appropriate to add real magnitudes. For this, see also Braakmann *et al.* (2005), and R ath *et al.* (2006). There are also difficulties with values reached by balances, as net exports or inventory investments, if they are zero. See, among others, Nierhaus (2005), Nierhaus (2007), and T odter (2005)

<sup>15</sup> This price deflator is also available over the entire period, however, the PI, which refers to the former Federal Territory of Germany, is reported as the PI for living of all households.

<sup>16</sup> Note, that for the second subperiod hedonic PI's are used, which also include a quality aspect.

<sup>17</sup> For example, GDP is reported in the GNIPA within the production and the use approach, but not within the distribution approach, because of missing data. This is in contrast to the reported GDP in the U.S.

<sup>18</sup> See the Appendix for a more detailed description of the following steps, wherein all computations are made with the nominal magnitudes. Note, that for convenience the time subscripts are repressed.

Starting from the use approach perspective of the new GNIPA data and keeping in mind that the theoretical framework does not distinguish between government and private consumption ( $C_{gov}$  and  $C_{pr}$ ) as well as investments, the private consumption expenditures in the data can be decomposed into long-lived durables, short-lived durables, non-durables, and services.<sup>19</sup> Only long-lived durables are included as  $I_{prdur}$  in the composite gross fixed investments,  $I$ , since these can be regarded as a kind of investment goods. For total consumption,  $C$ , therefore follows:

$$C = C_{gov} + C_{pr} - I_{prdur},$$

which is consistent in the model context.

Cooley and Prescott (1995), p. 38, argue that when “there is no foreign sector in this economy, net exports are viewed as representing additions to or claims on the domestic capital stock, depending on whether they are positive or negative”. We follow this argumentation and add the whole net exports as  $I_{NE}$  to the total gross investments,  $I$ , which also include government and private gross fixed capital formation or rather gross fixed investments ( $GI_{gov}$  and  $GI_{pr}$ ) as well as changes in inventories ( $CI_{gov}$  and  $CI_{pr}$ ). Thus  $I$  can be written as:

$$\begin{aligned} I &= GI_{gov} + GI_{pr} + CI_{gov} + CI_{pr} + I_{prdur} + I_{NE} = \\ &= GI + I_{prdur} + I_{NE} \end{aligned}$$

Therefore output reads:<sup>20</sup>

$$Y = C + I,$$

where  $Y$  stands consistently for GDP in data, which is valued at market prices.<sup>21</sup> But since the model framework assumes  $Y$  at factor prices,  $Y$  has to be adjusted in the sense of a subtraction of net taxes to get a valued GDP at factor prices. Then  $Y$  is consistent to the model.

The labor measure,  $N$ , is calculated as the average quarterly fraction of total hours worked and the real wage,  $W$ , is calculated as the nominal wage divided by the GDP-deflator.<sup>22</sup>

For the construction of a quarterly composite capital stock time series, the annual net fixed capital plus the

<sup>19</sup> It should also be mentioned that the time series of consumption expenditures used here also include home-based services. See Braakmann *et al.* (2005) and Burghardt (2006).

<sup>20</sup> This is also the resource constraint for the whole economy (2.9).

<sup>21</sup> In this paper the conceptually appropriate measure of output is GDP rather than GNP, also because of deflation problems. See Br ummerhoff and L utzel (2002), pp. 59 f. and 62 f. For this, see also Gomme and Rupert (2007).

<sup>22</sup> With this PI the main focus is on firms perspective, unlike the PI for final domestic use or the CPI, where the main focus is on households perspective. See the Appendix for a description of the different calculation opportunities of PI's in the GNIPA.

annual net stock of durable goods of the households can be combined with the calculated quarterly total gross investments with the “Perpetual Inventory Method” (PIM) to obtain such an adequate capital stock measurement.<sup>23</sup> For this purpose an interpolation method is conceivable: Let  $K_t$  denote the capital stock in year  $t$ . The GFSO provides capital stock data for each year and data on gross investments,  $I_{tq}$ , for each year and quarter. Therefore, we can interpolate between two years,  $t$  and  $t+1$ , in the following way:

$$K_{t+1} = I_{t4} + (1 - \delta_t)I_{t3} + (1 - \delta_t)^2 I_{t2} + (1 - \delta_t)^3 I_{t1} + (1 - \delta_t)^4 K_t$$

The variable  $\delta_t$  is the implicit rate of depreciation of the capital stock in the year  $t$ . Given  $K_{t+1}, K_t, I_{tq}, q = 1, 2, 3, 4$ , we can solve for the unique  $\delta_t \in (0, 1)$ . The time variant or rather variable quarterly depreciation rate,  $\delta_t$ , is the solution of this method to achieve that the capital stock at the end of period  $t$  is the same as the capital stock at the beginning of period  $t+1$ .<sup>24</sup> The average of this depreciation rate,  $\bar{\delta}$ , is used in subsection 4.1 for the calibration in each subsample.

Cooley and Prescott (1995) calibrate the Solow residual without fixed capital, arguing that the quarterly variations in the aggregate capital stock are approximately zero and so the omission of the capital stock has only little effect on the Solow residual at BC frequencies, which are typically between 6 and 32 quarters. They argue further in line with Prescott (1986) that any interpolation method for constructing a quarterly capital stock will be arbitrary and will bring some noise into the measures, because the capital stock series are only reported annually in the U.S. and in Germany. However it poses some difficulties as well to avoid the whole time series, also in consideration of the fact that the statistical offices, e.g. the GFSO, as well use extra- and interpolation methods for the construction of some time series.<sup>25</sup> For this argumentation, see also Gomme and Rupert (2007), who compute the Solow residual with and without a capital stock (aggregated as well as separated for market structures and equipment and software).<sup>26</sup> They find similar results of these three different methods, so that the parameter estimates of the Solow residual are not

<sup>23</sup> See also Heer and Maußner (2009), Gomme and Rupert (2007), and the Appendix for the construction of the capital stock. The latter also includes a briefly contemplation of the PIM used by the GFSO for the construction of the capital stock.

<sup>24</sup> An advantage of such a depreciation rate is that it is delimited equal as the composite capital stock and the total gross fixed investments.

<sup>25</sup> E.g. durables in the period 1970: I-1991: IV. See for instance R ath et al. (2006).

<sup>26</sup> They derive a quarterly series of the capital stock with a method based on Greenwood et al. (1997), who derived admittedly annual capital stocks.

too sensitive between these different calculations. We further compute the Solow residual without a capital stock and with a composite capital stock, where net fixed assets and the net stock of household durables are included, so that the Solow residuals can be computed as

$$z_{t1} = \frac{y_t}{eh_t^{1-\alpha}} \text{ and } z_{t2} = \frac{y_t}{eh_t^{1-\alpha} k_{t1}^\alpha}, \text{ where } eh_t \text{ denotes effi-}$$

cient working hours. The deviations from balanced

growth are therefore  $\hat{z}_{t1} = \frac{z_{t1} - \bar{z}_{t1}}{\bar{z}_{t1}}$  and  $\hat{z}_{t2} = \frac{z_{t2} - \bar{z}_{t2}}{\bar{z}_{t2}}$ , respectively.

**Used Variables.** The following list crudely enumerates the used variables for the pre and post reunification in the periods 1970: I-1991: IV and 1991: I-2012: IV:

1. Output measure  $Y_t$ : GDP at factor prices
2. Consumption measure  $C_t$ : Private and public consumption of non-durables
3. Investment measure  $I_t$ :
  - i. Private and public gross fixed investments
  - ii. Private and public gross fixed investments plus changes in inventories plus private consumption of consumer durables plus net exports<sup>27</sup>
4. Capital measure  $K_t$ : Private and public net fixed assets (structures, equipment, and inventories) plus net stock of consumer durables<sup>28</sup>
5. Labor measure  $N_t$ : Average quarterly fraction of total hours worked
6. Real wage measure  $W_t$ : Nominal wage divided by the GDP-deflator
7. Labor share  $1 - \alpha$ : Average mean over the sum of total real wage of the dependent employees plus a share of self-employed divided by the GDP at factor prices
8. TFP measure  $Z$ :
  - i. Based on labor variations only
  - ii. Based on labor and capital variations using the adequate capital measure

## 4. RESULTS

### 4.1. CALIBRATION

In consideration with the outlay of estimation methods and that in the “literature on intertemporally optimized models has shown a clear preference for calibrating rather than estimating parameters of interest”, as Favero (2001), p. 248, mentions, in this paper the decision falls also to classical or rather traditional calibration. Accordingly calibration simply means “to standardize as a measuring instrument”, as Cooley and Prescott (1995),

<sup>27</sup> As in Cooley and Prescott (1995).

<sup>28</sup> To that Cooley and Prescott (1995) also add land. They argue that this should as well integrated into the production function, but the data on the stock of land is inadequate and is omitted here.

**Table 4.1.** Calibration of the parameters for the GNIPA data set of the GFSO.

1970: I-1991: IV		1991: I-2012: IV	
Production	Preferences	Production	Preferences
$a = 1.006$	$\beta = 0.994$	$a = 1.003$	$\beta = 0.994$
$\alpha = 0.32$	$\eta = 2.0$	$\alpha = 0.34$	$\eta = 2.0$
$\delta = 0.015$	$N = 0.14$	$\delta = 0.017$	$N = 0.12$
$\rho_1 = 0.98$	$\theta = 5.80$	$\rho_1 = 0.97$	$\theta = 6.13$
$\rho_2 = 0.92$		$\rho_2 = 0.83$	
$\sigma_1 = 0.0089$		$\sigma_1 = 0.0086$	
$\sigma_2 = 0.0081$		$\sigma_2 = 0.0082$	

p. 22, or Cooley (1997), p. 58, argue, and this meaning applies to the idea behind calibration of the stochastic growth model considered here.<sup>29</sup> Table 4.1 reports the calibrated parameter values at the steady state equations (2.12a), (2.12b), (2.12c), and (2.12d) for the two different subsamples.<sup>30</sup>

For a comparison of these two subsamples one should hold in mind, that the territorial status is different in these two time periods. Accordingly it comes as no surprise that changes occur in all variables, apart from  $\eta$  and  $\beta$  which were set.<sup>31</sup> The time preference parameter  $\beta$  cannot be calculated by the steady state equations, because this violates the restriction  $\beta < 1$  in representative agent models. To simply bypass this problematic value, the time preference parameter is set to 0.994, as in Heer and Maußner (2009).<sup>32</sup>

Firstly, the growth rate ( $a - 1$ ) is inferred from fitting a linear trend to the log of GDP at factor prices per capita. It is a little bit lower for the new time period. This also emphasizes the observed reduction in the growth rate of GDP. These two derived values are in line with the values typically used in such models, see for example Cooley and Prescott (1995), who use  $a = 1.00156$ , or Gomme

and Rupert (2007), who use an average  $a$  of 1.005. Secondly, the capital income parameter  $\alpha$ , increased from 0.32 to 0.34 or inversely the labor income reduced from 0.68 to 0.66, which suggests a now more capital-intensive economy. In other words, the economy was more labor-intensive in the first time period. This argumentation also corresponds to the statement by Schmalwasser and Schidlowski (2006), who argue that production becomes more capital-intensive, because labor is increasingly replaced by capital and therefore the capital stock grows faster than production. These different values also suggest that a TFP shock affects the labor income share.<sup>33</sup> Further, related to the decline in the growth rates of investments and the capital stock over time, the degree of modernity of the capital stock is reduced.<sup>34</sup> For example, Cooley and Prescott (1995) calibrate the parameter  $\alpha$  as 0.40, which is greater than the usually used value of 0.40 by, e.g., Kydland and Prescott (1982), Hansen (1985), Prescott (1986) or Maußner (1994), because they included the imputed income of governmental capital. This suggests a more capital-intensive U.S. economy than the German economy. Gomme and Rupert (2007) calibrate the share of capital income as 0.283 and mention on p. 493 that their value “is toward the low end of values typically used in the “RBC/DSGE” literature”, such as the value in Heer and Maußner (2009). The values derived above are between these ranges. Furthermore, the U.S. NIPA data is more accurate for determining the income of the capital side, the GNIPA data is more accurate for determining the income of the labor supply side, because the data is very detailed, extensive, and more reliable, and so  $1 - \alpha$  is specified here, which equals the average wage share

<sup>29</sup> For a more detailed representation of the calibration methodology, see the Appendix.

<sup>30</sup> See Stock and Watson (1996) and Ireland (2004) for a discussion of parameter instability *per se*.

<sup>31</sup> Hall (1988) shows that a high value of  $\eta$  implies an insensitive consumption growth. For a survey of microeconomic estimates of the coefficient of relative risk aversion, see Mehra and Prescott (1985), who find, “that the bulk of the evidence places its value between 1 and 2”, as Gomme and Rupert (2007) on p. 487 mention. The value of 2 is an evidence for a greater consumption smoothing over the life cycle of the households and so this value is set to 2, as in Heer and Maußner (2009). Furthermore, a larger elasticity of the marginal utility of consumption “reduces the variability of output, working hours, and investments, and thus this choice provides a better match between the model and the respective German macroeconomic variables”, as Heer and Maußner (2009), p. 51, argue.

<sup>32</sup> Prescott (1986), Cooley and Prescott (1995), and Gomme and Rupert (2007) calculate this parameter as  $\beta = 0.99$ ,  $\beta = 0.987$ , and  $\beta = 0.9860$ , respectively, so that this value is toward the high end of values typically used in the literature considered here.

<sup>33</sup> For this, see Cantore *et al.* (2013), who examine *inter alia* this relationship within an RBC and a NK framework.

<sup>34</sup> This is the ratio of net to gross fixed assets, where this characteristic variable also provides information about the aging process of investment goods and indicates how much percentage of the assets are not impaired by wear or depreciated in value. See Schmalwasser and Schidlowski (2006).

in GDP at factor prices.<sup>35</sup> To that it should also be mentioned that this specification as well contemplates the governmental labor income, because the income time series include also public labor and so this approach is more or less identical to the approachy Cooley and Prescott (1995). Thirdly, the average quarterly depreciation rate,  $\delta$ , has also increased, which suggests a higher depreciation rate for, e.g., communication systems and personal computers. Cooley and Prescott (1995) choose the average depreciation rate as 0.048 yearly or 0.012 quarterly and argue that, if the economy does not explicitly include growth, these values must be larger in order to match the investment-output ratio. Furthermore, Gomme and Rupert (2007) compute an average depreciation rate of 0.0271 and so the above-derived values are also between these two ranges. The preference parameter  $\theta$  also increases, suggesting that the households now appreciate leisure more. The observed demographic change in Germany can be explained by the parameter  $N$ , which is slightly lower for the period 1991: I till 2012: IV, because the population as a whole grows older. So more people are on pension and no longer participate in the working life, which leads to a reduction of labor supply.<sup>36</sup>

The parameters of the shock in the period 1970: I-1991: IV with  $\rho_1 = 0.98$  and  $\sigma_1 = 0.0089$ , where only labor input is considered in the Solow residual, and  $\rho_2 = 0.92$  and  $\sigma_2 = 0.0081$ , where labor and capital input are integrated in the Solow residual, are more or less in line with the values normally taken in the literature. For example, Cooley and Prescott (1995) choose, among others, the value 0.95 and Gomme and Rupert (2007) choose the value 0.9641 for the persistence parameter  $\rho$ . For the volatility of the shock,  $\sigma$ , Cooley and Prescott (1995) take the value 0.007, Prescott (1986) chooses the value 0.00763, and Gomme and Rupert (2007), who also take consumer durables into account, choose the value 0.0082. This indicates that the derived values above are on the top of values typically used for this variable in this literature. Gomme and Rupert (2007) argue that the Solow residual is at best characterized by an autoregressive parameter of 0.9641 and a standard deviation of 0.0082, compared to more standard values of 0.95 and 0.00763, respectively. They further argue that their results are not sensitive, if no capital stock ( $\rho = 0.9697, \sigma = 0.0081$ ), one capital stock ( $\rho = 0.9643, \sigma = 0.0082$ ), or two capital stocks ( $\rho = 0.9641, \sigma = 0.0082$ ) is (are) included, but here this

is not the case, as well as the different values demonstrate. For both subsamples this difference is conspicuous for the autoregressive parameter  $\rho$ , which falls from 0.98 to 0.92 and from 0.97 to 0.83, if additionally the capital input is included into the Solow residual.<sup>37</sup> Also the volatility of the shock,  $\sigma$ , falls from 0.0089 to 0.0081 and from 0.0086 to 0.0082 in both subsamples, respectively. The finding that the shocks in the second subsample are smaller than in the first subsample emphasizes as well the argumentation by Buch *et al.* (2004), who find the same result for the period till 2001: IV with a counterfactual VAR analysis and call this phenomenon “good luck”. In this respect it should also be mentioned that  $\alpha$  does not account for a differentiation of these results in the shock process, the working hours also do not matter (only  $\sigma$  is a little bit higher), and only GDP and the capital stock do matter slightly. Also Cooley and Prescott (1995) mention that Prescott (1986) already argues that the volatility of the innovations might be affected by measurement errors in the measured labor input and taking these into account would actually very slightly increase the standard deviation of the innovations to technology, as just mentioned. However, just as Cooley and Prescott (1995) too, we choose to ignore it here and leave it for future research.

#### 4.2. PROPERTIES OF THE BUSINESS CYCLE

The following table displays the results from the computation of the real economy, where the variables are as defined and constructed in subsection 3.3.

A comparison between the two different subsamples reveals at first that the standard deviation of output is increased from 1.27 to 1.51 and the volatility of durables consumption is reduced by about a half. So it is apparent, on the one hand, that the decline of output volatility in Germany, as it is reported for the period 1970: I-2001: IV by Buch *et al.* (2004) as well, is not detected for the whole time period.<sup>38</sup> Thereto it should be mentioned that the reason is the financial crisis during the second subsample and thus, the output decline in Germany is only detected till 2008: IV, since both subsamples are compared with each other as point estimates as done in this paper solely. On the other hand, it is apparent that the reduction of durables volatility

<sup>35</sup> As in Heer and Maußner (2009). For this and the different calculation bases for GDP in Germany and the U.S., see again Schmalwasser and Schidlowski (2006) and further Schwarz (2008).

<sup>36</sup> For a recent analysis of changes in the age composition of the labor force and the connection to BC volatility in the G7 countries, see Jaimovich and Siu (2009) as well as Heer *et al.* (2013).

<sup>37</sup> In their model with all shocks, Gomme and Rupert (2007) set the autoregressive parameter  $\rho$  on durables technological change even to 0.9999.

<sup>38</sup> However it should be mentioned that Buch *et al.* (2004) use the Census X-11-ARIMA method for seasonal-adjusting and the HP-Filter with a smoothing parameter of 1000 for detrending, following Pedersen (2001). They argue on p. 454 that their “results were not affected”, since they choose a smoothing parameter of 1600, as done in this paper. Admittedly, it is not at all clear what the authors mean by “real GDP”, because they do not refer to how they achieve the price-adjusting at all.

**Table 4.2.** Estimated Second Moments for the GNIPA data set of the GFSO.

Variable	$s_X$	$s_X / s_Y$	$r_{XY}$	$r_{XH}$	$r_X$
<b>1970: I-1991: IV</b>					
Output	1.27 (0.21)	1.00	1.00	0.81 (0.11)	0.73
Durables Consumption	6.11 (0.42)	4.81	0.22 (0.12)	0.12 (0.08)	0.09
Non Durables Consumption	0.97 (0.13)	0.76	0.51 (0.14)	0.41 (0.20)	0.47
Gross Fixed Investments	4.12 (0.77)	3.24	0.72 (0.12)	0.75 (0.11)	0.70
Total Gross Fixed Investments	3.62 (0.63)	2.85	0.84 (0.07)	0.70 (0.14)	0.60
Hours	0.96 (0.23)	0.76	0.81 (0.11)	1.00	0.81
Real Wage	0.81 (0.09)	0.64	0.54 (0.15)	0.52 (0.12)	0.32
<b>1991: I-2012: IV</b>					
Output	1.51 (0.50)	1.00	1.00	0.72 (0.16)	0.81
Durables Consumption	3.28 (0.63)	2.17	0.17 (0.26)	0.16 (0.27)	0.27
Non Durables Consumption	0.77 (0.11)	0.51	0.45 (0.14)	0.41 (0.15)	0.58
Gross Fixed Investments	3.99 (0.79)	2.64	0.84 (0.07)	0.75 (0.10)	0.84
Total Gross Fixed Investments	4.35 (1.60)	2.88	0.93 (0.05)	0.69 (0.15)	0.82
Hours	0.93 (0.17)	0.62	0.72 (0.16)	1.00	0.66
Real Wage	0.79 (0.19)	0.52	0.28 (0.20)	0.20 (0.21)	0.72

**Notes:**  $s_X$  := standard deviation of HP-filtered time series  $X$ , where  $X$  stands for any variables from column 1.  $s_X / s_Y$  := standard deviation of variable  $X$  relative to standard deviation of output  $Y$ .  $r_{XY}$  := cross-correlation of variable  $X$  with output  $Y$ ,  $r_{XH}$  := cross-correlation of variable  $X$  with hours  $H$ ,  $r_X$  := first-order autocorrelation of variable  $X$ . Standard errors based on the quadratic spectral (QS) kernel with prewhitening in parantheses.

is presumably due to better financing opportunities for valuable consumption goods in the second subsample. Also the standard deviation of non-durables consumption decreased from 0.97 to 0.77. The standard deviations of gross fixed investments, total gross fixed investments, which includes all the magnitudes mentioned above, hours, and real wage have not changed significantly. The cross-correlations with output and with hours have overall fallen, apart from the gross fixed investments and the total gross fixed investments time series on the one hand and the durables consumption time series on the other hand. A reduction in the first-order autocorrelation is only discerned in the time series of hours and the respective increase of real wage is more than a half.

Table 4.3 displays a pairwise test of significance, where the used test statistic is a Wald test statistic, based on the procedure of Maußner (2013a) and displayed in

the first row.<sup>39</sup> The standard errors are based on the quadratic spectral (QS) kernel with prewhitening, as it was suggested, for example, by Ogaki (1993).<sup>40</sup> The respective marginal probability of the null hypothesis of no change in the estimated moments is presented in the second row.

On this occasion it is apparent that only the long-lived durables have changed with statistical significance, where all other time series remain unchanged, because the null hypothesis cannot be rejected at all usual levels of significance. With these considerations, one can conclude in this respect, that the nature of the German BC has not changed regarding the standard deviations of the considered magnitudes, except for durable goods.

<sup>39</sup> See Ogaki (1993) for some critical comments on the Wald test.

<sup>40</sup> For the properties and the automatic bandwidth estimators of the QS, Truncated, Bartlett, Parzen, and Tukey-Hanning kernel, see for example Andrews (1991) and further Andrews and Monahan (1992) for prewhitened kernel estimators.

**Table 4.3.** Test of Significance.

	sy1 sy2	scd1 scd2	sc1 sc2	sg1 sg2	sgi1 sgi2	sh1 sh2	sw1 sw2
Wald Statistic	0.142	20.279	0.108	0.039	1.331	0.003	0.001
p-value	0.706	0.000	0.742	0.844	0.249	0.958	0.970

**Notes:** Abbreviations: sx1 and sx2: standard deviation of variable  $x \in \{\text{Output, Durables Consumption, Non Durables Consumption, gross Fixed Investments, Total Gross Fixed Investments, Hours, Real Wage}\}$  in period 1970: I-1991: IV (1) and 1991: I-2012: IV (2), respectively.

### 4.3. DATA AND MODEL

**Model Implications.** Table 4.4 displays the findings from the simulation of the artificial benchmark model, where the calibration targets in Table 4.1 are used.<sup>41</sup> Of course, the number of observations is the same as the number of quarterly observations as are available for the German economy in the two considered time periods, which are both of the same length and include 88 quarters each.

Here it becomes apparent that both cross-correlations are almost identical, and the first time period displays slightly higher first-order autocorrelations. However, the cross-correlations are totally at odds compared with the cross-correlations of the real economy. The further comparison between the two subsamples reveals that the volatility of output increases slightly in the simulated model, where the second moments of the real economy show that the standard deviation highly increases between the two subsamples. However, the simulated standard deviation with 1.57 is strictly in line with the volatility of output in the real German economy with 1.51 in the second time period. As in the data for non-durables consumption, there is a reduction of the standard deviation of consumption in the artificial benchmark model. The volatility of gross fixed investments and real wage has also fallen slightly between these two subsamples in the model. But since Table 4.4 displays that the volatility of gross fixed investments falls, and Table 4.2 displays a rise in total gross fixed investments, this can only be explained by a slight decrease of gross fixed investments and mainly by a decrease of durables consumption, which falls from 6.11 to 3.28 as shown in Table 4.2.<sup>42</sup> This change of about a half, keeping in mind Table 4.3, is therefore significant as well. Also the volatilities of hours and real wage only show a small decrease from the period 1970: I-1991: IV to the period 1991: I-2012: IV for the real German economy. The simulated standard deviation of hours

behaves contrary to the data, because in the artificial economy the volatility increases from 0:78 to 0:91 and in the real economy the volatility decreases from 0:96 to 0:93. Though for this statement one should hold in mind the results in Table 4.3, where the changes of hours in the data are not significant. Apart from this, one explanation for this counterfactual result could be that there is less change in the number employed in data than in the artificial economy, which does not account for changes into and out of the labor market so that all variability in hours is not due to fluctuations in the number employed, but in hours worked.<sup>43</sup> The standard deviation of real wages decreases more strongly in the model than in the data, but this direction however is in line with the derived results above.

**Model Evaluation.** Since we now focus on the evaluation of the model in both time periods respectively, the structural break within the German reunification will not be explicitly contemplated.<sup>44</sup> In line with the suggestion of Krämer (2011), pp. 463–464, that it “should be standard practice” to test “whether the model that is entertained provides a proper approximation to the data”, the simulated model will be evaluated as follows.<sup>45</sup>

The straightforward measurement is the Euclidean distance, where the weighting matrix is the identity matrix. Since in this measurement there is no consideration of the respective standard errors, and taking into account the estimation errors, another weighting matrix should be used, because moments with small variance should be weighted more than moments with higher variance. One possibility to estimate such a weighting matrix is a general method of moments (GMM) approach, which uses only information contained in the first and second order moments of the

<sup>41</sup> Only the calibrated parameter values from the Solow residual with labor and capital input in subsection 4.1 are used here.

<sup>42</sup> However, one should hold in mind that the standard error of total gross fixed investments is 1.60 in the second subsample for the GNIPA data set of the GFSO.

<sup>43</sup> A more accurate mapping of the labor market in the model framework may explain these different results. For this, see also Hansen (1985) and Rogerson (1988).

<sup>44</sup> As also mentioned in the Appendix. Therefore there is no use of tests with a known break point, such as the popular Chow test, or with an unknown break point, such as the different CUSUM tests. For the latter, their extensions, and their asymptotic features, see for example Krämer et al. (1988) or Ploberger et al. (1989).

<sup>45</sup> Of course, for this purpose there exist manifold opportunities. See for instance the Appendix.

**Table 4.4.** Simulated Second Moments for the GNIPA data set of the GFSO.

Variable	$s_X$	$s_X / s_Y$	$r_{XY}$	$r_{XH}$	$r_X$
<b>1970: I-1991: IV</b>					
Output	1.53	1.00	1.00	0.99	0.66
Consumption	0.64	0.42	0.99	0.97	0.68
Gross Fixed Investments	5.09	3.32	1.00	1.00	0.66
Hours	0.78	0.51	0.99	1.00	0.66
Real Wage	0.76	0.50	0.99	0.98	0.68
<b>1991: I-2012: IV</b>					
Output	1.57	1.00	1.00	1.00	0.61
Consumption	0.55	0.35	0.99	0.97	0.63
Gross Fixed Investments	4.96	3.16	1.00	1.00	0.61
Hours	0.91	0.58	1.00	1.00	0.61
Real Wage	0.67	0.42	0.99	0.98	0.62

**Notes:**  $s_X$  := standard deviation of HP-filtered simulated time series  $X$ , where  $X$  stands for any variables from column 1, based on 1000 replications with 88 observations each.  $s_X / s_Y$  := standard deviation of variable  $X$  relative to standard deviation of output  $Y$ .  $r_{XY}$  := cross-correlation of variable  $X$  with output  $Y$ ,  $r_{XH}$  := cross-correlation of variable  $X$  with hours  $H$ ,  $r_X$  := first-order autocorrelation of variable  $X$ .

data. In this approach “the moments are weighted so as to minimize the covariance matrix of the estimator, or, in other words, to maximize the information content of the used moments”, as Iskrev (2013), p. 15, mentions. And “besides testing for stability, the estimated covariance matrix of the second moments [...] can also be used as a weighting matrix in a score statistic that measures how close a simulated DSGE model replicates a set of stylized facts”, as Maußner (2013a), pp. 11–12, mentions. For the standard errors Maußner (2013a) employs five different estimates:

- standard errors that assume uncorrelated disturbances,
- standard errors based on the QS kernel with and without prewhitening, and
- standard errors based on the Bartlett kernel with and without prewhitening.

To comprehensively summarize the information in a set of empirical moments and simulated ones such a score is displayed in the next table.

In Table 4.5, in which the measures for the difference between the moments estimated from the data and the moments obtained from the simulated model, or in other words, the measures for the distance between the data and the model are reported, our attention is focused on the time series discussed above: seasonal- and calendar-adjusted quarterly real GDP, consumption of non-durables, total gross fixed investments, hours, and real wage in both subsamples each. The focus is on the regarding standard deviation, the cross-correlation with output, and the cross-correlation

with hours. With these considerations the benchmark RBC model possesses a better match to the real economy regarding the considered second moments in the first time period than in the second, except for the sum of squared errors distance measure and the both measures, where the standard errors are based on the Bartlett kernel.<sup>46</sup>

## 5. CONCLUSION

In this paper, a benchmark RBC model was considered to look at the BC prior and after the territorial status of the Federal Republic of Germany in 1990. The model consistent data was obtained from the entire period between 1970: I and 2012: IV. The major findings are: *i*) the volatility of most aggregate time series has not changed significantly between the two time periods, *ii*) despite many conceptual differences between the European and the U.S. accounting systems, the calibrated parameter values for the German economy are within the range of values usually employed in the RBC literature, *iii*) the model based on the quadratic spectral kernel weighting matrix is closer to the data for the time period prior to reunification.

Although the data pre-adjustment resulted in that the model delineates the data quite well, the model is

<sup>46</sup> In order to circumvent misleading conclusions caused by some special events during the considered time period, e.g., the oil crisis in 1973 or the recent financial crisis, the Appendix includes a kind of sensitivity analysis, which restricts the period to 1976: I-1991: IV and 1991: I-2006: IV, respectively.

**Table 4.5.** Distance Test of the Data and the Model.

	<i>QED</i>	<i>AR = 0</i>	<i>QS</i>	<i>QS<sub>pw</sub></i>	<i>B</i>	<i>B<sub>pw</sub></i>
<b>1970: I-1991: IV</b>						
Score	3.452	305.454	93.584	100.753	100.054	107.014
<b>1991: I-2012: IV</b>						
Score	2.340	343.591	94.132	119.876	91.220	106.439

**Notes:** Abbreviations: *QED* : Quadratic Euclidean distance; *AR = 0* : standard errors without correction for autocorrelation; *QS* , *B* : standard errors from the quadratic spectral and Bartlett kernel, respectively; *pw* : with prewhitening.

far from perfect. Thus model extensions could be fruitful for a more detailed explanation of the BC in Germany. For example, more than one shock could be considered to see how additional shocks (e.g. a preference shock to uncover the cross-correlation between hours and real wage and/or a government spending shock to achieve a more elaborated theoretical framework) interact, because in reality “there may be additional shocks”.<sup>47</sup> A further contemplation could be also to integrate leasing as an important part in gross fixed investments and thus also in the capital stock.<sup>48</sup> Another model framework, such as the mentioned NK models in section 1, could also be more fertile than the simple benchmark RBC model considered here. Naturally, such extensions are in mind for further research.

## REFERENCES

- Andrews, Donald W.K. 1991. Heteroskedasticity and Autocorrelation Consistent Covariance Matrix Estimation. *Econometrica*. Vol. 59. pp. 817–858.
- Andrews, Donald W.K. and J. Christopher Monahan. 1992. An Improved Heteroskedasticity and Autocorrelation Consistent Covariance Matrix Estimator. *Econometrica*. Vol. 60. pp. 953–966.
- Balk, Bert M. and Utz-Peter Reich. 2008. Additivity of national accounts reconsidered. *Journal of Economic and Social Measurement*. Vol. 33. pp. 165–178.
- Braakmann, Albert, Norbert Hartmann, Norbert R ath, Wolfgang Strohm, and employees. 2005. Revision der Volkswirtschaftlichen Gesamtrechnungen 2005 f ur den Zeitraum 1991 bis 2004. Statistisches Bundesamt, Wirtschaft und Statistik 5/2005. pp. 425–462.
- Br ummerhoff, Dieter and Heinrich L utzel. 2002. Lexikon der Volkswirtschaftlichen Gesamtrechnungen. 3rd Edition. Oldenbourg. Munich.
- Buch, Claudia M., Joerg Doepke, and Christian Pierdzioch. 2004. Business Cycle Volatility in Germany. *German Economic Review*. Vol. 5. pp. 451–479.
- Burghardt, Michael. 2006. Zur Revision der privaten Konsumausgaben im Rahmen der Volkswirtschaftlichen Gesamtrechnungen 2005. Statistisches Bundesamt, Wirtschaft und Statistik 2/2006. pp. 136–144.
- Canova, Fabio. 1998. Detrending and business cycle facts. *Journal of Monetary Economics*. Vol. 41. pp. 475–512.
- Cantore, Cristiano, Miguel A. Le on-Ledesma, Peter McAdam, and Alpo Willman. 2013. Shocking Stuff: Technology, Hours, and Factor Substitution. Discussion Paper 09/13, University of Surrey.
- Cho, Jang-Ok and Thomas F. Cooley. 1995. The business cycle with nominal contracts. *Economic Theory*. Vol. 6. pp. 13–33.
- Cooley, Thomas F. 1997. Calibrated Models Oxford Review of Economic Policy. Vol. 13. pp. 55–69.
- Cooley, Thomas F. and Edward C. Prescott. 1995. Economic Growth and Business Cycles, in: Thomas F. Cooley (Ed.), *Frontiers of Business Cycle Research*. Princeton University Press. Princeton, NJ. pp. 1–38.
- Favero, Carlo A. 2001. *Applied Macroeconometrics*. Oxford University Press. New York.
- Gomme, Paul and Peter Rupert. 2007. Theory, measurement and calibration of macroeconomic models. *Journal of Monetary Economics*. Vol. 54. pp. 460–497.
- Greenwood, Jeremy, Zvi Hercowitz, and Per Krusell. 1997. Long-Run Implications of Investment-Specific Technological Change. *The American Economic Review*. Vol. 87. pp. 342–362.
- Hall, Robert E. 1988. Intertemporal Substitution in Consumption. *Journal of Political Economy*. Vol. 96. pp. 339–357.
- Hansen, Gary D. 1985. Indivisible Labor and the Business Cycle. *Journal of Monetary Economics*. Vol. 16. pp. 309–327.
- Heer, Burkhard and Alfred Mau sner. 2009. *Dynamic General Equilibrium Modeling. Computational Methods and Applications*. 2nd Edition. Springer. Berlin.
- Heer, Burkhard, Stefan Rohrbacher, and Christian Scharrer. 2013. Aging, the Great Moderation and business-cycle volatility in a life-cycle model. Mimeo.
- Hodrick, Robert J. and Edward C. Prescott. 1997. Postwar US business cycles: an empirical investigation. *Journal of Money, credit, and Banking*. Vol. 29. pp. 1–16.

<sup>47</sup> Heer and Mau sner (2009), p. 59. Here it should be mentioned that Cooley and Prescott (1995) argue by virtue of their result that the standard deviation of GNP in data is greater than in the model, is a hint for more than one shock which drives the economy, but here this is not the case. This argumentation however is only consistent if GNP rather than GDP is imposed. In this respect, see also the corresponding result in Gomme and Rupert (2007).

<sup>48</sup> For this, see St adtler (2002) and Schmalwasser *et al.* (2011).

- Ireland, Peter N. 2004. A method for taking models to the data. *Journal of Economic Dynamics and Control*. Vol. 28. pp. 1205–1226.
- Iskrev, Nikolay. 2013. On the distribution of information in the moment structure of DSGE models. Meeting Papers 339, Society for Economic Dynamics.
- Jaimovich, Nir and Henry E. Siu. 2009. The Young, the Old, and the Restless: Demographics and Business Cycle Volatility. *The American Economic Review*. Vol. 99. pp. 804–826.
- Krämer, Walter. 2011. The Cult of Statistical Significance — What Economists Should and Should Not Do to Make their Data Talk. *Schmollers Jahrbuch*. Vol. 131. pp. 455–468.
- Krämer, Walter, Werner Ploberger, and Raimund Alt. 1988. Testing for Structural Change in Dynamic Models. *Econometrica*. Vol. 56. pp. 1355–1369.
- Kydland, Finn E. and Edward C. Prescott. 1982. Time to Build and Aggregate Fluctuations. *Econometrica*. Vol. 50. pp. 1345–1370.
- Long, John B. and Charles I. Plosser. 1983. Real Business Cycles. *Journal of Political Economy*. Vol. 91. pp. 39–69.
- Mankiw, N. Gregory. 1989. Real Business Cycles: A New Keynesian Perspective. *Journal of Economic Perspectives*. Vol. 3. pp. 79–90.
- Mankiw, N. Gregory and David Romer. 1991. *New Keynesian Economics: Vol. 1 and 2*. MIT Press. Cambridge.
- Maußner, Alfred. 1994. *Konjunkturtheorie*. Springer Verlag. Berlin.
- Maußner, Alfred. 2013a. Testing the Stability of Time Series Moments: A GMM Approach. Mimeo.
- Maußner, Alfred. 2013b. *Computational Macroeconomics*. Lecture Notes. Mimeo.
- Mayer, Helmut. 2001. Preis- und Volumenmessung in den Volkswirtschaftlichen Gesamtrechnungen: Anforderungen und Perspektiven. *Statistisches Bundesamt, Wirtschaft und Statistik 12/2001*. pp. 1032–1043.
- Mehra, Rajnish and Edward C. Prescott. 1985. The Equity Premium: A Puzzle. *The Journal of Monetary Economics*. Vol. 15. pp. 145–161.
- Nierhaus, Wolfgang. 2001. Wirtschaftswachstum in den Volkswirtschaftlichen Gesamtrechnungen: Ein Vergleich Deutschland — USA. *ifo Schnelldienst 3/2001*. Vol. 54. pp. 41–51.
- Nierhaus, Wolfgang. 2004a. Wirtschaftswachstum in den VGR: Zur Einführung der Vorjahrespreisbasis in der deutschen Statistik. *ifo Schnelldienst 5/2004*. Vol. 57. pp. 28–34.
- Nierhaus, Wolfgang. 2004b. Zur Einführung der Vorjahrespreisbasis in der deutschen Statistik: Besonderheiten der Quartalsrechnung. *ifo Schnelldienst 15/2004*. Vol. 57. pp. 14–21.
- Nierhaus, Wolfgang. 2005. Vorjahrespreisbasis: Rechenregeln für die Aggregation. *Ifo Schnelldienst 22/2005*. Vol. 58. pp. 12–16.
- Nierhaus, Wolfgang. 2007. Vorjahrespreisbasis: Aggregation und Verkettungsdifferenz. *Ifo Schnelldienst 6/2006*. Vol. 60. pp. 29–33.
- Ogaki, Masao. 1993. Generalized Method of Moments: Econometric Applications, in G.S. Maddala, C.R. Rao, and H.D. Vinod (Eds.), *Handbook of Statistics: Vol: 11*. Elsevier. Amsterdam. pp. 455–488.
- Pedersen, Torben Mark. 2001. The Hodrick-Prescott filter, the Slutsky effect, and the distortionary effect of filters. *Journal of Economic Dynamics and Control*. Vol. 25. pp. 1081–1101.
- Ploberger, Werner, Walter Krämer, and Karl Kontrus. 1989. A New Test for Structural Stability in the Linear Regression Model. *Journal of Econometrics*. Vol. 40. pp. 307–318.
- Prescott, Edward C. 1986. Theory Ahead of Business Cycle Measurement. *Federal Reserve Bank of Minneapolis, Quarterly Review*. Vol. 10. pp. 9–22.
- Räth, Norbert, Albert Braakmann, and employees. 2006. Vergleichbare Zeitreihen der Volkswirtschaftlichen Gesamtrechnungen: Revidierte Ergebnisse 1970 bis 1991 für das frühere Bundesgebiet. *Statistisches Bundesamt, Wirtschaft und Statistik 10/2006*. pp. 1003–1020.
- Reich, Utz-Peter. 2003. Additiver Kettenindex für die Preisbereinigung der Volkswirtschaftlichen Gesamtrechnung: Kritische Überlegungen aus aktuellem Anlass. *Austrian Journal of Statistics*. Vol. 32. pp. 323–327.
- Rogerson, Richard. 1988. Indivisible Labor, Lotteries and Equilibrium. *Journal of Monetary Economics*. Vol. 21. pp. 3–16.
- Schmalwasser, Oda and Michael Schidlowski. 2006. Kapitalstockrechnung in Deutschland. *Statistisches Bundesamt, Wirtschaft und Statistik 11/2006*. pp. 1107–1123.
- Schmalwasser, Oda, Aloysius Müller, and Nadine Weber. 2011. Gebräuchsvermögen privater Haushalte in Deutschland. *Statistisches Bundesamt, Wirtschaft und Statistik 6/2011*. pp. 565–578.
- Schwarz, Norbert. 2008. Einkommensentwicklung in Deutschland: Konzepte und Ergebnisse der Volkswirtschaftlichen Gesamtrechnungen. *Statistisches Bundesamt, Wirtschaft und Statistik 3/2008* 197. pp. 197–206.
- Smets, Frank and Raf Wouters. 2003. An Estimated Dynamic Stochastic General Equilibrium Model of the Euro Area. *Journal of the European Economic Association*. Vol. 1. pp. 1123–1175.
- Städtler, Arno. 2002. Der Erfolg des Leasing — ein Problem für die Statistik. *Statistisches Bundesamt, Wirtschaft und Statistik 12/2002*. pp. 1116–1118.
- Stock, James H. and Mark W. Watson. 1996. Evidence on Structural Instability in Macroeconomic Time Series Relations. *Journal of Business and Economic Statistics, American Statistical Association*. Vol. 14. pp. 11–30.
- Subject-matter series 18, S.23, National Accounts, Quarterly Calculations of Gross Domestic Product in accordance with ESA 1995, Methods and Data Sources, New version following revision 2005.
- Subject-matter series 18, S.24, National Accounts, Methods of the price- and volume- measurement.
- Subject-matter series 18, S.27, National Accounts, Domestic product calculation, Revised quarterly results, 1970 till 1991.
- Subject-matter series 18, S.28, National Accounts, Domestic product calculation, Revised seasonally adjusted quarterly results by Census X-12-ARIMA and BV4.1, 1970 till 1991.
- Tödter, Karl-Heinz. 2005. Umstellung der deutschen VGR auf Vorjahrespreisbasis: Konzept und Konsequenzen für die aktuelle Wirtschaftsanalyse sowie die ökonometrische Modellierung. *Discussion Paper 31/2005*, Deutsche Bundesbank.
- Whelan, Karl. 2002. A Guide to U.S. Chain Aggregated NIPA Data. *Review of Income and Wealth*. Vol. 48. pp. 217–233.
- von der Lippe, Peter. 2000. Der Unsinn von Kettenindizes. *Allgemeines Statistisches Archiv*. Vol. 84. pp. 67–82.

# The Informal Economy and the Constraints That It Imposes On Pension Contributions in Latin America\*

**David TUESTA CÁRDENAS**

Chief Economist, BBVA Research, Madrid

david.tuesta@grupobbva.com

**Abstract.** Low contribution levels to pension schemes in Latin America are an enormous obstacle limiting the implementation of a broad-based social security system. Contribution rates measured as a ratio of contributors to the total labor force stand at an average of 40%, or 60% in the best of cases. Although previous studies explain this situation by factors related to growth, economic institutions and market considerations, only a few studies have quantified the specific determinants behind this problem. This study therefore aims to approach the subject by exploring the national household surveys for Brazil, Chile, Colombia, Mexico and Peru. Once the specific question relating to pension contributions has been identified in the surveys, probit models are used to estimate the probability that this event may occur, conditioned by the variables that theory considers as explanatory. The study finds the enormous relevance of labor markets as a common conditional factor affecting the likelihood to contribute to any pension system in Latin America. Working in the informal economy, being a self-employed worker or working in a micro-enterprise are particularly significant and show the highest coefficients in this geographical region. The high impact of these variables may give clues for economic policy in its search for eliminating the hurdles in labor market distortions that limits the impact of social security programs.

**Аннотация.** Низкий уровень взносов в пенсионные схемы в странах Латинской Америки является огромным препятствием, ограничивающим реализацию широкой системы социального обеспечения. Доля тех, кто платит взносы в пенсионные фонды, от общей численности рабочей силы составляет в среднем 40%, а в лучшем случае 60%. Ряд исследований объясняли это факторами, связанными с ростом экономических институтов, и рыночными соображениями, и только малая часть исследователей занимались количественным анализом параметров, лежащих в основе этой проблемы. Данное исследование изучает вопрос на основе анализа домашних хозяйств Бразилии, Чили, Колумбии, Мексики и Перу. Занятость в теневой сфере экономики, индивидуальное предпринимательство и работа на микро-предприятиях имеют широкое распространение в этом географическом регионе, и учет этих факторов может дать ключи для совершенствования экономической политики и устранения проблем на рынке труда, которые ограничивают эффективность программ социального обеспечения.

**Key words:** Coverage, contribution, pension, retirement, social security, AFP, AFORE, probit.

## 1. INTRODUCTION

Pension reforms in Latin America have included a series of changes with a twin goal: to provide financial stability for their systems and to increase the participation rate, thus allowing for an accumulation of funds that can be used to obtain better pensions (Gill *et al.*, 2004, Holzmann and Hinz 2005, Carranza *et al.*, 2012). Decisions to balance the budget through a redefinition of the parameters of “pay-as-you-go” (PAYG) systems, and the introduction of partial or

complete individual saving schemes under mandatory or voluntary contribution mechanisms, have largely achieved the goal of sustainability. However, the results with respect to participation have been far from generating a system of broad-based coverage.

Worth highlighting is the case of countries that introduced systems of mandatory individual savings under the so-called “Chilean model” of Pension Fund Administrators (or AFP in Spanish). Except for the case of Chile, where the contribution rate (total of contributors as a proportion of the labor force) is around 60%,

\* Теневая экономика и пенсионные взносы: опыт стран Латинской Америки.

in countries such as Colombia, Mexico and Peru the figures do not exceed 40% (Kay and Sinha, 2008; Carranza *et al.*, 2012). Brazil, which followed a different path from the Chilean model and based its reforms on parametric adjustments to its public PAYG system, plus the development of voluntary private pension schemes, had a coverage rate in 2010 of around 55% (Bosch *et al.*, 2013; Mesa-Lago, 2008). These figures reflect the low participation of extensive sections of the population which is a critical problem in Latin America. To some extent, this makes obvious the divorce between society and a state that does not have sufficient capacity to implement an inclusive pension system.

The capacity of mandatory pension systems to create incentives for workers to save in these economies is limited by various factors, such as macroeconomic conditions, household income levels, the structure of the labor market, and the capacity of the state to enforce the law (Carranza *et al.*, 2012; Tuesta, 2011). The analyses of these factors have normally been carried out from a theoretical perspective, but in only very few cases they have been calculated, particularly in Latin America, generally due to the lack of statistical information. However, more national household surveys in the region have been recently including more specific questions on the situation of social security in the countries in question. This enables to explore the copious information and provides both specific and comparative answers among countries.

The aim of this study will therefore be to quantify the factors that condition the higher or lower probability of individuals deciding to contribute to a formal pension system, whether public or private. It also seeks to draw conclusions for the region as a whole, based on the comparative analysis of statistics from five representative countries: Brazil, Chile, Colombia, Mexico and Peru. It will do so by using the respective national household surveys, from which it will identify those variables that the literature has defined as determinants in pension savings decision-making, and then include them in probabilistic estimates. The contribution of this work could be valuable, as this methodology rarely appears to have been applied simultaneously to various countries in the region as a whole to this problematic, nor has this question been approached from the point of view of trying to understand the problems of pension coverage in Latin America in order to give clues into economic policy decision-making.

Following this introduction, the second section will discuss the main aspects behind the participation in pension schemes highlighted by the economic literature. The third section sets out the characteristics of

the data and the methodology used. The fourth section discusses the results. Finally, section five presents the conclusions of this research.

## 2. THE PROBLEM OF PARTICIPATION IN PENSION SYSTEMS

Latin America has a low social security coverage rate, particularly in the case of pensions (Rofman *et al.*, 2008). A number of reasons lie behind. First, there is the problem of the capacity to save, which is closely related to per capita income and poverty (Costa *et al.*, 2011; Francke and Mendoza, 2005; Tuesta, 2011). Behind the problem of low income, we find poor economic growth strategies, deficient institutional bases and, from a more social perspective, inadequate policies for dealing with poverty, health, education and gender (Acosta and Ramirez, 2004). One particularly serious problem within the institutional area is the significant size of the informal economy, which makes it impossible to oblige to contribute, simply because the state cannot enforce compliance (Levy, 2008; Costa *et al.*, 2011; Tuesta, 2011; Carranza *et al.*, 2012).

Coverage rates are particularly low because the pension schemes they correspond to are based on the operation of formal labor markets. In fact, governments have based the operation of their mandatory systems by using employers as contractual agents of the labor force to ensure adequate social security coverage. The problem is that if the companies involved are informal, or if they are formal but have informal relations with their employees, they will not be able to act as the state's partners to enforce compliance with the law by using mandatory mechanisms to ensure the population has adequate social coverage (Carranza *et al.*, 2012; Saavedra and Torero, 2000; Loayza, 2008).

Although growth and macroeconomic stability in Latin America are generating conditions for starting to formalize the economy and thus improve coverage, their impact may not be sufficient if progress is not made in the institutional area to boost the function of the state (Lederman *et al.*, 2001). Given the limitations of the state to enforce the mandatory payment of pension contributions, the decision to contribute to the pension system largely falls to individuals.

Given this situation, studies and policy experience has been moving toward public intervention that creates incentives for saving for old age. This is the basis of the argument that the population requires different tools to raise their awareness of the need to participate in pension schemes. Some studies have tried to capture the factors that lie behind the decisions to contribute to pension systems. One approach is the analysis of policy interventions or incentives to par-

participation. For this kind of analysis, governments generally require experiments or specific surveys to be designed. These can be used to analyze the impact of a certain decision on a representative sample of individuals, establishing control groups against which the effects of the probable measure can be compared. For example, one of the increasingly used incentive mechanisms is government subsidies, whether through tax allowances or direct transfers (Whitehouse, 2012; Holzmann *et al.*, 2012). An increasingly popular type of financial incentive is that of “matching contributions”, where the government or employer (through tax incentives) supplements the workers’ contributions by adding a fraction of that amount to their pension accounts. Studies in developed countries find positive results for these kinds of mechanisms (Beshears *et al.*, 2010; Duflo *et al.*, 2006; Engelhardt and Kumar, 2007; Mills *et al.*, 2008; Choi *et al.*, 2002; Choi *et al.*, 2004; Choi *et al.*, 2006; Mitchell *et al.*, 2007), although the results are not conclusive in all cases. Of particular importance are the cases of New Zealand (Rashbrooke, 2012), Germany (Börsch-Supan *et al.*, 2012) and India (Palacios and Sane, 2012).

Other studies on incentives have highlighted the role of state intervention such as financial literacy programs, financial assistance for saving and automatic enrolment (Madrian, 2012; Mitchell and Utkus, 2004). The definition of financial literacy programs with respect to their impact on participation in pension schemes covers a broad range of actions, from supplying information (general or detailed) and education and training at different levels and ages. Experience suggests that the strategies and the methods of implementing them are important, as is persistence, given their long-term effects. This provides an explanation why, despite the consensus regarding the good intentions of these programs, sometimes the assessments made of their results have not always been encouraging (Hastings *et al.*, 2012; Roa, 2013). With respect to assistance for savings, some works include the effects of reminders for saving (e.g. through a telephone call, e-mail, text messages) with positive, though very limited, results on the intension of contributing to pension schemes in the United States (Karlan *et al.*, 2010) and Chile (Kast *et al.*, 2012). Other studies such as Lusardi *et al.* (2009) and Clark and Schieber (1998) found an extremely positive effect from simplifying the information given to the workers for making decisions on saving for old age. Meanwhile, two interesting studies on emerging countries include the role of savings commitment plans that aim to reduce the temptation to spend (Ashraf *et al.*, 2006; Soman and Cheema, 2011) and thus to earmark more funds to saving. Nevertheless, one of the most impor-

tant findings from the point of view of political interventions in the case of the 401 (k) pension scheme in the United States is that of automatic enrollment in voluntary pension systems, which in practice implies a semi-mandatory contribution to pensions, as enrollment is considered as the default option (Madrian, 2012; Beshears *et al.*, 2008).

Lack of participation in pension systems may also be categorized as one of the problems of financial inclusion. From this point of view, the subject of limitations to saving for retirement may be associated with the presence of barriers or obstacles that limit the possibility of accessing a retirement plan, if it is of interest for the individual. Thus, the situation may respond to the lack of capacity for saving for old age, the cost of the product (the problem of administrative fees), lack of confidence, paperwork and complications required for saving, and geographical aspects (Allen *et al.*, 2012; Demirguc-Kunt *et al.*, 2012).

Expanding on the above, one interesting approach is to evaluate the conditioning factors of saving through an assessment of the socioeconomic characteristics of individuals. Thanks to the recent development of national surveys focused on matters relating to social security, quantitative approaches to the problem of coverage are being developed. Along these lines, in Latin America, Chile has been undertaking the most interesting developments with specialized surveys. Notable among these are the studies by Correa (2011), who, working with the Household Financial Survey of 2007, finds that participation in voluntary pension schemes is affected by marginal tax bands, household wealth, knowledge of the pension system and the amount of collateral debt. At the same time, Bravo *et al.* (2008), using the Social Protection Survey of 2008, includes additional socioeconomic elements such as income levels, the individual’s age, and whether the individual has life insurance. Also in the Chilean case, Pizarro and Muñoz (2008) find similarities when using different household, financial and social protection surveys. Basett *et al.* (1998) finds for the case of the 401 (k) plans in the United States not only the role of income and age, but the role that having a stable job and higher educational level may have significance. Similarly, Huberman *et al.* (2007) uses a private survey to highlight the greater likelihood that women have to save in pension schemes.

Except for the case of Chile, quantitative analysis of the problem of low participation in retirement savings in Latin America has been lacking so far due to the lack of statistical information available to develop such an analysis. Nevertheless, national household surveys are little by little beginning to include specific questions on the subject of pensions and social

security. These statistics allow this study to estimate the factors that affect the probability of contributing to pension schemes in five Latin American countries, taking as a base the relevant aspects that theory points to as interacting on the decisions made by individuals. The results obtained at both the country and comparative levels may help shed light for policymakers on the lines of action that should be taken in this area.

### 3. DATA AND BASIC CHARACTERIZATION OF THE INDIVIDUALS

The richest source of information for finding answers to the socioeconomic conditioners that affect the financial decisions of individuals to save in pension schemes are the different national household surveys. This study is focused on the analysis of the cases of five relevant countries in Latin America: Brazil, Colombia, Chile, Mexico and Peru. Depending on the questions available in each of the national surveys, this study will concentrate on identifying the factors affecting the probability of participating in a formal pension system, which may mean a scheme that is public, and offered by the state, or a voluntary or mandatory pension scheme offered by the private sector, but whose operation is regulated by a specific legal framework.

Our study will focus on observing whether workers are contributing to a pension system, according to the answers they give in the surveys for each country. This is a more restrictive definition than coverage. It is different from the broad approach of participation or membership, whose statistics are included if people have contributed at some time in their employment history, which may not give them any rights at the time of retirement. Our definition of pension coverage is contribution, which implies that the person responds in the survey that he or she is currently contributing at that time toward future retirement.

A deep level of statistical data is required to obtain a detailed characterization of individuals allowing us to identify their different socioeconomic profiles, which in accordance with the revised theory may condition their active participation in pension systems. Such data can only be found in surveys that have a broad range of questions for a representative set of the population. A survey of these dimensions that is specialized in pensions may be the best means to offer different points of view on the problem of social security at the individual level in a country. However, surveys of this kind are not sufficiently extended in the region to address social security matters.

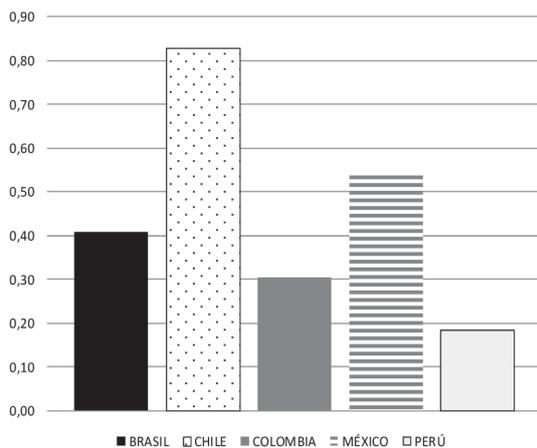
The only country that has made an important effort in Latin America in the latest decade has been Chile, with the specialized development of Social Protection Surveys (Subsecretaria de Prevision Social, 2013), where as well as obtaining a broad knowledge of the individual's profile, the questions are designed to ascertain all the relevant aspects on pension issues. Given that similar surveys are not available for the entire region, if we want a comparative approach such as in this study, the alternative is to work with national household surveys (see *Appendix 1* for details on the surveys), which have managed to construct a history of application and use in Latin America. Some questions relating to social security can be identified in these surveys, and these can be the basis for estimating the probability of workers contributing to a pension system, given their characteristics.

Thus, for Brazil, the study uses the National Household Sample Survey-PNAD of 2011 (IBGE 2011), which has been carried out by the Brazilian Geographical and Statistical Institute-IBGE; for Chile, the study uses Survey of National Socioeconomic Characterization-CASEN (Ministerio de Desarrollo Social de Chile 2011), which is promoted by the Ministry of Social Development; in the case of Peru, the National Household Survey-ENAHO of 2011 (INEI 2012) carried by the National Institute of Statistics and IT-INEI; for Mexico, this study uses the National Household Income and Expenditure Survey-ENIG of 2010, which has been carried out by the National Institute for Statistics and Geography (INEGI 2010); finally, in the case of Colombia, the data for this research has been extracted from the Large Integrated Household Survey-GEIH of 2011, which is managed by the National Administrative Department of Statistics (DANE 2011).

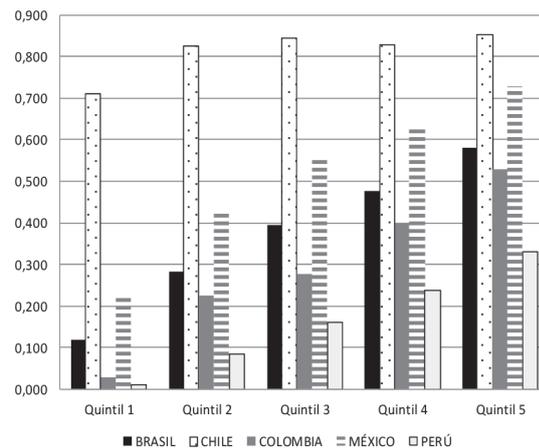
We have identified the variables that describe the level of participation in the formal pension systems in each of the national surveys of the five countries. As we have explained above, the most precise way of calculating this participation is through current contributions. We have therefore identified the question that indicates whether in the period of the survey the person was actually contributing toward retirement. People may contribute to a system that is administered by either the state or private-sector companies; they may also either be obliged by law to contribute, or contributions may be voluntary. Given the availability of questions in the surveys, the analysis will focus on the participation in any pension system, without differentiating between its particular characteristics.

Although the above may make the characterization of the situations less detailed, by analyzing the data

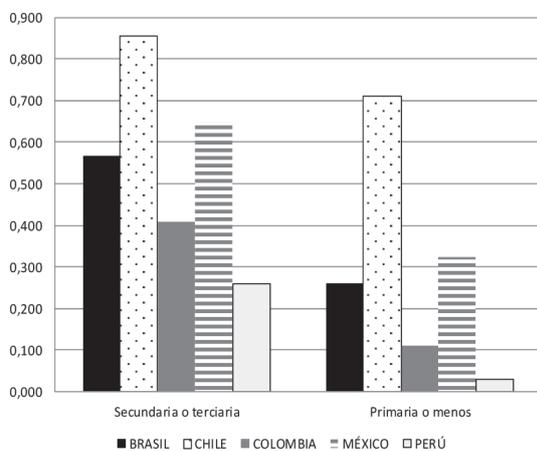
**Figure 1: Pension contribution ratio contributors as a % of employed population**



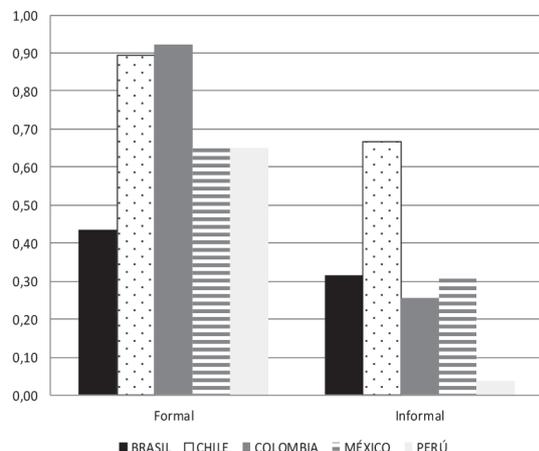
**Figure 2: Pension contributions - income quintile contributors as a % of employed population**



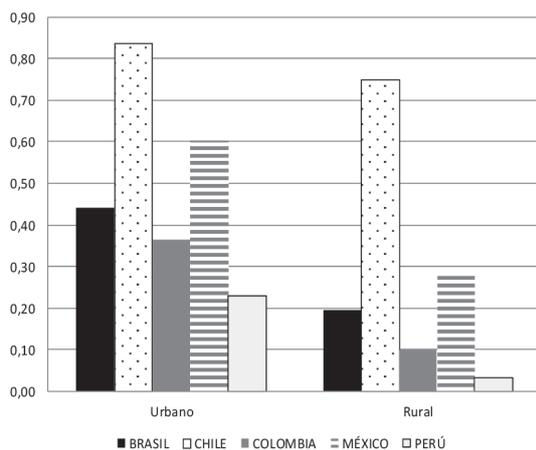
**Figure 3: Pension contribution ratio - education level contributors as a % of employed population**



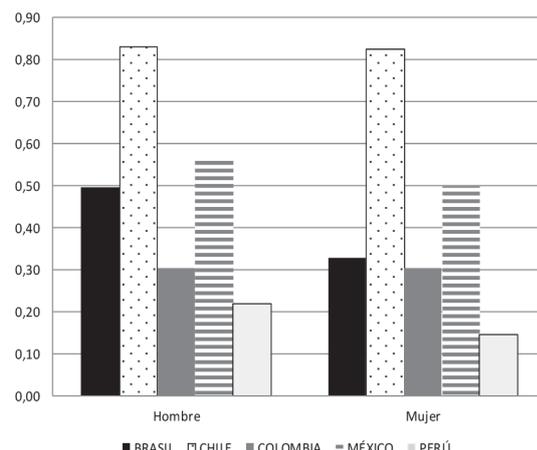
**Figure 4: Pension contribution-informal workers contributors as a % of employed population**



**Figure 5: Pension contribution - rural and urban area contributors as a % of total population**



**Figure 6: Pension contribution by gender contributors as a % of total population**



of the overall contribution to the pension system as a whole also provide us with very valuable information for this research. First of all, although the surveys do not allow us to differentiate in all the countries if the contribution is to a mandatory system or voluntary

system<sup>1</sup>, this seems to be less relevant for the study because of the low penetration of voluntary schemes

<sup>1</sup> The survey of Brazil used for this study, enables us to differentiate between mandatory and voluntary pension schemes. We will discuss this issue later in the document.

in the countries under analysis; secondly, given this, the data allow us to focus on conditions that promote pension savings, without it being particularly important what the type of pension product is; and third, the descriptive statistics shown below confirm that the contribution level in the pension system is fairly low, despite it being mostly mandatory. A breakdown of the characteristics of the variables used in the research that help us to characterize the individual and calculate the probability of contributing to a pension system is presented in *Appendix 2*.

Although this study is not going to discuss the particular institutional aspects of the pension systems in each country, it is important to stand out that a common factor was that they have all been reformed using the common goal of greater fiscal sustainability (Gill *et al.*, 2004; Tuesta, 2011). Thus, examining the different references in the literature (Gill *et al.*, 2004; Hinz and Holzmann, 2005; Tuesta, 2011; Carranza *et al.*, 2012) within the spectrum of pension systems, we can locate at one end the system in Chile, which after the reform in the 1980s was no longer a PAYG scheme and became, in essence, a private savings scheme (the model of pension fund administrators (AFP), with some solidarity components which were introduced in subsequent reforms. At the other end of the spectrum in Latin America is Brazil, which essentially maintains a PAYG scheme with successive parametric adjustments to make it more sustainable, and which introduced incentives for the creation of voluntary pension schemes. Half-way between these two extremes are the cases of Colombia, Peru and Mexico. Colombia and Peru have incorporated the AFP model, although in competition with a PAYG scheme, where the worker has the possibility of choosing either of both. In Mexico, although the new enrollments to the old PAYG scheme were closed and a system along the lines of AFPs was introduced (called the Retirement Fund Administrator – AFORE), those who had been contributing before 1995 had the opportunity to choose the benefits of the PAYG scheme if they thought they were better for them at the moment of retirement, even though they had begun to save in a capitalization scheme.

Based on information from Latin American household surveys, the series of figures below illustrate the contribution situation in Latin American pension systems according to different characterizations of individuals. Each of the figures presents the contribution rate to pension systems with respect to the total occupied population. This rate is important because it is not a measure of coverage applied to the whole economically active population (EAP), but rather to the ability to contribute to a pension system if the person is actively employed in the labor market. Thus, Figure 1

indicates that the highest contribution rate is in Chile, where more than 80% of the employed population contributes to a pension scheme. This rate, which is the highest in the region, contrasts with the contribution rates of the rest. In Mexico, the rate is slightly higher than 50%; in Brazil it is 40%; in Colombia 30% and in Peru it is slightly under 20%. To put it more clearly, although a significant fraction of the population generates income from work they are not contributing to any pension scheme, according to the answers in the survey.

From the contribution rate in the five countries according to income quintiles (Figure 2), it is worth noting in the case of Chile that the contribution does not vary with respect to the average in the case of the lower-income quintiles. However, in the rest of the countries the lowest quintiles, particularly 2 and 3, are fairly far removed from the average. The case of Peru is particularly striking, as the contribution rate there is fairly weak and even in the highest income quintile it barely rises above 30%. One would have expected a priori that it is precisely this group that was in the best position to save. Figure 3 highlights the role that education may play in contribution rates. The contribution rates out of all the working population are higher in groups with secondary level education or higher, once more highlighting the low contribution levels of the most educated population in the case of Peru, and the limited level of contribution of the population groups with only a primary or lower level of education, contrasting with what is observed in the other countries.

The form in which individuals are inserted in the labor market is particularly relevant for their contribution rates to pension systems. Based on specific questions in the country surveys, we define both formal and informal workers, who are different according to their contractual conditions and/or their relationship of formality with respect to the state (employment, licensing and tax requirements, among others), as specifically described in *Appendix 2* for each country. Thus, Figure 4 shows the high contribution rate in the formal group, in particular in the case of Chile and Colombia, with 90% of contributors in this group. The rest of the countries also show higher contribution rates in the formal group compared with the informal, as is to be expected. In addition, reviewing the group of informal workers in each country reveals a greater effectiveness in the case of Chile, with 70% of its working population contributing; at the other end is the situation in Peru, where the level of contributors among the informal group is practically non-existent.

At the same time, urban and rural conditions tend to affect the way in which people comply with the social security regulations, due to difficulty of access and/or control by the state. Figure 5 highlights the

higher contribution rates in all the countries among groups in urban areas compared with rural areas; although even more clearly, it highlights the high contribution rate among the rural population of Chile compared with the rest of Latin America. Figure 6 includes the gender elements that may affect the contribution rate to pension systems. In all cases it can be seen that women have lower contribution rates than men, although in the cases of Chile and Mexico, the differences are less marked.

As discussed in our review of the literature, these and other socioeconomic characterizations of the individual may condition the probability of contributing to a pension system. Finding these possibilities and comparing their results in Latin America may be very relevant for detecting their relative significance and, based on that, for providing economic policymakers with information that will allow them to set out priorities for actions to improve the viability of contribution levels to pension systems. These results will be calculated based on a probit model with a standard replication process for each of the countries, given the availability of questions in the surveys.

#### 4. METHODOLOGY

We assume an empirical discrete model based on a utility function that describes the eagerness of an individual to participate in a given pension system. This utility function is determined by specific individual characteristics, according to the revised literature.

Following Ziegler (2010), Christiadi and Cushing (2007) and Hausman and Wise (1976), the hypothetical utility of the potential pension participant  $i$  ( $i = 1, \dots, N$ ) can be defined as:

$$U_i = \beta'x_{ij} + \varepsilon_{ij}$$

Because we do not know the real individual's utility derived from the participation in a pension system, we assume that the contribution decision is a reflex of this utility function. In this case, there are  $j$  specific individual characteristics affecting the final decision to contribute or not to the pension system. The unknown parameter vectors are  $\beta$ . The values of the latent variables cannot be observed and depend on the stochastic components  $\varepsilon_{ij}$ , which summarize all unobserved factors that influence the final decision.

This approach is flexible enough to comprise a multitude of discrete choice models. In this case, it is considered the use of a probit model, based on the assumption that the  $\varepsilon_{ij}$  are jointly normally distributed.

Probit models are widely used for econometric analysis (Greene, 2011). They are binary classification

models where the dependent variable is dichotomous. These models are estimated by maximum likelihood and quantify the probability of whether or not an individual with certain characteristics pertains to the study target group. In this case, the question is whether or not they save in a pension system.

The aim of the empirical specification is to model contribution to or affiliation with the pension system by people over the age of 18  $y_{ai}$ . The variable to be explained is a binary response that takes the value 1 if the person contributes to a retirement scheme and 0 if not.

The proposed model suggests that the decision to make pension savings depends on a latent variable  $y^*$  which is determined by a set of exogenous variables, included in the vector  $x'$ , so that:

$$y_{ai}^* = x_i' \beta_j + u_i$$

$$y_{ai} = 1 \text{ si } y_{ai}^* > 0; y_{ai} = 0 \text{ si } y_{ai}^* \leq 0$$

Where the subscript  $i$  represents individuals  $y$ . Vector  $\beta$  represents the parameters of the model and  $u$  is a normal distribution error term of average 0 and variance 1.

A critical threshold  $y_i$  is assumed, based on which, if  $y_i^*$  is over  $y_i$  then an individual saves for retirement. This threshold  $y_i^*$ , similarly to  $y_i$ , is not observable; however, if it is assumed it is distributed normally with the same average and variance it is possible to estimate the regression parameters and thus obtain information on  $y_i$ .

$$P_i = P(y_i = 1 | x_i') = P(y_i \leq y_i^*) =$$

$$= P(Z_i \leq \beta x_i') = F(\beta x_i')$$

Where  $Z$  is a standard normal variable,

$$Z \sim N(0, \sigma^2) \text{ and } F = \left( \frac{1}{\sqrt{2\pi}} \right) \int_{-\infty}^{\beta x_i'} e^{-z^2/2} dz, \text{ is the}$$

cumulative normal distribution function.

The model is estimated for maximum likelihood as a series of probit models for the individuals. The marginal effects on the latent variable are calculated according to the different coefficients estimated in the models. The interpretation of these marginal effects is similar to that obtained in the linear regression models, so the coefficients represent the change in the probability of saving for retirement when a variable  $x_j$  belonging to the vector of exogenous variables  $x'$  changes, maintaining the other factors fixed, given that  $E(y^* | x') = x' \beta$ .

These estimates have been carried out using the information in the household surveys for Latin America, in particular the representative cases of Brazil, Chile, Colombia, Mexico and Peru. The model can be used to discover the probability of contributing to a pension system. Therefore, the dependent variable is a dichotomous type that reflects whether or not the person contributes to a pension system. This is determined by a common question asked in the five surveys (see *Appendix 2*), which will allow us to establish comparisons of the results obtained in each case.

With the aim of demonstrating the robustness of the models and identifying the most relevant explanatory variables to understand the decision to contribute for retirement in each country, three groups of explanatory variables have been included: first, personal characteristics (age, marital status, education, type of household, income, expenditure, zone of residence); second, labor market variables (sector, type of company, labor relationship, type of contract, formality); and finally, the complete model contains the two first groups of variables and also includes the geographical or regional dimension. A description of the variables can be reviewed in *Appendix 2*.

## 5. WHAT CONDITIONS THE PROBABILITY OF CONTRIBUTING TO A PENSION SYSTEM?

A review of the literature showed us that there are different approaches to the problem of low participation levels in pension systems. First, there are macroeconomic aspects that condition the growth of a country, income capacity and institutional aspects that make savings possible. Other aspects of a microeconomic nature, though they do not refute the above, focus the problems on the marginal improvements of greater or lesser participation in retirement savings given a particular macroeconomic situation. From this perspective, the analysis focuses on socioeconomic conditioners that allow a person to save for pension in Latin America.

Given this point of view, the studies give particular relevance to the role that the capacity to generate income may play, thus generating surplus for savings. Specific conditions such as gender, age, education or geographical area, that may affect consumption and savings over time (in a long-term product such as pensions) have also been taken into account. One element that at times is left out of political discussions but that may have an enormous impact on the success of a pension system is the labor-market condition. In this case, aspects related to the type of employment contract a worker has, or subjects related to the situation of informality in the firm's operation, may be relevant.

These elements are considered in the probit model we will discuss below, taking as a dependent variable the option that an individual has to contribute or not to pension systems, and as explanatory variables a set of socioeconomic characteristics grouped into personal aspects, an individual's employment situation, and geographical area. First we will carry out an analysis of the econometric results of each of the countries, and then provide a comparative analysis for Latin America.

As mentioned before, we will analyze the data of the overall contribution to the pension system without differentiating if the contribution is to a mandatory system or voluntary system. It was seen that the low penetration of voluntary schemes in the countries under analysis and the fairly low pension participation — despite it being mostly mandatory — makes this differentiation less relevant<sup>2</sup>.

### 5.1 RESULTS OF THE MODEL BY COUNTRY

#### Brazil

The model for Brazil (Table 1) shows the relevance of personal variables in explaining the probability of contributing to the pension system measured by an adjusted  $R^2$  of 20% that increases to 32% when employment variables are added.

Low educational and income levels are the factors that have the greatest negative influence on the probability of saving for retirement. Thus, in comparison with people with a higher education, those with only primary or lower have 27.5% less probability of contributing, while in people with secondary education, the probability falls by 12.9%. On the income side, people who form part of the three poorest quintiles are less likely to contribute to the pension system, with the probability down 25% in the case of quintile 1, 13% down for quintile 2 and 5.6% down for quintile 3.

Other personal variables that reduce the probability of contributing to the pension system are: being a woman, at 14.7% less probability compared with men; living in a rural zone, at 5% less than in an urban one; belonging to an ethnic group, at 4% less than for individuals not belonging to one; living in households with someone who is retired, at 6.5% less compared with those who do not; and age, where as the age rises, there is 0.04% less probability of contributing. It is worth pointing out that these two latter results are different from those found in

<sup>2</sup> Notwithstanding, we present in Appendix 3 the estimates for the private pension schemes in Brazil, which is mostly voluntary. The survey of this country allow us to make the differentiation, and we found that the results are similar to those obtained when analysing all the sample.

**Table 1.** Probit estimates for the determinants of pension contribution in Brazil. Source: Author's calculations.

	Contributes to federal, municipal or state social security institution or private funds?					
	Model 1		Model 2		Model 3	
Woman	-.1977109	***	-.1444574	***	-.1469201	***
Age	-.0044626	***	-.0003962	**	-.0004117	**
Rural	-.1183976	***	-.0632394	***	-.0503351	***
Married or with partner	.0647444	***	.0611959	***	.0565172	***
Size of household	.0018043	*	.0024525	*	.0030423	**
Primary education	-.2792839	***	-.264799	***	-.2747477	***
Secondary education	-.1254795	***	-.1259371	***	-.1289511	***
Belongs to ethnic group	-.0411065	**	-.0632347	**	-.0402469	
Household with minor(s)	.0668472	***	.0144115	***	.0127978	**
Household with pensioner(s)	-.1854143	***	-.0625944	***	-.0646418	***
Spending on housing	-2.20e-06		1.23e-06		-.0000112	
Income quintile 1	-.3776296	***	-.3010419	***	-.2498967	***
Income quintile 2	-.2436504	***	-.1649502	***	-.1299526	***
Income quintile 3	-.1303452	***	-.0745007	***	-.0564379	***
Income quintile 4	-.0178017	***	.0074504		.0098407	*
Independent worker			-.2569914	***	-.2496237	***
Unpaid worker			-.4760402	***	-.4749466	***
Informal worker			-.4968831	***	-.4917129	***
Primary sector			-.67049	***	-.6663555	***
Retail sector			-.1185654	***	-.1080489	***
Service sector			-.1041168	***	-.0962311	***
Lives in northern region					-.1688405	***
Lives in north-east region					-.1139732	***
Lives in southern region					.0248047	***
Lives in central region					-.0806546	***
Number of observations	197589		118880		118880	
Joint significance test	Wald chi2(15) =		Wald chi2(21) =		Wald chi2(25) =	
	35638.94		29928.59		30534.21	
	Prob > chi2 =		Prob > chi2 =		Prob > chi2 =	
	0,0000		0,0000		0,0000	
	Pseudo R2		Pseudo R2		Pseudo R2	
R2	= 0.2024		= 0.3247		= 0.3328	

other countries<sup>5</sup>, and may be related to the Brazilian policy, which apparently leans more toward solidarity, guaranteeing welfare retirement pensions to elderly adults who have not been able to accumulate savings for their retirement. According to Bertranou and Grafe (2007), in Brazil as adults approach retirement age their jobs become more precarious, so contributions to the pension system are reduced<sup>4</sup>. Given

<sup>5</sup> In *Appendix 4* it is presented the estimates including the Age-Squared variable, in order to see the marginal effect of age through the years.

<sup>4</sup> One hypothesis suggested in Bertranou and Grafe (2007) for this situation is the obsolescence of human capital, the impossibility of receiving welfare pensions when contributing to the pension system, or the preference for the more flexible jobs that are usually available in the informal sector.

this solidarity, Brazil is the Latin American country with the highest coverage rate for elderly adults (87% in 2002) receiving some kind of benefit.

The personal characteristics that increase the probability of contributing to the pension system are: being married, 5.6% more probable compared with single people; and living in households with underage, 1.2% more probable than for people who live without people under the age of 18.

It is interesting to point out that all the labor market variables included in the model are statistically significant at 99%, and all reduce the probability of saving in the pension system. Taking dependent employees as a parameter for comparison, independent workers have 24.9% less probability of making contri-

**Table 2.** Probit estimates for the determinants of pension contribution in Chile. Source: Author's calculations.

	Has contributed to the pension scheme in the reference year (2011)?		
	Model 1	Model 2	Model 3
Rural	-0,04257 ***	-0,01535 **	-0,01526 **
Woman	-0,22660 ***	-0,02315 ***	-0,02305 ***
Age	-0,00652 ***	0,00028	0,00028
Belongs to ethnic group	-0,03107 **	-0,02104 **	-0,01945 *
Married or with partner	-0,02700 ***	-0,01298 *	-0,01284 *
Primary education	-0,09229 ***	-0,02442 **	-0,02457 **
Secondary education	-0,03956 ***	-0,01055	-0,01056
Size of household	0,00903 ***	0,00195	0,00200
Household with minor(s)	0,00249 ***	0,00087	0,00086
Household with pensioner(s)	-0,09992 ***	-0,01299	-0,01311
Household receives public transfers	0,01329	-0,02390 ***	-0,02355 ***
Income quintile 1	-0,28281 ***	-0,14960 ***	-0,14992 ***
Income quintile 2	-0,11428 ***	-0,08048 ***	-0,08040 ***
Income quintile 3	-0,04555 **	-0,06730 ***	-0,06695 ***
Income quintile 4	-0,05825 ***	-0,06797 ***	-0,06761 ***
Spending on housing	0,0000002 ***	0,00000	0,00000
Spending on education	-0,0000002 ***	-0,00001% **	-0,0000001 **
Bank user	0,13647 ***	-0,00361	-0,00343
Employer		0,02331 *	0,02381 *
Independent worker		-0,03409 **	-0,03408 **
Family worker		-0,25426 ***	-0,25465 ***
With formal contract		0,53945 ***	0,53957 ***
Informal worker		-0,01856 *	-0,01873 *
Retail sector		-0,00239	-0,00206
Service sector		-0,01148	-0,01128
Primary sector		-0,00561	-0,00498
Micro-enterprise		-0,02551 ***	-0,02538 ***
Small company		0,00306	0,00292
Lives in poorest region			0,00089
Lives in region with average poverty level			-0,01017
Number of observations	53142	33492	33492
Joint significance test	Wald chi2(18) = 2512,91	Wald chi2(28) = 3907,66	Wald chi2(30) = 3913,02
	Prob > chi2 = 0,0000	Prob > chi2 = 0,0000	Prob > chi2 = 0,0000
R2	Pseudo R2 = 0,1425	Pseudo R2 = 0,4789	Pseudo R2 = 0,4791

butions, unpaid workers 47.5% and informal workers 49,2% less probability.

By economic sectors, compared with workers in the manufacturing sector, employees in the primary sector (66.6% less), retail trade (10.8% less) and services (9.6% less) all have a lower probability of contributing toward retirement. The result in the primary sector is particularly worth examining, as it is the most negative coefficient in the model and is not comparable with any of the other four countries. However, the data could be overestimated given that the pension system in the rural Brazilian sector, where agricultural activity is concentrated, is different and does not oblige workers to make contributions from income, while it does

receive major financial assistance (Bertranou and Grafe, 2007).

In a country the size of Brazil, geography is important; depending on the geographical division used, residents of the northern, central and north-east regions have 16.8%, 8% and 11.4% less probability of making contributions, taking as a reference the southeast region. Rio de Janeiro and Sao Paulo are located in the southeast, where most of the manufacturing sector and 42% of the population are concentrated. Using the same parameter for comparison, people who live in the south of the country have 2.5% greater probability of contributing to the system. Examining the reasons that favor contribution in the southern region is beyond the

scope of this study, but it should be pointed out that this region has consolidated an industrial park, the population is concentrated in the urban area and a significant proportion are European immigrants or their descendants.

#### Chile

Personal characteristics are statistically significant to explaining the decision to contribute to the Chilean pension system. In a country with a high contribution level, income is a limiting variable for individuals to contribute to the pension system. That is why belonging to the poorest quintile of the population reduces the probability of contribution by 14%, compared with the richest quintile. As income levels increase, the probability of contributing is greater. This can be seen with the reduction of negative coefficients in the model (Table 2).

Other personal variables that reduce the probability of contributing to the pension system by between 1% and 2% are: living in a rural zone, being a woman, having only primary education or less, being married, and belonging to an ethnic group. These coefficients are calculated in comparison with residents in the urban sector, men, single, who do not belong to any ethnic group and who have higher education. An interesting result in the case of Chile is the negative effect of spending on education, although the coefficient is very small ( $-0.00001\%$ ). This would be a reflection of the relative importance the population gives to private education in this country as a mechanism for economic transition<sup>5</sup>.

Labor market variables increase the explanatory power of the model (adjusted  $R^2$  increases from 14.2% to 47.8%). Thus, being bound by a formal contract increases the probability of contributing to the system of retirement savings by 54% compared with workers without a contract. This would be related to labor law, which requires employers to discount and pay the contributions corresponding to their workers into the pension system (Law 3500 of 1980 and its amendments or subsequent implementing regulations). Despite it being mandatory for self-employed workers to make contributions, being independent reduces the probability of them doing so by 3.4%; while the fact of being an employer increases the probability by 2.4%. At the same time, family workers have 25% less probability of making contributions compared with dependent workers.

With respect to the informality variable, in the case of Chile it only reduces the probability of making

contributions by 1.8%. This result may be explained because Chile is one of the Latin American countries with the lowest levels of this indicator. Some estimates put the Chilean working population not in the formal economy at 30%; this figure is lower than Brazil (38%), Mexico (54%), Colombia (56.8%) and Peru (68.8%)<sup>6</sup>.

Finally, the size of the company to which the individual is linked has an influence on the probability of the individual making contributions: workers in micro-enterprises have 2.5% less probability of contributing towards their retirement compared with employees in medium-sized or large companies. The variables of geographical location are not significant in Chile. This may be related to its size (only 17 million people), ease of communication and the policy of decentralization and integration between regions.

#### Colombia

The model for Colombia provides the highest level of explanatory power. With the three groups of variables considered, we achieve an adjusted  $R^2$  of 66%, but it is the employment variables that increase this value most (see Table 3). Individually, the variables that are relevant in the model, except for the "spending on housing" variable, are statistically significant to 99%.

The individual characteristics that lower the probability of saving for retirement are: being a woman (6.5% less probable than men) and only having primary education or lower (13.6% less probability than people with higher education). Other common variables that also reduce the probability of making contributions similar to the rest of the countries covered by this study are: living in a rural area (6.5% less probability in comparison with the urban population); having secondary-level education (7.8% less probability than people with higher education); and the size of the household, where with more people in the household the probability of contributing to the pension system reduces by 1.5%. Income is also a major barrier for contributing to the pension system. Compared with the richest population quintile, people in the first three quintiles have less probability of contributing to the pension system (the probability is 13% lower in quintile 1 and 2% lower in quintiles 2 and 3).

With respect to other factors, being married increases the probability of contributing by 5.6%; individuals who live in households with minors increase the probability by 1.5%; while increased age raises the probability by 0.4%. Other variables positively affect-

<sup>5</sup> According to the OECD (2011), while in OECD countries private finance of education represents 17.4% on average, in Chile spending by families at all educational levels amounts to 40% of the funding of the educational system. In Mexico this figure stands at 19.5%.

<sup>6</sup> CEPAL and OIT (2013).

**Table 3.** Probit estimates for the determinants of pension contribution in Colombia. Source: Author's calculations.

	Has contributed to the pension scheme in the reference year (2011)?		
	Model 1	Model 2	Model 3
Woman	-.0725382 ***	-.0642511 ***	-.0645414 ***
Rural	-.1080207 ***	-.0508095 ***	-.0475322 ***
Age	.0007015 ***	.0039166 ***	.0039262 ***
Size of household	-.0264152 ***	-.0191687 ***	-.0152874 ***
Married or with partner	.0569933 ***	.0539163 ***	.0564244 ***
Household with minor(s)	.0214324 ***	.0168131 ***	.014621 ***
Primary education	-.3234188 ***	-.1329078 ***	-.1355141 ***
Secondary education	-.2259994 ***	-.0788681 ***	-.0778521 ***
Income quintile 1	-.2637717 ***	-.1430441 ***	-.1292858 ***
Income quintile 2	-.0634356 ***	-.0352833 ***	-.0220524 ***
Income quintile 3	-.0464352 ***	-.0377754 ***	-.0294098 ***
Income quintile 4	.01978 ***	-.0016174	.0027492
Household with pensioner(s)	.0010726	.0034068	-.0037661
Spending on housing	3.12e-08 ***	2.82e-08 ***	1.54e-08
Household receives remittances	-.0457492 ***	-.0063311	-.0113148
Ease of response to shocks	.0433061 ***	.0158344 ***	.0182796 ***
Bank user	.0044164	.1008256 ***	.0864614 ***
With formal contract		.5806614 ***	.5774664 ***
Domestic employee or day worker		-.0025779	.0007749
Independent worker		-.1330025 ***	-.1208708 ***
Primary sector		-.0257559 ***	-.022434 ***
Retail sector		-.0087448	-.0032782
Service sector		.0028286	.0090023
Informal worker		-.1570865 ***	-.2071322 ***
Family worker		-.1536112 ***	-.1480287 ***
Micro-enterprise		-.2621656 ***	-.2637815 ***
Small company		-.0912806 ***	-.0902069 ***
Lives in Atlántica region			-.1137441 ***
Lives in Pacífica region			-.0327507 ***
Lives in Oriental region			-.0278123 ***
Lives in Central region			.017963 ***
Number of observations	311042,00	310645	310645
Joint significance test	Wald chi2(17) = 23997,83 Prob > chi2 = 0,0000	Wald chi2(27) = 47087.41 Prob > chi2 = 0.0000	Wald chi2(34) = 45377.91 Prob > chi2 = 0.0000
R2	Pseudo R2 = 0,2339	Pseudo R2 = 0.6531	Pseudo R2 = 0.6580

ing contribution to the pension system are banking use (8.6% more probable compared with those excluded from the banking system); and facility of response to exogenous shocks (such as loss of employment), at 1.8% more probable.

It is worth noting that the labor market variables, such as informality, are the most negative factors affecting pension saving. Being in the informal sector reduces the probability of contributing to the system by 20.7%, with respect to formal workers. This result

reflects the importance that informality has in Colombia, where according to the ILO<sup>7</sup>, between 57% and 70% of people work in the informal sector. This idea is reinforced by seeing that those who are in vulnerable jobs, self-employed (-12.1%) and unpaid family workers (-14.8%) are also less likely to save for their retirement.

Along the same lines as the above, workers in the primary sector and those employed by micro-enterprises and small companies are also less likely to contribute to the pension system. In the case of micro-enterprises, the probability falls by 2.2% compared with workers in the manufacturing sector. By size of companies, the coefficient for micro-enterprises (-26.4%) is the most negative, as it is in all the countries studied. The figures are very important, taking into account that these types of enterprises employ<sup>8</sup> 51% of the working population in Colombia.

In terms of geographical location, in Colombia, residents in the Atlantic, Pacific and Oriental regions are less likely to contribute to pension schemes, compared with those living in Bogota D.C. The coefficients for the Atlantic and Pacific regions are the most negative, at -11.4% and -3.3%, which is reasonable taking into account that these two regions have the highest poverty levels<sup>9</sup>. In contrast, residents in the Central region have a 1.8% greater probability of contributing to the system, which is in line with the fact that the departments with the lowest poverty levels, most economic activity and equality are concentrated in this region.

#### Mexico

The estimations for Mexico (*Table 4*) show that the personal characteristics that most negatively impact the probability of saving for retirement are: being a woman (-13.7%) compared with men; having only primary education (-17.8%); and having a low income. In Mexico, as in the other countries studied here, being in the poorest quintile is a limiting factor that reduces the probability of making pension contributions by 15.9%. At the same time, while increasing the income quintile reduces the estimated coefficient, it continues to be negative (-7% for quintile 2 and -2.8% for quintile 3). These results are based on a comparison with the richest income quintile.

<sup>7</sup> According to the Davalos (2013) who cites data of International Labor Organization-ILO, informality in Colombia in 2010 was nearly 70%, while the report by CEPAL and OIT (2013) indicates that urban informality in Colombia stands at 56.8%. DANE (2013) suggests informal employment stands at 49.5%.

<sup>8</sup> DNP (2005)

<sup>9</sup> According to DANE (2012) all the departments in the Atlantic region have a poverty level above the national average and three out of five departments with the highest poverty level belong to this region. The Pacific region has two of the poorest departments in Colombia: Chocó and Cauca.

Living in the rural sector rather than in an urban environment also leads to a lower probability of saving through the pension system, with a fall of 5%. The probabilities are also reduced if the individual belongs to an ethnic group (-3%); if the size of the household is bigger (-2.3%); if he or she receives remittances (-0.001%); or is a beneficiary of public transfers (-0.002%). Although the coefficient for remittances is small, it is worth pointing out that in Mexico remittances are the main source of income<sup>10</sup> for many households, and amounted to 2% of GDP in 2010; those who depend on them may not have sufficient money to save for their own retirement, or may see them as a source of income for retirement.

The personal variables that increase the probability of making contributions to the pension system are: being married (5.47%); living in households with underage (3.25%); using banks (2.28%); and the possibility of responding more easily to external shocks such as losing a job (1.68%). Being older also implies a 0.55% greater probability of saving for retirement. One interesting variable that is only significant and positive in Mexico is living in households that already include one retired person. In this case, the probability of making pension contributions increases by 14.69%. This result may indicate greater incentives to contribute when some family member already benefits from retirement.

By introducing the labor market variables, it is possible to obtain a more explanatory model (adjusted R<sup>2</sup> increases from 19.5% to 35%). The significant variables reveal that precarious employment has the greatest negative effect on the probability of saving for retirement, so informal workers reduce this probability by 23.6% compared to workers in the formal sector; self-employed workers by 19.6% compared with dependent workers, and employees of micro-companies or small companies by -11.1% and -4.3% respectively, compared with workers in medium-sized and large companies. In addition, workers in the retail (-5.4%) and services (-3.6%) sectors are also less likely to contribute to the retirement system, compared with employees in the manufacturing industry. Mexicans with a formal employment contract and those who work in private-sector companies are more likely to contribute to the pension system, compared with their peers without a contract; in the former case, the probability is 32% greater, while in the latter it increases by 11.7% for employees of private-sector companies compared with employees in public-sector companies.

The regional factor in Mexico has been calculated using the CONAPO municipal marginalization indica-

<sup>10</sup> According to the Bank of Mexico (2009), 86.4% of remittances are used to maintain the family.

**Table 4.** Probit estimates for the determinants of pension contribution in Mexico. Source: Author's calculations.

	Contribution to mandatory pensions and/or voluntary AFORE		
	Model 1	Model 2	Model 3
Rural	-0,13994 ***	-0,11099 ***	-0,05045 ***
Woman	-0,20753 ***	-0,13703 ***	-0,13733 ***
Age	0,00297 ***	0,00612 ***	0,00585 ***
Primary education	-0,28343 ***	-0,18370 ***	-0,18288 ***
Secondary education	-0,07725 ***	-0,02792 **	-0,03217 **
Belongs to ethnic group	-0,05999 ***	-0,05042 ***	-0,03014 ***
Married or with partner	0,05552 ***	0,05336 ***	0,05475 ***
Size of household	-0,03325 ***	-0,02594 ***	-0,02280 ***
Household with minor(s)	0,04080 ***	0,03413 ***	0,03241 ***
Household with pensioner(s)	0,14818 ***	0,15333 ***	0,14694 ***
Household receives remittances	-0,00001 ***	-0,00001 ***	-0,00001 ***
Household receives public transfers	-0,00004 ***	-0,00003 ***	-0,00002 ***
Income quintile 1	-0,30226 ***	-0,21274 ***	-0,15944 ***
Income quintile 2	-0,17896 ***	-0,09511 ***	-0,07068 ***
Income quintile 3	-0,09969 ***	-0,03975 **	-0,02822 *
Income quintile 4	-0,05296 ***	-0,01800	-0,01138
Spending on housing	0,00000 **	0,00000	0,00000
Health expenses	0,00000 **	0,00000	0,00000
Spending on education	0,00000	0,00000	0,00000
Bank user	-0,11496 ***	0,02922 **	0,02276 *
Ease of response to shocks	0,03742 ***	0,01645 **	0,01680 **
Independent worker		-0,19722 ***	-0,19064 ***
Works in family enterprise		0,00437	-0,02892
Works in NGO		-0,05352	-0,06440
Works in private enterprise		0,15523 ***	0,11694 ***
With formal contract		0,32118 ***	0,32062 ***
Informal worker		-0,22390 ***	-0,23423 ***
Retail sector		-0,04870 ***	-0,05394 ***
Service sector		-0,02793 *	-0,03598 **
Primary sector		-0,03841 **	-0,02202
Micro-enterprise		-0,12311 ***	-0,11168 ***
Small company		-0,05120 ***	-0,04269 **
Lives in town with high level of marginalization			-0,26982 ***
Lives in town with level rate of marginalization			-0,13978 ***
Number of observations	62136	37782	37782
Joint significance test	Wald chi2(21) = 6913,37 Prob > chi2 = 0,0000	Wald chi2(32) = 6205,36 Prob > chi2 = 0,0000	Wald chi2(34) = 6534,05 Prob > chi2 = 0,0000
R2	Pseudo R2 = 0,1957	Pseudo R2 = 0,3498	Pseudo R2 = 0,3619

tor<sup>11</sup>. This indicator classifies municipalities in Mexico as with high, medium and low levels of marginalization.

For this exercise, the high and medium-level marginali-

<sup>11</sup> This index is calculated by the National Population Council using a variety of dimensions: educational level; characteristics of the home; availability of basic services; overcrowding; earth floors; small, dispersed and isolated municipalities; and low monetary income.

**Table 5.** Probit estimates for the determinants of pension contribution in Peru. Source: Author's calculations.

Has contributed to the pension scheme in the reference year (2011)			
	Model 1	Model 2	Model 3
Rural	-0,03715 ***	-0,00348	0,00210
Woman	-0,06233 ***	-0,02689 ***	-0,02682 ***
Age	0,00077 ***	0,00141 ***	0,00139 ***
Married or with partner	0,02895 ***	0,02127 ***	0,02155 ***
Primary education	-0,16273 ***	-0,07531 ***	-0,07497 ***
Secondary education	-0,09275 ***	-0,02894 ***	-0,02959 ***
Size of household	-0,01104 ***	-0,00550 ***	-0,00543 ***
Household with minor(s)	0,00685	0,00979 **	0,00978 **
Household receives public transfers	0,00000 *	0,00000	0,00000
Receives remittances	0,00000 ***	0,00000	0,00000
Income quintile 1	-0,11589 ***	-0,06103 ***	-0,05857 ***
Income quintile 2	-0,07775 ***	-0,03479 ***	-0,03434 ***
Income quintile 3	-0,05180 ***	-0,02177 ***	-0,02172 ***
Income quintile 4	-0,02821 ***	-0,00960 **	-0,01003 **
Spending on housing	0,00000	0,00001	0,00001
Health expenses	0,00000	0,00000 **	0,00000 **
Spending on education	-0,00001 *	-0,00001	0,00000
Household with pensioner(s)	0,01184	0,00678	0,00552
Bank user	0,07550 ***	0,05246 ***	0,05211 ***
Independent worker		-0,07223 ***	-0,07089 ***
Family worker		-0,04702 ***	-0,04527 ***
contract		0,19415 ***	0,19306 ***
Informal worker		-0,13640 ***	-0,13624 ***
Primary sector		-0,02187 ***	-0,02324 ***
Service sector		-0,00686	-0,00598
Retail sector		0,00664	0,00714
Micro-enterprise		-0,01790 ***	-0,01708 ***
Small company		-0,01496 ***	-0,01519 ***
Costa			0,01412 ***
Sierra			-0,00911 **
Selva			-0,01144 **
Number of observations	61898	50721	50721
Joint significance test	Wald chi2(19) = 4510,70 Prob > chi2 = 0,0000 Pseudo R2 = 0,2110	Wald chi2(28) = 8371,71 Prob > chi2 = 0,0000 Pseudo R2 = 0,5123	Wald chi2(31) = 8361,47 Prob > chi2 = 0,0000 Pseudo R2 = 0,5134

zation municipalities are compared with those of low levels of marginalization. As was to be expected, living in municipalities with a higher level of marginalization reduced the probability of saving for retirement by 26.98%, while living in zones with a medium level of marginalization reduced it by 14%, compared with

people who live in municipalities with a low level of marginalization.

#### Peru

In the case of Peru, age, living with a partner and being in a household with children under the age of 18 increased the probability of paying into a pension

scheme by 0.1%, 2% and 1% respectively (see *Table 5*). In contrast, being a woman (−2.7%), living in a larger household (−0.5%) and having a lower income cut the probability of saving. As in the rest of the countries, an individual's income level can be a major barrier to making contributions to the pension system. Compared with the richest quintile, the poorest quintile has 5.9% less probability of making pension contributions; this figure falls to −3.4% for quintile 2 and −2.2% for quintile 3.

In Peru, having only primary education or less reduces the probability of making contributions by 7.5%, and those who have secondary education have 3% less probability of saving for retirement compared with individuals who have higher education. In addition, individuals who use banks have 5.2% more probability of saving for retirement compared with those who have no relationship with financial institutions. Unlike other countries studied, living in a rural area does not have any significant effect.

The introduction of employment variables increases the explanatory power of the model (adjusted  $R^2$  increases from 21% to 51%), and except for the employment link through a formal employment contract, the other variables included in the model reduce the probability of contributing to the pension system. The variable with the most negative effect is informality, which reduces the probability of contributions compared with formal workers by 13%. The type of employment situation is also relevant, with less probability for independent workers (−7.1%) and family workers (−4.5%). These figures may be associated with the special characteristics of the Peruvian labor market: first, there is the level of informality in Peru, which is one of the highest in Latin America and the Caribbean, amounting to 68.8% according to ILO figures; then there is the proportion of “vulnerable” employment<sup>12</sup>, which corresponds to 38.7% of workers (the self-employed, auxiliary family workers, informal salaried workers, subsistence workers). Along the same lines, it is interesting to see that the variable with the greatest positive effect on the probability of saving for retirement is work with a formal employment contract: 19.3% higher than those who do not have this kind of employment guarantee.

By economic sectors, workers in the primary sector have less probability, −2.3%, of making contributions compared with workers in the manufacturing sector. Similarly, it is less probable that employees in micro-enterprises, at −1.7%, and small companies, at −1.5%, make contributions to the pension system compared

with workers in larger companies. Meanwhile, in geographical terms, when comparing the different regions with metropolitan Lima, it can be seen that for those who reside in the Sierra or Selva regions, the probability of making contributions is reduced by 0.9% and 1.1% respectively. In contrast, living in the Costa region increases the probability by 1.4%.

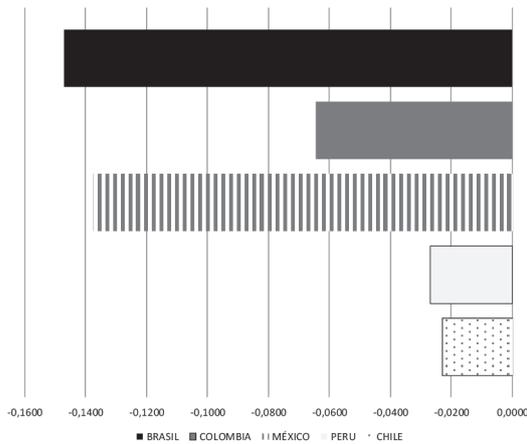
## 5.2 THE RELEVANCE OF THE LABOR MARKET IN THE PROBABILITY OF MAKING CONTRIBUTIONS: A LATIN AMERICAN COMPARATIVE

Reviewing the results for the region as a whole, some interesting aspects emerge that are worth highlighting. They include how the characteristics of individuals included in national household surveys affect the probability of contributing to a pension scheme. In a way that cuts across the different countries, it can be seen that rural areas have a negative statistical effect on the probability of contributing, except in the case of Peru. The maximum effect can be seen in Colombia, with a reduction of 5% in the probability of saving, compared with living in urban areas. Belonging to one of the native ethnic groups in the country, particularly in the cases of Brazil, Chile and Mexico, has a negative effect on the probability of contributing, with a maximum of 4% in the case of Brazil. Low educational levels also have a significant negative effect on the factors conditioning contributions to pension schemes, with a reduction in the probability of contributing in all cases, and a maximum impact of 8% in Peru. Being older appears to contribute positively as it increases the probability of contributing, although the percent difference is low; this would be in line with the reduced preference for immediate consumption in accordance with the life-cycle theory, although it is only seen in the case of Colombia, Mexico and Peru. However, it is interesting to observe the continued role of gender problems in the region, with negative and statistically significant effects on the probability of saving for retirement, at around 2%, and with a maximum negative effect in Colombia, where the contribution would fall by 6% simply because of being a woman (see *Figure 7*).

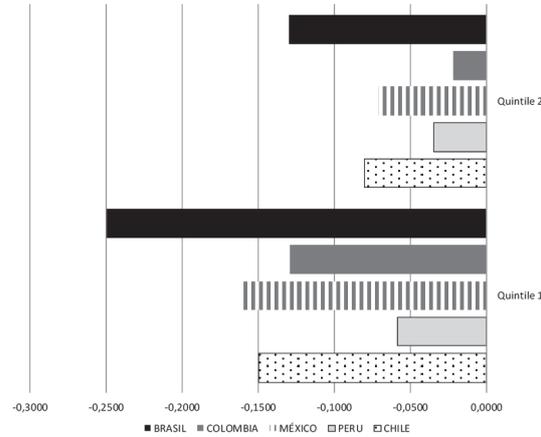
Other economic variables are also interesting, such as the case of public transfers, which give a negative and significant result in the cases of Mexico and Chile, at a maximum of 2%. Remittances from abroad, which is an important variable in Mexico, have a significant negative statistical effect only in this country, although with a probability coefficient of less than 1%. Greater access to the financial system is positively affecting the probability of making pension contributions in Peru and Colombia; in contrast, higher spending for house purchase, which could have been

<sup>12</sup> Id., ILO (2013). 2011 data.

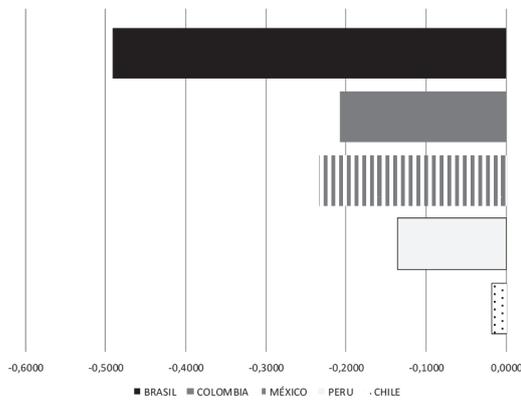
**Figure 7: Women contribution probit coefficients**



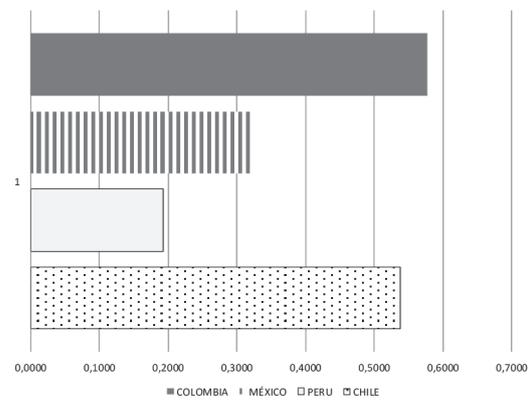
**Figure 8: Poorest income quintiles contribution probit coefficients**



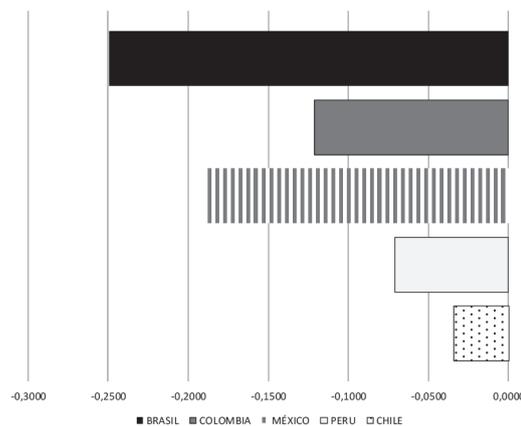
**Figure 9: Informal worker contribution probit coefficient**



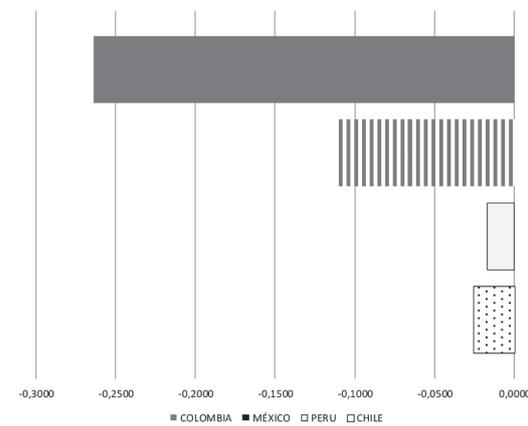
**Figure 10: Worker with legal contract contribution probit coefficient**



**Figure 11: Independent worker contribution probit coefficient**



**Figure 12: Microenterprise worker contribution probit coefficient**



thought to have a negative effect as the families may consider it as significant household investment savings, is not statistically significant.

Aspects related to income are therefore important elements that affect the probability of making contributions to pension schemes. It is relevant here to note that the surveys which include a question meas-

uring the ease of response to shocks that a person may experience show that this capacity positively affects the probability of making contributions, and that the results for Colombia and Mexico reveal impacts of around 2% in both cases. Measurement of income, classified by a person belonging to a specific income quintile, shows that the poorest groups have very neg-

ative and significant probability coefficients (Figure 8). The probabilities of contributions being reduced are above 10% in all the cases of people in quintile 1, with a maximum effect of 25% in the case of Brazil.

However, it is the characteristics of the labor market that present the most relevant and significant probabilistic effects, with a relevant effect in the adjustment of the model (R2) as a whole in all cases (compare the size of the increase of the R2 in Model 3 with respect of Model 1 and 2 in all the tables). Figure 9 shows the case of an informal worker, with negative and significant effects on the probability of contributing to a pension scheme, and maximum effects in Brazil of -49% and in Chile of -23%. Figure 10 shows the situation of workers who have a legal employment contract, which increases the probability of contributing substantially in all cases, particularly in Brazil, where this probability is 60% higher. Figures 11 and 12 include more specific aspects such as being an independent worker, whose greater employment vulnerability means that the probability of contributing reduces in all cases, with maximum effects of -25% and -12% in the cases of Brazil and Colombia respectively; while in the case of workers in micro-enterprises, the effect is also negative in the region, with the highest level in Colombia, at -23%. Also worth noting is that in the case of Chile, being a family worker has a significant negative effect on the probability of contributing, at 25%.

Meanwhile, except for the case of Chile, geographical variables have a negative effect on the probability of making contributions to pension schemes, although they are most significant only in the case of Colombia, Brazil and Mexico.

## CONCLUSIONS

Pension coverage in Latin America continues to be a pending challenge in the region. After approximately twenty years of structural reforms, progress has been minimal. Different studies have identified macro and microeconomic factors behind this reality, but efforts to properly quantify and identify common explanatory variables have been scarce. In this sense, this research has taken advantage of the information that national household surveys have been gradually recording on social security issues. Based on this, the study has designed probit models for each of the five representative countries in Latin America (Brazil, Chile, Colombia, Mexico and Peru) in order to identify individual's conditions that affect the likelihood to contribute to savings for retirement. Three groups of explanatory variables have been included in the models: personal characteristics (age, marital status, education, type of household, income, expenditure, zone of residence);

labor market variables (sector, type of company, labor relationship, type of contract, formality); and the geographical dimension.

Some relevant aspects stand out. It can be seen that rural areas have a negative statistical effect on the probability of contributing in most of the cases. Belonging to one of the native ethnic groups has a negative effect on the probability of contributing. Low educational levels also have a significant negative effect on the factors conditioning contributions to pension schemes. Being older appears to contribute positively as it increases the probability of contributing in the case of Colombia, Mexico and Peru. Also relevant is the continued role of gender problems in the region, with negative and statistically significant effects on the probability of saving for retirement.

Interesting is the case of public transfers, which give a negative and significant result in the cases of Mexico and Chile, and remittances from abroad, an important variable in Mexico, with a significant negative statistical effect. It is also relevant to note that the surveys which include a question measuring the ease of response to shocks that a person may experience show that this capacity positively affects the probability of making contributions. Measurement of income shows that the poorest groups have very negative and significant probability coefficients. Meanwhile, except for the case of Chile, geographical variables have a negative effect on the probability of making contributions to pension schemes, although they are most significant only in the case of Colombia, Brazil and Mexico.

However, labor markets in Latin America seem to be the most important aspect affecting the capacity of individuals to save for retirement. Labor market variables included in each of the country probit models stand out for their explanatory contribution to the estimations and their statistical significance. In those countries where there is a problem of informality, or greater vulnerability of employment (as manifested in more independent employment, family work or belonging to a small firm) the predictive value of the estimation model created increases substantially, as well as the absolute value of the probability coefficients of making contributions to a pension system. The results imply that if we want to achieve substantial improvements in the active participation of workers in pension systems, probably, two actions are required: firstly, in the long-term, to reduce the distortions that may hinder the improvement of how Latin American labor markets operate; and, secondly, simultaneously, to take actions in the short and medium-term in order to adapt to an informal labor market reality. Obviously how to operate in both sides is beyond the scope of this study and a topic for future research.

## REFERENCES

- Acosta, O. and J. Ramirez (2004). "Las Redes de Protección Social," Series Financiamiento del Desarrollo No. 141. Santiago de Chile, Chile: Cepal.
- Allen, F., A. Demircuc-Kunt, L. Klapper and M. Martinez Peria (2012). "The Foundations of Financial Inclusion: Understanding Ownership and Use of Formal Accounts," Policy Research Working Paper Series No. 6290. Washington, DC: The World Bank.
- Ashraf, N., D. Karlan and W. Yin (2006). "Tying Odysseus to the mast: evidence from a commitment savings product in the Philippines," *Quarterly Journal of Economics* 121 (2): 635–72.
- Banerjee, A. & E. Duflo (2011). *Poor Economics: A Radical Rethinking of the Way to Fight Global Poverty*, New York, NY: Public Affairs-Perseus Group Book
- Bassett, W., M. Fleming and A. Rodrigues (1998). "How Workers Use 401 (k) Plans: The Participation, Contribution, and Withdrawal Decisions," Staff Reports No. 38, March. New York, NY: The Federal Reserve of New York.
- Bertranou F. and F. Grafe (2007). "La Reforma del Sistema de Pensiones en Brasil: Aspectos Fiscales e Institucionales," Draft not edited No. RG-P1126. Washington, DC: Banco Inter-Americano de Desarrollo.
- Beshears, J., J. Choi, D. Laibson and B. Madrian (2008) "The Importance of Default Options for Retirement Savings Outcomes: Evidence from the United States," in S. Kay and T. Sinha, eds., *Lessons from Pension Reforms in the Americas*. Oxford, UK: Oxford University Press: 59–87
- Beshears, J., J. Choi, D. Laibson and B. Madrian (2010). "The impact of employer matching on savings plan participation under automatic enrolment" in David. A. Wise, ed., *Research Findings in the Economics of Aging*. Chicago, IL: Chicago University Press: pp. 169–210.
- Börsch-Supan, A., M. Coppola & A. Reil-Held (2012). "Riester Pensions in Germany: Design, Dynamics, Targetting Success and Crowding-In," in R. Hinz, R. Holzman, D. Tuesta and N. Takayama, ed., *Matching Contributions for Pensions: A Review of International Experience*. Washington, DC: The World Bank: pp. 81–101.
- Bravo, D., J. Eguiguren, T. Rau & J. Vásquez (2008). "Determinantes del Ahorro Previsional Voluntario en Chile". Departamento de Economía Universidad de Chile. Versión Preliminar. Julio 2008
- Bosch, M., A. Melguizo & C. Pages (2013) "Mejores pensiones, mejores trabajos. Hacia la cobertura universal en América Latina y el Caribe". Banco Interamericano de Desarrollo, Washington D.C.
- Carranza, L.A. Melguizo & D. Tuesta (2012). "Matching contributions in Colombia, Mexico and Peru: experiences and prospects," in R. Hinz, R. Holzman, D. Tuesta and N. Takayama, ed., *Matching Contributions for Pensions: A Review of International Experience*. Washington, DC: The World Bank: pp. 193–213.
- Cepal and OIT (2013). "Coyuntura laboral en América Latina y el Caribe: Avances y Desafíos en la Medición del Trabajo Decente" Reporte N° 8, May. Santiago de Chile, Santiago: Naciones Unidas-OIT.
- Clark, R. & S. Schieber (1998). "Factors affecting participation levels in 401 (k) plans," in O. Mitchell and S. Schieber, eds., *Living with defined contribution plans: remaking responsibility for retirements*. Philadelphia, PA: University of Pennsylvania Press: pp. 69–96.
- Choi, J., D. Laibson, B. Madrian and A. Metrick (2002). "Defined Contribution Pensions: Plan Rules, Participant Decisions, and the Path of Least Resistance," in J. Poterba, ed., *Tax Policy and the Economy*, Vol. 16. Cambridge, MA: MIT Press: pp. 67–115.
- Choi, J., D. Laibson, B. Madrian and A. Metrick (2004a). "Plan design and 401 (k) Savings Outcome," *National Tax Journal*, 57 (2): 275–98.
- Choi, J., D. Laibson, B. Madrian and A. Metrick (2004b). "Saving for retirement on the path of Least Resistance," in NBER Papers, N° NB04–08, Cambridge, MA: National Bureau of Economic Research.
- Christiadi and B. Cushing (2007). "Conditional logit, IIA, and alternatives for estimating models of interstate migration" Research Paper presented at the 46th annual meeting of the Southern Regional Science Association. Charleston, SC, March 29–31.
- Correa, G. (2011). "Un Estudio Empírico sobre el Ahorro Voluntario Previsional," Tesis de Grado Magister en Economía. Diciembre. Santiago de Chile, Chile: Pontificia Universidad Católica de Chile.
- Costa, R. Da, J.R. de Laiglesia, E. Martinez and A. Melguizo (2011). "The Economy of the Possible: Pensions and Informality in Latin America," OECD Development Centre Working Paper N° 295, Paris, France: Centro de Desarrollo de la OCDE.
- Davalos, J. (2013) "Labor Exclusion and Informality in a Latin American country, a Latent Class model approach," Presentation in *Jornadas sobre Análisis del Mercado Laboral, 2013*. Bogota: Colombia. DANE-Departamento Administrativo Nacional de Estadística (2013) "Medición del empleo informal y seguridad social" Bogotá. DANE-Departamento Administrativo Nacional de Estadística (2011) "Gran Encuesta Integrada de Hogares-GEIH para Colombia" <http://formularios.dane.gov.co/pad/index.php/catalog/185>
- DANE-Departamento Administrativo Nacional de Estadística (2012) "Pobreza en Colombia" Comunicado de prensa. 5 de Mayo de 2012
- Demircuc-Kunt, A. and L. Klapper (2012). "Measuring Financial Inclusion: The Global Findex Database," Policy Research Working Paper Series 6025. Washington, DC: The World Bank.
- Duflo, E., W. Gale, J. Liebman, P. Orzag and E. Saez (2006). "Saving Incentives for Low- and Middle — Income Families: Evidence from a Field Experiment with H&R Block," in *Quarterly Journal of Economics*, 121 (4): 1311–1346.
- Engelhardt, G and A. Kumar (2007). "Employer Matching and 401 (k) Saving: Evidence from the Health and Retirement Study," *Journal of Public Economics*, 91 (10): 1920–1943.
- Francke P. and W. Mendoza (2005). "El Grado de Orientación Pro-pobre de las Políticas Económicas Peruanas: Una Revisión Bibliográfica," *Revista Economía*, 28 (55–56): 11–82.
- Gill I., T. Packard, and J. Yermo (2005). *Keeping the Promise of Social Security in Latin America*, Washington, DC: The World Bank.
- Greene, William (2011). *Econometric Analysis*, 7<sup>th</sup> Edition. Prentice Hall
- Hastings, J., B. Madrian and W. Skimmyhorn (2012). "Financial literacy, financial education and economic outcomes," Working

- Paper No.18412, September. Cambridge, MA: National Bureau of Economic Research
- Hausman, J. and D. Wise (1976). "A conditional probit model for qualitative choice: discrete decisions recognizing interdependence and heterogenous preferences". MIT Working Paper Department of Economics No. 173. Cambridge, MA: Massachusetts Institute of Technology.
- Holzmann, R., R. Hinz and D. Tuesta (2012). "Early lessons from country experience with matching contribution schemes," in R. Hinz, R. Holzman, D. Tuesta and N. Takayama, ed., *Matching Contributions for Pensions: A Review of International Experience*. Washington, DC: The World Bank: pp. 3–26.
- Huberman, G., S. Iyengar and W. Jiang (2007). "Defined Contribution Pension Plans: Determinants of Participation and Contributions Rates," *Journal of Financial Services Research*, 31 (1): 1–32.
- INEI–Instituto Nacional de Estadística e Informática (2012). "Encuesta Nacional de Hogares (ENAH) para Peru"
- INEGI–Instituto Nacional de Estadística y Geografía (2010) "Encuesta Nacional de Ingresos y Gastos de los Hogares (ENIG) para México"
- Instituto de los Mexicanos del Exterior (2010). *Remesas*.
- IBGE–Instituto Brasileiro de Geografia e Estatística (2011) "Pesquisa Nacional por Amostra de Domicílios (PNAD) para Brasil"
- Kay, S. and T. Sinha (2008). "Overview: Lessons from Pension reforms in the Americas," in S. Kay and T. Sinha, eds., *Lessons from pension reforms in the Americas*. Oxford, UK: Oxford University Press: pp. 6–21.
- Karlan, D, M. McConnellly and S. Mullainathanz (2010). "Getting to the Top of Mind: How Reminders Increase Saving". Working Paper No. 16205. Cambridge, MA: National Bureau of Economic Research.
- Kast, F., S. Meier and D. Pomeranz (2012). "Under-savers Anonymous: Evidence on Self-help Groups and Peer Pressure as a Savings Commitment Device," IZA Discussion Paper No. 6311. Bonn, Germany: Institute for the Study of Labor.
- Levy, S. (2008). *Good intentions, Bad Outcomes: Social Policy, Informality and Economic Growth in Mexico*, Washington, DC: Brookings Institution Press.
- Lederman, D., N. Loayza, and R. Soares (2005). "Accountability and Corruption: Political Institutions Matters," *Economics and Politics*, 17 (1): 1–35.
- Loayza, N. (2008). "Causas y consecuencias de la informalidad en el Peru," *Revista de Estudios Económicos del Banco Central de Reserva del Peru*, 2013 (15): 43–64.
- Madrian, B. (2012). "Matching contributions and savings outcomes: a behavioral perspective," in R. Hinz, R. Holzman, D. Tuesta and N. Takayama, ed., *Matching Contributions for Pensions: A Review of International Experience*. Washington, DC: The World Bank: pp. 289–310.
- Mesa-Lago. C. (2008). "Social Insurance (Pensions and Health), Labour Markets and Coverage in Latin America," Social Policy and Development Programme Paper No.36, August. Washington, DC: United Nations–Research Institute for Social Development
- Ministerio de Desarrollo Social de Chile (2011) "Encuesta de Caracterización Socioeconómica Nacional (CASEN) para Chile"
- Mitchell, O. and S. Utkus (2004). "Lessons from Behavioural Finance for Retirement Plan Design," in O. Mitchell and S. Utkus, eds., *Pension Design Structure, New Lessons from Behavioural Finance*. Oxford, UK: Oxford University Press: pp. 3–42.
- Mitchell, O, S. Utkus, T. Yang (2007). "Turning workers into savers? Incentives, liquidity and choice in 401 (k) plan design," in *National Tax Journal*, 60 (3): 469–89.
- Mills, G., W. Gale, R. Patterson, G. Engelhardt, M. Eriksen & E. Apostolov (2008). "Effects of Individual Development Accounts on Asset Purchases and Saving Behaviour: Evidence from Controlled Experiments," *Journal of Public Economics*, 92 (5–6): 1509–1530.
- Palacios, R. and R. Sane (2012). "Learning from the Early Experience of India's Matching Defined Contribution Scheme," in R. Hinz, R. Holzman, D. Tuesta and N. Takayama, ed., *Matching Contributions for Pensions: A Review of International Experience*. Washington, DC: The World Bank: pp. 243–260.
- Pizarro, E. (2008). "Ahorro Privado en Chile: Un Análisis Microeconómico," Tesis para optar al Título de Ingeniero Comercial, Mención Economía. Facultad de Economía y Negocios. Escuela de Economía y Administración. Universidad de Chile.
- Rashbrooke, R. (2012). "New Zealand's Experience with the KiwiSaver," in R. Hinz, R. Holzman, D. Tuesta and N. Takayama, ed., *Matching Contributions for Pensions: A Review of International Experience*. Washington, DC: The World Bank: pp. 103–132.
- Roa, J. (2013). "Financial Education and Behavioral Finance: New Insights into the role of information in financial decisions," in *Journal of Economic Surveys*, 27 (2): 297–315
- Rofman, R., L. Lucchetti & G. Ourens (2008), "Pension Systems in Latin America: Concepts and Measurements of Coverage," Social Protection and Labour Discussion Paper No. 0616. Washington, DC: The World Bank.
- Saavedra, J and M. Torero (2000). "Labor Market Reforms and Their Impact on Formal Labor Demand and Job Market Turnover: the case of Peru," Working Papers–Research Network No. R-394. Washington, DC: Inter American Development Bank.
- Soman, D. and A. Cheema (2011). "Earmarking and Partitioning: Increasing Saving by Low-Income Households," *Journal of Marketing Research*, 48 (1): 14–22.
- Tuesta, D. (2011). "A Review of the Pensions Systems in Latin America," BBVA Research Working Papers No. 1/15. Madrid, Spain: BBVA Research.
- Whitehouse, E. (2012). "Policies to encourage private pension savings: evidence from OECD countries" in R. Hinz, R. Holzman, D. Tuesta and N. Takayama, ed., *Matching Contributions for Pensions: A Review of International Experience*. Washington, DC: The World Bank: pp. 27–50.
- Ziegler, A. (2010). "Individual characteristics and stated preferences for alternative energy sources and propulsion technologies in vehicles: a discrete choice analysis". Working Paper No. 10/125, March. Zurich, Switzerland: CER-ETH — Center of Economic Research at ETH.

Appendix 1. Description of national surveys. Source: DANE (2012), INEI (2011), INEGI (2010), IBGE (2011), Ministerio de Trabajo y Previsión Social de Chile (2011).

Country	Survey	Year	Source	Universe	Sample	Representativeness	Relevant characteristics
Chile	Survey of National Socioeconomic Characterization (CASEN)	2011	Ministry of Social Development	Population resident in private housing in the country as a whole, excluding areas considered of difficult access.	112,938 homes	National, regional, community and by urban, rural zone	Carried out since 1985 every two or three years. The surveys correspond to the years 1985, 1987, 1990, 1992, 1994, 1996, 1998, 2000, 2003, 2006, 2009 and 2011. The survey is cross-cutting and multi-purpose in nature. It is now the main instrument of socioeconomic measurement for the design and assessment of social policy in the country.
Peru	National Household Survey (ENAHO)	2011	National Statistics and IT Institute (INEI)	Private homes and their residents in urban and rural areas of the country. Does not include members of the armed forces who live in barracks, camps, ships, etc. or who live in collective housing (hotels, hospitals, monasteries, prisons, etc.).	22,640 homes (13,824 urban and 8,816 rural).	National, departmental, by urban or rural zone and for the regions Costa, Sierra, Selva and Metropolitan Lima.	The household survey has been carried out since 1995 with the aim of tracking indicators of living conditions. Since 2003 it has been carried out yearly. The information provided by the survey is used to measure the scope of social policy and is the basic source for research by public and private institutions.
Mexico	National Household Income and Expenditure Survey (ENIG)	2010	National Institute of Statistics and Geography	Households in the country	30,169 homes	National, with urban and rural breakdown and for the states of Chiapas, Distrito Federal, Guanajuato, Estado de México and Yucatán.	The Survey began in 1984, and is carried out every two years. It provides an analysis of household income and expenditure. It also provides information on housing infrastructure, the composition of households, and the economic activity of each of their members.
Colombia	Integrated Household Survey (GEIH)	2011	National Statistics Administrative Department (DANE)	Civil non-institutional population resident in the whole country, excluding new departments, called National Territories in the 1991 Constitution.	240,000 households	National, department, municipal center and others, five major regions (Atlántica, Oriental, Central, Pacífica and Bogota), 13 large cities with their metropolitan areas and 11 medium-sized cities.	Survey specialized in measuring the structure of the labor market (employment, unemployment and inactivity) in the country, as well as the socio-demographic characteristics of the Colombian population. It began to be carried out in 2006.
Brazil	National Household Sample Survey (PNAD)	2011	Brazilian Institute for Geography and Statistics (IBGE)	Population living in private housing in the whole country	358,919 people and 146,207 housing units	National, urban, rural, federations, large regions.	Survey carried out since 1967 to analyze variables of the country's socioeconomic development. It has been carried out on a yearly basis since 1971 and included new variables to update the demographic, social and economic information requirements.

**Appendix 2a.** Description of the variables or questions from the national surveys. Source: Ministerio de Trabajo y Prevision Social (2011).

	Chile	
Variable	Question	Options
Registered with Social Security	Are you a member of any pension scheme?	
Has contributed to a voluntary or mandatory pension scheme in the last month	Have you contributed to any pension scheme in the last month? (everyone over the age of 15 asked)	1. Yes, AFP (Pension Fund Administrator) Mandatory contribution by dependent worker 2. Yes, AFP (Pension Fund Administrator) Voluntary contribution by independent worker 3. Yes, IPS ex-INP (National Fund for Public-Sector Workers (CANEAMPU), Fund for Private-sector employees (EMPART), Social Security Service (SSS) 4. Yes, National Defense Fund (CAPREDENA) 5. Yes, Pension Directorate for Carabiniers (DIPRECA) 6. Yes, other. Specify
Rural	Area	
Woman	Gender	2. Woman
Age	How old are you [NAME]?	
Belongs to ethnic group	In Chile, the law recognizes nine indigenous peoples, do you belong to, or are you a descendent of one of them?	If recognizes belonging to ethnic group 1, if not 0.
Married or with partner	What is your current marital status?	1 Married 2. Living with partner
Employer	What is your main work or business?	1. Employer
Independent worker	What is your main work or business?	2. Self-employed
Family worker	What is your main work or business?	9. Unpaid family worker
Primary education	What is your highest or current level of education?	1 No formal education 2 Incomplete basic 3 Complete basic
Secondary education	What is your highest or current level of education?	4. Incomplete middle humanities 5. Incomplete middle professional technical 6. Complete middle humanities 7. Complete middle technical
With formal contract	Do you have a written contract in your main job?	1. Yes, signed 2. Yes, but has not signed it
Informal worker	Do you have a written contract in your main job?	3. No
	Where does he or she carry out activity or where is the business, company or institution of employment located?	7. In the street, land, air or water transport 8. In works, construction site, mining
Retail sector	Branch of economic activity	Service and construction activities
Service sector	Branch of economic activity	g Wholesale and retail trade
Primary sector	Branch of economic activity	a Agriculture, livestock, hunting and forestry b fishing c mining and quarrying
Micro-enterprise	How many people work in total in this business, enterprise or institution in Chile?	1. Only 1 (the interviewee) 2. 2 to 5 workers 3. 6 to 9 workers

	Chile	
Variable	Question	Options
Small company	How many people work in total in this business, enterprise or institution in Chile?	4. 10 to 49 workers
Size of household	Number of members of the household	
Household with minor(s)	Age	Construction: 1 households with members under 18, 0 if not.
Household with pensioner(s)	Income from retirement pensions in household	Variable constructed based on CASEN data, 1 if household receives income from this source, 0 if not.
Household receives public transfers	Income from public subsidies	If the household receives income from subsidies: 1, if not, 0.
Income quintile 1	Households in income quintile 1, by total income received	Sum of total current income and financial and capital receipts.
Income quintile 2	Households in income quintile 2, by total income received	
Income quintile 3	Households in income quintile 3, by total income received	
Income quintile 4	Households in income quintile 4, by total income received	
Lives in poorest region	Distribution of household income by region, according to income quintile	Regions with lowest income levels
Lives in region with average poverty level	Distribution of household income by region, according to income quintile	Regions with middle income level
Spending on housing	How much does he or she pay (or should pay) for loan payments?	Value of repayment for home or rental
	How much is the rent on the home?	
Spending on education	How much do you pay per month?	Total of the items
	How much does the course studied cost per month?	
	How much is the monthly payment for the course studied?	
Bank user	Do you have?	a) Debit card (Redbanc) b) Bank credit card (Visa, Mastercard, etc.) c) Store credit card (Falabella, Ripley, Paris, Presto, etc.) d) Checkbook e) Credit facility
	Do you have?	b1) Savings in a housing account b2) Savings in a bank account (savings account, time deposit, current account, demand deposit or RUT account) b3) Savings in a AFP 2 account and/or Voluntary Pension Savings (APV) account

**Appendix 2b.** Description of the variables or questions from the national surveys. Source:INEGI (2010).

Variable	Mexico	Options
	Question	
Contributes	Have you ever contributed to any social security institution? (ask all people over the age of 12)	1. Yes
	Do you voluntarily have a contract for a .... (asked to all people over the age of 12)	SAR, AFORE or pension fund?
Rural	Size of town (asked of all people over the age of 12)	Towns with a population of under 2,500
Woman	Is a	Man 1 Woman 2
Age	How old are you?	
Belongs to ethnic group	In accordance with the culture of (NAME), does he (she) consider him/herself as indigenous?	1. Yes
Married or with partner	At present	1 do you live with your partner? 2. Are you married?
Independent worker	Have you worked as self-employed?	1. Yes
Primary education	What year or grade did (NAME) reach at school?	0 None 1. Pre-school 2. Primary
Secondary education	What year or grade did (NAME) reach at school?	3. secondary 4. Preparatory or high school 5. Normal
With formal contract	Do you have a written contract?	1. Yes
Informal worker	Received the following benefits in the job, although they have not used them?	No benefits
	Is the business registered before a Notary Public as a company or cooperative?	2-No
	Does this enterprise or activity have the services of an accountant?	2-No
Retail sector	Last month, what did your company or business dedicate itself to?	2. Retail
Service sector	Last month, what did your company or business dedicate itself to?	3. Services
Primary sector	Last month, what did your company or business dedicate itself to?	4. Agricultural activities 5. Animal husbandry and livestock farming 6. Collecting activities 7. Reforestation and logging 8. Hunting and animal capture 9. Fishing
Micro-enterprise	Last month, how many people including you worked in this company or business?	01 1 person 02 2 to 5 workers 03 6 to 10 workers
Small company	Last month, how many people including you worked in this company or business?	04 11 to 15 workers 05 16 to 20 workers 06 21 to 30 workers
Size of household	Number of people in this household, not including domestic workers or their families, or guests.	Indicator constructed on the base
Household with minor(s)	Age	Construction: 1 households with members under 18, 0 if not.

	<b>Mexico</b>	
<b>Variable</b>	<b>Question</b>	<b>Options</b>
Household with pensioner(s)	Retirement, pensions and compensation for occupational accident, redundancy and voluntary retirement	Indicator constructed on the base of 1 if household has income from pensions and 0 if not
Household receives public transfers	Benefits from government programs.	Indicator constructed on the base
Income quintile 1	Households in income quintile 1, by total income received	Sum of total current income and financial and capital receipts.
Income quintile 2	Households in income quintile 2, by total income received	
Income quintile 3	Households in income quintile 3, by total income received	
Income quintile 4	Households in income quintile 4, by total income received	
Lives in town with high level of marginalization	CONAPO high	High level of marginalization
Lives in town with level rate of marginalization	CONAPO medium	Medium level of marginalization
Spending on housing	Sum of spending on payment for own home and rental and payment of services	
Spending on education	Expenditure on education items and services	Indicator constructed on the base
Bank user	How much money did ..... receive from Interest from fixed-term investments? Interest from saving accounts?	Indicator constructed, if complies with the above conditions
	Makes housing loan repayments on own home?	
	Pays by credit card to the bank or store?	
Ease of response to shocks	Do you believe that if you had to borrow from someone for the amount of money earned in your household in a month, it would be:	Impossible to manage it.....1 Difficult to manage it.....2 Easy to manage it..... 3 Very easy to manage it.....4
Household receives remittances	Income from other countries.	Indicator constructed on the base
Health expenses	Spending on healthcare.	Indicator constructed on the base
Works in family enterprise	We're saying that this company is:	Independent, personal or family
Works in NGO	We're saying that this company is:	An institution not administered by the government
Works in private enterprise	We're saying that this company is:	A private company or company in the private sector?

**Appendix 2c.** Description of the variables or questions from the national surveys. Source: INEI (2011).

	Peru	
Variable	Question	Options
Registered with Social Security	Are you currently a member of any pension scheme?	Construct indicator: 1 if member of a pension scheme and 0 if not
Contributes to social security	What was the last contribution to the pension system - Year (the question is only asked to those who said they were members, asked to all people over the age of 14).	Construct indicator: 1 if contributed to a pension scheme in 2011 and 0 if not
Rural	Lives in rural zone	7 Mixed rural zone - "AER Compuesto" 8 Simple rural zone - "AER Simple"
Woman	Gender	2 Woman
Age	How old are you?	
Married or with partner	What is your marital status?	1. Living together 2. Married
Independent worker	At your workplace were you:	1. Employer? 2. Independent worker?
Family worker	At your workplace were you:	5. Unpaid family worker? 6. Domestic worker?
Primary education	Educational level passed	1. No level 2. Initial 3. Unfinished primary 4. Finished primary
Secondary education	Educational level passed	5. Incomplete secondary 6. Complete secondary
contract	What type of contract?	1. Indefinite-term, official, permanent 2. Fixed-term contract 3. In probation period 4. Agreements for youth training / work experience 5. Training contract 6. Contract by service location (professional fees, RUC)
Informal worker	Registered as incorporated entity at the business where he or she works?	2. No
	Are the accounts carried out in the business where he or she works with an accounting system or books?	2. No
	What type of contract?	7. Without a contract
Retail sector	What is the activity of the business, body or company in which his or her main job was?	Retail and wholesale trade activities (CIIU Rev 4. Codes 4500 and 4700)
Service sector	What is the activity of the business, body or company in which his or her main job was?	Service activities (CIIU Rev 4. Codes over 4900 and construction)
Primary sector	What is the activity of the business, body or company in which his or her main job was?	All the codified activities for agricultural, mining, fishing sectors. (Codes under 1000)
Micro-enterprise	Including yourself, how many people worked at your workplace?	5-10 workers
Small company	Including yourself, how many people worked at your workplace?	11-99 workers
Size of household	Total members of the household	Variable constructed by INEI
Household with minor(s)	How old are you?	Constructed, if household has minors under 18: 1; if not, 0

	Peru	
Variable	Question	Options
Household with pensioner(s)	Retirement / early retirement pension	Constructed, if household has pensioner: 1; if not, 0
Household receives public transfers	Income from current public transfers	Variable constructed by INEI
Income quintile 1	Households in income quintile 1, by total income received	Variable constructed based on total income variable grouped by INEI
Income quintile 2	Households in income quintile 2, by total income received	
Income quintile 3	Households in income quintile 3, by total income received	
Income quintile 4	Households in income quintile 4, by total income received	
Costa	Geographical location in the Costa region	
Sierra	Geographical location in the Sierra region	
Selva	Geographical location in the Selva region	
Spending on housing	Monthly rental or house purchase cost (in soles)	
Spending on education	How much did school uniform cost?	Aggregate indicator based on the sum of each spending item
	How much did school uniform cost?	
	How much was the total for books and text books? ?	
	How much did school materials cost? ?	
	How much did school enrollment cost?	
	How much did the PTA cost?	
Bank use	Indicator of receipt of interest from bank, cooperative deposits	Constructed if the household RESPONDS Yes to one of the questions: 1, if not, 0.
	Have you used internet for online banking transactions?	
	Did you pay this work with: ? - a loan	
Receives remittances	Income from current transfers from abroad	Variable constructed by INEI
Health expenses	Group 5: Care, conservation, health... - Spending	Variable constructed by INEI

**Appendix 2d.** Description of the variables or questions from the national surveys. Source:DANE (2012).

	<b>Colombia</b>	
<b>Variable</b>	<b>Question</b>	<b>Options</b>
Contributes	Are you currently contributing to a pension fund? (asked of working people)	1. Yes
	What are you currently doing to maintain yourself financially in your old age? (asked of both workers and the unemployed)	Contribute to a mandatory pension fund (1); Contribute to a voluntary pension fund (2)
Rural	Class	2. Dispersed rural
Woman	GENDER	2. Woman
Age	How old are you?	
Married or with partner	Currently:	2. Is not married and lives with a partner for two or more years 3. Is married
Independent worker	In this work..... is:	4. Self-employed 5. Employer
Family worker	In this work..... is:	6. Unpaid family worker 7. Unpaid worker at other companies or households
Primary education	What is the highest educational level reached by... and the last year or grade passed at this level?	1. None 2. Pre-school 3. Basic primary
Secondary education	What is the highest educational level reached by... and the last year or grade passed at this level?	4. Basic secondary 5. Middle
With formal contract	Is the contract verbal or in writing?	2. In writing
Informal worker	Under the current contract, does he or she receive or have the right to:	Indicator 1 if receives: paid holidays, Christmas bonus and severance pay
	Where does he or she mainly carry out the work:	5. Door to door 6. In an open space on the street
	Has ..... registered the business with any authority or entity?	2. No
Retail sector	What is the activity of the company or person that contracted him or her?	CIUU classification Rev 3 for Colombia: 50 - 52 Wholesale and retail trade; vehicle repair automobiles, motorcycles, personal effects and domestic appliances
Service sector	What is the activity of the company or person that contracted him or her?	CIUU Rev 3 classification for Colombia: All the services with codes over 52 and 40 to 45
Primary sector	What is the activity of the company or person that contracted him or her?	CIUU Classification Rev 3 for Colombia: 01, 02, Agriculture, livestock, hunting and forestry; 05 Fishing; 10 - 14 Mining and quarrying
Micro-enterprise	How many people in total are there in the company, business, industry, office, firm, farm or location where ..... works?	Up to 10 workers
Small company	How many people in total are there in the company, business, industry, office, firm, farm or location where ..... works?	Between 11 and 50 people
Size of household	Total members of household:	
Household with minor(s)	Age	Construction: 1 households with members under 18, 0 if not.
Household with pensioner(s)	Last month, did you receive payments for: Retirement, invalidity or pension replacement pensions?	1. If the household received this income, 0 otherwise
Income quintile 1	Households in income quintile 1, by total income received	Index constructed based on sum of income from work and other income received by household.
Income quintile 2	Households in income quintile 2, by total income received	

	Colombia	
Variable	Question	Options
Income quintile 3	Households in income quintile 3, by total income received	
Income quintile 4	Households in income quintile 4, by total income received	
Lives in Atlántica region	Department	Atlántica region: Atlántico, Bolivar, Cesar, Córdoba, Sucre, Magdalena, La Guajira.
Lives in Pacífica region	Department	Pacífica region: Chocó, Cauca, Nariño, Valle.
Lives in Oriental region	Department	Oriental region: Norte de Santander, Santander, Boyacá, Cundinamarca, Meta.
Lives in Central region	Department	Central region: Caldas, Risaralda, Quindío, Tolima, Huila, Caquetá, Antioquia.
Spending on housing	How much do they pay per month for repayment of loan? How much do they pay for rental?	Sum of the loan repayment and rental
Bank user	Over the last twelve months did you receive: d. Money from interest on loans or for CDTs, savings deposits, profit from savings deposits, capital gains or dividends on investments?	
Ease of response to shocks	If you do not have a job, where would you mainly obtain the funds for your and your household expenses:	1. I wouldn't have funds, 2. I'd sell the home or household goods (6) or I'd pawn the household goods (7) I'd ask for a loan (9), 3. I'd get help from children or family members? (3) or severance pay or similar (4).4. Early retirement (1) or personal savings (2)?
Household receives remittances	Over the last twelve months, have you received money from other households or people living outside the country?	1. If the household received this income, 0 otherwise
Domestic employee or day worker	In this work..... is:	3. Domestic employee 8. Day worker or laborer

**Appendix 2e.** Description of the variables or questions from the national surveys. Source: IBGE (2011).

Variable	Brazil	
	Question	Options
Contributes	You were contributor to the pension institution of main work/secondary work/other work(s) of the reference week (asked solely to the employed)	Yes
	You were contributor of a private pension entity, in the reference month (employed)	Yes
Rural	Censitary situation code	4 Rural - Rural agglomerated of urban extension; 5. Rural - Rural agglomerated, isolated, center part; 6 Rural - Rural agglomerated, isolated, other agglomerates; 7 Rural - Rural area exclusive rural agglomerated
Woman	Gender	4. Woman
Age	Age	
Belongs to ethnic group	Color or race	Native
Married or with partner	Do you live with a spouse or partner?	Yes
Independent worker	Position in the main work occupation of the reference week	5. Self-employed in auxiliary services; 6. Self-employed in agriculture, silviculture or bovine cattle breeding, buffalo herds, caprine, bovine or swine; 7. Self-employed in another activity; 8. Employer in auxiliary services; 9. Employer in agriculture, silviculture or bovine cattle breeding, buffalo herds, caprine, bovine or swine; 10. Employer in another activity
Unpaid worker	Position in the main work occupation of the reference week	11. Non remunerated worker, member of the domicile unity; 12. Other non remunerated worker; 13. Self-consumption production worker
Primary education	Highest level of education achieved (all)	1. No education; 2. Middle school undergraduate or equivalent; 3. Middle school graduate or equivalent
Secondary education	Highest level of education achieved (all)	4. High school undergraduate or equivalent; 5. High school graduate or equivalent
Informal worker	The company is registered at the National Juridical Person Registration - CNPJ	3. No; 5. Doesn't know
	The company had an itemized bill or invoice to issue to clients	3. No; 5. Doesn't know
	Type of establishment where the main work of the reference week was exercised	7. In the street or a public area
Retail sector	Main activity groupings in the company for the main work in the reference week, for 10-year-old people or older	5. Commerce and repairing
Service sector	Main activity groupings in the company for the main work in the reference week, for 10-year-old people or older	6. Lodging and catering; 7. Transport, warehousing and communication; 8. Public administration; 9. Education, health and social services; 10. Domestic services; 11. Other collective, social and personal services
Primary sector	Main activity groupings in the company for the main work in the reference week, for 10-year-old people or older	1. Agriculture
Size of household	Number of family members (excluding those whose household's situation was pensioner, housemaid or housemaid relative)	

	<b>Brazil</b>	
<b>Variable</b>	<b>Question</b>	<b>Options</b>
Household with minor(s)	Age	Construction: 1 households with members under 18, 0 if not.
Household with pensioner(s)	Code 01 - You received retirement income of the pension institute or federal government regularly, in the reference month; Code 02 - You received pension income of the pension institute or federal government regularly, in the reference month; Code 03 - You received income from another type of retirement, in the reference month	1 If you received such income in the household, 0 otherwise
Income quintile 1	Households in income quintile 1, by total income received	Index built around the variable: Monthly domiciliary income per capita
Income quintile 2	Households in income quintile 2, by total income received	
Income quintile 3	Households in income quintile 3, by total income received	
Income quintile 4	Households in income quintile 4, by total income received	
Lives in northern region	Federation Unit	States of Acre, Amapá, Amazonas, Pará, Rondônia, Roraima and Tocantins
Lives in north-east region	Federation Unit	States of Maranhão, Piauí, Ceará, Rio Grande do Norte, Pernambuco, Paraíba, Sergipe, Alagoas and Bahia
Lives in southern region	Federation Unit	States of Paraná, Santa Catarina and Rio Grande do Sul
Lives in central region	Federation Unit	States of Mato Grosso, Mato Grosso do Sul, Goiás and Federal District
Spending on housing	What was the monthly value of the paid rent, or that should have been paid, in September of 2011?	
	What was the monthly value of the paid installment, or that should have been paid, in September of 2011?	

Appendix 3: Probit estimates for the determinants of voluntary pension contribution in Brazil . Source: Author's calculations.

Contributes to private pension funds?						
	Model 1		Model 2		Model 3	
Woman	-0.0090845	***	-0.0086068	***	-0.0085348	***
Age	.0002771	***	.0003089	***	.0003076	***
Rural	-.0127363	***	-.0112132	***	-.0110271	***
Married or with partner	.0066478	***	.0042939	***	.0042067	***
Size of household	-.0004946	*	-.000264		-.0002857	
Primary education	-.0363359	***	-.0296468	***	-.0297847	***
Secondary education	-.0170844	***	-.0164151	***	-.0164352	***
Belongs to ethnic group	.0017968		.0001074		.0005922	
Household with minor(s)	.0018606	**	.0017974	*	.0017482	*
Household with pensioner(s)	-.0037296	***	-.0022798	**	-.0024316	**
Spending on housing	6.16e-06	***	8.55e-06	***	8.48e-06	***
Income quintile 1	-.0170858	***	-.0153584	***	-.0145911	***
Income quintile 2	-.0164629	***	-.0156611	***	-.0150372	***
Income quintile 3	-.0139502	***	-.013152	***	-.012739	***
Income quintile 4	-.0118416	***	-.0118737	***	-.0116946	***
Independent worker			.0041387		.0044458	
Unpaid worker			-.0173967	**	-.0168119	**
Informal worker			-.0124293	***	-.0122069	***
Primary sector			-.0174348	***	-.0168453	***
Retail sector			-.005968	***	-.0055652	***
Service sector			-.0080334	***	-.0074895	***
Lives in northern region					-.0016432	
Lives in north-east region					-.004179	***
Lives in southern region					-.0001558	
Lives in central region					-.0063353	***
Number of observations	197589		118880		118880	
Wald chi2(15) =			Wald chi2(21) =		Wald chi2(25) =	
Joint significance test	3795.27		2377.84		2423.80	
Prob > chi2 =	0,0000		0,0000		0,0000	
Pseudo R2 =			Pseudo R2 =		Pseudo R2 =	
R2	0.1120		0.1126		0.1138	

Appendix 4: Probit estimates-Model 3, including Age 2. Source: Author's calculations.

	BRASIL	CHILE	COLOMBIA	MÉXICO	PERÚ
Woman	-0,153946 ***	-0,023214 ***	-0,072071 ***	-0,148508 ***	-0,027736 ***
Rural	-0,050124 ***	-0,015265 **	-0,042516 ***	-0,046325 ***	0,001789
Age	-0,018335 ***	0,000626	0,032776 ***	0,028627 ***	0,009018 ***
Age2	0,000225 ***	-0,000004	-0,000351 ***	-0,000260 ***	-0,000091 ***
Married or with partner	0,037738 ***	-0,013166 *	0,026304 ***	0,024266 **	0,010994 ***
Size of household	0,002736 *	0,002025	-0,013484 ***	-0,023116 ***	-0,004716 ***
Primary education	-0,273401 ***	-0,024483 **	-0,126960 ***	-0,172263 ***	-0,065969 ***
Secondary education	-0,123802 ***	-0,010522	-0,074562 ***	-0,025992 *	-0,026164 ***
Household with minor(s)	0,005785	0,000841	-0,000520	0,031011 ***	0,004990
Household with pensioner(s)	-0,050200 ***	-0,012905	-0,001399	0,157072 ***	0,002815
Belongs to ethnic group	-0,032559	-0,019410 *		-0,029292 ***	
Household receives public transfers		-0,023539 ***		-0,000017 ***	-0,000001
Household receives remittances			-0,009139	-0,000011 ***	-0,000001
Income quintile 1	-0,250979 ***	-0,150367 ***	-0,120765 ***	-0,158386 ***	-0,056460 ***
Income quintile 2	-0,128394 ***	-0,080546 ***	-0,025456 ***	-0,073285 ***	-0,035004 ***
Income quintile 3	-0,054251 ***	-0,066982 ***	-0,030311 ***	-0,033066 **	-0,022573 ***
Income quintile 4	0,010031 *	-0,067615 ***	0,003729	-0,013059	-0,010446 **
Spending on housing	-0,000011	0,000000	0,000000	0,000000	0,000006
Spending on education		0,000000 **		0,000000	-0,000003
Health expenses				0,000000	0,000001 **
Bank user		-0,003555	0,076631 ***	0,021528 *	0,049578 ***
Ease of response to shocks			0,021372 ***	0,019049 **	
Employer		0,023804 *			
Independent worker	-0,243153 ***	-0,034235 **	-0,124168 ***	-0,195069 ***	-0,070955 ***
Works in family enterprise		-0,254352 ***	-0,131617 ***	-0,024962	-0,043104 ***
Unpaid worker	-0,470827 ***				
Informal worker	-0,493054 ***	-0,018830 *	-0,195736 ***	-0,238592 ***	-0,135502 ***
With formal contract		0,539370 ***	0,561225 ***	0,318549 ***	0,183072 ***
Domestic employee or day worker			-0,008396		
Works in NGO				-0,065640	
Works in private enterprise				0,125271 ***	
Primary sector	-0,658198 ***	-0,004872	-0,014655 *	-0,022462	-0,019514 ***
Retail sector	-0,106013 ***	-0,001919	0,000769	-0,050575 ***	0,004058
Service sector	-0,099709 ***	-0,011234	0,006831	-0,041146 ***	-0,006732
Micro-enterprise		-0,025407 ***	-0,265880 ***	-0,109341 ***	-0,016722 ***
Small company		0,002889	-0,089817 ***	-0,037565 *	-0,014304 ***
Lives in northern region	-0,167315 ***				
Lives in north-east region	-0,114044 ***				
Lives in southern region	0,025187 ***				
Lives in central region	-0,080129 ***				
Lives in poorest region		0,000868			
Lives in region with average poverty level		-0,010149			
Lives in Atlántica region			-0,111599 ***		
Lives in Pacífica region			-0,033534 ***		
Lives in Oriental region			-0,025395 ***		
Lives in Central region			0,016751 ***		
Lives in town with high level of marginalization				-0,270129 ***	
Lives in town with level rate of marginalization				-0,141994 ***	
Costa					0,013619 ***
Sierra					-0,008502 **
Selva					-0,011033 **

# Study of Informational Requirements to Identify Reputational Risks\*

Taisiya IZNOVA

Economic Analysis Department, Financial University, Moscow

*i\_taisia@mail.ru*

**Abstract.** Over the recent years one can witness growing influence of stakeholders on business. Structure of involved stakeholders is expanding; informational requirements are becoming more complex. Numerous studies show that in spite of constantly increasing disclosure requirements, stakeholders still do not consider corporate reporting as sufficient source of fulfilling their informational requirements. The greatest uncertainty for stakeholders is associated with risks, forecasts, strategy, social and environmental responsibility sections. In order to maintain sustainable development in global risk context, company requires a sound system of stakeholders' relations. Risks affecting relations sustainability, which occur due to confidence loss, are reputational risks. The survey analyzes ways of increasing reporting transparency in order to maintain stakeholders' trust and minimize reputational risks in the future. Paper addresses systems of information disclosure on sustainability of customer relations, suppliers and community relations of five metals industry leaders (including two Russian companies, two Western and one Chinese). As the result the paper proposes the disclosure approach to the risks of sustainable stakeholders relations and makes a number of recommendations.

**Аннотация.** Последние годы наблюдается усиление влияния стейкхолдеров на управление бизнесом. Структура заинтересованных вовлеченных пользователей расширяется, информационные потребности усложняются. Многочисленные исследования показывают, что в настоящее время, несмотря на возрастающие требования к раскрытию информации, стейкхолдеры все еще не оценивают корпоративную отчетность как достаточный источник удовлетворения их информационных потребностей. Наибольшую неопределенность для заинтересованных сторон представляют разделы, посвященные рискам, прогнозам и перспективам, описанию стратегии и социальной и экологической ответственности. В условиях глобального риска для обеспечения устойчивости бизнеса необходима стабильная система отношений со всеми стейкхолдерами компании. Риски уменьшения устойчивости отношений, наступающие вследствие снижения доверия, – репутационные риски. В исследовании проанализированы направления повышения прозрачности отчетности в целях укрепления доверия стейкхолдеров и минимизации репутационных рисков в дальнейшем. Для целей исследования проанализированы системы раскрытия информации об устойчивости отношений с клиентами, поставщиками и обществом пяти лидеров металлургической отрасли, среди которых две российские компании, две западные и одна китайская. По результатам исследования предложена методика раскрытия информации о рисках устойчивости отношений со стейкхолдерами, и предложен ряд рекомендаций.

**Key words:** Reputational risks, sustainable relations, stakeholder involvement, corporate reporting.

## INTRODUCTION AND DEFINITION LANDSCAPE

In recent years corporate reporting development has been strongly influenced by increasing stakeholders' involvement and interconnection of their interests. The key stakeholders' requirement can be reasonably defined as the company's ability to maintain sustainable development progress.

As Steurer and Langer (2005) argued, stakeholder relations management (SRM) is one of such ways, through which corporations are confronted with economic, social, and environmental stakeholder claims.

Today global economic conditions deprive the companies of demonstrating previously common high rates of shareholders return. Balanced growth in the new reality involves maintaining the resource

\* Исследование информационных требований в целях идентификации репутационных рисков.

potential — a significant investment in the preservation of the environment, respect of the rights of employees against discrimination and constant increase of corporate governance transparency.

But in the context of stakeholders relations the distinction between previous and current global economy conditions gets little attention — companies struggling for capitalization and growth maintain face the same challenge as before — to meet stakeholders expectations and exceed them when possible.

If we attempt to summarize stakeholders requirements, they can be formulated in the following way: getting accurate and timely information to assess the risks posed to their relationship with the company. In this context, we are no longer talking about parties' economic interests only; understanding the company's business in the context of global risk is now crucial for stakeholders.

Stakeholders' informational expectations vary from earnings per share indicators to the company's environmental requirements compliance level.

To answer to the broader stakeholders' informational requirements, public companies' annual reports are becoming more complicated — usually they consist of more than 200 pages, and often supported by sustainability report containing approximately 150 more pages of information. Section with risks (including reputational) description portfolio and stakeholders relations also became an integral part of annual report.

Such a complicated structure of stakeholders requirements is based on economic instability when it becomes difficult for parties to estimate which factors in business practice may lead to threat, and even more difficult to understand in which direction it will evolve. Hence the continuously increasing requirements for disclosure in the financial statements, and a number of initiatives to develop standards of social and environmental responsibility, are intended to extend stakeholders comprehension of today's risks tomorrow.

Therefore it is necessary to focus attention on issues of stakeholders' perception and informational needs of stakeholders in terms of economic instability. In terms of corporate reporting these issues can be described as an attempt to consolidate information on implicit risks, in which the hierarchy of reputational risks takes a special place.

Back in the early 2000s, the term "reputational risk" was associated solely with the Enron and Arthur Andersen. Up to 2010–2011 most of the major western and Russian commercial banks and institutions have released internal policies for managing

reputational risk. In 2014 references to this term can be found in the light of socio-political events.

Scholars (Hayward, Zaman) evolved several approaches to the concept of reputational risk, but most accurately the nature of its origin can be characterized as follows:

*Reputational risk* is a risk of stakeholder confidence reduction, increasing when parties expect that violations in company business practice will affect their own economic interests.

To manage reputational risks, it takes constant increase of reporting transparency, allowing stakeholders to build trust by providing reliable, timely and representative information about the company's business. Besides own interest fulfillment, stakeholders assess the reputation of the company as a whole, which includes sustainability of its relations with other partners.

From the stakeholder perspective the information provided in corporate reporting can be divided into groups in accordance with the scope of risks, such as: what are the risks of the company in relations with customers, suppliers, employees, creditors, shareholders and investors. In other words, to what extent the system of relationships with company stakeholders is effective and sustainable? The effectiveness of this system determines reputation sustainability.

## METHODOLOGY

The purpose of research is, on the basis of stakeholder analysis, to identify the major trends and patterns that are typical for corporate reporting from reputational risks perspective and to discover possible ways of reporting development.

To achieve this objective it is necessary to identify what information is to be disclosed in corporate reporting to increase engagement and confidence of stakeholders in order to reduce the reputational risks.

To understand the keys to success in the transfer of initiatives of reputational risk management through the reporting development, we examine the experience of leading metal and mining companies from Russia (Norilsk Nickel, Novolipetsk Steel Company (NLMK)), Western (Vale, Xstrata), and China (Baosteel).

The study is based on critical analysis of corporate reporting including assessment of implementation of sustainable principles and initiatives.

Reputational risk management is based on information disclosure to minimize uncertainty in respect of the events — the causes, actions taken



**Figure 1.** Scheme of the informational stakeholders requirements concerning the risks of sustainable relations with other counterparts.

and directions for further monitoring. Information for the purposes of analysis, relationships with contractors companies can be divided into 4 blocks (Figure 1).

Stakeholders need this information to assess the extent and probability of company obligations fulfillment and the impact that company partners may produce on company business with own negative reputation.

Furthermore, as it shown before, reputational risk is enhanced by the lack of awareness among stakeholders about the risks of the company in relation to various partners.

In relation to mining and steel companies the following main risks associated with the stakeholders can be found (Table 1):

Significance and complexness of stakeholders relations discovers personal needs in information about the risks in relations with other contractors. For example, problems in relations with suppliers can lead to costs level higher than anticipated, disrupt of production time, violations in supply chain, which will have significant impact on the company's ability to meet its obligations to stakeholders.

## ANALYSIS AND FINDINGS

The major call during the recent years has been the implementation of stakeholder involvement principles to manage reputational risk, which determines the trend of relations system development — a partnership. The variety of existing risks requires significant partners' integration, going well beyond the contractual relationship.

The purpose of such integration is compliance with the standards of economic, social and environmental security by all participants in order to reduce their own risks.

Stakeholders need information on results of such cooperation, the analyzed aspects — data on the existence of internal control system in the company, which prevail in importance over the monitoring results itself.

Disclosure on existence and reliability of the internal control system is crucially important for the stakeholders. If it is superficial and uninformative, it cannot serve as a reporting tool for reputational risk management.

Chinese Baosteel and Brazilian Vale are disclosure practice leaders, mostly because they operate in regions associated with high social risks. Over the past three years, the quality of Russian companies' reports has also improved significantly.

Based on the study of how sustainable relations with stakeholders are seen from corporate reporting perspective, the following major results were obtained:

**1. Insufficiency of disclosed information obstructs stakeholders from making conclusions about the existence of reliable control systems.**

— As the results of the study show, the reputational risk cases are mostly associated with the supply chain; however suppliers relations remain the least analyzed in reporting;

— Information forecast remains the prerogative of management accounting and is disclosed poorly. Analyzed companies for the last three years limit forecast reporting to cautious assumptions about anticipated

**Table 1.** The main risks of steel and mining companies in stakeholders relations.

Stakeholders group	Potential threats and risks in stakeholders relations
Customers	<ul style="list-style-type: none"> <li>• Sensitivity to industrial production, together with the need for significant long-term capital investments;</li> <li>• Adverse economic developments in customer countries, influence of legal, political and social reforms;</li> <li>• Denials in demand for the products customers produce;</li> <li>• Product price is a subject to volatility;</li> <li>• Inability to adjust production volume in a timely or cost-efficient manner in response to changes in demand;</li> <li>• Involvement in legal proceedings that could have a material adverse effect on business;</li> </ul>
Government agencies	<ul style="list-style-type: none"> <li>• Disagreements with local communities where operations are taking place;</li> <li>• Government regulation (including probable changes in tax, ecological law, royalties on mining activities);</li> <li>• Enrichment requirements change risks (changes in processing limitations, export taxes, restrictions, or royalty for the raw ore);</li> <li>• Risks of restrictions implementation (on the activity in regions with major operations, alienation, nationalization risks);</li> <li>• Limitation on renewal of concessions, authorizations and licenses;</li> <li>• Risks of changes in the conditions of concessions, authorizations, licenses (timely renewal on timely basis, technology requirements, fees for renewal);</li> <li>• Inability to pass certification on necessary standards (REACH, CIP, ISO etc.).</li> </ul>
Employees	<ul style="list-style-type: none"> <li>• Industry employees health is a subject to risk;</li> <li>• Disputes with employees (influence of collective bargaining or other labor agreements);</li> <li>• Lack of skilled employees in the industry.</li> </ul>
Society	<ul style="list-style-type: none"> <li>• Environmental damage associated with the industry activity;</li> <li>• Part of production or processing territory can border to the territories of other owners that can give them the right to influence decisions regarding resources management;</li> <li>• Ownership for separate parts of territory where mining and other operations may be a subject to dispute.</li> </ul>
Suppliers	<ul style="list-style-type: none"> <li>• The risk of significant changes in raw material prices could lead to failure of suppliers to perform their contractual obligations on the agreed price for goods;</li> <li>• Risks of price increases for transportation, storage, logistics;</li> <li>• Delays or disruption of transportation.</li> </ul>
Joint companies, consortiums, subsidiaries	<ul style="list-style-type: none"> <li>• Inconsistencies of strategies between the companies;</li> <li>• Inability to meet its obligations (including supplying procedures);</li> <li>• Significant difficulties of integration between the company and acquired companies.</li> </ul>
Shareholders and investors	<ul style="list-style-type: none"> <li>• Significant changes of political, economical and social conditions in countries where company operates;</li> <li>• Project implementation risks;</li> <li>• Reserve estimates may materially differ from mineral quantities that are possible to recover;</li> <li>• External factors may render proven and probable reserves uneconomic to exploit and may ultimately result in a restatement of reserves;</li> <li>• Inability to replenish reserves (exploration programs may fail to result in the expansion or replacement of reserves depleted by current production);</li> <li>• Controlling shareholder possessing certain veto rights;</li> <li>• Investors located in jurisdictions which differ from key assets location may not be able to effect service of process within their home jurisdictions;</li> <li>• Investors' rights relating to shares may differ between jurisdictions.</li> </ul>
All groups (risk of inappropriate obligations fulfillment)	<ul style="list-style-type: none"> <li>• Stakeholders' inability to meet their obligations (direct or indirect concerning compliance with standards of ecological and social security);</li> <li>• Related parties influence;</li> <li>• Reputational influence on partner's business.</li> </ul>

Chinese economy recovery (as China is the major market) against revenues reduction background;

— Customers demand retention factors, sales strategy in the face of increasing Asian manufacturers influence remain unobvious;

— Companies claim for high standards compliance with the principles of responsibility in the supply chain, existence of associated monitoring system, but the systems themselves are poorly characterized — criteria used for assessing, implemented ap-

proaches, the frequency of inspections and following measures are not described in the statements;

- Reporting provides information only on estimates of individual criteria, does not demonstrate the existence of suppliers evaluation system;

- Percentage of analyzed audited suppliers is not defined, which characterizes control system as indefinite;

- Information about members of the Board of Directors traditionally is not sufficiently covered; performance reward systems, functions of independent directors, the relevance of the experience of certain key managers, as well as the mechanisms of their interaction stay uncertain;

- In terms of ecosystems risk, management must disclose information on high value areas, which are affected through extraction-transportation-processing-production-utilization-storage stages. Users need to understand the risks that assets location involves.

#### 2. Lack of quantitative indicators.

- Insufficient attention is paid to disclosure of quantitative information concerning impact assessment of changes on company performance. For example, all the companies except Chinese manufacturer disclose changes in the metal markets, the prices fluctuation data, the volume of supply and demand, but there is an acute shortage of managerial assessment of the situation – how such changes impact capacity utilization, the amount of reserves and inventories, etc;

- The revenue and accounts receivable structure in dynamics, power of impact of individual consumers also remain undisclosed, except for Chinese Baosteel company, which provides detailed information on the impact of the largest customers in terms of revenue payable, accrued reserves and extent to which the company is related with major debtors;

- Companies refer to significant procurement practices from local suppliers, with the volume of purchases not indicated or representing a small proportion of operating costs; auditing and monitoring system for such suppliers is not disclosed;

- Stakeholders need quantitative assessment of ecosystems impacts to understand the current state of the problem. Since the industry involves strikes risks, claims by environmentalists, local authorities and international community claims, stakeholders need to understand how critical and deep is the impact on the company's ecosystem.

#### 3. Risk minimization measures.

- Since a significant portion of the assets of mining companies is located in regions with high levels of social risks, adverse climatic conditions, the

need to disclose information about the directions of maintaining social security provided to employees increases. The study shows that the structure of these costs is disclosed poorly in reporting and measures taken to minimize the social risks are not described. Inadequate disclosure of risk management policy identifies weaknesses of internal control system, which reduces the confidence of stakeholders and enhances the reputation risk;

- The general level of education of employees in the industry is also quite weak due to the peculiarities of the regions where companies operate and industry where significant part of employees are workers. Therefore, to assess risks the users require more extensive information about the sources of new hired employees, as well as on educational programs for staff;

- Description of measures to improve achieved progress, such as increase in the proportion of products produced with advanced ecological safety technologies, supplied by quantitative indicators that allow interested parties to evaluate the company risk management.

#### 4. Characteristics of stakeholders relations with the description of conflicts.

- Cases of significant conflicts with employees are poorly represented in corporate reporting. Analyzed companies provide information on significant number of strikes that lasted more than 10 days, but do not disclose details of the damage, the measures taken, the risk of recurrence, monitoring employee satisfaction measures, and evaluation of the risk of recurrence of similar uprisings, which also leads to increase of reputational risk;

- Best disclosure practice includes information about the number of lawsuits in connection with disputes concerning the influence of companies on the territory of the presence, but the causes of conflict, economic costs of litigation and outcome of cases are not stated;

- In the statements of Russian companies there appears a section relating to the assessment of customer satisfaction, but the percentage of customers covered by monitoring, cases of conflict in relations with clients during the period, causes and methods of settlement are undefined;

- Information on the study of the degree of satisfaction of suppliers does not appear in the system of relationships with contractors.

### **FURTHER RECOMMENDATIONS**

Based on the existing standards review, stakeholders expectations, requirements analysis, and best

**Table 2.** Stakeholders informational requirements on sustainability of clients relations.

Informational requirements	Indicators and results
Market share (compared with competitors)	<ul style="list-style-type: none"> <li>• Characteristic of competitive environment in major markets with identification of company's own share and the shares of major competitors;</li> <li>• Competitive advantages of products that ensure the segment stability;</li> </ul>
Consumer portfolio	Revenue recognized history (in dynamics): <ul style="list-style-type: none"> <li>• upon industries;</li> <li>• upon geographical areas;</li> <li>• intergroup/external revenue;</li> <li>• received from new/constant partners</li> <li>• received from major clients (with reference if the parties are related);</li> <li>• received from products with higher added value;</li> <li>• received from brand value clients;</li> <li>• received from new and non-core products;</li> <li>• received from selling products which posses "green" characteristics.</li> </ul>
Specific character of products application	<ul style="list-style-type: none"> <li>• Products application specific features;</li> <li>• History of revenue recognized from products;</li> <li>• Description of new applications of existing products;</li> </ul>
Segment analysis results	<ul style="list-style-type: none"> <li>• Revenue, EBITDA, EBIT data by products and geographical assets;</li> <li>• Intersegment transfers.</li> </ul>
Settlement transactions practice	Accounts receivables data: <ul style="list-style-type: none"> <li>• ageing data;</li> <li>• major customers data;</li> <li>• related parties data;</li> <li>• bad debts data;</li> <li>• management comments on the causes and taken measures in respect of debts with past due balances, information on the accrual of reserves.</li> </ul>

reporting practice analysis we propose disclosure of following indicators in order to manage reputational risks.

#### *Consumer relations*

Regarding clients relations sustainability we highlighted the following areas of stakeholders interest: market share (compared with competitors), consumer portfolio, the specific character of products application, segment analysis results, and settlement transactions practice (Table 2).

To identify customers relations sustainability risks it is necessary to evaluate the impact of changes in industry supply and consumption volume and structure changes. These factors can determine the market changes in a long term. The consequences of these changes are: changes in the market participants' positions, changes in prices of basic products.

Consumer satisfaction data not only provides stakeholders with information about consumer loyalty, but also acts as a proof of monitoring system existence. The next essential element is products safety and quality risk assessment, in particular, at which production stages the monitoring takes place, how measures are documented and how clients are consulted to comply with security measures.

Stakeholders informational requirements concerning the ways of risk minimization applied in

customers relations can be divided into the following groups: factors that ensure a stable part of the demand (hedging arrangements), measures to correct supply under demand changes, changes in pricing policy, services, optimizing assets structure measures, plans for reconstruction and development.

To evaluate the effectiveness of the measures taken to minimize risks the stakeholders require information on results achieved for the period: corrective measures included in the production process, products released with the use of advanced technology and with improved competitive characteristics, significant changes in contractual practice.

Stakeholders need to understand the company's market share to make forecasts, which is crucial for markets having high prices volatility and undergoing significant changes.

Disclosure of information about the competitive environment and the description of the advantages ensuring the company position help users to deepen the understanding of company sustainability factors.

Information about the main consumers gives users the ability to assess the risks associated with changes in the economy of the company's customers.

To assess the stability of demand stakeholders particularly need to analyze the sources of revenue received.

**Table 3.** Stakeholders' informational requirements concerning the risks of sustainable clients relations and measures taken.

Informational requirements	Indicators and results
Current and planned anticipated changes in legislation, geopolitical and macroeconomic trends that may have an impact on market performance	<ul style="list-style-type: none"> <li>• Main factors determining the economics of industries and countries, customers and competitors;</li> <li>• Quantitative impact assessment, where possible</li> </ul>
Changes in consumption structure / consumer preferences in the industry during the period	<ul style="list-style-type: none"> <li>• Prospective evaluation of structural changes impact on production and sales volume.</li> </ul>
Assessment of main reasons which bring to prices fluctuation	<ul style="list-style-type: none"> <li>• Quantitative impact assessment, where possible.</li> </ul>
Significant changes in competitors positions	<ul style="list-style-type: none"> <li>• Significant mergers / acquisitions in the industry with a description of the consequences;</li> </ul>
Monitoring data of customer satisfaction	<ul style="list-style-type: none"> <li>• Description of customer satisfaction monitoring: <ul style="list-style-type: none"> <li>– frequency</li> <li>– number of participants</li> <li>– applied criteria</li> <li>– results (in dynamics)</li> <li>– analysis of customer satisfaction failure cases</li> <li>– statistics of claims received (including discussed, agreed, rejected, lawsuits), broken down by customer (new, existing, standing), stating reasons.</li> </ul> </li> </ul>
Monitoring of the risks associated with product safety (stages when implemented)	<ul style="list-style-type: none"> <li>• Percentage of production undergoing safety assessment (broken down by stages);</li> <li>• Share of products, concerning which consumers are informed about the properties, conditions of storage, transportation and security measures.</li> </ul>
Examination of products quality	<ul style="list-style-type: none"> <li>• Standards applied;</li> <li>• Certification received.</li> </ul>
Factors that ensure the stability of the demand (hedging arrangements)	<ul style="list-style-type: none"> <li>• Share of products manufactured against contracts with a predetermined price;</li> <li>• Share of the products manufactured against hedged contracts.</li> </ul>
Measures to correct the supply in respond to demand changes	<ul style="list-style-type: none"> <li>• Information on new products development, new technologies designed to improve the quality / safety of products, and the quality control system;</li> <li>• Measures to optimize the structure of assets;</li> <li>• Description of capital investments structure, the current significant projects for reconstruction, development, technical armament, the alleged period of implementation, adaptation and payback period.</li> </ul>

If the customer structure is diversified and includes partners from different industries and geographic regions, the classification of the revenue received from them also makes a significant contribution to the understanding company's risks. If a substantial portion of revenue comes from consumers whose industry or region is undergoing significant changes, or such consumers provide major markets for certain products, information about their interdependence with company will help users to adjust their expectations.

Stakeholders often require extensive information about the specific application of the individual products. The data allows better understanding of markets, and also describes the possibility of new

product applications. Dynamics of change of recognized revenue, broken down by type of product and the stage of completion of the production of the product provides information on trends, and helps to adjust the expectations. Description of new applications of existing products, if any, allows users to assess emerging risks and opportunities.

Information on revenue received by products, production stage, from the sale of non-core products, new and higher added value products demonstrate optimization measures in terms of price instability. Information about the revenue received from products produced with innovative resource-saving technologies demonstrates the steps towards reduction of sustainable development risks.

**Table 4.** Stakeholders' informational requirements on sustainability of suppliers relations.

Informational requirements	Indicators and results
Information on requirements to suppliers quality (analyzed factors, the selection criteria)	<ul style="list-style-type: none"> <li>• Suppliers analysis factors, the frequency of inspections and the approaches applied;</li> <li>• Share of analyzed suppliers (in total procurement costs).</li> </ul>
Information on suppliers diversity	<ul style="list-style-type: none"> <li>• Percentage of purchases from local suppliers at significant regions of operations;</li> <li>• Percentage of costs on suppliers, which have signed long-term contracts;</li> <li>• Percentage of costs on new suppliers;</li> <li>• The number of denials of suppliers offers;</li> <li>• The number of denials due to results of full-scale tests.</li> </ul>
Settlement practice	<ul style="list-style-type: none"> <li>• Information about outstanding prepayments to suppliers;</li> <li>• Accounts payable broken down by ageing;</li> <li>• Number of claims.</li> <li>• Number of canceled contracts.</li> </ul>

To identify what are the risks of sustainable client relations in respect of corporate reporting information and what measures have been taken to minimize the risk, stakeholders need the following information (Table 3):

Characteristics of significant changes in the external environment – related legislation, market trends, general economic and political trends that may affect company business is necessary for stakeholders not only to assess risk of changes of which they may not be aware, but also to understand of the company's management strategy in relation to such changes. To identify the risk of the users also require quantitative assessment of the impact where possible.

Changes in consumption structure / consumer preferences are also risks of sustainability; information about the projected impact of these changes helps to adjust users' expectations with regard to the company's business segments, which are exposed to such changes.

Information about significant mergers / acquisitions and other industrial events, which lead to formation of new competitors or current positions changes, enables users to understand how the company's management considers the increasing risks.

Data on monitoring system of customer satisfaction allows users to analyze the company's existing evaluation model of customer loyalty – frequency, number of participants, criteria applied, the results (in dynamics), analysis of customer satisfaction failure cases. Analysis of statistics of claims received in context of reasons and response helps to assess customer relations.

Because product quality and safety are the main product attributes to support the demand, stakeholders need more information about conflicts with clients that have arisen in relation to the lack of

satisfaction with the products, control measures to be taken.

Stakeholders also require information about how the company optimizes structure of its assets to provide cost-effectiveness, as well as hedge the exposure on manufactured products (which share is made against the contracts with predetermined price, which share is hedged using futures and options).

Information about actions the company has taken in response to demand changes includes data on new product development and introduction of new technologies to improve the quality / safety of products, quality control system, measures to optimize the structure of assets, description of the structure of capital investments, current significant reconstruction projects for.

#### Suppliers relations

Importance for contractors' sustainability of suppliers relations stands along with the stability of customers relations. If economic relations with suppliers are stable, it is expressed in controlled procurement costs, uninterrupted supply chain with no significant violation of economic, social and environmental security requirements.

The proposed system of informational disclosure concerning sustainability in suppliers relations may be considered as follows (Table 4).

Sustainability of suppliers relations is characterized by the company's approach to the selection of suppliers, their structure, and settlement practices.

To assess sustainability threats stakeholders need information about the regions of operations, the supply chain stages associated with the highest risk, and information about any violations, as well as data on new risks that may arise in response to macro-economic, political and market changes and the results of suppliers satisfaction monitoring.

**Table 5.** Stakeholders' informational requirements concerning the risks of sustainable suppliers relations and measures taken.

Informational requirements	Indicators and results
Information concerning stages and regions of the supply chain associated with highest risks	<ul style="list-style-type: none"> <li>• Description of supply chain risks associated with the region;</li> <li>• Risks identification throughout the supply chain (extraction- processing/production -package-transportation-sale).</li> </ul>
Information about identified suppliers' violations	<ul style="list-style-type: none"> <li>• Statistics of violations divided by region and supply chain stage;</li> <li>• Number of identified suppliers who do not meet the criteria of efficiency and safety.</li> </ul>
Information about the emergence of new risks in suppliers relations due to macroeconomic, political, market changes	<ul style="list-style-type: none"> <li>• Anticipated price increases;</li> <li>• Change in payment / delivery terms;</li> <li>• Factors that lead to the inability of suppliers to fulfill obligations;</li> <li>• Description of the key changes in the structure of the necessary raw materials and services.</li> </ul>
Monitoring results of suppliers satisfaction	<ul style="list-style-type: none"> <li>• Percentage of analyzed suppliers;</li> <li>• Number of suppliers whose satisfaction result stands out of the normal distribution.</li> </ul>
Directions of suppliers analysis	<ul style="list-style-type: none"> <li>• The frequency of the audits of all suppliers, the most risky and those whose practice faced the violations;</li> <li>• Plans to expand the list of analyzed factors and stages of analysis;</li> <li>• Plans to expand the proportion of analyzed suppliers.</li> </ul>
Information about cooperation measures to improve suppliers safety practice	<ul style="list-style-type: none"> <li>• Information on the implementation of joint projects (including training activities, joint development, advancing of risk assessment and control system) aimed at improving management of supply chain security.</li> </ul>
Data on the results achieved during the period	<ul style="list-style-type: none"> <li>• Percentage of analyzed suppliers;</li> <li>• Percentage of suppliers with violations that have agreed to implement advancing measures;</li> <li>• Percentage of suppliers excluded after analysis.</li> </ul>

Minimizing risk measures involve improving the practice of suppliers analysis, as well as the development of cooperation and control. As information on the achieved results, stakeholders need data about identified violations and responses (Table 4).

Supplier approval policy and its transparency shape the basis for assessing the stability of relations system. Applied evaluation criteria of economic efficiency, environmental, and social security, independence and availability of resources for cooperation, relations with other counterparts demonstrate the depth of implemented analysis.

Description of suppliers' diversity is crucial for users in order to assess company's transparency and involved risks. However, this aspect is very poorly represented in corporate reporting of surveyed companies.

Existing social initiatives concerning disclosure improvement, and first of all, GRI4 standards, pay great attention to the practice of procurement from local suppliers. Such practice reduces transportation period, contributes to the development of regional economy, employment, but also carries a high risk for regions with unstable social environment.

Beyond the issue of procurement from local suppliers, information on shares of new and regular sup-

pliers in the overall structure, and corresponding percentage of expenses for them are of great value. Such data demonstrates whether the company optimizes the structure of partners, and identifies the need for enhanced disclosure in case of significant volumes of purchases from individual counterparts. The number of denials due to non-compliance with suppliers approval policy, or due to results of full-scale tests demonstrates the existence and efficiency of selection of counterparts system in company.

Information about settlement practice assists stakeholders in assessing the degree of company's fulfillment of obligations.

To identify such risks stakeholders need information concerning stages and regions of the supply chain associated with highest risks.

As the survey results show, the reporting of the risks in relation to suppliers is very poorly represented in reporting; analyzed companies are no exception. General information describing that companies face the risk of unexpected failure of supply due to the fault of suppliers, as well as the lack of fulfillment of obligations, is not representative for the purposes of risk assessment.

Information about identified suppliers' violations — poor performance of contractual obligations, failure to

**Table 6.** Stakeholders' informational requirements concerning the risks of sustainable society relations and measures taken.

Informational requirements	Indicators and results
Electricity consumption practice	The volume of direct and indirect energy consumption of primary sources in dynamics
Waste management practice	Description of the ways of utilization and assessment of damage to ecosystems
Air emissions practice	Characteristics of substances emission, with indicated volume and percentage by type
Biodiversity practice	Characteristics and impact on ecosystems: <ul style="list-style-type: none"> <li>• Percentage of the area with high biodiversity value;</li> <li>• Characteristics of zones under influence.</li> </ul>
Water withdrawal practice	Characterization of influence on water withdrawal sources: <ul style="list-style-type: none"> <li>• Ground and surface volume;</li> <li>• Primary used and reused water.</li> </ul>
The practice of electricity saving	<ul style="list-style-type: none"> <li>• Savings from increasing energy efficiency;</li> <li>• Characterization of sources of energy savings, due to implementation of more efficient technologies or conservation facilities;</li> <li>• Initiatives for the development of products with energy efficiency or using alternative energy sources.</li> </ul>
Waste management control	<ul style="list-style-type: none"> <li>• Change in emissions in dynamics with management comments;</li> <li>• Number of spill cases, estimated volume and damage to ecosystems, the measures taken.</li> </ul>
Air emissions management	<ul style="list-style-type: none"> <li>• Description of research carried out to minimize impact on ecosystems and to improve the efficiency of production;</li> <li>• Description of control procedures.</li> </ul>
Biodiversity management	Description: <ul style="list-style-type: none"> <li>• Percentage of land under recovery;</li> <li>• Precious fauna and endangered species, for which conservation measures are taken;</li> <li>• Percentage of restored areas;</li> <li>• Plans to strengthen the sanctions for ecosystems damage.</li> </ul>
Water withdrawal management	<ul style="list-style-type: none"> <li>• Increase of reused water usage;</li> <li>• Directions of advanced technologies for water re-use</li> </ul>
Output of production, possessing high performance economic and environmental security characteristics	The share of output with outstanding economic and environmental efficiency

meet additional requirements — is the first evidence of existence of the organization's internal control system. It also seems reasonable to disclose information on the number of identified suppliers who do not meet the criteria of efficiency and security, so that users can assess internal control over suppliers.

After identification of existing threats, stakeholders need information about the methods applied to minimize them. It seems reasonable to divide these methods into two categories — information on improving the system of analysis, and auditing of suppliers, as well as the development of cooperation.

In relation to companies for which meeting the safety standards in all areas is crucial, development of cooperation with suppliers becomes a very important method of risk minimization. Such cooperation may take the whole complex of activities — from holding

informational meetings for new suppliers to explain the customer requirements to crediting counterparts in order to improve business practice.

The resulting indicators of suppliers monitoring is data on analyzed suppliers percentage, percentage of suppliers with violations that have agreed to implement advancing measures and percentage of suppliers excluded after analysis.

Information on monitoring results allows users to assess reliability of internal control system of the company.

In relation to the improvement of the production process, users also require data on the proposed period of implementation and adaptation to assess the conformity of measures changes in the market.

#### *Society relations*

In respect to environmental responsibility stakeholders are interested in the most relevant informa-

tion disclosure, which entails increased risks for the company. Disclosure of such information is the most critical for extracting, processing and producing companies, whose activity is characterized by large volumes of water consumption, depletion of natural resources, polluting emissions.

Stakeholders are interested in information regarding the company's policy in the area of monitoring, analysis and control of environmental impact, investment in cleaner production (Table 6).

Disclosure of the amount of direct and indirect energy consumption of primary sources in dynamics, description of waste management system and assessment of damage to ecosystems, characteristics of substances emission, description of the impact on biodiversity, and volume of water abstraction by source (primary and reused) – are included in ecosystems impact report.

To assess the implementation of electricity saving measures, stakeholders need information on energy savings sources to realize if the result is achieved through the introduction of more efficient technologies or conservation of assets. Information about the company's initiatives in energy efficiency and alternative energy is a proof of company's commitment to sustainable development.

To assess waste management system stakeholders require information on emissions of substances in dynamics, supplemented by management's comments. Data on the number of environmental violations in respect of the waste management system, estimated damage and measures taken, as well as the characteristics of ongoing researches to minimize the impact on ecosystems and improve the efficiency of production, description of procedures for monitoring the implementation of such measures demonstrate the reliability of the internal control system.

When impact on biodiversity areas is significant it is necessary to disclose information about the territories under recovery, rare fauna and endangered species, percentage of restored areas, as well as the company's further plans to strengthen the protection measures.

In relation water use reduction it is necessary to disclose information about proportion of reused water, and further use of recycling technologies.

## CONCLUSION

Public company's reputation is mainly determined by the information contained in corporate reporting. This study is based on a critical analysis of the composition and content of key reporting indicators that influence the reputational risk.

The survey demonstrates that in order to fulfill stakeholders informational requirements corporate reporting still has a long way to go. Major uncertainties are coming from insufficient evidence of internal control systems of relations monitoring – the practice of analyzing and auditing suppliers, identification of significant market risks, customer satisfaction, etc. Even when stakeholders are aware of risky events the company's strategy remains uncertain, which disables the risk assessment.

In order to improve stakeholders risks reporting we highlight the following areas:

- The disclosure should be based on the informational requirements of stakeholders, so they must be clearly identified;
- Disclosure of the most relevant information about the business (including quantitative indicators) will assist stakeholders to assess the risks;
- Information from different reporting sections should correlate;
- Disclosure of information about the key risks and less likely risks in stakeholders relations may be presented separately; the second group can be identified as strategic risks;
- Disclosure on major existing risks should be done on periodical basis.

Significant changes in markets and company performance indicators are mostly anticipated by stakeholders; their informational requirements are associated with the responsive strategy of the company. Therefore it seems reasonable to argue that further development of corporate reporting in order to manage reputational risks should demonstrate internal control soundness.

## REFERENCES

- Barnett, M.L., Salomon, R.M. (2011), "Does it pay to be really good? Addressing the shape of the relationship between social and financial performance", [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1860985](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1860985) [accessed 09 Jun 2011].
- Barnett, M.L. (2005), "Stakeholder influence capacity and the variability of financial returns to corporate social responsibility", [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=853086](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=853086) [accessed 23 Nov 2005].
- Eccles, R.G., Newquist, S.C., and Schatz, R. (2007), "Reputation and its risks", *Harvard Business Review* **85** (2), 104–116.
- Steurer, R., Langer, M.E., Konrad, A., Martinuzzi, A. (2005), "Corporations, Stakeholders and Sustainable Development: A Theoretical Exploration of Business–Society Relations", *Journal of Business Ethics* **61** (3), pp. 263–281
- Sustainability Reporting Guidelines GRI 4 (2013) <https://www.globalreporting.org/reporting/g4/Pages/default.aspx>

# Stakeholder Approach to Identification and Analysis of Value Creation Drivers\*

**Olga EFIMOVA, Ph. D., Professor**

*Economic Analysis Department, Financial University  
oefimova2002@mail.ru*

**Veronica SAMOHINA**

*Economic Analysis Department, Financial University  
universam92@mail.ru*

**Abstract.** The study presents the methodology of identification, selection and analysis of the value creation drivers. At the first stage of the study groups of key stakeholders were selected and their interests were estimated. The results of analysis helped to identify the indicators that reflect the mutual interests of the company and the stakeholders. Then, in the next step, based on the provided econometric model the most significant factors of the value creation were determined. The practical part of the research was carried for Group Cherkizovo as example.

The study has allowed to generate practice-oriented methodology for the identification, selection and analysis of the creating value drivers. The proposed methodology can be applied to any companies without significant corrections.

**Аннотация.** В исследовании представлена методология выявления, отбора и анализа факторов создания стоимости компании. На первом этапе исследования проводится отбор групп ключевых стейкхолдеров, анализ их интересов и определение показателей, отражающих взаимные интересы компании и стейкхолдеров. На следующем этапе на основе разработанной эконометрической модели выявляются наиболее значимые факторы создания стоимости компании и группы ключевых стейкхолдеров. Практическая часть исследования осуществлялась на примере компании ОАО "Группа Черкизово". Проведенное исследование позволило сформировать практико-ориентированную методологию выявления, отбора и анализа факторов создания стоимости компании. Предлагаемая методология может быть применена к любой выбранной для анализа компании без внесения существенных корректировок.

**Key words:** Stakeholders, stakeholder analysis, value creation, stakeholder value, value drivers identification.

## INTRODUCTION

In recent decades (for Russia this period can be estimated as a much shorter time interval) there have been very significant changes in the understanding the ultimate goals of companies, ways to measure their achievements, as well as the choice of specific performance indicators. The idea that the purpose of business is value creation is getting more common. This approach is well known as Value-Based Management, or VBM (managing for value); it has replaced the former one, oriented solely on profit.

Accordingly, for the purposes of evaluating the company performance that were based primarily

on the quantitative analysis of profitability (ROA, ROE, ROCE, and others) indicators characterizing the ability to create value-added (EVA, MVA, SVA, SFROI) are used.

Among the reasons that led to change in the priorities of efficiency criteria selection the following should be outlined:

- Usage of traditional measures of profit and profitability allows varying the accounting estimates;
- Traditional measures based on accounting profit and profitability ratios calculation ignore some kinds of intangible assets;
- Risk factors and required return on invested capital are excluded from consideration;

\* Стейкхолдерский подход к выявлению и анализу факторов создания стоимости.

- Focus on getting results in the current period and ignoring the possible effect in the future. A typical example of this is return on investment indicator (ROI) and its modification, which tends to decrease during the period of investment that may force to refuse profitable projects;

- Emphasis on internal factors. At the same time, to compete in the market successfully it is necessary to take into account external factors such as actions of competitors and customer satisfaction;

- Historical nature of the data used for the calculation of financial indicators;

- Lack of a coherent vision of business, the inability to build a business model for identifying the most important success factors and their interaction.

Despite the differences in calculation they all are based on common approach — value creation is recognized if actual return on investment is higher than the required return. Taking into account that the required rate of return is usually used the weighted average cost of capital (WACC) it is possible to conclude that added value is created only when companies get a return on invested capital that exceeds the cost of capital. The logic in this case is the following: the return on investment must be higher (or not less) than the value of its financing.

In view of this, the assessment of business performance in the long term is primarily based on indicators of value creation.

Despite the growing popularity of the value approach, both in theory and in practice there is a number of critical issues that need additional consideration. Among them, especially, it is necessary to highlight the following:

- What kind of company value (market, shareholder, other) should be considered as the objective function?

- Who and how creates value for business?

- What is the goal of value creation?

- How do market participants share created value, and others.

- We will try to assess the situation and questions raised.

## BACKGROUND & THEORY

The concept of VBM is aimed at solving the strategic objectives of the organization by focusing on the key drivers of value. However, all of the measuring instruments for value added (EVA and others) evaluation are based on the calculation and interpretation of solely financial performance. At the same

time, as it has been repeatedly discussed and argued in a huge number of domestic and foreign researches (Berman S.L., Wicks A.C., Koteha S., 1999; Cornell B., Shapiro A.C., 2007; Erkki K. Laitinen, 2004; Perrini, F. & Tencati, A., 2006), the key conditions of long-term value creation are connected with non-financial factors such as competitive advantages, customers and staff loyalty, supply chain and others. Moreover, non-financial factors affect financial performance. As result it is possible to conclude that the effective management of non-financial factors allows the company to achieve success, that can be measured by financial indicators (sales dynamics, optimize the cost of capital optimization, economic value added creation). In this case financial ratios are used as a benchmark.

To sum up it can be concluded that analysis of long-term value creation is based on both financial and non-financial factors evaluation.

There are different approaches that became internationally known, which are based on integrating financial and non-financial factors. Well-known in Russia and abroad are the system of comprehensive economic analysis of entities by A.D. Sheremet, Balanced Scorecard of Kaplan and Norton (Balanced Scorecard), SMART system by Cross and Lynch, and others.

Non-financial value drivers, ensuring long-term value, are formed with the participation and under the influence of a wide range of stakeholders (individuals and legal entities). The value of relationships with these parties is so high that, along with the theory of shareholder value the concept of stakeholder value (the stakeholder approach) is getting more popular.

Currently the stakeholder approach is a strategic management tool of long-term value creation. It is based on the understanding that the external and internal stakeholders, interacting and often conflicting with both the company itself and with each other, have a direct impact on its long-term sustainability.

The key concept of stakeholder theory of the firm is the idea that the goal of the company is much broader than wealth for its owners. It takes into account not only the interests of the owners, but also a much wider variety of agents — the stakeholders (Freeman R.E., 2010).

Considering the requirements and interests of the various stakeholders leads to increasing confidence in the organization that contributes to relational capital creation, and thus in turn creates the necessary (though not sufficient) condition for stakeholder value creation.

**Table 1.** Comparative analysis of shareholder and stakeholder value creation approaches\*.

Aspects of comparison	Shareholder value approach	Stakeholder value approach
Kind of decisions	Financial decisions relating to raising and investing of capital	Strategic decisions of comprehensive character
Area of implementation	Valuation	Strategic management
Methods of analysis	Quantitative	Qualitative
Persons and parties interested in the analysis	Shareholders, Investors	Stakeholders
The subject of analysis	Cash Flow	Communications
Resources	Financial	All resources, including financial, operational, human, natural, intangible.

\* Based on research of Figge F., Shaltegger S. (Figge F., Shaltegger S., 2000).

The stakeholder value concept is based on its key statements, such as:

- The value is not created solely by the organization itself or inside;
- The value is under the influence of external factors, risks and opportunities forming the environment in which the company operates;
- The value creates by joint efforts through relationships with stakeholders (customers, suppliers, society etc.).
- The value depends on the availability, accessibility, management of resources and types of capital (financial, industrial, intellectual, natural and social) that stakeholders provide (Freeman R.E., 2010).

There is a fundamental question of the relationship between shareholder and stakeholder value approaches – whether they are alternative or complementary. The position of authors is that these concepts cannot be regarded as mutually exclusive. Moreover, the concept of stakeholder value is a logical development of the shareholder value concept, because it allows to identify and to analyze the factors of shareholder value creation over the long term. Table 1 shows the results of a comparative analysis of two approaches to support this thesis.

As we can see, there is complementary relationship between the two concepts. Management of economic benefits in the form of market value or shareholder value added requires identification and analysis of non-financial factors discussed above. Non-financial value drivers, such as staff qualification and motivation, customer loyalty, effective communication, environmental and social responsibility, innovation, impact on the relevant financial drivers: sales, profit, return on invested capital, EVA, and as result influence market capitalization.

The recognition of relationship factors requires further study of the impact of non-financial factors on key indicators of value. Firstly it is necessary to find out which non-financial factors are most im-

portant for the analyzed company, and therefore the analysis of the interaction with which stakeholders is a priority for the company.

## HYPOTHESIS DEVELOPMENT

The above-mentioned analysis highlights the dependence of firm's value and its sustainable long-term growth on the effectiveness of company's interaction with stakeholders to a significant extent. This, in turn, indicates the necessity of identification and the consequent prioritization of stakeholders, as the selection of the most significant factors influencing the firm's value can only be made possible by means of appropriate identification of the most influential stakeholders. Taking into account that effective company value management is not possible without identification of the most important factors of influence, the above-mentioned analysis results in formulating the following hypotheses:

**Hypothesis 1.** It is possible to develop the model that would combine both financial and non-financial factors in order to evaluate their influence on stakeholder's value of a firm.

**Hypothesis 2.** This model will allow to separate significant factors from insignificant, and to provide quantitative assessment of the impact of significant factors on stakeholder's value of a firm.

**Hypothesis 3.** While electing factors for the model it is crucial to take into consideration business sector specifics and strategy of the firm in study.

## RESEARCH METHODS

In order to test the formulated hypotheses a research is conducted, based on applying modern econometric methods, such as regression analysis. The database for the research was created mainly by using sources such as firm's accounting and finan-

**Table 2.** Key stakeholders selection.

Key stakeholders	Factors of stakeholder value creation	Comments
State	Taxes	Tax rates reflect the quantification of the relationship between the state and the firm.
Business owners	EVA	Economic value added reflects the amount of value added created by a firm over a period. Business owners care about company development and gaining in a long-term perspective, so, from the point of view of business owners, EVA appears to be optimal as a factor of creating stakeholders value.
Consumers	Price for 1 kg of pork	Quantitative factor that significantly influences consumers' decision to purchase or not to purchase the firm's goods.
Staff	Salary	Salary is an economic expression of the employees' motivation to continue working for Cherkizovo company.
Competitors	Revenue of OMPK	Cherkizovo company and OMPK company are direct competitors, which means that they compete for the volume of consumer demand for the produced goods. The volume of consumer demand is directly related to the firm's sales volume, which, in turn, correlates with the volume of revenue.

**Table 3.** Factors of creating stakeholder value of a firm for each group of significant stakeholders. Semi-annual data was taken for Cherkizovo Group over the period of 2008 to 2013:

Index	Index calculation methodology
Taxes	Index was taken from income statement of Cherkizovo Group.
EVA	Index was calculated according to formula: $EVA = NOPAT - WACC * CE$ – NOPAT – operating profit after income tax; Operating profit and income tax rates were taken from the income statement of Cherkizovo Group. Calculation of NOPAT is presented in Table 4. – CE – capital employed; Volume of capital employed is calculated as a sum of total liabilities of a firm and its equity excluding current liabilities. Calculation of CE is presented in Table 5. – WACC – weighted average cost of capital; WACC data was taken from Bloomberg database and presented in Table 6.
Price for 1 kg of pork	Index was taken from Bloomberg database.
Salary	Index was taken from accounting reports of Cherkizovo Group.
Revenue of OMPK	Index was taken from income statement of Cherkizovo Group.

**Table 4.** Formation of research information base.

	Taxes, thousand dollars	Operating Profit, thousand dollars	NOPAT, thousand dollars
2008	1 462	103 468	102 006
6 months of 2009	2 112	62 933	60 821
2009	-3 347	140 190	143 537
6 months of 2010	3 246	84 861	81 615
2010	4 145	166 968	162 823
6 months of 2011	2 465	75 402	72 937
2011	5 819	168 454	162 635
6 months of 2012	2 400	107 794	105 394
2012	-14 281	232 139	246 420
6 months 2013	3 855	25 121	21 266
2013	2 121	88 664	86 543

**Table 5.** NOPAT calculation.

	Current liabilities	Long-term liabilities	Capital	Free sources of funding	CE
2008	344 357	362 268	425 149	140 822	990 952
6 months of 2009	226 193	366 136	454 561	119 217	927 673
2009	217 072	407 640	545 405	130 948	1 039 169
6 months of 2010	189 227	381 429	600 756	116 723	1 054 689
2010	306 367	494 931	638 586	138 773	1 301 111
6 months of 2011	459 770	622 837	755 902	188 653	1 649 856
2011	358 315	575 125	757 441	171 925	1 518 956
6 months of 2012	338 965	529 778	833 200	159 959	1 541 984
2012	564 702	549 232	950 963	195 476	1 869 421
6 months 2013	552 261	564 483	925 301	173 969	1 868 076
2013	533 502	535 084	952 481	212 061	1 809 006

**Table 6.** WACC data from the Bloomberg database.

Period	WACC	Period	WACC
2008	0,035	2011	0,07
6 months of 2009	0,035	6 months of 2012	0,07
2009	0,098	2012	0,044
6 months of 2010	0,098	6 months 2013	0,044
2010	0,115	2013	0,083
6 months of 2011	0,115		

cial statements, sustainability statements, industry analytics, as well as data taken from Bloomberg database.

The suggested hypotheses were tested on the example of OJSC Cherkizovo Group. At the first stage of research a firm industry analysis as well as company strategy analysis was conducted. This stage resulted in identification and prioritization of stakeholders that are most significant for the firm. The stakeholders that were recognized as the most significant for Cherkizovo Group are as follows:

**State.** This is primarily connected with the fact that the firm operates in Russian meat industry, and this industry is getting considerable financial support from the state, for instance, by subsidized interest rate, which eventually affects the cost of raising debt capital.

**Business owners.** Without this group of stakeholders the existence of a firm would not be possible, as these are business owners that provide such indispensable asset as owner's equity.

**Consumers.** Revenues and profit of a firm mostly come from selling the goods to the consumers. This makes existence of a firm impossible without this group of stakeholders.

**Staff.** In modern world human capital is considered to be one of the most important resources, thus, when considering the interests of stakeholders, such group as firm's employees cannot be ignored.

**Competitors.** The Russian meat industry market where Cherkizovo Group operates is highly competitive, so direct competitors of a company in question have strong influence on the results of company's activities, for example, on company's revenues. Against this background, this stakeholders group should also be considered when building a stakeholders value of a firm creation model.

At the second stage of the research a quantitative index that reflects mutual interests of a firm and its stakeholders in a best way, was assigned to each of the groups of stakeholders.

The following tables provide information used and reflect the sequence of calculations.

Market value of the firm was used for estimating firm's value, as this index reflects market evaluation of a firm, and therefore by definition takes into consideration maximum number of factors and data sources available on the market.

Thus, at the second stage of research database was developed to be used in further research.

**Table 7.** Formed information base of research.

	Market value of the company	Taxes	EVA	Price for 1 kg of pork	Revenue of OMPK	Salary
	Y	X1	X2	X3	X4	X5
2008	2929,1468	1462	67322,68	1,986551724	13963154	80004
6 months of 2009	10930,52145	2112	28352,445	1,646495726	8284202	30118
2009	18931,8961	-3347	41698,438	1,759603175	17311388	66450
6 months of 2010	28161,70555	3246	-21744,522	1,600630631	8589332	38056
2010	37391,515	4145	13195,235	1,9736	18852057	78387
6 months of 2011	30741,59745	2465	-116796,44	2,422719298	10094241	50681
2011	24091,6799	5819	56308,08	2,873032787	22276587	110819
6 months of 2012	24015,52355	2400	-2544,88	2,450336134	12041010	64370
2012	23939,3672	-14281	164165,476	2,327822581	25795195	131611
6 months 2013	24598,7635	3855	-60929,344	2,285798319	12828203	77884
2013	25258,1598	2121	-63604,498	2,493809524	26043260	153738

## MODEL SPECIFICATION AND REGRESSION ANALYSIS

Research was conducted with the help of modern econometric methods and regression analysis. Reference econometric model reflects a numerical dependency of stakeholder value of a firm as a function of selected factors of creating stakeholder value of a firm. In this research reference econometric model is expressed by the following regression equation:

$$Y = a_0 + a_1 * x_1 + a_2 * x_2 + a_3 * x_3 + a_4 * x_4 + a_5 * x_5 + u, \text{ where}$$

Y – stakeholder value of a firm, expressed numerically as market capitalization of a firm. This is endogenous variable, that depends on several regressors:  $x_1, x_2, \dots, x_5$ .

$x_1, x_2, \dots, x_k$  – factors of stakeholder value of a firm creation. These are exogenous variables that explain endogenous variable Y.

X1 – tax rate for Cherkizovo Group;

X2 – EVA for Cherkizovo Group;

X3 – price for 1 kg of pork;

X4 – revenue of OMPK;

X5 – salary for Cherkizovo Group employees.

Dependence between stakeholder value of a firm and selected factors is represented as a sum of products of factor scores and specific coefficients, as, from economic point of view, it is suggested that each factor contributes to creation of stakeholder value of a firm.

The following tests were consistently applied to initial specification of regression model:

**I.** In order to select an optimal functional form for regression model Schwarz information criterion was implemented.

The concept of Schwarz information criteria suggests that when selecting the best out of all possible options of functional forms of regression equations that were tested, the model with the lower value of BIC is the preferred one.

$$BIC = \ln \tilde{\sigma}^2 + \frac{(k+1) \ln n}{n}, \text{ where}$$

$\tilde{\sigma}^2$  – sample variance of the residuals calculated as residual sum of squares divided by the number of observations.

(k+1) – number of independent variables, including intercept. In this case (k+1) equals to 6.

n – number of observations. In the case of this research n equals to 11.

Implementation of Schwarz information criterion resulted in developing the following econometric model that reflects the stakeholder value as a function of selected factors:

$$Y = a_0 + a_1 * x_1^3 + a_2 * x_2 + a_3 * x_3^3 + a_4 * x_4^3 + a_5 * x_5^3 + u,$$

**II.** In order to test the significance of the model F-test was conducted. In an F-test observed F-statistic from Table 8 is compared to F-critical. Observed F-statistic for this model equals to 6.234, while F-critical equals to 4.347. As F-critical is less

**Table 8.** Least squares method for the t-test.

Regression statistics				
Multiple R	0,876077324			
R-squared	0,767511477			
Normalized R-squared	0,535022955			
Standard error	6357,143776			
Observations	11			
	<b>df</b>	<b>MS</b>	<b>F</b>	<b>F – significance</b>
Regression	5	133415850,3	3,301287603	0,107962307
Residue	5	40413276,98		
In total	10			
	<i>Coefficients</i>	<i>t-statistic</i>	<i>P-value</i>	<i>Lower 95%</i>
Y–intersection	16488,39167	<b>3,778687715</b>	0,012907261	5271,598082
Variable X 1	-3,00522E-09	-0,888274024	0,415076201	-1,17021E-08
Variable X 2	-0,159674561	<b>-3,690700396</b>	0,014135336	-0,270888283
Variable X 3	-40,61537617	-0,097215263	0,926332063	-1114,573778
Variable X 4	4,20405E-18	<b>3,119446102</b>	0,026268671	7,39699E-19
Variable X 5	-2,06158E-11	<b>-3,067142992</b>	0,027874303	-3,7894E-11

than F-observed, the regression model in question is recognized as significant.

**III.** In order to test the significance of the regressors in the model least squares method and t-test were applied. The significance of the regressors is verified by testing significance of corresponding regression coefficients. T-test method suggests that for each of the coefficients in the model observed t statistic is compared to critical t-value.

Conducting a t-test for the econometric model proved the following regressors to be statistically significant: intercept, regressor X2 (EVA), regressor X4 (revenue of OMPK company) and regressor X5 (salary of Cherkizovo company's employees).

The resulting econometric model is as follows:

$$Y = a_0 + a_2 * x_2 + a_4 * x_4^3 + a_5 * x_5^3 + u_t$$

**IV.** Pairwise correlation coefficients were used to test the model for multicollinearity, or correlation between regressors which would not allow the recognition of obtained results as distinct and suitable for definitive interpretation.

In regression model in study regressors X4 and X5, namely revenues of OMPK company and salary of Cherkizovo company's employees, demonstrate collinearity. From the point of view of common sense, such result can be motivated by the fact that both companies operate on the same market of Russian meat industry. In order to eliminate the negative influence of multicollinearity on the quality of the model and further interpretation of obtained results, the cause of multicollinearity, namely one of the multicollinear variables is to be eliminated. Regressor reflecting the salary of Cherkizovo company's employees was removed within this research. Thus, at the stage of primary testing the final version of the regression model was as follows:

**Table 9.** Values of pair correlation coefficients for significant covariates.

Corr (X2; X4^3)	0,38999867
Corr (X2; X5^3)	0,157428741
Corr (X4^3; X5^3)	0,937138161

$$Y = a_0 + a_2 * x_2 + a_4 * x_4^3 + u_t$$

V. Goldfeld-Quandt test and Durbin-Watson test were conducted on the model to detect the presence of heteroskedasticity and autocorrelation in the residuals correspondingly. Presence of heteroskedasticity and autocorrelation in the model decreases the quality and precision of obtained evaluations of model parameters, and eventually decrease the quality of interpretation of obtained results. Goldfeld-Quandt test and Durbin-Watson test conducted on studied model demonstrated the absence of heteroskedasticity and autocorrelation in the residuals.

VI. Confidence interval method was applied to the model to test its reliability. Results of application of this method indicate that the regression model under study can be recognized as reliable.

Thus, application of modern econometric methods resulted in developing reliable regression model of high explanatory and predictive power, and precision. This model contains only significant regressors, so that only truly significant factors of value creation are included:

$$Y = 15767,285 - 0,141 * x_2 + (4,36E - 18) * x_4^3$$

## ECONOMIC INTERPRETATION OF OBTAINED RESULTS

Conducted analysis of stakeholder value of Cherkizovo Group demonstrated that EVA and OMPK company revenue are significant factors of creating stakeholder value of this company. For every standard unit increase in EVA there will be a 0.141 standard unit decrease in stakeholder value of Cherkizovo Group. Decrease in stakeholder value as firm's value added increases over a period may seem unexpected as a result, but can be explained by the fact that stakeholder value reaction to increase or decrease in EVA lagged behind. Consequently, EVA may have been positively correlated with stakeholder value of a firm, if this factor were represented as lagged variable.

Developed regression model demonstrated positive correlation between stakeholder value of the firm and revenue of OMPK company which is direct competitor to Cherkizovo company. This means that increase in OMPK company revenue is followed by increase in stakeholder value of Cherkizovo company. This can be explained by the fact that both companies are operating on the same market of Russian meat industry, and thus are both prone to the tendencies of this market, such as seasonality of demand. In this case economic meaning of the intercept in the model

is the impact of unaccounted factors on stakeholder value of a firm.

It should also be mentioned that EVA index reflects not only firm's relationships with stakeholders, but also with the state, as in order to compute this index it is needed to consider WACC, which value directly depends on the state subsidizing firm's interest rate on loan.

Thus, EVA and OMPK company revenue are recognized as significant factors of creating stakeholder value for Cherkizovo company, while business owners, direct competitors and the state appear to be key stakeholders.

## RESULTS OF HYPOTHESES TESTING

The first hypothesis claimed that a model could be developed that would allow to combine both financial and non-financial factors in order to evaluate their impact on stakeholder value of a firm. Indeed, the conducted research demonstrated that such model could be obtained. The model developed as the result of research is reliable and possesses predictive and explanatory power. Comprehensive analysis of industry segment where the firm operates as well as analysis of the firm's strategy and specific features of its operations should be included in processes of building a database for developed model and selection of significant factors. Accounting and financial statements, sustainability statements, firm industry analytics, as well as data taken from independent databases, e.g. Bloomberg database, can serve as sources of information for primary data.

The second hypothesis suggested that the model would allow to separate significant factors from non-significant, and to quantitatively evaluate the impact of significant factors on stakeholder value of a firm. As a result of the application of econometric methods, such as t-test and F-test, to the model, the analysis of overall significance of the model and significance of each separate factor was provided. As a result of this stage of research, the significant regressors — those that influence the creation of the value of a firm — were selected.

The third hypothesis indicated that in order to select the proper factors for the model it is necessary to take into account industry specifics and strategy of a firm in study. This hypothesis proved to be correct, as both firm's strategy and industry specifics (e.g. active financial support to the industry provided by the government) were considered when selecting the factors of stakeholder value creation for initial regression model, and this prevented from omitting such an important stakeholder as the state is. At the same time,

the regression model did not include cattle food suppliers as significant stakeholder, as Cherkizovo Group is a vertical integrated group and thus provides food for its livestock from its own resources, whereas for other companies in this industry it would be vital to include cattle food suppliers into the model as they would appear to be key stakeholders.

## CONCLUSION

This research demonstrates the application of developed methodology of identification, selection and analysis of factors of creating a firm's stakeholder value, through the example of Cherkizovo Group. In addition, the developed methodology can be used for analysis of stakeholder value creation factors for any company. The example of Cherkizovo Group demonstrates the algorithm of application of this methodology, which includes, first of all, the identification of key groups of stakeholders for a firm in study. Secondly, it includes the estimation of key stakeholders' interests and conversion of qualitative interests into corresponding quantitative variables. Next stage is building initial regression model that reflects dependence of stakeholder value of a firm from selected potential factors of value creation. Modern econometric methods help to eliminate non-significant factors stepwise, while the model is checked for overall significance, quality and reliability. The resulting regression model allows to draw conclusions about which factors influence a firm's stakeholder value creation, and to provide a quantitative estimation of their influence. This algorithm can be applied to any firm.

Undoubtedly, the application of this algorithm for a specific firm demands that the firm's industry sector, strategy and operations specifics, as well as limits on available database, are to be taken into account. Nevertheless, the methodology of analysis itself stays unchanged.

Thus, the developed methodology appears to be practice-oriented instrument that helps firms to build relationships with key stakeholders in an effective way. This allows business owners and firm's top management to gain an opportunity of having successful long-term sustainable development, as well as a possibility to manage the value of the firm in most effective way.

## REFERENCES

ACCA, Deloitte (2010). Hitting the notes, but what's the tune? An international survey of CFOs' views on narrative reporting: A report from ACCA in partnership with Deloitte. Research Publications.

- Bebbington, J. (2007). *Accounting for Sustainable Development Performance*. London: Elsevier.
- Bell, S. & Morse, S. (2008). *Sustainability Indicators: Measuring the Immeasurable?* (2 ed.). London: Earthscan.
- Berman S.L., Wicks A.C., Koteha S., Jones T.M. (1999). *Does stakeholder orientation matter? The relationship between stakeholder management models and firm financial performance*. *Academy of Management Journal* 42, 488–506.
- Boston Consulting Group — BCG (2012), "The 2012 Value Creator report — Improving the OODS: Strategy for superior value creation", Research Publications.
- CFA Institute, (2007). *A Comprehensive Business Reporting Model: Financial Reporting for Investors*, Charlottesville.
- Cornell B., Shapiro A.C. (1987). *Corporate stakeholders and corporate finance*, in: *Financial Management*, vol. 16, 514.
- Donaldson T., Preston L.E. (1995). *The stakeholder theory of the corporation: concepts, evidence, and implications*, in: *Academy of Management Review*, vol. 20, #1, 65–91.
- Dunphy, D. D., Griffiths, A. & Suzanne, B. (2007). *Organizational Change for Corporate Sustainability: A Guide for Leaders and Change Agents of the Future* (2 ed.). London: Routledge.
- Erkki K. Laitinen, (2004) "Nonfinancial Factors as Predictors of Value Creation: Finnish Evidence", *Review of Accounting and Finance*, Vol. 3 Iss: 3, pp.84–130
- FEE (2011). Environmental, Social and Governance (ESG) indicators in annual reports *An introduction to current frameworks*. FEE Sustainability Group
- Figge F., Shaltegger S. (2000). *What is stakeholder value? Developing a catchphrase into a benchmarking tool*. Published in association with United Nations Environment Program
- Freeman R.E. (2010) *Strategic Management: A Stakeholder Approach*. Cambridge University Press.
- Friedman, A. L. & Miles, S. (2006). *Stakeholders: Theory and Practice*. New York: Oxford University Press.
- Gibson, R. B., Hassan, S., Holtz, S., Tansey, J. & Whitelaw, G. (2005). *Sustainability Assessment: Criteria and Processes* London: Earthscan.
- ICAEW, (2009), *Development in new reporting models*. Information for Better Markets
- IFAC (2009). *Developments in the Financial Reporting Supply Chain: Results from a Global Study among IFAC Member Bodies*, New York
- MacLean, R., & Rebernak, K. (2007). Closing the credibility gap: The challenges of corporate responsibility reporting. *Environmental Quality Management*, 16 (4), 1–6.
- Perrini, F. & Tencati, A. (2006). Sustainability and stakeholder management: The need for new corporate performance evaluation and reporting systems. *Business Strategy and the Environment*, 15 (5), 296–308.
- Post, J., Preston L., Sachs S. (2002). *Redefining the Corporation: Stakeholder Management and Organizational Wealth*. Stanford University Press.
- Steurer, R, Langer, M., Konrad, A., Martinuzzi A. (2005). *Corporations, Stakeholders and Sustainable Development: A Theoretical Exploration of Business–Society* *Journal of Business Ethics* (2005) 61: 263–281.

# National Intellectual Capital (NIC) – New Metrics\*

**Piotr WIŚNIEWSKI, Ph.D.**

Associate Professor, Department of Corporate Finance, Warsaw School of Economics, Poland  
piotr.wisniewski@sgh.waw.pl

**Anna WILDOWICZ-GIEGIEL, Ph.D.**

Associate Professor, Faculty of Economics and Management, University of Bialystok, Poland  
awildowicz@interia.pl

**Abstract.** National Intellectual Capital (NIC), the measurement of intellectual capital (IC) at national level, is a fairly novel approach to IC research as a whole. Thus far, NIC quantification has predominantly relied on well-established and increasingly obsolete benchmarks within the subsets of: national human capital (NHC), national market capital (NMC), national process capital (NPC), and national renewal capital (NRC).

**Аннотация.** Национальный интеллектуальный капитал (НИК) и измерение интеллектуального капитала (ИК) на национальном уровне представляют собой достаточно новый подход к исследованию ИК в целом. Ранее количественное измерение НИК в основном базировалось на критериях национального человеческого капитала и ряде других критериев, которые хорошо зарекомендовали себя в прошлом, но в последнее время оказались все более устаревающими.

**Key words:** National Intellectual Capital (NIC), intellectual capital (IC) measurement, macroeconomics, socioeconomic development.

The overall philosophy of the revised NIC measurement proposed herein is aimed at tilting the center of gravity from quantifying IC means (effort, expenditure, time) towards quantifying IC ends (efficiency, value and quality).

The proposed study helps revise the nascent methodology of NIC quantification. It is also expected to encourage a complex discussion on new socioeconomic policy goals to be formulated by nations and humanity as a whole in the IC domain.

## 1. REVIEW AND CRITIQUE OF NIC MEASUREMENT

Over the past few decades, intangible resources (as drivers of wealth, prosperity and socioeconomic progress), have attracted widespread attention, not only from academic researchers, but also from national policymakers. Because of the widening chasm between the book and market values of enterprises, largely attributable to intangibles, the concept of IC has also been the focus of keen interest. It is thus helpful to put the NIC concept in

(however limited) historical perspective. The initial stage of IC research, which traces its origins to the late 1980s and the 1990s, focused on recognizing and understanding the potential for IC at the firm level to render “the invisible more visible” (Petty, Guthrie, 2000). Pioneering research in this scope was inaugurated by practitioners, e.g. Edvinsson (1996), Sullivan (1996), Brooking (1996), Stewart (1997), Roos (1997). IC interpretations began to abound in the relevant literature, although the best known definition, coined by Edvinsson and Malone, was presented in the Skandia Value Scheme in 1997, on which basis two major subsets of IC, such as human and structural capital were added.

As a result, at the second stage of IC research (aimed to refine, expand and measure its basic elements), a number of frameworks for classifying measuring and reporting the concept emerged. It is worth stressing that when the world economy entered the era of the knowledge-based economy (in which the new wealth of nations began to be tied directly to the creation, transformation, and capitalization of knowledge), numerous theoretic-

\* Новые параметры измерения национального интеллектуального капитала.

**Table 1.** The selected models of measuring NIC.

Country/ researcher	General basic model	Dimensions	Nature of indicators
<b>Models developed by individual researchers (academic models)</b>			
Sweden (Rembe, 1999)	Skandia Navigator	Human capital, market capital, process, renewal capital	financial indicators, descriptive indicators
Malaysa (Bontis, 2000)	Skandia Navigator	Financial wealth, human capital, market capital, process capital, renewal capital	financial indicators, intangible indicators, descriptive indicators
Sweden (Spring Project 2002)	Skandia Navigator	Business recipe, human capital, structural capital, relational capital	innovative indicators, competence indicators, industrial indicators, company-universities indicators
Spain (Pomeda et. al., 2002)	Skandia Navigator	Human capital, organizational capital, technological capital, relay capital, social capital	descriptive indicators, intangible indicators, innovation indicators
EU Countries (Bounfour, 2003)	IC-dVAL Approach	resources, processes, outputs	financial indicators, descriptive indicators, innovation indicators
Arab Region (Bontis, 2004)	Skandia Navigator	Financial wealth, human capital, market capital, process capital, renewal capital	descriptive indicators, intangible indicators, financial indicators
Finland (Stähle and Pöyhönen, 2004)	Skandia Navigator	Human focus, market focus, process focus, renewal & development focus	industrial indicators, national indicators, financial indicators
Andriessen and Stam, 2005	Skandia Navigator	Human capital, structural capital, relational capital	financial indicators, descriptive indicators
Israel (Pasher and Shachar, 2007)	Skandia Navigator	Financial capital, human capital, market capital, process capital, renewal & development capital	financial indicators
EU Countries (Weziak, 2007)	Skandia Navigator	Human capital, relational capital, structural capital, renewal capital	financial indicators, descriptive indicators
Lin and Malone, 2011	Skandia Navigator	Human capital, market capital, process capital, renewal capital, financial capital	financial Indicators, descriptive indicators
<b>Models developed by international organization</b>			
United Nations Development Programme (UNDP, 1990)	Human Development Index (HDI)	Education, health, standard of living	financial indicators, quantitative indicators
Organization for Economic Co-operation and Development (OECD, 1998)	Science, Technology and Industry Outlook (ST I)	R&D, patents, researchers and other innovative performance	financial indicators, quantitative indicators
World Bank, 2002	Knowledge Assessment Methodology (KAM)	Economic and institutional regime, education and skilled human resources, dynamic information infrastructure, efficient innovation system, performance indicators	financial indicators, qualitative indicators
World Economic Forum (WEF, 2004)	Global Competitiveness Index (GCI)	Institutions, infrastructure, macroeconomy, health and primary education, higher education and training, market efficiency	financial indicators, quantitative indicators, qualitative indicators
European Union (EU, 2006)	Innovation Union Scoreboard (IUS)	Enablers: human resources, research systems, finance and support; firm activities: firm investments, linkages & entrepreneurship, intellectual assets; outputs: innovators, economic effects	financial indicators, quantitative indicators, qualitative indicators

Source: Own elaboration based on Lin, Edvinsson (2011b) and Labra, Paloma Sánchez (2013).

cians set out to simultaneously explore the concept of national intellectual capital (NIC).

From the societal perspective, IC is construed as a collection of various socioeconomic phenomena: education, training, work experience, know-how, science, technology, patents and social relations. NIC can thus be defined as “the intrinsic value of human talent, enterprises, institutions, communities and regions, which are current and potential sources of wealth” (cf. Bontis, 2004). These hidden values are key to dynamic and sustainable macroeconomic growth and social welfare. They also underscored the need for measuring NIC, as such quantification can facilitate the implementation of good policies and practices for a more balanced national development (Lin, Edvinsson, 2011a).

Macro-level research on IC came to the fore at the beginning of the 2000s (along with the third stage of IC studies), refuting grand theories in favor of the analysis of praxis (Marr and Chatzkel, 2004). Apart from the critical and performative approach (dominant at the third stage) and “what really happens within the firm”, there was an urgent need to examine an ostensive fourth stage of IC research based on IC eco-systems of cities and nations (Dumay, 2014).

NIC research has the potential to make an important contribution to understanding the sources of a country’s competitiveness and can act as a catalyst for national foresight and strategy. Nonetheless, it requires a reliable methodology for identifying, assessing and measuring NIC, which seems to be a daunting challenge at the fourth stage of IC research. However, it is worth noting that – beyond purely academic studies – comparative socioeconomic analyses and rankings of nations have also been conducted, compiled and published by international institutions, such as the UN, World Bank, European Union Commission or OECD.

In sum, contemporary socioeconomic literature contains at least, two clear-cut conceptual approaches towards NIC (cf. Labra, Paloma Sánchez, 2013):

- Firm-level: represented by academic models of measurement and management of IC derived from companies on the basis of the IC taxonomy championed by Edvinsson and Malone (1997). The relevant academics have contended that there is no need for a specific NIC model since the IC concept is relatively universal and easily transferable from the micro level upwards;

- Country-level: developed by international organizations, business schools and think tanks, seeking to study competitiveness, innovativeness

and development specifically at the country level (*de facto* assuming that socio- and macroeconomic IC drivers are unique enough to validate such a distinctive treatment).

In technical terms, the principal differences between both methods have revolved around general objectives, ways of measuring and analyzed components (see Table 1). The academic models have tended to focus directly on IC, whereas models derived from business organizations have zeroed in on competitiveness, innovation or development (without identifying IC itself, or IC components). Furthermore, in academic models intangibles have been evaluated individually, using non-financial proxies. Additionally, NIC oriented researchers have considered the necessity to separate the economic effects of NIC from the effects of other (more traditional) factors of production. As a result, the NIC dynamics have been measured either using numerous separate indicators (Stähle and Bounfour, 2008) or with a composite single index constructed on their basis (Andriessen and Stam, 2005; Węziak, 2007).

In contrast, under the country-level models, tangibles and intangibles have been evaluated in aggregate, mainly via financial indicators. Under this approach, researchers have not referred to themselves as the IC community, but have applied the concept of *intangible capital*.

Despite the varying approaches discussed as part of the aforementioned models, the results obtained, if limited to country rankings, are usually convergent because they share the evaluation of intangible assets. However, if intangibles are the subject of specific analysis in the context of their contribution to GDP output, result can be inconsistent. For example, Andriessen and Stam (2004) found no interdependence between GDP and the stock of intangibles, whereas Lin and Edvinsson (2011), in a study conducted across 40 economies, found a significant average correlation (0,88) between the proposed composite indices of NIC and GDP *per capita*. These contradictory findings might be attributable to discrepancies existing within the models and might relate to incongruous and obsolete methodologies for IC measuring and scaling.

Undoubtedly, a simple replication of the well-known micro-measurement models, such as INC, IC-dVAL and VAIC, can be problematic in a macroeconomic setting (Labra, Paloma Sánchez, 2013). Firstly, research on IC at the macro level involves a vast quantity of information (whose collection seems cumbersome because plenty of data concerning intangibles do not figure in routine in-

formation disclosure produced under national accounts). The systematic collection of such data without a prior, comprehensive and commonly accepted framework is a considerable practical impediment. Secondly, these models mainly use indicators of intangibles and report NIC through composite indices that enable cross-country comparisons. Comparisons among countries are usually based on disparate qualitative criteria and different regional/national statistic systems, and these differences may result in inconsistencies contained in final results.

Many authors raise the question whether the translation of models from the domain of business management to the national or regional levels is appropriate. In the case of the application of the Edvinsson and Malone model, there is a problem with defining structural, organizational and process capital. This can result in double-counting. It means that the same indicators characterizing various components of IC can appear twice, like in the case of the Węziak model (2007) where patents USPTO *per capita* are used jointly in process and market capital. The Edvinsson and Malone model does not offer clear underlying metrics or straightforward guidelines for conducting reliable and comparable analyses. The indicators for this model and the procedures of normalization used have been selected arbitrarily. The same caveat applies to the Andriessen and Stam model (2004), in which the statistical indicators selected for three categories – assets, investments and effects – were posited. In order to appreciate the difference between past, present and future development, each of the three classes of IC can be monitored from three different perspectives. As a result, we have, first of all, assets providing an indication of the present power of a nation, secondly investments (forward looking), which determine the future power of a nation, and finally effects that show the extent to which the nation has made its intangibles productive during the past period. However, the combination of disparate indicators into a composite is still based on speculative weightings and the model does not show inter-relational dependencies amongst IC components. The core problems of index formulation were not avoided by Bontis (2004), but his study is an important contribution to IC research on inter-related connections and dependences among IC components and their influence on overall economic performance (Stähle, 2008).

The issue of identifying the most critical drivers for each IC metric has not yet been resolved

definitely. To apply appropriate indicators, the fundamental criteria must be fulfilled, such as: comparability, reliability, objectivity or verifiability. With respect to macroeconomic qualitative indicators (used for estimating specific elements of IC like values, motivation, satisfaction or loyalty), it seems rather difficult because they usually suffer strongly from subjective biases, and are overly influenced by recent economic performance. Evidently, most national intellectual capital measurement models analyze existing data at the input and output levels, although some academics prioritize the effects of IC. Pulic (2005) was the first who focused explicitly on the connection between IC and economic performance operating solely via financial indicators. In spite of such an operational approach, findings from Pulic's VAIC model have been contradictory concerning the impact of IC on economic growth. The author presented rather straightforward formulae for calculating the VAIC index, but the implementation of some assumptions for the purpose of economic analysis, e.g. substituting the concept of human capital for *Personnel Expenses* or identifying the structural capital with the difference between *Value Added* and *Personnel Expenses*, seems to raise doubts as to its technical correctness. The explicit concentration on economic effects of intangibles also figured prominently in the model developed by Lev (2001), although, unlike Pulic, the author analyzes the economic effects of intangibles without using detailed indicators or definitions (Stähle, 2008).

Basing on the literature reviewed, it can be asserted that the IC global community has not yet managed to reach a consensus on the methodology of measuring NIC. Further studies are needed to harmonize and standardize such models originally derived from the IC taxonomy of Edvinsson and Malone. Apart from the necessity for a multi-dimensional conceptualization of the NIC paradigm, it appears to be particularly difficult to demonstrate the effect of IC on the national economy, since empirical findings on NIC's relevance to economic growth are fragmentary and contradictory. Due to the IC's intangible nature, inter-relational dependencies between IC indicators and GDP, or the different tempos of IC effects at different economic levels, the analysis should include the time context and the economic environment. What is more, one of the prerequisites for reliable such analysis is adjusting GDP by isolating the effect of non-IC drivers within the economy. It is noteworthy that neither academic nor international organizational models are able to identify

and measure the hidden value of NIC comprehensively. The World Bank (2002) proposed a knowledge assessment methodology (KAM) consisting of 69 structural and qualitative variables classified into five dimensions: economic and institutional regime, dynamic information infrastructure, performance indicators, education and skilled human resources as well as efficient innovation system, to assess a country's preparedness for developing a knowledge-based economy (Lin, Edvinsson, 2011b). Despite many variables on the scorecard, some components of IC, such as social and environmental aspects, quality of life, social well-being, values, attitudes and competences attributable to human capital, were not considered (Navarro, Lopez Ruiz, Nevado Peña, 2011). An analysis of NIC in the context of inputs (rather than outputs) also seems to be an important weakness of models proposed by international organizations, such as the OECD, but even academic models are not free from such shortcomings, offering a rather limited perspective (e.g. inputs or intellectual property rights) or containing too many disjointed variables to enable trend analysis (Lin, Edvinsson, 2008).

## 2. RATIONALE FOR NEW METRICS

Despite the undisputed appeal of the original NIC methodologies, continued insights into their structure are necessary to render them maximally representative of the new, IC relevant "wealth of nations".

The essence of a revised system of NIC metrics proposed here, as aforementioned, is shifting the center of gravity from quantifying IC means to quantifying IC ends. In this vein, the following vital notions should be incorporated to better account for:

- *Functional literacy vs. passive schooling participation* (enrollment) or education expenditure (budgets): it is by far more representative to measure educational progress through the skills and knowledge transferred rather than by the sheer amount of time and money allocated to the process (various contemporary yardsticks of empirical educational and training achievement can be used to this end);

- *Social media vs. information technology subscriber statistics*: as the nascent and progressively popular form of global interconnectedness, social media intensity has been taken into account here (and will eventually replace the most passive and increasingly outdated drivers of information technology use);

- *Socioeconomic progress vs. output of products or services* (notably via gross domestic product, GDP and human development index, HDI): both aggregates, have been major components of NIC and prevalent measures of socioeconomic progress, and are increasingly considered obsolete and detached from quality-of-life factors empirically measured on a global scale. The proposed research is tilting the scale towards ends-driven (and perceptible) indicators of human development;

- *Commercialism vs. formalism*: particular emphasis has to be placed on commercialism and usage data (rather basing on traditional macroeconomic reporting or isolated elements of intellectual property registration);

- *Ecological footprint vs. ecological ignorance*: the study incorporates the human demand on the Earth's ecosystems — a factor widely acknowledged as a major macroeconomic concern, yet oftentimes ignored in the measurement of socioeconomic progress (at national or supranational levels).

## 3. A CRITIQUE OF THE NIC MEASUREMENT FRAMEWORK

To illustrate proposed amendments to the NIC model, it is worth pointing out the weaknesses of indicators being used to value the individual NIC subsets as well as the rationale for changes. Table 2 encapsulates these criteria basing upon the on-line database maintained by P. Stahle, and S. Stahle (Bimac, 2014).

## 4. NEW METRICS

Alternations to the NIC measurement methodology should supplement it with variables that refine the existing NIC concepts so as to better reflect the socioeconomic priorities laid out at the outset of this paper. Table 3 demonstrates amendments to the aforementioned NIC indicators, the recommended metrics and sources.

## 5. CONCLUSIONS

National Intellectual Capital (NIC) is a groundbreaking research approach to intellectual capital (IC), whose socioeconomic and political significance is rising and warrants further scientific elaboration. The need to continuously examine NIC is dictated by the pivotal role played by intangible assets at macroeconomic level — a factor largely ignored in mainstream strategic and national policymaking.

Table 2. A critique of indicators making up NIC subsets.

NIC Subset	NIC Indicator used	Need for alteration	Reasons
NHC	Skilled labor	no	Skilled labor is a pivotal element of NHC and the availability of a skilled workforce determines macroeconomic competitiveness
	Employee training	no	In view of rising work complexity and more frequent labor mobility, ongoing employee training is key to long-run workforce competitiveness
	Secondary education up enrollment	yes	Most global economies are now saturated with secondary graduates, therefore further progress in this respect can be limited, whereas school participation at this level per se does not guarantee competitiveness growth (remote relevance to IC creation)
	Pupil-teacher ratio	yes	No theoretical or practical studies support the claim that the lowest pupil-teacher ratios benefit all aspects of educational performance (e.g. achievements involving teamwork – requisite in numerous complex research and development projects)
	Public expenditure on education	yes	Public expenditure on education is a typical means-oriented measure ignoring the efficiency of money being spent (in certain circumstances diverting capital from private business through higher fiscal levies can be downright counterproductive to IC growth)
	15–64 years old population	yes	Not only are most countries currently extending the working lives of their populations beyond the age of 64 (or will be forced to do it in the not-too-distant future) but an efficient use of human talent is required over an entire lifetime
	Qualified engineers	yes	Granted – IC intensive technologies require a stable inflow of qualified engineers, however, it is over-simplistic to assume that innovation is the exclusive product of engineers: other qualified professionals should be included as well
	Students PISA performance	no	Despite numerous constraints of the Program for International Student Assessment (PISA) methodology, this metric is a typical ends-oriented variable demonstrating empirical educational quality
	Human Development Index	yes	Although partially an ends-oriented measure, HDI overlaps other, more specific yardsticks of the quality of life are thus recommended
	Gender equality	no	The sex ratio for the entire world population is equally balanced between females and males, any gender inequality attests to inefficiencies in the use of NHC
	Years of education	yes	The length of education by itself is not a direct proxy for education quality, hence the need for alternation (a more specific measure of education intensity)
	R&D researchers	no	The number of individuals involved in research and development (R&D) activity, although not directly relevant to the output of NHC, determines the knowledge base for current and future innovation
	NMC	Corporate tax encouragement	yes
Cross border venture		no	Cross border venturing epitomizes the international marketability of businesses, therefore its incorporation in NMC should be preserved
Openness of culture		no	The openness of national culture to foreign investment reduces information asymmetries faced by parties involved in IC exchanges
Transparency of government policies		no	The transparency of government policies ensures the smooth running of market efficiencies (mitigating regulatory risks)
Image of your country		no	A country's image is a natural macroeconomic intangible (an equivalent of intellectual property held by companies), its inclusion into NMC is thus uncontroversial
Capital availability		yes	A more representative benchmark of financial market flexibility (that would quantify the competitiveness of an entire financial market) is needed
Trade to GDP ratio (exports + imports)		no	The proportion of foreign trade in Gross Domestic Product (GDP) demonstrates how globalized GDP is, which is an efficiency factor
Current account balance		yes	The current account balance relates to the structural nature of a given economy and has no direct bearing on IC marketability
Investment flows		no	Investment inflows show how attractive a given economy is to foreign capital and international commitments to that economy
Country credit rating		yes	The information relevance of sovereign credit ratings tends to be inferior to more dynamic (market oriented and timely) measures of sovereign debt quality
Investment risk		yes	No universal definition or measure of investment risk has yet been worked out internationally, however, modern perceptions of risk related to investment incorporate political hazards
Globalization index		no	Globalization determines the openness of a socioeconomic system to the exchange of IC (their current and future marketability) and should be preserved

NIC Subset	NIC Indicator used	Need for alteration	Reasons
NPC	Business competition environment	no	The business competition environment of a given economy drives the efficiency of its processes, therefore the necessity for this factor in NPC
	Government efficiency	no	Government efficiency enables efficiencies in all other sectors, which warrants the inclusion of this metric
	Computer per capita + Mobile subscribers	yes	Given the rapid sophistication and hybridization of consumer electronics, personal computer/mobile telephone penetration does not fully account for high-technology uptake and should be broadened by other, modern applications
	Internet subscribers + Broadband subscribers	yes	In an era of omnipresent social media use, personal computer/mobile telephone penetration largely ignores numerous aspects of online interconnectedness and should be expanded by Internet based social interaction
	Convenience in establishing new firms + start up days	yes	Convenience in establishing new firms is only a fraction of standards related to initiating, maintaining and closing business activity – a more comprehensive measure would thus be advisable
	Goods & services distribution efficiency	no	The distribution efficiency of goods and services determines the final stages of marketing, so its inclusion is necessary
	Overall productivity	no	Economic productivity is essential to the quality of processes, therefore it should be preserved
	Unemployment% + Youth unemployment%	yes	Unemployment rates (including youth unemployment) do not adequately capture the number of active jobseekers and are being increasingly criticized
	Consumer price inflation	no	The Consumer Price Index (CPI) is related to macroeconomic stability and directly relates to the efficiency of macroeconomic policy
	Health & environment	yes	Human health and environmental standards (especially if measured on the expenditure side) are difficult to quantify; an ends-oriented alternative appears to be advisable
	Corruption	no	Corruption is a challenge to IC processing, as it distorts free competition and interferes with the efficient allocation of scarce resources (including IC)
	Freedom of speech	no	Free speech is a sine qua non for minimizing information asymmetries – in consequence it can be interpreted as an efficiency factor
NRC	Business R&D spending	yes	The sheer amount of spending on research & development (R&D) does not always translate into economic effectiveness, so a more sophisticated measure is needed in this regard
	Basic research	no	If an exception should be made to the overriding desire to shift the philosophy of NIC measurement from means to ends, it is in funding for basic research (its applications – while usually not assumed at the outset and deferred – can be highly cross-disciplinary and IC relevant)
	R&D spending/GDP	no	With considerable reservations to Gross Domestic Product (GDP) as a proxy for macroeconomic progress, the proportion of research & development (R&D) in GDP shows the commitment of an economy to innovation
	R&D US\$ per capita	no	A measure of research and development (R&D) intensity related to population puts the R&D expenditure in a human relevant perspective
	IP right protection	no	The protection of intellectual property (IP) – if overaggressive – can occasionally hamper future IC creation, yet the lack of it undermines the propensity to innovate
	Utility Patents/ R&D expenditure	no	This particular measure aims to quantify the effectiveness of research and development (R&D) via patenting, which is a proxy for R&D
	Cooperation between corporations and university	no	Academic research commercialization is a sine qua non for synergies in tertiary education and a prerequisite for academic renewal (inter alia in access to sustainable funding)
	Scientific articles	yes	The sheer number of scientific articles does not guarantee their quality, hence the need for a more elaborate quantification of scientific output quality
	Patents per capita (USTPO+EPO)	yes	The intellectual property (IP) concept extends far beyond patenting, therefore diverse forms of IP registration should be accounted for
	Entrepreneurship	no	Entrepreneurship emblemizes the propensity of an economy to initiate new business ventures, which is closely related to IC creation
	Development & application of technology	No	The development and application of new technologies helps renew IC micro- and macroeconomically,
	Venture capital	No	Venture capital (private equity invested into young, entrepreneur-led, high-potential companies – typically driven by technological innovation) is a natural form of IC renewal based on commercial premises

Source: own elaboration based on the NIC model (BIMAC, 2014).

**Table 3.** New metrics proposed for selected NIC indicators, their reasoning and sources.

NIC Subset	NIC Indicator used	Proposed metric (reasoning) /Source
NHC	Secondary education up enrollment	Tertiary education enrollment (this metric would quantify participation in academic education: at under- and graduate levels). For professionals without this standard of formal education, their skills would be measured through other indicators (e.g. evidence of certification) /World Bank
	Pupil-teacher ratio	Teacher quality (a combination of formal education levels, experience, certification, periodical assessment and awards) /Education Ministries, national statistical offices
	Public expenditure on education	School quality (availability of technical infrastructure in public schools: educational resources, audiovisual equipment and Inter-/Intranet based applications) /Education Ministries, national statistical offices
	15–64 years old population	Employment-to-population (such a ratio highlights how effective a given economy is in job creation in relation to this economy's working-age population) /World Bank
	Qualified engineers	Qualified professionals (the percentage of professionals holding certifications widely recognized in a given industry) /Professional bodies authorized to award industry certifications
	Human Development Index	The where-to-be-born (quality-of-life) index based on life-satisfaction surveys and objective life-quality determinants/Economic Intelligence Index
	Years of education	The lifelong learning index combining the different learning environments of school, community, work and home life within four educational pillars ("learning to know", "learning to do", "learning to live together" and "learning to be") /UNESCO, Bertelsmann Stiftung
NMC	Corporate tax encouragement	The ease of paying taxes (the total tax rate, time needed to comply with major taxes and number of tax payments required under a given fiscal system) /PricewaterhouseCoopers
	Capital availability	The Global Financial Centres Index (this index demonstrates the competitiveness of global financial centers in three critical dimensions: "breadth" (diversity), "depth" (specialty), and "interconnectedness" (connectivity) /Qatar Financial Centre Authority
	Current account balance	The Gini coefficient (a measure of statistical dispersion intended to represent the income distribution of a nation's residents, most commonly used to gauge economic inequality, which IC marketability) /The World Bank
	Country credit rating	Sovereign default probabilities (based on currently tradable credit default swaps, CDS) / Deutsche Bank Research
	Investment risk	Such a yardstick ought to incorporate broad concepts of financial loss, including political uncertainty (i.e. World Investment and Political Risk reports) /MIGA, World Bank Group
NPC	Computers per capita + Mobile subscribers	To account for mobile connectivity, such a measure might be broadened by smartphone and tablet penetration (smartphones and tablets per capita) /Our Mobile Planet, Google
	Internet subscribers + Broadband subscribers	Besides Internet and broadband subscribers, this category should be broadened by the numbers of Facebook and LinkedIn users, i.e., respectively, "Facebookization" and "LinkedInization"
	Convenience in establishing new firms + start up days	Instead of the measure of convenience in establishing new firms (+startup days), a broad indicator of doing business standards (a function of the regulatory) should be applied, i.e. the Ease of Doing Business Index/International Finance Corporation, The World Bank Group; The World Bank
	Unemployment% + Youth unemployment%	Labor force participation rate (the percentage of working-age persons in an economy who are employed or are unemployed but looking for a job) /UBS, World Bank
	Health & environment	Longevity (life expectancy) and the ecological footprint (human demand on the Earth's ecosystems): on the one hand demonstrating the effectiveness of health care systems and, on the other hand, helping quantify environmental costs related to macroeconomic growth/World Health Organization, Global Footprint Network
NRC	Business R&D spending	The Global Innovation Index (ranking economies by their ability to create an environment propitious to innovation outputs) / Johnson Cornell University, INSEAD, World Intellectual Property Organization (WIPO)
	Scientific articles	Despite significant theoretical and practical limitations, the country h-index (attempting to measure both the productivity and impact of the published work of a the country's scientists or scholars) /SCImago Journal & Country Rank
	Patents per capita (USTPO+EPO)	The intellectual property (IP) concept extends far beyond patenting, therefore various forms of IP registration should be accounted for on a per country basis (i.e. patents, trademarks, industrial designs, copyrights and utility models/WIPO)

Source: own elaboration.

The recently emergent models of NIC research require further insights and enhancement. Given the constant evolution of concepts related to socio-economic progress, some of the metrics making up the original NIC subsets should be revised to better account for contemporary socioeconomic priorities. Among the recommended alternations are: an overall about-face towards quantifying socioeconomic ends (efficiency, value and quality) rather than means (effort, expenditure, time), a functional (achievement-based) approach to schooling at all levels (with particular emphasis on tertiary education), more emphasis on quality-of-life (individually perceptible) aspects of socioeconomic progress, commercialism (market orientation) in reporting macroeconomic phenomena and the need to factor in the ecological impact of civilization (sustainability).

The amended NIC methodology endeavors to address these concerns and is intended as a stepping-stone in the process of advancing NIC measurement.

Future research into NIC is expected to bear on the following specific concepts related to assessing the intellectual wealth of entire nations:

*Active participation in the debate on socioeconomic development:* to a large extent, the IC community involved in the discussion on NIC has thus far been a passive adopter of methodologies conceived and developed by macroeconomists — it must now become an active force in transforming the theory and practice of measuring socioeconomic progress;

*Exploring IC in social media:* social media have recently been a prominent feature of human interaction via modern technologies, yet its intuitive liaisons with IC have stayed out of the limelight and have neither been sufficiently studied by IC scholars — more scientific scrutiny should thus be applied to IC related aspects of online interconnectedness;

*IC vs. globalization and sustainability:* a principal constraint on NIC measurement is the rising interrelatedness of individual economies (especially in the intangible context) — prospectively, the research into NIC should expand into measuring IC of the entire planet (incorporating its social liabilities).

## REFERENCES

- Andriessen D., Stam C. (2004), *The Intellectual Capital of the European Union/Measuring the Lisbon Agenda*, Centre for Research in Intellectual Capital, INHolland University of Applied Sciences, Haarlem, p.23.
- BIMAC (2014), cross-country NIC database available online at: <http://www.bimac.fi/nic/>
- Bontis N. (2004) "National Intellectual Capital Index: A United Nations initiative for the Arab region", *Journal of Intellectual Capital*, Vol.5 No.1, pp.13–39.
- Dumay J. (2014), "15 Years of the Journal of Intellectual Capital and Counting. A Manifesto for Transformational IC Research", *Journal of Intellectual Capital*, Vol. 15 No. 1, p. 11.
- Labra R., Sánchez Paloma M. (2013), "National intellectual capital assessments models: a literature review", *Journal of Intellectual Capital*, Vol. 14 No. 4, pp. 594–600.
- Lin Yeh-Yun C., Edvinsson L. (2011a), "What National Intellectual Capital Indices Can Tell About the Global Economic Crisis of 2007–2009?", *Electronic Journal of Knowledge Management*, Vol. 8 Issue 2, pp. 253–255.
- Lin Yeh-Yun C., Edvinsson L. (2011b), *National intellectual capital: comparison of the Nordic countries*, Springer Science + Business Media LLC, pp.7–16.
- Lin Yeh-Yun C., Edvinsson L. (2008), "National intellectual capital: comparison of the Nordic countries", *Journal of Intellectual Capital*, Vol. 9 No.4, pp. 526–530.
- Marr B. Chatzkel J. (2004), "Intellectual capital at the crossroads: managing, measuring and reporting of IC", *Journal of Intellectual Capital*, Vol. 5 No.2, pp. 224–229.
- Navarro J.L., Ruiz Lopez V.R., Peña Nevado D. (2011), "An alternative to measure national intellectual capital adopted from business level", *African Journal of Business Management*, Vol.5 (16), pp. 6713–6715.
- Petty R, Guthrie J. (2000), "Intellectual Capital Review. Measuring, Reporting and Management", *Journal of Intellectual Capital*, Vol. 1 No. 2, pp. 155–156.
- Ståhle P. (2008), National Intellectual capital as an Economic Driver — Perspectives on Identification and Measurement, G. Ahonen (Ed.) *Inspired by Knowledge Organizations. Essays in honour of Professor Karl-Erik Sveiby in his 60<sup>th</sup> birthday*, Publications of The Swedish School of Economics and Business Administration, Helsinki, pp. 1–24.

# Key Insurers Indicators in the Reports of Insurance Companies: Russian and Italian Experience\*

**Nadezda KIRILLOVA, Professor**

Department "Insurance Business", Financial University, Moscow  
nvk\_66@mail.ru

**Andrea BELLUCCI, Professor**

University of Perugia, Italy  
andrea.bellucci@unipg.it

**Abstract.** The aim of this article is to analyze the main indicators of insurance companies which can be identified in the financial statements in accordance with Russian accounting standards, the first results of IFRS introduction in Russia; to analyze the first issues coming from the introduction of IAS-IFRS in Russian and Italian insurance companies in light of oncoming new standards and amendments.

**Аннотация.** В статье представлены основные показатели финансового состояния страховых компаний, которые могут быть определены по данным финансовой отчетности в соответствии с российскими стандартами учета; даны первые результаты внедрения МСФО на страховом рынке – российский и итальянский опыт.

**Key words:** Insurance companies, key insurance characteristics, Russian accounting standards, IFRS, Italian experience.

Under the draft regulations (the industry standard) of accounting for insurance organizations and mutual insurance societies, insurers should be guided by the federal accounting standards, IFRS, IAS explanations recognized in the territory of the Russian Federation, the actuarial standards.

Annually insurance companies prepare financial statements and reports for supervision. The main reports are published on the website of insurance supervision and contain the following characteristics of the insurance company<sup>1</sup>:

- Short and full name of the subject of the insurance business; organizational and legal form; location; registration number from the Unified State Register of insurance entities;
- Financial statements with the auditor's report (contains the auditor's opinion on the reliability of the reflection of significant facts):
  - Balance sheet of the insurer (f.1);

<sup>1</sup> Order of the Ministry of Finance of May 11, 2010 N 41H "Forms of Financial Statements of insurance companies and reporting for supervisory review".

- Report on financial results of the insurer (f.2);
  - Report on changes in equity of the insurer (and the net assets) (f.3);
  - Report on the cash flows of the insurer (f.4);
  - Notes to the balance sheet of the insurer and the report on the financial results of the insurer.
  - Statistical reports;
  - Report about shareholders (participants).
- Insurance companies also represent to the insurance supervisor reports on:
- Composition and the structure of assets (f. 7-insurer);
  - Insurance reserves (f. 8-insurer);
  - Solvency (f. 9-insurer);
  - Reinsurance operations (f. 10-insurer);
  - Structure of the financial results of insurance (f. 11-insurer);
  - Branches and representations (f. 12-insurer);

\* Основные показатели финансового состояния в отчетах страховых компаний: российский и итальянский опыт.

**Table 1.** Main characteristics of insurance companies.\*

Direction of assessment	Capital	Assets	Reinsurance	Solvency	Profit and Profitability	Cost of doing business	Business activity, Management
Characteristics	Structure, volume change of equity own insurance reserves loan.	Placement of insurance reserves. Covering the assets own funds. Placement of available assets. Investment policy in general. Presence of high-risk assets. Loans.	Availability of reinsurance program. Payments under the reinsurance contracts. Ratings of reinsurers. Reinsurance in Russia.	Regulatory compliance. Solvency for not insurance liabilities. Cost loans of credit institutions.	Profit and profitability of insurance operations and non-insured. Profit from insurance operations. Profitability of insurance reserves ROI as a whole.	Costs of the proceedings. Commissions to insurance agents. Salary of management. Dividends to shareholders.	Volume of premiums and payments. Regional networks. Sales channels. The absence of compromising information. Number of complaints by insureds. Bankruptcy procedures.
Form of the original data	Balance sheet of the insurer (f.1) Report on changes in equity of the insurer (and the net assets) (f.3) The insurance reserves (f.8-insurer)	Balance sheet of the insurer (f.1) Report on financial results of the insurer (f.2)	Reinsurance operations (f.10-insurer) Report on financial results of the insurer (f.2)	Balance sheet of the insurer (f.1) Report on financial results of the insurer (f.2) The solvency (f.9 – insurer)	Balance sheet of the insurer (f.1) Report on financial results of the insurer (f.2) Report on changes in equity of the insurer (and the net assets) (f.3) The structure of the financial results of insurance (f.11-insurer)	Report on financial results of the insurer (f.2) The structure of the financial results of insurance (f. 11-insurer)	Balance sheet of the insurer (f.1) Statistical Report No 1 “Data on key indicators of insurer” the branches and representations (f. 12-insurer) Shareholders (members) and other affiliated entities (f.13-insurer)

\* The author's method has been implemented at Magnitogorsk Iron & Steel Works.

- Shareholders (members) and other affiliated entities (f. 13-insurer).

Insurers must comply with the control relationships indicators of the annual financial (accounting) statements and statements in the order of supervision.

Statistical Report No.1 “Data on key indicators of insurer” includes the following important characteristics:

- Premiums and claims on insurance contracts, number of insurance contracts within and outside Russia;

- Insurance premiums on insurance contracts, concluded without brokers and agents or with their participation, commissions to intermediaries;

- Direct compensation for compulsory civil liability insurance of vehicle owners;

- Information about the number of members of a mutual insurance company.

The balance sheet of insurer contains three sections: assets, capital and reserves, liabilities.

In the profit and loss statement income and expenses are divided into:

- Life insurance;

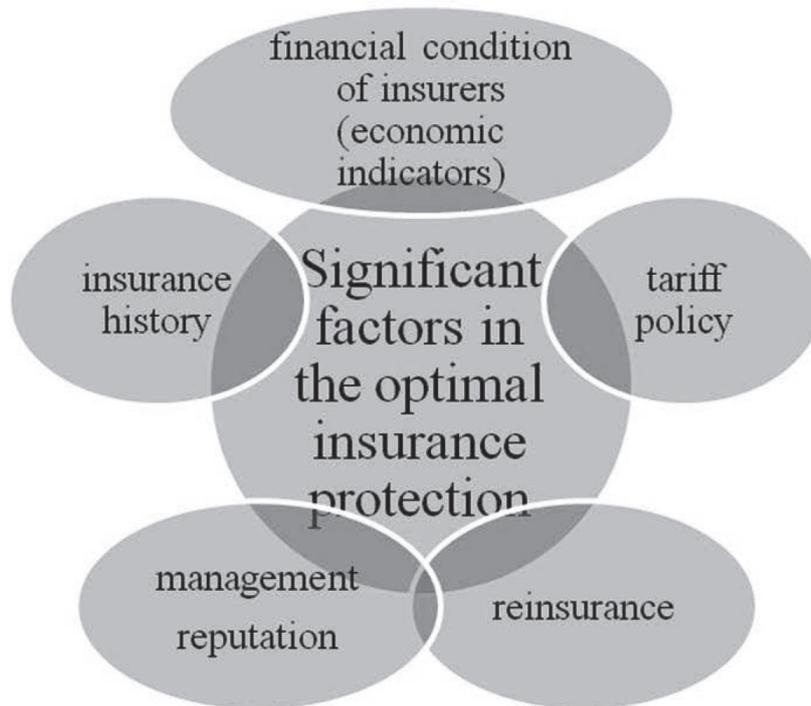


Figure 1. Significant factors in the insurance protection.

- Insurance other than life insurance;
- Income and expenses not related to the insurance operations.

It is easy to see formation of the financial result of the insurance company from this form. In general it can be represented as follows:

Income	Expenses
Premiums	Claims under insurance contracts
<b>Changes in insurance reserves</b>	
Income from investments	Loss of investments
<b>Income and expenses of insurance operations</b>	
Other income	Operation expenses

Thus, interested persons may identify comprehensive information about financial condition of insurers from the reports of insurance companies, see Fig. 1, 2.

We can take the main characteristics of insurance companies in these areas from financial reports (under Russian accounting standards), see Table 1.

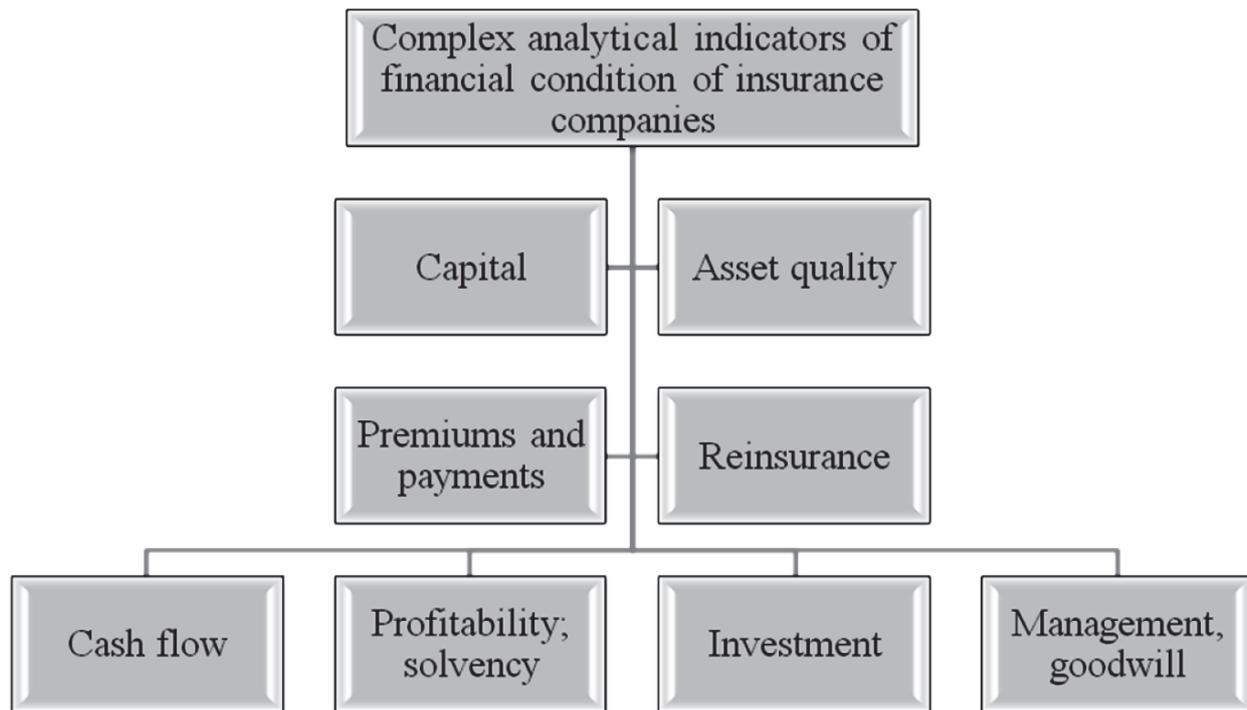
All these measures can be calculated according to the forms, which are published on the website of the insurance supervision<sup>2</sup> and according to the data found in open publications. Nevertheless, the

<sup>2</sup> The Central Bank of the Russian Federation, <http://www.cbr.ru>.

Russian standards are incomprehensible for foreign contractors. Russian insurance companies introduced the insurance supervisory authority reports under IFRS for the first time in 2012.

Under the draft regulations (the industry standard) on accounting for insurance organizations and mutual insurance societies, insurers should be guided by the federal accounting standards, IFRS, IAS explanations recognized in the territory of the Russian Federation, the actuarial standards. According to the analysis of the 20 largest insurance companies serving the Bank of Russia on the financial markets, insurers have become more successful: the net profit exceeds the results according to Russian accounting standards by 50%. During preparation a company is facing some problems: the need to identify additional data, such as claims settlement, the formation of the consolidated financial statements; recruitment and training of personnel. However, many companies have had enough experience with IFRS: Ingosstrakh since 2000, SOGAZ since 2001, PPF — life insurance since 2002, Energogarant since 2005, Uralsib since 2007, Transneft since 2010.

Out of twenty largest companies on volume premiums for 2012 (71.5% of total premiums in the amount of 812.5 billion rubles) 15 insurers demonstrated a net profit, five demonstrated loss, according to the study by Central Bank of Russia; the total volume of net profit of 20 leaders reached 25.1



**Figure 2.** Main directions of financial state evaluation of insurance companies.

billion rubles or, according to Russian accounting standards, 15.3 billion rubles. The total capital of the top 20 under IFRS amounted to 177.2 billion rubles, volume insurance reserves – 472.4 billion rubles, total assets – 876.1 billion rubles. Total insurance reserves under IFRS of the top 20 was about 30–40% higher than under RAS.

According to the results of comparison of two types of reporting in 96 companies by the Expert RA rating agency, the average combined loss ratio of insurers, which account for 80% of the market, in accordance with IFRS has reached 103.2% against 98.8% with RAS; return on equity transactions under IFRS is five times less than that under RAS: 3.2% against 15.7% for the year 2012; more correctly assessed reserves, overdue receivables reaching an average of 12%, under RAS – 8–9%.

Experts estimate that a significant difference in the results is determined by the basic principle of IFRS – substance over form, which is more strictly regulated in IFRS: IFRS not only describe the principles of accounting operations, but also have a requirement to disclose more information. IFRS clearly reflect the assets and liabilities of the company associated with the insurance and general activities. In the assets IAS is based on the concept of control, RAS – on the concept of ownership. Insurance reserves are estimated in RAS under certain formalized procedures; assessment of receivables is formalized. In reporting under IFRS insurance liabilities are es-

timated in accordance with the forecast of payments. IAS represents a choice of estimation methods, statistical information, different approaches to the estimation of the value of assets and liabilities (fair value, amortized cost, the cost of acquisition).

However, now a full transition to IFRS in Russia is not possible: this requires changes in the accounting of many participants; Russian accounting standards also are more consistent with the goals of control, including statistical data. At the same time, a more stringent approach in IFRS does not guarantee a completely adequate reflection of the assets, liabilities and operations of the company. In Italian insurance financial IAS-IFRS have been introduced in statements by European Act No. 1606 of 2002 and by Italian Act No. 58/98, then introduced in Italy for insurance companies by Law Act No. 209/2005 (“Insurance Code”) from annual reports of 2007. They are mandatory for consolidated financial reports and for reports of listed companies.

Previous empirical studies show that IAS-IFRS introduction have generated significant impacts on listed companies results (Callao, Jarne, Lainez, 2007; Horton, Serafeim, 2010; Hung, Subramanya, 2007; Mechelli, 2009; Stent, Bradbury, Hook, 2010; Alali, 2012). In particular, an increase in volatility is recorded in financial results and in equity value.

These effects are correlated to financial instruments evaluation, which is mainly based on a fair value approach. Actually, IAS-IFRS framework pro-

vides four financial portfolios by IAS 39 which are classified by how the entity manages its financial instruments regardless to their features: a) investments held for trading (fair value to profit or loss); b) investments held to maturity); c) investments available for sale, d) loans and receivables. These options can have different impact on results, so we have investigated Italian insurance companies choices on investments.

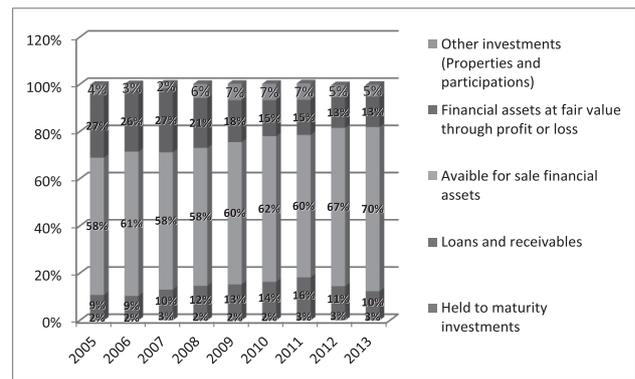
We have analyzed consolidated financial reports of the seven insurance companies placed on the top 20 of Italian market for total direct premiums collected (six listed and one mutual non-listed (source: ANIA, Italian National Association of Insurance Companies)). We have chosen only Italian ones and entities not held by bank (bancassurance) to understand specific investments policies of domestic market. As financial groups they represent more than the 35% of total market in terms of direct premiums collected (source: ANIA).

Their trends in the financial portfolios composition from 2005 to 2013 (Figure 3) show that, since the introduction of IAS-IFRS, Italian insurance companies opted for a prudent behavior concentrating main part of their investments on the “available for sale” portfolio for a share of the 58% of total financial assets. This share has been increasing the years after for few percentage point reaching peak in 2012 and 2013 up to 70% in the last year. The “financial assets at fair value through profit or loss” had in 2005 the 27% of total financial assets keeping the same values in the following years to decrease in the second part of the period up to 13% in 2012 and 2013. Loans and receivables reported for some years less than 10% up to stabilize on 13% in 2012 and 2013.

If we analyze standard deviation from the average, to understand homogeneity of investment behavior, we see a certain degree of heterogeneity in the composition of financial portfolios. This lack of uniformity remains until the financial crisis of 2007–2008 while, after 2011, there is a strong reduction of the dispersion and a very uniform behavior in investment decisions of analyzed companies. Just two groups, Generali and Unipol, have a high share of loans and receivables due, for Unipol Group, to direct control of a bank.

So we can say that Italian insurance groups have had throughout the analyzed period a prudential approach in investment choices, even compared to companies of other countries like United Kingdom, and they have intensified this behavior during and after the second crisis of 2011.

The concentration of financial assets on the “available for sale” portfolio has emphasized the



**Figure 3.** Trend of composition of IAS-IFRS portfolios on total financial assets: 2005–2013 (sample of seven Italian companies, no bancassurance).

Source: Financial statement documents of sample companies.

application of impairment test that, thanks to the framework base principle of IAS-IFRS, has allowed Italian companies to apply different thresholds for the depreciation, in terms of amount and duration, reported in the loss of value of financial assets from one company to each other.

This heterogeneity of companies’ behavior has created a lack of comparability among financial reports and has limited the full application of fair value from some companies delaying the losses through the use of “available for sale” portfolio to the following years. Some studies show how the IAS-IFRS adoption, even giving its flexibility, enables earning management, and smoothing in particular (Capkun, Collins, Jejean, 2012; Ahmed, Neel, Wang, 2013).

Rules No. 14 were introduced in Italy by IVASS (IVASS is Supervisory Authority of Italian Insurance Market) to improve impairment process disclosure, providing a better specification of fair value hierarchy in light the evaluation criteria adopted, and a specific statement for assets not measured at fair value.

Taking to account what has happened during the financial crisis, IASB intended, in 2008, to amend IAS 39, and published in November 2009 a new accounting standard IFRS 9 “Financial Instruments” which was subsequently amended. This standard shall be applied from January 1, 2015 retrospectively, and it is a part of phased process that aims to replace IAS 39 and introduce new requirements for the classification and measurement of financial assets and liabilities. In particular, with regard to financial assets, the new standard uses a single approach based on business model and on contractual cash flows characteristics of the

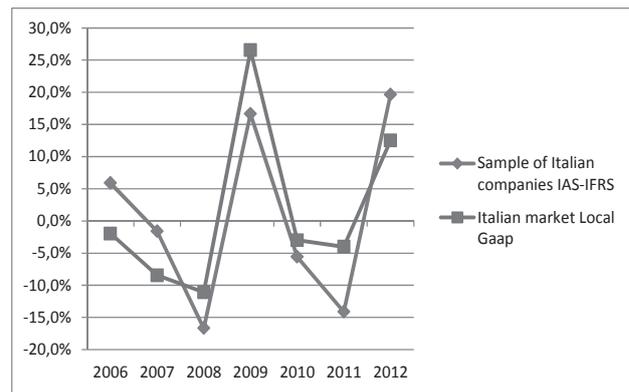
financial asset in order to determine the criteria replacing many different rules in IAS 39. For the financial liabilities, however, the main change concerns the accounting treatment of changes in fair value of financial liabilities designed as “fair value through profit or loss” in the event that the change is due to changes in credit risk of the liability. Under the new standard such changes shall be recognized in the other comprehensive income (OCI) and no longer in income statement.

Still on IFRS 9, in March 2013 IASB published the exposure draft “Expected credit loss” that introduced expected credit losses approach for financial asset measured at amortised cost. So, if, at the reporting date, effective credit losses exceed those expected at initial recognition, an impairment loss shall be recognized in the profit or loss. The exposure draft indicates three stages which reflect the deterioration of credit quality.

Finally, on IFRS 9, in November 2013 IASB published Financial Instruments — Hedge Accounting and Amendments to IFRS 9, IFRS 7 and IAS 39 to complete section relating to hedge accounting of the project to replace IAS 39. The most important new features relate to the effectiveness test of hedging relationships, the extension of possible hedging instruments and hedge items, and the conclusion and/or modification of the hedging relationship IFRS 9 will be applicable starting from 2018.

Regarding to liabilities, actually, IFRS 4 (Insurance contracts) provides for insurance liabilities and, in particular for technical reserves, a measurement according to Local GAAP and based on a cost approach. It provided a liability adequacy approach (LAT) and shadow accounting to mitigate the evaluation mismatch between financial asset carried at fair value according to IAS 39 and insurance provisions, which are accounted with Local GAAP. This accounting practice is applied to insurance contracts and investment contracts with discretionary participation features and provides and attributes to policyholders part of the margin coming from the difference between IAS-IFRS valuation on the basis on which the profit sharing is calculated and valuation used to determine the profit sharing actually paid. This kind of contracts are very important for Italian insurance balance sheets; more than 80% of life technical reserves is related to it.

Regarding to income statement, IASB published in June 2013 the Re-Exposure Draft, which proposed a new model for measurement insurance contracts that will replace the current IFRS 4. The valuation method is structured on a building block



**Figure 4.** Comparison of changes on equity in Local and IAS-IFRS GAAP financial statements (%).

Source: Financial statement documents of sample companies and ANIA Report 2013–2014.

approach based on the expected value of future cash flows weighted by probability of occurrence, on a risk adjustment and on a margin for services provided within the contracts. The contractual service is a component of the compensation that the insurer requires for its activity, and that is characterized by uncertainty and various types of risks. A simplified approach is permitted (“Premium Allocation Approach”) if the coverage period of the contracts is less than one year or if the model used for the assessment provides a reasonable approximation compared to the building block approach. The effective date is three years after the publication of the final standard. Early application is permitted.

A second issue of this article is to analyze comparison of equity trends under IAS-IFRS financial reporting and under Local GAAP financial reporting from 2005–2012, to see if they have reported different changes. We have used two different perimeters of analysis because different are the entities obliged or not obliged to use International Financial Reporting Standards, but we think that observation of the two trends could be a good proxy of the impact of IAS-IFRS on equity levels. For IAS-IFRS financial reporting we have used the same sample of the top seven groups — Italian only, and not of bancassurance. For Local GAAP we took the data of all the companies, which belong to Italian Association of Insurance Companies (ANIA).

Figure 4 shows how, during the period 2005–2008, the two clusters present a similar trend, even if in 2008 the decrease for IAS-IFRS equity change is more than five percent lower than for Local GAAP equity then, with the better financial market trend of 2009, companies of Italian market with Local GAAP show better performance (a greater increase in equity change of almost ten percentage

point) then, in 2010, they both report a decrease in equity and, from 2011, the two trends are more separated (in 2011 the IAS-IFRS equity changes is ten percentage points lower and then in 2012 is higher of seven percentage points). So we can say that Local GAAP financial statements report a better situation during and after 2007–2008 crisis while, from 2011 to the end of analyzed period, for the IAS-IFRS sample changes in equity become more volatile.

First general evidence is that the impact of IAS-IFRS introduction in Italian insurance sector is influenced by their partial implementation because fair value is not still applied for technical reserves, which are among the most important items of insurance balance sheet. Another pillar of these standards, former IAS 39, showed, during the crisis in particular, limits and a procyclical effect that led IASB to amend it and to replace it with IFRS 9. This consolidation is the prerequisite to realize that comparability which is the basis and one of the most important pillars for the IAS-IFRS introduction.

From the other hand the introduction and the implementation of the Other Comprehensive Income statements could be very useful to improve disclosure quality of financial report of insurance companies by bringing out some potential losses not reported in profit or loss statement and by showing the different impact of the cost view evaluation in profit or loss compared to the application of interest rate changes in OCI. At the same time we have to be careful not to make more difficult reading and interpretation of performance coming from financial reports. One risk is to put in Other Comprehensive Statements what we don't want to report in Profit or Loss Statement. From this point of view the proposal to put revenue and expenses in the statement of OCI improves disclosure providing a gross performance view, not included in the previous draft, but trying to find a difficult comparison among disclosure across many, very different industries.

The principle based approach of IAS-IFRS requires high attention to setting the guidelines of the evaluation also due to the fact that, following the fair value approach, we are not always aligned with the long term feature of main part of insurance liabilities. Giving the specific features of insurance industry, the accounting system applied has to connect assets to related liabilities in measuring their value. This point of view has been emphasized by practitioners and by exponents of insurance industry (Demaria, Rigot, 2014).

From a positive point of view the IAS-IFRS Phase II has realized a strong convergence between accounting criteria of evaluation and Solvency II implementation. This convergence is very important to ensure a stronger alignment between financial results and capital strength and solvency.

## REFERENCES

- Ahmed A.S., Neel M., Wang D., 2013, "Does Mandatory Adoption of IFRS Improve Accounting Quality? Preliminary Evidence", *Contemporary Accounting Research*
- Alali F.A. (2012), "The Value Relevance of International Financial Reporting Standards: Empirical Evidence in an Emerging Market", *The International Journal of Accounting*
- Callao S., Jarne J.I., Lainez J.A. (2007), "Adoption of IFRS in Spain: Effect on the comparability and relevance of financial reporting", *Journal of International Accounting, Auditing and Taxation*, vol. 16
- Capkun W., Collins D.V., Jeanjean T., (2012), "Does Adoption of IAS/IFRS Deter Earnings Management?", Google Scholar, SSRN, uiowa.edu, accessed 22/8/2014
- De Maria S., Rigot S. (2014), "IFRS Standards and Insurance Companies: what stakes for long term investment? A French case explanatory analysis", *GREDEG Working Paper No. 2014–04*
- Efimova O.V. Sustainability Reporting of Company: evaluation information requirements of users. Bulletin of the Russian Peoples' Friendship University. Series: the Economy. № 4, 20126 p. 75–82
- Horton J., Serafeim G. (2010), "Market Reaction and Valuation of IFRS Reconciliation Adjustments: First Evidence from the UK", *Review of Accounting Studies*, vol. 15, 4
- Hung M., Subramanyam K.R. (2007), "Financial statement effects of adopting international accounting standards: the case of Germany", *Review of Accounting Studies*, vol. 12, 4
- Investigation of investment attractiveness of Russia. Shaping the Future of Russia. EY, 2013
- Jermakowicz E.K., Gornik-Tomaszewski S. (2006), "Implementing IFRS from the perspective of EU publicly traded companies", *Journal of International Accounting, Auditing and Taxation*, 15 (2006) 170–196
- Jurgens I.Y. All-Russian Insurance Association. Analytical report "The insurance market in 2014: Challenges and Opportunities". URL: <http://autodiscover.ins-union.ru>
- Mechelli A. (2009), "L'adozione di principi contabili internazionali in Italia: profili teorici ed evidenze empiriche", *Rivista Italiana di Ragioneria e di Economia Aziendale*, No. 11/12
- Stent W., Bradbury M., Hooks J. (2010), "IFRS in New Zealand: effects on financial statements and ratios", *Pacific Accounting Review*, vol. 22, 2
- The new reality: an overview of the insurance market in Russia. KPMG, July 2014. <http://www.kpmg.com/RU/ru/IssuesAnd-Insights>

# Default Risk and Its Effect for a Bond Required Yield and Volatility\*

**Pavel ZHUKOV, Ph.D.**

*Financial Management Department, Financial University, Moscow*

*paul-joukov@yandex.ru*

**Abstract.** The basic conclusion is that the default risk cannot be reflected completely in the volatility of the bond price and thus should be accounted separately. Hence, default risk can not be precisely assessed through option models and it should to be considered separately from the volatility risk. This point is proved analytically and supported by empirical results. Proposed measure for the default risk increment in the required yield is the old and good mathematical expectance of a loss at a default, which depend quasi linearly by credit spread. This measure of a default risk is analyzed and its effect for portfolio strategy is formalized in suppositions and propositions. Outcomes are in the necessity of the separate account for default risks increments while building portfolios of stocks and bonds, and for estimation of weighted average cost of capital (WACC). The latter leads to substantial increase of WACC when debt exceeds safe limit.

**Аннотация.** Основной вывод статьи состоит в том, что риск дефолта не может быть полностью отражен в волатильности цены облигаций. Следовательно, этот риск не может быть точно рассчитан через опционные модели и должен учитываться отдельно от риска волатильности. Эта точка зрения обоснована аналитически и подтверждена эмпирическими результатами. Для учета дополнительного риска в требуемой доходности предлагается классический подход – математическое ожидание потерь при дефолте, которое квазилинейно зависит от спреда доходности. Эта мера риска дефолта проанализирована, и ее эффект для стратегии формирования портфеля формализован в гипотезах и выводах. Выводы заключаются в необходимости отдельного учета поправок на риск дефолта при построении портфеля акций и облигаций и для оценки WACC. Последнее приводит к существенному увеличению средневзвешенной стоимости капитала (WACC), когда долг превышает безопасный предел.

**Key words:** Risk of the bonds, required yield of the bonds, default risk, individual risk, common risk, the average price of the capital.

## 1. INTRODUCTION – THE PRICE VOLATILITY, DEFAULT RISK, DISCOUNT RATES AND THE RISK STRUCTURE OF RISKY BONDS

After CAPM and the connected theory of Modigliani-Miller emerged in the 1960-s, risk of securities (both stocks and bonds) became treated almost exclusively as a synonym for the price volatility. However these theories did not consider the possibility of default and, as a result, they could not include default risk. However, this approach was substantially reconsidered in the Merton's (1974) classical work. He stated that his option model completely considered default risk increments through volatility of the bond price. That would remove restrictions

on default in CAPM and closely align with CARM Modigliani-Miller's theory<sup>1</sup>. At the same time, it is well-known that in reality cost of capital depends on debt to asset ratio (see e.g. Basel III framework<sup>2</sup>). Also it is known that Merton's option model allows to predict default for several months, not years<sup>3</sup>. And, describing risk as volatility implies stationarity assumption, which does not match with empirical evidences. So, there are two questions (at least). The first question – whether really default risk is

<sup>1</sup> It may be easily shown, that Modigliani-Miller's theorem may be proved with CAPM and using Hamada's formula.

<sup>2</sup> Basel III: A global regulatory framework for more resilient banks and banking systems [assessed 11.03.2014] //URL: [www.bis.org/publ/bcbs189.htm](http://www.bis.org/publ/bcbs189.htm)

<sup>3</sup> Moody's KMV model: [www.defaultrisk.com](http://www.defaultrisk.com)

\* Риск дефолта и его влияние на требуемую доходность облигаций и волатильность.

completely reflected by volatility of bond price? The second question — at what extent required income of the bond may be calculated from the bond price volatility and at what extent (if any) it depends on the default risk?

From the fundamental assumption of investor's rational behavior it follows that market price for an asset depends on expected economic gains under estimated risk (see e.g. Damodaran, 2008a). For the security with fixed income and  $N$  years maturity, the investment value of security  $V$  is equal to its market value  $MV$ , if discount factor is equal to  $y=YTM$  (yield to maturity, which may be treated as the income rate, required by market), that is:

$$MV = PV(CF_t, y) = \sum_{t=1}^N \frac{CF_t}{(1+y)^t} \quad (1)$$

Here  $CF_t$  — fixed cash flows to the fixed income security.

In case of common stock there is an additional uncertainty (as the income is not fixed) and instead of fixed cash flows  $CF_t$  it is necessary to use expected cash flows  $E(CF_t)$  with an infinite time limit. The alternative is to set forecasting horizon, forecast  $E(CF_t)$  before this horizon, and then to use additional estimations for price at the horizon and its average grows rate. Thus, there is always an uncertainty caused by different ways to estimate  $E(CF_t)$ , price at the horizon, and especially expected grows rate. If an income required by the investor, denoted as "k", does not coincide with market yield "y", then investor will probably get security price estimation different from the market value:

$$V = PV(CF_t, k) = \sum_{t=1}^{\infty} \frac{E(CF_t)}{(1+k)^t} \quad (2)$$

Thus, one investor's estimation of  $k$  may differ from market value simply because it may estimate risk by a way which is different from the one used by the majority of market participants. One may notice that any estimation of risk is inevitably subjective. The wide review of this problem was made e.g. by Damodaran (2008b). Clearly risk may be reflected either in required return  $k$  or in estimated grow rate  $g$ , using Gordon formula, where  $CF_0$  is actual cash flow reported:

$$V = (CF_0 (1 + g)) / (k - g) \quad (3)$$

This may be useful for practical approach, but hardly gives a clear explanation of  $g$  and  $k$  together. With given discount rate  $k$ , and market price  $V$ , average  $g$  may be assessed, and *vice versa*.

The objective estimation of risks and expected cash flows can be reached only in the equilibrium, but the real markets are deprived of this convenient property underlying CAPM and APT. Fama and French (2006) examined whether the CAPM explains value premiums, and whether, in general, average returns compensate  $\beta$  in the way predicted by the CAPM. They stated that throughout 1926 to 2004 variation in  $\beta$  unrelated to size and the value-growth characteristic (which are the factors used in Fama and French model) goes unrewarded. In the real markets security prices are often distorted by irrational behavior of investors, or by market price bubbles, or by the market manipulations, despite all efforts of regulating authorities.

Besides the specified reasons, difference of market price from the investor's investment appraisal is the major condition for liquidity of the market. After all if one assumes that market price is completely fair and equal to the investor's appraisal, then, sale or purchase of any assets becomes senseless, taking into account commission fees. Under this assumption investors will not make any transactions just because this would incur losses. The only way to resolve this contradiction is to assume that investors make transactions, counting on change in market prices in future. But then it is obvious that an investment price of an asset worth for trade must be resulted by discounting with a rate different from market anticipation. From formulas (1) and (2) the source of volatility for market price is not clear. What is the main source of volatility — changes in expected cash flows, or changes in discount rates? Or, maybe, both? For stocks it would be reasonable to expect stronger dependence on cash flows, while for bonds, on the contrary, it would be reasonable to assume that as expected cash flows are fixed, so volatility of price is caused by the discount rates.

Moreover, as usually CAPM (and its updated versions, such as ICAPM) is applied for assessment of discount rates, then discount rates are considered as relatively stable (see, for example, Teplova and Shutova, 2011). Thus commonly cash flow volatility is considered responsible for volatility in stock prices. The first looks on assessing sources of volatility belongs probably to Campbell and Shiller (1988) who proposed model to investigate relation between dividend-price ratio and discount factors. Later Campbel and Shiller (1991) researched yield

spreads and interest rate movements. And then much later Cochrane, and Piazzesi (2005, 2008) researched sources of bond risk premium and decomposed the yield curve. These results for portfolio theory and asset pricing were observed and cited in many works by Cochrane (2005, 2007).

Most recent results exposed in fundamental review by Cochrane (2011) are fairly convincing that, in contrast of the common view, volatility in discount rates mainly makes up volatility of market prices both for stocks and bonds. This conclusion, according to Cochrane (2011), looks absolutely unexpected. Of course, it is obvious that changes in estimation of financial risks by investors during crisis should lead to changes in prices. Surprise is that it attracts volatility in discount rates, instead of cash flows. And the most natural and most likely mechanism of the influence of risks to discount rates (required income) for bond should be probability of default. Same mechanism should operate for stocks as well, as in case of default owner of stock completely losing his investment. Besides, the prices of stocks and bonds depend often on similar factors of individual and common risk.

All known researches of fluctuations in market prices certainly show that both the bond and portfolio of bonds have common risk and the individual risks, and both are described by volatility. Most explicitly this effect emerged during the crisis of 2007, as described in the work of Baba, Naohiko, and Packer (2009). Worsening in a global market situation involves deterioration in financial position for wide set of corporations and, hence, increased default risks for bonds and stocks. Besides, increased are all the risks, that directly affect volatility in bond prices, such as interest rate risk, rating risk, liquidity risk, as described in the work of Brunnermeier, Markus (2009). And Froot, Kenneth A., and P. O'Connell (2010) discussed the reinsurance of intermediated risks.

The number of defaulting firms is a good measure for common risk, and as it is shown in Bruche and González-Aguado (2010), during recession the number of defaulted firms grows, and the average amount recovered on the bonds of defaulting firms tends to decrease, which authors interpret as the "credit cycle".

Tang and Yan (2010) identify implied volatility as the most significant determinant of default risk among firm-level characteristics. But actually they tested implication that default probability and credit spread increase with jump risk. Empirically, they measure jump risk using the slope of implied volatility over strike prices for S&P 500 index op-

tions and its dependence on GDP grows or fall. Their main hypothesis is: "Default probability and credit spread are lower if the GDP growth rate is higher, if the growth volatility is lower, if the consumer sentiment is stronger, and if the implied volatility smile of S&P 500 index options is flatter". So, this research did not investigate firm level characteristics and individual risk. Rather these results characterize common risk.

Thus, back to the central question: is default risk the major factor for volatility? Cochrane's (2011) results suggest it is not in long run. Then, next question is: can one get required income from volatility assessment? Let's remind that this assumption is one of the basic hypotheses underlying CAPM. Other important assumption for CAPM, and for the Modigliani-Miller's theory implicitly connected with CAPM, is the assumption of "ongoing concern". That assumption ignores default risk. Merton (1974) made nice try to eliminate this obvious lack of CAPM and Modigliani-Miller's theory. Change in the value of firm  $dV$  in Merton's work is described by Gauss-Winer stochastic process  $dz$  with volatility  $\sigma$ .

$$dV = (\alpha V - C) dt + \sigma V dz \quad (4)$$

In this formula  $\alpha$  — income on the capital, and  $C$  — all payments to creditors and proprietors, both considered as known and determined. Stochastic process involved is only fluctuation of firm value  $\sigma V dz$  as a result of stochastic change in market price. Thus, all the information on probability of a default in this model is perceived by participants of the market and indirectly reflected by them in change of  $\sigma V dz$ . Here  $\sigma$  is instantaneous variance of the return on the firm per unit time. And "instantaneous" character of the  $\sigma$  is one of the most questionable point, added to the same points for  $\alpha$  and  $C$ . Can "instantaneous variance" be calculated by 30, 90 or 120 days, or permanently?

However, while  $dz$  is Wiener-Gauss process with unit volatility,  $\sigma dz$  is not stationary process. And, as it is not stationary process, Black-Scholes model is not applicable. At the same time, if it was stationary process it would not be relevant to reality. This is difficult dilemma, but hardly Merton's solution for this problem is rigorous. Latest applications of this model made by Moody's KMV model or by e.g. Elizondo and Padilla (2008) use stationary processes, which is mathematically correct, but sometimes more difficult in coinciding with practice.

And back to the difference between “implied volatility” and actual volatility — while implied that volatility is constant, actual volatility is not. Use of “implied volatility” in option models may cause two types of biases. Firstly, using “implied volatility” for option price one may just find volatility which matches market price. For example, if one knows the market price  $V$  of a common share, and proper discount rate  $k$ , he may find from (3) “average pace of growth  $g$ ” (or, *vice versa*,  $k$  from  $g$  and  $V$ ). Does it mean that the firm will really grow with pace  $g$ ? Secondly, as far as many investors use Black-Scholes model to calculate option price, the price for these options (like CDS) may be formed by “implied volatility”, used by the majority of investors. One may suppose that CDS price will reflect default probability, because of the law of one price. But it is not necessary, as CDS is sometimes illiquid and CDS is not available for the most of corporate bonds. Fontana and Alessandro (2010) explored persistent negative CDS-bond basis during the financial crisis, and deviations from the law of one price were also researched by Garleanu and Pedersen (2011).

The probability of a default in Merton (1974) work turns out as a result of option model for artificial asset  $F(V, t) = V - Eq(V, t)$ , that is a full firm value minus equity. Thus YTM (required income  $R(t)$ ) is described by equation  $F(V, t) = B \exp(-R(t)t)$ , where  $B$  — face value of a debt. For time of maturity  $T$ , the award for risk  $R(t) - r_f$  is function of two indicators — volatility of firm operations (more precisely, its all-round price)  $\sigma$  and  $d = B \exp(-r_f t)/V$  — relations resulted cost of face value of a debt at the moment of time  $t$  to firm all-round price during the initial moment of time.

Thus a situation when face value of a debt is less than market firm value is recognized as default. And the ratio of debt face value to full firm price is fairly perceived, as the characteristic of probability of a default. This point proved to be practical and holds in contemporary-styled models.

Another point that eventually holds is Merton’s (1974) unequivocal identification concept of “risk” with volatility of bond price. This is required for alignment with CAPM and it implies assumption of direct dependence for required income of the “risk”.

However this assumption does not hold an empirical check neither for stocks nor for bonds. It is well known, that for stocks it may hold at some extend, but for huge portfolios only. And portfolios under consideration should be different from market portfolio in CAPM sense. Other factors and other risks should be considered, as Merton (1973)

described in his brilliant ICAPM theory, that has substantially improved CAPM, and probably got the multifactor models started. This theory now is widely applied for factor models, specified for different countries, as example for Japan by Tsuji (2011), and for theoretical researches by Cochrane (2008). The importance of different factors along with the value premium and the CAPM market portfolio was observed later in works by Fama and French (2006), French and O’Connell (2008). P. Maio (2012) discussed relation of multifactor models with the ICAPM, while neither ICAPM, nor other factor models count for default probability.

Coming back to questions that have been put in the beginning of section, both negative answers eventually emerge. Firstly, if investor holds bonds to maturity (on HTM — held to maturity basis), and as bonds cash flows to investor are fixed, then the main factor of risk is default risk. Secondly, dependence of required income from volatility and default risk should be various for bonds with a various rating and repayment terms. For the investor holding bonds as temporary asset (AFS, and MM — available for sale and marked to market), risks of liquidity and rating risk may be essential (e.g. see Cochrane, 2005). These risks undoubtedly should be reflected in the price volatility, as well as interest rate risk, currency risk and risk of inflation. But are these risks really essential? Perhaps, for long-term bonds mainly, as these risks linearly depends of maturity. Thus, it is logical to assume that dependence of YTM (yield to maturity) from volatility may be largely (while not completely) replaced with dependence of YTM on a duration.

At the same time, if the probability of a default fluctuates, following casual fluctuations of cash flows, then it may be reflected in price volatility. However, it is feasible only for the firm with high debt to asset ratio and insufficient level of operational cash flow. So, it should not be evident for the investment grade firm. Management of two factors of financial risk of corporation — debt to asset and cash flow is described by Zhukov (2012). Castréna, Déesa and Zaherb (2010) performed stress tests for corporate sector probabilities of default in euro area, under a wide range of domestic and global macro-financial shocks. The result is not a puzzle: shocks affect seriously default probability and bond return. While bonds returns at crisis were significantly affected, it is clear, that casual fluctuations of cash flows could not change essentially default risk for investment grade bonds if debt and asset quality is sufficient.

Relations between GDP, default risk and credit spreads were researched in above-cited work of Tang and Yan (2010). Exploring CDS spreads for S&P500 index, they find that average credit spreads decrease in GDP growth rate, but increase in GDP growth volatility and jump risk in the equity market. At the firm level, they state, that credit spreads generally rise with cash flow volatility and beta, with the effect of cash flow beta varying with market conditions. That seems to be true.

However, if one perceives increase in the general volatility, as a signal of a coming financial crisis, then it surely can be the indicator of increase in default risk. Thus, dependence of bond required income on volatility caused by common risk is not exposed to doubts; the issue is dependence on volatility caused by individual risk.

The main hypothesis is — an individual risk of default is irrelevant to volatility in bond price, and therefore it may not be obtained as option price with Black-Scholes model. To back up this hypothesis further, in sections 2 and 3 fairly simple theoretical model is suggested, and in 4 some of empirical results are added.

## 2. INFLUENCE OF DEFAULT PROBABILITY ON REQUIRED INCOME – THE EXPLICIT FORM

If one wants to completely separate default risk from volatility risk influence on required income of the bond, he should take an investor who is indifferent to price fluctuations. For this purpose investor who holds bond for maturity (HTM) is considered. Such investor will be indifferent to fluctuations in the bond price, given two factors — probability of a default  $p_d$  and a share of debt  $\lambda$ , which investor will lose in case of a default (maturity and interest). Thus, additional required income  $\Delta y$  demanded by the investor (to cover possible losses at the case of a default) will be expressed as function from these parameters, and this function should reflect sensitivity of the investor to risk exposure.

$$\Delta y = U(\lambda, p_d)$$

Despite simplicity of dependence for a bond spread  $\Delta y$  from  $p_d$  and  $\lambda$ , the author did not manage to find the correct one, so let's deduce it.

In particular, for this dependence Sharp, Alexander and Bailey (1999) proposed:

$$y = (y^* + \lambda p_d) / (1 - p_d) \quad (5)$$

Here  $y = k_d$  — required income for the bond with default probability  $p_d$ ,  $\lambda$  — a part of the debt which will be lost at a default,  $y^* = r_f$  required income of riskless bonds.

However, this expression contains an error, it is fair only at  $\lambda = 1$  and demands correction — instead of  $(1 - p_d)$  it should be  $(1 - \lambda p_d)$  in (5). In the work of Denzler, Dacorogna, Müller, McNeil (2006), the wide review on probability of a default is described. And the similar formula deducted (but erroneously) for a spread of the bond, connected with probability of a default for a case of linear function of utility (neutral perception of risk).

Following the old and good classical approach by Morgenstern and von Neumann (1953), in the case of risk neutral investor, “risk-neutral equivalent” of expected return for a bill with face value  $F$  is:

$$E[F] = F(1 - p_d) + F(1 - \lambda)p_d = F(1 - \lambda p_d)$$

Further face value  $F$ , discounted on rate for risky bond  $y = k_d$  is equal to riskless equivalent discounted on riskless rate  $r_f$ :

$$F / (1 + k_d) = E(F) / (1 + r_f) = F(1 - \lambda p_d) / (1 + r_f)$$

Expressing required income  $k_d$  through  $r_f$  and  $\lambda$ , it is easy to get for required income:

$$1 + k_d = (1 + r_f) / (1 - \lambda p_d) = 1 + (r_f + \lambda p_d) / (1 - \lambda p_d) \quad (6)$$

Expression for a spread of required income of bonds is easy for receiving, subtracting from this expression riskless required income<sup>4</sup>:

$$\Delta y = k_d - r_f = (r_f + \lambda p_d) / (1 - \lambda p_d) - r_f = (r_f + \lambda p_d - r_f(1 - \lambda p_d)) / (1 - \lambda p_d) = (r_f + 1) \lambda p_d / (1 - \lambda p_d)$$

The result is linear dependence of spread from “risk”  $p_d \lambda$ :

$$\Delta y = k_d - r_f = (r_f + 1) p_d \lambda / (1 - p_d \lambda) \quad (7)$$

Though this formula is deduced for 1 year, it is easy to extend to any  $T$  similarly (but corrected to the right) with above-cited work by Denzler, Dacorogna, Müller, McNeil (2006).

Taking probability of a default for 1 year is equal to  $p_d$ , denote that probability for  $T$  years as  $q_d$  (in-

<sup>4</sup> Author begs pardon for so much elemental details, but as experience show, “devil is hiding in details”.

cludes possibility of 1, 2, 3, 4 and 5 years default), and  $1 - q_d$  will represent opposite event probability.

$$q_d = \sum_{t=1}^T p_d (1 - p_d)^{t-1}$$

If the compensation for investor doesn't depend on bankruptcy date (as debtor obligation comes into force at maturity T), then expression for T years is similar to (7), while  $q_d$  replaces  $p_d$ , and  $K_d$ ,  $R_f$  are T years rates, so

$$\begin{aligned} K_d &= (1 + k_d)^T - 1, R_f = (1 + r_f)^T - 1 \\ \Delta Y &= K_d - R_f = (r_f + 1) q_d \lambda / (1 - q_d \lambda) = \\ &= (1 + k_d)^T - (1 + r_f)^T \\ \Delta y &= k_d - r_f = [(r_f + 1) q_d \lambda / (1 - q_d \lambda) + (1 + r_f)^T]^{1/T} \end{aligned} \quad (8)$$

Separate estimation of  $\lambda$  and  $p_d$  (or  $q_d$ ) is challenging problem. Both are unknown to the investor and both estimations always involve an element of subjectivity. In particular, in the cited work by Denzler, Dacorogna, Müller, McNeil (2006), the factor of losses  $\lambda$  was assessed as equal to 0.4 (as recovery rate was assessed at 0.6), proceeding from its average value, based on some statistical data. Hardly is it possible to consider this assumption as universal recipe. For each firm the estimations for  $\lambda$  and for  $p_d$  should be individual. And each of those (similarly to Merton's approach) may be represented in the form of synthetic security with option.

However, in case of investor neutral to risk, an independent estimation of  $\lambda$  and  $p_d$  is not required, as the estimation of default risk is known in the form of  $w = p_d \lambda$ , which is equal to a mathematical expectance of losses of the investor. And as this estimation depends linearly on spread, it can be getting directly under assumption that market estimate of risk is right. While the question remains: is this estimate of default risk true?

For a bond without imbedded options it may be obtained with formula (7) for 1 year or (8) for T years. But if the bond has imbedded options, OAS-spread instead of a G-spread should be used (assuming that value of options is correctly assessed).

Assuming that investor will be sensitive to a risk estimation, as mathematical expectance of losses at a default  $p_d \lambda$  it is possible to describe this sensitivity by substitution  $w = U(p_d \lambda)$  (or, in the most general case  $w = U(p_d, \lambda)$ ), where nonlinear function U sets sensitivity of the investor to risk.

For example, one may use polynomial function:

$$U(w) = (r_f + 1) w^{1+b} / (1 - w^{1+b}) \quad (9)$$

where  $b > 0$  reflects sensitivity level.

### 3. FORMALIZATION OF CONDITIONS AT WHICH REQUIRED INCOME CORRESPONDS TO A MATHEMATICAL EXPECTANCE OF LOSS

Despite of the intuitive evidence for correspondence between required income and mathematical expectance of loss, for theoretical justification it is necessary to formalize possible assumptions at which this dependence holds. Further the possible variant of formalization is proposed.

**Supposition 1.** The huge number of independent investors M operates in the bond market. And everyone can form any portfolio from N liquid risky bonds, where N is great enough. Additionally, riskless bonds are available with annual rate  $r_f$ . Besides, average required income N of liquid risky bonds makes  $r_f + \delta$  at average default risk  $w = \sigma$  (these instantaneous variables may depend on time and some other parameters).

**Remark 1.** Presence of a considerable quantity of bonds with various risk and income rate is practical. Average excess of required income over riskless bonds is observed variable. While influence of the embedded options may change yield, it is possible to consider only a certain subset of a set of risky bonds, traded in market, which satisfies requirement.

**Supposition 2.** The instantaneous default risk for every risky bond does not depend on instantaneous default risk of any other bond, with some exceptions, which may be overcome by filtering out given list of bonds.

**Remark 2.** Independence of default probability for bonds is the simplifying assumption which is not always carried out. There are external factors (state of the economy or bank industry conditions or oil prices, etc.) which can change common risk of all securities simultaneously. However it can better be described as dependence of external factors, than as dependence of one bond from another. In the work of Blöchlinger (2011) the relation between rating and pricing of bonds was derived in a large market with a "quasi-factor" structure, constructed by author. Setting some conditions of *force majeure* through a vector of external parameters  $\beta$ , one may deduct that at the fixed value of a vector  $\beta$  default risks of different firms will be roundly independent. Exceptions are if an influence of one firm on others is unusually high. The latter can be observed in the exceptional case of the largest banks, monopolies, or other companies taking exclusive positions as suppliers, or buyers.

**Supposition 3.** The investor is capable to estimate instantaneous mathematical expectance of the loss at a default ( $w=p_d\lambda$ ) for each bond, while the exact estimation of default probability and loss at a default separately may be inaccessible.

**Remark 3.** Ability of investors to estimate instantaneous default risk ( $w=p_d\lambda$ ) is an assumption that may seem strong enough. However without that estimation any investment activity would be impossible. Besides, today many methods are developed for that kind of estimation.

**Supposition 4.** Sensitivity of the every investor for default risk ( $w=p_d\lambda$ ) is described by a function  $U$ , that is monotonously increasing and continuous on an interval  $(0,1)$  and  $U(0)=0$ . If expected required income of investment instantaneously exceeds riskless rate above  $U(w)$ , then investor buys bonds, and if it is below  $U(w)$ , sells.

**Remark 4.** This assumption represents quite realistic approach to motivation for trade, though it ignores commissions and bid-ask spread (and it is possible to be improved on this way by adding it to  $U$ ). While sensitivity of investors to risk can be various, it may be described in form (6). In the work by the author (Zhukov, 2013) an explicit form for default risk function was proposed, as polynomic function of risk factors. But it was not empirically checked.

**Statement 1.** If an average mathematical expectance of loss is  $\sigma$  for a great number of risky papers  $N_1 < N$ , and it is below average additional income required  $\delta$  (see Supposition 1) at big enough  $N_1$ , for any sensitivity to risk  $U$ , an investor will prefer to exchange a portfolio of riskless bonds to an equally weighted portfolio of risky assets.

By supposition 1, in equally weighted portfolio of  $N_1$  risky bonds average risk decreases to the level below  $\sigma/N_1$  (portfolio volume is taken as 1). Further, owing to continuity  $U(w)$  by Supposition 4, at any sensitivity of investor to risk, at big enough  $N_1$  additional required income of a portfolio  $\delta$  will exceed an individual estimation of risk  $U(\sigma/N_1)$  and, according to the Supposition 3, the investor will prefer risky papers.

**Remark 5.** Thus, the effect of risk diversification is observed not only for the volatility risk, but also for default risk defined as instantaneous mathematical expectance of loss. Also, what will depend on investor sensitivity to risk is only number  $N_1$ . If this number is big enough for ALL investors, then ALL investors will change riskless portfolio to risky one if  $\delta$  is greater 0, and therefore riskless rate must go up. While, taking in account common risk, investors may use CAPM to invest

some money into riskless bonds, or use some hedging derivatives (like options for index) for the common risk hedging.

**Statement 2.** If sizes of  $M$  and  $N_1$  are big enough, then additional instantaneous income required  $\delta_1=\Delta y$  which investors demand for possible loss at a default of the one bond will tend to  $w=\sigma_1$  – instantaneous mathematical expectance of loss in the case of default. In other words, if quantities of securities  $N_1$  and investors  $M$  are big enough, then investors become neutral to risk.

Proving this, the incremental risk of investor on the one bond at equally weighted portfolio is equal  $\sigma_1/N_1$ . As  $N_1$  can be as much as one wishes, risk may be reduced to size, when  $U(\sigma_1/N_1) < \delta$ . Then, by Supposition 3 about a continuity of monotonous function  $U$ , investor will sell bond for which risk is above required income, replacing it with riskless one. Or, on the contrary, he will replace riskless bond with risky bond if risk is less than additional required income. Thus, bond price will go down until its risk exceeds income, or go up until income exceeds risk.

**Remark 6.** To some extent this may be supported by empirical data, see Gabaix, Xavier, Krishnamurthy, and Vigneron (2007) or Brunnermeier and Pedersen (2009). However this statement is still hypothetic and requires more empirical evidences.

**Statement 3.** Let's assess default risk and income for equally weighted bond portfolio, assuming that risk and income for each bond are random variables, dependent on time (previously risk and income were expected to be instantaneous). Denote by  $N_1$  number of bonds in and total portfolio risk by  $\mu$  (expected loss in portfolio, dependent on time).

Then, while  $N_1$  tends to infinity, distribution of  $\mu$  tends to normal. Hence, average portfolio income above riskless bond tends to constant value  $\delta$  and average risk (mean of  $\mu$ ) tends to constant value  $\sigma$ . Besides variance of  $\mu$  tends to 0 as square root of  $N_1$ .

The proof clearly follows from Central Limit Theorem, as sum of independent stochastic variables tends to normal distribution (by Supposition 2 bond risks are independent), and volatility  $\mu$  will tend to zero, proportionally square root from  $N_1$ . However, it is clear, that average risk of risky bonds portfolio may not prevail over its average spread, as otherwise riskless bonds will be useless. Hence  $\delta = (r_f + 1) \sigma / (1 - \sigma)$ .

Let's draw some conclusions and assumptions.

1. It is possible to assume that though awards for risk of bond usually are not stationary in time

**Table 1.** Results for sample 1, BB rated bonds (76 bonds).

**A. Results for full panel.**

Call: lm (formula = ytm ~ mty + vol + oas + dta)

Residuals: Min	1Q	Median	3Q	Max
-1.5474	-0.8815	-0.5320	-0.1987	9.9402
Coefficients:	Estimate	Std. Error	t value	Pr (> t )
(Intercept)	1.8434050	0.8088247	2.279	0.0255 *
Mty	-0.4681503	0.3905977	-1.199	0.2345
Vol	-0.0040874	0.0353038	-0.116	0.9081
Oas	0.0086703	0.0015660	5.537	4.34e-07 ***
Dta	-0.0007702	0.0123905	-0.062	0.9506

Signif. codes: 0 “\*\*\*\*” 0.001 “\*\*\*” 0.01 “\*\*” 0.05 “.” 0.1 “ ” 1

Residual standard error: 2.16 on 75 degrees of freedom

Multiple R-squared: 0.3073, Adjusted R-squared: 0.2704

F-statistic: 8.319 on 4 and 75 DF, p-value: 1.311e-05

**B. Results with parameters mty and oas excluded from panel.**

Call: lm (formula = ytm ~ vol + dta)

Residuals: Min	1Q	Median	3Q	Max
-2.4913	-1.4511	-0.8886	0.3826	10.2238
Coefficients:	Estimate	Std. Error	t value	Pr (> t )
(Intercept)	3.542041	0.690647	5.129	2.12e-06 ***
Vol	-0.003744	0.041154	-0.091	0.928
Dta	-0.015229	0.014255	-1.068	0.289

Signif. codes: 0 “\*\*\*\*” 0.001 “\*\*\*” 0.01 “\*\*” 0.05 “.” 0.1 “ ” 1

Residual standard error: 2.542 on 77 degrees of freedom

Multiple R-squared: 0.01461, Adjusted R-squared: -0.01099

F-statistic: 0.5707 on 2 and 77 DF, p-value: 0.5675

(no less than required income of portfolio), but for the big and equally weighted portfolio under the fixed macroeconomic conditions and during the fixed time interval, expected loss and required income should be close to stationary. Probably, common risk is exactly the factor, which breaks stationarity, because of business cycles and crises. To get this effect parametrical dependence on common risk factors should be used.

2. In particular, assume (see Remark 2) that there are external factors of common risks  $\beta$ , reflecting business cycles, and shocks (*force majeure*)

which can change risks of all securities simultaneously. Such parameters, in particular, may characterize general recession, or local recessions and lifting, and also crises of industries, technological shifts, bank crises, weather conditions, the prices of raw materials shocks and etc.

3. Notice also that the proposed account of default risk leads to changes in portfolio strategy. In particular, if the default risk makes primary impact on required income and risk of portfolio of bonds, it should be formed separately from a portfolio of stock, because principles of calculation of required

**Table 2.** Results for sample 2, AA rated bonds (329 bonds).

**A. Results for full panel.**

Call: lm (formula = ytmAA ~ dtaAA + oasAA + volAA + mtyAA)

Residuals: Min	1Q	Median	3Q	Max
-1.1076	-0.5593	-0.2849	0.0465	9.3262
Coefficients:	Estimate	Std. Error	t value	Pr (> t )
(Intercept)	0.064124	0.174745	0.367	0.713890
dtaAA	0.008257	0.002392	3.451	0.000631 ***
oasAA	0.010217	0.001347	7.587	3.45e-13 ***
volAA	-0.034001	0.013961	-2.435	0.015409 *
mtyAA	0.225331	0.113336	1.988	0.047629 *

Signif. codes: 0 “\*\*\*\*” 0.001 “\*\*\*” 0.01 “\*\*” 0.05 “.” 0.1 “ ” 1

Residual standard error: 1.19 on 326 degrees of freedom

Multiple R-squared: 0.222, Adjusted R-squared: 0.2125

F-statistic: 23.26 on 4 and 326 DF, p-value: < 2.2e-16

**B. Results with parameters mty and oas excluded from panel**

Call: lm (formula = ytmAA ~ dtaAA + volAA)

Residuals: Min	1Q	Median	3Q	Max
-4.4675	-0.6389	-0.2245	0.0810	9.7494
Coefficients:	Estimate	Std. Error	t value	Pr (> t )
(Intercept)	0.278544	0.166589	1.672	0.0955
dtaAA	0.010743	0.002612	4.112	4.96e-05 ***
volAA	-0.018948	0.015183	-1.248	0.2129

Signif. codes: 0 “\*\*\*\*” 0.001 “\*\*\*” 0.01 “\*\*” 0.05 “.” 0.1 “ ” 1

Residual standard error: 1.31 on 328 degrees of freedom

Multiple R-squared: 0.05088, Adjusted R-squared: 0.04509

F-statistic: 8.791 on 2 and 328 DF, p-value: 0.0001909

income of stocks and bonds essentially differ. At the same time, the risk of stock also needs revaluation taking into account default risk as it is not reflected completely in volatility risk.

4. The account of default risk leads to changes in WACC calculation. Usual assessment for opportunity cost of equity  $k_E$  may be represented with CAPM equality:  $k_E = r_f + \beta_L \text{MRP}$ . Here  $\beta_L = \beta_U (1 + D/Eq (1 - T))$  (Hamada equality).

Then:  $WACC = k_{ps} w_{ps} + k_d w_d (1 - T) + k_E w_E$ , where  $w_{ps}$ ,  $w_d$  and  $w_E$  are shares of preferred stocks, debt and common stocks in capital,  $k_{ps}$  — interest on

preferred stocks,  $k_d$  — average interest on debt. Taking into account probability of the default, required income  $k_d$  will no longer be a constant, it will depend on capital structure. It will lead to sharp increase in WACC at a growth of the debt over safe limits. For required income on equity one should use expression where  $\Delta y$  compensates default risk:

$$k_E = r_f + \Delta y + \beta_L \text{MRP} \tag{10}$$

If  $k = r_f + \Delta y$  coincided with average interest for debt  $k_d$ , it would not be a novelty. Many investment

companies use this update for more realistic calculation of WACC. However, unlike the creditor who in case of a default can apply for a property part, the proprietor in case of a default theoretically loses all (that completely proves to be true in practice) as the default means that market value of assets is less than debt. Therefore for calculation of  $\Delta y$  in (10) it is necessary to accept  $\lambda = 1$ , where  $\Delta y = (r_f + 1) p_d / (1 - p_d)$ , which means that additional required income for default risk for stock is essentially above that for bond.

#### 4. EMPIRICAL CHECK FOR DEPENDENCE OF BONDS REQUIRED INCOME FROM PARAMETERS OF VOLATILITY AND PROPERTY RISK

Empirical check of factors influencing the required income of bonds held two samples. Let's remember, that theory in section 3 used instantaneous values of required income and default risk. As trade is available at every moment, then it is supposed, that essential relations must be observable at any time, as information efficiency is observed.

So, the cross-sectional, one moment analysis was done for big number of bonds. All the data was taken from Bloomberg as of September 26, 2014. The statistical analysis has been done with use of R tools.

First sample consisted of 76 bonds rated BB (from BB- to BB+) with maturity from 1 to 2 years for which all necessary data were given in Bloomberg.

Second sample consisted of 329 bonds rated AA (from AA- to AA+) with the same maturity and data as the first sample.

Possible dependence (independence) of yield to maturity (ytm) from other variables was investigated. The independent variables were chosen in accordance with arguments exposed above (see Section 1 of this paper):

1. Debt to assets ratio (dta). Market value of assets is understood as a debt plus capitalization.
2. A spread for embedded options was taken into account (oas).
3. Duration was added as described above (mty).
4. 90-day volatility is added (vol).

The statistical data of results of research for 76 bonds of class BB (from BB- to BB+) is presented in Table 1, and for 329 bonds of class AA (from AA- to AA+) — in Table 2.

For the first sample (76 for bonds of class BB) required income does not depend on volatility with probability 0.9081, which completely confirms con-

clusions of Section 1. As default risk is highly essential to these bonds with low rating, then volatility risk does not render influence on required income.

The low correlation of YTM with OAS is a puzzle. Probably it means that option model used to calculate OAS doesn't work properly at moment, which again turn us to the question: how "implied volatility" of these models relates to actual volatility.

For the second sample (327 bonds of class AA) it is impossible to make such a definite conclusion — probability of independence is only 0.01099. And this fact also corresponds with conclusions in Section 1. For rated AA bonds the default risk during 2 years is rather low, and greater influence on their required income is rendered by factors of interest rate risk and common risk which are described by volatility. However, it is not so easy to explain why for the bond of classes AA and BB dependence on the debt to market ratio (dta) is absolutely different, namely: required income of bonds of class BB does not depend on this variable (with probability 0.9506), and required income of bonds of class AA, on the contrary, depends on it (probability of independence 1.418e-05).

It is a puzzle, as theoretically for BB that dependence should be higher, than for AA, as for BB probability of default is higher. The assumption is: dependence for bonds BB from debt to asset ratio is masked by dependence from OAS spread (oas).

To check it, parameters of a duration (mty) and OAS spread (oas) were excluded from panel and it caused some change in results — required income of class BB depends on debt to asset ratio, but significance is not small enough (0.289) while required income of class AA still depends on it with high probability (1-4.96e-05). So, puzzle still is not explained completely.

And another puzzle is — why dependence of YTM of OAS does not correspond with expected. The expectation was — correlation coefficient close to 1. But in reality it is at range 0.1-0.2, which means that option algorithms for OAS calculation doesn't align with practice. And, again, it is not against theory, as Black-Scholes model is not applicable for non-stationary process. But it is surprising, as option models are widely recognized as highly reliable. Perhaps, it may be caused by errors in volatility estimations. At the same time, the main purpose of empirical study was to check dependence of volatility. And independence YTM for BB bonds from 90-days volatility was not changed, which allows to assume stability and the impor-

tance of these results. Same is true for the low dependence of YTM for AA bonds from 90-days volatility, as this result sustained as well.

## 5. CONCLUSIONS

Let's repeat the basic conclusions.

1. Merton's conclusions that the default risk is completely reflected in volatility of the bond prices do not prove to be true by neither theoretical nor empirical results.

2. It is necessary to divide default risk which is understood as the mathematical expectance of loss at a default, and volatility risk which reflects common risks — percentage risk of bonds, risk of decrease in a rating, risk of liquidity and macroeconomic risks.

3. Required income on the bond essentially depends on default risk which may be treated as mathematical expectance of loss at a default. This dependence can be quasi-linearly expressed through a required income spread (7).

4. Though bond income usually is not stationary in time, but for the big and equally weighted portfolio under the fixed macroeconomic conditions and during the fixed time interval, expected loss and required income should be close to stationary. And, probably, common risk is exactly the factor, which breaks stationarity, because of business cycles and crises. To get this effect parametrical dependence on common risk factors should be used.

4. The external factors reflecting cyclical changes in the economy, and shocks caused by global or local crises (*force majeure*) which can change risks of all securities simultaneously, must be considered as external parameters. Change in these parameters eventually causes change in default risks and volatility risks.

5. Dependence of portfolio on default risk of separate bonds can be minimized at the expense of diversification. Thus criterion VAR of a portfolio for default risk of emitters becomes additive. At the same time, dependence on *force majeure* situations, the general for all emitters, should be considered as additional common risk.

6. Taking into account default risk, required income of a company debt and required income of its equity both should be increased, depending on capital structure. Thus, the account of default risk leads to changes in portfolio strategy and in WACC calculation. Required income of stocks and bonds should be increased by default risk. It will lead to increase for WACC at growth of a debt over safe limits.

## REFERENCES

- Basel III: A global regulatory framework for more resilient banks and banking systems [assessed 11.03.2014] URL: [www.bis.org/publ/bcbs189.htm](http://www.bis.org/publ/bcbs189.htm)
- Brunnermeier M. (2009) "Deciphering the liquidity and credit crunch 2007–2009", *Journal of Economic Perspectives* **23**, 77–100.
- Brunnermeier M., and Pedersen L.H. (2009) "Market liquidity and funding liquidity", *Review of Financial Studies* **22**, 2201–2238.
- Belo F. (2010) "Production-based measures of risk for asset pricing", *Journal of Monetary Economics* **57**, 146–163.
- Blöchliger A. (2011) "Arbitrage-free credit pricing using default probabilities and risk sensitivities", *Journal of Banking & Finance* **35**, 268–281.
- Bruche, González-Aguado M.C. (2010) "Recovery rates, default probabilities, and the credit cycle", *Journal of Banking & Finance* **34**, 754–764.
- Campbell J.Y., and Shiller R.J. (1988), "The dividend-price ratio and expectations of future dividends and discount factors", *Review of Financial Studies* **1**, 195–228.
- Campbell J.Y., and Shiller R.J. (1991) "Yield spreads and interest rate movements: A bird's eye view", *Review of Economic Studies* **58**, 495–514.
- Campbell J.Y., and Mei J. (1993) "Where do betas come from? Asset pricing dynamics and the sources of systematic risk", *Review of Financial Studies* **6**, 567–592.
- Castréna O., Déesa S., Zaherb F. (2010) "Stress-testing euro area corporate default probabilities using a global macroeconomic model", *Journal of Financial Stability* **6**, 64–78.
- Câmara A., Popova I., Simkins B. (2012), "A comparative study of the probability of default for global financial firms", *Journal of Banking & Finance* **36**, 717–732.
- Cochrane, John H. (2005), *Asset Pricing*, Princeton: Princeton University Press.
- Cochrane J.H. (2011) "Presidential Address: Discount Rates", *The Journal of Finance* **4**, 1046–1108.
- Cochrane J.H., and Piazzesi M. (2005) "Bond risk premia", *American Economic Review* **95**, 138–160.
- Cochrane, J.H. (2008) "A mean-variance benchmark for intertemporal portfolio theory" Working paper, University of Chicago.
- Cochrane, J.H., and Piazzesi Monika (2008) "Decomposing the yield curve", Working paper, University of Chicago.
- Chen J., Hill P. (2013) "The impact of diverse measures of default risk on UK stock returns", *Journal of Banking & Finance* **37**, 5118–5131.
- Darrell D., and Berndt A. (2011) "Explaining corporate debt returns", Working paper, Stanford University.
- Damodaran, A. (2008), *Investment Valuation*, New York: John Wiley and Sons.
- Damodaran A. (2008), *Strategic risk taking: a framework for risk management*, New York: Prentice Hall.
- Denzler S.M., Dacorogna M.M., Müller U.A., McNeil A.J. (2006) "From default probabilities to credit spreads: Credit risk models do explain market price", *Finance Research Letters* **3**, 79–85.

- Elizondo R., Padilla P. (2008), "An Analytical Approach to Merton's Rational Option Pricing Theory", Working Papers N 2008-03, Banco de Mexico Documentos de Investigacion, Mexico
- Fama E.F., and French K.R., "The value premium and the CAPM", *Journal of Finance*, 2006, 61, 2163-2185.
- Fontana A. (2010) "The persistent negative CDS-bond basis during the financial crisis, 2007/08", Working paper, Università Ca' Foscari, Venice.
- Froot, Kenneth A., and O'Connell P. (2008), "On the pricing of intermediated risks: Theory and application to catastrophe reinsurance", *Journal of Banking and Finance* 32, 69-85.
- Garleanu N., Pedersen L.H. (2011) "Margin-based asset pricing and deviations from the law of one price", *Review of Financial Studies* 24, 1980-2022.
- Gabaix, Xavier, Krishnamurthy, Vigneron (2007) "Limits of arbitrage: Theory and evidence from the mortgage backed securities market", *Journal of Finance* 62, 557-596.
- Joshua M.P., Mungo W. (2010) "Average Correlation and Stock Market Returns", *Journal of Financial Economics* 96 (3), 364-380.
- Merton R. (1974) "On the pricing of corporate debt: The risk structure of interest rate", *The Journal of Finance* 29, 449-470
- Merton R. (1973) "An intertemporal Capital Asset Pricing Model", *Econometrica* 5, 867-887.
- Moody's KMV model [assessed 15.11.2014] URL: [www.default.risk.com](http://www.default.risk.com).
- Maio P. (2012) "Multifactor models and their consistency with the ICAPM", *Journal of Financial Economics* 106, 586-613.
- Naohiko B., and Packer F. (2009) "Interpreting deviations from covered interest parity during the financial market turmoil of 2007-08", *Journal of Banking and Finance* 33, 1953-1962.
- Sharpe W.F., Alexander G.J., Bailey J.V. (1999), *Investments*, New York: Prentice Hall.
- Teplova T., Shutova E. (2011) "A higher moment downside framework for conditional and unconditional CAPM in the Russian stock market" *Eurasian Economic Review* 2, 157-178.
- Tang D.Y., Yan H. (2010) "Market conditions, default risk and credit spreads", *Journal of Banking & Finance* 34, 743-753.
- Tsuji C. (2011) "Exploring the Priced Factors in ICAPM in Japan", *Modern Economy* 2, 701-705.
- Von Neumann J., Morgenstern O. (1953), *Theory of Games and Economic Behaviour*, Princeton: Princeton University Press.
- Zhukov P.E. (2012) "Management of financial risks of corporation — structures of the capital and a free cash flow", *Financial Journal of the State Financial University of the Ministry of Finance of Russian Federation* 4, 47-56.
- Zhukov P.E. (2013) "Influence of financial risks of corporation on the rate of discounting and probability of a default", *Financial Journal of Scientific research institute for the Ministry of Finance of Russian Federation*, 2, 55-62.