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GENDER AND CENTRAL BANKING

Ibrahima Diouf and Dominique Pépin

ABSTRACT

Female Central Bank chairs represent but a tiny minority. To understand why, this article analyzes socio-economic and socio-political characteristics of the countries where females have chaired Central Banks. Then, it suggests that gender differences in preferences as regards monetary policy goals may have some influence. This hypothesis is based on an empirical analysis showing that female Central Bank chairs focus more than their male colleagues on achieving the price stability goal. This means, then, that females are more resistant than males to political pressures. Finally, it concludes that gender differences in degree of conservatism, may be an explanatory factor in female underrepresentation in the Central Bank chairs.

KEYWORDS

Central Bank, conservatism, female underrepresentation, gender gap, monetary policy

JEL Codes: E58, J16, Z10

INTRODUCTION

« Mr. Summers and Mr. Yellen... euh, Ms. Yellen ».

This slip of the tongue by President Obama speaks volumes about females' absence in the world of central bankers (Steven Perlberg 2013).

There is a considerable body of literature on the absence of females on large firms' corporate boards and the consequences on their performance (Renée Adams and Daniel Ferreira 2009; Ian Gregory-Smith, Brian Main and Charles O'Reilly III 2013). Norway became a pioneer, in 2003, by adopting a reform that imposes a quota of 40% of females in non-executive positions on the boards of large companies, in an effort to improve gender equality (Harald Dale-Olsen, Pål Schone, and Mette Verner 2013). This reform has sparked a movement in other countries of the world, as in India, Malaysia and South Africa (Mary Curtis, Christine Schmid and Marion Struber 2012). Its scale is especially noticeable in Europe where many countries (Austria, Belgium, Finland, France, Germany, Iceland, Italy, Netherlands, Norway, Poland, Spain and the United Kingdom) have taken initiatives (Mari Teigen 2012). It inspires the European Union (EU) project on gender equality, proposed by Justice Commissioner Viviane Reding, who wants companies to allot 40% of their board seats to females by 2020.

Comparatively, while the differing impact of monetary policy on males' and females' unemployment rates is the major concern of the 'gender bias' literature (see e.g. Elissa Braunstein 2013; Gerald Epstein and Erinc Yeldan 2010; Yelena Takhtamanova and Eva Sierminska 2009; Elissa Braunstein and James Heinz 2008; John Abell 1991), the gender of the Central Bank's chair has so far not been a subject of academic work. However, females'

absence in the world of Central Banks is certainly comparatively worse than it is inside companies. The appointment of the first female, Ms. Janet Yellen, in 2014, to chair the world's most powerful Central Bank, the US Federal Reserve Bank, is certainly an important milestone for female representation in the world of monetary policy (Claire Jones 2013).

Indeed, Central Banks are in fact among the most important institutions of modern economies. In charge of the definition and the implementation of monetary policy, they determine the stock of money in circulation, set the level of short rates and perform the essential public functions (management of foreign exchange reserves, banking supervision). Central Bank chairs are powerful in the mastery of the monetary policy agenda (Alessandro Riboni and Francisco Ruge-Murcia 2008). For example, the Fed governor, today, Ms. Janet Yellen, is considered as the second most powerful person after the US President (David Gergen 2013).

Obviously, there is not one specific factor that explains the absence of females from the top ranks of Central Banks. However, formal or informal barriers are often pointed out, for example:

- . the reluctance of females to study economics and finance (Galina Hale and Tali Regev 2001);

- . females' absence in the tight-knit clubs from which Central Bank chairs are chosen.

The first argument cannot stand up to rigorous examination. As noted by the website *Worldwide Guide to Women in Leadership*, between 2000 and 2015 over 200 females have headed the Ministry of economy, finance and/or budget in their country or territory. In early 2015, five are still in office, in: East Timor; Lesotho; Republic of Bosnia-Herzegovina; Somaliland; the United Kingdom. These positions require commitment, availability and competence, at least on a par with those of a Central Bank chair.

The second argument is, in the final analysis, misleading. That is what appears from John Kenneth Galbraith's ironic words when he observed that "In Central Banks, as in diplomacy, the look, well-cut conventional clothing and an ease to keep company with very rich people counts for a lot with much lower results" (John Kenneth Galbraith 1977: 217). However, it should not be excluded from discussion. The underlying idea is that there are differences in preferences for the monetary policy goals assigned to Central Banks (Stefan Krause and Fabio Méndez 2008). In particular, in a context of independent Central Banks, governments want someone with preferences compatible with theirs to chair their Central Banks. Similarly, commercial banks want the Central Bank chair to be known to them to ensure that their preferences are not in contradiction with their own interests. Differences in preferences can be explained simply because monetary policy decisions will affect, as the case may be, price levels, economic growth, employment and income with consequences on individual and collective well-being (Gerald Epstein and Erinc Yeldan 2010). Hence, aversion to inflation will change according to individuals or individual generations (Etienne Farvaque and Alexander Mihailov 2009; Kenneth Scheve 2004). From the *Public Choice* perspective, the economic analysis of bureaucracy establishes that Central Banks' decisions can have very high political costs (Eugenia Toma and Mark Toma 1986). Therefore, no doubt there is rationality in governments' appointment of Central Bank chairs with preferences compatible with their objectives, a rationality that is easily transferable to commercial banks anxious to preserve their interests.

Considering that females' absence from Central Bank chairs is simply a question of differences in the degree of aversion to inflation, this paper examines female Central Bank chairs' degree of conservatism, in the sense of Kenneth Rogoff (1985), with respect to their male colleagues. For that purpose, it is based on an empirical analysis of the balance they maintain between monetary policy goals. But first, it should be noted that only a minority of females have managed to break the glass ceiling to reach the chair of the Central Bank. It also

points out the institutional and political context of the country in which they are appointed and emphasizes personal characteristics.

A MINORITY OF FEMALE CENTRAL BANK CHAIRS

Close scrutiny of Central Banks' organization charts reveals that they are overwhelmingly chaired by males. The oldest among them, the Swedish Riksbank (founded in 1668) has never been chaired by a female. In 2015, only sixteen females are chairing a Central Bank out of a total of 184 worldwide, i.e. less than 10% (8.69%). Among the thirty-four Organization for Economic Cooperation and Development (OECD) countries, i.e. economically influential, twenty-seven never have appointed female Central Bank chairs; the seven exceptions are Austria, Denmark, Finland, former East Germany, Israel, Poland and the United States. In Europe, among the twenty-three-member policy board and the six-member Executive Board of the European Central Bank (ECB), there are no women at all. Since its creation, the ECB's Executive Board has included only two. Only a minority of females, therefore, have managed to break the *glass ceiling* and have reached the Central Bank chair.

By crossing available data in periodicals and newspapers (Central Banking; Financial Times) and several websites (CentralBankNews.info; The Group of Thirty; Council for Parity Democracy; Worldwide Guide to Women in Leadership; www.guide2womenleaders.com; BloombergBusiness; CentralBanking.com; Connecting Women in Sovereign Entities Globally (WSE)), we have identified fifty-six female chairs, since 1949, for forty-six Central Banks¹. The results obtained are summarized in table 1.

Table 1 Central Banks with female chairs

Central Banks	Year of creation	Number of Governors	Females Chairs	Date of appointment
National Bank of Ukraine	1992	10	Valeriya Gontareva	Since 06/2014
Central Bank of Cyprus	1963	7	Chrystalla Georghadji	Since 04/2014
Maldives Monetary Authority	1981	6	Azeema Adam	Since 04/2014
Federal Reserve Bank	1913	15	Janet Yellen	Since 02/2014
Central Bank of Nigeria	1958	10	Sarah Alade	02/2014-06/2014
Central Bank of Madagascar	1960	9	Vonimanitra Razafimbelo	10/2013-10/2014
Central Bank of Somalia	1960	na	Yussur Abrar	09/2013-12/2013
Reserve Bank of Tonga	1989	4	Siosi Cocker Mafi	07/2003-07/2013
Bank of Israel	1954	10	Karnit Flug	Since 11/2013
Bank of Russia	1990	7	Elvira Sakh. Nabiullina Tatiana V Paramonova	Since 06/2013 10/1994-12/1995
Banco Central de El Salvador	1961	19	Marta Evelyn A. de Rivera Luz Maria S. de Portillo	04/2013-05/2014 08/2002-5/2009
Central Bank of Venezuela	1939	21	Edmee Betancourt Ruth de Krivoy	04/2013-08/2013 04/1992-04/1994
National Bank of Serbia	2003	5	Jorgovanka Tabakovic Kori Udovicki	08/2012 07/2003-02/2004
Central Bank of Seychelles	1983	6	Caroline Abel	Since 03/2012
Central Bank of Lesotho	1978	7	Retselisitsoe A. Matlanyane	Since 01/2012
Central Bank of Samoa	1984	6	Atalina Ainuu Enari	Since 08/2011
National Bank of Republic of Belarus	1992	6	Nadejda Ermakova Tamara D Vinnikova	07/2011-12/2014 02/1996-01/1997
National Bank of Kyrgyzstan	1991	4	Zina Asankojoieva	06/2011-04/2014
Banco central de la Republica de Argentina	1935	36	Jeenbaeva Baktygyl Mercedes Marcó del Pont Maria Elena Mondragon de Villar	07/2010-06/2011 02/2010-11/2013 01/2010-01/2014
Banco Central de Honduras	1950	11	Sandra Regnia de Midence Gabriela Nunez de Reyes Victoria Asfura de Diaz	2002- 2006 2009 – 2010 2006- 2009 1998-06/1999
Bank of the Marshall Islands	1982	na	Ann Marie Muller	Since 2009-
South Africa Reserve Bank	1921	7	Gill Marcus	11/2009-11/2014
Central Bank Van Aruba	1986	10	Jeanette R. Semeleer	Since 09/2008
Bank of Thailand	1942	13	Tarisa Wantanagase	11/2006-09/2010
Banco de Guatemala	1945	20	María A. Del Cid Navas de Bonilla	10/2006-09/2010
Central Bank of Kenya	1966	9	Jancinta Mwatela (acting)	03/2006-03/2007

State Bank of Pakistan	1948	17	Shamshad Akhtar	01/2006-01/2009
Central Bank of the Bahamas	1974	5	Wendy Craig	Since 06/2005-
Banco Central del Paraguay	1952	13	Monica L. Perez dos Santos	05/2005-02/2007
Central Bank of Turkmenistan	1991	na	Mukhammedova Shakersoltan	Since 2003
Bank Negara Malaysia	1959	6	Zeti Akhtar Aziz	05/2000-2005
Bank of Botswana	1975	7	Linah Mohohlo	Since 04/2011
Central Bank of Barbados	1972	6	Marion Williams	Since 10/1999
Central Bank of Sao Tome e Principe	1975	6	Maria Do Carmo Trovoada Silveira	11/1999-11/2009
Monetary Authority of Bermuda	1969	10	Cheryl Ann Lister	1999-06/2005
Cayman Islands Currency Board	1971	na	Cindy Scotland Bush	Since 03/2011
Bank of Guyana	1965	6	Dolly Sursattie Singh	1999-12/2006
Denmark Nationalbank	1818	42	Bodil Nyboe Andersen	Since 06/2002--
Banco Central del Ecuador	1926	35	Ana Lucia Armijos	04/1998-12/2014
National Bank of Poland	1945	15	Hanna Gronkiewicz-Waltz	11/1995-10/2005
Bank of the Lao PDR (Laos)	1968	11	Pany Yathotou	07/1993-08/1996
Central Bank of Finland	1812	32	Sirkka Hämäläinen	03/1992-12/2000
National bank of Austria	1816	11	Maria Schaumayer	1988-1992
People's Bank of China	1948	11	Chen Muhua	1995-1997
Banco Central de Bolivia	1928	53	Tamara Sánchez Peña	4/1992-5/1998
National Bank of East Germany	1949	6	Margarete Wittkowski	05/1990-05/1995
			Margaretha Kuckhoff	03/1985-04/1988
				1985/1985
				1967-1974
				1950-1958

Note: We count the number of governors in charge since 1949, except for Ecuador (since 1986) and Austria (since 1992).

The majority of female Central Bank chairs were appointed in emerging countries. Among the forty-six Central Banks listed, only seven (Belarus, East Germany, Russia, Serbia, Honduras, Kyrgyzstan) were chaired by females more than once² since 1949. Similarly, those with a high turnover rate have only one nomination. Thus, the Banco Central de Bolivia has only one female (under 2%) among its fifty-three successive governors; Banco Central de la Republica de Argentina, one out of thirty-six (2.7%); Banco Central del Ecuador, one out of thirty-five, (2.8%); Central Bank of Finland, one out of thirty-two (3%). There have been many arguments put forward to explain this low representation, including: the conservative and reactionary ideology of Central Banks; the stereotypes in children's education related to customs, religion; the differentiated educational guidance received by boys and girls in terms of curriculum preparing them for the world of work; the absence, in some countries, of gender-positive policies; the way Central Bank chairs are appointed with a sort of natural bias in favor of males³.

These various arguments posit the existence of circumstances that are more or less favorable to the promotion of female as Central Bank chairs. What are those circumstances? What are their characteristics? To highlight them, we refer to the socio-economic and socio-political indicators established by the United Nations Development Program (UNDP).

The socio-economic indicators

They concern the Human Development Index (HDI) and the Gender Inequality Index (GII). The HDI measures the average level of human development achieved in a country in three basic dimensions: health and longevity, access to education and decent standard of living. Its value is between 0 and 1. The higher the index is, the more the people of a country enjoy significant well-being. Depending on the HDI value, UNDP ranks 195 countries or territories in four categories: *very High human development* (forty-nine countries); *High human development* (fifty-two countries); *Medium human development* (forty-one countries); *Low human development* (forty-two countries). Eight countries are not classified. From the available data, countries with female Central Bank chairs appear as follows:

Table 2 Indicators of Human Development 2013

	Country	HDI rank	Human Development value	Gender Inequality Index value	GII rank	Share of seats in parliament	Number of female Central Bank chairs
Very high human development (HDI > 0,80)	United States	5	0.914	0.262	47	18.2	1
	Germany	6	0.911	0.046	3	32.4	2
	Denmark	10	0.900	0.056	5	39.1	1
	Israel	19	0.888	0.101	17	22.5	1
	Austria	21	0.881	0.056	5	28.7	1
	Finland	24	0.879	0.075	11	42.5	1
	Cyprus	32	0.845	0.136	23	10.7	1
	Poland	35	0.834	0.139	26	21.8	1
	Argentina	49	0.808	0.381	74	37.7	1
High human development (0,80 > HDI > 0,70)	Bahamas	51	0.789	0.316	53	16.7	1
	Belarus	53	0.786	0.152	28	29.5	2
	Russia	57	0.778	0.314	52	12.1	2
	Barbados	59	0.776	0.350	66	21.6	1
	Malaysia	62	0.773	0.210	39	13.9	1
	Venezuela	67	0.764	0.464	96	17.0	2
	Seychelles	71	0.756	Na	na	43.8	1
	Serbia	77	0.745	Na	na	33.2	2
	Ukraine	83	0.734	0.326	61	9.4	1
	Thailand	89	0.722	0.364	70	15.7	1
	China	91	0.719	0.202	37	23.4	1
	Ecuador	98	0.711	0.429	82	38.7	1
	Tonga	100	0.705	0.458	90	3.6	1
Medium human development (0,70 > HDI > 0,55)	Maldives	103	0.698	0.283	49	6.5	1
	Turkmenistan	103	0.698	Na	na	16.8	1
	Samoa	106	0.694	0.517	111	4.1	1
	Botswana	109	0.683	0.486	100	7.9	1
	Paraguay	111	0.676	0.457	88	18.4	1
	Bolivia	113	0.667	0.472	97	30.1	1
	El Salvador	115	0.662	0.441	85	26.2	2
	South Africa	118	0.658	0.461	94	41.1	1
	Guyana	121	0.638	0.524	113	31.3	1
	Guatemala	125	0.628	0.523	112	13.3	1
	Kyrgyzstan	125	0.628	0.348	64	23.3	2
	Honduras	129	0.617	0.482	99	19.5	4
	Lao PDR	139	0.569	0.534	118	25.0	1
Sao Tome & Principe	142	0.558	Na	na	18.2	1	
Low human development (HDI < 0,550)	Pakistan	146	0.537	0.563	127	24,5	1
	Kenya	147	0.535	0.548	122	19.9	1
	Nigeria	152	0.504	Na	na	6.6	1
	Madagascar	155	0.498	Na	na	15.8	1
	Lesotho	162	0.486	0.557	126	26.8	1
Others countries or territories	Marshall Islands	na	na	na	na	3.0	1
	Somalia	na	na	na	na	13.8	1

Note: Data in the tables are those available to the Human Development Report Office as of 15 November, 2013, UNDP report. Data on territories of Bermuda, Cayman Islands and Van Aruba do not appear in the UNDP ranking.

By crossing data from tables 1 and 2, among the fifty-six female Central Bank chairs:
. ten originate from nine of the forty-nine countries classified as *Very High human development*;

. seventeen from thirteen countries of the fifty-two ranked in *High human development*;

. nineteen from fourteen countries of the forty-one ranked in *Medium human development*;

. five from five of the forty-two countries classified as low human development;

. two from eight unclassified countries.

Therefore, female Central Bank chairs are mostly to be found in *Medium human development* countries (33.9% of the total). Then respectively in: *High human development* countries (30.3% of the total); *Very high human development* countries (17.8% of the total); *Low human development* countries (8.9% of the total). This distribution shows there is no obvious

relationship between the countries' level of human development and female Central Bank chair appointments.

Inequality gaps between males and females

Those are measured by the Gender Inequality Index (GII), which provides a measure of the losses in terms of human development caused by inequalities between females and males in the three dimensions of reproductive health, empowerment and the labor market. Its value varies from 0 (situation in which females have a salary equal to males) to 1 (situation in which the status of females is as bad as possible).

By crossing available data from tables 1 and 2, among the fifty-six female Central Bank chairs:

- . five come from four countries, out of the fifteen ($0 \leq \text{GII} < 0.1$) where the treatment of females is almost identical to that of males; they have 8.9% of total female Central Bank chairs;

- . nine come from eight countries, out of the thirty-five ($0.1 \leq \text{GII} < 0.3$) where the treatment of females is similar to that of men; they have 16.0% of the total;

- . twenty-two come from fifteen, of the fifty-two countries ($0.3 \leq \text{GII} < 0.5$) where the treatment of females is quite remote from that of men; they have 39.3% of the total;

- . seven come from seven countries, out of the eighty-five ($0.5 \leq \text{GII}$) where the treatment of females is very remote from that of males; they have 12.5% of the total.

These different distributions indicate that the socio-economic indicators of female/male inequality gaps, as measured by the Gender Inequality Index (GII), have more influence than the level of human development, measured by the Human Development Index (HDI) for the access of females to Central Bank chairmanship.

Socio-political characteristics

They are observed from three types of indicators: the importance of the political representation of females; the political system; the majority religion.

The importance of the political representation of females is measured by their weight in Parliament. In the UNDP ranking, only Rwanda has a female majority in Parliament. It has not, however, appointed a female Central Bank chair.

The analysis of data from tables 1 and 2 shows that where females hold in the Parliament:

- . under 10% of the seats, there are seven female Central Bank chairs (12.5% of the total) in six countries out of a total of thirty-three;

- . between 10% and 30% of the seats, there are thirty-four female Central Bank chairs, or 60.7% of total, in seventeen countries out of 153;

- . between 30% and 50% of the seats, twelve females have succeeded one another at the Central Bank chair, or 17.8% of the total, in ten countries out of a total of thirty-two.

This distribution helps establish a relationship between the relative importance of the political representation of females and their nomination as Central Bank chairs.

As for the nature of the organization of the political system, countries can be divided into four subsets of political systems (western-style democracies, former popular democracies, monarchies, others)⁴:

Table 3 The political systems

Western-style democracies	Former popular democracies	Others	Constitutional monarchies
Argentina; Austria; Bolivia; Botswana; Cyprus; Ecuador; El Salvador; Finland; Guatemala; Guyana; Honduras; Kenya; Maldives; Marshall Islands; Paraguay; Israel; Madagascar; Nigeria; Pakistan; Sao Tome e Principe; Seychelles; South Africa; United States; Venezuela	Belarus; China; East Germany; Lao PDR; Kyrgyzstan; Poland; Russia; Serbia; Turkmenistan; Ukraine	Somalia	Bahamas; Barbados; Bermuda; Cayman Islands; Denmark; Lesotho; Malaysia; Samoa; Thailand; Tonga; Van Aruba
24 countries, twenty nine female Central Bank chairs	10 countries, fifteen female Central Bank chairs	1 country, one female Central Bank chair	11 countries, eleven female Central Bank chairs

Crossing data from tables 1 and 3 shows that the earliest female Central Bank chair appointments were made in countries claiming *progressive ideology*, namely: East Germany (1950, 1967); China (1985); Lao PDR (1988); Poland (1992); Russia (1994, 2013); Belarus (1996, 2011); Kyrgyzstan (2010, 2011); Serbia (2003, 2012); Turkmenistan (2003); Ukraine (2014). These countries have quickly promoted the emancipation of females through the implementation of gender-friendly policies with the aim of ensuring equality between males and females in all spheres of society: political, economic, cultural, educational and family life. For example, in China, in 1954, the constitution stipulated equality between males and females and, in 1956, a law was passed to protect the rights and interests of females (Olivia Cox-Fill 1996). The fifty-six female Central Bank chairs are divided into:

- . twenty-four in the Western-type democratic countries;
- . ten in the former people's democracies;
- . eleven in the constitutional monarchies;
- . one in a country with another political system.

Thus, even if the former people's democracies did make the first appointments of female Central Bank chairs, their number is twice as important in countries organized on the model of Western democracy; they account for 51.7% of appointments compared to 26.7% for former people's democracies. The constitutional monarchies account for 19.6% of the total. Finally, the weight of tradition and/or the characteristics of the majority religion may more or less influence the role and status of females in society. Indeed, some factors related to traditions influence economic choices and the economic development process (Alberto Alesina and Paola Giuliano 2013). By and large, these factors can be approached in reference to the geographical location of countries.

Table 4 Number of female Central Bank chairs distributed by Continent and Country

Europe	America	Africa and Indian Ocean	Asia, Indian-subcontinent and the Pacific
Austria (1); Belarus (2); Cyprus (1); Denmark (1); East Germany (2); Finland (1); Poland (1); Russia (2); Serbia (2); Ukraine (1)	Argentina (1); Bahamas (1); Barbados (1); Bermuda (1); Bolivia (1); Cayman Islands (1); Ecuador (1); El Salvador (2); Guatemala (1); Guyana (1); Honduras (4); Marshall Islands (1); Paraguay (1); Samoa (1); United States (1); Van Aruba (1); Venezuela (2)	Botswana (1); Kenya (1); Lesotho (1); Madagascar (1); Nigeria (1); Sao Tome e Principe (1); Seychelles (1); Somalia (1); South Africa (1)	China (1); Israel (1); Kyrgyzstan (2); Lao PDR (1); Malaysia (1); Maldives (1); Pakistan (1); Thailand; Tonga (1); Turkmenistan (1)
10 countries, 14 female Central Bank chairs	16 countries, 22 female Central Bank chairs	9 countries, 9 female Central Bank chairs	10 countries, 11 female Central Bank chairs

The fifty-six female Central Bank chairs are distributed in forty-six countries belonging, geographically, to the mainland: America, seventeen countries, including eleven in South America; Europe, ten countries; -. Asian, Pacific and the Indian subcontinent, ten countries; -. Africa and the Indian Ocean, nine countries.

This distribution shows that the American continent has the highest proportion of female Central Bank chairs (39.2% of the total), followed by: Europe (25%); Asia, the Indian subcontinent and the Pacific (19.6%); Africa and the Indian Ocean (16.07%).

The weight of religion has effects on the countries' development processes (Robert Barro and Rachel McCleary 2003). In particular, it affects the status and role of females in the society. By religion, countries with female Central Bank chairs are distributed as follows:

Table 5 Distribution of countries by majority religion (at percentage)

	Christians	Jews	Buddhists/Taoists	Muslims	Others
Argentina	70-90				
Austria	90				
Bahamas	81				
Barbados	67				
Belarus	55				
Bermuda	90				
Bolivia	76				
Botswana	70				
China			87,5		
Cayman Islands	81				
Cyprus	78				
Denmark	77,8				
Ecuador	80				
El Salvador	83				
Finland	75				
East Germany	85				
Guatemala	87				
Guyana	57				
Honduras	87				
Israel		75,4			
Kenya	82,6				
Kyrgyzstan				80	
Lao PDR			67		
Lesotho	90				
Madagascar					52
Malaysia				62	
Maldives				99	
Marshall Islands	97				
Nigeria	50,8				
Pakistan				98	
Paraguay	96				
Poland	87,5				
Russian Federation	41				
Samoa	98				
Sao Tome & Principe	82				
Serbia	85				
Seychelles	90				
Somalia				99,8	
South Africa	80				
Thailand			94		
Tonga	83				
Turkmenistan				89	
Ukraine	72				
United States	70				
Van Aruba	81				
Venezuela	92				

Sources – The data for each country are obtained from websites: Wikipedia; Le Guide du Routard; Encyclopedia of the Nations.

When classifying religions into three subsets (Christians-Jews, Muslims-others Buddhists-Taoists), and crossing data from tables 1 and 5, it appears that fifty-six females Central Bank chairs are located in: thirty-six predominantly Christian countries (Catholics, Orthodox, Lutherans) and Jewish; seven countries where the majority is Muslim/others; three countries where Buddhist/Taoist are predominant. Countries with a majority of Christians or Jews thus account for 80.0% of female Central Bank chairs against 14.3% in the countries where Muslims are predominant or others, and 5.35% with a majority of Buddhist/Taoist.

Thus, the observation of countries with female Central Bank chairs, according to socio-economic criteria (level of human development (HDI), gap of inequality of treatment between males and females (GII)), socio-political criteria (nature of the political organization, the weight of cultural traditions, the majority religion) shows that:

- . female Central Bank chair nominations seem correlated to the relative weight of tradition, the majority religion and the gap in treatment between males and females;
- . there is no obvious relationship between the countries' level of human development and the female Central Bank chairs named.

As appears from table 1, there is a small minority of females in the closed circle of the world's Central Banks. This situation is partly due to the fact that appointing Central Bank chairs is strictly the government's prerogative. Therefore, it would appear important to focus on the characteristics of appointed female Central Bank chairs.

THE PROFILES OF FEMALE CENTRAL BANK CHAIRS

The extent of the absence of female Central Bank chairs is such that it is beginning to elicit a number of reactions, particularly in the advanced economies. For example, in 2012, Members of Parliament rejected the appointment of the Governor of the Central Bank of Luxembourg, Yves Mersch, to the Executive Board of the ECB (Eva Kuehnen 2012). Quite obviously, neither Mr. Mersch's expertise nor his experience was to blame. But, simply, he was just another male, while there were plenty of qualified females with the ability and motivation to take on those roles⁵. The question remains as to what factors underlie the selection of Central Bank chairs.

Following Kenneth Rogoff (1985), who recommended appointing a conservative Central Bank chair to effectively fight inflation, a large literature emphasizes that Central Bank chair preferences, on monetary policy goals, are influenced by their careers and academic backgrounds (Alexander Jung 2013). Some studies emphasize the impact of career background and career concern (Georgios Chortareas and Emmanouil Noikokyris 2014), others the academic background and partisan affiliations (Ibrahima Diouf and Dominique Pépin 2010; Silja Göhlmann and Roland Vaubel 2005).

The results show that Central Bank chairs' academic and career backgrounds influence not only their preferences on monetary policy goals, but also their ability to achieve them.

First, we must remark that female Central Bank chairs have mainly been named in the past twenty-five years. This development coincided with major changes in the institutional context of the definition and implementation of monetary policies.

The institutional context of monetary policy

Until the 1980s, in most countries, monetary policies used to be altogether dependent on political cycles. The monetary tool was available to governments that imposed their preferences on Central Bank goals. Central bankers were issued instructions and made decisions that matched government preferences. A government official sits on the Central Bank decision-making bodies with the task of monitoring its activities. Then, the Central Bank acts as a *transmission belt* for the Ministry of Economy and Finance, the real locus of monetary power⁶.

The 1990s were characterized by the acceleration of economic globalization with the liberalization of markets, the deepening of integration processes (e.g. in Europe). The interdependence between economies was strengthened and national policies lost weight⁷.

Under the influence of the Chicago School, monetary policy became the main component of economic regulation. Under the philosophy of the Washington Consensus, the major international financial institutions (International Monetary Fund, World Bank, Organization for Economic Co-operation and Development) recommended granting Central Banks independence⁸, promoting price stability which is, in a context of global competition, a prerequisite for economic growth (Jakob De Haan and Jeroen Klomp 2010; Marcello D'Amato, Barbara Pistoiesi, and Francesco Salsano 2009; King Banaian 2008).

Now, Central Banks no longer receive instructions from the political power. They play a major role and organize their actions in a long-term perspective. Central bankers find themselves projected the limelight in assessing macroeconomic performances between countries. Markets constantly scrutinize their actions and are interested in their partisan affiliation. Accordingly, the appointment of a Central Bank chair is no longer a simple administrative act, but a political signal with effects on expectations and decisions of various economic agents and therefore on macroeconomic stability. This movement of the Central Bank independence affects all groups of countries, especially the emerging market countries (Christopher Crowe and Ellen Meade 2008; Jakob De Haan and Willem Kooi 2000). It was in this new context, as shown in table 1, that fourteen female Central Bank chairs were appointed.

The Central Banks' independence means that monetary authorities have more freedom to pursue their goals, which can be summarized, by and large, in the quest for price stability. According to the results of empirical studies, there is a correlation between the degree of independence of Central Banks and the inflation level: the more independent the Central Banks, the better their performances on price stability (Alex Cukierman, Geoffrey Miller, and Bilin Neyapti 2002; Alex Cukierman 1992).

Table 6 compares Central Banks' performances on inflation with female Central Bank chairs:

Table 6 Inflation (2001-2013)

Argentina 9,8	Austria 2,0	The Bahamas 2,0	Barbados 4,0	Bermuda na	Belarus 26,3	Bolivia 5,1	Botswana 8,7
China 2,4	Cyprus 2,2	Denmark 2,0	Ecuador 7,5	El Salvador 3,2	Finland 1,8	Germany 1,7	Guatemala 6,3
Guyana 5,5	Honduras 7,1	Israel 2,1	Kenya 7,7	Kyrgyzstan 7,8	Lao 7,2	Lesotho 6,7	Madagascar 9,5
Malaysia 2,3	Maldives 5,1	Marshall Islands 4,1	Nigeria 11,6	Pakistan 8,7	Paraguay 7,1	Poland 2,8	Russia 11,2
Samoa 4,9	Sao Tomé 15,1	Serbia 8,4	Seychelles 6,6	Somalia* 53,7	South Africa 5,9	Thailand 2,7	Tonga 6,9
Turkmenistan 6,9	Ukraine 9,3	USA 2,2	Van Aruba* 2,7	Venezuela 23,8			

Source: calculation from International Monetary Fund, World Economic Outlook Database, April 2015.

* drawn from the database of the Federal Reserve Bank of St. Louis over the period 2000-2010 (Penn World Table of University of Pennsylvania).

Central Banks are classified into two subsets:

- . the first includes those with an average inflation rate below 5%. They are located in influence areas of the two major Central Banks, ECB and the US Fed, deemed the most politically independent. Around the ECB, Central Banks of Austria, Cyprus, Finland, Germany and Poland⁹ are to be found; around the US Fed, the Central Banks of the Bahamas, Barbados, Marshall Islands, Samoa and Van Aruba¹⁰;
- . the second includes Central Banks with an average inflation rate over 5%.

Although reservations were expressed about the interpretation of macroeconomic data in some countries, particularly the developing or transition ones (Juliet Johnson 1997; Marvin Goodfriend and Eswar Prasad 2009), these differences in levels of inflation reflect, to some

extent, the Central Banks' political degree of independence. With the exception of ECB and US Fed, among Central Banks being chaired by females, only Malaysia and Israel are fully independent.

The performance on price stability can also be indebted to the skills, preferences and personalities of the Central Bank chair. These factors are related to their academic and career backgrounds.

Female Central Bank chairs: academic and career backgrounds

To analyze the female Central Bank chairs' academic and career backgrounds, we collected biographical data available from the websites of national Central Banks and supplemented with those available from other websites. Data are summarized in table 7.

Table 7 Data on the academic and career backgrounds

Central Banks	Governors	Career background							Academic background					
		Central Bank	Banks/ insurance	Teachers	Public sector	Private sector	Politics	International functions	PhD of Economics	PhD of Business management	Masters of Economics	MBA/finance s/commerce	Bachelor	Others diploma
Ukraine	Valeriya Gontareva		X		X	X					X			
Cyprus	Chrystalla Georghadji		X		X									
Maldives	Azeema Adam	X			X									
US	Janet Yellen	X		X	X		X	X						
Nigeria	Sarah Alade	X		X	X					X				
Madagascar	Vonimanitra Razafimbelo	X			X									
Somalia	Yussur Abrar		X			X						X		
Tonga	Siosi Cocker Mafi	X			X						X			
Israel	Karnit Flug	X			X			X	X					
Russia	Elvira Sakhizadovna Nabiullina		X		X	X		X						
	Tatiana V Paramonova	X	X			X			X					
El Salvador	Marta Evelyn Arévalo de Rivera	X	X	X							X			
	Luz Maria Serpas de Portillo	X	X								X			
Venezuela	Edmee Betancourt		X	X	X		X							X
	Ruth de Krivoy	X	X	X	X	X	X	X	X					
Serbia	Jorgovanka Tabakovic						X	X	X					
	Kori Udovicki			X	X		X	X	X					
Seychelles	Caroline Abel	X									X			
Lesotho	Rets'elitssoe Adelaide													
	Matlanyane	X		X					X					
Samoa	Atalina Ainuu Enari	X									X			
Belarus	Nadejda Ermakova	X	X		X							X		
	Tamara D Vinnikova		X											
Kyrgyzstan	Zina Asankojoeva	X			X							X		
	Jeenbaeva Baktygyl	X	X		X	X	X				X			
Argentina	Mercedes Marcó del Pont		X	X	X	X	X	X						
	María Elena Mondragón de Villar	X			X	X					X			
Honduras	Sandra Regnia de Midence													
	Gabriela Nunez de Reyes	X	X	X	X	X	X				X			
	Victoria Asfura de Diaz	X										X		
Marshall Islands	Ann Marie Muller													
Van Aruba	Jeanette R. Semeleer	X			X						X			
South Africa	Gill Marcus	X	X	X		X	X						X	
Thailand	Tarisa Wantanagase	X						X	X					
Guatemala	María Antonieta Del Cid Navas de Bonilla	X			X	X	X				X			
Kenya	Jancinta Mwatela	X					X					X		
Pakistan	Shamshad Akhtar	X	X		X			X	X					
Bahamas	Wendy Craig	X	X								X			
Paraguay	Monica Lujan Perez dos Santos	X						X	X					
Turkmenistan	Mukhammedova, Shakersoltan								na	na	na	na	na	na
Malaysia	Zeti Akhtar Aziz	X						X	X					
Botswana	Linah Mohohlo	X				X		X			X			

Barbados	Marion Williams	X				X	X		
Sao Tome Principe	Maria Do Carmo Trovoada Silveira					X			X
Bermuda	Cheryl Ann Lister		X						X
Cayman Islands	Cindy Scotland Bush	X		X					X
Guyana	Dolly Sursattie Singh								
Denmark	Bodil Nyboe Andersen	X	X	X	X	X			X
Ecuador	Ana Lucia Armijos	X				X	X		X
Poland	Hanna Gronkiewicz-Waltz			X	X	X	X	X	
Laos	Pany Yathotou	X				X			X
Finland	Sirkka Hämäläinen	X		X	X			X	
Austria	Maria Schaumayer		X	X	X			X	
China	Chen Muhua				X	X			X
Bolivia	Tamara Sánchez Peña	na							
East Germany	Margarete Kuckhoff Margaretha Wittkowski			X	X	X			X
				X	X	X		X	

Sources: websites: Bank for International Settlements; The Group of Thirty; Women in Sovereign Entities; periodic reviews: World Who's who – Marquis Who's who; The Banker; Europa Year Book.

Central Bank chair preferences, on monetary policy goals, are influenced by their career background. That is the case when he or she is encouraged to express his or her loyalty to some interest groups or an industry, a political party, a bureaucracy... In particular, a past career in Central Bank staff may encourage executives to identify their own interests to the Central Bank's goals. Indeed, as an institution, the Central Bank seeks to build a reputation and maintain credibility. Those are based on its ability to fulfill its mission, mainly summarized by maintaining price stability. Compared to a past career as a politician or official (including international civil servants), the Central Bank chair is prompted to a stronger preference for price stability¹¹. Those differences stem from motivations that are linked with redistribution policies, real state debt reduction, stimulus policy. A past career in the private sector (companies, financial and banking sectors...) will influence the Central Bank chair's preferences in the direction of business satisfaction. All in all, officers with a background in Central Bank staff, as business executives (insurance companies, commercial banks, managerial sector) or in public service have, on average, a stronger preference for price stability than those with a background as politicians or trade-unionists.

The observation of female Central Bank chairs career background data reveals that:

- . 71.4% have held various responsibilities within the Central Bank as vice-chair, board member, economist, department manager...;
- . 40.8% have had experience in banking and/or finance and insurance;
- . 26.5% have taught as university professors or assistants;
- . 51.0% have worked in the public sector;
- . 39.6% have worked in the private sector;
- . 39.6% have been very active in politics as members of parliament, ministers, prime ministers;
- . 33.3% have worked for international institutions such as IMF, World Bank, UNPD.

These figures show that a very large majority of female Central Bank chairs held various positions in the Central Bank before being appointed. Many had worked in the public and private sectors and had experience in the banking and financial sectors. A significant proportion was very active in politics. It would thus seem that the profiles of these female Central Bank chairs seem to tilt the preferences in favour of price stability.

From the academic background depends the ability to understand economic and inflation mechanisms. From the perspective of Public Choice, the Central Bank chair with an economist's profile will normally have an advantage enabling him to influence policy decisions in favor of his own preferences or specific targets (Keith Acheson and John Chant 1973). A more business-oriented training (managers, engineers) will predispose the Central

Bank chair to greater aversion to inflation. Indeed, price stability is a major asset for the economy and business development (Frederic Mishkin 2007).

The academic background data for female Central Bank chairs reveal (see table 8) that they are holders:

- . 40.8% of a Ph.D. or equivalent, of whom 31.2% specialize in economics and 10.4% in business and management;
- . 48.98% of a Master's degree or equivalent, including 31.25% specialized in economics and 18.7% in finance or business administration or commerce;
- . 6.12% of a specialized Bachelor or equivalent in economics, finance, commerce or accounting techniques;
- . 4.08% of another diploma or certificate (accounting, engineering).

Thus, female Central Bank chairs have mostly technical capacities to influence monetary policy decisions in the direction of their preferences. Even if a significant proportion holds a business-related diploma, it would be premature to infer their preferences between various potential monetary policy goals. Overall, the analysis of data related to the female Central Bank chairs career background leads us to the conclusion that, on the monetary policy goals, their preferences mostly go towards price stability. The examination of their academic background shows that they have the capacity to take advantage of it. Only the results of the empirical analysis, however, can robustly establish the exact nature of their preferences with respect to price stability, in comparison with male Central Bank chairs. To this aim, we present hereafter a model of monetary policy designed for estimating the policy parameter of female Central Bank chairs compared to their male counterparts.

GENDER AND THE INFLATION/OUTPUT TRADE-OFF

In the literature about the optimal monetary policy, it is standard to assume that monetary authorities operate by following a targeting rule, as defined by Lars Svensson (1999). The Central Bank chair is supposed to minimize a quadratic loss function L_t , which penalizes deviations of the objective variables from their target. Suppose that these objective variables are the output gap x_t (the deviation of the actual GDP from its potential value) and the inflation rate π_t , which the Central Bank chair wants as close as possible to zero and the inflation target $\bar{\pi}$. The quadratic loss function is specified as

$$L_t = \alpha x_t^2 + E_t \left[(\pi_{t+1} - \bar{\pi})^2 \right] + \sum_{i=1}^{\infty} \beta^i E_t \left(\alpha x_{t+i}^2 + (\pi_{t+i+1} - \bar{\pi})^2 \right), \quad 0 < \beta < 1, \alpha \geq 0, \quad (1)$$

where β is an intertemporal discount factor and α represents preferences of the Central Bank chair regarding the stabilization of the output, relatively to the stabilization of the inflation rate around its target $\bar{\pi}$. This quadratic loss function is a slightly modified version of the loss function frequently used in the literature, with the present quadratic inflation deviation $(\pi_t - \bar{\pi})^2$ replaced with the expected value $E_t \left[(\pi_{t+1} - \bar{\pi})^2 \right]$. This is because we suppose that π_t does not depend on the current monetary policy. Due to delay of the monetary transmission mechanism, the monetary policy cannot influence the contemporaneous value of the inflation rate, and it operates only on one-year forward inflation rate anticipation. Apart from that, Eq. (1) is conventionally interpreted; the higher α , the less conservative the Central Bank chair is in the sense of Kenneth Rogoff (1985). Our aim is to estimate the value of α for female Central Bank chairs comparatively to their male counterparts. Are female Central Bank chairs more, less or as conservative as males?

The Central Bank chair is supposed to control the output gap x_t . At first sight it may seem too strong a hypothesis, but it is in fact a common tacit assumption in monetary models, the policy-maker setting the interest rate to control the output gap (see for example Richard Clarida, Jordi Galí and Mark Gertler 1999). With this assumption, we will not need to specify a demand or ‘IS’ curve. This is clearly an advantage as our results are independent of the demand equation specification. The only structural equation we need to specify is a New-Keynesian Phillips equation, which is supposed to be of the form

$$\pi_{t+1} - \bar{\pi} = \lambda x_t + \beta(E_t \pi_{t+2} - \bar{\pi}) + u_{t+1}, \quad \lambda > 0, \quad (2)$$

where E_t is the expectation operator, conditional on information available at date t , and u_{t+1} is a supply shock, eventually autocorrelated. In this forward-looking formulation of the Phillips equation, output gap affects the inflation rate with one-year lag, which is consistent with annual data according to Lars Svensson (1997). Eq. (2) is grounded on dynamic general equilibrium theory, which keeps the Lucas critic away, and apart from the fact we suppose that there is a control lag of one year, it is of the same form as the Phillips curve considered in Richard Clarida, Jordi Galí and Mark Gertler (1999).

The policy problem is to choose a time path for x_t which minimizes the loss function (1), subject to the constraint (2). This problem reduces to minimizing $\alpha x_t^2 + E_t[(\pi_{t+1} - \bar{\pi})^2]$, the controllable part of (1), subject to (2). The first order condition of this problem is $2\alpha x_t + 2\lambda E_t(\pi_{t+1} - \bar{\pi}) = 0$, which can be written

$$-\frac{\lambda}{\alpha} [E_t(\pi_{t+1}) - \bar{\pi}] = x_t. \quad (3)$$

When the expected inflation rate is above (below) target, the Central Bank reduces (raises) the output gap. The aggressiveness of this response depends on parameters λ and α . The response is more aggressive if the influence of output gap on inflation is high (λ is high), and if the conservatism of the Central Bank chair is more pronounced (α^{-1} is high). This last parameter is likely to depend on the personality of the policy maker. It may also depend on the economic, political context in which the Central Bank chair is doing his job.

Let $\varepsilon_{t+1} = \pi_{t+1} - E_t(\pi_{t+1})$ denote the inflation forecast error. Eq. (3) can be rearranged

$$\pi_{t+1} = \bar{\pi} - \gamma x_t + \varepsilon_{t+1} \quad \gamma = \frac{\alpha}{\lambda} > 0, \quad E_t(\varepsilon_{t+1}) = 0. \quad (4)$$

Eq. (4) can be estimated by OLS. According to condition $E_t(\varepsilon_{t+1}) = 0$, errors of this model cannot be serially correlated. Eq. (4) shows that for a country whose monetary policy is consistent with the model defined by (1) and (2), the regression of π_{t+1} on x_t must produce a negative slope $-\gamma$ and must be characterized by a serially uncorrelated error term. But not every country’s monetary policy is consistent with this model. Countries which are not consistent with it, particularly those which are not following a targeting rule described by the loss function (1), should not be included in our empirical analysis. Eq. (4) suggests that the way to select those which are consistent with the model is to look at the estimated slope and at the residuals of the regression equation (4).

In case the Central Bank policy is not constant, depending on the current Central Bank chair, we have to make allowance for its variability. In particular, if female Central Bank chairs operate differently from their male counterparts, it should be the case that α , and thus γ , will differ according to gender of the policymaker. The loss function (1) would be different for males and females, in that the constant parameter α would be replaced with a variable parameter α^t . In order to generalize the model in this way, consider the exogenous gender

indicator d_t which can either be $d_t = 0$ (the Central Bank chair of period t is a male) or $d_t = 1$ (the Central Bank chair of period t is a female). According to gender of the Central Bank chair, the relative weight for stabilization of the output gap in the loss function can be either $\alpha^t = \alpha^M$ (for $d_t = 0$) or $\alpha^t = \alpha^F$ (for $d_t = 1$). So the slope of the regression of π_{t+1} on x_t can vary with the value of the gender indicator; it can be either $\gamma^t = \gamma^M = \frac{\alpha^M}{\lambda}$ for ($d_t = 0$)

or $\gamma^t = \gamma^F = \frac{\alpha^F}{\lambda}$ (for $d_t = 1$). The generalized model of the inflation/output trade-off is then

$$\pi_{t+1} = \bar{\pi} - \gamma x_t - \phi d_t x_t + \varepsilon_{t+1}, \quad E_t(\varepsilon_{t+1}) = 0. \quad (5)$$

For $d_t = 0$, $\partial E_t(\pi_{t+1})/\partial x_t = -\gamma$ so $\gamma^M = \gamma$, whereas for $d_t = 1$, $\partial E_t(\pi_{t+1})/\partial x_t = -\gamma - \phi$ so $\gamma^F = \gamma + \phi$. A positive (negative) value for ϕ indicates that the female Central Bank chairs are less (more) conservative than their male counterparts. More precisely, as $\frac{\gamma^F}{\gamma^M} = \frac{\alpha^F}{\alpha^M}$, we get

that $\frac{\phi}{\gamma} = \frac{\alpha^F - \alpha^M}{\alpha^M}$. The ratio ϕ/γ measures in percentage how much female Central Bank chairs are more cautious about output stabilization than males.

Estimating the policy preferences by the way of running the regression equation (5) is a much more simple methodology than those used in the literature (see Stephen Cecchetti and Michael Ehrmann 2002; Carlo Favero and Riccardo Rovelli 2003; Umit Ozlale 2003; Efrem Castelnuovo and Paolo Surico 2003; Minoru Tachibana 2004; Stefan Krause and Fabio Méndez 2005; Richard Dennis 2006). In these aforementioned studies about the estimation of Central Banks' preferences, an identification problem arises, due to the nature of the objective. In effect, the common objective to all these studies is to get an estimate of the preference parameters. It requires estimating all the structural and preference parameters in order to recover the preference parameters from the reduced form of the model. On the contrary, our methodology is simpler (and presumable more robust to error specification) because we do not try to estimate the preference coefficients α^F and α^M but only to estimate how they differ. To do so, we don't need to estimate the structural parameter λ ; it is not even necessary to estimate an aggregate demand curve. The basic principle of this methodology is borrowed from Ibrahima Diouf and Dominique Pépin (2010).

Estimation of policy preferences are usually based on estimation of all policy and structural parameters. These traditional estimation procedures require an estimation of the structural macroeconomic model and an interest rate rule, in order to recover all the parameters (Carlo Favero and Riccardo Rovelli 2003; Umit Ozlale 2003; Castelnuovo and Paolo Surico 2003; Richard Dennis 2006), or of the structural macroeconomic model and the first-order equation of the loss function's minimization (Carlo Favero and Riccardo Rovelli 2003; Minoru Tachibana 2004), using an approach close to ours. Another approach is to estimate the structural macroeconomic model and to use an estimation of the variances of inflation and output gap to recover the preference parameters (Stephen Cecchetti and Michael Ehrmann 2002; Stefan Krause and Fabio Méndez 2005). More simply, we focus on the first-order condition, which solves the optimization problem faced by the Central Bank chair. Our methodology is also distinctive in preferring a forward-looking model to a backward-looking one, and using annual data (instead of quarterly data).

Estimating Eq. (4) and testing the significance of $\hat{\phi}$ (the OLS estimator of ϕ) is then sufficient to find out if female and male Central Bank chairs behave in a similar way or not,

and in case they don't, to infer about their differences. Theoretically, we can run such a regression for every country to assess the differences between females and males. For every country, we can estimate the country parameters γ and ϕ . The drawback of running individual (country) regressions is that the individual estimators $\hat{\phi}$ will be imprecisely estimated if the number of observations characterized by $d_t = 1$ is low. And it is in fact the case for almost every country that this number is very low, because of the overrepresentation of males in the Central Banks' management. If we estimate ϕ country by country, the variance of $\hat{\phi}$ would be high, and the estimated parameter would not be statistically significant, even if the true parameter is non zero. Thus we prefer to adopt an alternative estimation and test methodology, based on a panel data analysis. On the one hand, the drawback of such a methodology is to impose a restriction on country regressions that implies the existence of a common parameter; but on the other hand, using the panel sample produces a better estimate of this common parameter.

The panel model can be written

$$\pi_{j,t+1} = \bar{\pi}_j - \gamma_j x_{j,t} - \rho \gamma_j d_{j,t} x_{j,t} + \varepsilon_{j,t+1}, \quad E_t(\varepsilon_{j,t+1}) = 0 \quad (6)$$

where j is introduced to identify the country j ($j = 1 \dots N$). All the variables $\pi_{j,t+1}$, $x_{j,t}$, $d_{j,t}$ and $\varepsilon_{j,t+1}$ are country-specific, just as the parameters $\bar{\pi}_j$ and γ_j . The parameter ρ is common to all countries included in the panel.

By generalizing our previous notations, we can write $\gamma_j^M = \gamma_j = \frac{\alpha_j^M}{\lambda_j}$ and $\gamma_j^F = (1 + \rho)\gamma_j = \frac{\alpha_j^F}{\lambda_j}$.

So $\gamma_j^F = (1 + \rho)\gamma_j^M$ or in an equivalent manner $\alpha_j^F = (1 + \rho)\alpha_j^M$. The common parameter ρ represents the deviation of the weights given to stabilization of output by females, against the weights given by males, in percentage of the weights given by males. For example, if $\rho = 0,10$, then female Central Bank chairs are 10% more inclined to stabilize output gap than males. The panel model restricts this difference between female and male Central Bank chairs to be the same, whatever country is considered.

Eq. (6) is a non-linear panel model, which has to be estimated by numeric methods (like Gauss-Newton). The system of N equations (6) can be estimated by non-linear Least Squares. But as the errors $\varepsilon_{j,t+1}$ are contemporaneously correlated between countries, we implement a non-linear Seemingly Unrelated Regression (SUR) method to estimate this system, exploiting this additional information.

A PANEL DATA ANALYSIS

The macroeconomic data used is from the FMI web site. At the time we picked up the data the last update was 03/2015. We use annual GDP data (valued at constant prices in national currency) and annual end of period consumer prices index¹² relative to thirty-three countries (Argentina, Austria, Bahamas, Barbados, Belarus, Bolivia, Botswana, China, Denmark, Ecuador, Salvador, Finland, Guatemala, Guyana, Honduras, Kenya, Kyrgyzstan, Lao, Lesotho, Malaysia, Marshall Islands, Pakistan, Paraguay, Poland, Russia, Samoa, Sao Tome, Serbia, Seychelles, South Africa, Tonga, Turkmenistan and Venezuela). Data are collected on the period 1980-2014 or on a shorter period for some countries¹³. We calculate the inflation rate for every country by applying the formula $\pi_t = 100 \times \ln(P_t / P_{t-1})$, with P_t designing the price index. The potential GDP is estimated by regressing the actual GDP on a quadratic trend, and

the output gap is then defined by $x_t = 100 \times \ln(Y_t / Y_t^*)$, with Y_t and Y_t^* for respectively the actual and potential GDP.

For every country j and every year t we set the dummy variable d_{jt} to 1 if a woman was the Central Bank chairman for at least six months. Otherwise the dummy is set to 0. In the initial data set, seven countries have a unique $d_t = 1$ in 2014 (Cyprus, Israel, Madagascar, Maldives, Nigeria, Ukraine and the US). As inflation depends on monetary policy with a delay of one year, and because we have not yet the 2015 data, these countries don't bring any information about the parameter of interest in this study (ρ). This is why they are not included in the previous list of thirty-three countries.

Individual Regressions

In order to select countries to be included in the panel analysis, individual regressions were run. For every country, Eq. (5) is estimated by OLS.

Some adjustments have been made for some countries, about the intercept $\bar{\pi}$ of the regression and about the sample period. These adjustments were necessary because the countries examined in the study are not similar, particularly concerning inflation rates. Firstly, some countries have experienced disinflationist processes. So the implicit inflation target $\bar{\pi}$, which equals the long term inflation rate if the Central Bank hits the target in the long run, cannot be supposed constant. So the constant intercept $\bar{\pi}$ was replaced with a quadratic trend $a_\pi + b_\pi t + c_\pi t^2$. This adjustment concerns Bahamas, Botswana, Denmark, Finland, Guyana, Honduras, Lesotho, Paraguay, Poland, Russia, Sao Tome, Salvador and Serbia. To decide of the inclusion of the quadratic term, we looked at the serial correlation of the residual term, by means of the Breusch-Godfrey Serial Correlation LM Test. A significant autocorrelation of residuals detected in the model without quadratic trend may indicate the existence of a trend in the inflation process. So, if we detected a significant autocorrelation of residuals, and if inclusion of quadratic trend makes this autocorrelation disappear, we include the trend in the regression. It has to be noted that the inclusion of the quadratic trend has little impact on the estimated parameters $\hat{\gamma}$ and $\hat{\phi}$, because the output gap is a de-trended series by construction. So the inclusion of quadratic trends has no consequences on the results; it only makes the residuals' autocorrelation disappear. Secondly, adjustments have also been made about the sample period. The theoretical model described by equations (1) and (2) may be a good description of the monetary policy for some countries on a more recent period, but not since the early 1980s. The concept of a targeting rule is relatively recent, and not many of the Central Banks in the world have followed such a rule since the early 1980s. For some countries included in the sample, it is obvious that the apparent inflation instability is not compatible with the inflation/output trade-off. In these countries, monetary policy was not intended to control inflation, even partially, but to fund public spending, this policy creating hyperinflation. Some of these countries have more recently regained control of inflation, and we do take these periods of stability into account when running the regressions. Argentina experienced instability of inflation process up to 1992. Before 1992, inflation measured with the logarithmic formulae, which underestimate inflation for high rates relatively to the index price growth rate, was over 60% (on the period 1980-1991). The inflation index fell down from 1992 and was fairly stable since then. In Belarus, inflation stabilizes from 1996. Between 1993 and 1995, inflation was over 200% before dropping. In Kyrgyzstan inflation rate was over 200% in 1993 and 100% in 1994, before dropping in 1995. In Turkmenistan, inflation stabilized under 25% from 1998 onwards. The Polish inflation rate was unstable up

to 1991. In addition, in China and in Ecuador inflation stabilized respectively from 1995 and 2002 onwards, but as there was no more female Central Bank chair from these years, we didn't shorten the sample period. Moreover, there is a lack of reliability with Paraguay's inflation data before 1990. The reported inflation rate was exactly the same (23.58702) every year from 1980 to 1989; so we excluded this period of the sample. And finally, inflation was analyzed in Austria up to 1998, as the country entered the Euro zone in 1999.

Table 8 presents the results of the individual estimations of Eq. (5). We test the hypothesis of nullity of parameters $\hat{\pi}$, \hat{a}_π , \hat{b}_π , \hat{c}_π and $\hat{\phi}$, and we test the hypothesis of negativity of $\hat{\gamma}$ (in others words we look if $\hat{\gamma}$ is significantly positive). The results show that few countries have adopted a monetary policy compatible with the model of inflation/output trade-off. In order for the results to be consistent with the model, keep in mind that $\hat{\gamma}$ has to be significantly positive (and the residuals have to be non-serially correlated). Only eight countries out of the thirty-three considered seem consistent with the model. Moreover, the Breusch-Godfrey test shows that the null hypothesis of non-autocorrelation of residuals of the regressions for these eight countries is not rejected for conservative significance level (probabilities are over 1%). The countries concerned are Argentina, Belarus, Guatemala, Guyana, Kyrgyzstan, Paraguay, Salvador and Turkmenistan. According to indicators of human development in table 2, these countries are mostly characterized by medium human development, except for Belarus which is classified as a high human development country and Argentina which is in the very high human development category. There is no country characterized by low development in this panel. As for the nature of the organization of the political system (table 3), five countries are Western-style democracies and the other three are former popular democracies. There is no monarchy in the panel. None of these countries is located in Africa or in the Indian Ocean; only Belarus is a European country; others countries are located in America or in central Asia. Results of individual regressions for these eight countries are discussed below.

The estimated parameter $\hat{\gamma}$ exhibits noticeable variations from one country to another. It varies from 0.193 for Turkmenistan to 2.282 for Belarus. If $\hat{\gamma} = 2$, it means that to keep the inflation rate to 1% above the target, the Central Bank chair maintains the output gap at 0.5%. And if $\hat{\gamma}$ is less than 2, which is the case for most of the eight countries, the Central Bank chair agrees to let the output gap vary even more. So the estimated values of $\hat{\gamma}$ are economically significant, proving the existence of an important trade-off between inflation and output.

The constant implicit inflation targets of Argentina, Belarus, Guatemala, Kyrgyzstan and Turkmenistan are of course significant, but above all, they are high, from 7.96% for Argentina to 36.95% for Belarus. And, for three other countries (Guyana, Paraguay and Salvador), the inflation trend is decreasing over the period, but starting from a high level of inflation.

Finally, it is tempting to comment the estimated values of $\hat{\phi}$, but we have to keep in mind that the number of points in the sample characterized by $d_t = 1$ is very low: 4 for Argentina, 4 for Belarus, 4 for Guatemala, 16 for Guyana, 4 for Kyrgyzstan, 2 for Paraguay, 7 for Salvador and 1 for Turkmenistan. So, we know that the standard error of the parameter is likely to be very high at an individual regression level. And effectively $\hat{\phi}$ is not significant in any of the 8 regression except in the case of Salvador. Nevertheless, the parameter $\hat{\phi}$ is positive in seven out of eight cases, which may be indicative of the positivity of ϕ . This positivity indicates that female Central Bank chairs would be more conservative than their male counterparts. The first step consists to test the significance of a difference between female and male Central Bank chairs in the panel model (6).

Table 8 Individual estimations of equation (5)

Country	Sample period	$\hat{\pi}$	\hat{a}_{π}	\hat{b}_{π}	\hat{c}_{π}	$\hat{\gamma}$	$\hat{\phi}$	LM test
Argentina	1992-2014	7.960 (1.736) 0.000				0.415 (0.212) 0.032	-0.950 (1.109) 0.401	1.595 0.206
Austria	1981-1998	3.257 (0.249) 0.000				-0.652 (0.119) 0.999	0.060 (0.398) 0.88	2.629 0.104
Bahamas	1981-2014		8.148 (0.860) 0.000	-0.491 (0.109) 0.000	0.009 (0.002) 0.003	-0.064 (0.039) 0.940	-0.118 (0.109) 0.284	4.216 0.040
Barbados	1981-2014	4.072 (0.555) 0.000				-0.275 (0.141) 0.969	0.048 (0.304) 0.874	3.532 0.060
Belarus	1996-2014	36.954 (7.367) 0.000				2.282 (0.983) 0.016	-2.430 (1.917) 0.223	3.262 0.070
Botswana	1981-2014		11.134 (1.299) 0.000	-0.067 (0.162) 0.680	-0.001 (0.004) 0.650	-0.132 (0.070) 0.9651	0.174 (0.180) 0.339	3.497 0.061
China	1987-2014	4.269 (1.105) 0.000				0.084 (0.320) 0.397	-3.661 (1.139) 0.003	12.83 0.000
Denmark	1981-2014		8.912 (0.897) 0.000	-0.629 (0.115) 0.000	0.012 (0.002) 0.000	-0.106 (0.089) 0.879	-0.217 (0.271) 0.428	6.079 0.013
Ecuador	1981-2014		18.858 (7.843) 0.022	2.641 (1.032) 0.016	-0.099 (0.027) 0.001	-0.600 (0.782) 0.775	4.005 (2.283) 0.089	8.723 0.003
Finland	1981-2014		10.627 (0.688) 0.000	-0.798 (0.099) 0.000	0.016 (0.002) 0.000	-0.115 (0.058) 0.971	0.028 (0.104) 0.787	5.383 0.020
Guatemala	1981-2014	9.683 (1.199) 0.000				0.765 (0.311) 0.009	-0.183 (1.310) 0.889	4.053 0.044
Guyana	1981-2014		30.546 (7.177) 0.000	-0.929 (0.962) 0.342	0.001 (0.025) 0.951	1.175 (0.244) 0.000	-0.602 (0.640) 0.360	6.058 0.013
Honduras	1981-2014		1.852 (3.309) 0.580	1.407 (0.410) 0.001	-0.040 (0.010) 0.000	-1.251 (0.509) 0.989	1.224 (0.680) 0.082	4.325 0.037
Kenya	1981-2014	10.702 (1.211) 0.000				-0.546 (0.262) 0.977	-2.140 (2.919) 0.468	8.061 0.004
Kyrgyzstan	1995-2014	11.693 (2.019) 0.000				1.427 (0.474) 0.003	-2.267 (1.646) 0.186	0.359 0.548
Laos	1981-2014	19.037 (4.026) 0.000				-1.868 (1.698) 0.860	0.238 (2.975) 0.936	2.699 0.100
Lesotho	1981-2014		14.478 (1.653) 0.000	-0.260 (0.218) 0.244	-0.001 (0.006) 0.871	-0.086 (0.180) 0.681	0.081 (0.822) 0.921	1.332 0.248
Malaysia	1981-2014	2.933 (0.280) 0.000				-0.155 (0.049) 0.998	-0.150 (0.337) 0.658	2.858 0.090
Marshall Islands	2004-2014	3.479 (1.246) 0.023				-1.119 (0.961) 0.861	0.754 (1.334) 0.587	0.631 0.426
Pakistan	1981-2014	7.694 (0.473) 0.000				-0.598 (0.178) 0.998	-0.514 (0.447) 0.259	3.308 0.068
Paraguay	1990-2014		62.767 (8.977) 0.000	-4.139 (0.820) 0.000	0.073 (0.017) 0.000	0.283 (0.136) 0.025	0.424 (0.391) 0.291	0.654 0.418
Poland	1991-2014		137.50 (23.47) 0.000	-9.922 (2.130) 0.000	0.178 (0.044) 0.000	0.053 (0.329) 0.436	-0.135 (0.191) 0.488	0.995 0.318
Russia	1993-2014		635.20 (79.11) 0.000	-45.57 (6.788) 0.000	0.808 (0.139) 0.000	-1.723 (0.473) 0.999	-3.733 (2.566) 0.163	0.459 0.498

Salvador	1981-2014		22.342 (2.375)	-1.004 (0.298)	0.010 (0.007)	0.541 (0.102)	-0.806 0.395	0.038 0.844
			0.000	0.002	0.177	0.000	0.050	
Samoa	1981-2014	4.642 (1.621)				-0.445 (0.264)	-0.365 (1.068)	0.008 0.926
		0.007				0.949	0.734	
Sao Tome	1981-2014		-1.009 (6.418)	3.390 (0.799)	-0.093 (0.020)	-0.465 (0.823)	-3.638 (2.035)	9.323 0.002
			0.876	0.000	0.000	0.712	0.084	
Serbia	1999-2014		323.16 (127.7)	-20.37 (9.493)	0.326 (0.172)	0.349 (0.664)	-2.075 (2.931)	0.208 0.647
			0.028	0.055	0.085	0.354	0.493	
Seychelles	1981-2014	3.927 (1.309)				-0.228 (0.196)	0.519 (1.044)	1.399 0.236
		0.005				0.872	0.622	
South Africa	1981-2014	8.941 (0.728)				-0.209 (0.256)	-0.626 (1.086)	23.70 0.000
		0.000				0.789	0.568	
Tonga	1981-2014	6.549 (0.856)				-0.055 (0.084)	0.434 (0.334)	2.042 0.153
		0.000				0.741	0.202	
Turkmenistan	1998-2014	8.177 (1.084)				0.193 (0.064)	-0.394 (0.379)	0.217 0.641
		0.000				0.004	0.316	
Venezuela	1981-2014	25.664 (2.499)				-0.677 (0.358)	-1.052 (1.375)	12.16 0.000
		0.000				0.966	0.450	

Note: For every parameter, we present the estimated value, the standard error (into brackets) and the probability of the test of nullity of the estimated parameter, except for $\hat{\gamma}$, for which the probability is the one associated with the unilateral test of negativity. LM test refers to the Breusch-Godfrey serial correlation LM test; the first value is the statistics of the test and the second the probability of the null hypothesis of no autocorrelation of residuals.

Panel Regression

According to the results of the previous section, we selected eight countries (Argentina, Belarus, Guatemala, Guyana, Kyrgyzstan, Paraguay, Salvador and Turkmenistan) to estimate the non-linear panel model (6). The model is estimated using a non-linear SUR method, which exploits the errors correlation of the different countries.

Table 9 presents the results relative to the country-specific estimated parameters ($\hat{\pi}_j, \hat{a}_{\pi j}, \hat{b}_{\pi j}, \hat{c}_{\pi j}$ and $\hat{\gamma}_j$), and table 10 presents the results of the common estimated parameter $\hat{\rho}$.

Table 9 Panel estimation of country-specific estimated parameters

Country	Sample period	$\hat{\pi}$	\hat{a}_{π}	\hat{b}_{π}	\hat{c}_{π}	$\hat{\gamma}$
Argentina	1992-2014	7.841 (1.539)				0.323 (0.197)
		0.000				0.051
Belarus	1996-2014	39.337 (6.596)				2.670 (0.809)
		0.000				0.000
Guatemala	1981-2014	9.841 (1.064)				0.557 (0.256)
		0.000				0.015
Guyana	1981-2014		26.300 (5.525)	-0.724 (0.731)	0.001 (0.019)	1.039 (0.215)
			0.000	0.323	0.926	0.000
Kyrgyzstan	1995-2014	12.204 (1.809)				1.353 (0.380)
		0.000				0.000
Paraguay	1990-2014		51.652 (7.056)	-3.167 (0.640)	0.054 (0.013)	0.275 (0.119)
			0.000	0.000	0.000	0.015
Salvador	1981-2014		19.939 (1.640)	-0.875 (0.207)	0.011 (0.005)	0.468 (0.092)
			0.000	0.000	0.022	0.000
Turkmenistan	1998-2014	8.647				0.189

(0.968)
0.000

(0.055)
0.000

Note: For every parameter, we present the estimated value, the standard error (into brackets) and the probability of the test of nullity of the estimated parameter, except for $\hat{\gamma}$, for which the probability is the one associated with the unilateral test of negativity.

According to Table 9, panel estimation gives similar results to those of individual regressions. The restriction induced by the common parameter and the consideration of the error correlation does not seem to alter the results.

Table 10 Panel estimation of the common parameter ρ

$\hat{\rho}$	Standard error of $\hat{\rho}$	Probability (test of nullity of ρ)
-0.736	0.274	0.007

Table 10 presents the main result of the paper: $\hat{\rho}$ is significantly different from zero, and it is negative, confirming the results of individual regressions, that female Central Bank chairs appear to put more emphasis on price stability than output stability in comparison to male Central Bank chairs. The estimated parameter $\hat{\rho}$ is even highly negative, the female Central Bank chairs being 73% less attached to the stabilization of output objective than males. Clearly, monetary policy appears to be less accommodative when conducted by female Central Bank chairs. In fact, we can even ask if female Central Bank chairs are interested in output stabilization, as $\hat{\rho}$ is close to -1. We decided to test $\begin{cases} H_0 : \rho \leq -1 \\ H_1 : \rho > -1 \end{cases}$, which is more

convenient than $\begin{cases} H_0 : \rho = -1 \\ H_1 : \rho \neq -1 \end{cases}$ as ρ can't be less than -1, using the t-statistics $(\hat{\rho} + 1) / \text{stand. err.}$ of $\hat{\rho}$. The value of the statistics is 0.936, and the probability of a standard normal variable to be more than 0.936 is 0.175, which is the probability of the test. Thus the hypothesis that female Central Bank chairs don't regard output stabilization, and are concerned only with inflation stabilization, cannot be rejected for a significance level of 10%, which assesses the importance of gender in central banking.

CONCLUSION

The contribution of this study to the literature on gender and monetary policy is to provide a deep insight of the female's under-representation among Central Bank chairs over the world, and to describe the way they resolve the inflation/output trade-off relatively to their male counterparts. To this aim, we have built a unique data set compiling information about female Central bank chairs since 1949. Of course, there are other available data sets but they are incomplete or display some errors (misunderstandings about persons, confusions between Central Banks and national banks).

From the data compiled, we identified fifty-six female Central Bank chairs, i.e. a very small minority. By using various international data about socio-economic indicators (level of human development, gender gaps) and socio-political characteristics (religion, traditions, political representation, political organization, geographical location), we found that: the female Central Bank chairs appointment were not influenced by the countries' level of human development; female under-representation, as Central Bank chairs, seems to be due to tradition, religion and to the inequality gap with males, which is globally prevalent in societies.

As long as Central Banks were totally dependent of politics, roughly before the 1990s, the governments showed a clear inclination to appoint male Central Bank chairs. Since the beginning of the 1990s, Central Banks have become more independent and empowered to focus on the price stability goal, and governments started to appoint, more frequently, female Central Bank chairs, albeit always in a low proportion. Perhaps this is entirely due to the fact that the international movement of institutional monetary reforms coincided with a social change for females. Another explanation may be due, simply, to female preferences on monetary policy goals in comparison with males. Indeed, while Central Banks were given independence, females selected to chair Central Banks have a career and an academic background consistent with a preference for the price stability, which leads us to think that the appointment of females may have been the result of a political will.

As only an empirical analysis can establish how female and male Central Bank chairs differ in the conduct of monetary policy, we examine if policy preferences are influenced by gender. We develop an innovative methodology, based on an idea first coined by Ibrahima Diouf and Dominique Pépin (2010), which does not require estimating all the structural and preference parameters of a monetary model, but only how males and females' parameters differ.

As a preliminary, the empirical analysis of the inflation/output trade-off reveals that, on the thirty-three countries in the sample, only eight appear to be consistent with a model of inflation targeting (Argentina, Belarus, Guatemala, Guyana, Kyrgyzstan, Paraguay, Salvador and Turkmenistan). Preferences cannot be inferred from the other twenty-four countries, as the implemented monetary policy in these countries does not seem to result from a compromise between stabilization of inflation and output growth. A panel data analysis conducted about the eight countries, whose monetary policy is consistent with inflation targeting, shows that female Central Bank chairs put more emphasis on stabilization of inflation comparatively to their male counterparts. They are 73% less attached to the objective of output stabilization than males, which reveals they are more conservative in the sense of Kenneth Rogoff (1985). Actually, female Central Bank chairs appear so conservative according to our results that we cannot even reject the hypothesis that they are only concerned with inflation stabilization. This high conservatism may be a factor explaining their coming to the Central Bank chair, as the central banker's conservatism has been advocated, on the basis of Kenneth Rogoff's work, as a way to gain in credibility. To some extent, this attachment to the ultimate monetary policy goal, reflected by a high degree of conservatism, can be interpreted as a sign of a greater ability to resist political pressures, and therefore of independence in the conduct of monetary policy.

Nevertheless, we have to be cautious with the interpretation of these empirical results, because they are based on the empirical analysis of only eight countries which are mostly in the medium human development category. It will be interesting to repeat the estimation conducted in this paper within a few years, when more data about countries in the very high human development category are available.

NOTES

¹ Some websites, such as *the Worldwide Guide to Women in Leadership*, wrongly include female Central Bank chairs: Ms Ellen Johnson Sirleaf (the current president of Liberia); Violeta Asfura in Venezuela; Felisa Miceli Jsefina (former Minister of Economy and Production of Argentina, 2005-2007); Ana Dias Lourenco (former Ministry of Planning in Angola). On Guatemala, there is a confusion between Ms. Lilly Zapata and Mr. Willy Zapata Waldemar Sagastume (President of the Banco Central, 1993-1997).

² Of the 56 female Central Bank chairs, 4 were named twice at different periods (Ms. María Elena Mondragón Villar in Honduras; Ms Zeti Akhtar Aziz in Malaysia; Ms Yathotou Pany in Lao PDR; Ms Maria Do Carmo Trovoada in Sao Tome principle). In total, there are thus 60 nominations.

³ See interviews of female Central Bank chairs in *Central Banking Journal*, Vol. XI, No. 3, Feb 16, 2001.

⁴ With the exception of Denmark, Finland and the United State, all countries are in democratic transition: free elections are held periodically. But in most, there is no social compromise and not really thorough legal system.

⁵ Hanna Gronkiewicz-Waltz (Poland) has been cited, four times (1994,1997,1998, 1999), by the US magazine *Global Finance* among the best world central bankers; Ms. Linah Mohohlo (Botswana) ranked by *the Financial Time Magazine* and *The Banker*, in 2001, as governor of the Central Bank of the year for Africa and the Middle East; Zeti Akhtar Aziz (Malaysia) cited by Euromoney, in 2005, as the governor of the Central Bank of the year again; according to a ranking of *Global Finance magazine*, in 2014, Ms. Karnit Flug (Israel), Akhtar Aziz Zeti (Malaysia) are named among the best governors in the world.

⁶ Only Central Banks in federal structures, such as the Swiss National Bank and the US Federal Reserve and the Bank of England, statutorily independent, do not display these characteristics.

⁷ In Europe, from the perspective of the single currency, the Central Banks independence is one of the criteria that the candidate countries must comply. Thus, the Banque de France became independent in 1995, while in Germany the Bundesbank has been since a 1957 Act.

⁸ The Central Banks independence means its ability to define and implement monetary policy without political or external influence. It's granted by the political power through statutory provisions that protect central bankers from any form of political pressure. But it can be operational e.g. resulting from the personal qualities of the Central Bank chairman or deliberate monetary policy strategy aimed at limiting the influence of politicians. This is the case when the Central Bank adopts rigid inflation targets.

⁹ The Denmark is part of the European Union but not of the Euro-area. Its currency (Danish crown) is linked to the euro by the mechanisms of the European Exchange Rate Mechanism (ERM II) which restricts the independence of its Central Bank.

¹⁰ These territories are using the Us dollar as the currency or have currencies linked to the Us dollar.

¹¹ From the *Public Choice* perspective, Central Bank chairs' preferences have influence on the monetary policy goals. Hence, it is in the service of their own interests or special interest groups. For example, a past of commercial banker will lead to the capture of the Central Bank to the banking sector.

¹² For Argentina and China, we use annual average consumer prices index.

¹³ For Belarus, Russia and Turkmenistan, the GDP date are available from 1992 and the inflation data from 1993; for China, the inflation data are available from 1987; for Kyrgyzstan, the GDP and inflation data are available from 1993; for Marshall Islands, the GDP data are available from 1997 and the inflation date from 2004; and for Serbia, the GDP and inflation data are available from 1998.

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