Moneda y Crédito

Segunda Epoca

224

[2007]

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Procyclicality of the financial system
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Reserve accumulation and monetary policy
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INTRODUCCIÓN Y RESUMEN

El presente número recoge las ponencias presentadas al XIX Simposio de Moneda y Crédito aceptadas tras el proceso de evaluación. El XIX Simposio de Moneda y Crédito, con el título *Monetary and Financial Stability: Harmony or Conflict?* se celebró en Madrid los días 6 y 7 de noviembre de 2006.

Safeguarding Financial Stability: Conceptual Issues and Policy Challenges *

Garry Schinasi
International Monetary Fund

Abstract

Global financial developments over the past several decades have increased the importance of financial stability considerations in economic policy making. In addition to discussing the public sector's role in finance, the paper frames and analyzes the conceptual challenges policymakers face in safeguarding financial stability and in particular in monitoring and assessing financial stability. The paper discusses four ongoing structural changes that are posing formidable challenges for policy makers. It also discusses why central banks have a natural interest and role in safeguarding financial stability.

1. Introduction and Motivation

Safeguarding financial stability is now widely recognized as an important part of maintaining macroeconomic and monetary stability, and as important for achieving sustainable growth. Many advanced-coun-

*. Invited paper prepared for the XIX Annual Symposium of *Moneda y Crédito* on "Monetary and Financial Stability: Harmony or Conflict?" held in Madrid, Spain on November 6-7, 2006. The paper is based on the author's book S*afeguarding Financial Stability: Theory and Practice* and related material published in the journal of the U.K. National Institute of Economic and Social Research. The views expressed in this paper are those of the author and do not necessarily represent those of the IMF or IMF policy.

try central banks, as well as the International Monetary Fund, devote considerable resources to monitoring and assessing financial stability and to publishing financial stability reports. A casual reading of these publications would suggest that financial stability practitioners share some common understandings. To cite a few, it is more or less taken for granted that:

- finance is fundamentally different from other economic functions such as exchange, production, and resource allocation;
- finance contributes importantly to other economic functions and facilitates economic development, growth, efficiency, and ultimately social prosperity;
- financial stability is an important social objective – a public good – even if it is not widely seen as being on a par with monetary stability;
- monetary and financial stability are closely related, if not inextricably intertwined, even though there is no consensus on why this is so.

There is also a growing academic literature, much of it covering specific financial stability topics in considerable depth and some of it providing rigorous anchors for debating substantive and policy issues. For example, there are extensive literatures on banking dealing with the special role and fragility of banks in finance, the costs and benefits of deposit insurance, and the causes, consequences, and remedies for bank failures. There are also new and growing literatures on market sources of financial fragility and systemic risk more generally.

Despite considerable practical and intellectual progress in recent years, compared to macroeconomic and monetary analysis, financial stability analysis is still in a formative stage of development. The various literatures taken together do not yet provide cohesive and practical approaches or tool kits for assessing financial stability, for analyzing systemic issues and controversies, and for designing policies to optimize the net social benefits of finance. In short, the discipline lacks a widely accepted and useful framework.

Nevertheless, the practice of assessing and safeguarding financial stability is ongoing. This paper selectively discusses conceptual issues and policy challenges in safeguarding financial stability. The paper is organized to address the following questions.

- Why have concerns about financial stability increased in recent decades?
- What is the public sector's role in finance, which is mainly a private activity?
- What are the important conceptual challenges faced by policy makers in safeguarding financial stability?
- What are some of the ongoing structural changes that are posing formidable challenges?
- What is the role of a central bank?

2. WHY HAVE FINANCIAL STABILITY ISSUES BECOME IMPORTANT RECENTLY?

Since the early 1990s, safeguarding financial stability has become an increasingly dominant objective in economic policymaking, as illustrated by the financial stability reports published by more than thirty three central banks and several international financial institutions (including the IMF), as well as by the more prominent place given to financial stability in the organizational structures and mandates of many of these institutions.[1] The greater emphasis on financial stability is related to several major trends and structural changes in financial systems during the past several decades reflecting the expansion, liberalization, and subsequent globalization of financial systems—all of which have increased the possibility of larger adverse consequences of financial instability on economic performance.

First, financial systems expanded at a significantly higher pace than the real economy. In advanced economies, total financial assets now represent a multiple of annual economic production. Table 1 illustrates this expansion during 1970–2000 for a heterogeneous group of advanced economies with relatively mature financial systems. For example, while currency remained relatively steady as a percentage of GDP over the 30-year period, total assets in financial institutions grew from 110 percent of GDP in 1980 to 377 percent in 2000 in the United Kingdom, from 182 percent in 1980 to 353 percent in 2000 in Germany, and from 111 percent in 1980 to 257 percent in 2000 in the United States. The growth of assets in the equity and bond markets is just as phenomenal. While differences between countries reflect their more market- or bank-orient-

1. See Oosterloo, de Haan, and Jong-A-Pin (2006).

Table 1.
Development of Key Financial Aggregates (In percent of GDP)

	1970	1980	1990	2000		1970	1980	1990	2000
United States					**Germany**				
1 Currency	6	5	5	6	1 Currency	5	6	7	6
2 M1	21	15	14	11	2 M1	15	17	22	28
3 M2	60	57	56	50	3 M2	25	29	39	...
4 M3	65	72	72	73	4 M3	42	48	59	68
5 Total bank assets[1]	54	54	53	58	5 Total bank assets[1]	121	160	216	303
6 Total financial institution assets	...	111	171	257	6 Total financial institution assets	...	182	259	216
7 Equity	34	25	35	132	7 Equity	11	7	17	48
8 Bonds	47	53	108	157	8 Bonds	26	37	67	112
6+7+8	...	189	314	546	6+7+8	...	226	343	513
United Kingdom					**Japan**				
1 Currency	8	5	3	4	1 Currency	8	9	10	13
2 M4	52	50	86	93	2 M1	29	29	27	48
3 Total bank assets[1]	51	47	108	156	3 M2	74	86	114	127
					4 M3	127	136	180	219
4 Total financial institution assets	...	110	242	377	5 Total bank assets[1]	66	77	134	127
5 Equity	41	23	57	167	6 Total financial institution assets	122	157	269	260
6 Bonds	52	31	33	74					
					7 Equity	41	25	76	70
4+5+6	...	164	332	618	8 Bonds	23	60	78	124
					6+7+8	186	242	423	454
France					**Italy**				
1 Currency	10	5	4	3	1 Currency	10	7	6	7
2 M1	29	24	25	23	2 M1	44	42	35	18
3 M2	44	51	44	44	3 M2	76	79	67	...
4 M3	62	69	74	65	4 M3	76	89	88	...
5 Total bank assets[1]	...	...	...	...	5 Total bank assets[1]	...	...	...	...
6 Total financial institutions assets	...	...	...	...	6 Total financial institutions assets	...	...	...	...
7 Equity	6	4	14	84	7 Equity	7	3	10	57
8 Bonds	14	19	42	55	8 Bonds	...	39	65	108
6+7+8	...	...	...	...	6+7+8	...	...	...	...
Canada					**Netherlands**				
1 Currency	4	3	3	3	1 Currency	8	6	7	5
2 M1	11	9	7	11	2 M1	23	21	25	35
3 M2	38	47	56	48	3 M2	...	...	...	...
4 M3	46	63	64	65	4 M3	53	60	77	92
5 Total bank assets[1]	...	...	...	...	5 Total bank assets[1]	71	129	184	254
6 Total financial institution assets	...	...	...	...	6 Total financial institution assets	116	191	285	431
7 Equity	9	18	26	87	7 Equity	41	16	38	185
8 Bonds	33	52	68	76	8 Bonds	11	25	73	85
6+7+8	...	...	...	...	6+7+8	168	232	396	701

Note: Currency is coins and bank notes in circulation; M1, M2, M3, and M4 are national definitions. Total assets of financial institutions consist of total bank assets and (depending on data availability) assets of insurers, pension funds, and mutual funds. Equity is total stock market capitalization; bonds are total debt securities outstanding (government and corporate).

Sources: Thomson Financial, IMF, Bank for International Settlements, Merrill Lynch, Salomon Smith Barney, and various national sources.

ed financial systems, most aggregates have increased. The broad measures of an economy's total financial assets invariably involve some double counting due to claims between financial institutions, but even these mutual holdings are relevant for financial stability because they represent the links, interactions, and complexities in the financial system.

Second, this process of financial deepening has been accompanied by changes in the composition of the financial system, with a declining share of monetary assets (aggregates), an increasing share of nonmonetary assets, and, by implication, greater leverage of the monetary base. The amount of currency relative to GDP has been broadly stable or decreased in all countries except Japan. In the United States, even the sizes of both M1 and M2 have fallen as financial innovation has progressed. For outlier Japan, the increasing importance of narrow money in the 1990s may be attributable to greater incentives to hold money due to the Japanese financial sector's fragile state and enduring deflationary pressures.

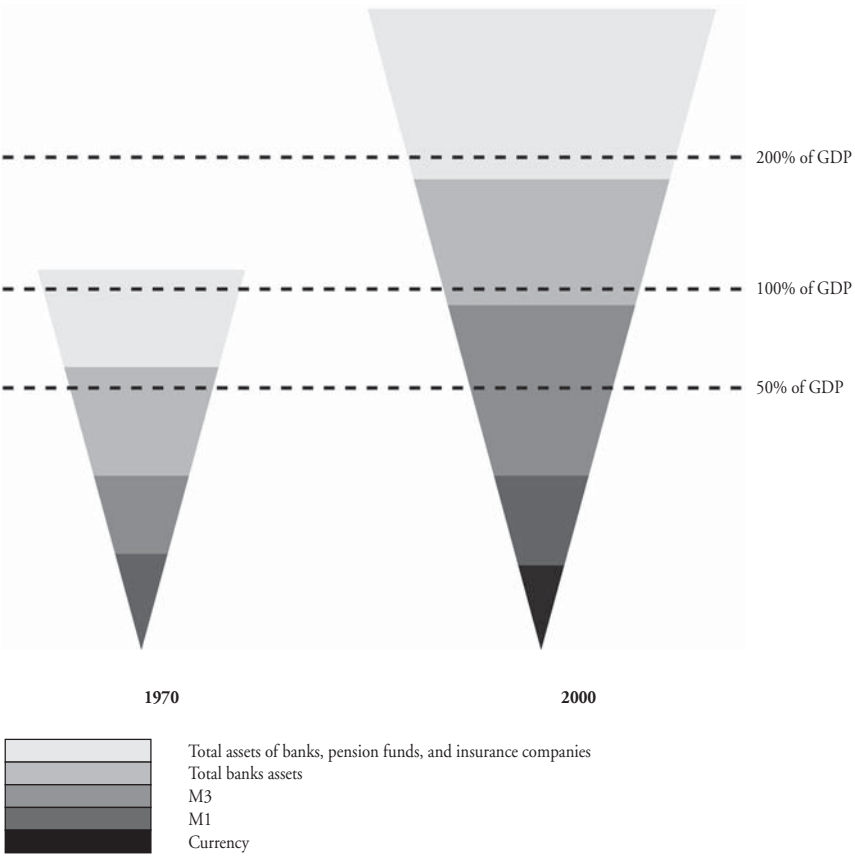
The simple average expansion of the financial systems shown in Table 1 is illustrated in Figure 1, in which total assets of financial institutions are reflected by the triangle's surface. Figure 1 shows rather dramatically that between 1970 and 2000 the size of these assets almost tripled relative to GDP. Note also how the average of the financial systems has become more highly leveraged, in the sense that the broader monetary and financial assets represent a much greater share of the triangle in 2000 than in 1970 relative to central bank money (or currency).

Figure 2 shows the change in composition of the financial system over the past decades by expressing key financial aggregates as a percentage of their value in 1970 (all deflated by GDP). Clearly, the relative importance of monetary aggregates has decreased, while nonmonetary components have increased rapidly.

Third, as a result of increasing cross-industry and cross-border integration, financial systems are more integrated, both nationally and internationally. Financial institutions now encompass a broader range of activities than that of a traditional bank, which takes deposits and extends loans. This is reflected in the rise in financial conglomerates, which provide a vast array of banking, underwriting, brokering, asset-management, and insurance products and/or services.[2] In the 1990s, the number of mergers and acquisitions within the financial sector soared (Figure 3).

2. See the various issues of the IMF's *International Capital Markets* report and Group of Ten (2001).

Figure 1.
Composition of Key Financial Aggregates in 1970 and 2000
(In percent of GDP, average of the United States, Germany, the United Kingdom, Japan, France, Italy, Canada and the Netherlands)

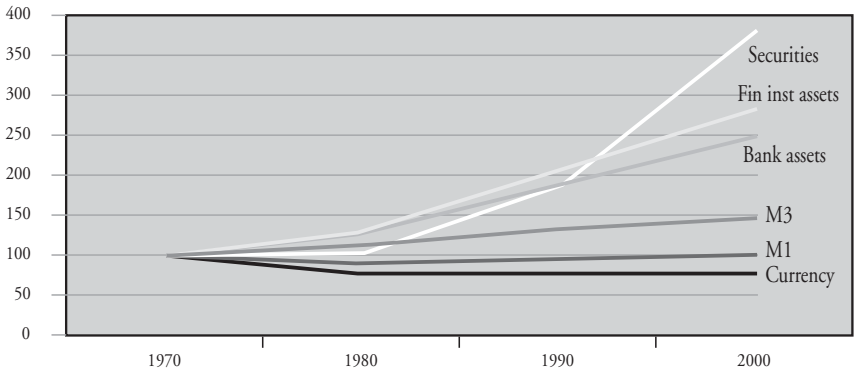


Source: Table 1.1.

Some of these transactions involved different industries or countries, especially in Europe where roughly half the deals in this period were either cross-border, cross-industry, or both (Table 2). In addition, cooperation between financial institutions intensified through joint ventures and strategic alliances[3]. The greater international orientation of financial systems is also reflected in the

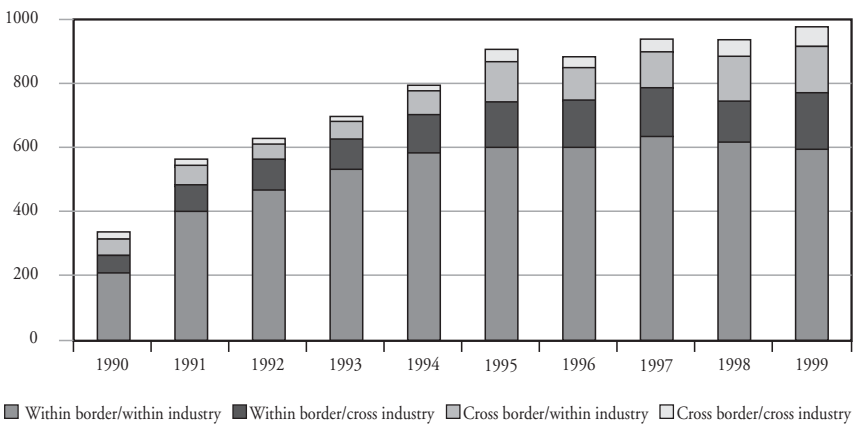
3. Van der Zwet (2003) discusses this blurring of distinctions between financial sectors and across countries, including by looking at variables such as the share of financial institutions' cross-border and cross-sector revenues.

Figure 2.
Developmnet of Key Financial aggregates, 1970-2000.
(Average for the US, Japan, Germany, the UK, France, Italy, Canada and the Netherlands, 1970=100)



Source: Table 1.1.

Figure 3.
Financial Sector Mergers and Adquisitions, 1990-1999
(Number of M&As in G10 countries).



Source: Group of Ten, 2001.

increasing size of cross-border transactions in bonds and equity relative to GDP (see Table 3). On this score, the amount of outstanding international debt securities surged over the past decades (Table 4).

Fourth, the financial system has become more complex in terms of the intricacy of financial instruments, the diversity of activities, and the concomitant mobility of risks. Deregulation and liberaliza-

Table 2.
Financial Sector Mergers and Acquisitions, 1991-1999. Distribution (percentages).

	North America	Europe	Japan/Australia
Within border/within industry	80	53	64
Within border/cross industry	12	19	16
Cross border/within industry	6	21	14
Cross border/cross industry	2	8	5
Total	100	100	100

Source: Group on Ten (2001)

Table 3.
Cross-Border Transactions in Bonds and Equities (In percent of GDP).

	1975-79	1980-84	1985-89	1990-94	1995-99	2000-03	2001	2002	2003
United States									
Bonds	4.0	9.4	63.6	93.9	139.0	188.0	161.4	208.4	262.1
Equities	1.9	3.6	9.9	14.7	45.0	90.8	87.4	85.0	82.1
Japan									
Bonds	2.2	9.8	115.3	72.9	63.7	70.2	73.7	73.8	77.8
Equities	1.1	4.4	14.9	9.6	17.2	36.5	36.7	33.1	35.3
Germany									
Bonds	5.3	9.7	37.8	86.5	208.7	350.5	378.7	351.1	394.0
Equities	1.9	3.4	11.7	14.9	48.6	132.6	133.6	115.6	112.2
France									
Bonds	...	6.8	21.9	108.6	233.5	293.9	288.1	299.3	362.0
Equities	...	2.4	12.1	16.9	56.1	150.7	140.2	138.1	154.0
Canada									
Bonds	1.2	3.9	29.3	104.5	216.6	149.5	135.6	157.0	175.8
Equities	3.3	6.5	14.8	19.2	52.3	122.8	101.9	151.5	132.1
Italy[1]	0.9	1.4	9.4	114.7	518.8	1,126.5	821.9	1,197.0	1,705.2

Sources: Bank for International Settlements, and national balance of payments data.
Note: Gross purchases and sales of securities between residents and nonresidents.
1/ No breakdown in bonds and equities is available.

tion created scope for financial innovation and enhanced the mobility of risks. In general, this greater complexity, especially the increase in risk transfers, has made it more difficult for market participants, supervisors, and policymakers alike to track the development of risks within the system and over time.

To illustrate the globalization of finance further, and the greater mobility of risks across global markets, Table 5.a. and Table 5.b. present the worldwide development and use of derivatives instruments since the mid-1980s, for exchange-traded derivatives, and since the 1990s, for over-the-counter derivatives. Regarding exchange traded

Table 4.
Outstanding International Debt Securities by Nationality of Issuer.
(In percent of GDP).

	1970	1980	1990	2000	2003	2004
United States	0.1	0.7	3.1	17.8	27.9	28.6
Japan[1]	0.0	1.5	10.5	6.0	6.3	6.4
Germany2	0.1	0.4	4.5	47.9	80.5	86.4
France[1]	0.1	2.1	7.8	24.0	42.2	45.9
Italy	0.1	0.5	4.6	19.4	35.8	40.6
United Kingdom[1]	0.2	2.3	14.9	40.8	63.0	68.0
Canada	0.2	13.4	18.6	27.9	31.0	29.9
Netherlands	0.6	2.4	13.0	79.4	112.6	118.6
Sweden[1]	0.3	7.5	20.1	44.5	52.4	52.4
Switzerland[2]	0.5	1.7	4.5	41.2	49.0	72.9
Belgium	0.4	2.1	15.0	57.3	82.5	85.9

Sources: Bank for International Settlements, IMF, *World Economic Outlook* database.
1/ Figure in 1970 column is from 1971.
2/ Figure in 1970 column is from 1972.

derivatives, in nominal terms, total notional amounts outstanding have increased more than 60 times since the mid-1980s, while the number of derivative contracts traded has increased more than seven-fold. Regarding over-the-counter derivatives, the notional value of contracts increased from $80 trillion at end-Dec 1998 (just after the LTCM crisis) to nearly $285 trillion at end-December 2005; a tripling of the notional value of contracts in 8 years. The gross market value of these contracts – or replacement value – which is a proxy for the credit-risk or counterparty exposures associated with these notional values increased from around $3 trillion at end-Dec 1998 to around $9 trillion at end-Dec 2005, also a tripling. Note that the majority of derivative transactions were interest-rate contracts.

These trends and developments reflect important advances in finance that have contributed substantially to economic efficiency, both nationally and internationally. They evidently also have had implications for the nature of financial risks and vulnerabilities and the potential impact of risks and vulnerabilities on real economies, as well as implications for the role of policymakers in promoting financial stability. Consider financial system and market developments in the 1990s and early 2000s—a period during which global inflation pressures subsided and in many countries were eliminated. During this period, reflecting in part the above-mentioned trends, national financial systems around the world either experienced, or were

Table 5a.
Exchange-Traded Derivative Financial Instruments:
Notional Principal AmountsOutstanding and Annual Turnover.

	1986	1990	1995	2000	2005	2006 Q3
Notional principal amounts outstandings			(In billions of U.S. dollars)			
Interest rate futures	370.0	1,454.8	5,876.2	7,907.8	20,708.7	24,699.0
Interest rate options	144.0	595.4	2,741.8	4,734.2	31,588.2	43,369.3
Currency futures	10.2	17.0	33.8	74.4	107.6	139.9
Currency options	39.2	56.5	120.4	21.4	66.1	68.0
Stock market index futures	13.5	69.1	172.2	377.5	802.9	985.6
Stock market index options	37.8	93.6	337.7	1,148.4	4,542.6	6,316.5
Total	614.8	2,286.4	9,282.0	14,263.8	57,816.2	75,578.4
North America	514.6	1,264.4	4,852.3	8,168.0	36,394.2	45,898.7
Europe	13.1	461.4	2,241.2	4,197.9	17,982.4	24,631.4
Asia-Pacific	87.0	560.5	1,990.1	1,611.8	3,014.0	4,534.8
Other	0.1	0.1	198.4	286.2	425.5	513.5
Annual turnover			(In millions of contracts traded)			
Interest rate futures	91.0	219.1	561.0	781.2	2,110.4	669.3
Interest rate options	22.2	52.0	225.5	107.7	430.8	146.7
Currency futures	19.9	29.7	99.6	43.5	143.0	55.5
Currency options	13.0	18.9	23.3	7.0	10.4	6.4
Stock market infex futures	28.4	39.4	114.8	225.2	918.7	291.6
Stock market index options	140.4	119.1	187.3	481.5	3,139.8	773.4
Total	314.9	478.2	1,211.5	1,646.0	6,762.0	1,942.9
North America	288.7	312.3	455.0	461.3	1,926.8	648.9
Europe	10.3	83,0	354.8	718.6	1,592.8	466.5
Asia-Pacific	14.3	79.1	126.4	331.3	2,932.4	722.2
Other	1.6	3.8	275.5	134.9	310.0	105.4

Sources: Bank for International Settlements.

exposed to, repeated episodes of unpleasant financial-market dynamics including asset-price volatility and misalignments; volatile if not unsustainable financial and capital flows; extreme market turbulence, at times leading to concerns about potential systemic consequences; and a succession of costly country crises in 1994–95, 1997, 1998, 1999, and in the early 2000s (Table 6). The experiences of, and fallout from, these financial stresses and strains occurred within both advanced countries with highly sophisticated financial markets and developing countries with financial systems of varying degrees of immaturity and dysfunction. As these developments were occurring, economic and financial policymakers became increasingly concerned

Table 5b.
Global Over-the-Counter Derivatives Markets: Notional Amounts and Gross Market Values of Outstanding Contracts by Counterparty, Remaining Maturity, and Currency 1/ (In billions of U.S. dollars)

	Notional Amounts			Gross Market Values		
	End-Dec. 1998	End-Dec. 2000	End-Jun. 2006	End-Dec. 1998	End-Dec. 2000	End-Jun. 2006
Total	80,309	95,199	369,906	3,232	3,183	10,074
Foreign exchange	18,011	15,666	38,111	786	849	1,134
By counterparty						
With other reporting dealers	7,284	5,729	15,281	336	271	367
With other financial institutions	7,440	6,597	15,120	297	357	471
With nonfinancial customers	3,288	3,340	7,710	153	222	296
By remaining maturity						
Up to one year 2/	15,791	12,888	29,578	...	...	...
One to five years 2/	1,624	1,902	5,841	...	...	...
Over five years 2/	592	876	2,692	...	...	...
By major currency						
U.S. dollar 3/	15,810	14,073	31,771	698	771	967
Euro 3/	...	5,981	15,348	...	361	472
Japanese yen 3/	5,319	4,254	9,510	370	274	242
Pound sterling 3/	2,612	2,391	5,219	62	82	148
Other 3/	12,283	4,633	14,374	442	210	439
Interest rate 4/	50,015	64,668	262,296	1,675	1,426	5,549
By counterparty						
With other reportingdealers	24,442	31,494	114,474	748	638	2,219
With other financialinstitutions	19,790	27,048	115,089	683	610	2,613
With nonfinancial customers	5,783	6,126	32,734	244	179	718
By remaining maturity						
Up to one year 2/	18,185	24,107	90,582	...	...	...
One to five years2/	21,405	25,923	101,795	...	...	...
Over five yeras2/	10,420	14,638	69,918	...	...	...
By major currency						
U.S. dollar	13,763	19,421	88,094	370	486	2,149
Euro	...	21,311	103,607	...	477	2,358
Japanese yen	9,763	13,107	32,214	212	232	472
Pound sterling	3,911	4,852	19,079	130	113	296
Other	22,578	5,977	19,302	963	118	276
Equity-linked	1,488	1,891	6,783	236	289	671
Commodity 5/	408	662	6,394	43	133	718
Other	10,387	12,313	35,969	492	485	1,707

Source: Bank for International Settlements.
1/ All figures are adjusted for double-counting. Notional amounts outstanding have been adjusted by halving positions vis-à-vis other reporting dealers. Gross market values have been calculated as the sum of the total gross positive market value of contracts and the absolute value of the gross negative market value of contracts with non-reporting counterparties.
2/ Residual maturity.
3/ Counting both currency sides of each foreign exchange transaction means that the currency breakdown sums to twice the aggregate.
4/ Single-currency contracts only.
5/ Adjustments for double-counting are estimated.

that global financial stability was becoming more difficult to safeguard.

3. WHAT IS THE PUBLIC SECTOR'S ROLE IN FINANCE?

Table 6.

Table 6. Market Turbulence and Crises in the 1990s and Early 2000s

1992	ERM Exchange rate crisesinvolving Italy and the United Kingdom.
1994	Bond market turbulencein G-10 Countries.
1994-95	Mexican (*tesobono*) Crisis. Failure of Barinfgs.
1996	Bond market turbulence in United States.
1997	U.S. equity market correction.
1997-98	Asian crises (Thailand, Indonesia, South Korea).
1998	Russian default. Long-Term Capital management crisis and market turbulence.
1999	Argentina and Turkey crises.
2000	Global bursting of euirty price bubble.
2001	Corporate governance problems–Enron, Marchni, Global Crossing, etc. September 11 Terrorist Attack.
2001-2	Argentina crisis and default. Parmalat.

Source: Schinasi (2006).

A. Money and Finance: Harmony or Conflict?

The title of this symposium asks whether monetary and financial stability are in harmony or conflict. While this is a practical, policy related question, it is also a deeply philosophical one. The title also seems to suggest that money and finance are somehow related and possibly competing instruments. Before discussing why the public sector has an important role in finance and in safeguarding financial stability, it is worthwhile considering how money and finance are related and their public-good roles. Consider the following abbreviated, simple, and somewhat philosophical discussion of money and finance familiar to students of money, banking, and finance.

- In modern economies, fiat money (or legal tender) provides ultimate liquidity services in the form of finality of payment. It also has the quality of anonymity: a currency is accepted in the home

country irrespective of who exchanges it. Accordingly, money is a public good and society's 'surrogate for trust' in trade and exchange.[4]

- Used as a store of value, money is imperfect and less unique. Its effectiveness depends on the ability of a small group of public servants (working in a monetary authority or central bank) to design and execute policies to maintain its value. Thus, an element of uncertainty surrounds the durability of the value of money.
- Historically, and even before the introduction of monies of various forms, societies have created and used substitute or alternative stores of value. Broadly construed, this is finance: a process, comprising private contracts and social arrangements (codes of conduct, institutions, laws, governance), that produces and exchanges stores of value.
- Specifically, finance creates instruments of no intrinsic value that enable private counterparts to transfer the finality-of-payment services of money to others in exchange for a promise to reverse the transfer later, either for equal or greater value or to share in some reward (profit) in the future. Thus, finance is intimately related to the value and dynamic character of money and also embodies uncertainty – including counterparty risk.
- Like money, finance provides both private and social benefits. Finance enhances and redistributes the finality-of-payment services of money. It also facilitates and increases the opportunities for intertemporal economic processes and social prosperity: it facilitates a greater amount of exchange, production, savings, and investment,; a more efficient allocation of resources,; greater and more effective opportunities for wealth accumulation and economic development/growth,; and greater opportunities and effectiveness in unbundling, repackaging, pricing, and trading financial and economic risks. Thus, finance enhances the amount and efficiency of resource allocation, production, and so on.
- In doing so, finance also poses both private and social downside risks. When the veracity of promises to pay comes to be doubted in finance, uncertainty and risk tend to rise; financial counterparts reassess, reallocate, and re-price uncertainty and risk about trust. This process usually occurs in an orderly fashion. But often enough it does not.

4. See Tobin (1992) on the first point and Shubik (1999) on the second.

- Widespread uncertainty about trust in finance can lead to panic and a dramatic rise in the demand for legal tender (usually central bank money) until trust and confidence are restored. Because of the relationships between money, finance, intertemporal economic processes, and uncertainty about trust, when financial stability is called into question, monetary stability—and economic stability more generally—will also be at risk. Likewise, when monetary stability is called into question, so too is financial stability.

Coming back to the title of this symposium, the main implication to be drawn from this logic is that both harmony and conflict are present in the relationship between money and finance. And, they are both likely to be present in the simultaneous pursuit of monetary and financial stability.

B. Need for Collective Action

The obvious private and social benefits of finance as well as the incidence of financial problems (such as the disturbing events of the 1990s and early 2000s) and their relationship to financial stability can be understood as either the result of, or reflecting, the strengths and weaknesses of finance noted above. Finance embodies uncertainty – including about the ability or willingness to pay – and is associated with market imperfections (see Table 7):

- Some financial services provide positive externalities, and are therefore under produced or consumed, while others provide negative externalities and are therefore over produced or consumed.
- Some financial services are public goods and are under produced or consumed.
- There are information failures, which can work both ways.
- Financial markets are incomplete, which leads to underproduction of financial products and services.
- Competition is not always perfectly balanced, and when there is not enough of it goods are under produced; when there is too much of it goods are overproduced.

The practical import of this is that some market imperfections in finance can lead to the under consumption and underproduction of some socially desirable financial activities, and the over consumption

and overproduction of some socially undesirable ones. In addition, these market imperfections can, at times, lead to the creation and accumulation of both economic and financial imbalances, which if not corrected could threaten financial stability.

There is currently a line of research in the central banking community concerned with determining whether the pursuit of price sta-

Table 7.
Sources of Market Imperfections in Finance

Public good
- Finance provides unit-of-account services to financial balances (+)
- Finance extends universal acceptability benefits of fiat money to financial system (+)

Externalities
- Trust in finance enhances efficiency in intertemporal and interspatial allocations (+)
- Financial system creates network benefits (+)
- Finance subject to contagion and systemic risks (-)

Incomplete information
- Incomplete information in finance leads to price misalignment, resource misallocation, and multiple equilibria, possibly resulting in liquidity and credit runs (-)
- Asymmetric information between borrowers and lenders leads to adverse selection, moral hazard, and credit rationing (-)

Incomplete markets
- Uninsurable liquidity risks (lender-of-last-resort financing) increase economic uncertainty (-)
- Non-price discrimination in provision of finance leads to missed exchange opportunities (-)

Imperfect competition
- Single money issuer improves services provided by fiat money and economizes on transaction balances (+)
- Monopoly of money supply generates seignorage with incentives for over-issue (-)
- Economies of scale and too-big-to-fail considerations lead to insufficient or excessive competition between financial institutions and with new entrants (-)

Note: (+) and (-) indicate a positive or negative contribution to market efficiency.

Source: Schinasi (2004a and 2006).

bility at low levels of inflation could be associated with the greater incidence of financial and economic imbalances that have posed threats to financial stability in the 1990s and early 2000s.[5] This is a worthwhile avenue of research, as it is possible that the financial consequences of the market imperfections inherent in finance either come to the surface more readily, or have a greater impact, in low

5. See Borio and Lowe (2002).

inflation environments than in high inflation environments. As far as can be told from the published literature, however, this is a working hypothesis that is yet to be tested. In the absence of evidence to the contrary, it is also possible that it is the inherent imperfections themselves that are giving rise to the greater incidence of financial imbalances and that the consequences of these imperfections are being triggered by some as yet to be determined combination of other microeconomic and macroeconomic factors.

Obtaining the full extent of the private net benefits of modern finance requires, at a minimum, the existence and effectiveness of many private-collective, publicly sanctioned, publicly mandated, and taxpayer-financed conventions, arrangements, and institutions. Many of these important social arrangements are taken for granted. For example, modern private financial contracts are predominantly written in terms of the social convention of a legally sanctioned unit of account. This unit-of-account service has the properties of a pure public good, and is part of every financial transaction. All receive benefits and none pay a private cost, except as taxpayers. The service could be provided and financed privately, but most attempts to do so throughout history have neither succeeded nor endured. A second example is that settlement and delivery of payments for financial transactions typically require a universally accepted legal tender (a fiat money), which, as argued earlier, also has the characteristics of a public good. Third, transactors presume the availability of legal recourse in the absence of financial contract performance, which relies on the effectiveness of a publicly financed and enforced legal system. Other aspects of social-collective action underlie the effectiveness and efficiency of private finance, including well-run and well-supervised financial institutions, effective micro- and macro-financial system policies, and effective micro- and macro-economic policies.[6]

Although finance would no doubt exist and bestow benefits without these particular codes of conduct and social arrangements (including laws and enforcement mechanisms), there would most likely be significantly less of it, and it would be significantly less effi-

6. Levine (1999) finds that the legal and regulatory environment of financial intermediaries is positively associated with economic growth. More specifically, Leahy and others (2001) show that the transparency and enforcement of these legal and regulatory frameworks, in particular in terms of investor protection, accounting, and auditing requirements, is broadly linked to innovation and investment in new enterprises. Beck, Demirgüç-Kunt, and Levine (2003) establish that countries with better developed national institutions and policies governing issues such as property rights, the rule of law, and competition are less likely to suffer systemic banking crises.

cient and supportive of economic activity, wealth accumulation, growth, and ultimately social prosperity. Is this not the case in many (if not most) developing countries in which financial systems have yet to reach a critical point of development to reap the benefits of effective, if not, efficient finance?

Thus, while modern finance may be viewed mainly as involving private agents and transactions, the private net benefits originate in two inseparable sources. First are the direct individual private net benefits derived from private financial transactions. Second are the indirect private and collective net benefits associated with having access to an effective process of finance and sharing in the enormous collective efficiency gains finance creates for the economic system as a whole. In mature economies, the enormous and pervasive private benefits of modern finance and financial systems result from the existence of an effective financial system that has long been understood and supported as a public good. This is not meant to imply that all public policy involvement in private finance is appropriate, beneficial, or acceptable. Nor should this be taken to mean that all citizens benefit equally or have equal access to these private and social benefits. But the social benefits are there for the taking, especially in the more democratic societies with liberalized economies.

Although there now seems to be a consensus that many of the social conventions and arrangements in finance that have developed over time are essential prerequisites for effective finance, this reflects a relatively new and modern understanding of the role of finance. Less than 75 years ago, society's mismanagement of both money and finance played an important and devastating role in the Great Depression. More recently, some of these lessons have been learned again, in both mature markets and in an increasing number of emerging- and less-developed-market countries. For example, in the aftermath of recent corporate scandals in some mature markets in the early 2000s, improvements are being advocated and implemented—in accounting standards and their enforcement and in corporate governance procedures and accountability, for instance. Likewise, as the result of recent financial crises in emerging-market countries, many of these social arrangements are being aggressively advocated for adoption in both less advanced and least developed economies and financial systems.

As in other economic policy areas, it would seem reasonable to think that private-collective and public actions could be designed and

implemented to address each source of market imperfection in finance, depending on how significant the efficiency losses associated with each might be. The overall objective for collective action would be to move the economic and financial system toward a more economically efficient and socially optimal level, mix, and allocation of finance, measured in part by the ability of finance to facilitate real economic processes. In this way, collective action in finance could enhance both private and social welfare.

For example, for cases in which the presence of a market imperfection inhibits consumption and production of desirable financial activities, the challenge would be to provide incentives to supply and consume more of the activities that provide public benefits and positive externalities, that tend to open up new markets, and that increase competition unless there are natural monopolies. For cases in which a market imperfection encourages consumption and production of undesirable goods, the challenge would be to minimize the production and consumption of financial activities that result from these market failures. In considering this approach, the effectiveness of policies could be improved if they were designed and implemented in a cohesive fashion so that a policy designed to eliminate the negative impact of one kind of market imperfection does not offset the benefits of a policy designed to deal with another. It is not clear to what extent such policy cohesiveness and coordination is actually achieved in practice by countries or across borders.

Because tendencies to under produce and overproduce financial activities exist simultaneously, financial-system policies would be more effective if they could strike a reasonable balance between *maximizing* the net social benefits of the positive externalities and public goods and *minimizing* the net social costs of the other market imperfections in finance. This would most likely encompass a combination of both private-collective and public policy involvement, which could also strive to achieve some approximate social optimum. Striving to achieve a reasonable balance could entail difficult choices, including trading off some individual private benefits for the greater good, if and when this can be justified.

In sum, while finance provides tremendous private and social benefits, important aspects of finance are associated with market imperfections and inherently hold the potential (although not necessarily a high likelihood) for fragility, instability, systemic risk, and adverse economic consequences. When private incentives and actions alone

do not lead to an efficient pricing and allocation of capital and financial risks, it is possible that some combination of private-collective action and public policy could provide incentives to encourage the private sector to obtain a more efficient and desirable outcome.

Whether something can or should be done about this is the subject of active debate, but practically depends on the social net benefits of taking action. If the private and social benefits of taking action and providing incentives outweigh the private and social costs, they are worthy of consideration. A rule to consider, although difficult to implement, is that only policies that provide clear and measurable net benefits should be implemented.

This calculus most often involves both spatial and intertemporal trade-offs. While immediate benefits might be associated with specific private-collective or public sector policies, there may be greater future costs associated with private market reactions and adjustments to the policies. Examples include the costs of moral hazard and regulatory arbitrage.

Ultimately, it is a social and political decision whether private-collective and public sector involvement and intervention are appropriate. These cost-benefit, intertemporal, and social and political considerations are key reasons that financial-system policies are so difficult to devise and implement successfully.

4. WHAT ARE THE CONCEPTUAL CHALLENGES?[7]

Public policy typically tries to mitigate the impact of efficiency losses associated with market imperfections. In finance, however, each and every loss of efficiency does not necessarily require intervention. The desirability or necessity of some form of collective intervention is much clearer when a market imperfection in finance leads to an inefficiency that poses a significant threat to financial stability, because of the impact on either financial institutions or markets or both.

Unfortunately, the financial-system policy literature rarely makes a clear distinction between sources of market imperfections that

7. This section is based on material in Schinasi (2006), Fell and Schinasi (2005), and Houben, Kakes, and Schinasi (2004). I am grateful to my coauthors and to the UK National Institute Economic Review for granting permission to use all or part of this material.

threaten stability and those that do not. This is because it is difficult to measure the efficiency losses associated with market imperfections in finance and to assess the risks to financial stability associated with market imperfections. These are some of the challenges in the period ahead, for which an analytical framework for financial stability would be useful for policy purposes. But this, too, is an enormous challenge as is discussed in this section.

A. What is the Financial Stability Challenge?

There are many ways in which to characterize the challenges faced in achieving and maintaining financial stability. Moreover, the nature of the challenge will depend to some extent on the structure and maturity of the economic system. For mature financial systems, the financial stability challenge can be characterized as:

maintaining the smooth functioning of the financial system and its ability to facilitate and support the efficient functioning and performance of the economy.

To achieve financial stability, it is necessary to have in place mechanisms designed

to prevent financial problems from becoming systemic and/or threatening the stability of the financial and economic system, while maintaining (or not undermining) the economy's ability to sustain growth and perform its other important functions.

The challenge is not necessarily to prevent all financial problems from arising.

- First, it is not practical to expect that a dynamic and effective financial system would avoid instances of market volatility and turbulence, or that all financial institutions would be capable of perfectly managing the uncertainties and risks involved in providing financial services and enhancing financial stakeholder value.
- Second, it would be undesirable to create and impose mechanisms that are overly protective of market stability or overly constraining of the risk-taking of financial institutions. Constraints could be so

intrusive and inhibiting that they could reduce the extent of risk-taking to the point where economic efficiency is inhibited. Moreover, the mechanisms of protection or insurance could, if poorly designed and implemented, create the moral hazard of even greater risk taking.

Maintaining the economy's ability to sustain growth and perform its other important functions is an important aspect of the challenge of financial stability. The achievement and maintenance of financial stability should be balanced against other and perhaps higher-priority objectives such as economic efficiency. This reflects the notion that finance is not an end in itself but plays a supporting role in improving the ability of the economic system to perform its functions.

That the challenge is a balancing act can be seen by considering that the likelihood of systemic problems could be limited in practice by designing a set of rules and regulations that restrict financial activities in such a way that the incidence or likelihood of destabilizing asset price volatility, asset market turbulence, or individual bank failures could be eliminated. But it is also likely that this type of 'stability' would be achieved at the great expense of economic and financial efficiency.

This reasoning leads to the impression, if not conclusion, that there is an *ex ante* trade-off between achieving on the one hand economic and financial efficiency and on the other economic and financial stability. That is, if one is concerned solely with 'stability', then it may be possible to achieve and maintain it by trading off some efficiency.

The possibility of an *ex ante* trade-off can be illustrated by narrowing the definitions of stability and efficiency. Consider a market for a good whose price is sensitive to incoming information. This characterizes many asset prices. One could in principle limit the variability of the asset price by imposing restrictions in the market that would inhibit the ability of traders to price-in every small piece of information. But from a trader's and investor's perspective, such restrictions would be inhibiting the efficiency of the market's ability to price and allocate resources in the presence of uncertainty.

On the other hand, it is possible to try to maintain efficiency, and even enhance it, while at the same time allowing the financial system room to innovate, evolve, and better support the economic system. If the cost of doing so is greater asset price volatility or capital flow volatility, it is up to society to choose a point along this trade-off.

This is beyond the scope of this paper, however.

Some have characterized the difference between the American financial system and the European financial system as choices of different points along this trade-off. The American system is more market oriented in that the financing of both household and corporate activities is accomplished more through markets than in Europe, where there is much greater reliance on bank funding and less reliance on tradable securities (although this is changing). While one might argue that the American system of finance has led to greater economic productivity and efficiency, this greater efficiency is accompanied by greater asset market volatility and turbulence, and a greater observed propensity to financial stress.

From a broader perspective, the challenge of achieving and maintaining financial stability goes well beyond the stability of asset prices, or prices more generally. This is not to say that authorities, and central banks in particular, should not be concerned with asset price volatility, and price volatility more generally, because they determine the value of money. Instead, the point is that the challenge of financial stability is broader than, and in fact encompasses, the need to limit the impact of price instability on the functioning of the overall financial system. In fact, if the financial system is stable, then it will be able to tolerate higher levels of asset price volatility, as well as other financial problems, including in financial institutions. To jump immediately to the highest level of generality, one can see the challenge of financial stability as managing the risk of a system-wide problem, or what is known as systemic financial risk. But what is this, and how should we think of it? This will be defined more rigorously towards the end of what follows in the next section.

B. What are the Required Conceptual Elements of a Framework?

A framework for financial stability can best be understood as a set of definitions, concepts, and organizing principles that impose discipline on the analysis of the financial system. An important component of a framework for safeguarding financial stability is the early identification of risks and vulnerabilities that might threaten the maintenance of stability.

An effective framework would seem to require three important standards. First there must be rigorous definitions and understand-

ings of key concepts, such as what is meant by the terms financial system, financial stability and instability, and systemic, just to name a few. Second, to be most useful for monitoring and policy, the framework's concepts and definitions ultimately must be either directly measurable or correlated with measures: in other words the concepts and definitions must have useful and policy relevant empirical counterparts. Third, the set of definitions, concepts, and organizing principles along with their empirical counterparts must serve the purpose of ensuring internal consistency in the identification of sources of risks and vulnerabilities and in the design and implementation of policies aimed at resolving difficulties should they emerge.

It is important to define appropriately the relevant concepts, especially what is meant by the financial system, financial stability and instability, and systemic risk.

What is meant by 'financial system'?

Broadly, the financial system can be seen as comprised of three separable but closely related components. First there are financial intermediaries that pool funds and risks and then allocate them to their competing uses. Increasingly, financial institutions provide a range of services and not just traditional banking services of taking deposits and making loans. Now institutions such as insurance companies, pension funds, hedge funds, and financial-nonfinancial hybrids (such as General Electric) supply a range of financial services. Second, there are financial markets that directly match savers and investors, for example through the issuance and sale of bonds or equities directly to investors. Third, there is the financial infrastructure, comprised of both privately-and publicly-owned and operated institutions – such as clearance, payment, and settlements systems for financial transactions – as well as monetary, legal, accounting, regulatory, supervisory, and surveillance infrastructures.[8]

Notably, both private and public persons participate in financial markets and in vital components of the financial infrastructure. Governments borrow in markets, hedge risks, operate through markets to conduct monetary policy and maintain monetary stability, and own and operate payments and settlement systems. Accordingly, the term 'financial system' encompasses both the monetary system

8. On the role of the legal system see for example, Levine (1999), Leahy and others, and Beck and others.

with its official understandings, agreements, conventions, and institutions as well as the processes, institutions, and conventions of private financial activities[9]. Any analysis of how the financial system works and how well it is performing its key functions requires an understanding of these components.

From this definition, one could reasonably expect that financial-stability and monetary-stability considerations are related in some meaningful ways. These relationships will become more transparent in what follows.

What is meant by the term 'financial stability'?

There is as yet no widespread agreement on a useful working definition of financial stability. Some authors define financial instability instead of stability,[10] and others prefer to define the problem in terms of managing systemic risk rather than as maintaining or safeguarding financial stability.[11] Consistent with some aspects of these alternative definitions, Schinasi (2004b and 2006) proposes and analyzes a definition of financial stability that has three important characteristics.

- First, the financial system is efficiently and smoothly facilitating the inter-temporal allocation of resources from savers to investors and the allocation of economic resources generally.
- Second, forward-looking financial risks are being assessed and priced reasonably accurately and they are also being relatively well managed.
- Third, the financial system is in such condition that it can comfortably if not smoothly absorb financial and real economic surprises and shocks.

If any one or a combination of these characteristics is not being maintained, then it is likely that the financial system is moving in the direction of becoming less stable, and at some point might exhibit instability. For example, inefficiencies in the allocation of capital or

9. This particular formulation is an adaptation of 'international financial system' in Truman (2003).

10. See for example the definitions of Chant et al (2003) , Crockett (1996), the Deutsche Bundesbank (2003), Duisenberg (2001), Ferguson (2002), Foot (2003), Large (2003), Mishkin (1999), Norges Bank (2003), Padoa-Schioppa (2003), Schwartz (1986), and Wellink (2002) that are surveyed in Schinasi (2004b and 2006). Davis (2002) develops a typology of instability.

11. From a policy perspective, a positive approach focusing on financial stability is more useful than a negative one focusing on financial instability (see Schinasi (2006) pps. 91-93).

shortcomings in the pricing of risk can, by laying the foundations for imbalances and vulnerabilities, compromise future financial system stability.

All three of these aspects of the definition can and do entail both endogenous and exogenous elements. For example, surprises that can impinge on financial stability can emanate both from within and from outside the financial system. Moreover, the inter-temporal and forward-looking aspects of this particular way of defining financial stability serve to emphasize that threats to financial stability arise not only from shocks or surprises but also from the possibility of disorderly adjustments of imbalances that have built endogenously over a period of time – because, for example, expectations of future returns were mis-perceived and therefore mis-priced.[12]

There are several important implications of defining financial stability in this way.

First, judgments about the performance of the financial system entail how well the financial system is facilitating economic resource allocation, the savings and investment process, and ultimately economic growth. There are two-way linkages; the real economy can be positively or negatively affected by the financial system, and the performance of the financial system can be affected by the performance of the real economy. A framework useful for assessing financial stability must pay attention to these linkages.

Disturbances in financial markets or at individual financial institutions need not be considered threats to financial stability if they are not expected to damage economic activity at large. In fact, the incidental closing of a (minor) financial institution, a rise in asset-price volatility, and sharp and even turbulent corrections in financial markets may be the result of competitive forces, the efficient incorporation of new information, and the economic system's self-correcting and self-disciplining mechanisms. By implication, in the absence of contagion and the high likelihood of systemic effects, such developments may be viewed as welcome – if not healthy – from a financial stability perspective. Just as in Schumpeterian business cycles, where the adoption of new technologies and recessions have both constructive and destructive implications, a certain amount of instability can be tolerated from time to time because it may encourage long-term

12. That financial stability should not be thought of simply as a static concept of shock absorption capacity has been emphasized, among others, by Minsky (1982) and by Kindleberger (1996).

financial system efficiency.[13]

Second, financial stability is a broad concept, encompassing the different aspects of the financial system – infrastructure, institutions, and markets. Because of the interlinkages between these components, expectations of disturbances in any one component can affect overall stability, requiring a systemic perspective. Consistent with the definition of the financial system, at any given time, stability or instability could be the result of either private institutions and actions, or official institutions and actions, or both simultaneously and/or iteratively.

Third, financial stability not only implies that the financial system adequately fulfills its role in allocating resources, transforming and managing risks, mobilizing savings, and facilitating wealth accumulation and growth, but also that within this system the flow of payments throughout the economy functions smoothly (across official and private, retail and wholesale, and formal and informal payments mechanisms). This requires that money – both central bank money and its close-substitute, derivative monies (such as demand deposits and other bank accounts) – adequately fulfills its role as means of payment and unit of account and, when appropriate, as a (short-term) store of value. In other words, financial stability and what is usually regarded as a vital part of monetary stability overlap to a large extent.[14]

Fourth, financial stability requires the absence of financial crises and the ability of the financial system to limit and deal with the emergence of imbalances before they constitute a threat to stability. In a well-functioning and stable financial system, this occurs in part through self-corrective, market-disciplining mechanisms that create resilience and that endogenously prevent problems from festering and growing into system-wide risks. In this respect, there may be a policy choice between allowing market mechanisms to work to resolve potential difficulties and intervening quickly and effectively – through liquidity injections via markets, for example – to restore risk-taking and/or to restore stability. Thus, financial stability entails both preventive and remedial dimensions.

Last, but not least important, financial stability can be thought of as occurring along a continuum – reflecting different possible com-

13. See Schumpeter (1934).

14. See Padoa-Schioppa (2003) and Schinasi (2003) on the role of central banks in financial stability.

binations of conditions of the financial system's constituent parts. An analogy is the health of an organism, which also occurs along a continuum. A healthy organism can usually reach for a greater level of health and well being, and the range of what is normal is broad and multi-dimensional. In addition, not all states of un-health (or illness) are significant, systemic, or life threatening and some illnesses, even temporarily serious ones, allow the organism to continue to function reasonably productively and return to a state of health without permanent damage. One implication of seeing financial stability in this way is that maintaining financial stability does not necessarily require that each part of the financial system operates persistently at peak performance; it is consistent with the financial system operating on a 'spare tire' from time to time.[15]

The concept of a continuum is relevant because finance fundamentally involves uncertainty, is dynamic (meaning both inter-temporal and innovative), and is composed of many interlinked and evolutionary elements (infrastructure, institutions, markets). Accordingly, financial stability is expectations-based, dynamic, and dependent on many parts of the system working reasonably well. What might represent stability at one point in time might be more stable or less stable at some other time, depending on other aspects of the economic system – such as technological, political, and social developments. Moreover, financial stability can be seen as being consistent with various combinations of the conditions of its constituent parts, such as the soundness of financial institutions, financial markets conditions, and effectiveness of the various components of the financial infrastructure.

What is meant by systemic risk?

According to the G-10 Report on financial consolidation and risk,

"Systemic financial risk is the risk that an event will trigger a loss of economic value or confidence in, and attendant increases in uncertainly about, a substantial portion of the financial system that is serious enough to quite probably have significant adverse effects on the real economy. Systemic risk events can be sudden and unexpected, or the likelihood of their occurrence can build up through time in the absence of appropriate policy responses. The adverse real economic

15. See Greenspan (1999).

effects from systemic problems are generally seen as arising from disruptions to the payment system, to credit flows, and from the destruction of asset values."[16]

The G-10 study notes that this definition encompasses much of what is in the literature but it is stricter in two respects. One is that the negative externalities of a systemic event extend into the real economy. They are not confined to the financial system. The second is that this extension into the real economy occurs with relatively high probability. The emphasis on real effects reflects the view that it is the output of real goods and services and the accompanying employment implications that are the primary concern of economic policymakers. "In this definition, a financial disruption that does not have a high probability of causing a significant disruption of real economic activity is not a systemic risk event."

Taken together, a good understanding of what is meant by financial stability and what is meant by financial instability can serve to define boundaries around the scope of the analysis. The safeguarding of financial stability should not be understood as a zero tolerance of bank failures or of an avoidance of market volatility but it should avoid financial disruptions that lead to real economic costs.[17]

C. Assessing Financial Stability

With working definitions of the financial system, financial stability, and systemic risk in hand, it is now possible to discuss the key role of financial stability assessments in safeguarding financial stability. The core objectives of a framework for safeguarding financial stability are the *prevention* and *resolution* of systemic financial problems. That is, safeguarding financial stability fundamentally requires a framework to *prevent* problems from occurring and/or to *resolve* problems if prevention fails.

A key to prevention is the early identification of risks to stability and of potential sources of vulnerability in the financial system before

16. Group of Ten (2001).

17. Papers that focus on aspects of systemic risk are: De Bandt and Hartmann (2000), Hoelscher and Quintyn (2003), and Summer (2003).

they lead to unsustainable and potentially damaging imbalances and consequences. For example, weaknesses and vulnerabilities could exist in any of the components of the financial system – institutions, markets, infrastructure – and could entail all three simultaneously. Along with identifying potential sources of risks and vulnerabilities, it is also desirable to attempt to calibrate their intensity and potential for (or probability of) leading to financial-system problems and possible systemic effects. Financial stability assessments are a key part of prevention.

The key to resolution is to have mechanisms in place and policy tools available to remedy situations in which the financial system seems to be in the early stages of moving towards instability. Such tools would include moral suasion and intensified supervision and/or market surveillance, for example. Should remedial measures fail, or undetected endogenous factors or unanticipated exogenous factors lead to instability, tools should be available for resolving problems and instabilities quickly and with minimum collateral damage, either to the financial system or the economy. Such tools would include emergency liquidity assistance.

A schematic that might be considered as a reasonable "model" of such a framework for prevention and resolution is presented in Figure 4. Both prevention and resolution of financial difficulties are part of the framework, although resolution is well beyond the scope of this paper and is not discussed.[18]

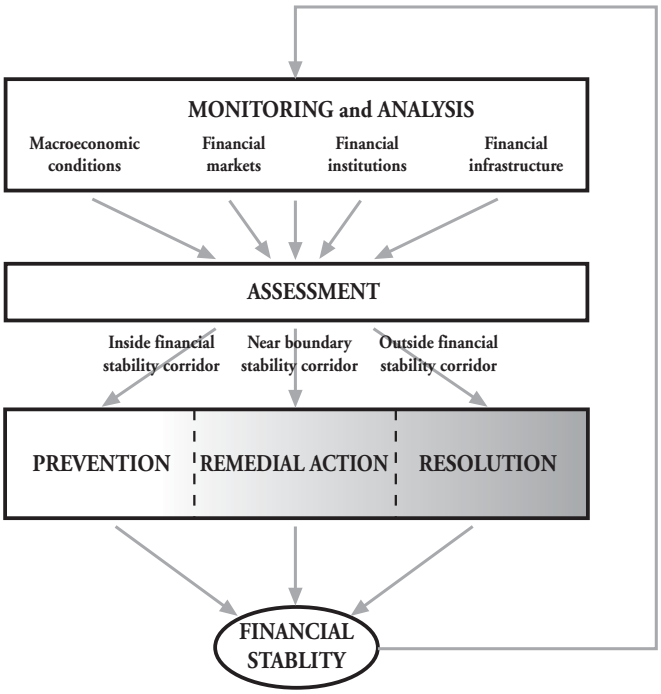
In order to prevent problems from occurring or becoming significant enough to pose a risk to financial stability, it would be desirable if the approach taken were to entail a continuous process of information gathering, technical analysis, monitoring, and assessment. Because of the linkages between the real economy and the financial system, and also the various components of the financial system, this continuous process would be most useful if it encompassed both economic and financial dimensions, and institutional knowledge about institutions, markets, and the financial infrastructure. In effect, the process needs to be comprehensive and analytical (see the top bar in Figure 4). Note that ongoing and more fundamental research into

18. See pp. 114-118 in Schinasi (2006) for a brief analysis of the resolution phase. Also see the conference papers discussed at a recent conference held at the Federal Reserve Bank of Chicago on *International Financial Instability: Cross-Border Banking and National Regulation*, which deals in part with the challenges in resolving cross-border banking problems in a world in which regulation and supervision are nationally oriented.

the changing structure of the financial system and its changing linkages to the real economy, as well as the further development of measurement techniques for detecting growing imbalances and calibrating risks and vulnerabilities, are vital for keeping up to date this important monitoring phase.

The process entails information gathering about, and monitoring of, the macro-economy (and at times microeconomic aspects as well) and the various aspects of the financial system through supervisory, regulatory, and surveillance mechanisms. Each of the financial-system monitoring components could entail both macro- and microprudential characteristics. For example, when it comes to gathering information about and monitoring individual institutions, the supervisory process could be aided by knowledge about where the economy is along the business and credit cycles and how markets have been performing overall: the reason being that the macro-economy and markets provide the background against which the operational performance of individual institutions should be assessed. Likewise an

Figure 4.
Framework for Maintaining Financial System Stability.



Source: Schinase (2006) and Houben, Kakes, and Schinasi (2004).

assessment of the condition of financial markets could be different depending on whether the major institutions operating in the markets were well capitalized and profitable or not. This is another way of observing that there are tradeoffs, even in the assessment process in safeguarding financial stability.

The reason for gathering information, analyzing it, and continuously monitoring the various components of, and influences on, the financial system is systematically and periodically to make assessments of whether the financial system is more or less performing its main functions well enough to be judged to be within a corridor of financial stability along the continuum discussed earlier. Such an assessment could lead to three conclusions each of them having quite different implications for action (see the middle bar in Figure 4 labeled assessment and the arrows). The financial system can be judged to be in a zone or corridor of financial stability, as approaching a boundary of stability/instability, or outside a zone or corridor of stability. Within the third category, the financial system could be further judged to be in a position in which self-corrective processes and mechanisms are judged to be likely to move the system back toward the corridor of stability or alternatively to need prompt remedial and even emergency measures to reverse the instability.[19]

One could also develop a delineation of financial conditions and potential difficulties according to their intensity, scope, and potential threat to systemic stability. For example, potential financial difficulties can be thought of as falling into one of the following fairly broad categories:

- difficulties in a single institution or market not likely to have system-wide consequences for either the banking or financial system;
- difficulties that involve several relatively important institutions involved in market activities with some nontrivial probability of spillovers and contagion to other institutions and markets; and
- problems likely to spread to a significant number and types of financial institutions and across usually unrelated markets for managing liquidity needs, such as forward, interbank, and even equity markets.

Problems occurring within each of these categories would require different diagnostic tools and policy responses, ranging from doing

19. As Kindleberger (1996) puts it: "....markets work well, on the whole, and can normally be relied upon to decide the allocation of resources and, within limits, the distribution of income, but that occasionally markets will be overwhelmed and need help".

nothing to intensifying supervision or surveillance of a specific institution or market, to liquidity injections into the markets to dissipate strains, to interventions into particular institutions.

D. Practical Challenges in Implementing a Framework

While categories of possible assessments may be easy to discuss in principle, they are difficult to identify in actual practice. How should the boundary of stability be defined and measured, for example? When does an isolated small problem threaten to become a systemic one? There would also seem to be a bias to be prudent and overreach in identifying both potential sources of risks and vulnerability and overestimate their likelihood and importance. Thus, it would be useful to establish some ground rules or guidelines for disciplining the continuous process of information gathering, analysis, and monitoring, and most importantly for identifying sources of risks and vulnerabilities. A check list of disciplining principles for identifying risks and vulnerabilities and for assessing where along the stability spectrum the financial system might be could include the following:[20]

- Is the process systematic?
- Are the risks identified plausible?
- Are the risks identified systemically relevant?
- Can linkages and transmission (or contagion) channels be identified?
- Have risks and linkages been cross-checked?
- Has the identification of risks and the assessment been time consistent?

In practice, the process of assessing financial stability entails a *systematic* identification and analysis of the sources of risk and vulnerability that could impinge on stability in the circumstances in which the assessment is being made. For example, consider the comprehensive list of sources of risks in Table 8. An operationally significant distinction is made between endogenous sources of risk that are present within the financial system and exogenous sources of risk that might emanate from outside the realm of finance.

20. These ideas and concepts are developed in detail in Fell and Schinasi (2005).

Table 8.
Sources of Risk to Financial Stability

Endogenous	**Exogenous**
Institutions-based:	*Macroeconomic disturbances:*
• Financial risks	• Economic-environment risk
◦ Credit	• Policy imbalances
◦ Market	*Event risk*
◦ Liquidity	• Natural disaster
◦ Interest rate	• Political events
◦ Currency	• Large business failures
• Operational risk	
• Information technology weaknesses	
• Legal/integrity risk	
• Reputation risk	
• Business strategy risk	
• Concentration risk	
• Capital adequacy risk	
Market-based:	
• Counterparty risk	
• Asset price misalignment	
• Run on markets	
◦ Credit	
◦ Liquidity	
• Contagion	
Infrastructure-based :	
• Clearance, payment and settlement system risk	
• Infrastructure fragilities	
◦ Legal	
◦ Regulatory	
◦ Accounting	
◦ Supervisory	
• Collapse of confidence leading to runs	
• Domino effects	

Source: Schinasi (2006) and Houben, Kakes, and Schinasi (2004).

In keeping with the broad definition of the financial system outlined above, endogenous sources of risk can arise either in financial institutions, or in financial markets, or in the infrastructures, or in any combination. For instance, credit, market or liquidity risks may be present in financial institutions which, if they materialize, could hamper the process of reallocating financial resources between savers and investors. Financial markets can be a source of endogenous risk not only because they offer alternative sources of finance to non-financial sectors but also because they entail systemic linkages between financial institutions, and

more directly between savers and investors. Financial infrastructures are also an important endogenous source of risk, in part because they entail linkages between market participants as well, but also because they provide the institutional framework in which financial institutions and markets operate.

Outside the financial system, the macroeconomic environment can be an exogenous source of risk for financial stability because it directly influences the ability of economic and financial actors (households, companies, and even the government) to honor their financial obligations. Financial stability assessments should entail a systematic and periodic process of monitoring of each of these sources of risks, both individually and collectively by taking account of cross-sector and also cross-border linkages. This process should satisfy at least the list above.

There are also formidable measurement and modeling challenges in the ability to assess the strength and robustness, or to calibrate the plausibility and importance of the various risks, or to appraise quantitatively the potential costs should risks materialize. In actual practice many shortcuts and qualitative judgments must be made in order to produce an overall assessment.

For most macroeconomic or monetary policy objectives (unemployment, external or budgetary equilibrium, price inflation, etc.) there is a widely-accepted measurable (set of) indicator(s) that define, and measure deviations from, the objective, even if still subject to methodological and analytical debate and even controversy. In the case of both macroeconomics and monetary economics it took each of them some twenty-to-thirty years of practice, trial, and error, measurement and modeling development, and fundamental research to accomplish this. As noted in the introduction, financial stability analysis is still in an infant stage of development. Thus, by contrast, there is as yet no widely-accepted set of measurable indicators of financial stability that can be monitored and assessed over time. In part, this reflects the multifaceted nature of financial stability, as it relates to both the stability and resilience of financial institutions, and to the smooth functioning of financial markets and settlement systems over time.[21] Moreover, these diverse factors need to be weighed in terms of their potential ultimate influence on real economic activity. But it also reflects the relatively

21. Sets of indicators have been developed, and are widely used, for assessing the soundness of banking institutions. See for example the IMF Soundness Indicators, both core and encouraged sets in IMF (2003), and the IMF's guide on financial soundness indicators (accessible for the IMF website), IMF (2004).

young age of the discipline of assessing financial stability. Because measurement is not highly developed yet, it is reasonable to see the current practice of making financial stability assessments more as an art form than as a rigorous discipline or science.

Challenges in measuring financial system stability reach well beyond the challenges of measuring the degree of stability in each individual sub-component of the financial system. Financial stability requires that the constituent components of the system – financial institutions, markets, and infrastructures – are jointly stable. Weaknesses and vulnerabilities in one component may or may not compromise the stability of the system as a whole, depending on size and linkages – including the degree and effectiveness of risk-sharing between different components. Moreover, as different parts of the system perform different tasks, there are challenges to aggregating information across the system. For example, in diversified financial systems - where both financial institutions and markets are important providers of finance - there is no commonly accepted way of aggregating information on the degree of stability in both the banking system and financial markets to form an overall assessment of system stability. If the banking system is functioning well but, at the same time, there are signs of strains in financial markets, the overall assessment of financial system stability is likely to be ex ante ambiguous, particularly if the respective shares of the two components as providers of finance are similar. The more complex and sophisticated is a financial system, the more complex is the task likely to be of measuring overall stability in a precise way.

Financial stability assessments carry a higher degree of uncertainty than ordinarily associated with forecasts based on macro-econometric models. This is because there are formidable practical challenges to measuring, modeling, and assessing the consequences of rare events.

- First, if past crises were prevented or tackled by policy actions, assessments of the likely costs of a selected scenario, based on simulations drawn from historical data-sets, will likely prove to be biased unless sufficient account is taken of policy reaction functions. It is doubtful that past policy responses to episodes of financial stress could be summarized by a mechanical reaction function, particularly if the authorities were mindful of avoiding the moral hazards that typically follow from predictable behavior. Moreover,

even in cases that did not lead to policy responses, the frequency of crises in historical data sets may be too low to facilitate precision in estimating the likely 'policy neutral' consequences of a stylized scenario.

- Second, confidence intervals around the expected output losses associated with the materialization of a specified scenario may be neither well defined statistically, nor defined at all. For instance, simulations based on historical episodes tend to be founded on statistical relationships that reflect the central tendency of probability distributions, rather than the tails. Moreover, for hypothetical scenarios, which have not occurred in the past, it may not be possible to compute a confidence interval around the simulation because the events themselves may be subject to Knightian uncertainty – or unquantifiable risk.[22]
- Third, most macro-econometric models used for stress-testing tend to be built on the basis of log-linear relationships. For simulations, this means that a doubling of the size of a shock will result in a proportionate change in the effect. However, in reality, it can never be excluded that in situations of financial stress, unpredictable non-linearities may surface, for instance due to threshold effects.
- Fourth, as witnessed during the near collapse of Long Term Capital Management in 1998, unexpected linkages may surface during crises – such as correlations between financial markets that ordinarily tend to be uncorrelated. Given such uncertainties, the real economic costs associated with a particular scenario could well prove to be larger than those predicted by an empirical model. Such considerations would suggest that the output of any stress-testing exercise should only be viewed as indicative of how, or if, the financial system would endure adverse disturbances. In order to avoid complacency, this calls for a high degree of caution and judgment in forming financial assessments.

In order to advance the practice of financial stability assessment from what is essentially an art towards a science, progress is necessary on at least three fronts: data, models, and understanding of linkages. A priority for data gathering must be micro balance sheet data covering financial institutions, households, and firms. While a picture of

22. See Knight (1921)

the aggregate risks borne within each of these sectors can be useful for financial stability analysis, far more important is an understanding of the way in which the risks are distributed across sectors and especially whether or not concentrations or pockets of vulnerabilities can be pinpointed. In mature economies, the availability and comprehensiveness of such data is rather mixed, particularly for the household sector.

Two areas where more and better analytical research on financial stability modeling appears necessary include models for identifying risks and vulnerabilities and models for assessing the consequences of adverse disturbances.[23] Concerning the identification of risks, the literature suggests that it is doubtful that models will ever be capable of predicting crises, particularly precise timing. Nevertheless, this should not stand in the way of developing models for assessing vulnerabilities. Even simple single indicator approaches can be useful for gauging risks to financial stability (see Campbell and Shiller (2001)) and current work holds promise for the development of more comprehensive frameworks for pinpointing the sets of variables (see IMF (2004)) and the conditions that raise the likelihood of financial stress (for example, see Aspachs, Goodhart, Segoviano, Tsomocos, and Zicchino (2006)). As for the prediction of crises, it cannot be excluded that drawing on the intellectual advances made in other disciplines in the modeling of complex and discontinuous processes – such as the prediction of earthquakes – may offer insights for financial stability assessment.

5. WHAT ARE SOME OF THE PRESENT FINANCIAL STABILITY CHALLENGES

The changes in the financial market landscape since the early 1970s, and the rapid acceleration of those changes in the 1990s and beyond, have resulted in unprecedented growth and unprecedented challenges, including the growing importance of safeguarding financial stability. The forces of globalization have combined with the development of ever-more sophisticated financial instruments and markets to produce an international financial system open to more participants, but

23. See Sahajwala and Van den Berg (2000) for an overview of early warning systems used by some G-10 authorities, and Persson and Blåvarg (2003) on the use of financial market indicators.

cloaked in a level of complexity that masks the nature, ownership, and systemic importance of the system's underlying financial risks. The national authorities and international bodies responsible for ensuring and maintaining the stability of this financial system are coming to grips with their need for a framework that allows them to monitor and regulate the system without reining in the benefits it provides, thereby safeguarding financial stability while maintaining efficiency. Four areas that are presently posing formidable challenges are discussed next, but only very briefly: the globalization of finance, the increased reliance on over-the-counter derivatives markets, the additional complexities of credit derivatives, and the growing global capital markets activities of insurance and reinsurance companies. Much more can be said about the challenges in each area.[24]

A. Globalization of finance

The globalization of finance is a result of the same technical advances in communications and information technology that have made the world's economies more interconnected on a business, personal, and political level. Financial markets are linked to one another, physically through computerized connections, and financially through the use of one market's assets to diversify the risks created in another market. Globalization has led to tighter integration of national financial markets; the greater importance for markets of nonbank financial institutions, such as hedge funds, insurance companies, and pension funds; the greater engagement of nonfinancial institutions in financial activities; as well as the emergence of hybrid entities that added financial endeavors to their core businesses—auto manufacturers and industrial giants, for example. In addition, the once-staid backbone of finance, the banking sector, has diversified into new lines of business that allow it to compete more aggressively with new entrants into the business of finance. Thus, banks are providing more "finance" and doing less lending, as measured in relative terms.

The resulting advances make international financial markets more liquid, contribute to the worldwide mobility of capital, and allow financial flows and asset prices to adjust more quickly. On the whole, markets and market participants benefit tremendously from greater efficiency.

24. Part III, Chapters 8-11 of Schinasi (2006) devotes an entire chapter to each of these four issues.

Along with such valuable benefits, of course, come new and unmeasured risks. Market interdependencies, and the complexity of those interdependencies, contribute to the potential for volatility, turbulence, and crises to spread far beyond the entity, or even the country, of origin. The speed with which globalization has occurred has left two clear gaps in the usual system of checks and balances. First, although the efficiency of private finance has been enhanced by globalization, the appropriateness and effectiveness of regulatory and supervisory approaches has lagged behind. Second, emerging market countries accessing international capital markets—in some cases for the first time—often are faced with riding a financial roller coaster as they experience good times and bad. Finance is now easier to obtain in world markets, and many emerging markets have benefited in good times from their new-found access to international finance. But because emerging-market countries often have not made concomitant reforms in their macroeconomic, microeconomic, and financial structures, they lack smoothing mechanisms and the resilience required to brake the adverse consequences of the roller coaster's descent when faced with unexpected financial turmoil.

From a globalization perspective, the crises and turbulence of the 1990s and early 2000s should have resulted in three lessons learned: First, greater private and official supervisory attention can usefully be focused on internal risk management and control systems, private management's understanding of risk issues, and corporate governance mechanisms. Second, market discipline is an effective and crucial tool. Errant institutions should be allowed to fail and be liquidated, and this can happen without causing instability if financial supervisors have insight into risk levels and interconnectivity through regulatory disclosure. Third, international financial stability is a global public good requiring more regular and effective—and perhaps even binding—international coordination mechanisms.

B. Over-the-counter derivatives markets.[25]

Delving one layer below the surface of global financial markets and the forces of globalization, are over-the-counter (OTC) derivatives and markets. In many ways these instruments and the markets in which they are priced and traded make up the core of liquidity and

25. See Schinasi, et al (2001) for an exhaustive coverage of these markets and challenges.

finance in the international financial system. OTC derivatives allow financial risks to be tailored to preferences and tolerances, contributing to more complete financial markets. The trade-off is that OTC derivatives can also contribute to vulnerabilities because they are unregulated to a large extent, disclosure is poor, and transparency is an issue. OTC derivatives also can introduce layers of complexity that make risks harder to manage: not only must the risk of default and loss given default be assessed and managed, but the potential changes in the value of credit extended must be assessed, and the ultimate link between the derivative and the underlying asset market must be understood.

Roughly two-thirds of OTC derivatives instruments are simple forwards and swaps, generating little additional risk and thus not deserving of undue regulatory scrutiny. Nonetheless, OTC derivatives are emblematic of the widening gap between regulated and regulator. Regulation has had its greatest impact on OTC derivatives in the effort put into avoiding regulation—through choice of jurisdiction, legal structure, and the structure of trading, clearing, and settlement. The financial institutions that trade heavily in OTC derivatives—the top 20 or so global financial institutions—are safeguarded by virtue of being well capitalized, supervised (so far), and partially insured (with safety nets); but spillovers and contagion can affect the stability of markets and countries only indirectly linked, as demonstrated by the effects of the Long-Term Capital Management (LTCM) crisis in 1998.

The greater use and increasing sophistication of these markets are challenging those entities operating in areas that could be sources of instability to take responsibility for enhancing stability. Private financial institutions should continue to improve risk management and control systems; but the fact that little has been done in this regard since the near collapse of LTCM suggests that it is a complex problem, perhaps somewhat ignored because of the existence of financial safety nets. The public and private sectors can usefully work together to identify and overcome inconsistent incentives and signals. The official sector in league with national legislatures can cooperate to reduce legal and regulatory uncertainties, especially concerning clearinghouse arrangements, closeout procedures during bankruptcy, and netting. Supervisory bodies can also work closely with financial institutions to strike a better balance on information disclosure. In principle, creditors would demand information sufficient to allow them

to gauge risks and risk concentrations adequately; reality indicates otherwise, due to competitive pressures and the perception that confidentiality may be at stake. Therefore, the official sector can define its role such that counterparties receive adequate information, but not at the expense of reducing the private information advantage and efficiency. Finally, both private entities and the public sector can work to reduce systemic risk. Foremost among these efforts must be the drive within private institutions to be well managed and sufficiently capitalized. Authorities can provide additional incentives in this direction, including through capital requirements for off-balance-sheet credit risks.

C. Credit derivatives and markets.

Credit risk transfer vehicles, such as credit default swaps and collateralized debt obligations, allow credit origin to be separated from credit risk bearing, thus contributing to the efficiency and completeness of financial markets. By allowing entities other than banks to take on credit risk, the overall concentration of risk becomes more dispersed and credit exposures can be managed more flexibly. Compared to OTC derivatives, the notional value of credit risk transfer vehicles is small; the associated risk, however, is huge, because credit exposure can rise to up to 100 percent of the notional amount.

Credit risk transfer vehicles subject financial market stability to the same challenges as OTC derivatives—complexity, regulatory arbitrage, new market participants—then add the additional uncertainties of poorly defined credit default events. The complexity of these vehicles combined with return-seeking but inexperienced market participants leads to a potential magnification of the risks, further exacerbated by the reduction in transparency of the institutional distribution of credit risk. Because exposures have been shifted outside the banking system—to hedge funds, pension funds, insurance companies—traditional regulatory and supervisory functions that would uncover potential volatile concentrations of risk do not come into play.

The Railtrack, Enron, and JP Morgan episodes illustrate that experiencing an outcome that credit risk transfer vehicles are designed to cover is not sufficient to trigger payment. The way in which that outcome occurs is also significant. Thus, better documen-

tation is needed to help refine the definition of a credit event and what constitutes a default.

Retail investor involvement in credit risk transfer vehicles raises investor protection issues. In addition to high net worth individuals investing directly in such vehicles, other retail investors are becoming exposed through mutual funds and hedge funds that invest in credit risk transfers. Insufficient disclosure and transparency, combined with the inexperience of the investor could lead to investment mistakes, rapid unwinding of positions once the mistakes are discovered, and a tendency toward increased volatility in credit prices and spreads.

D. Global market activities of insurance and reinsurance companies.

The insurance and reinsurance industry has become a significant player in the international financial market. Several forces compelled the industry to step beyond its traditional role and pursue more finance-related activities. In addition to needing to offset underwriting losses and to pay for high guaranteed returns offered to policyholders in the 1980s and 1990s, insurance companies are fulfilling the demand from the remainder of the financial sector for insurance against capital risk. In doing so, insurance companies have brought an innovative approach to capital markets, developing new instruments that bridge the gap between insurance and banking. These instruments include "Cat" bonds, with payoffs triggered by catastrophic events, and customized reinsurance products available in the "alternative risk transfer" market.

Although observers foresee little possibility of a systemic impact from the possible failure of an insurance company due to its financial activities, issues similar to those that apply throughout the rest of the financial system arise. Among them are the balance between official oversight and market discipline, the need for disclosure and transparency, the understanding of legal obligations, and capital adequacy. Despite regulatory differences among countries, the overriding focus is on policyholder protection, with little concentration on the asset side of the balance sheet or on off-balance-sheet activities. Thus, little information is available regarding internal risk management and controls. Insurance companies also have different legal obligations than financial companies. Finally, although capital is typically more

than adequate, it is not clear that some European and Japanese companies are properly capitalized on a risk-adjusted basis.

6. What Is the Role of Central Banks in Safeguarding Financial Stability?

This is not a trivial question and is what this symposium is about. Naturally, there are arguments that can be made on both sides of this issue. This section argues that the central bank has a natural role to play in safeguarding financial stability that is perfectly consistent with its monetary policy responsibilities. Here I only discuss sSeveral reasons are discussed why central banks have a natural – if not pre-ordained – role to play.

Specific features of central banking make central banks a natural contender for having a role in financial stability. Consider the traditional definition of monetary stability from Henry Thornton's classic monograph, *An Enquiry into the Nature and Effects of the Paper Credit of Great Britain*, published in 1802[26]:

> To limit the amount of paper issued, and to resort for this purpose, whenever the temptation to borrow is strong, to some effectual principle of restriction; in no case, however, materially to diminish the sum in circulation, but to let it vibrate only within certain limits; to afford a slow and cautious extension of it, as the general trade of the kingdom enlarges itself; to allow of some special, though temporary, enquiries in the event of any extraordinary alarm or difficulty, as the best means of preventing a great demand at home for guineas; and to lean to the side of diminution, in the case of gold going abroad, and of the general exchanges continuing long unfavorable; this seems to be the true policy of the directors of an institution circumstanced like that of the Bank of England. To suffer either the solicitations of merchants, or the wishes of government, to determine the measure of the bank issues, is unquestionably to adopt a very false principle of conduct. (Thornton, 1802, p. 259)

This definition is consistent with the traditional monetary policy

26. See also Capie (2000).

role of a central bank. It has the ingredients of managing monetary aggregates and interest rates. It refers to the monetary transmission mechanism and to monetary targets.

Thornton also seems to have had fairly clear ideas about the Bank of England's role in ensuring financial stability. Three passages from his classic work appear relevant:

> If any one bank fails, a general run upon the neighboring ones is apt to take place, which if not checked in the beginning by pouring into the circulation a large quantity of gold, leads to very extensive mischief. (p. 180)

> [I]f the Bank of England, in future seasons of alarm, should be disposed to extend its discounts in a greater degree than heretofore, then the threatened calamity may be averted through the generosity of that institution. (p. 188)

> It is by no means intended to imply that it would become the Bank of England to relieve every distress which the rashness of country banks may bring upon them: the bank, by doing this, might encourage their improvidence. There seems to be a medium at which a public bank should aim in granting aid to inferior establishments, and which it often must find it very difficult to be observed. The relief should neither be so prompt and liberal as to exempt those who misconduct their business from all the natural consequences of their fault, nor so scanty and slow as deeply to involve the general interests. These interests, nevertheless, are sure to be pleaded by every distressed person whose affairs are large, however indifferent or even ruinous may be their state. (p. 188)

The first passage describes a process of contagion that is likely to occur with a run on one bank. The second describes the role of the Bank of England in a crisis. The third passage describes the concept of moral hazard. The three passages together show clearly that Thornton had a working definition of the role of central banks in financial stability.

Consider a more modern view of the role of central banks in ensuring financial stability, which is consistent with Thornton's view. The following view was expressed by Paul Volcker in 1984, when he was Chairman of the Board of Governors of the U.S. Federal Reserve

System:

> A basic continuing responsibility of any central bank—and the principal reason for the founding of the Federal Reserve—is to assure stable and smoothly functioning financial and payments systems. These are prerequisites for, and complementary to, the central bank's responsibility for conducting monetary policy as it is more narrowly conceived…. To these ends, the U.S. Congress has over the last 70 years authorized the Federal Reserve (1) to be a major participant in the nation's payments mechanism; (2) to lend at the discount window as the ultimate source of liquidity for the economy; and (3) to regulate and supervise key sectors of the financial markets, both domestic and international. These functions are in addition to, and largely predate, the more purely "monetary" functions of engaging in open market and foreign exchange operations and setting reserve requirements; historically, in fact, the "monetary" functions were largely grafted onto the "supervisory" functions, not the reverse. (Volcker, 1984, p. 548)

According to Volcker, the Federal Reserve System was first established to ensure financial stability and only later became responsible for monetary stability as we know it today. Certain key points made by Thornton and Volcker establish the reasons for central banks to have a natural role in financial stability.

First, the central bank is the only provider of the legal means of payment and of immediate liquidity. That is, only the central bank provides "finality of payment," a point discussed earlier in the paper that links money and finance, and their simultaneous public good roles.

The second natural role for the central bank is to ensure the smooth functioning of the national payments system. It is within the context of the soundness and stability of national payments systems that policymakers have traditionally and naturally considered systemic risk. Systemic risk has been viewed as the possibility that problems at one bank would create problems at other banks, in particular, banks that make up the core of the national payments system. In this view, problems at one bank would cascade through the payments system and perhaps lead to bottlenecks in payments and the possibility of a widespread domino effect. The payments system, being the core of the financial market, has been the subject of much discussion,

policy, and reform. Through Group of Ten efforts, there now exist real-time gross payments settlements systems that try to prevent the failure of one institution from cascading through the payments system and affecting other institutions within the payments system. So, again, the central bank has a natural role to play in financial stability—even if it is confined to the payments system.

The third natural role relates to the fact that the banking system is the transmission mechanism through which monetary policy has its effect, in the first instance, on the real economy. If the banking system is experiencing distress, the central bank will find it difficult to provide the liquidity necessary to achieve its monetary objectives. For this reason alone, central banks have a natural interest in sound financial institutions and stable financial markets. Central banks have, therefore, an interest in maintaining the stability of the banking system, in having the ability to see problems at an early stage, and in being in a position to influence corrective actions.

Finally, monetary stability and financial stability are explicitly linked. In Anna Schwartz's definition of a financial crisis, she refers to the propensity for the money supply to collapse (Schwartz, 1986). One simple equation makes this clear. Basic money-and-banking courses often begin with an equation called the money multiplier, which establishes a relationship (some would even say an identity, if these parameters are fixed) between central bank money *B* held as bank reserves by the banking system and the money supply *M?*. Formally,

$$M = mB$$

that is, the money stock (*M*) is equal to high-powered money or the monetary base (*B*) times the money multiplier (*m*). This can be written explicitly as follows:

$$M = \left[\frac{1 + \frac{C}{D}}{\frac{C}{D} + \frac{R}{D}} \right] B$$

where $\frac{C}{D}$ is the currency to deposit ratio of the public, and $\frac{R}{D}$ is the cash (or reserves) to deposit ratio of the banks.

It has not been made clear in the above discussion whether *M* is a

narrow monetary aggregate (comprised only of base money and demand deposits) or a broad monetary aggregate (comprised of base money, demand deposits, and time deposits, and perhaps even money-market mutual funds): that will depend on what the ratios $\frac{C}{D}$ and $\frac{R}{D}$ are. Regardless, the money supply of the economy is directly linked to what the central bank provides in the way of central bank money. In the midst of a financial crisis, a run on liquidity could occur. Everyone will demand liquidity (and the finality of payment), and everyone in the system understands that the only liquidity that really exists is central bank money, that is, base money B. In this rush for central bank money, the money supply shrinks because the ratio $\frac{C}{D}$ increases very rapidly as everyone increases C and reduces D. If the money supply (M) is shrinking very rapidly in the presence of financial instability, it will not take long before the central bank will have to supply liquidity, or (B), to restore monetary stability as the monetary aggregates collapse, because monetary stability objectives (unquestionably the central bank's responsibility) are less likely to be achieved, even in the short run, without more central bank money. So when financial instability occurs, monetary instability is likely to follow. This establishes a link between the natural role of the central bank as the provider of payment finality and its role in financial stability.

7. CONCLUDING REMARKS

The purpose of this paper was to explore the various challenges in safeguarding financial stability, which have become more important over the past twenty years or so. As discussed, there are formidable conceptual challenges in defining financial stability and in analyzing it. From the perspective of assessing the performance of financial systems, and their likelihood of encountering difficulties, the financial-stability discipline – if it can yet be labeled as such – does not yet know how to integrate knowledge and information about financial institutions and financial markets. Nor does it know how to conceptualize usefully, and model empirically the important systemic linkages between financial processes and the real economic process finance is designed to facilitate. In short, the discipline lacks a widely accepted framework. Current practice probably compares with the way monetary policy assessment was practiced by central banks two

or three decades ago – before there was a widely-accepted, rigorous framework.

The challenges that lie ahead for financial stability analysis concern both measurement and theory. The challenges are formidable, in part because financial stability assessments must not only take stock of disturbances as they emerge, but also identify and examine the vulnerabilities that could lead to such disturbances occurring in the future. A forward-looking approach is required in order to identify the potential build-up of financial imbalances and to account for the transmission lags in policy instruments. The real difficulty is that financial crises are inherently difficult, if not impossible, to predict, in part because of contagion effects and likely non-linearities in both the build-up of imbalances and their transmission to the real economy. In addition, financial stability risks often reflect the far reaching consequences of unlikely events. This implies that the focus of the attention is not the mean, median or mode of possible outcomes but the entire distribution of outcomes, in particular the 'left tail'.

While many conceptual and methodological challenges lie ahead, it is important to acknowledge that significant progress has been made in recent years. Even though there is no obvious framework for summarizing developments in financial stability in a single quantitative measure, a growing number of central banks around the world are making financial stability assessments and publishing financial stability reports, many of them based on a broad and forward-looking conception of financial stability.

The challenges to financial stability posed by the globalization of finance, the increasing use of sophisticated instruments, and the entrance of new large participants in global markets, separately and collectively, lead to the strong conclusion that further and continuous reforms are desirable and should be aimed at striking a better balance between relying on market discipline and relying on official or private-collective action. In some countries—most of them advanced countries with mature markets—a rebalancing toward greater reliance on market discipline is desirable. In other countries—many with poorly developed markets—strong efforts need to be made to improve the financial infrastructure through private-collective and government expenditures and commitments, and to target the role of government to enhance the effectiveness and efficiency of market mechanisms for finance.

Reforms in the following specific areas would go a long way in

improving the prospects for safeguarding financial stability where it presently exists, and in promoting it where it is yet to be achieved.

- Improve internal governance at the board-of-directors level, management and risk controls, and the alignment of incentives of board, management, and staff — by realigning private incentives within all financial institutions.
- Reduce moral hazard and other adverse incentives — by reevaluating and reforming existing regulatory incentives and their consistency with private market incentives.
- Improve market discipline and strengthen private-collective and official surveillance and supervision — by enhancing financial transparency through disclosure by a wide range of financial and nonfinancial entities.
- Reduce informational asymmetries and the tendency toward adverse selection — by improving financial market transparency.
- Reduce, and if possible eliminate, legal uncertainties where laws are still ambiguous (such as with closeout procedures for credit derivatives and other complex structured financial instruments)— by introducing new legislation developed in a coordinated fashion by private financial industry, official, and legislative representatives.
- Improve the ability to monitor, assess, and safeguard financial stability, and to restore it when this fails — by aggressively developing and implementing comprehensive and appropriately targeted frameworks, analytical tools, and the necessary data and information.
- Reduce opportunities for international regulatory arbitrage, and eliminate international gaps of information and analyses — by enhancing international cooperation and coordination in financial-system regulation, surveillance, and supervision.

The complexity of the challenges and the rapidity and creativity with which new financial instruments are developed and disseminated require a systemic approach to safeguarding financial stability such as was examined earlier in the paper and analyzed in detail elsewhere. The financial system, working within the context of the broader economic, social, and political systems, affects the performance of the economy and well-being of society. In turn, those systems must operate hand in hand to safeguard the stability of the financial system,

and the constellation of tools they provide must be used to ultimately ensure economic stability.

Ultimately, the goal is to maintain financial stability so that the financial system is capable of performing its three key functions: the intertemporal allocation of resources from savers to investors and the allocation of economic resources generally; the assessment, pricing, and allocation of forward-looking financial risks; and the absorption of financial and real economic shocks and surprises.

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Monetary and prudential policies at a crossroads? New challenges in the new century*

Claudio Borio
Bank for International Settlements

"The greather our knowledge increases the more our ignorance unfolds"
John F. Kennedy

Abstract

It is hard to find a period in the post-war era in which inflation-adjusted interest rates have been so low for so long and monetary and credit aggregates have expanded so much without igniting inflation (the "Great Liquidity Expansion puzzle"). What lies behind these developments? How benign are they? This paper argues that financial liberalisation, the establishment of credible anti-inflation monetary policies and (real-side) globalisation have resulted in subtle but profound changes in the dynamics of the economy and in the challenges faced by policymakers. In the new environment which has gradually been taking shape, the main "structural" risk may not be so much run away inflation. Rather, it may be the damage caused by the unwinding of financial imbalances that occasionally build up over the longer expansion phases of the economy, typically spanning more than one higher-frequency business cycle. Depending on its intensity, the unwinding can lead to economic weakness, unwelcome disinflation and possibly financial strains. The analysis has implications for monetary and prudential policies. It calls for a firmer long-term focus, for greater symmetry in policy responses between upswings and downswings, with more attention being paid to actions during upswings, and for closer cooperation between monetary and prudential authorities. In recent years, the intellectual climate and policy frameworks have gradually evolved in a direction more consistent with this perspective. At the same time, obstacles to further progress remain. They are of an analytical, institutional and, above all, political economy nature. Removing them calls for further analytical and educational efforts.

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INTRODUCTION

In recent years, when judged against traditional macroeconomic yardsticks, developments in global interest rates and measures of "liquidity" have been remarkable. It is hard to find a period in the post-war era in which inflation-adjusted interest rates have been so low for so long and monetary and credit aggregates have expanded so much *without* igniting inflation (Graph 1). And by and large this has occurred against the backdrop of strong global growth, with historically record rates of late. One might even call this the Great Liquidity Expansion puzzle.[1]

From one perspective, this seemingly benign constellation of observations could be taken as a further confirmation of the so-called Great Moderation. The economic performance of much of the industrialised world since at least the 1990s, if measured in terms of short-term output volatility, has improved significantly compared with the past, not least with the Great Inflation era.[2] Have we finally reached the promised land of sustainable, non-inflationary growth? Have we finally mastered the secrets of the inner workings of the economy?

On the surface at least, there are good grounds to believe that we have learnt from past mistakes. No one could dispute that the drawn-out but successful battle against inflation has been fundamentally shaped by the lessons learnt in the 1970s. Likewise, it would be foolhardy to deny that the length of the current economic expansion, like that of the previous one in the 1990s, has a lot to do with inflation quiescence. Compared with the past, there has been less need for central banks to tighten aggressively in order to fight strong inflationary pressures. No doubt, greater anti-inflation credibility has better anchored inflation expectations. The remarkably benign effects of the latest oil price shock, at least so far, are testimony to this newfound stability.

And yet, past experience should counsel caution. Some of the most serious risks in the past have not arisen from the mechanical repetition of errors in identical circumstances. They have stemmed

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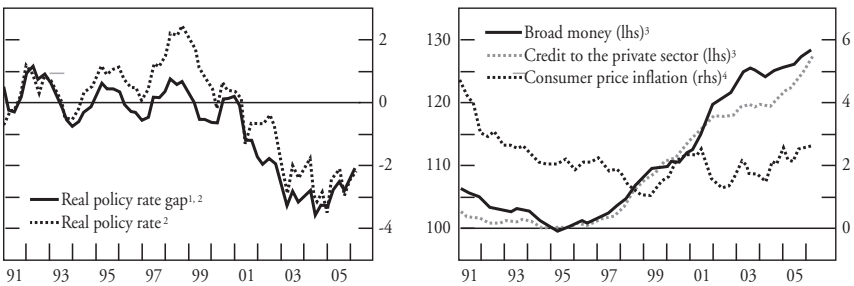
1. The vaguer term "liquidity" is used instead of "monetary" to encompass a broader range of measures, including, in particular, credit aggregates.

2. On these issues, see eg Blanchard and Simon (2001), Dalsgaard et al (2002), Stock and Watson (2003) and Galati and Melick (2006).

from the interaction between policy and changes in the economic environment (eg BIS (2005a) and Knight (2006)). And they have arguably reflected overconfidence in our ability to understand economic processes, a sense that policy was finally on the right track. It was so in the 1960s when, having "digested" the lessons of the Great Depression, policymakers thought that they had understood how to achieve full employment at the cost of moderate inflation. It was so in the lead-up to the Asian crisis, when fiscal probity and low inflation were seen as guaranteeing the sustainability of the Asian boom. And it was so even in the lead-up to the Great Depression, when the roaring twenties held out the promise of permanent prosperity.

Might we not be overestimating our understanding of the economy yet again?

Graph 1.
The Great Liquidity Expansion puzzle



Note: data for the G3 (the United States, euro area and Japan) are weighted averages, bases on 2000 GDP and PPP exchange rates. Prior to 1999, euro area data are calculated from member countries´ statistics.

1 Defined as the real policy rate less the natural rate. The real rate is the nominal rate adjusted for four-quarter consumer price inflation. The natural rate is defined as the average reall rate (1985-2005; for Japan 1985-95) plus the four-quarter growth in potential output less its long-term average.
2 Quarterly averages, in percent points.
3 Relative to nominal GDP, 1995 = 100.
4 In percent.

Sources: IMF; OECD; national data.

In some research work carried out at the BIS we have been exploring this possibility. Our main motivation has been to avoid the risk of one-sidedness in the interpretation of economic trends. Our focus has been on changes in what one might call the "tectonic plates" of the world economy, on those deep forces that, slowly but cumulati-

vely, can fundamentally alter the configuration of economic phenomena on the surface. Our goal has been to identify how the challenges faced by central banks may have been changing and to suggest possible solutions, conditional on that diagnosis.

In our analysis, we have been focusing on a triad of deep-seated forces: financial liberalisation, the establishment of credible anti-inflation monetary policies and, more recently, (real-side) globalisation.[3] Each of them, taken in isolation, is undoubtedly beneficial. All of them, in isolation *and* as a package, are precious and worth safeguarding. Taken together, though, they may have been changing the workings of the global economy in subtle ways that may not have been fully grasped, springing up new challenges from unsuspected quarters. Safeguarding the benefits of these remarkable forces may thus call for adjustments to current policy frameworks.

The overarching hypothesis we have been exploring is that in the new environment which has gradually been taking shape, the key "structural" risk may not be so much run away inflation. Rather, it may be the damage caused by the unwinding of financial imbalances that can build up over the longer expansion phases of the economy, typically spanning more than one higher-frequency business cycle. The unwinding can lead to economic weakness, unwelcome disinflation and possibly severe financial strains.

We have used the term "elasticity" to refer to the property of the economy which makes it more vulnerable to the cumulative, if occasional, build-up of imbalances (Borio and Lowe (2002a), Borio and White (2004)). The analogy is with an elastic band, which can be extended further, but which at some point could snap.[4]

The analysis has implications for monetary and prudential policies. In a nutshell, it calls for a firmer long-term focus, for greater symmetry in policy responses between upswings and downswings, with more attention being paid to actions during upswings, and for closer cooperation between monetary and prudential authorities. These refinements to current policy frameworks reinforce the more durable lessons

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3. The stress here is on real-side globalisation, as the implications of financial globalisation are already largely subsumed under financial liberalisation. For a discussion centred on these two dimensions of globalisation, see BIS (2006).

4. Another term used is "excessive procyclicality", especially when dealing with the prudential policy implications; see Borio et al (2001).

learnt from the past. They highlight the importance of long-term horizons, of heightened prudence in good times and of avoiding the shoals of time-inconsistent responses. But they do so from a fundamentally different perspective from the one to which we are accustomed.

Since these arguments were first articulated a few years ago, they have contributed to a broad-ranging debate. On balance, it is fair to say that they have found a more receptive audience among policymakers than among academics. They may have helped to better rationalise policy changes already in train. And they may even have indirectly contributed to some of those changes, by adding yet another perspective to discussions of monetary and prudential questions.

In this lecture, I would like to revisit these issues and extend the analysis a bit further. The revisiting part involves a summary of the main elements of the hypothesis and of some of the supporting empirical evidence. The extension part involves elaborating on the role of (real) globalisation, on what might be termed the Great Liquidity Expansion puzzle and on the degree to which policy initiatives have been consistent with the analysis put forward.

My remarks are divided into three sections. The first sets out the basic hypothesis, developing the implications of the changes in the financial, monetary and real economy regimes for the elasticity of the economy and hence for the nature of business fluctuations and for the nexus between monetary and financial stability. Special attention is paid to the role of globalisation, less discussed in previous work. The second section reviews the empirical evidence for the hypothesis. Here again, particular attention is paid to the more novel aspects of the work. The final section takes stock of policy changes in the monetary and financial arenas, highlighting what has been done and the challenges ahead.

I. The hypothesis

The basic hypothesis is that changes in the financial, monetary and real economy regimes worldwide may have been subtly altering the dynamics of the economy and hence the challenges that monetary and prudential authorities face (Borio and Lowe (2002a), Borio and White (2004) and Borio (2005)).

Financial liberalisation may have made it more likely that financial factors in general, and booms and busts in credit and asset pri-

ces in particular, act as drivers of economic fluctuations. The establishment of a regime yielding low and stable inflation, underpinned by central bank credibility, may have made it less likely that signs of unsustainable economic expansion show up first in rising inflation and more likely that they emerge first as excessive increases in credit and asset prices (the "paradox of credibility"). And the globalisation of the real economy may have represented a sequence of pervasive supply side "shocks", raising world growth potential and helping to keep inflation down while at the same time encouraging the asset price booms on the back of liquidity expansion.

As a result, the current environment may be more vulnerable to the *occasional* build-up of financial imbalances, ie overextensions in (private sector) balance sheets. These imbalances herald economic weakness and unwelcome disinflation down the road, as they unwind. The unwinding may occur either because inflation eventually *does emerge* and the central bank is forced to tighten or because the boom falters *under its own weight*.

The role of the financial regime

The financial liberalisation wave that the world has witnessed since the 1980s has been spectacular. Over the last couple of decades of the past century, heavily controlled and segmented domestic financial systems gave way to a lightly regulated, open and competitive global financial environment. To use a famous phrase coined by Padoa-Schioppa and Saccomanni (1994), by the early 1990s the transformation from a government-led to a market-led financial system was essentially complete.

Financial liberalisation is undoubtedly critical for a better allocation of resources and long-term growth. The serious costs of financial repression around the world have been well documented. But financial liberalisation has also greatly facilitated the access to credit. It has therefore also increased the scope for perceptions of wealth and risk to drive the economy, more easily supported by external funding. More than just metaphorically, we have shifted from a cash flow-constrained to an *asset-backed global economy*.[5]

5. To my knowledge, the term "asset-backed economy" was first used by Calverley (2004).

During booms, self-reinforcing processes can develop. These are characterised by rising asset prices, falling perceptions of risk, loosening external financing constraints and rising output. Financial imbalances arise when, less constrained by this looser anchor, the processes go too far. Under the surface, distortions in the real economy develop, notably in the form of capital misallocations, masked by the shiny financial gloss. As a result, the financial system does not build up sufficient cushions and loses resilience, thereby sowing the seeds for a subsequent bust. And the real-side distortions result in a more protracted and costly adjustment.

The deep reasons why the physiological and benign inherent "procyclicality" in the financial system can give rise to such occasional "pathological" episodes of "excessive procyclicality" are not well understood. We have argued elsewhere, however, that the pathological manifestations can arise from two "gaps" (Borio (2003) and Knight (2003)). They relate, respectively, to risk perceptions and incentives.

The *risk perceptions gap* refers to the observation that economic agents seem to be better at measuring the cross-sectional than the time dimension of risk, especially that of system-wide risk (Borio et al (2001) and Lowe (2002)). Market indicators of risk, such as price-earnings ratios and credit spreads, tend to be comparatively low close to the peak of the financial cycle. And this is precisely when, at least in hindsight, risk is highest.[6] Markets behave as if risk fell in booms and rose in recessions. But it may be better to think of risk as rising in booms, if and when financial imbalances build up, and as materialising in recessions, as they unwind. The length of the horizon over which risk is assessed is key here, as short horizons can lull economic agents into a false sense of security.

The *incentives gap* refers to the possibility that actions that may be rational, or indeed compelling, at the level of individual agents or institutions need not result in desirable aggregate outcomes. Familiar notions here include prisoner's dilemmas, coordination failures and herding. For instance, it may not be reasonable to expect a bank or asset manager to trade off a sure loss of market share in a boom against the distant hope of regaining it in a future potential slump. Here again, short horizons are key. And they may, in turn, result from the contractual mechanisms designed to overcome "asymmetric

6. As we shall see later, crisis indicators exploit this relationship.

information" obstacles, which may thus have unintended consequences. The routine monitoring of performance based on short-term benchmarks is one such example.[7]

The role of the monetary regime

The story of the great battle against inflation is well known. Since the 1990s, we have entered a phase of low and stable inflation across most of the world. This has gone hand-in-hand with institutional changes designed to hard-wire this success. They have taken the form of the establishment of monetary policy regimes focused on inflation control and underpinned by a greater degree of central bank independence.

It is equally well appreciated now that high and variable inflation can distort the allocation of resources and generate financial instability. Both a priori reasoning and past experience attest to this.

But financial imbalances can and do also develop in a low inflation environment. Favourable supply side developments can easily trigger and support the overly optimistic expectations that tend to fuel unsustainable booms. These, in turn, naturally put downward pressure on prices. More subtly, the credibility of policymakers' commitment to price stability, by anchoring expectations and hence inducing greater stickiness in prices and wages, can attenuate and significantly delay the inflationary pressures normally associated with the unsustainable expansion of aggregate demand. This can be regarded as a "paradox of credibility" (Borio and Lowe (2002a)). And low inflation, by obviating the need to tighten monetary policy, can also remove a key constraint on the development of the imbalances. There is a risk of unwittingly accommodating their build-up.

The role of the real economy regime

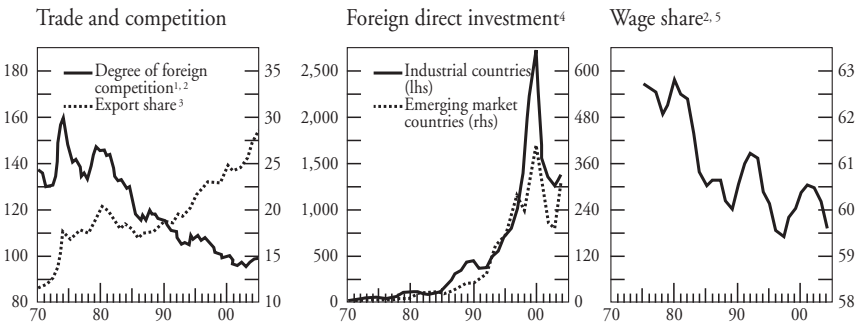
To my mind, the changes in the financial and monetary regimes just described are sufficient to increase the elasticity of the economic system. They provide the tinder to fuel the occasional wildfire. And the transitions from a repressed financial system to a liberalised one

7. On these issues, see also Rajan (2005).

or from high to low inflation can themselves supply the necessary spark to ignite it.

In our more recent work, however, we have been paying closer attention to the additional role of the globalisation of the real economy (BIS (2005a), (2006) and Borio and Filardo (2006)). True, the deeper integration of goods and services markets has been a gradual process throughout the post-war period. But it has no doubt accelerated since the early 1990s, with the integration into the market system of previous command economies such as China and the former Soviet Union and with a greater acceptance of market principles across many developing countries, not least India (Graph 2). The atomisation of production processes across borders (the so-called "supply chains") and the increasing tradability of services through outsourcing are among the most concrete manifestations of this process.

Graph 2.
Indicators of globalisation



1 Export prices/GDP deflator for G10 countries.
2 Weighted average based on 2000 GDP and PPP exchange rates; in per cent.
3 World exports/GDP, in per cent.
4 Sum of gross foreign direct investment inflows and outflows; in billions of US dollars.
5 Total economy in the G10 countries; as a percentage of value added.

Sources: IMF; OECD; United Nations; national data.

The potential impact of globalisation is multifaceted. It can be either direct or, more importantly perhaps, indirect, through interactions with monetary policy. What these various mechanisms have in common is that, under some conditions, they can all increase the "elasticity" of the economic system.

First, globalisation may have provided a spark or, more precisely, a sequence of sparks to ignite financial imbalances. The globalisation

wave has freed previously untapped resources, representing a significant outward shift in the production frontier of the world economy.[8] In particular, the effective increase in the labour force directly and indirectly "plugged into" the global economic system has been enormous (Freeman (2005)). Especially in China, the concrete possibility of shifting the corresponding underemployed resources to more productive uses at little additional cost can result in rather "soft" constraints on potential output, at least over the medium run. Moreover, globalisation has surely improved the efficiency with which resources are employed across the world. It has thereby leveraged comparative advantages and promoted a better dissemination of technological know-how, not least through foreign direct investment flows. Other things equal, by simultaneously putting downward pressure on prices and underpinning output growth, globalisation may also have given a pervasive boost to asset valuations across the globe.

Second, globalisation may have helped to underpin central bank credibility. The tailwinds of globalisation have arguably supported the disinflation process and made it easier, at least so far, to keep underlying inflation low in the face of increases in the prices of oil and other commodities.[9] By the same token, they may have contributed to strengthening central bank credibility, anchoring expectations more firmly. Thus, surprisingly perhaps, the "paradox of credi-

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8. More generally, any major improvements in the production possibilities of the economy would have a similar effect; a faster rate of technological advances is one other such example. Higher productivity growth driven by technological change has played a prominent role in some countries over the last decade or so, not least in the United States. The focus on globalisation derives from the broader geographical extension of the phenomenon.

9. There is no denying that, in the long run, inflation is a monetary phenomenon; however, *over any reasonable horizon relevant for policy*, real factors can have a significant effect. First of all, there is a direct effect, which includes the impact on prices and wage dynamics, *given monetary conditions*. There is also an indirect effect, reflecting the interaction between globalisation and *monetary policy decisions*. Central banks may choose to accommodate unexpected positive supply developments ("shocks") so as to gradually guide inflation lower, as noted in the so-called "opportunistic approach" to disinflation. While most central banks have adopted firmer inflation objectives since the 1990s, they all recognise that the pace at which inflation should be brought back towards the objective depends on the nature of the shocks to the economy and their resulting implications for the output costs of the adjustment. In addition, and more importantly, the authorities may have less than full control over the inflation rate over the short- and even medium-term horizons. For example, systematic underestimation of the influence of increases in global capacity on domestic prices could lead to systematic overestimation of inflation and a downward trend in policy rates to counteract it. They may not use the appropriate "model" of the economy, be unable to identify accurately the forces affecting it or have limited leverage over its evolution. Under these conditions, the influence of real developments such as increases in productivity growth or potential output could exhibit themselves as lower inflation. For a discussion of these and other channels, see Borio and Filardo (2006) and BIS (2005a), (2006)).

bility" and globalisation may be related and mutually reinforcing.

Third, if the nature of its *medium-term* disinflationary forces is not properly understood, globalisation could contribute to excessive monetary policy accommodation. Starting from a low level of inflation, favourable supply side developments could easily threaten to tip inflation below comfortable levels and into negative territory. In contrast to demand-driven deflations, however, such supply side-driven ones have historically been quite benign (eg Borio and Filardo (2004), Bordo et al (2004) and Bordo and Filardo (2005)). Not least, they have tended to go hand-in-hand with rising asset prices, liquidity expansion and strong output performance. One recent example is the strong expansion of China despite falling prices for goods and services in the late 1990s and, intermittently, some of the early years of the new century. Another is the even more recent experience of Sweden. The risk here is that by resisting these tailwinds too much through an easing of policy, the monetary authorities may further accommodate the build-up of financial imbalances (see below). Paradoxically, excessive resistance to "good deflations" can, over time, lead to "bad deflations", if the imbalances eventually unwind in a disruptive manner (Borio and Filardo (2004), White (2006a)).

Finally, under some conditions, globalisation could actually cloud the emergence of *short-term* inflation pressures, thereby further delaying the necessary monetary tightening. Globalisation has arguably implied that country-specific measures of slack in goods and labour markets have become less reliable as a guide to inflation pressures. In a world characterised by greater substitutability in goods and factor inputs, we would expect measures of global excess demand pressure to have gained significance at the expense of purely domestic ones. There is a sense in which the inflation process may have become less country-centric and more globe-centric (Borio and Filardo (2006)). If so, the risk is that, by focusing excessively on more traditional and purely *domestic* indicators of slack, the authorities might underestimate the build-up of near-term inflation pressures, if in fact *global* conditions turned out to be tighter.

Two stylised paradigms: the orthodox and the unorthodox

It is worth bringing these arguments together by highlighting the analytical differences between the paradigm just developed and the

one prevailing in much of the current academic work. For want of a better term, we call them the "unorthodox" and "orthodox" paradigm, respectively (Borio and White (2004)). Table 1 summarises the differences in an intentionally highly stylised way.

The "orthodox" paradigm stresses a number of points. In the simplest benchmark models, inflation is a sufficient statistic for distortions in the economy: stabilising prices stabilises output around its "natural" or flexible price equilibrium (eg Woodford (2003)).[10] By and large, financial factors play a peripheral role. In some mainstream versions of the models, they act as amplifying mechanisms for business fluctuations, through such channels as the financial accelerator mechanism (eg Bernanke et al (1999)). But, in our terminology, these are benign physiological procyclical forces; there is no role for financial imbalances as such. In particular, business fluctuations are seen as largely driven by sequences of exogenous economic shocks, with the economy quickly converging towards equilibrium. In effect, non-linearities are assumed away or to be of second order. Procyclical, time-varying risk tolerance of economic agents is unimportant. And rational expectations are standard, so that agents and policymakers are assumed to know the model of the economy and to use this information optimally.

Table 1.
Two stylised paradigms for economic fluctuations

	Orthodox	Unorthodox
Price stability for economic stability?	sufficient	not sufficient
Role of financial factors	peripheral	core
Financial imbalances/instability	little importance	critical
Business cycle	exogenous shocks – rapid convergence to equilibrium	endogenous – self-perpetuating cycles
Non-linearities	unimportant	critical
Changing risk tolerance	unimportant	critical
Rational expectations	standard	too constraining

The "unorthodox" paradigm is quite different. While strongly contributing to macroeconomic stability, price stability is not per se sufficient to ensure it. Financial mechanisms are at the core of busi-

10. Woodford himself, of course, recognises that other "rigidities" or frictions could play a role, violating this "divine coincidence", as termed by Blanchard (2005). Wage rigidities are one such example, which would imply seeking to stabilise wages too (eg Blanchard and Gali (2005)). Dupor (2002) argues that financial rigidities could provide a rationale for stabilising asset prices.

ness fluctuations, and the occasional build-up of financial imbalances is critical for output and inflation dynamics, as emphasised to varying degrees in the work of Kindleberger (1995) and Minsky (1982). Harking back to an even earlier intellectual tradition, the paradigm stresses the endogenous, self-perpetuating nature of business fluctuations.[11] Non-linearities and discontinuities are critical. Changing risk tolerance and risk premia play an important role in initiating and amplifying output dynamics. And the assumption of rational expectations is too constraining, unable to capture the endemic uncertainty in economic life.

II. The evidence

There are various pieces of evidence that are broadly consistent with the basic hypothesis outlined here. None of them, of course, is decisive. Some are at best suggestive. But, taken together, they do indicate that the implications of the hypothesis are worthy of further exploration and consideration in policymaking.

Five such pieces of evidence deserve highlighting: the pattern of financial booms and busts since financial liberalisation; the predictive content of financial imbalances; the coexistence of financial imbalances and low inflation; the implications of globalisation for inflation; and the signs of policy accommodation. Given previous work, in what follows I will recall briefly the first three and elaborate a bit more on the last two.

Credit and asset price booms and financial liberalisation

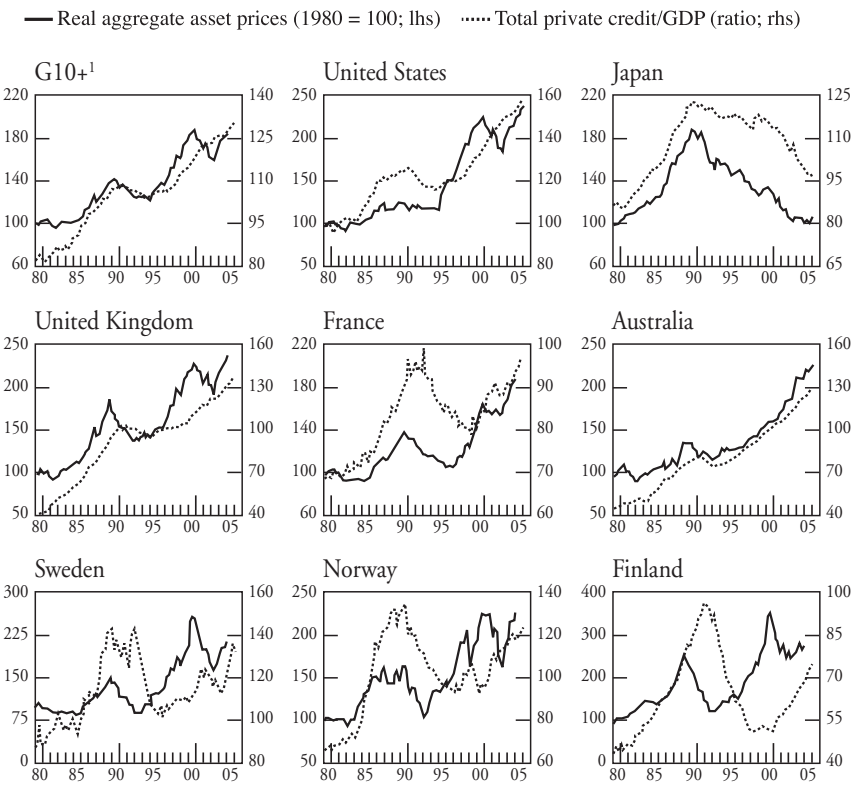
Especially since financial liberalisation in the early 1980s, we have seen larger booms and busts in credit and asset prices. These have often been followed by outright financial crises or at least serious financial strains with material consequences for the real economy.

The experience of the financial crises in emerging market countries is well known. Graph 3, however, illustrates that a similar, if more muted, phenomenon has also been taking place in the advanced indus-

11. This refers to the pre-Keynesian business cycle tradition, encompassing such widely different views as those of Hayek (1933), Schumpeter (1939), Pigou (1929) and Fisher (1932), as well as the post-war school that stresses endogenous business cycles, including Burns and Mitchell (1946) and Zarnowitz (1999).

trial world. The pattern is highlighted through the use of an aggregate asset price index, which combines equity and property prices, for both residential and commercial properties. The evidence indicates that since the early 1980s medium-term cycles, lasting around a decade, are clearly pervasive. The close link between (private sector) credit and asset prices stands out, both in the aggregate and for the residential property segment (Graph 4). The existence of this link has also been supported by more rigorous empirical evidence.[12] The ex post output costs associated with the booms and busts have also received considerable attention (IMF (2003), Detken and Smets (2004), Cecchetti (2006)).

Graph 3.
Large medium-term swings in asset prices and credit



1 GDP-weighted average of the Group of Ten countries, plus Australia, Denmark, Finland, Norway and Spain; weigths based on 2000 GDP and PPP exchange rates.

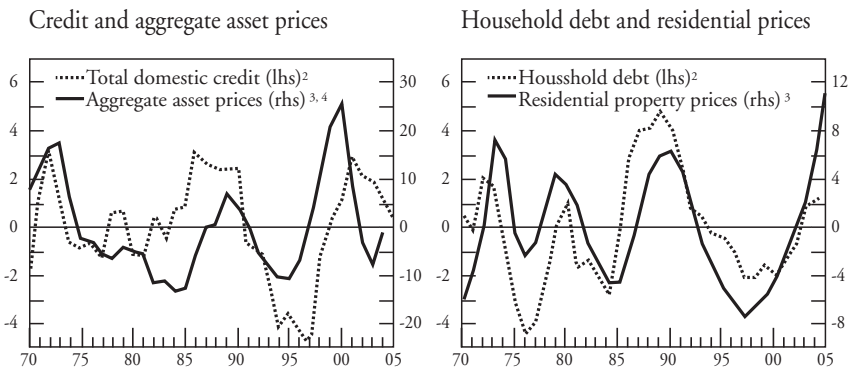
Sources: Private real estate associations; national data; BIS calculations.

12. For some examples, see Borio et al (1994), Gerlach and Peng (2002), Hofmann (2001), Davis and Zhu (2004) and Goodhart et al (2005).

The predictive content of financial imbalances

More formal empirical evidence suggests that simple indicators of financial imbalances can help to *predict* banking distress, economic weakness and *disinflation* over a 3–5 year horizon *as the boom develops* (Borio and Lowe (2002a, 2002b, 2004) and Table 2).

Graph 4.
Credit, asset prices and household debt[1]



1 Weighted average for G10 countries, based on 2000 GDP and PPP exchanfe rates; 1970 and 2004 figures are partly estimated. Data are deviations from trend calculated using a two-sided Hodrick-Prescott filter.
2 As a percentage of GDP.
3 Nominal prices, deflated by the personal consumption deflator.
4 Weigthed geometric mean, based on net wealth data, of three asset classes (equity, residential property and commercial property).

Sources: OECD: national data: BIS calculations and estimates.

Crucially, the indicators are based on *real-time* measures of *joint* excessive asset price increases and credit growth. The proxies are intended to measure the coexistence of asset price misalignments with a limited capacity of the system to absorb the asset price reversal. Misalignments are simply captured by deviations of equity[13] and possibly exchange rates from trend, and the absorption capacity of the system by the ratio of private sector debt to GDP. Importantly,

13. Equity, as opposed to real estate, prices were used simply because of restrictions on data availability. Conceptually, real estate prices should be expected to perform better. If anything, it is surprising how much mileage one can get by simply relying on equity prices. In part, this may result from the historically close correlation between the two asset classes, with booms and busts being temporally close and with peaks in equity prices tending to lead those in real estate prices by about a couple of years (Borio and McGuire (2004)). This tight correlation has been less in evidence in the cycle under way.

Table 2.
Financial imbalances[1] as predictors of banking distress, output weakness and disinflation

Horizon (years)[4]	Banking distress[2]					Industrialised countries[3]				
	Industrialised Countries		Emerging market countries			Credit gap (4) and equity gap (60)		Credit gap (4), equity gap (60) and output gap (2)		
	Credit (4) and asset price (40)		Credit (4) and (asset price (40) or exchange rate (13))		Horizon (years)[4]	Banking distress		Horizon (years)	Output weakness	Disinflation
	Noise/ signal	% crises predicted	Noise/ signal	% crises predicted		Noise/ signal	% crises predicted		Conditional probabilities[5]	
1	0.09	50	0.16	67	3	0.06	47	2	55 (1.06)	36 (–1.07)
1, 2	0.06	56	0.12	71	3, 4	0.02	47	3	99** (2.91)	55 (0.31)
1, 2, 3	0.04	63	0.09	75	3, 4, 5	0.02	73	4	1.00[6] –	92* (2.38)

[1] The proxies for financial imbalances are calculated based on deviations of the corresponding variables from ex ante (one-sided) recursive Hodrick-Prescott filter trends ("gaps", with percentage points in brackets). The value of lambda is 1,600 (for annual data) and 400,000 (for quarterly data). Depending on the exercise, the variables used include the ratio of private sector credit to GDP, inflation-adjusted equity prices, the real effective exchange rate and the output gap (conventionally measured, with lambda equal to 1,600 in quarterly estimation).

[2] Annual data.

[3] Quarterly data.

[4] A signal is correct if a banking crisis takes place in any of the corresponding years ahead included in the horizon.

[5] Conditional probabilities of output weakness (ex ante output gap smaller than minus 1%) and of a decline in inflation (average for the year) in the given year ahead. The corresponding unconditional probabilities are 39% (output weakness) and 50% (decline in inflation). Z statistics for the probit regressions in brackets. Two and one asterisks correspond to statistical significance at the 1% and 5% level, respectively.

[6] Conditional probability calculated by counting the frequency of events; the econometric routine does not converge. If the output gap is excluded from the indicator, the corresponding figures for the combined credit and equity gap are 41 (0.50), 66** (5.54) and 75** (7.00) for the horizon in year 2, 3 and 4 ahead respectively.

Sources: Borio and Lowe (2002b, 2004).

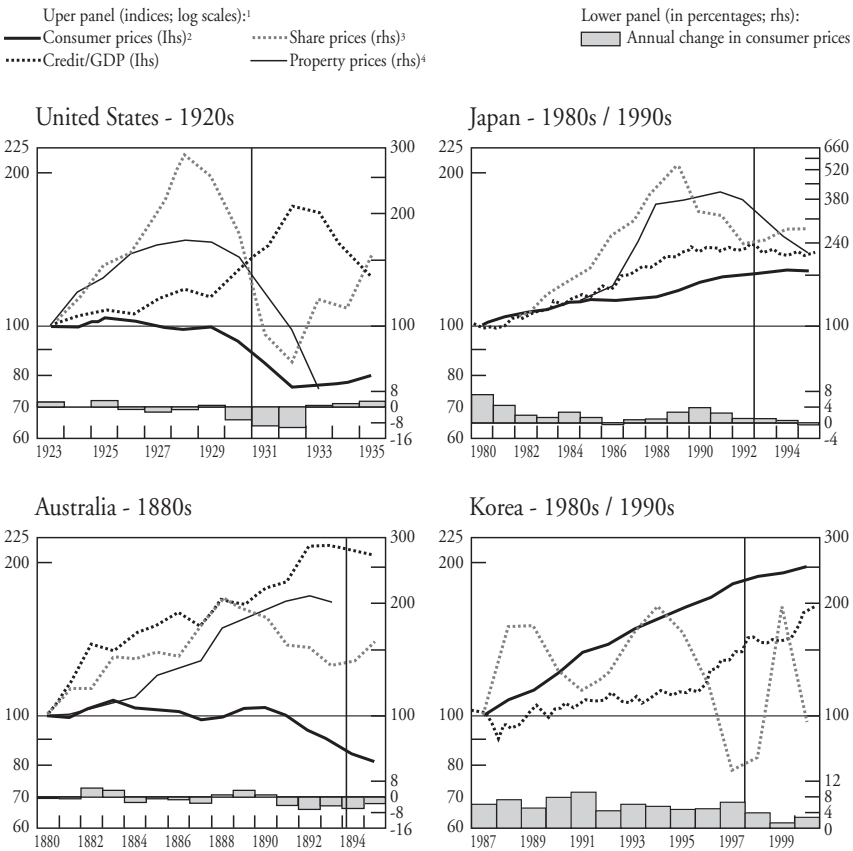
these indicators are based only on ex ante information, ie on information that is available at the time the assessments of vulnerabilities are made; in particular, the trends are calculated only up to that point. And the information content is *additional* to that contained in output gap measures and the past history of inflation.

Financial imbalances and low inflation

The above evidence does not differentiate between periods of high and low inflation, or between those of rising and falling inflationary pressures. Experience indicates, however, that while present during

high inflation periods, financial imbalances have also occurred during periods of low and stable inflation (Graph 5) (Borio and Lowe (2002a)). In the distant past, well known examples include the financial crises during the classical and exchange gold standards (Bordo et al (2001), Goodhart and De Largy (1999) and Eichengreen and Mitchener (2003)). More recently, cases in point include the expe-

Graph 5.
Low and stable inflation and financial instability: selected episodes



1 Base year: for the United States, 1923; for Japan, 1980; for Australia, 1880; for Korea, 1987.
2 For Australia, GDP deflator.
3 For the United States, S&P 500; for Japan, Nikkei 225; for Australia, All Ordinaries.
4 For the Unites States, Chicago land value; for Japan, Tokyo commercial land prices; for Australia, Melbourne capital value of rateable property.

Sources: For property prices: Tokyo National Land Agency and local governments; Chicago, Hoyt (1993); Melbourne, Kent and D´Arcy (2001); otherwise, Taylor "Global Financial Data" (database) and national data; Borio and White (2004).

rience in Japan and several countries in East Asia and, without a full-blown crisis following, in the United States. Arguably, at present, developments in China as well as in housing markets in many countries around the world exhibit similar characteristics (Borio and McGuire (2004), BIS (2005a)). I will return to this point later. Moreover, the same evidence also suggests that, if anything, *on average* inflation declines as financial imbalances build up ((Borio and Lowe (2002a)).

Globalisation and disinflation

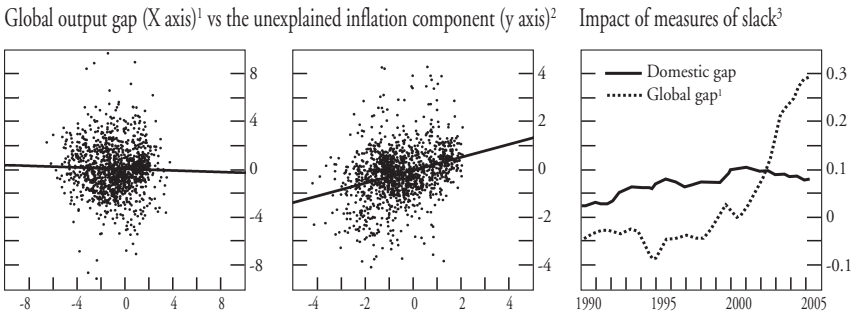
Within the business world and policymaking circles, the notion that globalisation may have been helping to reduce and then keep inflation under control has become common currency. In academia, however, this proposition has not received much attention.[14] The evidence so far has indeed been suggestive of an effect of globalisation on inflation, at least based on the more recent experience (Tootell (1998), Morimoto et al (2003) and Ciccarelli and Mojon (2005)).[15]

Exploratory work that we have done at the BIS has also been supportive of this effect (Borio and Filardo (2006)). We have focused on one specific implication of globalisation, namely the expectation of a stronger impact of global measures of slack in addition to, and possibly at the expense of, purely domestic ones. Graph 6 illustrates this point. The scatter plot shows that over a large set of industrial countries there is an economically and statistically significant impact of global slack measures on inflation. This influence is discernible over and above any effect that might result from domestic measures of slack. And it has grown over time, as indicated by the rising coefficient from a panel regression calculated over 20-year intervals. While not shown, these results are also confirmed in single-country regressions and survive the inclusion of various controls, such as import and oil prices.

14. Rogoff (2003) has been a major exception. Drawing on the framework developed by Barro and Gordon (1983), he has focused on the impact of competitive pressures on central bank incentives to generate surprise inflation. Whether this is a useful descriptive hypothesis, however, is somewhat doubtful. The anti-inflation frameworks established in the 1990s were specifically designed to insulate central banks from pressures to deliberately inflate the economy to reduce unemployment below its perceived equilibrium level.

15. There is also a related literature looking at the link between openness and inflation; see eg Romer (2003).

Graph 6.
Global measures of slack and domestic inflation



Note: The first two panels cover the periods 1972-1992 and 1985-2005 respectively.

1 Measured as a weighted average of the output gaps of the top 10 importers per country, with weights corresponding to their import shares. The results also hold for other measures of global slack.
2 Residual from a regression of the deviation of actual CPI inflation from underlying inflation on the domestic aoutput gap for 16 industrial economies (including the euro area where possible). The output gap is measured usin a Hodrick-Prescott filter. Underlying inflation is measured witn a Hodrick-Prescott on core inflation.
3 Coeficient of a 20-year rolling regression ending in the corresponding year.

Source: Borio and Filardo (2006).

Monetary policy accommodation

The evidence of monetary policy accommodation of financial imbalances is not straightforward to establish. The main difficulty is setting appropriate benchmarks with respect to which to measure it. With this caveat firmly in mind, however, several observations are broadly consistent with the hypothesis.

This is the message that emerges from some econometric work we have done for a sample of industrial countries, based on *estimated* Taylor rules augmented with proxies for financial imbalances (Borio and Lowe (2004)). That work suggests that since the early 1980s central banks generally either have not responded systematically to financial imbalances or, to the extent that they have, have responded asymmetrically. Specifically, they may have loosened policy further than normal in the face of economic weakness associated with the unwinding of financial imbalances ("headwinds") but do not appear to have leaned against them in a similar fashion as they built up. This should not be surprising, since it confirms the view put forward by policymakers that

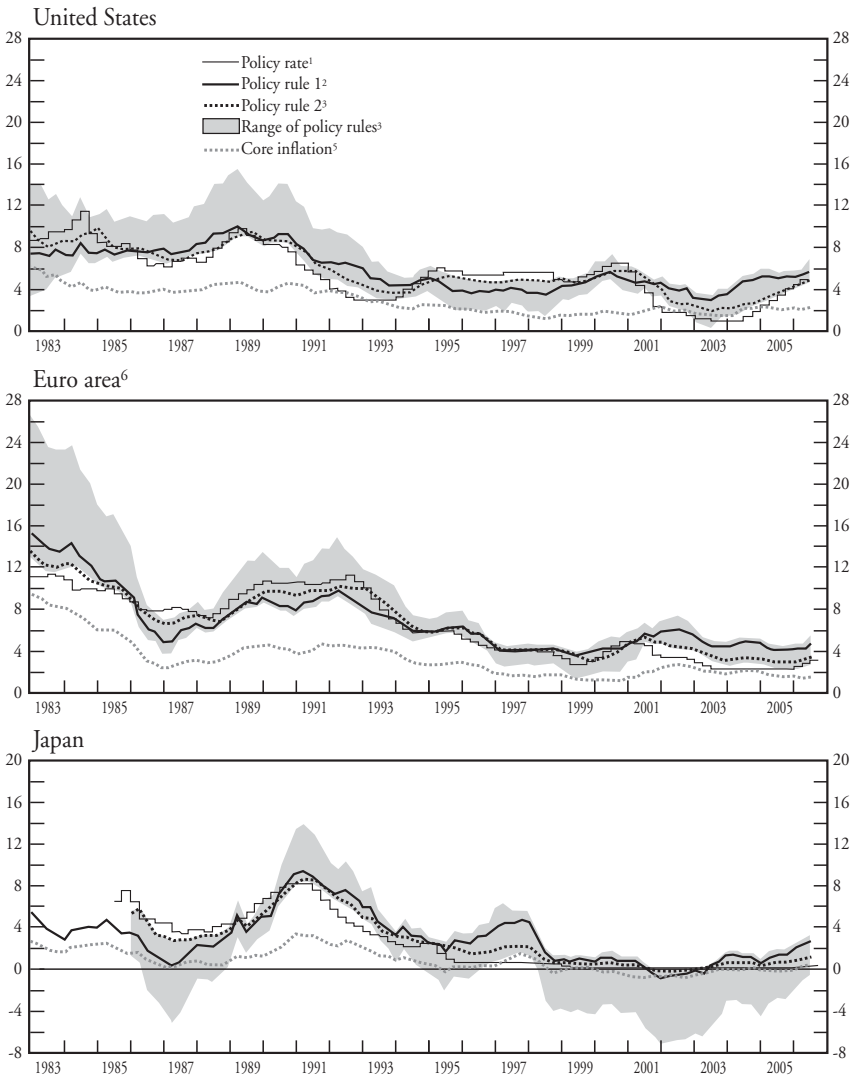
uncertainties are simply too large to warrant a different approach.[16]

A similar message emerges from a look at "reasonable" Taylor rules, based on a range of typical parameter values from model *calibrations* found in the literature (Borio and Lowe (2004), BIS (2002)). The point is illustrated in Graph 7, which relates to the United States, the euro area and Japan. In particular, interest rates were below the bottom part of the range following the stock market crash of 1987 and again in the more recent period, following the equity market collapse in 2000 and the onset of the recession, exacerbated by the uncertainties associated with the 9/11 attacks. The exception recently was Japan, where nominal rates were constrained by the zero lower bound. Both then and more recently, the accommodative monetary policy arguably contributed to booms in property markets. In the late 1980s to early 1990s, these booms unwound with serious macroeconomic costs and generated financial strains.

Less formally, it is quite striking that the period since the 1990s has witnessed a major cumulative expansion in credit and monetary aggregates while inflation-adjusted policy rates have been almost as low as during the initial stages of the Great Inflation era (Graph 8). If the growth potential of the world economy has indeed increased as a result of supply side developments, not least globalisation, one would expect equilibrium steady-state policy real interest rates to have risen. This indicates a certain tension between the path that actual interest rates have followed, in response to the *short-run* behaviour of inflation, output and financial strains, and the *end-point* towards which they would be expected to move over time. Hence, one possible reason behind the recurrent talk about "normalisation" of interest rates in policymaking circles. Only recently has the gap begun to narrow, partly in response to uneasiness with this configuration of factors. There is a question of whether the asymmetric response to the imbalances may not have contributed to this situation. This is the time-inconsistency issue in a different guise (Borio and White (2004), White (2006a)): responding in a compelling fashion to a sequence of short-run untoward developments may, over the longer term, not necessarily result in an optimal trajectory of responses.

16. See, for instance, Ferguson (2003) and Kohn (2006). Note that these asymmetries may in part reflect non-linearities in economic relationships, such as in the transmission mechanism of policy (eg the well known pushing-on-a-string argument, particularly relevant at times of financial strains).

Graph 7.
Calibrated Taylor rules: sensitivity analysis

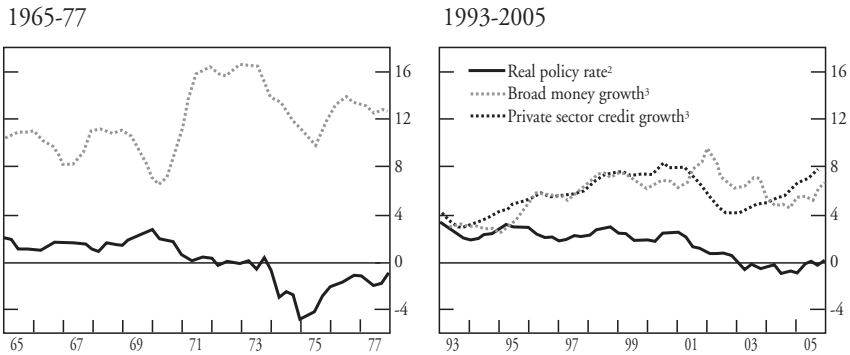


Note: The areas of vertical shading represent periods in which the composite credit (4%) and equity (60%) gap indicator signals financial imbalance.

1 Fot the United States, federal funds rate; for Japan, uncollateralised overnight money market rate; for the euro area, main refinancing rate.
2 Rule 1 = $r + \pi_t + \alpha(\pi_t - \pi^*) + \beta(y_t - y^*_t)$, where r is the natural rate of interest (assumed to equal 3%), π_t is core inflation, $(y_t - y^*_t)$ is the output gap, π^* is the baseline inflation (assumed to equal 2%), α=0.5 and β= 0.5.
3 Rule 2 = 0.4 (rule 1) + 0.6 i_{t-1}, where i_{t-1} is the policy rate lagged one quarter.
4 Range of policy rules with r set to 2.5% or 3.5%, α set to 0.5 or 2 and β set 0.5 or 1.
5 Percentage change over four quarters in core conumer goods and services. For Japan, excluding the effect of the introduction (1989) and increase (1997) of the consumption tax.
6 Prior to 1999, calculations based on euro area economies´data.

Source: Borio and Lowe (2004), updated.

Graph 8.
Two great liquidity expansions compared[1]



1 Weighted averages for G10 countries based on GDP and PPP exchange rates, in per cent.
2 Nominal policy rate adjusted for four-quarter consumer price inflation.
3 Four-quarter changes. Includes non-G10 euro area countries.

Sources: OECD; national data; BIS calculations and estimates.

The current situation through the unorthodox lens

Bringing all this together, looking back at the experience over the last two decades, it is possible to detect patterns in global developments in output, inflation and financial variables that are consistent with the hypothesis outlined here. They suggest that the dynamics of the world economy may indeed have changed in ways that have significantly altered the policy environment.

Consider first the developments leading up to the slowdown in the early years of the century. The experiences in Japan, some countries in East Asia and, in several respects, in the United States shared a common characteristic: investment-led booms that were reinforced by financial developments and that did not usher in rapidly rising inflation.[17] These tended to coincide with periods during which sustainable growth prospects were considerably overestimated.[18] In those cases where financial imbalances grew sufficiently large and unwound in a disruptive way, financial strains emerged, helping to put further

17. There is, of course, considerable debate over the reasons for the observed tendency to overpredict inflation in the second half of the 1990s, as several factors may have been at play (eg BIS (2001a, 2001b) and, more recently, BIS (2003)).

18. Long-term growth prospects have typically been adjusted markedly downwards in the wake of the disruptive unwinding of imbalances. For example, between April 1997 and April 2001, the con-

downward pressure on prices. And in contrast to much of the post-war experience, the global slowdown that began in the autumn of 2000 was *not* fundamentally triggered by a tightening of monetary policy to restrain inflation pressures. Rather, it was mainly the result of the spontaneous reversal of the previous investment boom and of the collapse of equity prices, which had reached unsustainable heights. Although the subsequent recession in the United States was comparatively mild, the global slowdown was rather strong by past standards. If output is measured in PPP terms, the slowdown among the G7 ranks close to those associated with the oil price shocks of the 1970s (Borio and White (2004)).

The subsequent developments up to the present are equally telling. With inflation remaining quiescent and even threatening to fall further, monetary policy became very accommodative globally, compounding in some cases a sizeable fiscal stimulus. Indeed, this strong response was an important reason why the slowdown was not greater. In some cases the easing reflected purely domestic developments. In others, especially in emerging market countries, it was in part the result of resistance to undesired upward pressure on the exchange rate. The result, not unlike what had occurred following the stock market crash of 1987, was that the global recovery was critically supported by a real estate boom, in this case limited to the residential sector on the back of the build-up in household debt. By contrast, against the background of previous excessive capital accumulation, business fixed investment has remained unusually subdued. The exception has been China, which is experiencing a strong investment-led expansion supported by rapid credit expansion and buoyant asset prices, not unlike the ones that preceded it elsewhere. In the meantime, inflation-adjusted interest rates have remained unusually low by historical standards, even as global growth, while very uneven geographically, has regained vigour, recording some of the strongest rates ever in the last few years. Only more recently have questions been raised about whether *near-term* inflationary pressures may not finally be emerging and be underestimated, as global short-term capacity constraints may be approached in several large countries *simultaneously*.

sensus long-term (10-year) growth forecast for four East Asian countries experiencing financial crises in 1997 (Indonesia, Korea, Malaysia and Thailand) was reduced from just over 7% to 5.5%, reflecting a slowdown in productivity growth. See also Borio et al (2003) for a discussion of these issues and corresponding references.

How is this consistent with the Great Moderation? The basic hypothesis outlined here pays more attention to potential longer-term "misalignments" in the real economy than to shorter-term fluctuations, the metric used to measure the lower volatility associated with the Great Moderation. An analogy with financial markets is helpful here. It is well known that short-term volatility is low in bull markets, including when misalignments develop, and high in bear markets, when they unwind. Taking a long-term perspective, the same could be said of the performance of the real economy. Moreover, measured by the usual metric, not all countries have experienced the same Great Moderation. In particular, a number of those experiencing major financial strains after the boom phase did experience higher short-term volatility, including Japan and East Asia (Borio and White (2004)).

III. THE POLICY IMPLICATIONS

The hypothesis, if accepted, has a number of significant implications for prudential and monetary policies and for their coordination (Borio and White (2004), Borio (2005) and White (2006b)). Next, I outline these implications and then, against their backdrop, I assess how policy has evolved in recent years.

The desiderata

Prudential policy

As regards prudential policy, the main implication is the need to strengthen the macroprudential orientation of the existing frameworks (Crockett (2000), Borio (2003)). This means taking further the current shift away from a focus on individual institutions towards one on the system as a whole. And it means addressing more explicitly the endogeneity of risk with respect to the collective behaviour of institutions. This is the endogeneity of risk that arises largely from the incentives gap identified above, whereby extension can result in over-extension and retrenchment in over-retrenchment.

What does this mean more concretely?

First, it means encouraging the build-up of cushions in good times so that they can be run down, up to a point, in bad times.

Unless they are run down, they cannot act as cushions in the first place, so they need to be sufficiently high to start with. This policy would strengthen individual institutions and the system as a whole. Moreover, by leaning against the procyclical forces of the economy, it could limit the size of financial imbalances and hence the risk of subsequent financial instability.

Second, it means improving the measurement of system-wide risks. This would help calibrate prudential instruments and improve firms' own risk management (Tarashev (2005)).[19] Better measurement could be based on a broader assessment of vulnerabilities. It would be guided by the type of considerations behind the indicators developed above and complemented by macro-stress testing and a large dose of judgement. Fitch Ratings, for instance, has implemented a combination of micro- and macroprudential indicators to rate banking systems and countries, with the macroprudential component based on the indicators presented here (Fitch Ratings (2005)).

Monetary policy

As regards monetary policy, it is essential for the framework to allow enough room for policy to lean against the build-up of imbalances *even if near-term inflation pressures remain subdued*.[20] This would limit the risk of bigger dislocations later on, with serious consequences for the real economy and also for inflation. Importantly, with inflation low to start with, one should not underestimate the twin risks of unwelcome deflation and of hitting the zero lower bound for policy interest rates.

The additional flexibility calls for two policy refinements. The first is *lengthening the policy horizon* beyond the one to two years typical of some inflation targeting regimes.[21] The corresponding cumulative processes through which imbalances build up and unfold take

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19. In particular, Tarashev (2005) finds that measures of imbalances based on Borio and Lowe (2002a) can help to improve the predictive performance of well known and widely used micro-based models of default.

20. Much of the technical and academic debate on this has been couched in terms of the response to asset price "bubbles"; see eg Bernanke and Gertler (1999, 2001) and Gruen et al (2003) (interpreted as being against the use of pre-emptive monetary policy) and Kent and Lowe (1998), Cecchetti et al (2000, 2003), Blanchard (2000) and Dupor (2002) (seen as being in favour). Bordo and Jeanne (2002) is probably the closest in spirit to Borio and Lowe (2002a), as they focus on the interaction between debt and asset prices. For a further discussion of these issues, see Filardo (2004). For a focus on credit, see eg Lorenzoni (2005).

21. For a detailed discussion of the horizon questions, see also Disyatat (2005).

considerable time. The second is *paying more attention to the balance of risks* to the outlook. The timing of the unwinding of the imbalances is highly uncertain. And given the obvious forecasting difficulties, the longer horizon should primarily be seen as a device to assess the balance of risks facing the economy in a more meaningful and structured way.

The room for manoeuvre allowed by this framework is especially important in the presence of benign deflations. In the future, as recent experience suggests, one may expect a greater likelihood of periods characterised by supply-driven very low inflation – if not outright mild deflations – below central bank objectives, against the backdrop of a buoyant economy, rising asset prices and liquidity expansion. Leaning against such "good deflation" pressures by easing policy could unwittingly accommodate the further build-up of imbalances, with the paradoxical risk of setting the stage for a "bad deflation" further down the road, if the imbalances unwound in a particularly disruptive manner.

Cooperation and policy coordination

It is clear that the hypothesis also puts a premium on cooperation and coordination between prudential and monetary authorities. This is so at various levels.

The first level relates to the intellectual framework. A precondition for effective policy coordination is developing a common understanding of the issues. This in turn calls for an intense dialogue between the two sets of authorities. Monetary authorities can bring to the table their long-standing expertise in assessing the links between the macroeconomy, the financial system and market behaviour; prudential authorities can offer their intimate knowledge of the banking business and risk management practices, key to understanding the evolution of risk assessments, risk attitudes and pricing (BIS (2005b)).

The second level relates to the development of the necessary tools. Developing them should leverage the expertise of each type of authority. For example, diagnostic tools such as macro-stress tests require a good understanding of the nexus between the evolution of the macroeconomy and the financial system, on the one hand, and the response of banks to deterioration in the quality of their assets, on the other (eg Sorge (2004) and IMF (2005)).

The third level relates to the deployment of the tools. Action is

most effective if the authorities speak with one voice and coordinate their responses. It is possible to envisage a graduated sequence of policy actions. Once a problem is identified, and the diagnosis shared, the initial response could be coordinated warnings about the sign of overextension. The next step would depend on the precise nature of the problem. Targeted tools would be preferable if the problem was largely limited to a particular segment, such as commercial real estate. Examples include, for instance, requiring specific stress tests, tightening lending and underwriting standards, lowering loan-to-value ratios or raising minimum capital through the supervisory review process. However, if the problem was more generalised or was building through market, as opposed to bank, finance, the interest rate tool might be more effective. And joint action could add bite to the policy response.

The state of play

It is fair to say that, over the last few years, the intellectual climate among policymakers has become more receptive to aspects of the hypothesis put forward here. On the prudential front, the watershed was the Asian financial crisis, which highlighted the strong linkages between system-wide financial sector vulnerabilities and macroeconomic performance. In addition, the development of more risk-sensitive approaches to capital standards (Basel II) put the spotlight on the implications of time-varying risk assessments for minimum capital, bank lending and the macroeconomy.[22] As a consequence, the terms "macroprudential" and "procyclicality" have risen from virtual obscurity to become very familiar to policymakers, practitioners and academics alike. On the monetary front, the coexistence of recurrent asset price booms, rapid monetary and credit expansion in the absence of obvious inflationary pressures, and sometimes even alongside mild deflation, have inevitably posed difficult choices for central banks. Policymakers have tried to incorporate these new phenomena within their frameworks. In fact, the speed of the change could hardly have been anticipated a few years back.

22. The literature on this has been growing exponentially; see eg Borio and Crockett (2000), Borio et al (2001), Danielsson et al (2001), ECB (2001), Gordy and Howells (2004), Catarineu-Rebell et al (2003), Segoviano and Lowe (2002), Kashyap and Stein (2004), Ayuso et al (2004) and Taylor and Goodhart (2005)).

Progress has been somewhat slower in translating this more favourable intellectual backdrop into concrete policy actions. Concrete implementation has faced serious obstacles of an analytical, institutional and political economy nature. Cultural factors loom large (White (2004), BIS (2005a), Borio et al (2001), Borio and Lowe (2002a)).

Prudential policy[23]

Macroprudential monitoring has become more prominent within the prudential community, supplementing in a more systematic way the more traditional peer-group analysis. It has tended to combine the use of quantitative tools, such as macro-stress tests, leading indicators of financial distress of the type reported in this lecture, and less formal indices of vulnerabilities, with an inevitable and healthy large dose of judgement. The IMF and World Bank have played an important role in encouraging these practices through their Financial Sector Assessment Programs (FSAPs). At an international level, several fora now exist where this type of analysis has become routine. The Financial Stability Forum, for instance, brings together senior representatives of national and international prudential authorities, central banks, ministries of finance and international financial institutions.[24]

A stronger macroprudential orientation has also begun to filter through to the calibration of prudential instruments. First, following a wide-ranging debate, the Basel Committee made adjustments to Basel II, partly with a view to reducing its potential procyclicality (Borio (2003) and Caruana (2004)). Moreover, the supervisory review pillar can in principle be used to adjust capital in the light of the build-up of financial imbalances, if these are identified in good time. Second, some supervisory authorities have designed certain prudential tools so as to act as built-in stabilisers through the cycle. The best such example is the introduction of statistical loan provisioning by the Bank of Spain, calibrated to average historical experience in loan losses in order to avoid excessive

23. A macroprudential approach to financial supervision has implications for the design of the framework with respect to both the time dimension (procyclicality) and the cross-sectional dimension (addressing common exposures across financial institutions). This section deals only with the time dimension, closer to the main thesis of the lecture. For an analysis of the cross-sectional dimension, see Borio (2003).

24. Another such forum is the BIS-based Committee on the Global Financial System, which includes exclusively central bank representatives.

declines in provisioning levels in good times (eg Fernández de Lis et al (2001)). Finally, several authorities have discretionarily adjusted prudential tools so as to limit procyclicality[25]. In most cases, this has entailed tightening standards in good times. Examples include, for instance, loan-to-value ratios (eg Hong Kong, Korea and Thailand), capital requirements against real estate lending (eg India, Norway and Portugal), provisioning rules (Korea) and overall exposures to the property sector (eg Hong Kong, Malaysia). In at least one other case, it has involved relaxing standards, at least temporarily, to avoid vicious circles of falling asset prices and additional sales. In particular, in 2002 the UK FSA adjusted the stress test requirements for insurance companies to avoid destabilising sales of equities (FSA (2002)).

Several obstacles have stood in the way of a further strengthening of the macroprudential orientation.

Analytically, a number of outstanding issues remain. They concern the identification of vulnerabilities in good time and the calibration of the tools. In identifying vulnerabilities, despite the progress made, the technology and practice are still in their infancy. Both macro-stress tests and leading indicators of distress still fall short of providing a degree of comfort generally regarded as sufficient to underpin discretionary policy responses. In calibrating the tools, there are questions concerning their effectiveness, which can vary with the characteristics of the financial system, eg the degree of openness, the relative importance of banks and open capital markets, etc. Clearly, there is a catch 22 here: some of these questions cannot be resolved until the approach is actually put into practice, but questions about its effectiveness may inhibit its implementation.

Institutionally, the alignment between objectives, control over instruments and expertise to use them is often imperfect. The objectives of prudential authorities may not be easily reconcilable with a macroprudential orientation. In particular, many prudential authorities have strong depositor/investor protection elements in their mandates, which can make the use of the tools from a macroprudential perspective rather difficult. In addition, control over instruments may be dispersed across various types of authorities with different objectives. For instance, statistical provisioning can be seen as inconsistent with interpretations of current international accounting standards. It clearly helps if, as in Spain, the prudential authority is also in charge of interpreting and implemen-

25. See Borio and Shim (2007) for a detailed list and assessment of the measures taken.

ting those standards for the banking sector. But this is more the exception than the rule.[26] And, finally, the prudential authorities may lack the necessary expertise. The natural predominance of legal and accounting backgrounds in the regulatory and supervisory profession does not provide a very receptive soil for macroprudential seeds.

Finally, from a political economy perspective, the actions may face strong resistance on the part of the regulated firms, the body politic and the public at large. The nature of the prudential mandates can be one reason for resistance. But, beyond this, there are broader cultural elements at work. Not least, there is as yet only limited recognition of the importance of a macroprudential perspective beyond narrow policy circles, hindering acceptance for its day-to-day implementation. Securing acceptance is especially hard as one of the hallmark implications of the perspective is the need to take tough measures *in good times* to prevent the emergence of problems. As we know from experience with monetary and fiscal policy, taking away the punch bowl when the party gets going is not a particularly popular task. The proper incentives are not hard-wired institutionally (White (2006a)).

Monetary policy

The concrete possibility that financial imbalances may build up in periods of low and stable inflation and cause subsequent macroeconomic damage has by now been widely recognised within the central banking community. Likewise, the case for a preventive monetary response, *at least in the sense of not ruling it out a priori*, has gradually been gaining greater favour. So much is evident from public pronouncements in speeches and official documents.[27] At least from a rhetorical perspective, it has been helpful to shift the debate away from the emotional and almost metaphysical question of the response to asset price "bubbles" to the more concrete one of identifying the financial symptoms that might herald macroeconomic risks over a medium-term horizon (eg "financial imbalances").[28] Above all, it has brought firmly into the picture the role of credit and monetary aggregates, historically much more familiar to central banks.

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26. As an alternative, additional provisions could be replaced by higher capital requirements. On this, see Borio and Lowe (2001) and Borio and Tsatsaronis (2005).

27. See Bean (2003), Issing (2003) and (2004), Bäckström (2002), Gjedrem (2004), Dodge (2003), Stevens (2003) and Bollard (2004). For a contrary view, see eg Ferguson (2003) and Kohn (2006).

28. This is not to say, though, that for strictly analytical purposes the concept of a "bubble" is necessarily unhelpful. For a defence of this point, see Filardo (2004).

The way this new element has been accommodated, *at least in principle*, within the various monetary policy frameworks has depended on their characteristics. In inflation targeting regimes, it has been acknowledged that the policy horizon may sometimes need to extend beyond the one to two years typically used in practical policy implementation (Bean (2003)). From this perspective, the Norges Bank actually lists financial imbalances as one factor that may influence its interest rate decisions, requiring a lengthening of the traditional horizon (Qvigstad (2006), Haugland and Vikren (2006)). In the case of the ECB, where the medium-term orientation has been more in evidence from the beginning, the "monetary analysis" pillar has been invoked also as a safeguard against the build-up of financial imbalances (eg Issing (2003, 2004) and ECB (2005)). Correspondingly, alongside monetary aggregates, credit aggregates have also become more prominent than in the past. In the framework recently announced by the Bank of Japan, the required flexibility is provided by the so-called second perspective, designed to address the risk of low probability but high cost events, which complements the more traditional analysis of the short-term outlook for inflation and economic activity found in the first perspective (Bank of Japan (2006)).

It is harder to say how far actual policy decisions have been coloured by such considerations. Even so, in a number of cases they seem to have been broadly consistent with a more preventive approach. In November 2003, for instance, the Reserve Bank of Australia was probably the first to cite rapid credit growth and house price increases as one reason for tightening policy, when this was said to coexist with the risk to inflation and economic stability beyond a two-year horizon (RBA (2003)).[29]

29. In the corresponding press release, we read: "…The housing market continues to be buoyant. The effect of the rise in house prices over the recent years is likely to be expansionary for the economy in the period ahead, as higher wealth is accessed to support household spending. In the short term, these developments are unlikely to make for significant problems for CPI inflation. Indeed, it *will most likely decline for a time*, as the effect of the appreciation of the exchange rate shows up in retail prices. Over the longer term, *inflation is currently expected to be consistent with the target,* but the risks to the forecast are beginning to tilt upwards. The prevailing stance of policy has been expansionary, as is clear not only from the current low level of nominal and real interest rates, but also from the behaviour of borrowers. Credit outstanding is rising at around 14 per cent per year, and at over 20 per cent to households. That is a much faster rate of growth than can be expected to be consistent with economic stability *over the longer run.* Short periods of rapid credit growth have not typically been a major concern for monetary policy, but this growth has been sustained for some time and at present shows no sign of abating. Given the above, the Board's view is that it is no longer prudent to continue with such an expansionary monetary stance. *The strength of the demand for credit* increases the danger associated with delaying a tightening of policy that is called for on general macroeconomic grounds" (RBA (2003), italics added). The Reserve Bank came under criticism for this decision by some commentators who argued that it was not consistent with the inflation targeting mandate.

Several references to such concerns can be found in the minutes of the Bank of England's Monetary Policy Committee in 2004 and 2005[30] as well as in the inflation reports of the Norges Bank.[31] Most recently, in Sweden, the Riksbank has explicitly stated that it in early 2006 it had brought forward an increase in interest rates, despite inflation not clearly threatening to be above target within the usual policy horizon, owing to concerns with rising housing prices and household debt (Ingves (2006)).[32] For its part, the ECB has been routinely making references to rapid money and credit growth, alongside exceedingly buoyant asset price dynamics, when taking decisions.[33]

The obstacles that have stood in the way of a further policy shift are in many ways analogous to those faced by prudential authorities.

The first set of obstacles relates to the analytical challenges faced in identifying financial imbalances and in calibrating a response. The identification problems are identical to those faced by prudential authorities. Despite the greater macroeconomic expertise of monetary

30. For instance, in the minutes for March 2004 we read: "…the pick up in house price inflation and the continued rapid accumulation of debt by households increased their [some Monetary Policy Committee members] concern that, without policy action, households' financial position could become unsustainable and so increase the probability of an eventual abrupt adjustment process, complicating the achievement of the inflation target". Or again, in May 2005: "A rise in the repo rate would also help to slow households' accumulation of unsecured debt, hence reducing the risk of a sharp fall in demand at a later date".

31. Thus, in March 2006, we read: "Wide fluctuations in asset prices and credit may constitute a source of instability in demand and output *in the somewhat longer run*. The low interest rate level in Norway has contributed to a sharp rise in house prices. The level of house prices may now appear high in relation to developments in income, interest rates, unemployment and housing starts. A gradual increase in the interest level will probably contribute to a slower rise in house prices ahead. This may reduce the risk of a substantial correction in house prices *further ahead*" (Norges Bank (2006), page 9, italics added).

32. Ingves notes, referring to a risk, which "may actually be beyond the forecast horizon": "One risk is that a sharp break in house prices could lead to households perceiving their debt burden to be too high, and that they would therefore quickly increase their saving. This could lead to a severe *decline* in demand in the economy and *in inflation*. In the considerations behind our decision on the interest rate at the beginning of the year, we considered these risks to be a reason for *not postponing an increase* by a few months – which I otherwise believe would have been entirely possible given the forecasts that we otherwise make and the precision of these forecasts… As I said, the world will not come to an end *in two years' time*" (Ingves (2006), italics added). Likewise, in the Inflation Report for October 2005 we find: "Over the past year, for instance, a credit boom and house price trends have had some significance for the monetary policy stance" (Sveriges Riksbank (2005), page 45).

33. In the Monthly Bulletin for April 2006, for instance, one finds: "In an environment of ample liquidity, improved economic sentiment and an ongoing recovery of the real economy, the strong growth of money and credit points to *upside risks to price stability over the medium and longer term*. Moreover, these developments imply a need to monitor asset price dynamics carefully, given the potential for price misalignments to emerge", ECB (2006), page 11, italics added. Similar references can be found in other issues of the Bulletin, with the underlying logic being spelled out in detail in a special article in the Bulletin of April 2005; ECB (2005).

authorities, the set of diagnostic tools is not part of the mainstream, as macroeconomic models are ill-suited to take fully into account phenomena of this kind. This, in turn, complicates the calibration of the response, in terms of both timing and intensity, raising questions about its effectiveness. As their prudential counterparts, monetary authorities face a catch 22: the effectiveness of the tools is unclear until the strategy is actually implemented. The jury is still out.

The second set is of a more institutional and political economy nature and is by far the more difficult to overcome. For an institution whose clear mandate is to control inflation, it is generally very hard to justify a tightening of monetary policy when the main objective, inflation, is well behaved, not least if asset prices are booming. And it is especially hard to justify tightening on the basis that it might actually help to avoid unwelcome *disinflationary* pressures in the future, as the imbalances unwind. The communication problem is particularly acute for inflation targeting regimes. In this case, for a long time the corresponding rhetoric has trained the public, markets and the body politic to judge success and failure *exclusively* on the basis of the attainment of inflation objectives over short horizons, as a means of enhancing the accountability of the central bank.

4. Conclusion

The history of policymaking is one of lessons learnt and unlearnt, of challenges old and new. The never-ending task of policymakers consists in exploring the economic landscape in search for clues of how the interaction between policies and the economic environment may alter the dynamics of the system. The objective is to understand the associated risks and to develop adequate policy responses. One of the greatest dangers is to think that we have finally come to master the secrets of the economy, for these are a moving target.

I have argued that we may well be living through one of those historical phases in which the underlying dynamics of the economy may have changed substantially, in this case compared with that of the Great Inflation period. If so, there are risks in mechanically applying the lessons learnt during that period without modifications. The main forces at work have been financial liberalisation, the establishment of central bank anti-inflation credibility and the globalisation of the real side of the economy. The basic hypothesis is that their

joint effect has been to create an environment in which financial factors are more important drivers of economic activity and in which the main risk is not so much runaway inflation as the damage to the economy from the slow and cumulative build-up of financial imbalances that at some point unwind. If accepted, this hypothesis would call for refinements in policy frameworks, based on a firmer long-term focus, greater symmetry in policy responses between upswings and downswings, and closer coordination between monetary and prudential authorities.

In recent years, the intellectual climate and policy frameworks have gradually evolved in a direction more consistent with this perspective. There has been a growing awareness of the potential problem. The macroprudential orientation of regulatory and supervisory arrangements has been strengthened. Monetary authorities have sought to incorporate financial imbalances into their frameworks in a more meaningful way. And cooperation between monetary and prudential authorities has intensified.

This evolution is welcome. It has clearly reduced the risk that the problem could fall through the cracks. At the same time, obstacles to further progress remain. They are of an analytical, institutional and, above all, political economy nature. Removing them calls for further analytical and educational efforts. The former should provide a stronger conceptual and operational basis to articulate the technical aspects of policies. The latter should foster the necessary public support for their implementation. Just as in the fight against inflation, a key to success is to set up institutional arrangements that hard-wire the necessary incentives for successful action based on an agreed diagnosis. Doing so should help us edge closer to securing in a more lasting way the benefits of the momentous changes in monetary, financial and real economy regimes that have been so sought after for so long.

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Comment

Xavier Freixas
Universitat Pompeu Fabra

Claudio Borio's article, "Monetary and prudential policies at the crossroads? New challenges in the new century", presents us with an ambitious project. He argues that, in spite of the multiple indicators showing a low inflation, a stable growth path and a healthy economy, some financial imbalances may be building in the background. This is of course of paramount concern and it is crucial to establish whether this is the case and how it should be taken into account when considering financial and monetary stability.

The fact that we today's environment is characterized by a lower inflation, by an improved financial environment a lower macroeconomic volatility, seems to point out indeed at a better financial management of shocks macroeconomic and financial shocks. This would be in line with literature on the impact of financial structure and volatility on growth (See, e.g. Levine et al. (2000)). This is basically the consensus view and it is referred to as the orthodox view.

Confronting it, Borio's unorthodox view claims that there is a potential financial fragility through the building of imbalances, that there are endogenous business cycles, and that expectations need not be rational.

This "irrationality" of expectations may result from two gaps: the risk perception gap and the incentives gap. The former reflects the fact that market indicators of risk fail to fully reflect the effects of the

business cycle. The later reflects the fact that incentives, e.g. based on benchmarking, may lead to herding and to inefficient decision making.

In support of the unorthodox view several arguments are developed. First, in terms of predictions, Borio and Lowe(2002,2004) show that simple indicators of financial imbalances, and, particularly, out-of-range measures of assets and leverage, can help predict banking distress, economic weakness and disinflation over a 3 to 5 year horizon.

Second, there seems to be monetary policy accommodation of financial imbalances. The evidence here is based on the estimation of Taylor rules augmented with proxies for financial imbalances, and shows that Central banks have not responded to financial imbalances.

Third, the phenomenon of globalisation may also have an implication on the building of financial imbalances. The author shows how measures of slack explain inflation better at the world level than at the national level. Consequently, price increases may be building up in assets rather than in consumption goods.

Borio's thesis is definitely a challenging one. Its consequences in terms of regulation are capital, as it implies changing the main focus of policy from inflation indicators to financial imbalances indicators. Still, the thesis is open to a number of criticisms we will now develop.

First, the basic implication of the unorthodox view, that we may have been increasing the risk of a large crisis, may be the result of an intermediate "Alternative View" that would inherit some of the characteristics of the unorthodox view. This would be based on the observation that the total risk in an economy is a characteristic of the technology and of the investment projects that are implemented, so, although risk sharing might have improved, the total risk is the same. The implication is that during the last decades of the *great moderation,* we might be exchanging the risk of frequent small crises against the risk of large and infrequent ones.

Second, financial imbalances in terms of high asset prices for real state property as well as for stocks are simply the result of low interest rates. An asset producing constant cash flows over an infinite horizon has an infinite price when interest rates are zero. Consequently, financial imbalances may be a characteristic of equilibrium, as for interest rates close to zero, the elasticity of asset prices to small inter-

est rates movements may, itself, be infinity. From this perspective, therefore, the evidence is simply the result of low interest rates.

Third, the result on banking crises is not surprising. A necessary condition for a banking crisis is to have high levels of credit and an overpriced collateral, as, otherwise, there is no reason for the banking crisis to develop. Consequently, the fact that variables measuring these two phenomena are predictors of banking crises is hardly surprising.

To conclude this is indeed an original and ambitious project. It has far reaching consequences as it implies taking into account the financial imbalances into the design of monetary policy. Taken as a whole, the unorthodox view may raise some scepticism, as any new approach usually does. Nevertheless, some of the aspects that are develop, as the irrationality of expectations (irrational exuberance) based on the risk perception and incentives gap should definitely be taken into account in the analysis of financial fragility. So, even if one does not fully endorse the thesis of the unorthodox view, Borio's contribution teaches us that the orthodox view should be made more flexible in order to to encompass the impact of financial imbalances.

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Global financial integration, monetary policy and reserve accumulation. Assessing the limits in emerging economies*

Enrique Alberola
José María Serena
Banco de España

Abstract

A protracted and intense reserve accumulation process has been going on in the last decade in a context of increasing integration of global financial markets. This process is ever more clearly driven by emerging economies and exchange rate management considerations and it has jumped to the forefront of policy discussion due to their perceived contribution to global imbalances. Less importance has been attributed to the internal costs of the process, even if they could become central for future reserve accumulation, and therefore could determine the sustainability of the global imbalances. In this paper we address the issue of internal costs of reserve accumulation, trying to assess whether these costs constitute a limit to the continuation of the process. We setup an empirical model of reserve accumulation conveying the presumed costs -in particular, in the monetary sphere- to prove to what extent they may be limiting reserve accumulation. The conclusions suggest that the costs of the process have been increasing but manageable, either through a higher recourse to sterilization or being more proactive in the use of reserves. In practice, to date, no emerging country has called off the process of accumulation due to the perceived costs, although, looking forward, the evidence underscores that the scope for further accumulation could be dwindling.

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1. INTRODUCTION

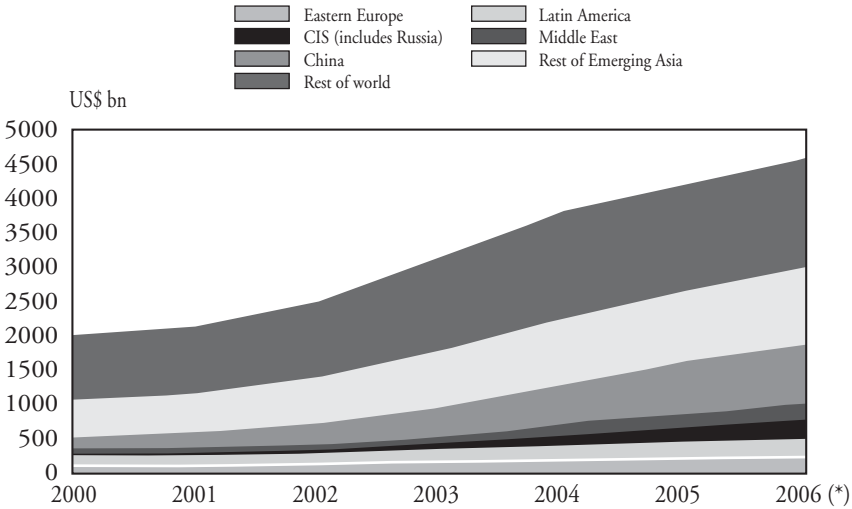
Globalization has fostered a large increase in the financial flows among countries in the last fifteen years. Although the increase in flows has been particularly acute among developed countries, developing countries and in particular emerging market economies have also experienced an important increase in the magnitude of flows, which are characterised by their volatility. In parallel with these developments, as shown in graphs 1 and 2, the level of accumulated reserves, in particular in emerging countries has registered unprecedented growth since 1997, leading the global stock of foreign exchange reserves to unknown magnitudes and to a marked concentration.

This process of reserve accumulation has arguably had an important impact on the global economy, in particular, through its perceived contribution to global imbalances. The demand of dollar treasuries would have helped to maintain long run interest rates relatively low for the current cyclical expansion and prevented the dollar from adjusting. Both elements would have facilitated the persistence of a situation of twin deficits- current account and fiscal balances- in the US. Since the countries which accumulate reserves do not seem to internalize the costs they impose on global financial stability and multilateral negotiations for a coordinated adjustment progress slowly, the sustainability of the process –and of global imbalances- basically rests on the perceived balance of costs and benefits by the reserve accumulating countries.

In a first stage, the main driver for reserve accumulation in most emerging countries was to replenish the stock of reserves in the aftermath of severe financial crises in order to reduce financial vulnerabilities for the future. Nowadays, however, the magnitudes largely surpass in many cases this precautionary aim, so that the persistence of the process is seen as driven generally by the objective of managing the exchange rates at a certain desired level or range.

However, it is well known that reserve accumulation entails also some domestic costs –monetary, financial, fiscal,…– which have remained absent in much of the recent discussions on the issue, although they are becoming an increasing concern in some countries. Moreover, the empirical analyses have focused on the drivers of reserve accumulation, but not on its limits. Given these considerations, the goal of this paper is to explore to what extent economic costs are or may

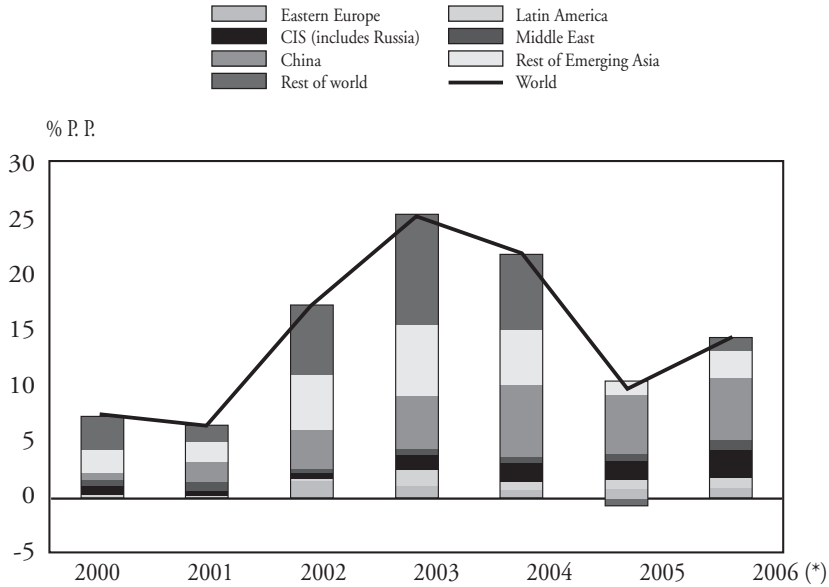
Graph 1.
Reserve accumulation. Holdings by region



(*) Second Quarter

Source: International Monetary Fund (International Financial Statistics)

Graph 2.
Reserve accumulation. Rates of growth and regional contributions



(*) 2Q 2006 relative to 2Q 2005.

Source: International Monetary Fund (International Financial Statistics)

become an effective determinant –and eventually a constraint- of reserve accumulation in the context of increasing global flows. This is done both through an empirical analysis, whose results are not conclusive, and through the examination of several country cases which highlight the costs of the process. We hope the results may shed some light on the eventual limits on the reserve accumulation process currently underway.

The rest of the paper is structured as follows: section 2 discusses recent empirical work on the drivers of reserve accumulation; section 3 discusses the main costs of reserve accumulation; section 4 presents three case studies –China, Russia and Argentina; section 5, tests empirically the main hypothesis -that the costs of reserve accumulation, together to the benefits of reserve accumulation, explains the current process of reserve accumulation; the final section presents the main conclusions.

2. DRIVERS OF RESERVE ACCUMULATION. RECENT EMPIRICAL EVIDENCE

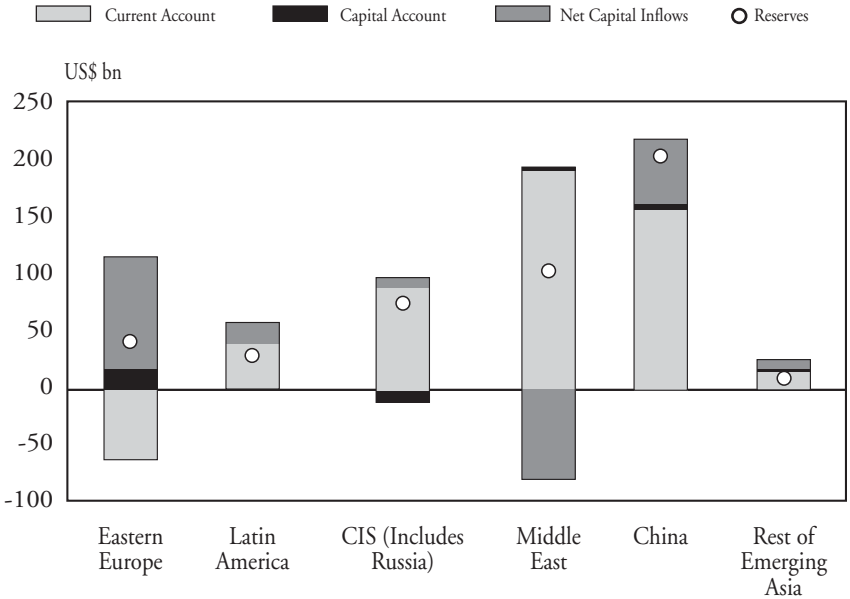
From a financial accounting point of view, the process of reserve accumulation is given –in a number of countries- by the co-existence of large current account surplus and capital inflows. More precisely, the following equality approximately holds

Reserve accumulation = Net capital inflows + Current account balance + Errors and omissions

As shown in the graph 3 all emerging regions –but Eastern Europe- display a remarkable current account surplus and some of them also large net financial inflows.

Beyond accounting, this evidence uncovers the two main drivers for reserve accumulation: the desire to keep the exchange rate around a desired level and the desire to self-protect against sudden stops of financial flows, and to attain a healthier country balance sheet. Implicitly, reserves are accumulated in order to counteract appreciation pressures, which are driven by capital inflows and, as a consequence, the current account surpluses are prevented from adjusting. Note that this surplus external position also entails a reduction in

Graph 3.
Current account, capital flows and reserves



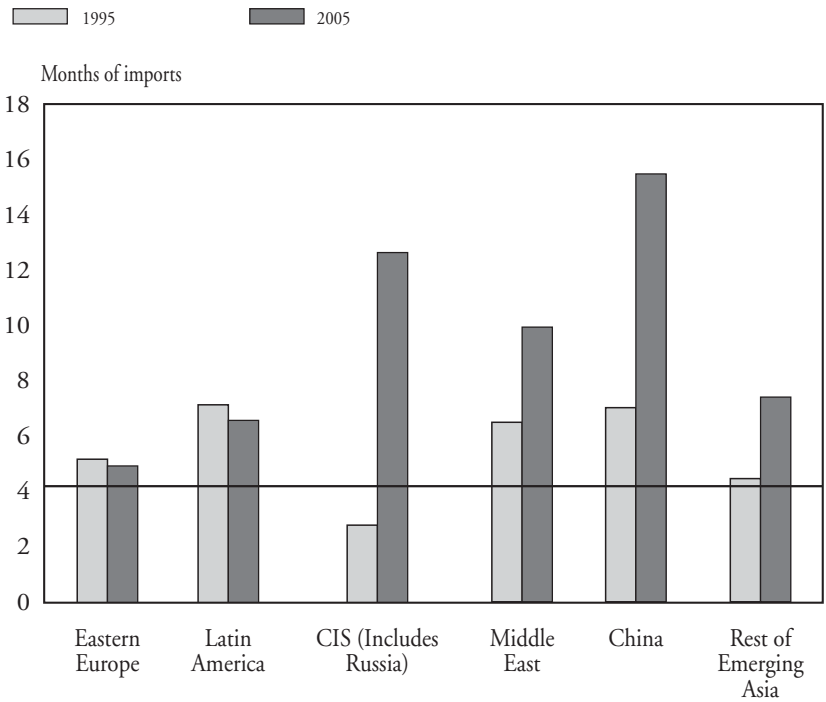
Source: International Monetary Fund (International Financial Statistics) and World Economic Outlook [June 2006])

vulnerability since the country as a whole is a net exporter of capital, not being reliant on the foreign capital. This suggests that the drivers of accumulation are rooted in such identity.

A number of recent papers, which in general focus on the precautionary motive, have re-estimated reserve demand equations. The econometric evidence (Edison, 2003; Gosselin and Parent, 2005) suggests that traditional determinants of the demand of international reserves -imports and short term to GDP, etc, - fail to explain the very large volume and distribution of reserve accumulation. The graph 4 shows that the months of imports covered by reserves is much higher than the precautionary level (four, according to the literature), while in graph 5, it is observed that the ratio of short-term external debt by 2004 was larger than 1 in all the cases, the threshold suggested by the Guidotti-Greenspan rule as enough to counteract liquidity needs in case of financial turmoil.

One problem with this sort of evidence is that the optimal level of reserves is made contingent on the current economic situation. Since the precautionary motive aims at insuring against prospective crises,

Graph 4.
Reserves over imports



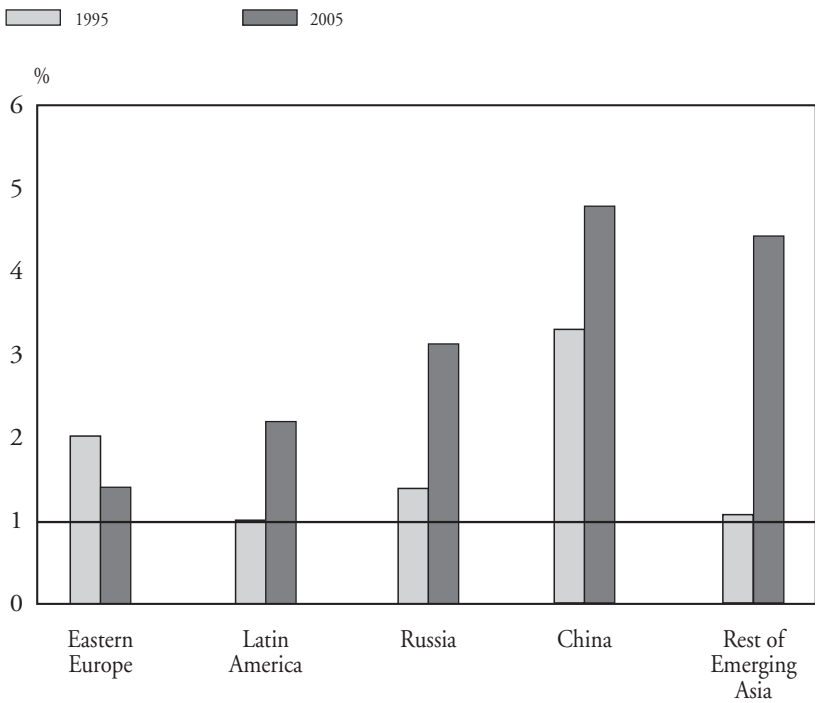
Source: International Monetary Fund (International Financial Statistics)

it is more interesting to conjecture whether the current level of reserves would be enough to effectively face a crises. However, when these considerations have been taken into account (Jeanne and Ranciere, 2006)– the finding is still that the level of reserves is beyond the optimal in many countries. In particular, according to their findings, international reserves would be adequate in Latin America, and excessive in Asia. The main shortcoming of these results is that they assess reserve adequacy until 2003, and since then the vulnerability has been further reduced, the fundamentals have improved and in spite of it reserves have go on increasing.

Some authors (Aizenman and Marion, 2002a, 2002b; Aizenman and Lee, 2005; García and Soto, 2004; Kim et al, 2004) have explained this failure (and also the differences in the patterns of reserve accumulation among emerging countries) by suggesting that the emphasis is now higher on precautionary motives. Furthermore, it is also argued that increasing financial globalisation and the higher magnitude and volatility of capital flows that it entails, probably call

for a higher scale of accumulation, regardless of the underlying motives. On the one hand, the quantity of reserves to manage the exchange rates is increasing in the magnitude and volatility of capital flows; on the other hand, the potential reversal of flows within a financial crises is also larger, requiring also a higher level of reserves to guarantee effectiveness. Redrado et al. (2006) point out that the huge reserve accumulation of countries in an intermediate level of development, in a context of global financial integration, can be explained by self-protection motives due to the inexistence of a lender of last resort, and find that inertia and regional imitation are other relevant drivers of the process.

Graph 5.
Reserves over short-term external debt



Source: International Monetary Fund (International Financial Statistics)

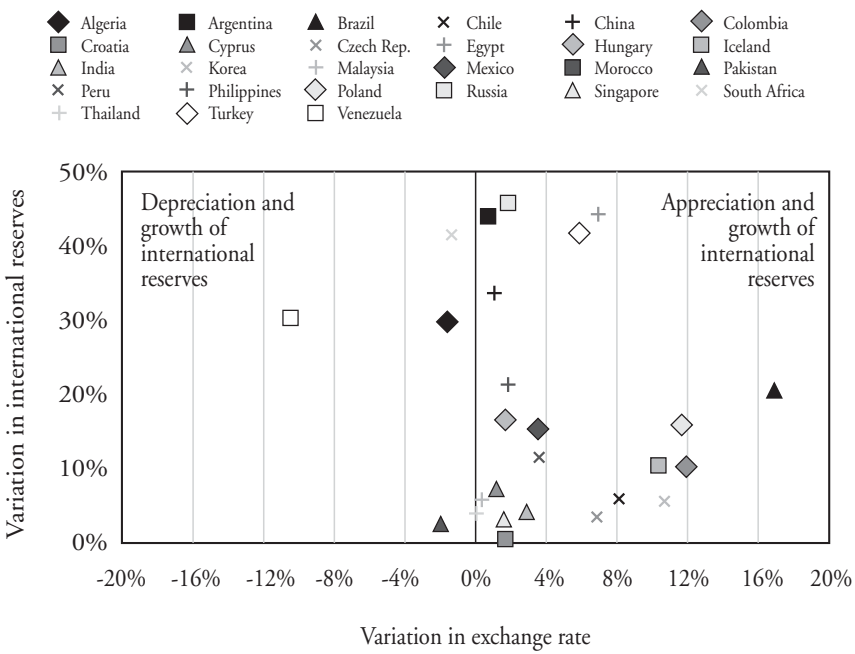
All in all, the magnitude and persistence of the current process suggest that the mercantilist motives may be increasingly relevant. This is most clear in Asia, but it also applies to other countries, like some Latin American countries and oil producers, where the desire to limit exchange rate appreciations is evident. The stability of exchange rates

in countries with high reserve accumulation can be observed in graph 6, where the variation in international reserves and exchange rates are displayed for the countries in our sample within the period 2004-2005.

A quite suggestive theory explaining the process in Asia, and mainly, the perspective that it will continue for a long time, has been advocated by Dooley, Folkerts-Landau and Garber (2005). They state that the process of reserve accumulation by Asian countries is a consequence of an export-led growth strategy that, by maintaining the exchange rate depreciated with respect to the rate that would emerge had the central bank not act in the markets, generates current account and financial account surpluses, thanks to trade balance surplus and expectations of appreciation of the exchange rate. If a central bank wants to maintain the exchange rate at the desired level, it has to act in financial markets, consequently accumulating reserves.

The possibility that, based on the strategic incentives of the accumulating countries, the process of accumulation could persist in the long run –as Dooley et al. defend for Asia-, and the implications for the global economy, raise the issue of the factors that may call a halt

Graph 6.
Exchange rate variation and reserve accumulation (2004-2005)



Source: International Monetary Fund (International Financial Statistics)

to the process, that is, whether the implied costs of accumulation may eventually outweigh the perceived benefits.

3. The costs of reserves accumulation

Much of the attention devoted to the costs of reserve accumulation focus on the fiscal costs of *holding* reserves (Hauner, 2005; Rodrik, 2006; Summers, 2006). However, the most immediate impact of reserve accumulation is on the monetary aggregates. It is convenient to make a digression to briefly explain how reserve accumulation can be managed by the central bank, through sterilization, and then assess the costs differentiating between costs arising when reserve accumulation is non-sterilized, and costs that arise when there is sterilization. The interest of this distinction rests on the fact that empirically we observe that at the beginning of the process of reserve accumulation, sterilization is more scarce and less important, but as the process goes on, and increases in reserves threatens domestic monetary policy, sterilization becomes more intensive until, eventually, the central bank is faced has to give priority either to domestic monetary policy or to exchange rate targeting. This implies that the type of costs arising vary at different stages of the process.

3.1. A conceptual framework: Management of monetary policy under reserve accumulation

Foreign exchange reserves accumulate as an asset of the Central Bank. In the balance sheet of the Central Bank (table I), the asset side is completed with the domestic credit of the central bank, which includes domestic credit to the banking system, and other assets. The liability side includes, roughly, bonds and monetary base (M), which comprises both currency in circulation and deposits (reserves) of the commercial banks, obtained mostly through reserve requirements. Net International reserves (NIR)[1] are defined as foreign exchange

1. We will use the terms net international reserves (NIR) and net foreign assets (NFA) alike. Given the way in which we have constructed the variable -see data appendix- they represent the same concept. Alternative constructions of NIR and NFA might lead to differences between the concepts -for instance, if liabilites with international financial institutions are included in NFA, but not in NIR.

reserves minus foreign liabilities, and Net Domestic Assets (NDA) of the central bank are the sum of credit to the banking system and other domestic assets minus bonds.

Table 1.
Central Bank Balance Sheet

Assets	Liabilities
Credit to the banking system (NDA)	Foreign Liabilities (-NIR)
Foreign Exchange Reserves (NIR)	Currency in circulation (M)
Other domestic assets (NDA)	Reserves of the banking system (M)
Government CB Bonds (-NDA)	

Therefore, the following identity holds:

$$M = NDA + NIR \tag{1}$$

and

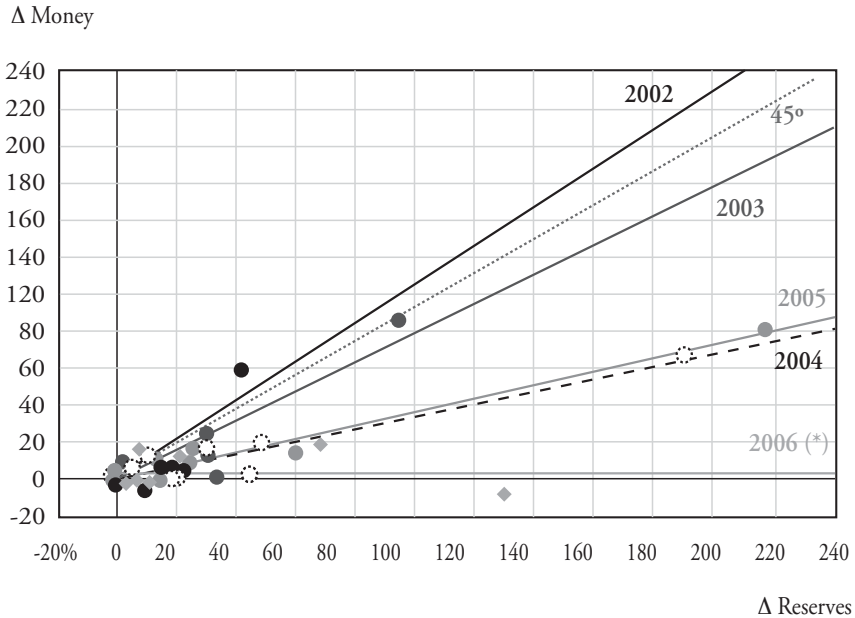
$$\Delta NIR = \Delta M - \Delta NDA \tag{2}$$

With no further action of the Central Bank, reserve accumulation (an increase in NIR) implies an increase in the currency in circulation and thus on the liquidity of the economy. The liquidity so injected into the economy may lead to an expansion of credit and inflationary pressures and threaten the monetary policy targets of the Central Banks.

Therefore, the Central Bank can decide to sterilize the reserve accumulation to prevent it from filtering into higher liquidity in the system. This is done either through a reduction in the net domestic assets, which can be carried out in different ways, or through an increase in the mandatory reserve deposits of banks (which increase the monetary base, without expanding the currency in circulation.) The reduction in net domestic assets can be achieved in different ways. Indeed, sterilization can be done through market instruments, by issuing central bank bonds, or selling goverment bonds, or through the use of repos and swaps and the overnight deposit facility, and also through non-market instruments such as government deposits on the central bank or sales of reserves to the government (in order to reduce the latter´s external debt, for instance). In all these cases, increases in currency circulation are lower than the increase in reserves (partial accumulation) or is nil (complete sterilization)

In the current process, sterilization is being implemented mainly through market instruments -open market operations- and to less extent through fiscal policy management (deposits of the government

Graph 7.
Increases in reserves and sterilization (2002-2006)



Source: International Monetary Fund (International Financial Statistics).
(*) 2Q 2006 relative to 4Q 2005

on the central bank, stabilization funds, and so on). However, historical evidence shows that when capital inflows are sustained for a prolonged period of time, it may become so cumbersome and costly to sterilize through open market operations that the central bank can turn to sterilization through non-market instruments, such as reserve requirements. In particular, non-market instruments were used intensively in the nineties (see Reinhart and Reinhart, 1999; Montiel and Reinhart, 2001), but in the recent episode, few countries have raised reserve requirements to sterilize, with the relevant exception of China (see the case study)[2].

The magnitude of sterilization can be assessed in the scatterplot in graph 7, where the increase in currency in circulation is plotted against the increase in reserves. Points below the 45º line (increases in reserves higher than increases in currency in circulation) evidence sterilization.

2. An interesting issue is, therefore, whether sterilization is firstly implemented through market instruments, and when it becomes too costly, non-market instruments are used until, finally, central banks give up sterilization and their foreign exchange market intervention.

Different colours are used for the years, being China the extreme right observation in every year. The parameter of a regression between both variables (pooling all the observations) is 0.37, implying that 63% percent of the increase in reserves is sterilized on average. The evidence presented in graph 7, that allows disentangling the evolution of sterilization over time, suggests that countries are sterilizing increasing proportions of the additional reserves, as since 2002 the sterilization curve becomes flatter every year. In 2006, as it turns out from the horizontal line, the accumulation of reserves did not translate into increases of the monetary base, on average, due to the large sterilization efforts by China. It is also noteworthy to see in graph 8 the evolution of sterilization and how countries reduced NDA as they accumulated NIRs, either from the beginning (negative slope) or after some time (the curve shifts from positive to negative). Examples of the first case are the Asian countries and of the second case is China: at the beginning it did not sterilize inflows, but it has started to sterilize them. By the moment, China seems able to sterilize the increases in reserves, as the pace of reserve accumulation does not seem to slowdown.

The sterilization policy by the central bank is determined by several factors. First, the link between the increase in the monetary base and the expansion of credit and inflationary pressures is not equal in all countries, and depends very much on the different features of the domestic financial systems and of the growth of the economy. In economies where money holders tend to deposit their money in commercial banks, and where there is a well developed domestic banking system, able to channel domestic saving into an increase in credit, therefore causing inflationary pressures and asset bubbles, reserve accumulation can produce more problems with domestic monetary policy objectives than the problems that would be caused in an economy with a less developed domestic banking system. In compensation, the deeper the domestic financial market the larger the number of potential sterilization instruments. Moreover if the economy is growing at a high pace, the demand for money tends to be high, which implies that the increase in prices is lessened. Thus, in some cases monetary authorities do not face a trade-off between implementing an autonomous monetary policy and allowing the increase of capital inflows

Given the preeminence of the exchange rate management motives in the current process of reserve accumulation, it is important to recall the proposition that in a framework of high capital mobility, it

is not feasible to peg the exchange rate and manage domestic monetary policy autonomously…in the long run. Actually, sterilization is an attempt to bypass this basic proposition, at least for some time. As a matter of fact some central banks are being able, to some extent, to manage exchange rates and accumulate reserves without losing control of domestic monetary policy objectives, but this is an increasingly difficult challenge. Sooner or later the costs and limitation on monetary policy will come to the fore.

3.2. Perceived costs from accumulation and sterilization

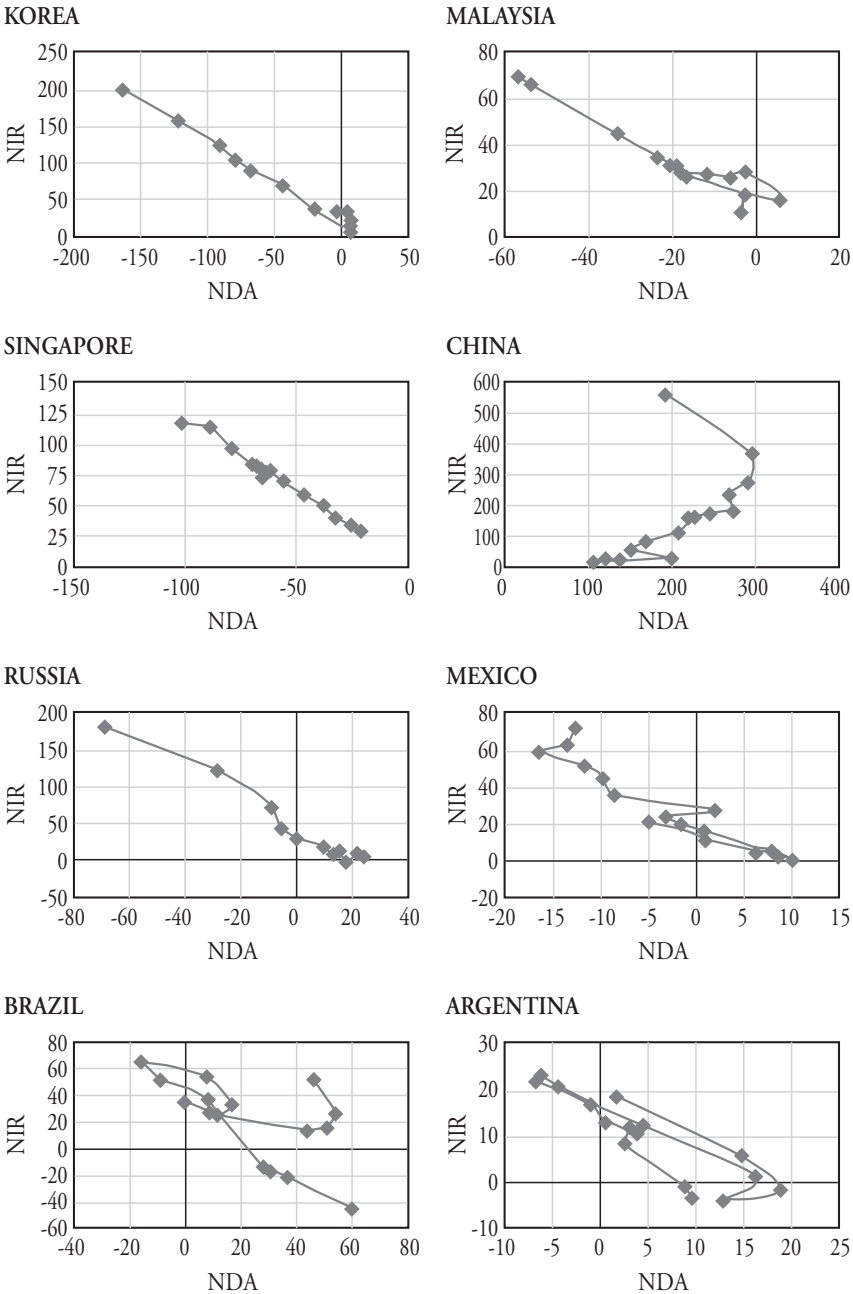
The main problem of non-sterilized intervention is that expansion of the monetary base can disrupt monetary policy management and feed into inflation. Central banks are expected to care about inflation, so *before* inflationary pressures deriving from non-sterilized intervention could arise, they turn to sterilize interventions. Therefore, sterilization may become a sign that domestic monetary policy objectives are jeopardised and therefore, usually the costs of non-sterilized intervention remain latent through sterilization –which poses a challenge for a rigorous empirical approach.

Sterilization, in turn, generates a wide array of problems, whose nature depends on whether they sterilize through market or non-market instruments.

When sterilization is done through market instruments[3], there is an increase in the debt of the central bank, which is remunerated at a given interest rate –the one fixed in the auction of the debt. Part of these costs are reflected in prices, while others are disturbances on the financial system that are more difficult to identify. When there is an interest rate differential between the return on assets and the return on liabilities, there is an explicit cost, sometimes called quasifiscal cost of holding reserves. Table II provides the interest rates of intervention of the central banks that, compared with the returns on US Treasuries, are usually considered as proxies of these costs. Domestic interest rates differ substantially among countries, from the 15.5% interest rate in Brazil to the zero interest rate in Japan. This implies that while some countries enjoy benefits after sterilizing accumulated reserves, other countries suffer important losses.

3. In the following discussion we restrict to issuance of debt to drain liquidity.

Graph 8.
Reserve accumulation and sterilization (4Q 1990 - 4Q 2005)*



* All figures expresed in US$ bn.

Source: International Monetary Fund (International Financial Statistics).

Sterilization through open market operations can lead to increases in interest rates if the supply of funds is high in relation to the demand for them. Both increases in debt and in interest rates generate potential risks of debt monetization. As Mohanty and Turner (2003) point out, unlike in other periods, during the current episode of foreign exchange market intervention, large scale issuance of sterilization bond has not pressed the interest rates up, as the domestic demand for these assets has been high. However, this does not imply that sterilization is absent of problems, Indeed, large scale sterilization coupled with high domestic demand by the banking system and pension funds can generate different problems even when the financial system seems to absorb the issuances without pressing the interest rates up. For instance, the large-scale issuance of sterilization bonds can create a crowding out on the private sector if there is a large appetite for these bonds given that as domestic bonds gain importance within the portfolio of financial intermediaries, they decrease other investment, and this way there might arise of problem of lack of credit, increases in interest rates for private loans, and so on (see the case of Argentina). Moreover, if the portfolio of the banking sector gets concentrated in government debt, there might be problems for domestic financial stability and conflicts between monetary policy and financial stability. In any case, all in all, these hidden costs differ substantially between countries.

Even if it is difficult to provide general lessons, it can be concluded that large scale sterilization (through debt issuance) creates problems of crowding out and reduction in credit to the private sector. Moreover, it entails problems of either increases in domestic interest rates, risks of monetization and increasing quasifiscal costs, if there is low demand for sterilization bonds, or domestic financial stability, if there is demand for these assets and gain importance in the portfolios of the domestic financial intermediaries, in particular the banking sector.

The main costs of sterilization through reserve requirements are the distortions introduced in the commercial banking system. Reserve requirements act as a tax on the banking system, and contribute to a widening in the gap between loans and deposits interest rates[4]. Perhaps because of the distortions they introduce, central banks are avoiding to the extent of possible their use.

4. See Reinhart and Reinhart (1999) for a discussion of the distortions caused by sterilization through reserve requirements.

Sterilization through fiscal policies, such as deposits of the government on the central bank, does not introduce direct distortions on the economy. However, it might lessen the independence of the central bank, and exposes the central bank to a sudden increase in the monetary base if the government changes its commitment and asks back the deposit. Sales of foreign reserves to the government that are paid with cash are a good way of sterilization, as drain liquidity in a permanent manner. However, it can pose problems such as the ones discussed before: possible reduction in central bank independence or dependence on the government to get involved in such an operation.

Table 2.
Interest rates and reserve accumulation

Country	Interest rate (average 2003-2005)	Accumulation NIR (total 2003-2005) US $ bn	Total NIR –end 2005 US $ bn
Japan	0,12%	373	834
China	1,95%	478	778
Turkey	24%	20	13
Brazil	19,5%	39,5	51
Argentina	3,2%	22,7	18
Korea	3,6%	86	203
Singapore	1,3%	32	115
Malaysia	2,72%	35	70
Thailand	1,71%	16	52
South Africa	8,23%	11	16
Mexico	7,8%	20	68

Looking forward, it is obvious that more sterilization has been done in past years, the more costly the process can be. This derives from the fact that distortions do accumulate, and that, when sterilization is done through issuance of government or central bank paper, it has to be sterilized once again when the debt matures. Moreover, large scale sterilization can be technically unfeasible in some countries, so sterilization costs can go together to growing expansion of liquidity and their consequences.

4. CASE STUDIES

While the costs of accumulation can be easily described, to put our hypothesis to test in a panel becomes even more contentious when we

take into account the diverse determinants, drivers, environments in which different countries accumulate. This is clearly seen in the annex where three of the most relevant cases of reserve accumulation in the last years –China, Russia and Argentina- are described in detail.

China is the largest holder of international reserves, having recently surpassed the trillion dollars of reserve holdings. Although the authorities state that the exchange rate floats, it is evident that keeping a controlled exchange rate is the overwhelming goal of the monetary policy, not only for competitiveness reasons but also to manage with more degrees of freedom the transition to a more open economy from a financial point of view. Russia epitomises accumulation related to the oil price and commodities boom and here the process is justified by the need to smooth out a shock which may be transitory. Argentina, finally, conveys both rationale; a positive terms of trade shock plus a strong wish to maintain a competitive exchange rate.

To be sure, all three countries are facing increasing costs. Explicit inflationary pressures are only clearly evident in Argentina; authorities are facing increasing difficulties to manage the increase in reserves, also because monetary policy is not completely independent. In China, the large excess in liquidity has not transferred into headline inflation, due to the peculiarities of the financial system, but concerns of overheating of the economy and distortions in the financial system are increasing. In Russia, the problems have also a monetary dimension, but they are intertwined with fiscal concerns, since the sterilisation instruments are of fiscal nature and held in the central banks. Such big quantities of money are really tempting and they generate tensions between the central bank and the fiscal and political authorities.

These different typologies do not hide a common fact. Despite the increasing difficulties the accumulation of reserves continues at a strong pace. All three countries have resorted to strategies to reduce the opportunity costs of reserves, like investment in alternative assets –like China or Russia- or helping to solve financial problems in other spheres of the economy –debt repayment in Argentina, bank recapitalisation in China. Moreover, in all of them the normal functioning of monetary policy and institutions is being jeopardised. China has resorted to controls and quantitative limits to credits, while Argentina has imposed tight price controls and disuassive actions to control inflationary pressures. In Russia, central bank autonomy is obviously threatened by potential clashes with politicians.

All in all, there seem to persist leeways, actions or measures which allow the process of accumulation to go on. This, together to the heterogenity across countries, makes testing the question we posed a challenge, indeed.

5. TESTING THE LIMITS OF RESERVE ACCUMULATION

After reviewing the potential costs of accumulation and the three cases above, it is remarkable that the literature has taken a very limited approach to assess the costs of reserve accumulation. To be fair, most past works trying to identify the determinants of reserve holdings did try to take into account the costs of holding reserves, but they just contemplated the quasifiscal costs (usually including interest rates differentials with the Treasury rates). Therefore, we focus on assessing the other costs, mostly in the monetary sphere since the actual costs of accumulating reserves arise predominantly from the monetary implications.

We thus turn now to test whether current or prospective costs of the increase in reserves impinge on the process of accumulation. The testing strategy is not straightforward. We start by constructing a benchmark model for reserve accumulation. We proceed next to determine whether sterilization is the first measure to deal with the monetary effects of reserve accumulation. We turn finally to test whether the prospective monetary costs are a determinant of reserve accumulation.

5.1. Benchmark model

In order to construct a benchmark model, we choose as dependent variable the increases in reserves -ΔNFA- and not the level of reserves, since we are interested in understanding the determinants of reserves accumulation and not of reserve adequacy, unlike most previous work. The basic benchmark equation is the following

$$\Delta NFA_{it} = \alpha + \phi' y_{it} + \eta_i + \varepsilon_{it} \qquad (1)$$

where y_{it} is the set of explanatory variables and η_i are fixed effects.

It should be first noted that estimating the model with fixed effect, together to the fact that the period of interest (1999-2005) is quite short, implies that variables such as, for instance, dummies for recent export-led growth policies, new precautionary motives after the financial crisis in the late 90s or scale variables (GDP) cannot be properly identified as are time invariant or display low variation over time. In the vector y_{it}, we first include the lagged level of NFA to control the time-variant trend in the growth of reserves. As proxies of precautionary motives we include two variables. First, a real exchange rate index, that allows to compute the importance of more or less aggressive export-led growth policies on reserve accumulation within each country. Second, a measure of the (in)flexibility of the nominal exchange rate, that roughly controls for possible interventions to avoid appreciation. Finally, the precautionary motives are captured including, as usual, imports and short term external debt.

Table 3.
Determinants of reserve accumulation: equation 1

Determinants of reserve accumulation (Dependent variable is *ΔNFA*)		
	[1]	[2]
NFA(-1)	0.354***	0.378***
	0.000	0.000
RER	-0.131**	-0.126**
	0.044	0.047
Short term external debt	0.762***	0.841***
	0.000	0.000
NER flexibility	-0.063	
	0.727	
Imports	0.083	
	0.151	
Constant	-4.449	-3.474
	0.499	0.579
Observations	162	166
Number of country	29	29
R-squared	0.879	0.874

P values in parentheses.
* significant at 10%; **significant at 5%; *** significant at 1%.

The results of the estimation of the model are displayed in Table III.

As expected, after controlling for the scale variable, conveyed in the lagged level of reserves, countries with higher holdings of short term external debt accumulate more reserves –see column [1]. The

effect of the real exchange rate is negative, something that implies that the more aggressive the export-led growth strategy (the lower real exchange rate) the higher reserve accumulation. Neither imports nor the degree of flexibility of the nominal exchange rate are significant, albeit both display the expected sign. In column [2] the non-significant variables are dropped, and we will use this results as benchmark.

5.2. Sterilization and determinants

Before using this benchmark model we have to assess whether central banks engage in systematic sterilization when they face an undesirable expansion of liquidity. We consider that all central banks try to avoid the undesirable expansion of liquidity, and its effects, so we would expect sterilization to be more intense the greater the monetary problems. In graph 7 we indeed saw that sterilisation rates were getting overall more intense. We start by identifying the determinants of sterilization through the estimation of equation (2):

$$\Delta NDA_{it} = \alpha + \beta' x_{it} \Delta NFA_{it} + \eta_i + \varepsilon_{it} \qquad (2)$$

This equation is related to the literature on sterilization, which attempts to identify the coefficient of sterilization, that is, the coefficient of ΔNFA in a regression of ΔNDA on ΔNFA and a set of controls. Here the rationale, and also the functional form, is different.

We are interested in identifying the determinants of sterilization, and in obtaining a quantitative measure of their importance, so we include interactions of the vector **x** and ΔNFA. Such vector includes lagged inflation and lagged ratio of increases in ΔM2 to GDP. Inflation is included because the central bank is considered to be more reluctant to allow further expansions of the monetary base when the inflation is relatively high, and therefore sterilizes more on those cases. The ratio of ΔM2 to GDP is a potential explanation of reserve accumulation in two dimensions. First, it is a measure of latent risks of inflation, and central banks with inflation targeting focus on it as a forward looking measure of inflation. Second, some central banks do not have inflation but money targets. For both reasons, central banks should be more reluctant to let the monetary base expand when the ratio of ΔM2 to GDP is high. In consequence, a high

ratio should be associated with more sterilization. The reason why these variables are interacted with ΔNFA is that what makes compelling sterilization is the joint effect of potential monetary problems and high ΔNFA.

A potential problem is to obtain consistent estimators of the vector **β**, because of the endogeneity of the variables of the vector **x**, that arise from the reverse causality –reserve accumulation, unless completely sterilized leads to inflation, credit and asset booms- and from the fact that the increase of reserves depends on the ability to sterilize (a shock on the ability to sterilize would probably affect the increase in reserves, so that $\mathrm{cov}(\Delta NFA_{it}, \varepsilon_{it}) \neq 0$). The exogeneity of the vector **x** has been preserved using lagged variables, so that $x_{it} = \left[1, \pi_{it-1}, \frac{\Delta M2_{it.1}}{GDP_{it-1}}\right]$ but, still, contemporaneous ΔNFA would remain endogenous. In order to overcome this problem, we use as instruments the lagged values of ΔNFA. All in all, if the coefficients of the vector **β** were negative, this would be evidence that sterilization depends on these factors in the expected way: for a given ΔNFA, the higher the inflation or ΔM2 to GDP, the more large-scale sterilization is.

Table IV displays the results of the estimation of equation (3) by within groups estimation and taking into account endogeneity with the instrumental variable discussed. Column [2] and [3] show that both inflation and growth in money aggregates are sig-

Table 4.
Results of sterilization determinantsmodels-equation (2)

Determinants of sterilization (Dependent variable is *ΔNDA*)			
	[1]	[2]	[3]
ΔNFA	-0.768***	0.437*	
	0.000	0.080	
ΔNFA*π(-1)		-0.190***	-0.133***
		0.000	0.000
ΔNFA*ΔM2(-1)/GDP(-1)		-1.836***	-0.910***
		0.000	0.000
Constant	2.027***	1.316	2.147***
	0.000	0.134	0.004
Observations	166	137	137
Number of country	29	29	29
R-squared	0.8044	0.7748	0.8166

P values in parentheses.
* significant at 10%; **significant at 5%; *** significant at 1%.

nificant explanatory variables of sterilization: for a given ΔNFA, sterilization is larger the higher are inflation and growth of money aggregates.

5.3. Assessing the limits

From these results it follows that, as conventional wisdom suggests, all central banks care about the monetary effects of reserve accumulation, and their first measure in order to maintain monetary policy independence is sterilization. The remaining question is whether costs of accumulating reserves are relevant explanatory variables. As explained in section 3 the costs are of two principal types -fiscal and monetary. Other costs (to the financial system, conflicts among authorities, etc), are even more difficult to measure empirically

We include a measure for quasifiscal returns, based in the difference between the return on reserves and the domestic cost of opportunity. If these returns are positive, reserves yield a benefit, otherwise they imply a cost (see data appendix), . Given this definition we would expect our measure of quasifiscal benefits/costs to display a positive sign –net fiscal benefits would be positively related to reserve accumulation, net costs would be negatively related to it. Less obvious is how to proxy the prospective monetary costs. We do not include directly any measure of (undesired) expansion of liquidity as possible deterrent of the process, because such measures are plagued with reverse causation problems. Inflation is not included either in this last equation, as their effects are taken into account through the real exchange rate. However, we have shown that the sterilization efforts are related to potential excess liquidity and inflationary pressures, conveyed in the interaction with the reserve accumulation, as shown in table IV.

This means that monetary costs may be reflected in the sterilisation effort rather than in the accumulation process itself. Therefore, the previous analysis on sterilisation sets the basis for the variables conveying monetary costs. More precisely, we consider, on the one hand, the stock of net domestic assets as a proxy of ability to sterilize, as all sterilization is reflected in the central bank balance sheet as a reduction in NDA, no matter whether sterilization is done through government deposits, reduction in loans to the banking

system or –as usual- open market operations.[5] Thus, central banks with higher NDA are expected to be more able to accumulate more reserves, meaning a expected positive sign. We include this variable lagged, as what we expect to explain reserve accumulation at time t is NDA in the previous period, known at t-1.

On the other hand, we include a rather general proxy of the need to sterilise by including the moving averages of effective sterilisation, both in absolute and relative levels. In particular, we consider two variables:

- *Absolute Moving Average of sterilization (AMA_need),* with a two-year window: $AMA_{it} = (\Delta NDA_{it-1} + \Delta NDA_{it-2})$, which is a measure of sterilization in the previous two periods.
- *Relative Moving Average of sterilisation (RMA_need)*:
  $$RMA_{it} = \frac{\Delta NDA_{it-1} + \Delta NDA_{it-2}}{\Delta NFA_{it-1} + \Delta NFA_{it-2}},$$
  which takes into account the total reserve accumulation.

In both cases a negative value of the variables indicates sterilization. We conjecture that a negative coefficient for these variables in the regression indicates that central banks implement sterilisation and this allows for continued accumulation of reserves. On the contrary, if the sign were positive this would evidence that previous sterilisation is limiting current accumulation, yielding complementary evidence of limits of the ability to sterilize. In other words, if the lsign revealed in the regression is negative we infer that the sterilisation needs are there, but they not impinge on the process of accumulation so far.

The extended model is the following:

$$\Delta NFA_{it} = \alpha + \beta' X_{it} + \gamma qf_{it} + \lambda_1 NDA_{it-1} + \lambda_2 AMA_need_{it} + \lambda_3 RMA_need_{it} + \upsilon_{it} \quad (3)$$

The results of the extended model are displayed in table V. Quasifiscal returns are significant when they are included in the basic model (column [1]), and display the expected sign, albeit become non-significant in the fully extended model, where we include the three proxies of prospective monetary-sterilization costs. As expected,

5. For those central banks that sterilize with open market operations and cannot issue their own notes to sterilize, NDA can be taken as a quite adequate measure of ability to sterilize. Less tight is the link between NDA and ability to sterilize in those countries where the central bank implements open market operations issuing its own debt, or thanks to government deposits.

the higher are the NDA -the higher the ability to sterilize- the more reserves are accumulated. *AMA* and *RMA* are both significant and display a negative sign: the higher is sterilization in absolute terms, and relative to the growth in reserves, the more intense is reserve accumulation. This suggests that, so far, sterilisation provides extended scope for further accumulation, rather than limiting it. To sum up, the empirical evidence points to the notion that that monetary effects matter insofar as the ability to sterilize –as measured by NDA- is jeopardised, but that they are not effectively binding, since countries go on accumulating reserves by increasing sterilisation.

Table 5.
Results of the estimation of the extended model – equation 3

Determinants of reserve accumulation (Dependent variable is *DNFA*)					
	[1]	[2]	[3]	[4]	[5]
NFA(-1)	0.383***	0.525***	0.471***	0.433***	0.438***
	0.000	0.000	0.000	0.000	0.000
RER	-0.123*	-0.112*	-0.173***	-0.115**	-0.112**
	0.054	0.059	0.005	0.044	0.046
Short term external debt	0.851***	0.663***	0.785***	0.688***	0.672***
	0.000	0.000	0.000	0.000	0.000
Quasifiscal results	0.145**	0.074	0.089	0.054	
	0.045	0.284	0.187	0.382	
NDA(-1)		0.269***	0.202***	0.392***	0.408***
		0.000	0.002	0.000	0.000
RMA_need			-0.023***	-0.016**	-0.016**
			0.004	0.023	0.025
AMA_need				-0.323***	-0.328***
				0.000	0.000
Constant	-4.714	-7.855	-1.793	-6.190	-6.054
	0.456	0.187	0.770	0.273	0.275
Observations	162	162	162	162	166
Number of country	29	29	29	29	29
R-squared	0.878	0.895	0.902	0.919	0.918

P values in parentheses.
* significant at 10%; **significant at 5%; *** significant at 1%.

6. CONCLUSIONS

In this paper we have assessed, in two different ways, whether domestic costs are imposing a limit on reserve accumulation. Fiscal or quasi-fiscal costs, which have been the main focus of the literature do

not seem to be of overwhelming concern in most cases, due to the environment of low global interest rates. More important seem to be the challenges within the monetary sphere. There, rather conventional problems are being faced, such as inflationary pressures and credit booms. Difficulties to carry out proper sterilization are also issues in countries with less developed financial system. Other less known nuisances are arising, such as the potential conflict of interest with fiscal authorities (when the sterilization instruments are government paper or when the central bank paper compete with government bonds) or/and a greater dependence on governments -and thus need to coordinate- to sterilize inflows. The impact of sterilization on domestic financial stability and restructuring is also an important concern in countries with underdeveloped financial system. The case studies have highlighted the wide array of challenges reserve accumulation imposes on domestic monetary policy, and the different solutions that are being taken.

Indeed, countries seem to keep accumulating reserves with no respite, and the empirical approach taken in this paper suggests that the perceived cost have not in general impinged on the process of reserve accumulation. On the one hand, fiscal costs are not relevant in the panel. To this may have contributed, in practice, the more active reserve management carried out in recent times by central banks, in search of higher profitability and/or diversification of reserve holdings. On the other hand, the analysis of monetary costs faces some important challenges which have been addressed throughout the empirical part. We have shown that indeed, excess liquidity and inflationary pressures determine the degree of sterilisation –that is, perceived monetary costs, call for a reaction of the authorities–. Therefore, accumulation is not inocuous in terms of costs, but we have also shown that the policy reaction has not entailed an obstacle for the accumulation process; rather the central banks through increased sterlisation are able to manage the situation –at least in the short to medium run- since we have not found that higher sterilisation is associated to limits to reserve accumulation.

Thus, at this stage, central banks are able to contain the monetary costs of reserve accumulation through sterilization and without resorting to a change of policy. This does not mean that the concern about the consequences –and, therefore, the degree of sterilization, has increased over time. The reason is probably that the final goal of reserve accumulation –increasingly identified with exchange rate

management- is of overwhelming importance, so that, before changing this overriding goal, a wide battery of policy measures (sterilisation, alternative investments and , eventually in some countries, capital controls, credit ceilings or price controls) are being instrumented to limit the arising costs and to maintain the process. Looking forward, the perceived scope to manage increase in reserves, do not point at drastic change of policies, but, if anything, to a very gradual shift.

ANNEX. Three case studies: China, Russia, Argentina

In this annex three cases are described. Each focuses on how the central bank has managed to deal with the associated potential problems, and with the domestic consequences of reserve accumulation.

A. China: Exchange Rate Undervaluation and Overheating

Description

In 2001, just before its accession to the World Trade Organization (WTO), China's international assets represented 169 billions. In contrast, China has currently become the top holder of international reserves and it has by 2006 surpassed the trillion dollars of reserve holdings, nearly six times higher than in 2001, and one fifth of the world total holdings. After growing smoothly from 1998, the pace of the reserve accumulation process fostered in 2001 when the negotiations with the WTO were near to end, and since when the effective real exchange rate began to depreciate. The acceleration of reserve holding reached a peak in November 2003, when the first signals of economic overheating arose. Between 2004 and 2006, the holdings increased by 550 billions USD (graph 9.1) and the pace of the accumulation remained very high, within a range of 30-50% y-o-y, boosted mainly by trade flows, due to the discretional capital controls (graph 9.2).

Drivers

Because of the size of the reserve holdings and the persistence of accumulation, it is widely recognized this phenomena is closely related to China's exchange rate policy and the well-known and increasing renminbi undervaluation in real effective terms[6]. Over the last decade, the exchange rate of the renminbi, although theoretically flexible, has been closely tied to the dollar. As a result, the Chinese currency underwent significant depreciations in real effective terms during the period from end-2001 to 2004. In 2005, the Chinese authorities took successive steps to reform the exchange rate regime, which high-

6. A number of indications lend weight to this view, namely the substantial dynamism of the Chinese economy, export growth, its growing trade surplus, the increase in its share of international markets and its massive accumulation of foreign reserves.

lights the renminbi revaluation against the dollar by 2.1% and the formal pegged to a basket of currencies. These reforms had the effect of reversing the renminbi's depreciation and, between December 2004 and August 2006, the currency appreciated 3.8% against the dollar and 7% in real effective terms over this period and the pace of reserve accumulation slowed from 52% to 30% yoy. From a broader perspective, however, in real effective terms the renminbi still depreciated by 3.7% compared with 2001.

Consequences and policy response

In the past three years, the export-led growth strategy and the consequent reserve accumulation has caused a substantial and growing liquidity in the economy (graph 9.3). In 2004, the loose monetary conditions fed overinvestment in certain sectors, a residential price bubble in high growth cities, and a substantial rise in inflation, fuelling a more generalized overheating of the economy, like the one in the early 1990s. The associated rapid growth in bank credit also raised the spectre of substantial wave of nonperforming loans (NPLs) in the mid-term, adding to the large stock of existing NPLs. When the problem was identified, the Central Government settled a series of administrative controls to contain investment. The People's Bank of China (PBC), the central bank, increased interest rates, reserve requirement and began to sterilize the rise in net foreign assets (graph 9.1 and 9.3). Nonetheless, these efforts to cool the economy through administrative controls on lending and property investment reached limited success: the series of tightening measures slowed the pace of investment growth, although it remained high and substantial liquidity persisted in the banking system. In 2005, the central bank continued with the sterilization operations in the inter-bank market through open market operations (OMOs) and the issuance of central bank bills (C-bills) in a regular basis (graph 9.4). In the second quarter of 2006, new signs of overheating arose: investment, credit and monetary aggregates grew at very fast pace. Monetary policy responded with a further tightening in order to avoid that a continued rise in credit growth fuelled a further increase in investment growth and affected financial stability in the medium term. Thus, it increased the reference rate on loans twice in 54 bp and on deposits in 27bp. Moreover, it intensified OMOs, accelerated the issuance of C-bills and raised the reserve requirement in order to sterilize the growth in reserves.

Perceived problems

In addition to other pernicious effects of the China's exchange rate export-led policy, the accumulation of reserves inherent in this strategy has important domestic consequences. First, instead of contributing to fostering investment or, especially, consumption, or to the repayment of external debt, it is channelling a portion of domestic savings abroad. Second, as previously seen, the growth in foreign assets is also creating problems for the operation of monetary policy, as the assets have to be sterilised, at least partially, to prevent excess liquidity and credit expansion boosting investment and generating overcapacity, feeding inflation of consumer prices or asset price bubbles and, in the medium term, exacerbating the problem of NPLs. Third, sterilization's operations have increased interest rates in the inter-bank market, which could be translated to public debt market –introducing fiscal costs- or, even, to the rest of securities –crowding-out investment-. Moreover, sterilization operations could lower even more the commercial bank's profitability. In fact, commercial banks' balance sheet structure has changed recently, as in 2005 loans represented 52% of the assets, 8 points less than in 2001, reflecting the increase of their acquisition of sterilization instruments[7]. Then, the efforts to set up a commercially driven, profitable, efficient and solvent banking system could be jeopardized. Moreover, the economic authorities' attempts to restrain indirectly bank lending also contradicts the government's goal of creating a sound banking sector. Fourth, other reserve accumulation costs that affect a central bank's balance sheet, such as foreign exchange risk or interest rate risk, should not be forgotten, because they can affect the conduction of monetary an exchange rate policy.

Nonetheless, the Chinese economy shows some peculiarities that alleviated some of the adverse domestic consequences, or even helped to mitigate some mounting problems. This was the case with the use, between 2003 and 2005, of part of the reserves to strengthen the capital base of the banking system through the injection of 60 billion USD into the three of the four major state commercial banks[8] that, by the moment, cannot be converted into RMB. Additionally, this

7. There is a substantial gap between the reference rate on loans (1 year: 6.11%) and the current C-bills return (around 2.2%), that obviously could affect the overall profitability of commercial banks.

8. There were two capital injections of 22.5 billion USD each in December 2003 to the China Construction Bank and to the Bank of China and a capital injection of 15 billion USD in April 2005 to the Industrial Commercial Bank.

increased the scope for further accumulation. Another example is, the discretional use of controls on capital inflows and outflows in order to diminish the accumulation of reserves, (such as the recently introduced Qualified Domestic Institutional Investor (QDII) scheme which softens capital controls on outflows), although the effectiveness of capital controls inevitably erodes over time as domestic and international investors find channels to evade them. The underdevelopement of financial markets has allowed the interest rates increases in the inter-bank not to move to other securities alleviating fiscal costs, or crowding-out of investment. Morerover, the high degree of intervention of the public authorities in the economy through moral suasion and administrative controls has constrained credit, investment and prices in certain sectors. Nonetheless, this reliance in non-standard instruments will have to diminish as the increasing sophistication of the economy reduces their effectiveness and raises the cost of the distortions that they create.

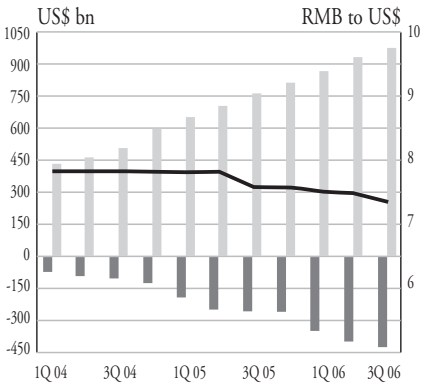
On the other hand, China's foreign assets accumulation has also had global repercussions. The accumulation of reserves, mostly in the form of dollar-denominated assets, could have contributed to the reduction in the US long term interest rates and to finance the growing US current account and fiscal deficit. A sudden change in China's policy of accumulating reserves –which already account for roughly one-fifth of the world total– could well have an impact on global financial stability.

Assessment

The current process of reserve accumulation is not sustainable forever as its costs will overcome the benefits. To date, China has incentives to maintain artificially an undervalued renminbi to promote the export sector, while smoothing some domestic imbalances, such as regional and wealth inequalities, and the job losses resulting from the restructuring of state-owned enterprises. Moreover, the weakness of the financial system will impede a greater flexibility of capital controls and discourage a greater flexibility of the exchange rate. Therefore, in the mid term, it is likely that the current undervaluation of the renminbi was maintained to some extent and, consequently, the accumulation of international assets. Nonetheless, the aforementioned internal and external costs of this will probably increase, feeding the already growing pressures of the international community to China to make him play a bigger role in the reduction

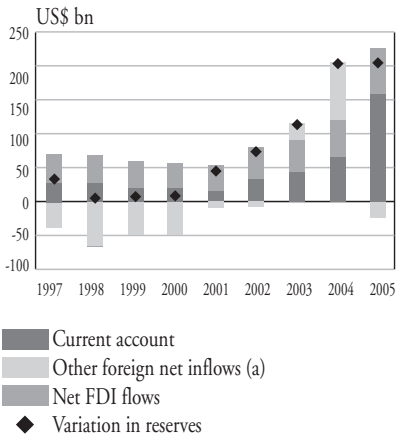
Graph 9.
CHINA: Reserve accumulation and monetary effects

1. Reserves, sterilization and nominal exchange rate



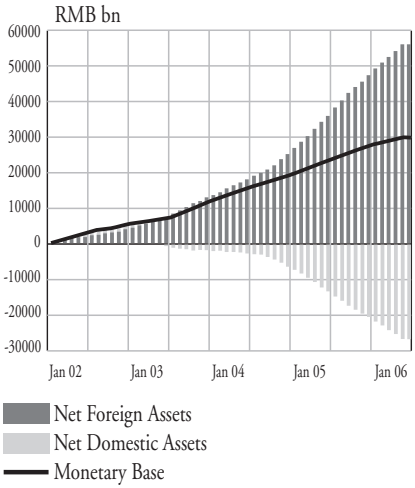
Source: People´s Bank of China

2. Balance of payments



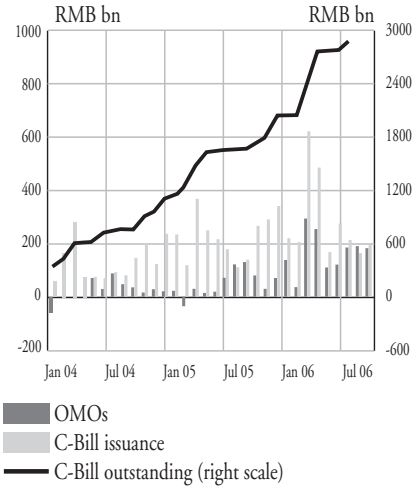
Source: People´s Bank of China.
(a) Includes net inflows of portfolio investment, other investment and error and omissions

3. Determinats of monetary base increase
Annual increase



Source: People´s Bank of China

4. Sterilization instruments



Source: People´s Bank of China

of the global imbalances through a higher renminbi's flexibility. Therefore in the long term, it is likely a greater exchange rate flexibility and a reduction of the reserve accumulation process, which would benefit not only to China but also the rest of the world.

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B. Russia: Dealing with the Mixed Blessed of Oil prices

Description of the process:

Russia's international reserves were 27.9 billions of Us $ in 2000 (9.5% GDP). Since then, they have risen at a fast pace, reaching 265 billions of Us$ in August 2006 (23% GDP). Together to this increase in international reserves, Russia's wealth has expanded through the constitution and growth of an oil stabilization fund. The fund, kept in rubles at an account at the Central Bank, was established in 2004 and it has grown steadily, reaching the equivalent of more than 66 billion Us $ in August 2006. During the second quarter of 2006, nearly 20 billion Us $ of the stabilization fund have been converted into foreign currency and kept in a Federal Treasury Account in the Central Bank[9].

Drivers

The key factor in the growth of the foreign assets of the central bank has been the increase in oil prices. The price of oil was over 30 Us$/bbl at the beginning of 2000, and has risen steadily since then reaching 70 Us$/bbl, in the second quarter of 2006. This oil boom has generated a wide trade and current account surplus, and it has flooded the economy with foreign currency, putting upward pressure on the exchange rate. Given the commitment of the Central Bank towards maintaining a managed floating exchange rate with the Us $, the Central Bank has intervened in the foreign exchange market acquiring Us $ in order to avoid the appreciation of the ruble, this way accumulating reserves[10].

The parallel buildup of the stabilization fund is also closely linked to oil prices. Although oil companies are private, the state has established different taxes on oil -among which it is worth mentioning the tax on the extraction of oil, and a progressive tax on oil revenues when the price exceeds a given threshold (established on 27 $US barrel). These fiscal revenues have been huge and a fraction of them are placed in the Stabilization Fund in order to smooth the government revenues. The taxes on oil revenues are

9. Although we are not sure about whether the foreign currency has been purchased from the central bank's international reserves or from the foreign exchange market, the idea was to implement this measure through purchases of international reserves, and we tend to think this has been the case. The following discussion builds on that assumption.

10. The central bank is also intervening on the euro/ruble exchange rate.

paid in rubles so the resources of the Stabilization Fund are also held in domestic currency. To sum up, the upward trend in oil prices has contributed to the accumulation of international reserves by the central bank and to the constitution of a Stabilization Fund, increasing the wealth of Russia's public sector and reducing (if not eliminating) its vulnerability towards sudden stops of capitals.

Monetary effects of the process

The impact of higher reserves on the monetary base has been limited. Sterilization of the increases in liquidity through market instruments would be difficult in Russia, as local bond markets are not well developed and neither central bank paper, nor government debt can be used in large scale sterilization. Interestingly, the Stabilization Fund has become the central sterilizing device. It is a central bank liability in domestic currency and its parallel growth with reserves implies that it actually sterilises their growth, limiting the expansion of the monetary base. The current volume of the Stabilization Fund is 1.800 billion rubles, a substantial magnitude relative to the total monetary base, as graph 10.2 shows. The strong economic growth associated to the favourable oil cycle allows to absorb the additional liquidity of the system, and so far although inflation remains high for current international standard (13% in 2005), it has been kept under control.

Perceived problems

The ad hoc nature of the stabilization fund and the limited potential for alternative massive sterilization is a potential problem. The large quantities of money kept idle in the Stabilization Funds have raised political pressures to use them for other purposes, either to spend or to invest. The monetary consequences of the mobilization of the resources of the fund would differ depending on the kind of use attached to the resources. Given the scale of the fund spending these resources in consumption would fuel inflationary pressures, both through its impact on demand, and through the flood of liquidity into the economy. If, on the contrary, the resources of the Fund were invested, their impact would differ depending on whether they were invested within Russia or outside Russia. If the resources are invested domestically-either in physical capital or assets- there would be an increase in the money in circu-

lation, and at the same time the investment may contribute to the generation of financial bubbles. Given the shallowness of the domestic financial system, it may also entail risks for financial stability. On the contrary, if the fund were invested in foreign assets –in search for profitability- and the foreign assets are purchased from the central bank –that is, if the government buys international reserves with the resources of the fund- the operation would not change the consolidated public sector debt, nor would have impact on inflation or the domestic financial markets. As a matter of fact, it would imply a reduction in the central bank balance sheet, letting more leeway for further interventions.

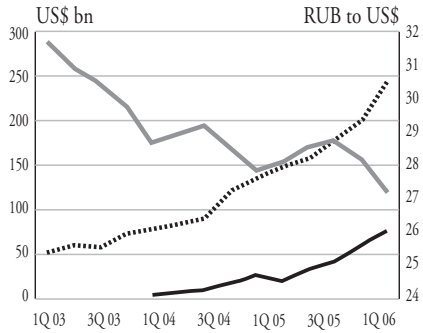
The recent investment of resources from the stabilization funds in foreign investment has followed these lines, therefore overcoming the inflationary effects of the expenditure of the funds within the domestic economy. However, the political pressures entailing this situation and the discretion of the 'de facto' government in the management of the fund, implies a potential risk for the joint achievement of monetary policy and exchange rate goals. Given the paramount importance given to the exchange rate level –in order to avoid competitiveness losses in non-energy (oil and gas) sectors (Dutch disease effects), it is unlikely that the Central Bank let the exchange rate appreciate. The loss or downsizing of the stabilization fund as sterilization device has thus the potential to generate a severe inflationary problem.

Assessment

The Russian case highlights the monetary management problems arising from an oil boom in a large exporter. The underdevelopment of the financial system difficults traditional sterilization devices, but an unorthodox instrument, also derived from the oil booms, helps to mitigate the problem. Since the management of this Fund is in the hands of the government, there is a clear subordination of the monetary policy management to the fiscal authority decision, putting the central bank in a weak position to achieve autonomously its monetary policy objectives.

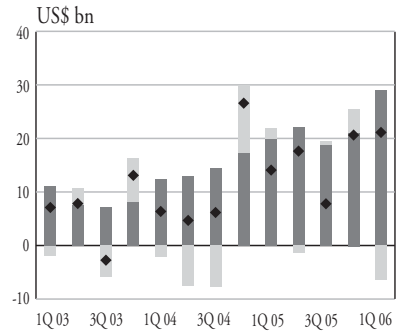
Graph 10.
RUSSIA: Reserve accumulation and monetary effects

1. Reserves, stabilization and nominal exchange rate



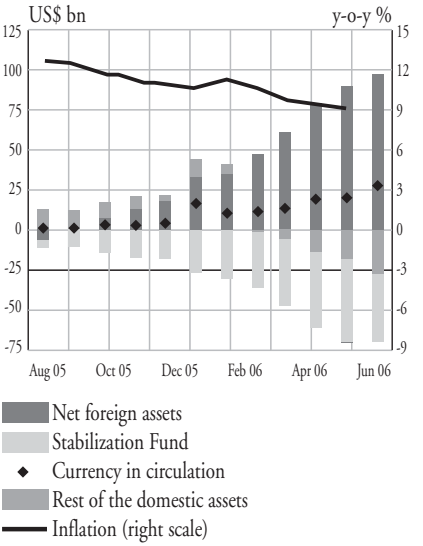
Source: International Monetary Fund (International Financial Statistics) and Ministry of Finance of the Russian Federation

2. Balance of payments



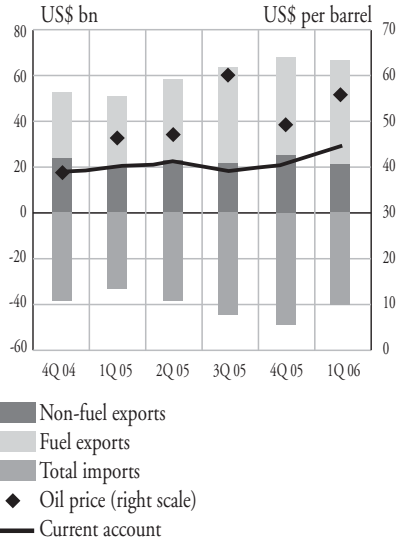
Source: International Monetary Fund (International Financial Statistics)

3. Inflation and accumulated variation of net foreign assets, currency in circulation, sterilization



Source: International Monetary Fund (International Financial Statistics) Central Bank and Ministry of Finance of the Russian Federation

4. Foreign trade, current account and oil price



Source: International Monetary Fund (International Financial Statistics) Central Bank and Ministry of Finance of the Russian Federation

C. Argentina: Reserve accumulation and inflationary pressures

Description of the process

During the severe crisis of 2001-2002, -which implied a sovereign default, the compulsory dedollarization of the economy, a deep banking crisis and an extreme economic depression- the international reserves of Argentina dropped to 10 billion US $, and the exchange rate experienced a substantial depreciation. Soon after, Argentina started to accumulate reserves at a rapid pace, so that they reached the pre-crisis levels during the first half of 2005, and arrived to more than 28 billion dollars at the end of that year. As graph 11.1 shows, international reserves dropped to 18 billion Us $ in January after Argentina used 9.5 billion of US $ to repay the outstanding debt with the IMF, but by the end of the summer they already surpassed the holdings of the end of 2005.

Drivers

The accumulation of foreign reserves by Argentina can be attributed to two reasons: the objective of maintaining the exchange rate at a competitive level (i.e, the consecuence of offsetting the strong appreciation pressures on the peso), and the replenishment of reserve holdings after the crisis in order to the reduce financial vulnerability.

It is not easy to disentangle the importance of each reason on the interventions of the central bank. At the beginning of the process, the low level of the international reserves called for a rebuiliding of the stock of reserves. The reduction of vulnerability has been achieved not only directly (by building up a buffer against sudden stops of capitals), but also indirectly, through their use to pay back external debt. The biggest of the operation took place in January of 2006, when the central bank repaid the 9,5 billion outstanding debt with the IMF. As a matter of fact, the IMF loan was deposited as reserves in the Central Bank and as a counterpart the liability side of the CB was increased by the same amount but, without a comfort level of autonomous reserves, Argentina would have not been able to implement this measure. The impact of the repayment can be seen in the graphs. It implied a fall in reserves (graph 11.1) a strong reversal in the financial account (11.2), but no impact on the net foreign assets (11.3). Furthermore, the cost of the loan was higher than other internal credit to the government, so there was not only a reduction in

external debt but also of the debt burden[11].

Notwithstanding the importance of these precautionary motives, it soon became evident that they could not explain by itself the size of the dollar purchases, and that there was a tacit policy objective of targeting the exchange rate at around 3 ARS/Us$. By maintaining the nominal exchange rate undervalued with respect to the market exchange rate (and as long as inflation is relatively contained), the real exchange rate remains competitive with respect to its main trade partners. Thus, the exchange rate policy is supporting a remarkable and persistent current account surplus that, together to the financial account surplus, matches statistically the increase in reserves, as graph 11.2 shows. The exchange rate policy is also having important fiscal effects. The trade-related tax revenues are collected in ARS pesos, so the combination of an undervalued exchange rate and high export revenues leads to important fiscal revenues. In fact, although these taxes are causing important distortions on the economy, their contribution to total revenues is substantial, as they accounted in 2005 to 10,1% of the total public sector revenues (2.3% of GDP), representing a 88.5% of the primary balance.

Monetary effects

The large purchases of dollars to maintain the nominal exchange rate are generating increasing difficulties in the management of domestic monetary policy. Graph 11.3 shows how the increases in reserves are the main source of creation of monetary base, and, even if at the beginning of the process only a small fraction of increases of reserves were sterilized, the importance attached to preventing monetary base expansions -sterilization- has increased substantially since 2004. However, the monetary conditions, as the negative real interest rates show, are quite loose in spite of the inflationary pressures.

The central bank is partially offsetting the expansion of liquidity through different instruments, of which the issuance of central bank bonds (LEBAC and NOBAC) has been the main one (Graph 11.4). The situation of financial rebuilding of Argentina makes difficult an assessment of the impact of this large-scale issuance of this paper on

11. However, this use of reserves is not free of problems. The pay back deprives the authorities in Argentina from a discipline anchor (indeed, the desire to feel free of the IMF´s surveillance is often considered the underlying motive of the operation). Moreover, the central bank dependence of the government has increased through the decree enacted to allow the operation. All together, the operation provides more room for interventions in support of the exchange rate.

interest rates, since very different developments converge nowadays (for example, change of instruments, banking sector refurbishing, large liquidity, etc). However, it seems that there is no such upward pressure on interest rates, given that the banking sector is showing an important appetite for these assets. Rather than helpful, this may be a further obstacle for the management of monetary policy, since the transmission mechanism is being quite disturbed and the monetary authorities, even when they may control liquidity, have no clear levers to influence directly on the interest rates. An often neglected problem of sterilization through bonds, which could be relevant in Argentina, is that the sterilization is only temporary. In other words, when the maturity of the sterilization bonds arrives, new bonds have to be issued to avoid the expansion of liquidity arising from the face value of the bonds and their interests. Therefore, sterilization through bonds entails a potential rollover problem, that could eventually lead to an expansion of liquidity.

The second instrument used to drain liquidity has been the repayment of the loans (rediscount lines) given to the commercial banking system during the 2001-2002 crises, which are also displayed in figure 11.4. Through these repayments 13 billion pesos have been sterilized, and at the same time commercial banks balance sheets have been tidied up.

Moreover, in the last few months, there has been an increase in government deposits on the central bank, that, although could be withdrawn from the central bank, temporary offset the expansion of the monetary base. However, it cannot be argued that the government is purposefully sterilizing through this mechanism (as it happens in Russia with the stabilization fund).

Perceived problems

Together to the problems arising from sterilization (discussed in the previous point), the process is creating a wide range of problems. The most evident is the fact that expansion of liquidity arising from the partial sterilization is feeding into inflationary pressures. Given the limitations of monetary policy both in priorities –the exchange rate controls seem to be the paramount objective-, and instruments –the transmission mechanism is much distorted and the ability to control inflationary pressures of the central bank jeopardised-, alternative tools have been in place to control the inflationary pressures. These tools consist of compulsory price controls, moral suasion and regu-

lated prices not responding to the increase of shocks. Indeed, these unorthodox measures have temporarily stabilised inflation around 10%, a high level that, however, seems within the tolerable range. However, inflationary pressures remain latent and price controls are distorting the price assignment mechanism in different ways, this way causing substantial inefficiencies in the economy.

Looking ahead, however, the margin of manoeuvre to go on sterilizing is being reduced. The central bank cannot rely on the remaining 8.9 billion loans to the commercial banking system to sterilize, as the debtor banks do not seem to have the financial soundness to repay in advance, so this sterilization instrument seems a bit exhausted. Furthermore, there is a limit on the amount that banks can accommodate central bank paper. Probably, this limit has been widened with the law which limit government paper to the banks to 40% of their assets, but in any case, the magnitudes which they already hold are huge, and the rollover problem applies. Therefore, as it has happened during the first quarter of 2006 (see figure 11.4.), future sterilization will have to be done through open market operations, so it will probably become more difficult and costly.

A cause of greater concern is how the interaction between central banks and government objectives affect the former's autonomy. Monetary policy is not only subordinated to the exchange rate, but the sterilization needs may eventually put pressure on the interest rates on the whole range of instruments, including government bonds. This is a potential source of conflicts between both institutions.

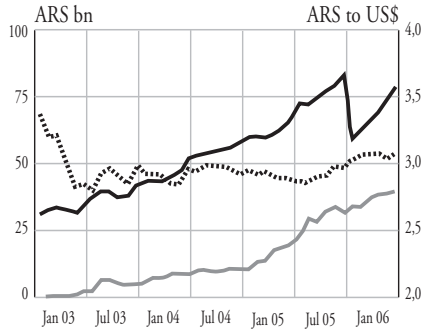
Finally, although it is fair to mention that, with all its drawbacks, ample liquidity conditions have allowed a gradual recomposition of the banks balance sheets and a recovery of their activity with reduced costs, the distortions on the balance sheets of banks may generate financial stability problems in the medium term.

Assessment

To sum up, domestic monetary policy in Argentina is subordinated to the exchange rate target implicitly determined by the government. The main operational goal of the central bank now is to manage the process of reserve accumulation through sterilization to avoid feeding further into inflationary pressures. Control of inflation is being carried out mostly through administrative measures which reinforce the interventionist drive of the economy in other sector. Given the strong

Graph 11.
ARGENTINA: Reserve accumulation and monetary effects

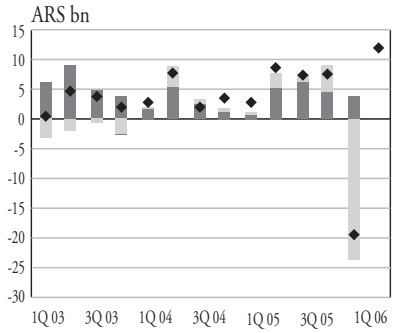
1. Reserves, sterilization and nominal exchange rate



Reserves
Cumulative sterilization
Exchange rate (right scale)

Source: Central Bank of Argentina

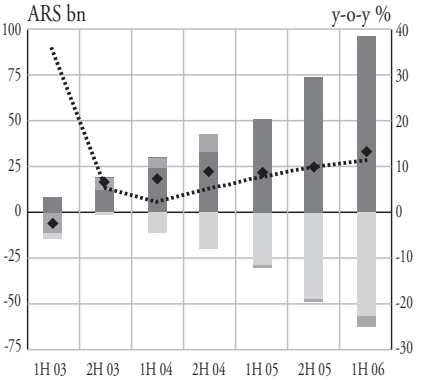
2. Balance of payments



Current account
Financial account
Variation of reserves

Source: Ministry of Economy and Production of Argentina

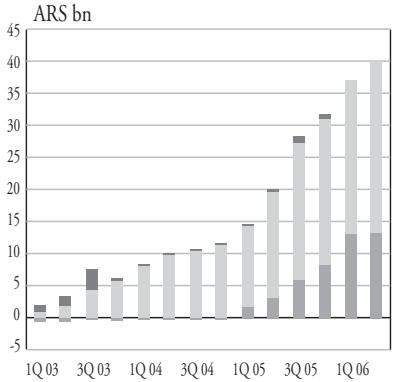
3. Inflation and accumulated variation of net foreign assets, monetary base and sterilization



Net foreign assets
Sterilization
Other sources of creation of money
Monetary base
Inflation (right scale)

Source: International Monetary Fund (IFS) and Central Bank of Argentina

4. Instruments of sterilization



Government deposits
Central bank bonds (LEBAC + NOBAC)
Repayment of credits to commercial banking system

Source: Central Bank of Argentina

reliance of fiscal revenues and continued growth on a competitive exchange rate, a voluntary change of strategy –allowing a more appre-

ciated exchange rate and a halt in the accumulation process- is not envisaged in the short run. Rather, if the inflationary pressures continue and the current monetary strategy is pushed to its limits, an strengthening of the administrative controls and a further drift towards interventionist policies is granted in the medium run.

DATA APPENDIX

a. Sample

Our sample contains yearly observations for 29 emerging economies[12] during the period 1999-2005. We drop from the sample several observations in which there was a sudden reduction in NFA, so that we have, at the end, 166 observations.

b. Variables

- **Net foreign assets (NFA):** Foreign assets (IFS, line 11) minus foreign liabilities (IFS, line 16)
- **Net Domestic Assets (NDA):** Net domestic assets of the central bank are obtained substracting from the value of the central bank balance sheet the value of net foreign assets. Given the identity NDA+NFA=M, this assures that we obtain NDA. Monetary base is obtained from the central bank balance sheet (IFS, line 14).
- **GDP:** When possible, real GDP has been obtained from IFS (line 99b). In some countries the information has been obtained from other sources. These are:
  - Brazil, Chipre, India and Venezuela: Datastream.
  - China: constructed from Asia Regional Information Center data.
  - Russia: measured in domestic currency. Obtained from Datastream for the period 2003Q1 to 2005Q4, and own estimation from 1992Q1 to 2002Q4.
- **Nominal interest rates:** When possible, we have used the overnight interest rate (IFS, line 60b). The exceptions are the following: China, (one week repo from CEIC database); Egypt,

12. These are: Algeria, Argentina, Brazil, Chile, China, Colombia, Croatia, Cyprus, Czech Republic, Egypt, Hungary, Iceland, India, Indonesia, Israel, Korea, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Poland, Russia, Singapore, South Africa, Thailand, Turkey, Venezuela.

Hungary and Israel, (Treasury interest rate); India and Peru: (Datastream).

- **Inflation:** CPI interannual inflation, obtained from IFS (líne 64). In China, we have used CPI inflation obtained from CEIC for the period 2001Q1-2005Q4, and own estimation based on the reconstruction of the index for the period 1987Q1-2001Q4, using CEIC data and year-on-year rates from IFS.
- **Nominal exchange rate:** Quarterly nominal exchange rate measured in US$ per national currency, obtained from IFS (line AH).
- **M2:** IFS (line 35l).
- **Imports:** IFS (line 71).
- **Short term external debt:** IIF database.
- **NER flexibility**: coefficient of variation of the nominal exchange rate (standard deviation of the nominal exchange rate standardized by the average nominal exchange rate), with monthly data.
- **Quasifiscal results**: defined as

$$QF_{it} = \frac{irate_{it-1} * NDA_{it-1} + ieeuu_{it-1} * NFA_{it-1}}{NDA_{it-1} + NFA_{it-1}}.$$

- **RER index**: weigthed real exchange rate using bilateral nominal exchange rates and trade flows, and inflation, obtained from JP Morgan database.

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Comment

José Manuel Campa
IESE Business School

This paper documents the intense increase in reserve accumulation by a number of emerging countries during the last decade. The paper evaluates the internal costs fir these countries from accumulating reserves. The paper concludes that the costs of this reserve accumulation have been manageable and that, in practice, no country has yet stopped this process of reserve accumulation due to the perceived costs.

The paper is divided into three distinct parts. The first part of the paper describes the process of reserve accumulation and evaluates conceptually what are the perceived costs from reserve accumulation. In the second part, the paper reviews the case studies of China, India and Russia paying special attention how these countries are managing the perceived costs. The third part provides econometric evidence on the size of these costs. My comments will follow the same structure.

Emerging markets have increased their foreign currency reserves from $717 billions in 1998 to $2,998 billions in 2006 according to the IMF. This increase in reserves has taken place in all emerging markets. The increase has been most significant in developing Asia where reserves have increased from $307.7 billions to $1,451.4 billions in this period. The bulk of this increase has occurred in China, which had accumulated by 2006 reserves worth $1,062 billions. The

reasons for this accumulation of reserves are well-known. Large economic growth, increases in commodity prices that are mainly exported by emerging markets and excess demand from developed markets that have led them to experienced large current account deficits are the main factors behind this development. Reinforcing these forces the lack of exchange rate changes to compensate from these trends has also contributed to this large accumulation of official reserves by emerging markets.

The paper focuses on the evaluation of the perceived costs from this accumulation of reserves. The paper does not judge the potential benefits from reserve accumulation. The most important role of reserves in emerging markets is precautionary. Capital flows to emerging markets are volatile, countries may want to hold reserves to avoid that sudden withdrawals of capital from their economies may result in large exchange rate fluctuations that may affect relative prices. Avoiding exchange rate crises has been a major policy goal in emerging markets. The paper by choosing to focus only on the costs can lead to misleading conclusions in this respect.

Focusing on the costs from reserve accumulation, two types of costs are of particular interest: the cuasi-fiscal costs from foregone revenues and the increase in domestic monetary aggregates from the accumulation of reserves. The discussion of the case studies of Argentina, China and Russia are very enlightening in this respect. First, the reasons for the accumulation of reserves are very different in each of these countries. Russia has had a large inflow from increases in the prices of commodities that it exports. China in turn has been accumulating reserves as a side consequence from its internal imbalances. Finally, Argentina has accumulated reserves to increase its precautionary savings in expectation of not-so-good times in the future. The paper describes also the way these countries have been managing this reserve accumulation. There are differences in the way the money is being invested, the degree of sterilization, and the institutional setting used to manage this inflow. Russia has been accumulating reserves in a Stabilization Fund managed by the government , while China has it in the hands of the Central Bank. The paper falls short of providing any guidance at this point. Is there an optimal way to manage the increase in reserves? Should we favour one institutional setup vs. another?

The last part of the paper provides econometric evidence on the

evolution of reserves. The paper does a careful analysis of controlling for the endogeneity between reserve accumulation, the variable of interest, and many of the macroeconomic aggregates used in the regression. The main interest is to evaluate the *ability* and the *need* to sterilize. The paper shows that the monetary effects (i.e. costs) matters as long as the ability to sterilize is affected, but that they are not effectively binding in these countries.

The paper is very insightful and provides a thorough review of the issues relating the large increase in reserve accumulations from emerging markets. By focusing on the monetary costs from reserve accumulation, and concluding that these costs are very small, the paper suggests that this process can continue in the future. The paper however, misses to evaluate some of the potential benefits from the accumulation of reserves. The historical volatility of capital flows to emerging markets points to precautionary factors from increasing reserves as the most prominent benefit. Given the historically high levels of reserves in some of these countries, it is hard to justify persistent reserve accumulation for precautionary saving reasons. Thus, although the paper suggests that the costs from further reserve accumulation are small, a full cost-benefit analysis is needed for a more balanced diagnose of the likelihood of further accumulation in the future.

Financial Contagion in Interbank Markets*

José Luis Peydró-Alcalde[1]
European Central Bank

Abstract

Financial instability has significant real effects for the economy. Therefore, understanding financial contagion from the failure of an important bank is of utmost importance. In this paper, I present the different types of financial contagion in interbank markets and I discuss their empirical validity. Finally, I discuss some parallelisms between banks failures and hedge fund failures and their impact on financial contagion.

1. Introduction

The idea that interbank markets can act like a double-edged sword is widely acknowledged. On the one hand, interbank markets play a very important role for the provision of liquidity among banks, for the disciplining and monitoring of banks, and for the conduct of monetary policy (Meulendyke, 1998; Hartmann et al., 2001; Cocco et al., 2004). On the other hand, if a bank fails, the interbank mar-

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*. The views expressed in this article are those of the author and do not reflect the views of the European Central Bank.

1. European Central Bank, Kaiserstrasse 29, D-60311, Frankfurt am Main, Germany. Emails: jose.peydro@gmail.com and jose-luis.peydro-alcalde@ecb.int.

ket could transmit the shock (contagion) thereby increasing the likelihood of a banking crisis (systemic risk). Given the economic importance of interbank markets and, the huge economic costs associated with banking crises (Friedman and Schwartz, 1963; Bernanke, 1983; Calomiris and Mason, 2003b; Dell'Ariccia et al., 2005), understanding the role of the interbank market in transmission of shocks is of crucial importance.[2]

2. DIFFERENT TYPES OF FINANCIAL CONTAGION IN INTERBANK MARKETS

The failure of a large bank raises the risk of contagion to the rest of the banking system. There is contagion if the failure of a bank causes a significant negative externality to other banks.[3] The three types of contagion that may arise (Gorton and Winton, 2002, pp. 85-87; De Bandt and Hartmann, 2002, pp. 251-256; Allen and Gale, 2000) are the following: (i) contagion due to interbank linkages (or interbank contagion): the failure of a bank leads to a loss in value for its creditor banks which hold interbank claims in the failed bank. Furthermore, the loss for the creditor banks may increase due to the (over) reaction of their depositors and other creditors (see e.g., Allen and Gale, 2000; Freixas et al. 2000; Dasgupta, 2004; Iyer and Peydró-Alcalde, 2005).[4] (ii) "Information" based contagion: the failure of a bank could lead depositors and creditors to update their beliefs about the likelihood of failure of other banks with similar characteristics as the failed bank (Chen, 1999, Acharya and Yorulmazer, 2005). (iii) "Pure" contagion: in this case, the contagion

2. Hoggarth et al. (2002) find that, for banking crises, direct resolution costs are approximately 5% of GDP, and cumulative output losses incurred during crisis periods are found to be roughly 15%-20% of annual GDP. Furthermore, they find that output losses incurred during crises in developed countries are as high, or higher, on average, than those in emerging market economies.

3. For a very similar definition of contagion, see Kaminsky and Reinhart (2000). For an excellent survey on bank contagion, see Kaufman (1994).

4. In Rochet and Tirole (1996), a bank failure signals to the rest of the banking system that monitoring has not been effective, in turn increasing the probability of systemic risk. In Aghion et al. (2000), a bank failure signals an aggregate liquidity shortage. In Diamond and Rajan (2005), the failure of a bank causes a negative externality through the reduction of available liquidity. In Cifuentes et al. (2005), the sale of assets by a distressed bank creates a negative externality through the reduction of the market price for assets. See also Flannery (1996), Leitner (2005) and Brusco and Castiglionesi (2005).

is purely random and has no relation either with interbank linkages or with information commonalities (i.e., no relation with fundamentals). This taxonomy of contagion builds on the theoretical literature on bank runs, i.e. information and fundamental based theory of bank runs (Chari and Jaganathan, 1988; Jacklin and Bhattacharya, 1988; and Allen and Gale, 1998) versus the sunspot-based theory of bank runs (Diamond and Dybvig, 1983).[5]

2.1 An example

The fear of contagion was present for example when Continental Illinois Bank failed in 1984. Continental Illinois was at that time the seventh biggest US bank with approximately 2300 banks having interbank exposures with it. Thus Continental was a bank with systemic importance: both large in size and in interbank connections. Hence, Continental Illinois was bailed-out.[6] The statement issued by the U.S. Comptroller of Currency C.T. Conover, justifying the bailout of Continental Illinois Bank, aptly summarizes these concerns.[7] In his testimony before the Congress, he asserted that: "Had Continental failed and been treated in a way in which depositors and creditors were not made whole, we could very well have seen a national, if not an international financial crisis, the dimensions of which were difficult to imagine. None of us wanted to find out." The Chairman at the Fed at the time of the bailout, Paul Volcker said: "As if we had not stepped in, the ultimate domino effect that so many people have feared for so long, would have occurred and wiped out the Western financial system."[8] The fear of contagion and systemic risk when an important bank fails is a general concern. For instance, three quarters of the 104 bank failures considered by Goodhart & Schoenmaker (1995) involved a bailout. They conclude that: "it has been revealed preference of the monetary authorities in *all* developed countries to rescue those

5. See also Bhattacharya and Gale (1987) and Bhattacharya and Fulghieri (1994) on the role of the interbank market to cope with bank specific liquidity shocks.

6. See Kaufman (1994).

7. See U.S. Congress, House of Representatives, Subcommittee on Financial Institutions Supervision, Regulation and Insurance, Inquiry into Continental Illinois Corp. and Continental Illinois National Bank (98-111), (98th Congress 2nd session, 1984).

8. For this reference, see Degryse and Nguyen, 2004.

large banks whose failure *might* lead to a contagious, systemic failure."[9]

3. EMPIRICAL LITERATURE

3.1. "Information" based contagion

Most of the existing empirical studies on contagion focus primarily on measuring equity returns around large bank failures. These papers test whether all banks experience negative abnormal returns or, whether negative abnormal returns are limited to banks with similar characteristics to the failed banks.

Aharony and Swary (1983) study the market reaction to the three biggest US bank failures prior to Continental Illinois. Swary (1986) and Jayanti and Whyte (1996) examine the market effect of the failure of Continental Illinois. Aharony and Swary (1996) study the market reaction in the context of five large bank failures that occurred in the Southwest region of the U.S. during the mid-1980s. These papers find that surviving banks are most affected if they have portfolio characteristics similar to the failing institution. This, they argue, is evidence of "information" based contagion.[10]

3.2. Interbank contagion

A major problem in testing for interbank contagion (or contagion due to interbank linkages) is the lack of detailed data on interbank linkages during a crisis time. Most often it is almost impossible to get information on the interbank positions of banks. In consequence, at the time of the failure of a bank, it is very difficult to map the transmission of the shock due to interbank linkages. Apart from the lack of data on interbank linkages, there is also dearth of large-bank failures, which implies

9. See the excellent survey on contagion through interbank markets by Upper (2006).

10. More recently, Gropp et al. (2005) use the tail properties of distance to default to study contagion risk in Europe; they find that contagion risk in Europe is important. Hartmann et al. (2005) study tail risk in major banks in the Euro Area and United States; they find that multivariate tail risks among major banks have recently increased.

a lack of events for empirical studies. One of the main reasons for lack of large-bank failures is that regulators generally resort to bailouts whenever there is a large-bank failure that poses the risk of contagion due to interbank linkages (see Goodhart and Schoenmaker (1995)).

One partial solution to avoid the empirical problems for testing interbank contagion is to study the possibility of financial contagion due to interbank linkages via simulations.[11] Humphrey (1986) uses data from the Clearing House Interbank Payments System (CHIPS) to simulate the impact of a settlement failure of a major participant in the payment system. He shows that this failure could lead to a significant level of further settlement failures. Upper and Worms (2004) study financial contagion due to interbank exposures in the German interbank market. Through a simulation, they find that the failure of a single bank could lead to the breakdown of 15% of the banking system. In contrast, Furfine (2003) uses exposure data on interbank federal funds to simulate the risk of financial contagion and finds it to be negligible.[12] Elsinger et al. (2003) use detailed data from the Austrian interbank market and study the possibility of contagious failures due to an idiosyncratic shock. In their simulations, they find the probability to be low.[13] While the above papers explore the issue of financial contagion due to interbank exposures, they do not capture the endogenous response of depositors and creditors during a crisis.[14]

To the best of my knowledge, the only paper that has a bank failure and the interbank exposures of banks to the failed bank is Iyer and Peydró-Alcalde (2007). They use a unique dataset from India which allows them to identify the interbank linkages in conjunction with an idiosyncratic and exogenous shock caused by... instead of an idiosyncratic shock (exogenous to a large extent) caused by the failure of a large bank. This is an ideal platform to test for interbank contagion. The authors find that banks with higher level of exposure to the failed bank experience more deposit withdrawals. In addition, to further push on causality, they use overall lending in the interbank

11. See the excellent survey by Upper (2006).

12. Furfine (2002) studies the federal funds market during the LTCM and Russian crises; he finds that risk premiums on overnight lending were largely unaffected and lending volumes increased.

13. Although the probability of contagious default is low, there are cases in which up to 75% of the defaults are due to contagion.

14. See also Sheldon and Maurer (1998), Cifuentes (2003), Müller (2003), Lelyveld and Liedorp (2004), Wells (2004), Degryse and Nguyen (2005), Mistrulli (2005)

market (excluding lending to the failed bank) as an instrument of interbank exposure to the failed bank. Their evidence suggests that interbank exposure to the failed bank transmits the shock (contagion) to other banks. The authors also find that the impact of exposure on deposit withdrawals is non-linear (in particular, convex) and is higher for banks with weaker fundamentals. Finally, they find that small depositors discipline banks in the process of contagion and they provide evidence that suggests that banks discipline other banks with high levels of exposure. Iyer and Peydró-Alcalde (2007) show that financial contagion is much stronger when both (i) the fundamentals of the banking system are weak and (ii) the exposure levels of the financial system to the failed bank are high. This, in turn, implies that bail-outs of failed institutions are more likely to happen and be successful when both the fundamentals of the financial system are not strong and the failed bank is systemically important. Their results lend support to the theories of financial contagion due to interbank markets (Allen and Gale, 2000; Dasgupta, 2004; Iyer and Peydró-Alcalde, 2005).

3.3. Depositor discipline

Another related strand of empirical literature investigates depositor runs on banks during a crisis. This literature explores whether depositors run randomly across banks or run on banks based on fundamentals (i.e., a test between the sunspot-based theory of bank runs by Diamond and Dybvig, 1983, versus the information-based theory of bank runs by Chari and Jaganatthan, 1988, Jacklin and Bhattacharya, 1988 and Allen and Gale, 1998). One can see the empirical literature on "information" based and interbank contagion as the literature on depositor discipline in which depositors not only discipline on bank fundamentals but depositors also discipline on interbank exposures, especially on interbank exposures with a failed bank.

Schumacher (2000) studies depositor behaviour in Argentina following the Tequila Shock, and finds that depositors primarily concentrate their runs on fundamentally weak banks. Martinez Peria and Schmukler (2000) also find evidence of depositor discipline in Argentina, Mexico and Chile. Calomiris and Mason (1997) look at the Chicago Banking Panic of 1932, and investigate whether solvent

banks fail during the crisis. They find that banks that fail during the panic are ex-ante weak banks. They also provide some evidence in support of interbank cooperation helping prevent failures of solvent banks. Gorton (1988) studies the banking panics during the U.S. National Banking Era (1865-1914). He finds them not random events but products of revisions in the perceived risk of the banking system based on the arrival of new information.

4. Conclusion

Financial instability has significant real effects for the economy. Therefore, understanding financial contagion from the failure of an important financial institution is of utmost importance. In this paper, I present the different types of financial contagion in interbank markets and I discuss their empirical validity.

Finally, I think there are very close conections between bank failures and hedge fund failures and their impact for financial contagion. For instance, the failure of Amarath (a very big hedge fund) did not cause any significant impact in the economy whereas the failure of LTCM was very important. Both funds were very large in assets, however, LTCM was systemically more important than Amaranth because e.g. many important banks were heavily investing in LTCM. Also, the fundamentals of the economy were not so good in August 1998 vis-a-vis 2006. Theoretical models like Allen and Gale (2000) and empirical tests like Iyer and Peydró-Alcalde (2007) help us understanding why LTCM was bailed-out whereas Amarath was not.

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Monetary Policy and Capital Regulation: Is there a conflict?*

Stephen G. Cecchetti
Brandeis University
Lianfa Li
Peking University

1. Introduction

It may be skill or it may be luck. Regardless, the world today is a much more stable place than it was a decade ago – or, at least much of it is. Monetary policymakers' commitment to price stability means that today only 4 of the 29 countries the IMF lists as "advanced economies" has inflation in excess of 3 percent. And since the collapse of Long Term Capital Management in the fall of 1998, there has not been a serious financial disturbance. The system has withstood the century date change on 1 January 2000, the bursting of the dotcom bubble several months later, the terrorist attacks of 11 September 2001, and most recently the collapse of both General Motors bonds and hedge fund Amaranth Advisors.[1] All of this has yielded a world more stable growth.[2] Whatever policymakers are doing (or not doing), it is working – at least, so far.

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*. Cecchetti is Barbara and Richard M. Rosenberg Professor of Global Finance at the Brandeis International Business School and Research Associate at the National Bureau of Economic Research; Li is an Assistant Professor at School of Economics, Peking University. This paper was prepared for the XIX *Moneda y Crédito* Symposium "Monetary and Financial Stability: Harmony or Conflict?" in Madrid on November 6/7, 2006. We thank our discussant, Fernando Restoy, as well as participants in the conference for helpful comments and discussions.

1. During the late summer of 2006, Amaranth Advisors lost roughly $6.5 billion of its $9 billion value in less than a month by using leveraged futures transactions to bet that natural gas prices would rise. The fund managers spent the next few months liquidating their positions.

2. Comparing 1985 to 1994 with 1995 to 2004, the standard deviation of real growth in the 29 "advanced economies" fell from an average of 2.3 percentage points to 1.8 percentage points.

Innovations in both monetary theory and practice have contributed to this success. Today, central bankers know that price stability should be their primary objective, and politicians understand that central banks must be independent.[3] And monetary policy is implemented through changes in short-term interest rate targets that react to deviations of inflation from an agreed upon target and the gap between real activity and an estimate of the full-employment level. As the Bank of England's Governor Mervyn King (2004) said several years ago "any [coherent] monetary policy can be written as an inflation target plus a response to supply shocks." Furthermore, today's policymakers understand that controlling inflation means that when the inflation rate rises by one percentage point, they must raise their nominal interest rate target by more than one percentage point.

Monetary policy success has come together with increases in the sophistication of the financial system. Risks and payments streams can now be sliced up, packaged, sold, sliced up again, repackaged, and resold again almost endlessly. The result is a dizzying array of asset-backed securities and derivatives. As of the end of June 2006 the estimated notional value of derivatives in the world was approaching $300 trillion; over 6 times world GDP. The vast majority of these derivates, around $250 trillion, are interest rate and currency-based. Of the remaining $50 trillion, the bulk is in credit default swaps – an instrument that didn't even exist five years ago!

The development of these new financial instruments, and the markets where they are traded, is a two-edged sword. The ability to allocate risk to those who are most willing and best able to bear it has improved the efficient operation of the economy. The availability of low-priced insurance means people are undertaking activities that they would not have in the absence of the insurance. There is every reason to believe that the financial development, especially by insuring household consumption risk created by income volatility, has been a driving force behind the recent real economic stability.[4]

But together with the ability to trade risk cheaply, comes the ability to concentrate it. Concentration of risk tends to increase the

3. See Chapter 15 of Cecchetti (2006) for a discussion of the role and design of central banks.

4. Both Dynan, Elmendorf, and Sichel (2005) and Cecchetti, Flores-Lagunes, and Krause (2005) conclude that the decline in the volatility of real growth since the mid-1980s, the so-called "great moderation," can be tied to financial liberalization and innovation. Specifically, the increase in the availability of loans to households has allowed them to smooth their consumption in ways that they could not before.

chances of collapse. And, because of the way markets are naturally organized, the collapse of a large financial institution, especially one that has accumulated risk from a large number of counterparties, can substantially impair the operation of other financial institutions.

Originally, many of us hoped that monetary stability would enhance financial stability. While we have averted broad scale crises of the type we saw in the late-1990s, asset price booms and busts look to still be with us. As documented in Cecchetti (2006), housing booms worsen growth prospects, creating outsized risks of very bad outcomes. By contrast, equity booms have little impact on the expected mean and variance of macroeconomic performance, but worsen the worst outcomes.

All of this has led to a focus on financial stability. In 1995, no central bank that we know of issued anything that resembles financial stability reports. These are the periodic publications that examine systemic financial risks in countries or currency areas. There was no Financial Stability Forum or Committee on the Global Financial System – bodies that bring together various regulators and supervisors from around the world. Today we are much more concerned about both the linkages among financial institutions and the behavior of nondepository institutions. Professionals inside and outside central banks devote substantial time and energy to studying the causes of instability and how to stop it.

The problem is that monetary and regulatory policy may work at cross purposes. Success in one might make the other more difficult. Real and nominal stability, especially in the form of low and stable interest rates, have the potential to encourage excessive risk-taking that creates financial fragility. And, risk-based capital requirements intended to reduce volatility in the financial system have the potential to make lending procyclical and destabilize the real economy.

Our purpose in this essay is to examine the issues raised by the potential conflict between monetary policy and capital regulatory policy. We begin in the next section with an overview of the macroeconomic performance over the last three decades, focusing on what has happened to the volatility of various economic and financial indicators. In the following section we discuss what we will refer to as the old or narrow policy framework, in which the two branches of policy operate completely separately. We then move on to a description of the new environment and the new challenges that it brings: How monetary stability threatens financial stability and vice versa. Section

5 proceeds with a discussion of a simple model in which monetary policymakers can internalize the destabilizing impact of capital regulation, and go on to set interest rates in a way that eliminates its procyclical impact. Then, in Section 6 we summarize some old and new empirical results showing that interest-rate policy does depend in part on a combination of the state of the banking system and asset prices. But, unfortunately, the results are not robust. The final section concludes with a discussion of the challenges monetary and financial policy officials are likely to face in the next few years.

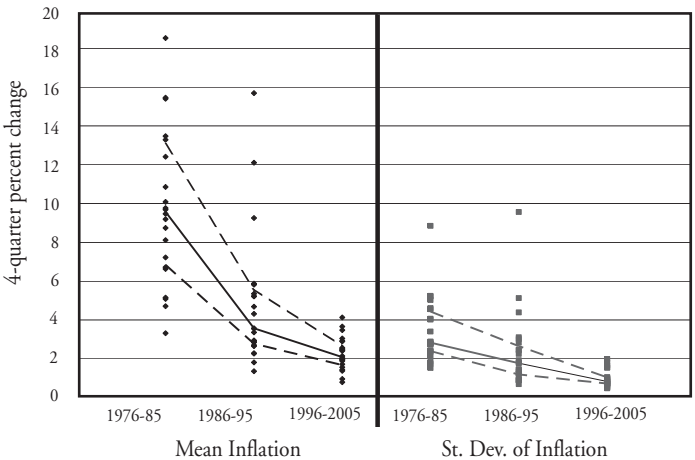
2. THE CHANGING ENVIRONMENT

Let's start by looking at data on inflation, growth, credit, equity prices, and housing prices over the past three decades across a broad cross-section of industrialized countries. Start with inflation in Figure 1.[5] The left-side of the figure shows mean inflation for each of 24 countries over each of the past 3 decades. The solid line is the median across countries, and the dashed lines represent the inter-quartile range. We see what we already know: Inflation fell substantially in the industrialized world over the past 30 years. Across this sample of countries, the median inflation for 1976 to 1985 was nearly 10 percent. Twenty years later the median is 2 percent. Not only that, but today the countries are closely grouped; the inter-quartile range has fallen from more than 6 percentage points to 1 percentage point.

The right-hand side of Figure 1 tells an equally interesting story. Each point in this portion of the figure represents the standard deviation of inflation within the decade for a particular country. This gives some indication of the stability of inflation. And looking across countries we see whether some have been more or less stable than others. As expected, we see that in the most recent decade, inflation has been substantially more stable than it was before – and that stability is now widely shared. Not only has the median of the standard deviation fallen from nearly 3 percentage points to less than one, but the inter-quartile range across the countries has nearly disappeared. Inflation is both lower and more stable!

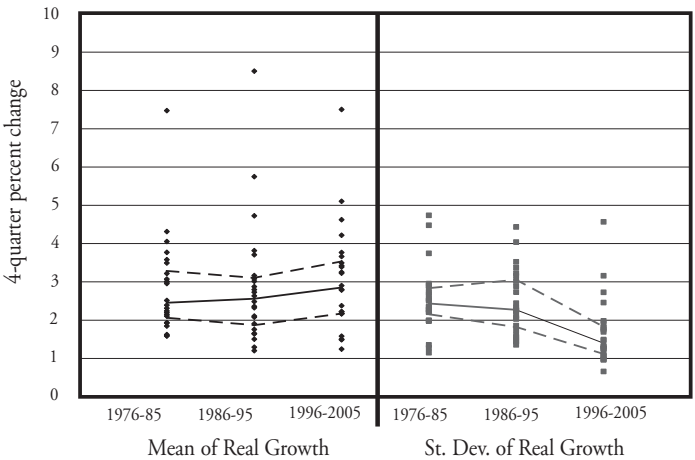
5. The results for the standard deviations reported in this section are robust to using filtering techniques that remove time-varying means.

Figure 1.
Mean and Standard Deviation of Inflation
By Decade, Various Countries



The left panel of the figure shows the decadal averages of the four-quarter change in consumer price inflation for a sample of 24 industrialized countries. The solid line is the median across countries, and the dashed lines are the 25th and 75th percentiles, respectively. The right panel of the figure plots the decadal standard deviation of the four-quarter change in consumer price inflation for the same sample of countries. Again, the solid line is the median across countries, and the dashed lines are the 25th and 75th percentiles, respectively. The data are all from the International Financial Statistics online. The countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States.

Figure 2.
Mean and Standard Deviation of Real Growth
By Decade, Various Countries

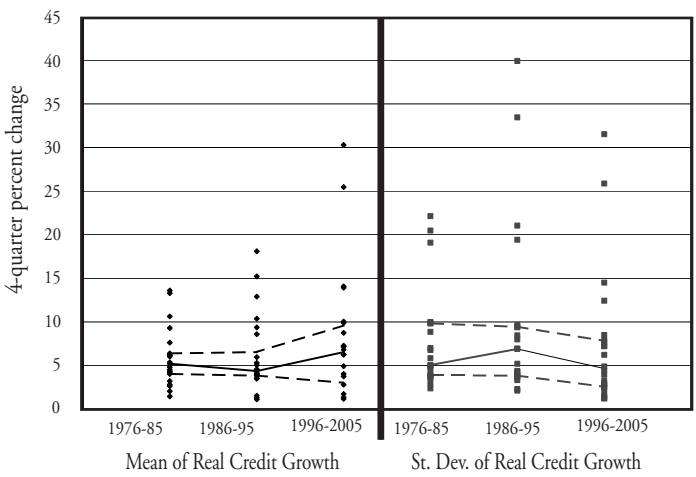


See the note to Figure 1.

Has inflation stability led to higher and more stable growth? To answer this question, we turn to GDP data. Figure 2 does for growth data what Figure 1 did for inflation data. The results are suggestive, but inconclusive. Unlike the patterns in Figure 1, we suspect that careful statistical analysis of these data would not reveal a very dramatic increase in growth (that's the left side of the figure). But, as Cecchetti, Flores-Lagunes, and Krause (2005) show, the volatility decline is statistically and economically important. Taking a look at the right side of Figure 2, we see that the median of the decadal standard deviation of real growth across countries fell from roughly 2 ½ percentage points in the 1976 to 1985 period to less than 1 ½ percentage points in the most recent decade. By contrast, the median growth rate rose from 2 ½ percent to 2 ¾ percent.[6]

What about the financial system? To get some sense of what has happened, we look at real credit growth, real equity price growth, and real housing price growth. The results are in Figure 3, 4 and 5. They allow the following tentative conclusions:

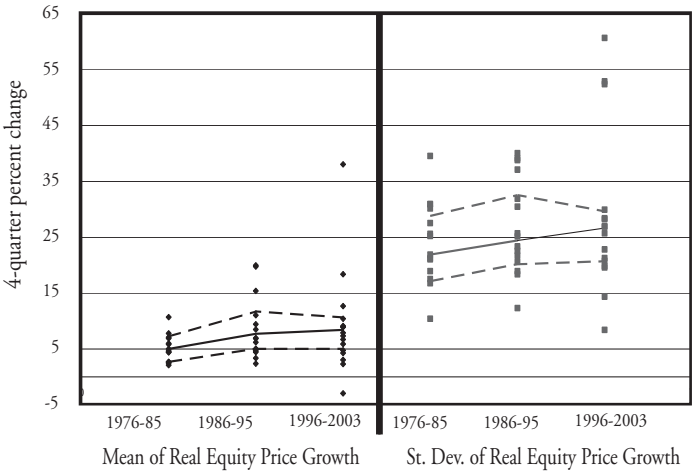
Figure 3.
Mean and Standard Deviation of Real Credit Growth
By Decade, Various Countries



See notes for Figure 1. Countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States.

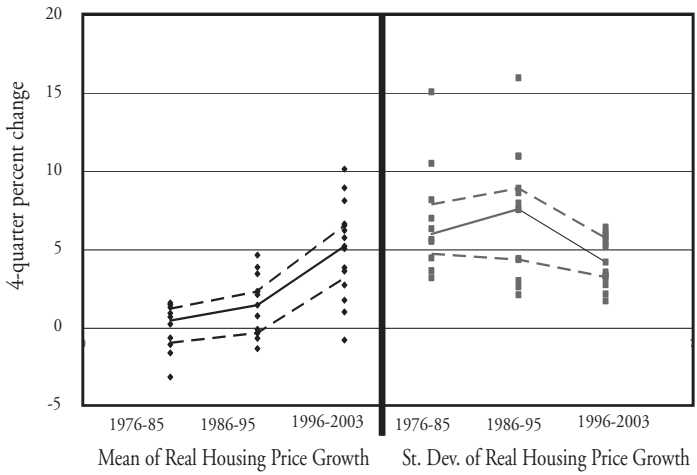
6. Cecchetti, Flores-Lagunes, and Krause (2006) suggest that better monetary policy is the likely source of these improved macroeconomic outcomes.

Figure 4.
Mean and Standard Deviation of Real Equity Price Growth
By Decade, Various Countries



See notes for Figure 1. Countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, South Korea, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States from various sources.

Figure 5.
Mean and Standard Deviation of Real Housing Price Growth
By Decade, Various Countries



See notes to Figure 1. Countries are Australia, Belgium, Canada, Denmark, Finland, Greece, Ireland, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States from various sources.

- Credit growth has increased and become somewhat less volatile.[7]
- Equity prices are growing more rapidly, on average, but are decidedly more volatile.
- Housing prices are growing more rapidly and are less volatile.

Taking all of this together, there is only modest evidence for increases in financial volatility. And, more importantly, even if the financial system has become less stable, there is virtually no evidence that this instability has been transmitted to the real economy.[8]

3. THE NARROW POLICY FRAMEWORK

Twenty-five years ago most monetary economists ignored the financial system. Banks and other financial institutions were interesting and people studied them, but macroeconomic models (and textbooks) ignored them. The theory of monetary policy didn't make much mention of financial intermediation. In this narrow policy framework, inefficient economic outcomes were largely associated with two kind disorders: high inflation and the health of individual financial institutions. Interest-rate instruments could address the first, securing price stability (combined with high, stable real growth); while financial regulators could use prudential supervision and capital regulations to ensure that individual banks and other financial intermediaries remained solvent. Importantly, since interactions between the real and the financial system could be ignored, there was no need to coordinate among the various authorities.

This narrow framework was based on logic that went something like this: In a market-based economy, the opportunity to succeed is also an opportunity to fail. New restaurants open and others go out of business. In fact, only one in ten restaurants survives as long as three years. In principle, banks should be no different from restaurants: new ones should open and others close. But few of us would want to live in a world where banks fail at the same rate as restaurants. Banks serve some crucial functions in our economy: They provide access to the payments system, and they screen and monitor borrow-

7. The growth rate of the ratio of nominal credit to GDP shows the same pattern.

8. This is different statement from the one in Borio and Lowe (2002). They show that, like asset price booms, credit booms are harbingers of declines in real growth.

ers to reduce information problems. If your favorite restaurant closes suddenly, you can still eat; but if your bank closes, you lose your ability to make purchases and pay your rent. Today we realize that without financial stability, the economy will not operate properly. So while no one suggests that the government appoint officials to minimize restaurant closings, everyone expects the policymakers to safeguard banks. And that job was given to regulators and supervisors.

In recent years, the narrow framework has given way to a broader one. First, there was a realization that traditional descriptions of the monetary transmission mechanism were inadequate. The idea that interest rate changes had a material impact on firm investment decisions was not borne out in the data. And yet, there is broad agreement that monetary policy affects short-run economic decisions. This caused monetary economists to realize that banks and the financial system provided the critical missing link in their theory. For the vast majority of individuals and firms, the cost of issuing either stocks or bonds is prohibitive. These borrowers do not have access to direct capital market financing; instead, they must go to banks, which step in to reduce the information costs faced by small borrowers. A small business that is denied a bank loan has nowhere else to turn, so the project it wishes to undertake goes unfunded. When banks stop lending, then, a large class of borrowers simply can't obtain financing. Thus, bank lending is an important channel through which monetary policy affects the economy.[9] By altering the supply of funds to the banking system, policymakers can affect banks' ability and willingness to lend.

Along with the awareness of the fundamental role played by banks in the monetary policy transmission mechanism came the realization that the banking system is still fragile. Bank runs and panics were common until the mid-1930s. The hope was that various regulatory changes would make things more robust. But as financial systems were liberalized in the last half of the 20th century, the world was subjected to a nearly continuous series of financial crises. Since the late 1970s, 93 countries have experienced a total of 117 system-wide and 51 smaller disruptions in their financial systems.[10] Virtually no part of the world has been spared; large industrialized countries have suf-

9. Studies of how and why monetary policy is transmitted through bank lending and balance sheets include Bernanke and Gertler (1995) and Kashyap and Stein (1994).

10. See Caprio and Klingebiel (2003).

fered along with smaller, less developed ones. And, when the financial system collapses it really doesn't matter what else you do.

The response has been to continue to adjust the regulatory and supervisory environment. Primarily this has meant a move toward the widespread adoption of risk-based capital regulation, combined with explicit restrictions on composition of bank balance sheets. Importantly, though, the focus has been on depository institutions. This is because the primary rationale for financial regulation has not changed. It continues to be to protect small, unsophisticated depositors who are not capable of monitoring their bank's balance sheet and, at the same time, prevent runs from the sudden fall in either the value of the bank's assets or the confidence of the bank's depositors.

4. A New Environment with New Challenges

Comparing today's financial and economic environment with that of a quarter century ago reveals two enormous changes. First, monetary policy has made the world a calmer place. Inflation is lower, growth is higher, and both are more stable – at least, for now. Second, financial innovation has brought the ability to buy and sell virtually anything. Most importantly, the assets that once formed the core of banking system balance sheets – mortgages, consumer credit, and business loans – are now marketable. Each creates new challenges that threaten stability.

Monetary Policy's Threat to Financial Stability

There is a concern that the new monetary stability is a breeding ground for financial instability in the form of asset price booms and busts. Borio and White (2004) and White (2005) note this possibility, as does Rajan (2006). Rajan's argument begins by noting that stability presents some very real challenges for asset managers – especially stability that brings low nominal interest rates with it. In the world of finance, risk is opportunity. Without volatility, there is no risk; without risk, there are no returns; and without returns, there are no jobs for asset managers. This means that the managers have an incentive to take more risk than they otherwise would in order to

obtain the returns that will keep them in business. Combining this with the fact that asset manager's compensation is tied to their return performance as compared to their peers at short horizons and that investors are the ones that sustain the losses if they occur, tend to get a very volatile mix. The result is lower risk premia, and higher asset prices. But when things start to go wrong, investors withdraw funds from these managers.

The benign macroeconomic environment affects the behavior of lenders providing funds as well as that of asset managers who are borrowing them. Lenders will base risk assessments on historical experience in ways that normally give a heavier weight to the recent past. Successful stabilization policy makes it look as if there is little risk. As Borio (2003) notes, people are generally better at cross-sectional than time-series risk evaluation. The result is a credit boom that will further fuel asset price increases.

In this atmosphere, a price decline can trigger a sequence of events that lead to disaster – a feedback loop where one price decrease leads to a sequence of future decreases. First, high risk tolerance gives way to high risk aversion, raising risk premia, forcing price down even further. Second, as prices fall, empirical estimates of volatility based on the recent past rise, and lenders require higher risk premia. Third, the price declines themselves impair the collateral of the borrower leading the lender to either reduce the size of the loan or require additional collateral.[11]

Finally, there is White's (2005) argument for how monetary stability can create financial instability. It goes like this. Consider a case in which policymakers have been successful in creating an environment of stable prices. Now, along comes a positive productivity shock that raises the sustainable growth rate of the economy. This has three immediate effects: (1) It depresses prices; (2) it raises growth; and (3), it raises the neutral real interest rate. Fearing the prospects of a destabilizing deflation, the natural response is to ease. Easing in this circumstance can be dangerous, White observes, since

11. As Federal Reserve Bank of New York President Timothy Geithner notes in a recent speech, this can happen in derivatives markets through margin as well. In most circumstances, derivatives traders are required to post something called *variation margin* that buffers counterparties against losses. When the price of the derivative moves, the loser must have sufficient margin to cover both the most recent move and potential future moves – that is, margin to insure against adverse variation in the price. The result can be further sales to raise the liquidity, forcing prices down even further.

it can lead to the excessive credit growth and asset price booms. Under such a circumstance, price stability today will lean to instability in the future.

The solution, according to White, is to realize that the neutral real interest rate is now higher. This means both that a fixed nominal interest rate is associated with a more expansionary policy, and that the zero nominal rate floor is less likely to bind. Both imply that nominal policy rates should not be lowered. Instead, the appropriate policy is to raise interest rates in order to offset the impending financial imbalances.

Financial Stability's Threat to Monetary Stability

There is concern that the move to risk-based capital requirements will exacerbate business-cycle downturns, make it more difficult for monetary policy to achieve its stabilization goals. So far, this hasn't happened. But implementation of Basel II has not started, so it might.[12]

The problem is straightforward. Imagine a mild cyclical downturn starts. This reduces the creditworthiness of borrowers, causing the marked-to-market value of bank assets deteriorates. This translates directly into a reduced level of capital. Lower capital means less lending and less lending means a worse business climate and a worse downturn. And the reduced level of lending is unlikely to be offset by either well-capitalized banks or other sources of credit.

Evidence that supports this statement is reviewed in Jackson and Furfine (1999). As intermediation falls, the level of economic activity goes down with it. The Basel Committee on Banking Supervision (2001) itself notes that capital regulation "has the potential to amplify business cycles." It looks as if regulation deepens recessions, while monetary policy tries to stimulate the economy. As Kashyap and Stein (2004) explain, the problem is that there is an increase in required capital just when it is getting expensive.

12. According to the value-at-risk ("VaR") paradigm, such alignment is achieved by keeping a level of bank capital that is sufficient to cover up to certain range of the distribution of portfolio losses, so that the probability of survival over horizon is above the targeted level (for instance, 99.90%). In other words, the bank capital is set so that the probability of bank default (PD) is under, say, 0.10% over horizon (usually over the next year). In an excellent paper, Gordy (2003) show that capital requirements in the form of the Basel II are the most efficient approach to keep banks' targeted probability of default below the threshold level, under certain circumstance.

Capital regulation may also increase the uncertainty with which we can estimate the impact of monetary policy actions. The banking system is an important part of the monetary transmission mechanism, so any changes in the behavior of intermediaries has immediate implications for how monetary policy works. Using a general equilibrium framework, Tanaka (2002) shows that the more stringent capital adequacy requirements are, the less effective monetary policy will be. The author concludes that Basel II-style risk-based capital requirements could very well reduce the effectiveness of monetary policy as a tool for stabilizing output following a downturn.

5. Using Monetary Policy to Offset the Procyclicality of Capital Requirements

Looking at the current structure, we see that financial regulatory policies are formulated to control the risks of *individual* financial institutions. Supervisors are decidedly less concerned with the macroeconomic impact of what they do. As we have just suggested, there is the clear possibility that capital regulation will exacerbate business cycle fluctuations. Blum and Hellwig (1995) provided the first theoretical demonstration of this. They show how a binding capital requirement can amplify the impact of negative shocks on aggregate output.

But Blum and Hellwig treat monetary policy as exogenous, so their treatment is incomplete. It is more realistic to include the central bankers as active participants working to stabilize output. What if central banks conduct monetary policy to explicitly account for the impact of capital requirements? Will the procyclical effect of capital requirements remain? Is this the optimal thing to do for central banks? To answer these questions, Cecchetti and Li (2005) derive an optimal monetary policy rule with both static and dynamic models in which the potential procyclicality of capital requirements is embedded.

Cecchetti and Li show how interest rate policy, by reacting to the possibility that capital requirements will be binding, can neutralize the impact of regulatory policy. It is worth providing a brief summary of the static version of their model (the dynamic model has the same properties). The setup is a straightforward extension of an

aggregate supply and aggregate demand model, with a banking system added.[13] Here are the critical components:

- Aggregate demand is a function of the real deposit rate, a real lending rate, and inflation.
- The nominal deposit rate is set by the monetary authority.
- There is a loan market that determines the lending rate:
  - Loan supply depends on the level of deposits and the level of bank capital.
  - A maximum leverage ratio defines when the capital requirement binds, and when it does this constrains loan supply.
  - The value of bank capital moves with the level of aggregate output.
  - Loan demand depends on the real deposit rate and the level of aggregate output.
- Aggregate supply depends on unanticipated inflation.

With the deposit rate fixed, a sufficiently negative shock to output reduces value of the bank's capital, causing the capital requirement to bind. This constrains loan supply, and drives the lending rate up. A higher lending rate drives output even lower making the initial shock even worse.[14] This is the Blum and Hellwig result.

Following Svensson (1997, 1999), Cecchetti and Li go on to embed this model in with a policymaker who is intent on stabilizing a weighted average of inflation and output volatility. In this environment, the optimal policy sets the deposit rate to account for the possibility of the capital constraint binding, thereby neutralizing its impact on output and inflation.[15] As one would expect, the model predicts that banking system stress will lead to lower policy-controlled interest rates, all other things equal.

Before going on, we note that if capital requirements are administered in a manner that creates procyclical lending behavior, then there is another solution. Instead of using monetary policy to undo poorly constructed financial regulatory policy, why not change regulatory policy? That is to change the way in which bank capital is com-

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13. The model is a based on a long literature including, but not limited to Brainard (1964), Brunner and Meltzer (1972, 1993), Friedman (1970), Tobin (1969), Bernanke and Blinder (1988), and Gaspar and Kashyap (2006).

14. Section 2 of Cecchetti and Li (2005) contains the mathematical details.

15. What Cecchetti and Li actually show is that policymakers can neutralize demand shocks so long as behave as if their control variable is a specific linear combination of the deposit rate and lending rate.

puted, making it so that lending behavior is less likely to be adversely affected in a downturn.

6. MONETARY POLICY RESPONSES TO FINANCIAL IMBALANCES

Viewing this theoretical discussion in a broader framework suggests that policymakers should be responding to the potentially destabilizing effects of a variety of financial imbalances. In addition to reacting to banking system stress, central bankers should be using their interest rate tools to combat the effects of equity and housing price booms. Do they take account of the potential negative feedback between monetary and financial stability?

In several papers written over the past few years, we have addressed this question by estimating interest rate policy reaction functions – modified Taylor rules – for the central banks. Cecchetti and Li (2005) study responses to banking system stress, and Cecchetti (2003) discusses reactions to equity price misalignments. Here we present evidence on housing price booms.

All of this work is based on Taylor (1993). In his original work characterizing the Federal Reserve behavior from the mid-1980s through the early 1990s, he suggested that what the FOMC actually did was to set the nominal federal funds rates so that

$$i_t = r^* + \pi_t + 0.5(\pi_t - \pi^*) + 0.5 y_t, \tag{1}$$

where i_t is the nominal federal funds rate at period t, r^* is the natural real interest rate (Taylor set this to 2 percent), π_t is current inflation, π^* is the inflation target (Taylor set this to 2 percent), and y_t is the percentage deviation of actual output from a measure of potential or trend output. More recently, Clarida, Gali and Gertler (1998, 2000) proposed estimating a forward-looking version of this interest-rate rule based on the view that policymakers are forward-looking. That is, they derive a reaction function of the form

$$i_t^* = r^* + \pi^* + \gamma_\pi (E_t \pi_{t,k} - \pi^*) + \gamma_y E_t y_{t,q}, \tag{2}$$

where i^*_t is the target rate for the nominal short-term interest rate in period t, $\pi_{t,k}$ is the inflation from period t to period $t+k$, $y_{t,q}$ is the output gap of period $t+q$, and $E_t(\cdot)$ is the expectation conditional on information at t. As a sufficient (but not necessary) condition for the model to be well behaved, the coefficient on inflation has to be larger than one (recall Taylor's original rule-of-thumb was to set γ_π equal to 1.5).

To see whether the central bank's response depends on the state of housing prices, equity prices, or banking system stress, we augment equation (2) with certain measure of the extent of a misalignment. Our augmented version of equation (2) is

$$i_t^* = r^* + \pi^* + \gamma_\pi (E_t \pi_{t,k} - \pi^*) + \gamma_y E_t y_{t,q} + \gamma_h h_t + \gamma_e e_t + \gamma_b b_t , \qquad (3)$$

where h_t, e_t, and b_t are measures of housing price bubbles, equity price bubbles and banking-system stress, respectively.

We assume that the observed interest rate adjusts smoothly to this desired level according to the partial adjustment equation

$$i_t = \Psi(L) i_{t-1} + [1 - \Psi(1)] i_t^* + \upsilon_t , \qquad (4)$$

where $\Psi(L)$ is a polynomial in the lag operator L, and υ_t is an i.i.d. random variable that we can think of as a monetary policy control error resulting from things like unanticipated shifts in the demand for bank reserves. Equation (4) summarizes the view that policymakers are responding smoothly to a combination of inflation and the output gap. The standard procedure is to substitute equation (3) into equation (4) and estimate the resulting equation using Generalized Method of Moments on quarterly data for a variety of countries. In the estimation, we use quarterly data, with two lags in the interest rate adjustment equation - $\Psi(L)$ is a second-order polynomial. The instrument set includes a constant, plus lags 1-3 of short-term interest rates, output gaps, inflation rates (CPI), changing rates of PPI and term spreads, growth rates of M2 (M3 for Germany and Australia), leverage ratio, housing price and equity price[16].

Estimation requires that we make assumptions about both the target inflation (π^*) and the target natural real interest rate (r^*). For

16. The instrument set for Finland includes 3 lags of unemployment rates and investment growth rates since money supply and term spread data is not available.

the U.S., we assume these both to be 2 percent. For Germany, Australia, Canada, Finland and Sweden, the inflation target is set at 2 percent, and the natural real interest rate is determined in the estimation. For New Zealand, the inflation target is set as zero, and the natural real interest rate is estimated. And for Japan, the inflation target is set as an HP filtered trend, and the natural real interest rate is estimated.

We report estimation results as central banks react to the output gap[17] and inflation 4 quarters ahead ($q = k = 4$). In the following regressions, the banking-system stress is measured as deviation of banking-system leverage ratio from its HP trend. The leverage ratio is measured as total loans of the banking system divided by the sum of bank equity and subordinated debts for the U.S., and total assets divided by bank capital plus reserves for the rest of countries. Housing price misalignments are measured as deviation of real housing price from its HP trend. We have used two measures for equity price misalignments. The first is the deviation of real equity price from its HP trend and the second is the deviation of equity risk premium from its trend, which is called an excessive risk premium as in Cecchetti (2003). Details of the sources and construction are described in the Appendix.

The sample countries in Cecchetti (2003) and Cecchetti and Li (2005) are the US, Germany and Japan; while the sample countries for housing price analysis in this paper includes the US and five countries that have adopted inflation targeting regime, that is, Australia, Canada, Finland, New Zealand and Sweden. Sample periods differ based on data availability and are noted in the tables of results.

Banking System Stress

Cecchetti and Li (2005) estimate reaction functions using quarterly data for the Federal Reserve during the 1990s, and for the Deutsche Bundesbank and the Bank of Japan during the 1980s. To focus on potential asymmetries, that paper examines whether policymakers

17. The output gap data for the US comes from the Federal Reserve, for the Germany and Japan comes from the OECD. For the rest of countries, we constructed the output gap as the deviation of real output from its HP trend, while the real output data comes from Cecchetti (2006).

respond differently depending on the sign of the output gap. Table 1 presents results drawn from that paper. These allow the following conclusion. All other things equal, the Federal Reserve raised interest rates when the leverage ratio was higher-than-trend during upturn. But there is little evidence of FOMC reactions to bank-system stress during cyclical downturns.

Table 1.
Reactions to Banking System Stress

Country	Inflation Gap (γ_π)	Output Gap (γ_Y)	Banking-System Stress (γ_b)		Adjustment Coefficient (Ψ)
			Downturn	Upturn	
United States	1.82**	1.31***	-0.16	1.87**	0.92***
1989-2000	(0.02)	(0.00)	(0.73)	(0.02)	(0.01)
Germany	1.18*	0.40	6.65***	-0.66***	0.73***
1979-1989	(0.08)	(0.13)	(0.00)	(0.00)	(0.01)
Japan	1.33	0.61	1.13**	0.09	0.75***
1979-1989	(0.61)	(0.28)	(0.01)	(0.29)	(0.01)

This table reports and extract from Cecchetti and Li (2005) Table 2. Estimates are by GMM, using the correction for heteroscedasticity and autocorrelation of unknown form with a lag truncation parameter of 4. The instrument set includes a constant, plus lags 1-3 of short-term interest rates, output gaps, inflation rates (CPI), changing rates of PPI and term spreads, growth rates of M2 (M3 for Germany) and leverage ratio. Robust p-values are reported in parentheses. The sum of two adjustment coefficients (2 lags of adjustment equation for interest rate) is presented. The null hypothesis for the coefficient before inflation is γ_π=1. The superscripts ***, ** and * indicate that the estimates are significant at 1, 5, and 10 percent level, respectively. The numbers of observation for the US, Germany and Japan are 39, 37 and 37, respectively. See Cecchetti and Li(2005) for more details.

Although the standard error is large, it is still helpful to get some ideas of the economic magnitude of the response. In this case, a one-standard-deviation increase in the leverage ratio equals 1.82 and that is estimated to result in a 0.36 percentage point cut in the federal funds rate in a downturn and a 2.8 percentage point rise in the federal funds rate in an upturn, all other things equal.

Tables 2 and 3 present results for the U.S. case when we control for equity and housing price misalignments. The results in Table 2, controlling for just equity, imply a much more modest 0.58 percentage point interest rate response to the same one standard deviation rise in the leverage ratio. In Table 3, when housing price misalignments are added, we see that in the results for the US the coefficient on the banking-system stress is still negative. In this case, a one-standard deviation rise in the leverage ratio causes a 0.15 percentage point cut in the federal funds rate. That is, there is modest evidence that the Federal Reserve could be cutting interest rate when the leverage ratio of the banking system is above the trend.

Table 2.
Reactions to Equity Price Misalignments

	Inflation Gap (γ_π)	Output Gap (γ_y)	Equity Misalignment (γ_e)	Banking-System Stress (γ_b)	Adjustment Coefficient (Ψ)
U.S.	1.72	0.45***	0.19	-0.20**	0.93***
1989–2000	(0.16)	(0.00)	(0.28)	(0.03)	(0.00)
Germany	1.07	1.06**	0.06***	-1.07***	0.80***
1979-1989	(0.61)	(0.02)	(0.01)	(0.00)	(0.00)
Japan	0.65**	0.27	0.01	0.32***	0.59***
1979-1989	(0.02)	(0.13)	(0.53)	(0.00)	(0.00)

Estimates are by GMM, using the correction for heteroscedasticity and autocorrelation of unknown form with a lag truncation parameter of 4. The instrument set includes a constant, plus lags 1-3 of short-term interest rates, output gaps, inflation rates (CPI), changing rates of PPI and term spreads, growth rates of M2 (M3 for Germany), leverage ratio and equity risk premium. Robust p-values are reported in parentheses. The sum of two adjustment coefficients (2 lags of adjustment equation for interest rate) is presented. The null hypothesis for the coefficient before inflation is γ_π=1. The superscripts ***, ** and * indicate that the estimates are significant at 1, 5, and 10 percent level, respectively. The numbers of observation for the US, Germany and Japan are 39, 37 and 37, respectively.

Turning to the Bundesbank and the Bank of Japan, the estimates in Table 1 suggest reactions, but of the wrong sign. That is, to the extent that these central banks are reacting to problems in the banking system, over and above their reactions to output and inflation gaps, it was making matters worse, not better. For Germany, the coefficients imply that a one-standard-deviation increase in leverage ratio will raise call money rate by 5 percentage points in a downturn and lower it by 0.9 percentage points in an upturn. For Japan, a one-standard-deviation increase in leverage ratio during a downturn equals 1.56 and this causes a 2 percentage point rise in the call money rate, all other things equal.

Looking a bit further, we see in Table 2 that, once we control for the equity misalignments, the Bundesbank does appear respond to banking-system stress by lowering interest rates. To get some ideas of economic magnitude of the response, we compute that a one-standard-deviation rise in the leverage ratio equals 1.33 and this causes a 1.4 percentage point cut in the call money rate.

While the Bank of Japan does look to be reacting to banking-system stress, consistent with the results in Cecchetti and Li (2005), they are exacerbating problems created by banking-system stress. In this case, a one-standard-deviation rise in the leverage ratio equals 2.32 and this causes a 0.74 percentage point rise in the call money rate. But the coefficient on inflation is 0.65,

Table 3.
Central Bank Reactions to Financial Imbalances

Inflation Gap γ_π	Output Gap γ_y	Housing Price Misalignment γ_h	Equity Misalignment γ_e	Bank Stress γ_b	Adjustment Coefficient Ψ	Goodness of Fit Adj. R^2
United States, 1989-2000						
1.36**	0.42***				0.92***	0.95
(0.02)	(0.01)				(0.01)	
1.38*	0.42***	-0.37*			0.91***	0.95
(0.05)	(0.01)	(0.08)			(0.01)	
1.42*	0.45***	-0.27		-0.07**	0.92***	0.95
(0.06)	(0.01)	(0.21)		(0.04)	(0.01)	
1.36*	0.63**		-0.02	-0.02	0.92***	0.95
(0.06)	(0.04)		(0.53)	(0.88)	(0.01)	
1.40*	0.53	-0.29	-0.01	-0.03	0.92***	0.95
(0.09)	(0.14)	(0.18)	(0.78)	(0.80)	(0.01)	
Australia, 1993-2003						
0.58***	-0.66*				0.91***	0.91
(0.01)	(0.01)				(0.01)	
0.29***	-0.87***	-0.07***			0.85***	0.91
(0.01)	(0.01)	(0.01)			(0.01)	
0.50***	-1.25***	-0.15***		0.05***	0.86***	0.91
(0.18)	(0.01)	(0.01)		(0.01)	(0.01)	
0.23**	-0.42***		-0.12***	-0.03***	0.81***	0.93
(0.04)	(0.01)		(0.01)	(0.01)	(0.01)	
0.23***	-0.91**	-0.10***	-0.09***	0.004	0.73***	0.93
(0.04)	(0.01)	(0.01)	(0.01)	(0.65)	(0.01)	
Canada, 1991-2003						
1.30	0.49**				0.82***	0.67
(0.72)	(0.04)				(0.01)	
2.69	0.87**	0.20**			0.83***	0.65
(0.18)	(0.03)	(0.04)			(0.01)	
2.52	0.83*	0.17		-0.02	0.84***	0.64
(0.32)	(0.08)	(0.37)		(0.84)	(0.01)	
1.29	0.41		0.02	-0.12**	0.82***	0.65
(0.78)	(0.15)		(0.49)	(0.04)	(0.01)	
3.32	1.25*	0.48	0.09	0.05	0.88***	0.62
(0.30)	(0.09)	(0.20)	(0.18)	(0.78)	(0.01)	

Estimates are by the Generalized Method of Moments, using the correction for heteroscedasticity and autocorrelation of unknown form with a lag truncation parameter of 4. The instrument set for the estimation includes a constant, 3 lags of short-term interest rates, consumer price inflation, output gaps, producer price inflation, M2 growth (for Australia is M3), the term spreads between the long-term bond rate and short-term interest rate, housing price, bank leverage ratio and equity price. The sum of two adjustment coefficients (2 lags of adjustment equation for interest rate) is presented. The superscripts ***, ** and * indicate that the estimates are significant at 1, 5, and 10 percent level, respectively. Numbers in parentheses are p-values for the test that the coefficient estimate is equal to zero, except for the inflation gap variable, where the null hypothesis is that the coefficient is one. The numbers of observation for the US, Australia, Canada, Finland, New Zealand, Sweden are 39, 41, 44, 25, 49 and 37, respectively.

Table 3. cont.
Central Bank Reactions to Financial Imbalances

Inflation Gap γ_π	Output Gap γ_y	Housing Price Misalignment γ_h	Equity Misalignment γ_e	Bank Stress γ_b	Adjustment Coefficient Ψ	Goodness of Fit Adj. R^2
Finland, 1991-1998						
2.74***	-1.70***				0.49***	0.94
(0.00)	(0.00)				(0.01)	
1.02***	-1.73***	0.11***			0.56***	0.94
(0.00)	(0.00)	(0.00)			(0.01)	
0.68**	-1.71***	-0.01***		-0.14***	0.48***	0.94
(0.01)	(0.00)	(0.00)		(0.00)	(0.01)	
0.58***	-1.64***		-0.03***	-0.06***	0.38***	0.94
(0.00)	(0.00)		(0.00)	(0.03)	(0.01)	
0.57***	-1.64***	0.01	-0.03***	-0.05***	0.39***	0.95
(0.00)	(0.00)	(0.28)	(0.00)	(0.03)	(0.01)	
New Zealand, 1990-2003						
1.75	0.12				0.85***	0.83
(0.48)	(0.66)				(0.01)	
4.45**	-0.35	0.27***			0.87***	0.84
(0.03)	(0.22)	(0.00)			(0.01)	
4.58	-0.60*	0.27**		0.05	0.87***	0.83
(0.11)	(0.07)	(0.01)		(0.26)	(0.01)	
3.91	-0.79**		0.76**	0.01	0.89***	0.84
(0.15)	(0.03)		(0.02)	(0.92)	(0.01)	
3.93	-0.74*	0.11	0.53	0.01	0.89***	0.84
(0.15)	(0.05)	(0.36)	(0.16)	(0.07)	(0.01)	
Sweden, 1993-2003						
3.40**	1.72***				0.96***	0.97
(0.02)	(0.00)				(0.01)	
3.32***	-0.13*	-0.20***			0.86***	0.97
(0.18)	(0.07)	(0.00)			(0.01)	
2.57***	-0.40***	-0.19**		-0.22***	0.85***	0.98
(0.39)	(0.40)	(0.00)		(0.00)	(0.01)	
0.64	0.22		-0.03***	-0.53***	0.94***	0.97
(0.15)	(0.53)		(0.00)	(0.00)	(0.01)	
2.09***	-0.25***	-0.15***	-0.02***	-0.13***	0.75***	0.98
(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	

which means that as inflation rose in Japan, the BoJ did not increase the nominal call money rate sufficiently to ensure that the real interest rate increased. This is likely a consequence of the fact that during in 1980s, the Bank of Japan was not independent of the Ministry of Finance, so when fiscal authorities pursued an expansionary policy, the Bank of Japan could not raise short-

term interest rates sufficiently to counteract the inflationary pressure.[18]

Finally, Table 3 reports results for the five inflation targeting countries that we study. In the case of Finland[19] and Sweden, the coefficients on banking-system stress are negative and significant, suggesting that the central banks in these countries are doing the same thing as the Fed, at least qualitatively. The standard deviations for the leverage ratios gap (from the trend) are 17.7, 10.6 and 6.0, respectively. The estimations suggest that the short-term interest rates for these countries will cut by 0.53, 0.53 and 0.78 percentage points respectively when the banking-system leverage ratios rise by one standard deviation.

The results for Australia[20] and Canada are somewhat mixed. Like the Bank of Japan, the central bank in New Zealand reacts to the condition of banking system by exacerbating the stress. In this case, a one-standard-deviation rise in the leverage ratio gap (from the trend) equals 15.26 causes a 0.15 percentage point rise in the short-term interest rate.

Equity Prices

Turning to the impact of equity price misalignments, we begin with the results in Table 2. Here, we look at the excessive equity premium.[21] It turns out that signs of coefficients on equity misalignments are positive. These signs suggest that central banks in the US, Germany and Japan do *not* respond to equity bubbles by raising interest rates, all other things equal, since an equity premium below trend signals a equity bubble. For the US, Germany and Japan, the

18. See Okazaki (1999) for details.

19. The coefficient on inflation reported in Table 3 is less than one. To understand this, we can look at the Finish monetary policy during the period. In 1994 -1995, for example, labor costs were increasing, so inflation was expected to rise. But, with the unemployment rate at 18 percent, the Bank of Finland responded with only a modest increase in its policy rate. At the same time, fiscal consolidation and a move to inflation targeting helped to lower inflation expectations without the need for an interest rate increase. Pikkarainen, Suvanto, Hukkinen and Pyyhtia (1997) discussed the details.

20. The case of Australia is somewhat unsatisfactory, since the coefficient on inflation in the modified-Taylor rule is less than one. As was the case for Japan, this is likely a consequence of the specific economic events, including the adoption of inflation targeting, that we are unable to include directly in our estimation. See Stevens (1999) for details.

21. The details of constructing equity risk premium see Cecchetti (2003).

standard deviations of excessive risk premium are 0.65, 11.82 and 12.59, respectively. The estimations in the Table 2 suggest that the short-term interest rates for these countries will cut by 0.12, 0.71 and 0.13 percentage points when excessive risk premium falls by one standard deviation, all other things equal.

Turning to Table 3, as the equity price misalignments are measured as the deviation of real equity price from its HP trend, we find that the signs of coefficients on US equity misalignment change to be negative. This is consistent with the results for the US in Table 2, since a real equity price above trend signals an equity bubble. In both tables (Table 2 and Table 3), the US coefficients are not significant. For the US, the data does not support to add equity misalignments in the regression. The estimation in Table 3 suggests that the federal funds rate will cut by 0.2 percentage points when the equity-price deviation from the trend rises by 19.54 (percent) – one standard deviation.

Among the remaining countries, Australia, Finland and Sweden behave like the US, but the effects of equity misalignments on short-term interest rates become more significant (all coefficients for these three countries on equity misalignments are negative and significant). The standard deviations of equity-price misalignments for these countries are 8.83, 20.71 and 31.94 respectively. A one-standard-deviation of rise of equity-price gap causes a cut of short-term interest rate by 0.79, 0.62 and 0.63 percentage points, respectively.

The central banks in Canada and New Zealand seem to do the right things, rising interest rates to the equity bubbles, since the coefficients on equity misalignments for these countries are positive (significant sometime but not always). In this case, the standard deviations of equity-price misalignment for these countries are 16.84 and 14.44 respectively. A one-standard-deviation of rise of equity-price gap causes a rise of short-term interest rate by 1.5 and 7.6 percentage points, respectively.

Housing Price Misalignments

We now move on to an examination of housing price misalignments presented in Table 3. In this case, the banking-system stress variable also does not distinguish between upturns and downturns. For the US, while the sign of γ_h is negative, the data do not support adding h_t to the policy rule. That is, the FOMC did not react strongly to the

housing prices when it is above the trend, all other things equal. To get some ideas of the economic magnitude of the response, we compute that the standard deviation of housing price misalignments equals 1.07 and this causes a 0.3 percentage point cut in the federal funds rate – not what we would have expected.

The cases for Australia, Sweden are similar to that of the US. Central banks in these two countries also did not raise interest rate to the housing prices. Again, for these two countries, we can compute that the standard deviations of housing price misalignments equal 9.36 and 12.08 respectively, and this causes 0.94 and 1.8 percentage point cuts in the short-term interest rate for these countries, respectively. This suggests that either we are missing something in the estimation, measuring housing booms poorly, or that the central banks are behaving in a way that exacerbates the problem.

For Canada and New Zealand, the coefficients on housing price misalignments are positive, suggesting that these central banks react to the housing price boom by raising interest rate, a policy strategy suggested by a broader policy framework. In this case, the standard deviations of housing price misalignments for these countries are 5.41 and 6.44 respectively. A one-standard-deviation of rise of housing price misalignments causes a rise of short-term interest rate by 2.6 and 0.71 percent, respectively. The result for Finland is mixed.

Taken together, the estimates of these policy reaction functions suggest that the policies of central banks in Canada and New Zealand are *most* consistent with a broader policy framework, that is, to raise interest rate in response to the rising housing prices and equity bubble[22]. It turns out that other central banks we tracked did not react to the housing price and equity price in a way that is consistent with a broader policy framework. That is, these central banks *might* have lowered their overnight interest rates, relative to the baseline, during period when housing prices and equity prices were above the trend — the opposite of what the broad framework suggests is optimal. But we do find evidence that most central banks (except for Japan and New Zealand[23]) tend to react to the banking-system stress in a sensible way.

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22. The responses to banking-system stress are mixed for Canada and insignificant for New Zealand, see Table 3.

23. The coefficient for Japan has "wrong" sign and significant, and that for New Zealand has "wrong" sign but insignificant, see Table 2 and Table 3.

It is important to point out a number of limitations of these estimates. First, we are examining specific historical periods. Current policymakers in these countries almost sure behave differently. Second, even when we do find evidence of reactions to financial imbalances these could be a consequence of correlations with things that are omitted from the reaction function. So, when we find that interest rates are moving with housing price bubbles it seems likely that they are adjusting to changes in consumption forecasts. Third, in the cases of Australia and Finland the reaction functions are not well behaved, as the coefficient on inflation is less than one[24]. Fourth, our parameter estimates tend to be quite imprecise. One explanation for this is that the financial imbalances may figure into our estimates of the expected future output gap, and so they are redundant. And finally, and as we discuss in the conclusion, the evolving nature of financial intermediation is surely changing the monetary transmission mechanism, forcing policymakers to adjust their reactions.

7. CONCLUSIONS

Central bankers are right not to rest on the laurels of their inflation-fighting success. Yes, inflation is now lower and more stable that it was a decade ago. And real growth has been higher and more stable. But financial innovations have created a new capacity for risks to become highly concentrated. As a result, there is new concern that monetary and financial stabilization may work at cross purposes.

Our results suggest several reasons for optimism. First, to the extent that there has been an increase in financial instability over the past decade, it has not found its way into the real economy. Despite the disturbances to both individual financial intermediaries and to the system as a whole, real growth has been largely unaffected – or, at least it appears so. Second, today's central bankers are clearly aware of the risks posed by financial disturbances and they are willing to use the tools at their disposal to insulate and address them. They have

24. It is important to keep in mind that the Taylor rules we estimate suffer from the fact that they do not account for a myriad of potentially important macroeconomic effects. For example, we are unable to include the impact of worldwide slowdowns or speedups in activity, changes in fiscal policy, or complex adjustments in inflation expectations.

adopted a broad framework for possibly that takes account of financial imbalances. As a practical matter, this means that reaction to shocks depends on the nature of the shock and the environment in which it occurs. For an inflation-targeting central bank, the horizon over which inflation is brought back to its target must vary depending on why the deviations have occurred.

Finally, the financial system is not standing still. There is constant innovation that creates added reason to remain optimistic. As we were writing this paper, we came across a story in *The Economist* entitled "Collateral thinking." The article recounts the creation of new mortgage products tying the value of the loan to the value of the property. "One version includes a put option…linked to [a] house-price index. At a cost of 0.5% a year, this option ensures that, if regional house prices fall, the size of the loan will decline in tandem. [A] second version links the level of the mortgage rate to the house-price index."[25]

Beyond these new financial instruments, there is also a change in the organization structure of the financial system. As we noted above, one of the primary functions of banks overcome the adverse selection and moral hazard problems inherent in the relationship between borrowers and lenders. The concern is that when a bank fails, information is lost, and certain classes of borrowers are left without sources of funds. But today we see that screening and monitoring have moved outside of banks. Households have credit scores, large corporations have ratings, and those in between have become easier to evaluate. And funds used to provide loans now come from a broad array of sources. All in all, the financial system is evolving in ways that help to stabilize the economy central bankers are evolving with it.

25. "Collateral thinking," *The Economist*, September 23rd-29th, pg. 86.

Data Appendix:

1. Converting Data Frequency

When we interpolating low frequency to high frequency data (the leverage ratios), we fit a local quadratic polynomial for each observation of the low frequency series, then use this polynomial to fill in all observations of the high frequency series associated with the period. The quadratic polynomial is formed by taking sets of three adjacent points from the source series and fitting a quadratic so that the average of the high frequency points matches to the low frequency data actually observed. For most points, one point before and one point after the period currently being interpolated are used to provide the three points. For end points, the two periods are both taken from the one side where data is available.

2. Data Sources

Price Data: Computed for consumer price inflation data was obtained from the International Financial Statistics on line and the OECD Economic Outlook No. 76, December 2004.

GDP: GDP data was obtained from the International Financial Statistics CDROM (December 2004) and the OECD Economic Outlook No. 76, December 2004.

Housing Prices: Data for Australia, Canada, Finland, Sweden, and U.S. are all from the BIS. Data for New Zealand are from the Reserve Bank of New Zealand.

Interest Rates: Money market rate was obtained from the International Financial Statistics CD-ROM.

Bank Capital and reserve: OECD Bank Database.

Bank Assets: OECD Bank Database.

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Comment

Fernando Restoy
Banco de España

INTRODUCTION

The paper contains a wealth of theoretical, empirical and policy material on highly relevant issues. The authors deal with a relatively wide variety of topics such as the impact of recent developments in financial systems on macroeconomic and financial stability, the links between prudential and monetary policies, the role of asset price bubbles and other indicators of financial stress on monetary policy.

Much of the material is already known thanks to previous contributions, notably those by Steve Cecchetti and his co-authors. However, the paper incorporates some new evidence on the role of financial imbalances in connection with monetary policy. My remarks will focus on a few normative issues inspired by the paper and on the empirical section.

THE NORMATIVE ISSUES

Most of the profession would probably agree by now that the development and globalisation of the financial system in a context of low interest rates have made episodes of excessive risk-taking and finan-

cial imbalances more likely, and this may be relevant for supervisory authorities. In particular, these new developments should encourage more effective financial regulation and supervisory practices.

Although there is less consensus on the implications for monetary policy, nobody would of course doubt that central banks should respond to financial developments, at least insofar as they have an impact on its primary objectives. In particular, as developments in the financial and credit markets do typically alter the macroeconomic outlook (through wealth effects, balance sheet effects, the credit channel, etc.), they modify both output and inflation prospects as represented in standard monetary policy rules.

The paper does make, however, a relevant additional point: the optimal response to output or inflation may depend on some relevant financial developments. For example, if financial regulation exacerbates the procyclicality of credit supply, central banks with standard objective functions should respond more aggressively to output fluctuations. In other words, not only the arguments but also the shape of the optimal reaction function can change as a result of financial stability considerations.

Unfortunately, these well-founded theoretical considerations bear little relevance to the actual policy debate. For instance, opponents of the view that abnormal developments in asset markets should be directly taken into account in monetary policymaking typically use three types of rather practical arguments: bubbles are hardly predictable, central banks cannot easily disinflate them and, even if they could, this may have counter-productive effects on macroeconomic stability.

I believe some of these arguments have lost force recently. There is now some new evidence (see e.g. Borio and Lowe, 2002, Detken and Smets, 2004, Adalid and Detken, 2007) suggesting that costly episodes of asset price misalignments can be identified on the basis of financial and real-sector information. Moreover, recent research indicates that excessively lax monetary conditions -which could well be compatible with consumer price stability- make those episodes more likely and, therefore, may trigger collapses with disproportionate costs in terms of output and employment.

I find this research quite supportive of a policy of *leaning against the wind,* along the lines defended in the paper. The open question is whether this should be a regular feature of monetary policy reaction functions or simply a position to be activated by central banks only

in particular circumstances. I will return to this point below.

THE EMPIRICAL ISSUES

In the empirical section, the authors aim at exploring whether indicators of financial stress enter significantly into the reaction functions of central banks in several OECD countries, the function being specified in terms of expected output and inflation. In particular, the focus is on work with proxies for banking stress, *excessive* equity price growth and *excessive* housing price growth.

The results are not very conclusive. In particular, no indicator is significant in three countries and equity and housing imbalances are normally not significant; indeed, when they are, they are of the wrong sign. Only the proxy for banking stress is significant and with the expected sign in some countries. But, in those cases, the estimated policy responses to output and inflation take implausible values.

It seems that there are significant multicollinearity problems. Since indicators of financial imbalances can probably help forecast future aggregate demand, they will be correlated with the expected output gap, which appears in the specification of the policy rule. This is important because the relevant hypothesis is not whether financial variables are correlated with interest rates but whether these variables explain monetary policy actions beyond their effect on the standard arguments of the Taylor rule.

More generally, the hypothesis tested is actually whether financial imbalances enter regularly into monetary policy rules. This is a tough test for the empirical relevance of the leaning-against-the-wind hypothesis. Even those who think that financial stress may matter for monetary policy -including probably the authors-, they tend to accept that their influence on interest rate actions is only warranted in very specific (if not extreme) circumstances. Therefore, even if all central banks in the sample were to agree with the authors' views, the test would not unveil this policy position as the data incorporate only a few of those relevant episodes in which financial imbalances should matter.

In sum, I liked the paper and shared most of its policy prescriptions, particularly that regarding the insufficiency of strict direct inflation targeting strategies to take properly into account the macro-

economic implications of episodes of financial distress. Indeed, it is my impression that monetary policymakers now feel a pressing need for further conceptual analysis to provide practical guidance on when and how deviations from standard reaction functions are warranted from a welfare point of view.

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*The importance of Stock Market returns in estimated monetary policy rules: A structural approach**

Jesús Vázquez
Universidad del País Vasco

Abstract

This paper estimates a standard version of the New Keynesian Monetary (NKM) model augmented with financial variables in order to analyze the relative importance of stock market returns and term spread in the estimated U.S. monetary policy rule. The estimation procedure implemented is a classical structural method based on the indirect inference principle. The empirical results show that the Fed seems to respond to the macroeconomic outlook and to the stock market return but does not seem to respond to the term spread. Moreover, policy inertia and persistent policy shocks are also significant features of the estimated policy rule.

1. Introduction

The analysis of how monetary policy reacts to financial markets news has started to receive considerable attention in recent years. On the one hand, there is a strand of literature (Gerlach-

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Kristen, 2004; Rudebusch and Wu, 2004; Ang, Dong and Piazzesi, 2005; and María-Dolores and Vázquez, 2005) estimating monetary policy rules that include the term spread (or a long-term interest rate) in addition to the traditional determinants (inflation and output gap) using quarterly data.[1] On the other hand, Rigobon and Sack (2003) estimate the reaction of U.S. monetary policy to the stock market using daily data whereas Rigobon and Sack (2004) study the impact of monetary policy on stock prices.

The aim of this paper is to analyze the relative importance of term spread and stock market returns in the characterization of the estimated U.S. monetary policy rule. A major problem in estimating the reaction of monetary policy to financial variables is that these variables are by nature endogenous due to the simultaneous response of financial markets to policy decisions. As pointed out by Rigobon and Sack (2003, 2004), the policy reaction is difficult to identify using traditional approaches for dealing with the endogeneity problem such as instrumental variables because it is hard to find any good instrument (i.e. an instrument very closely correlated with financial variables without being correlated with monetary policy shocks). Rigobon and Sack propose an identification scheme based on the heteroskedasticity of stock market returns at the daily frequency. In contrast, this paper estimates the U.S. policy rule using quarterly data to study the importance of financial variables in the policy rule. The sample frequency may matter when estimating the monetary policy reaction functions for two reasons. First, financial variables may display quite different dynamics at alternative data frequencies. For instance, Diebold (1988)

1. Two key aspects distinguish these papers: (i) the way term structure is introduced and (ii) the structural econometric approach followed. Gerlach-Kristen (2004) uses a maximum-likelihood approach to directly estimate a reduced form policy rule that includes the term spread in addition to the explanatory variables considered in a standard Taylor rule. Rudebusch and Wu (2004) build upon a typical affine no-arbitrage term structure representation with two latent factors (level and slope) by linking, (admittedly) in an ad-hoc fashion, these two factors to macroeconomic variables (inflation and output gap) which are determined by a New Keynesian Monetary (NKM) model. They also follow a maximum-likelihood approach. In a similar vein, using little macroeconomic structure, Ang, Dong and Piazzesi (2005) consider a single latent factor interpreted as a transformation of Fed policy actions on the short rate. In their model, persistent policy shocks are allowed but policy inertia is not. Ang et al. (2005) implement a Bayesian estimation approach to estimate their macro-finance model of the term structure. In contrast to these papers, María-Dolores and Vázquez (2005) introduce term structure by simply considering a representative agent optimization problem allowing the agent to have access to bonds of different maturities. Moreover, they follow an indirect inference estimation approach.

has shown analytically that ARCH effects tend to disappear as sample frequency decreases. Second, since the Federal Open Market Committee (FOMC) meets every six weeks, the estimated monetary policy rule based on quarterly data averages the policy decisions made at two FOMC meetings and the estimated policy rule is expected to be smoother as the sample frequency becomes smaller.

As noticed by Rigobon and Sack (2003), there is a recent debate in the relevant literature on the Fed motivation for reacting to movements in stock prices. On the one hand, Cecchetti, Genberg, Lipsky and Wadhwani (2000) argue that the monetary authority should react to perceived stock price misalignments in order to prevent stock market bubbles. On the other hand, Bernanke and Gertler (2001) suggest that the Fed should react to stock process just because they anticipate future movements in inflation and output.

Closely related with this debate, there is another major problem in estimating monetary policy rules that consider financial variables in addition to the standard variables entering a Taylor rule: the issue of disentangling the independent effect of financial variables on the policy rule from the indirect effect of these variables through expected inflation and expected output gap.

One possible way of overcoming these problems is to specify and structurally estimate a general equilibrium model in order to measure the reaction of monetary policy to alternative financial variables. We consider a model that builds upon the now-standard New-Keynesian Monetary (NKM) model by considering that the representative agent can accumulate stocks and bonds of different maturities. More precise, we build on the NKM model augmented with term structure studied by María-Dolores and Vázquez (2005) to include stock market returns. We also follow María-Dolores and Vázquez (2005) by considering (i) a structural econometric approach based on the *indirect inference* principle and (ii) three alternative specifications for the monetary policy rule called the standard, forward-looking and backward-looking Taylor rules. Considering these alternative policy specifications characterized by different degrees of forward-looking behavior allows us to assess whether monetary policy reacts independently to alternative financial variables or reacts to financial variables simply because these variables anticipate expected movements in

output and inflation.

Using U.S. data for the Greenspan period, the empirical results show that the Fed seems to respond to the stock market excess return in addition to the standard macroeconomic indicators in a standard Taylor rule.[2] However, the Fed does not seem to respond to the term spread, confirming the results obtained by María-Dolores and Vázquez (2005). Moreover, the fact that the excess return is significant under a backward-looking and standard Taylor rule but not under a forward-looking rule suggests that the Fed may respond to the information content of the excess return about future inflation and real activity, but does not seem to respond independently to the excess return. Hence, the empirical results seem to support Bernanke and Gertler's (2001) argument that the Fed responds to stock market movements only to the extent that they affect expectations about future inflation and output. Furthermore, the empirical results show that policy inertia and persistent policy shocks are also significant features of the estimated policy rule.

The rest of the paper is organized as follows. Section 2 introduces the log-linearized approximation of a standard version of the NKM augmented with term spread and stock returns. Section 3 describes the structural estimation method used in this paper. Section 4 presents and discusses the estimation results. Section 5 provides diagnostic tests and comovement analyses to identify features of the data that the augmented NKM model does (not) account for. Section 6 concludes.

2. A NEW KEYNESIAN MONETARY MODEL WITH FINANCIAL VARIABLES

The model analyzed in this paper is a now-standard version of the NKM model augmented with financial variables (NKMMFV), which is given by the following set of equations:

$$y_t = E_t y_{t+1} - \tau(i_t - E_t \pi_{t+1}) + g_t, \tag{1}$$

2. Given an investment horizon, the stock market excess return is defined in this paper as the difference between the stock market return and the interest rate associated with a Treasury bond.

$$y_t = E_t y_{t+4} - \tau(i_t^{\{4\}} - E_t \pi_{t+4}) + c_t, \tag{2}$$

$$y_t = E_t y_{t+4} - \tau(r_t^{\{4\}} - E_t \pi_{t+4}) + s_t, \tag{3}$$

$$\pi_t = \beta E_t \pi_{t+1} + \kappa y_t + z_t, \tag{4}$$

$$i_t = \rho i_{t-1} + (1-\rho)[\psi_1 \pi_t + \psi_2 y_t + \psi_3 (i_t^{\{4\}} - i_t) + \psi_4 (r_t^{\{4\}} - i_t^{\{4\}})] + v_t. \tag{5}$$

where y, π, $i^{\{4\}}$ and $r_t^{\{4\}}$ denote the log-deviations from the steady states of output, inflation, nominal interest rate associated with the four-period bond and expected nominal return associated with a stock that is sold four periods after its time of purchase (i.e. the expected payoff at time $t+4$), respectively. E_t denotes the conditional expectation based on the agents' information set at time t. g, c and s, denote aggregate demand shocks associated with the three alternative IS-curves whereas z and v denote aggregate supply and monetary policy shocks, respectively. Each of these shocks is further assumed to follow a first-order autoregressive process

$$g_t = \rho_g g_{t-1} + \epsilon_{gt}, \tag{6}$$

$$c_t = \rho_c c_{t-1} + \epsilon_{ct}, \tag{7}$$

$$s_t = \rho_s s_{t-1} + \epsilon_{st}, \tag{8}$$

$$z_t = \rho_z z_{t-1} + \epsilon_{zt}, \tag{9}$$

$$v_t = \rho_v v_{t-1} + \epsilon_{vt}, \tag{10}$$

where $\in_{gt}$, $\in_{gt}$, $\in_{st}$, $\in_{zt}$ and $\in_{vt}$ denote i.i.d. random shocks. We further allow for correlation between $\in_{gt}$, $\in_{ct}$ and $\in_{st}$ shocks.

As discussed by Ireland (2004), there is a long standing tradition (that goes back at least to Sargent, 1989) of introducing additional disturbances into dynamic stochastic general equilibrium models until the number of shocks equals the number of data series used in the estimation. The reason is that models of this type are quite stylized and introduce fewer shocks than observable variables, which implies that models are stochastically singular. That is, the model implies that certain combinations of endogenous variables are deterministic. If these combinations do not hold in the data, any approach

attempting to estimate the complete model will fail. To cope with this stochastic singularity problem, we consider that the shocks are different due to measurement errors and the approximation error that results from the log-linear approximation implemented.[3]

Equations (1) (2) and (3) are the log-linearized Euler conditions obtained from the representative agent optimization plan associated with the one-period bond rate, the four-period bond rate and the four-period stock return, respectively. More precisely, for any asset i the agent optimal plan requires the basic pricing equation to hold:

$$E_t\left[\beta^j \frac{U'(C_{t+j})}{U'(C_t)} R_{it}^{\{j\}}\right] = 1,$$

where j is the horizon of the payoff of asset i, C_t is consumption at t, and $R_{it}^{\{j\}}$ is the j-period realized return from t to $t+j$ of asset i. The parameter $\tau > 0$ in equations (1)-(3) represents the intertemporal elasticity of substitution obtained when assuming a standard constant relative risk aversion utility function

$$U(C_t) = \frac{1}{1-\frac{1}{\tau}} C_t^{1-\frac{1}{\tau}}.$$

As shown by Andrés, López-Salido and Nelson (2004), implicitly in the Euler equations associated with bond holdings at different maturities is a term structure relationship linking the interest rates on short- and long-term bonds. Similarly, by considering stock holdings in addition to bond holdings, the set of asset pricing equations (1)-(3) is implicitly linking bond yields and stock returns.[4]

Equation (2) is the new Phillips curve that is obtained in a sticky price à la Calvo (1983) model where monopolistically competitive firms produce (a continuum of) differentiated goods and each firm

3. See also Hamilton (1994, p.426) for a lucid discussion on the need to add error terms to behavioral equations and its consequences on econometric identification.

4. Most papers in the relevant literature use the one-period asset pricing equation (1) to derive recursively the prices of all assets in the economy by assuming that state variables are log-normal instead of considering a set of asset pricing equations associated with alternative financial assets. By considering a set of asset pricing equations, our approach allows the researcher to deviate from the log-normality setup by applying high-order approximation techniques to solve the model. The disadventage is that the consideration of long-term investment horizons implies that the number of state variables increases dramatically. For instance, if we consider the 10-year maturity bond rate Γ_0 and Γ_1 defined below would be 90 x 90 matrices. Nevertheless, the approach carried out in this paper is rather similar in practice to the one followed in the literature because state-variables are also lognormal by construction: (i) a log-linear approximation is used for solving the model and (ii) the shocks are assumed to follow normal distributions.

faces a downward sloping demand curve for its produced good. The parameter $\beta \in (0,1)$ is the agent discount factor and κ measures the slope of the New Phillips curve.[5]

Equation (5) is a standard Taylor-type monetary rule where the nominal interest rate exhibits inertial behavior, captured by parameter ρ, for which there are several motivating arguments in the relevant literature.[6] Moreover, the monetary policy rule (5) assumes that the nominal interest rate responds to (i) current deviations of output and inflation from their respective steady state values; (ii) term spread, $i_t^{\{4\}} - i_t$; and (iii) excess return of stocks $r_t^{\{4\}} - i_t^{\{4\}}$. For the sake of simplicity we further assume that the one-period bond and the policy interest rate are the same.[7]

Alternatively, we also consider a forward-looking Taylor rule

$$i_t = \rho i_{t-1} + (1-\rho)[\psi_1 E_t \pi_{t+1} + \psi_2 E_t y_{t+1} + \psi_3 (i_t^{\{4\}} - i_t) + \psi_4 (r_t^{\{4\}} - i_t^{\{4\}})] + v_t, \tag{11}$$

and a backward-looking Taylor rule

$$i_t = \rho i_{t-1} + (1-\rho)[\psi_1 \pi_{t-1} + \psi_2 y_{t-1} + \psi_3 (i_{t-1}^{\{4\}} - i_{t-1}) + \psi_4 (r_{t-1}^{\{4\}} - i_{t-1}^{\{4\}})] + v_t. \tag{12}$$

By considering alternative policy rule specifications, the term spread in the estimated policy rule and a structural estimation procedure, we expect to shed light on a relevant question: does the Fed respond only to the information content of financial variables about future inflation and real activity, or does it respond independently to them?

The use of a structural econometric strategy to estimate monetary policy rules can be further motivated as follows. As pointed out by Clarida, Galí and Gertler (1999), the forward-looking Taylor rule

5. See, for instance, Galí (2002) for a detailed analytical derivation of the New Phillips curve.

6. These arguments range from the traditional concern of central banks for the stability of financial markets (see Goodfriend, 1991 and Sack, 1997) to the more psychological argument posed by Lowe and Ellis (1997) that there might be a political incentive for smoothing whenever policymakers are likely to be embarrassed by reversals in the direction of interest-rate changes if they believe that the public may interpret them as repudiations of previous actions. By contrast, a series of interest-rate changes in the same direction looks like a well-designed programme, and that may give rise to the sluggish behavior of the intervention interest rate.

7. This assumption is not very harmful when using quarterly data since the 3-month T-bill rate dynamics are similar to the Fed rate dynamics, which is the short-term rate used by the Fed to monitor monetary policy. More precisely, the sample correlation between these two interest rates is 0.994 during the Greenspan era.

can be solved in order to get a reduced-form for the interest rate in terms of predetermined variables. At first sight, this reduced-form looks like standard and backward-looking Taylor rules, but the difference is that the coefficients associated with the reduced-form of the forward-looking rule are cumbersome functions linking structural and policy parameters. More precisely, the reduced-form coefficients associated with the forward-looking rule must satisfy a set of cross-equation restrictions imposed by the rational expectations assumption. Therefore, alternative policy rules are not likely to be statistically identical and a structural (system-based) econometric procedure is then required to discriminate between alternative monetary policy rules. Later on, Section 5 provides evidence that the alternative policy rules lead to different dynamic features in terms of persistence and the comovement dynamics exhibited by pairs of variables.

The system of equations (1)-(10) (together with eight extra identities involving forecast errors) can be written in matrix form as follows

$$\Gamma_0 X_t = \Gamma_1 X_{t-1} + \Psi \epsilon_t + \Pi \eta_t, \tag{13}$$

where[8]

$$\begin{aligned} X_t &= (y_t, \pi_t, i_t, i_t^{\{4\}}, r_t^{\{4\}}, E_t y_{t+1}, E_t y_{t+2}, E_t y_{t+3}, E_t y_{t+4}, E_t \pi_{t+1}, \\ &\quad E_t \pi_{t+2}, E_t \pi_{t+3}, E_t \pi_{t+4}, g_t, c_t, s_t, z_t, v_t)' \end{aligned}$$

$$\epsilon_t = (\epsilon_{gt}, \epsilon_{ct}, \epsilon_{st}, \epsilon_{zt}, \epsilon_{vt})',$$

$$\begin{aligned} \eta_t &= (y_t - E_{t-1}[y_t], E_t[y_{t+1}] - E_{t-1}[y_{t+1}], E_t[y_{t+2}] - E_{t-1}[y_{t+2}], \\ &\quad E_t[y_{t+3}] - E_{t-1}[y_{t+3}], \pi_t - E_{t-1}[\pi_t], E_t[\pi_{t+1}] - E_{t-1}[\pi_{t+1}], \\ &\quad E_t[\pi_{t+2}] - E_{t-1}[\pi_{t+2}], E_t[\pi_{t+3}] - E_{t-1}[\pi_{t+3}])'. \end{aligned}$$

Equation (13) represents a linear rational expectations (LRE) system. It is well known that LRE systems deliver multiple stable equilibrium solutions for certain parameter values. Lubik and Schorfheide (2003) characterize the complete set of LRE models with indeterminacies and provide a numerical method for computing them that builds on Sims' (2002) approach.[9] In this paper, we deal only with sunspot-free equilibria.[10]

8. Appendix 1 displays the matrices $\Gamma 0$, $\Gamma 1$, Ψ and Π.

9. The GAUSS code for computing equilibria of LRE models can be found on Frank Schorfheide's website.

10. Lubik and Schorfheide (2003) deal with multiple equilibria by assuming that agents observe an

3. ESTIMATION PROCEDURE

In order to estimate the structural and policy parameters of the NKMMFV, we follow the *indirect inference* principle proposed by Gouriéroux, Monfort and Renault (1993), Smith (1993), and Gallant and Tauchen (1996). Following Smith (1993), an unrestricted VAR representation is considered as the auxiliary model. More precisely, we first estimate a five-variable VAR with four lags in order to summarize the joint dynamics exhibited by U.S. quarterly data on output gap, inflation, Fed funds rate, 1-year Treasury constant maturity rate and 1-year ex-post Standard & Poor's stock market returns. Second, we apply the simulated moments estimator (SME) suggested by Lee and Ingram (1991) and Duffie and Singleton (1993) to estimate the underlying structural and policy parameters of the NKMMFV.[11]

This estimation strategy is especially appropriate in this context for three main reasons.[12] First, we must emphasize that the NKMMFV is a highly stylized model of a complex world. Therefore, maximum-likelihood (ML) estimation of the model will impose strong restrictions which are not satisfied by the data and inference will be misleading. In the words of Cochrane (2001, p. 293) *"[ML] does the "right" efficient thing if the model is true. It does not necessarily do the "reasonable" thing for "approximate" models."* We believe that one of the main virtues of the indirect inference approach is that the econometrician has in principle the possibility of choosing an auxiliary model that imposes looser restrictions than those imposed by

exogenous sunspot shock ζ_t, in addition to the fundamental shocks, $\in_t$. Since an LRE system such as (13) is linear, the forecast errors, η_t, can be expressed as a linear function of $\in_t$ and ζ_t: $\eta_t = A_1 \in_t + A_2 \zeta_t$, where A_1 is 8 × 5 and A_2 is 8 × 1 in this model. There are three possible scenarios: (i) no stable equilibrium; (ii) a unique stable equilibrium in which A_1 is completely determined by the structural parameters of the model and $A_2=0$; and (iii) multiple stable equilibria in which A_1 is not uniquely determined by the structural parameters of the model and A_2 can be non-zero. In this last case, one can deal only with a stable sunspot-free equilibrium by imposing $A_2=0$ and then the corresponding equilibrium can be understood as a sunspot equilibrium with no sunspots.

11. In this vein, Rotemberg and Woodford (1997), Amato and Laubach (2003), Christiano, Eichenbaum and Evans (2005), and Boivin and Giannoni (2006) use a minimum distance estimator based on impulse-response functions instead of VAR coefficients. See Gutiérrez and Vázquez (2004), Ruge-Murcia (2003), María-Dolores and Vázquez (2005) for other recent applications of this estimation strategy based on VAR coefficients.

12. At this point, the reader may have the following three questions in mind. Why do we not estimate the NKM model by maximum-likelihood directly? Why do we use a VAR as the auxiliary model? What do we learn from the estimation of the NKM model based on the indirect inference principle? This paragraph answers these three questions.

ML. Second, we consider an unrestricted VAR instead of matching the structural impulse responses because a reduced form VAR does not require the arbitrary identification of structural shocks. Moreover, applications of the minimum distance estimator based on impulse response functions use a diagonal weighting matrix that includes the inverse of each impulse response's variance on the main diagonal. This weighting matrix delivers consistent estimates of the structural parameters, but it is not asymptotically efficient since it does not take into account the whole covariance matrix structure associated with the set of moments.[13] By considering the VAR coefficients as the set of moments to implement the minimum distance estimator, an estimator of the efficient weighting matrix is found to be straightforward.[14] Finally, the unrestricted VAR auxiliary model nests the NKMMFV model considered. As shown by Gallant and Tauchen (1996), if the auxiliary model nests the structural model then the estimator is as efficient as ML. Moreover, the estimation approach based on the indirect inference principle may help to identify which structural parameter estimates are forced outside the economically reasonable support (for instance, the prior distribution support used by Bayesian estimator applications) to achieve a better fit of the model.

The SME makes use of a set of statistics computed from the data set used and from a number of different simulated data sets generated by the model being estimated, i.e. the statistics used to carry out the SME are the coefficients of the five-variable VAR with four lags, which is considered as the auxiliary model in this paper. The lag length considered is fairly reasonable when using quarterly data. To implement the method, we construct a $p \times 1$ vector with the coefficients of the VAR representation obtained from actual data, denoted by $H_T(\theta_0)$, where p in this application is 120,[15] T denotes the length of the time series data, and θ is a $\kappa \times 1$ vector whose components are the model parameters. The true parameter values are denoted by θ_0. In the NKMMFV, the structural and policy parameters are $\theta = (\tau, \beta, \rho, \kappa, \psi_1, \psi_2, \psi_3, \psi_4, \rho_g, \rho_c, \rho_s, \rho_z, \rho_v, \rho_{cg}, \rho_{sg}, \sigma_g, \sigma_c, \sigma_s, \sigma_z, \sigma_\varepsilon, \pi^*)$ and then $k = 21$. ρ_{cg} and ρ_{sg} denote the coefficients characterizing

13. Boivin and Giannoni (2006) indicate this drawback, but provide no alternative.

14. See Duffie and Singleton (1993, p.939) for a discussion on the choice of a weighting matrix in order to obtain asymptotic efficient estimates.

15. We have 105 coefficients from a four-lag, five-variable system and 15 extra coefficients from the non-redundant elements of the variance-covariance matrix of the VAR residuals.

the noisy linear relationships between ϵ_{gt} and ϵ_{ct} shocks and between ϵ_{gt} and ϵ_{st} shocks, respectively.[16]

As pointed out by Lee and Ingram (1991), the randomness in the estimator is derived from two sources: the randomness in the actual data and the simulation. The importance of the randomness in the simulation to the covariance matrix of the estimator can be decreased by simulating the model a large number of times. For each simulation a $p \times 1$ vector of VAR coefficients, denoted by $H_{N,i}(\theta)$, is obtai- $N = nT$ ned from the simulated time series of output gap, inflation, interest rates and stock return generated from the NKMMFV, where is the length of the simulated data. Averaging the m realizations of the simulated coefficients, i.e. $H_N(\theta) = \frac{1}{m}\sum_{i=1}^{m} H_{Ni}(\theta)$, we obtain a measure of the expected value of these coefficients, $E(H_{Ni}(\theta))$.

The choice of values for n and m deserves some attention. Gouriéroux, Renault and Touzi (2000) suggest that is important for the sample size of synthetic data to be identical to T (that is, $n = 1$) to get identical size of finite sample bias in estimators of the auxiliary parameters computed from actual and synthetic data. After checking for robustness, we make $n = 1$ and $m = 500$ in this application.

To generate simulated values of output gap, inflation, interest rates and stock returns we need the starting values of these variables. For the SME to be consistent, the initial values must have been drawn from a stationary distribution. In practice, to avoid the influence of the starting values we generate a realization from the stochastic processes of the five variables of length $200 + T$, discard the first 200 simulated observations, and use only the remaining T observations to carry out the estimation. After two hundred observations have been simulated, the influence of the initial conditions must have disappeared.

The SME of θ_0 is obtained from the minimization of a distance function of VAR coefficients from actual and simulated data. Formally,

$$\min_{\theta} \; J_T = [H_T(\theta_0) - H_N(\theta)]' W [H_T(\theta_0) - H_N(\theta)],$$

where W^{-1} is the covariance matrix of $H_T(\theta_0)$.

Denoting the solution of the minimization problem by $\hat{\theta}$, Lee and Ingram (1991) and Duffie and Singleton (1993) prove the following

16. We have also allowed for correlation between $\in_{gt}$ shock and $\in_{zt}$, but the correlation parameter turns out to be non-significant.

results: $$\sqrt{T}(\hat{\theta} - \theta_0) \to N\left[0, \left(1 + \frac{1}{m}\right)(B'WB)^{-1}\right],$$

$$\left(1 + \frac{1}{m}\right) TJ_T \to \chi^2(p-k),$$

where B is a full rank matrix given by $B = E(\frac{\partial H_{Ni}(\theta)}{\partial \theta})$.[17]

4. EMPIRICAL EVIDENCE

This section starts by briefly describing the data set considered, then goes on to discuss the estimation results.

4.2 The data

We consider quarterly U.S. data for the output gap, the inflation rate obtained for the implicit GDP deflator, the Fed funds rate, the 1-year Treasury constant maturity rate and the 1-year ex-post return from the Standard & Poor's stock market indexes during the Greenspan era.[18] We focus on the Greenspan period for several reasons. First, it allows a more straightforward comparison of the estimated monetary policy rules of Gerlach-Kristen (2004), Rudebusch and Wu (2004) and María-Dolores and Vázquez (2005). Second, the Taylor rule seems to fit better in this period than in the pre-Greenspan era. Third, considering the pre-Greenspan era opens the door to many other issues studied in the relevant literature, including the presence of macroeconomic switching regimes and the existence of switches in monetary policy (see for instance, Sims and Zha, 2004, and references therein). These issues are outside the scope of this paper. Figure 1 shows the time series studied in this paper.

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17. The objective function J_T is minimized using the optimization package OPTMUM programmed in GAUSS language. The Broyden-Fletcher-Glodfard-Shanno algorithm is applied. To compute the covariance matrix we need to obtain B. Computation of B requires two steps: first, obtaining the numerical first derivatives of the coefficients of the VAR representation with respect to the estimates of the structural parameters θ for each of the m simulations; second, averaging the m-numerical first derivatives to get B. The GAUSS programs for estimating the NKMMFV are available from the author upon request.

18. U.S. output gap is measured as the percentage deviation of GDP from the real potential GDP time series constructed by the U.S. Congressional Budget Office. Appendix 2 describes the data sources.

4.2 Estimation results

Table 1 shows the estimation results under the standard, forward-looking and backward-looking Taylor rules. The values of the goodness-of-fit statistic, $\left(1+\frac{1}{m}\right)TJ_T$, which is distributed as a $\chi^2(p-k)$,[19] confirm the hypothesis stated above that the NKMMFV is too stylized to be supported by actual data. The best fit is obtained under a backward-looking Taylor rule.

At this point the reader may wonder why we should consider a model that does not fit the data well. Moreover, he/she may wonder why it is of interest to look at parameter estimates when the model is misspecified. I believe it is a worthwhile econometric exercise to estimate misspecified models because we can gain confidence on which parameters can be robustly estimated by estimating the model under alternative specifications (for instance, under alternative specifications of the policy rule).[20]

In order to discriminate between alternative policy rules it is also important to look at the parameters measuring shock persistence. Since the estimation procedure forces the shock processes to be stationary, the finding of a near-random walk process may indicate that the specified model is flawed. Except for ρ_s, the coefficients measuring the persistence of shocks are significantly different from a stationary, but highly persistent, alternative hypothesis (such as, $\rho_i = 0.99$ for $i = g, c, z, v$) at any standard significance level under the backward-looking and forward-looking Taylor rules. However, this is not the case for the monetary policy shock under the standard rule.

Focusing on the parameter estimates, we observe that (i) the relative aversion parameter, τ, and the Phillips curve slope parameter, κ, are poorly estimated for all three policy rule specifications since their standard errors are large; (ii) the estimate of the discount factor, β, is reasonable (implying a 3 percent real interest rate) for all policy rules considered and significantly different from one; (iii) the size of the policy response to inflation, output gap and stock market excess

19. For the NKMMFV the goodness-of-fit statistic is distributed as a χ^2 (99) since the number of VAR coefficients is p=120 and the number of parameters being estimated is k=21.

20. This econometric exercise is valuable for precisely the same reason that policy analysis is believed to be worthwhile when performed in a misspecified framework. That is, one gains confidence on the policy prescriptions implied by a misspecified model only if they are fairly robust to alternative specifications.

return depend on the policy rule considered. Result (iii) is not surprising at all since the Fed is reacting to different information sets under the alternative policy rule specifications; (iv) the coefficients associated with policy inertia (ρ) and the persistency of policy shocks (ρ_v) are significant at any standard significance level. However, the coefficient associated with the term spread (ψ_3) is not significant under any policy rule; in fact the point estimate is zero; (v) the fact that the excess return is significant under backward-looking and standard Taylor rules but not under a forward-looking rule suggests that the Fed may respond to the information content of the excess return about future inflation and real activity, but does not seem to respond independently to the excess return. Apart from the estimation results related to the stock market return, the empirical results obtained in this paper are qualitatively similar to those found by María-Dolores and Vázquez (2005) for the NKM model augmented with term structure.

5. MODEL PERFORMANCE

Based on the *J*-Wald test, we have concluded above that the overall performance of the alternative versions of the NKM considered is not good. This result does not mean that the model fails in all interesting dimensions. In this section, we consider diagnostic tests and comovement analysis to identify features of the data that the NKMMFV does (not) account for.

5.1 Diagnostic tests

The components of the vector $[H_T(\theta_0) - H_N(\theta)]$ contain information on how well the NKMMFV accounts for the estimates of the VAR (auxiliary) model. Larger components point to the estimates of the auxiliary model that the NKMMFV has trouble accounting for. As suggested by Gallant, Hsieh and Tauchen (1997) the following quasi-*t*-ratio diagnostic statistics can identify sources for model failure:

$$\sqrt{1+\frac{1}{n}}\sqrt{T}\left[\left(diag(W_T^{-1})\right)_i^{1/2}\right]^{-1}[H_T(\theta_0) - H_N(\theta)]_i \quad \text{for} \quad i = 1, ..., p, \quad (14)$$

where W_T is a consistent estimate of W, $\left(diag(W_T^{-1})\right)$ denotes the i-th element of the diagonal of matrix W_T^{-1} and $[H_T(\theta_0) - H_N(\theta)]_i$ is the i-th element of $[H_T(\theta_0) - H_N(\theta)]$. In particular, a large i-th diagnostic statistic indicates that the NKMMFV does a poor job of fitting the i-th coefficient of the VAR model.

The second and third columns in Table 2 show the VAR estimates and the corresponding standard errors, respectively. The remaining columns in Table 2 show the corresponding quasi-t-ratio diagnostic statistic (14) for the alternative policy rules studied. Looking at Table 2 three general conclusions emerge. First, the qualitative results from the diagnostic statistics are quite robust to alternative specifications of the policy rule. Second, the NKMMFV has trouble in accounting for output gap, inflation, Fed rate and the 1-year rate persistence since for each of these equations some of the diagnostic statistics associated with dependent variable lags are large. However, the NKMMFV under the forward- and the backward-looking Taylor rule is capable of capturing the persistent dynamics exhibited by the 1-year stock return.

5.2 Comovement analysis

Den Haan (2000) proposes using correlations of *VAR* forecast errors at different horizons to analyze the comovement between pairs of variables. As discussed by Den Haan (2000), this method has two main advantages. First, variables need not be stationary for their comovement to be analyzed, so prior filtering is not required. Second, it avoids the type of *ad-hoc* assumptions necessary to compute impulse response functions. Since the comovement between a pair of variables is an equilibrium outcome (that is, an outcome resulting from the interaction between supply and demand shocks that is observed in the data with no need for any identifying assumption) comovement dynamics are good statistics for analyzing a model's performance.

We apply the method suggested by Den Haan to analyze the comovement between (i) the level of economic activity measured by the output gap and inflation; and (ii) the Fed funds rate and the 1-year stock return. The goal is to analyze the ability of the NKMMFV to replicate the type of comovement between pairs of variables observed in U.S. data.

Figures 2-4 show the comovement between output gap and inflation for the NKMMFV under the standard, backward-looking and forward-looking Taylor rules, respectively. Similarly, Figures 5-7 show the comovement between the Fed funds rate and the 1-year stock return under the standard, backward-looking and forward-looking Taylor rules, respectively.[21] In each figure, the solid line represents the estimated correlations at different forecast horizons using U.S. data, the line with closely spaced dots shows the correlation coefficients implied by the model and the two remaining lines are 95% confidence bands computed using bootstrap methods. Figures 2-4 show the presence of a weak comovement between output and inflation in the U.S. Moreover, Figure 2 shows that the NKMMFV under the standard Taylor rule fails to reproduce the weak negative comovement between output gap and inflation at the short-term forecast horizons (up to six quarters). Figures 3-4 show that results are much worse for the NKMMFV under the backward- and forward-looking rules: the model generates a strong negative comovement between output and inflation that is not displayed by actual U.S. data.

Figures 5-7 show a weak comovement between the Fed rate and the 1-year stock return for the U.S. data at any forecast horizon that it is well reproduced by the NKMMFV under the alternative policy rules.

6. CONCLUSIONS

This paper follows a system-based econometric approach to analyze the importance of stock market returns in the characterization of the estimated U.S. monetary policy rule. The framework considered is an NKM model augmented with financial variables (NKMMFV) where the monetary policy rule is one of the building blocks. A structural econometric approach based on the *indirect inference* principle is implemented. In order to study the robustness of the empirical results, three alternative specifications for the monetary policy rule are considered, called standard, forward-looking and backward-looking Taylor rules.

The paper also investigates the ability of the NKMMFV to reproduce two features observed in U.S. data, namely the weak comove-

21. See Den Haan (2000) for details on this method of analyzing comovement.

ment between output and inflation and the persistent dynamics exhibited by output gap, inflation, interest rates and stock market returns.

The empirical results show that the Fed seems to respond to the stock market excess return in addition to the macroeconomic indicators in a standard Taylor rule. However, the Fed does not seem to respond to the term spread, confirming the results obtained by María-Dolores and Váquez (2005). Moreover, the fact that the stock market excess return is significant under backward-looking and standard Taylor rules but not under a forward-looking rule suggests that the Fed may respond to the information content of stock returns about future inflation and real activity, but does not seem to respond independently to the stock return movements. The empirical results then seem to support Bernanke and Gertler's (2001) view that the Fed responds to stock market movements only to the extent that they affect expectations about future inflation and output. Furthermore, the empirical results show that policy inertia and persistent policy shocks are also significant features of the estimated policy rule.

Finally, we show that the NKMMFV under a standard Taylor rule is able to reproduce well the weak comovement between output and inflation at medium- and long-term forecast horizons but fails to mimic the weak negative comovement at the short-term forecast horizons. Moreover, the model is able to mimic the weak comovement between the Fed funds rate and the 1-year stock return observed in actual data. Furthermore, diagnostic tests show that the model fails to reproduce the highly persistent dynamics characterizing U.S. output gap, inflation, Fed rate and 1-year rate time series, but it is able to reproduce the persistent dynamics exhibited by the actual 1-year stock market return.

Our empirical results should be interpreted with caution since the structural NKMMFV studied, like any other dynamic stochastic general equilibrium model, is likely to be misspecified in several dimensions. As is well known (see, for instance, Lubik and Schorfheide, 2005), overall model specification is important since it may lead to biased estimates, prevent identification of the true structural parameters and affect model selection. In spite of these warnings, the estimation of the NKMMFV looks like a reasonable approach for empirically analyzing the interaction between monetary policy, the macroeconomy and financial markets.

APPENDIX 1

This appendix shows the matrices involved in equation (13).

$$\Gamma_0 = \begin{pmatrix}
1 & 0 & \tau & 0 & 0 & -1 & 0 & 0 & 0 & -\tau & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \\
1 & 0 & 0 & \tau & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & -\tau & 0 & -1 & 0 & 0 & 0 \\
1 & 0 & 0 & 0 & \tau & 0 & 0 & 0 & -1 & 0 & 0 & 0 & -\tau & 0 & 0 & -1 & 0 & 0 \\
-\kappa & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\beta & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 \\
\Gamma_0^{51} & \Gamma_0^{52} & \Gamma_0^{53} & \Gamma_0^{54} & \Gamma_0^{55} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\
1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix},$$

$$\Gamma_1 = \begin{pmatrix}
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & \rho & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \rho_g & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \rho_c & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \rho_s & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \rho_z & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \rho_v & 0 \\
0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix},$$

$$\Pi = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix},$$

$$\Psi = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{pmatrix},$$

where $\Gamma_0^{51} = -(1-\rho)\psi_2$, $\Gamma_0^{52} = -(1-\rho)\psi_1$, $\Gamma_0^{53} = 1 + (1-\rho)\psi_3$, $\Gamma_0^{54} = -(1-\rho)(\psi_3 - \psi_4)$ and $\Gamma_0^{55} = -(1-\rho)\psi_4$.

APPENDIX 2

This appendix describes the time series considered.

Economic activity indexes:

- GDP: quarterly, seasonally adjusted data. Period: 1987:3-2004:3. Source: U.S. Department of Commerce, Bureau of Economic Analysis.

- Real potential GDP: quarterly data. Period: 1987:3-2004:3. Source: U.S. Congress, Congressional Budget Office.

Price level index:

- U.S. implicit price deflator of GDP: quarterly, seasonally adjusted data. Period: 1987:3-2004:3. Source: U.S. Department of Commerce, Bureau of Economic Analysis.

Interest rates and stock returns:

- Federal funds rate: monthly and quarterly data. Period: 1986:8-2004:6. Source: Board of Governors of the Federal Reserve System.

- 1-year Treasury constant maturity rate: monthly and quarterly data. Period: 1986:8-2004:6. Source: Board of Governors of the Federal Reserve System.

- 1-year ex-post real return: monthly and quarterly data. Period: 1986:8-2004:6. Source: Robert Shiller's web-site.

Table1.
Estimation results for the five-variable model

	Backward-Looking	Forward-Looking	Standard Taylor rule
J_T	5.7683	7.5223	7.1932
τ	0.9987	0.9991	0.9987
	(0.2077)	(0.3649)	(0.3687)
β	0.9973	0.9924	0.9940
	(0.0004)	(0.0005)	(0.0008)
ρ	0.9568	0.3297	0.3156
	(0.0069)	(0.0744)	(0.0487)
κ	0.9987	0.9979	0.9988
	(0.1396)	(0.3426)	(0.2992)
ψ_1	0.0000	0.6017	0.9226
	(0.1307)	(0.1125)	(0.0180)
ψ_2	5.4196	0.6276	0.0725
	(1.0130)	(0.2210)	(0.0200)
ψ_3	0.0000	0.0000	0.0000
	(0.0720)	(0.0933)	(0.0611)
ψ_4	0.5614	0.0557	0.0645
	(0.0849)	(0.0415)	(0.0094)
ρ_g	0.7826	0.8898	0.9158
	(0.0510)	(0.0501)	(0.0169)
ρ_c	0.8655	0.9575	0.9388
	(0.0325)	(0.0249)	(0.0148)
ρ_s	0.9921	0.9330	0.9384
	(0.0016)	(0.0335)	(0.0135)
ρ_z	0.9231	0.9775	0.9820
	(0.0117)	(0.0091)	(0.0061)
ρ_v	0.9702	0.9857	0.9999
	(0.0127)	(0.0142)	(0.0080)
ρ_{cg}	0.9984	0.9987	0.6320
	(0.1305)	(0.2902)	(0.0801)
ρ_{sg}	0.0000	0.0000	0.9992
	(0.1163)	(0.1988)	(1.5819)
σ_g	0.0151	0.0082	0.0238
	(0.0053)	(0.0044)	(0.0103)
σ_c	0.0043	0.0106	0.0008
	(0.0009)	(0.0032)	(0.0008)
σ_s	0.2079	0.1960	0.3920
	(0.0467)	(0.0825)	(0.1654)
σ_z	0.1215	0.0618	0.0407
	(0.0237)	(0.0276)	(0.0126)
$\sigma_\in$	0.0003	0.0000	0.0000
	(0.0009)	(0.0019)	(0.0009)
π^*	0.8166	1.8865	1.9076
	(0.1260)	(0.1682)	(0.2285)

Note: Standard errors in parentheses.

Table 2.
VAR estimates and diagnostic tests

Variable	Estimate	Standard error	Diag.stat. for(5)	Diag.stat. for(11)	Diag.stat. for(12)
	Output	**gap**	**equation**		
constant	-0.5577*	0.3298	1.0718	1.2013	0.6857
output gap (1)	1.1505***	0.1442	2.4783	1.3138	1.1124
outputgap (2)	–0.0045	0.2163	–1.2023	–0.7821	–0.3292
outputgap (3)	–0.4329**	0.1984	–2.2091	–2.2631	–2.2291
outputgap (4)	0.1641	0.1411	1.5381	1.6350	1.5600
inflation (1)	0.0849	0.0872	0.5680	0.7044	1.2905
inflation (2)	–0.0695	0.0869	–2.9584	–2.2775	–0.8261
inflation (3)	–0.0597	0.1004	–1.7138	–1.9282	0.3110
inflation (4)	0.0059	0.0975	–0.9845	–1.1844	–3.0503
Fed rate (1)	0.2030	0.2774	2.8705	2.7278	3.1931
Fed rate (2)	–0.0787	0.3521	0.2981	–0.3064	–1.7936
Fed rate (3)	–0.1264	0.3304	–0.5941	–0.5781	0.2562
Fed rate (4)	–0.0673	0.1734	0.6173	0.7865	1.3604
1-year rate (1)	–0.0129	0.1167	–1.9118	–2.0120	–2.1259
1-year rate (2)	0.0846	0.1496	–1.3682	–1.1704	–0.6162
1-year rate (3)	–0.2174	0.1439	–3.2246	–3.3211	–2.1890
1-year rate (4)	0.2530	0.1521	1.5668	1.5259	0.4822
1-year return (1)	0.0246**	0.0093	2.3132	2.2350	3.3848
1-year return (2)	0.0000**	0.0000	–1.8376	–1.8469	–3.0197
1-year return (3)	0.0000**	0.0000	0.1572	0.1746	0.5017
1-year return (4)	0.0000	0.0000	2.2930	2.2730	1.6943
	Inflation	**equation**			
constant	1.2805**	0.5305	2.7724	2.9328	2.8030
outputgap (1)	0.2497	0.2320	1.5612	1.1983	0.8518
outputgap (2)	–0.3147	0.3479	–0.5477	–0.2992	0.0077
outputgap (3)	0.2523	0.3192	–0.0431	0.0776	0.1465
outputgap (4)	–0.1990	0.2269	–1.0222	–0.8727	–0.8482
inflation (1)	0.1698	0.1402	–3.8813	–2.3362	–1.8393
inflation (2)	0.0315	0.1398	–0.0451	–0.0253	0.3806
inflation (3)	0.0982	0.1616	0.51635	0.5131	1.0359
inflation (4)	0.3664**	0.1568	3.7835	4.0241	4.7389
Fed rate (1)	–0.0810	0.4462	–0.8252	–1.6569	–2.1464
Fed rate (2)	0.1541	0.5664	0.5447	0.7045	1.2109
Fed rate (3)	0.6847	0.5314	1.8982	1.9706	1.6543
Fed rate (4)	–0.1584	0.2789	–1.6697	–1.7270	–1.9915
1-year rate (1)	0.1793	0.1877	0.8605	1.4377	1.1608
1-year rate (2)	–0.0678	0.2406	0.0577	0.3527	0.3843
1-year rate (3)	–0.4307*	0.2315	–2.0861	–1.9690	–1.9217
1-year rate (4)	–0.3032	0.2446	–1.7535	–1.6514	–1.5221
1-year return (1)	–0.0220	0.0149	–2.6845	–2.7198	–2.7562
1-year return (2)	0.0000	0.0000	1.7414	1.7432	2.0363
1-year return (3)	0.0000	0.0000	0.0195	–0.0014	0.2760
1-year return (4)	0.0000	0.0000	–0.7452	–0.8857	–0.5783

Table 2. (Continued)
VAR estimates and diagnostic tests

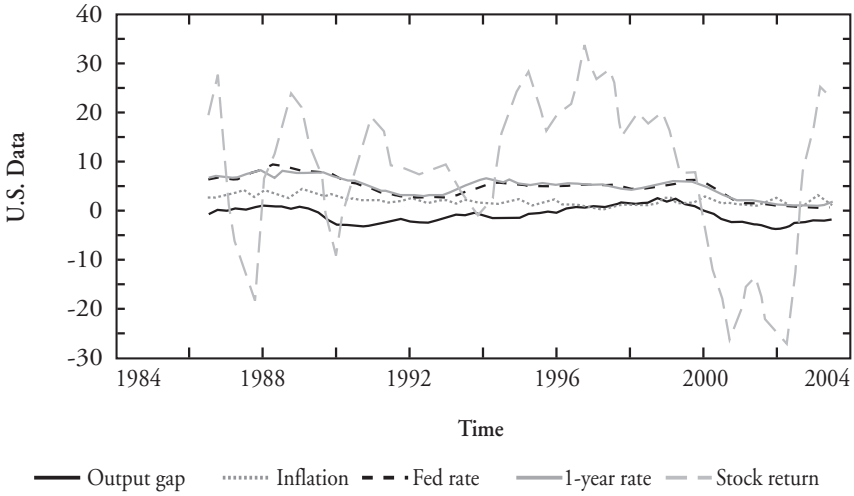
Variable	Estimate	Standard error	Diag.stat. for(5)	Diag.stat. for(11)	Diag.stat. for(12)
	Fed	**rate**	**equation**		
constant	–0.3142*	0.1746	–0.9249	–3.7030	–1.0865
outputgap (1)	0.3308***	0.0764	2.8401	2.1388	–0.5706
outputgap (2)	–0.0315	0.1145	–0.9737	–1.1862	2.1447
outputgap (3)	–0.1294	0.1051	–1.2633	0.0352	–0.6109
outputgap (4)	–0.0005	0.0747	–0.5855	–1.4568	–2.2931
inflation (1)	0.0409	0.0462	–0.7019	–0.1965	–1.8146
inflation (2)	0.1772***	0.0460	0.7378	1.6280	3.2193
inflation (3)	0.0655	0.0532	–2.1937	–0.8251	–1.6260
inflation (4)	0.0636	0.0516	0.0536	–2.2120	–0.9399
Fed rate (1)	0.8553***	0.1469	1.6169	–0.8624	–1.5248
Fed rate (2)	–0.5025***	0.1865	–2.4207	–1.0849	–0.3978
Fed rate (3)	0.2447	0.1749	2.3847	2.1566	2.7193
Fed rate (4)	–0.1901**	0.0918	–1.5658	–1.0142	–2.0646
1-year rate (1)	0.3363***	0.0618	0.3276	3.4774	2.2097
1-year rate (2)	0.1039	0.0792	0.3405	0.8791	0.7645
1-year rate (3)	0.1055	0.0762	1.1526	1.0840	0.7799
1-year rate (4)	–0.0687	0.0805	–1.2198	1.8478	–1.7009
1-year return (1)	0.0078	0.0049	3.4555	3.2396	–1.3947
1-year return (2)	0.0000**	0.0000	–3.8730	–4.1576	–0.8335
1-year return (3)	0.0000	0.0000	0.5421	0.6537	0.9184
1-yearr return (4)	0.0000	0.0000	0.8495	1.0766	0.0293
	1-year	**rate**	**equation**		
constant	0.0454	0.4349	–0.5193	–3.5549	0.0857
outputgap (1)	0.3767*	0.1902	2.6564	2.1170	0.5319
outputgap (2)	–0.0448	0.2852	–0.5695	–1.3088	0.3057
outputgap (3)	–0.0954	0.2617	–1.1491	0.1320	–1.2290
outputgap (4)	–0.1130	0.1860	–0.0792	–1.5115	–1.1446
inflation (1)	–0.0217	0.1150	–0.0222	–2.0608	–2.9835
inflation (2)	0.2741**	0.1146	2.7634	3.6504	1.7924
inflation (3)	0.0098	0.1324	0.2616	1.9702	–1.0967
inflation (4)	0.0404	0.1286	0.3097	–0.8568	–1.3725
Fed rate (1)	0.2612	0.3658	0.5399	–0.1712	–0.0507
Fed rate (2)	–0.5048	0.4643	–0.2586	0.4767	0.4746
Fed rate (3)	0.2355	0.4356	0.3410	0.0255	0.9785
Fed rate (4)	–0.0777	0.2286	–0.0615	–0.1376	0.0447
1-year rate (1)	0.6209***	0.1539	–3.2290	–1.0660	–1.7187
1-year rate (2)	0.2818	0.1973	1.1362	1.1235	0.5304
1-year rate (3)	0.2434	0.1898	1.0227	1.1894	0.6306
1-year rate (4)	–0.2232	0.2005	–1.5513	–2.0642	–2.1953
1-year return (1)	0.0067	0.0123	–0.7969	–0.5962	–3.8225
1-year return (2)	0.0000	0.0000	1.0339	0.6112	2.4048
1-year return (3)	0.0000	0.0000	–0.4701	–0.4939	–1.1270
1-year return (4)	0.0000	0.0000	1.2671	2.1028	0.7255

Table 2. (Continued)
VAR estimates and diagnostic tests

Variable	Estimate	Standard error	Diag.stat. for(5)	Diag.stat. for(11)	Diag.stat. for(12)
	1-year	**ex-post**	**stock**	**return**	**equation**
constant	9.9034**	4.3557	–1.7241	–1.0574	–1.1898
outputgap (1)	–2.2855	1.9048	3.5257	3.6352	3.3730
outputgap (2)	2.4115	2.8560	–1.3039	–1.9294	–1.3599
outputgap (3)	–1.7836	2.62039	–0.5502	–0.7805	–2.2802
outputgap (4)	–0.0571	1.8632	1.6615	0.5983	2.3892
inflation (1)	–0.6010	1.1513	0.6436	–1.0885	0.8559
inflation (2)	–1.8431	1.1475	–0.1557	–1.9313	–2.6921
inflation (3)	–0.9214	1.3264	4.0583	0.7764	2.2096
inflation (4)	–1.5965	1.2876	2.3605	–0.1162	0.1340
Fed rate (1)	3.6430	3.6634	–1.5105	–0.4387	–0.7753
Fed rate (2)	2.7068	4.6502	1.2119	1.7381	2.0566
Fed rate (3)	–1.9574	4.3626	–2.0874	–1.9007	–2.8735
Fed rate (4)	0.1942	2.2897	0.6565	0.6755	1.7482
1-year rate (1)	–2.8936*	1.5409	–1.7778	–0.4172	–0.3054
1-year rate (2)	–1.1741	1.9754	1.3615	0.8074	0.7094
1-year rate (3)	–0.0050	1.9005	0.6977	–0.9629	–0.5232
1-year rate (4)	1.0486	2.0081	1.7899	1.1453	1.1866
1-year return (1)	0.5443***	0.1227	2.7688	1.2124	0.9940
1-year return (2)	0.0000**	0.0000	0.2782	–0.1389	–0.0622
1-year return (3)	0.0000	0.0000	–0.6836	–0.5474	–0.6501
1-year return (4)	0.0000	0.0000	–0.2778	–0.3397	–0.4484
	VAR residuals	**variance**	**matrix**		
s11	0.1399	0.1989	6.1782	6.2207	6.0996
s21	–0.0665	0.2303	–2.5969	–2.5280	–2.3833
s31	0.0144	0.0673	1.8330	1.8450	1.9093
s41	0.0366	0.1848	2.0302	1.5914	1.2939
s51	0.6242	2.2869	2.5840	2.4391	2.4311
s22	0.3438	0.4887	6.1051	6.1116	5.7093
s23	0.00755	0.1033	0.2425	1.1889	0.6136
s24	–0.0141	0.2843	0.4769	0.7220	1.3965
s25	–0.5996	3.4997	–1.0787	–1.4753	–1.5023
s33	0.0305	0.0434	4.5432	4.6280	5.9687
s34	0.0348	0.0916	4.6788	–0.5050	3.1506
s35	–0.2036	1.0477	–2.2076	–2.0436	–1.7111
s44	0.2321	0.3299	2.6926	0.2747	2.6323
s45	0.2382	2.8425	–2.4145	0.2520	0.2367
s55	4.2240	48.6414	1.7180	6.0083	1.6932

Note: ***, **, * denote that the corresponding coefficients are statistically significant at the 1%, 5% and 10% levels, respectively.

Figure 1.
U.S. time series



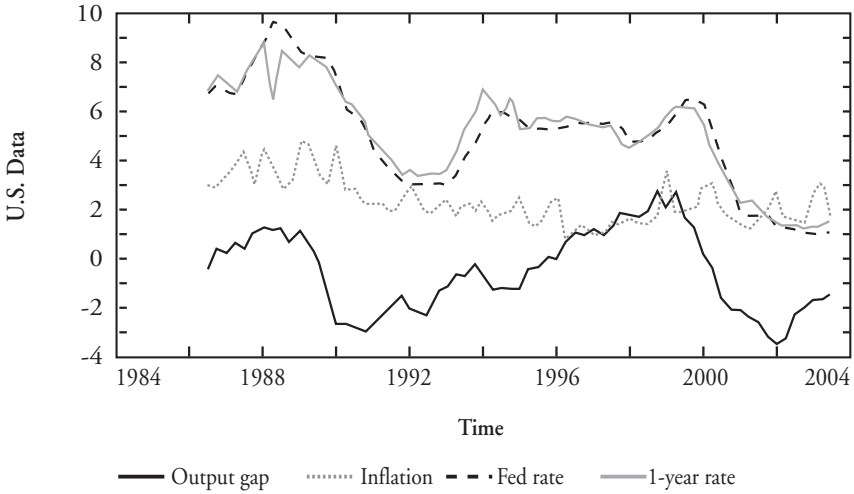


Figure 2.
Comovement between output gap and inflation under the standard Taylor rule

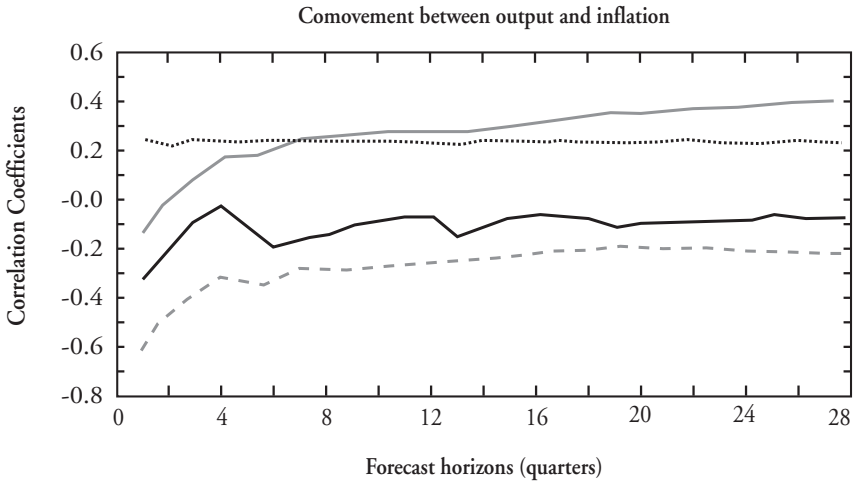


Figure 3.
Comovement between output gap and inflation under the backward-looking Taylor rule

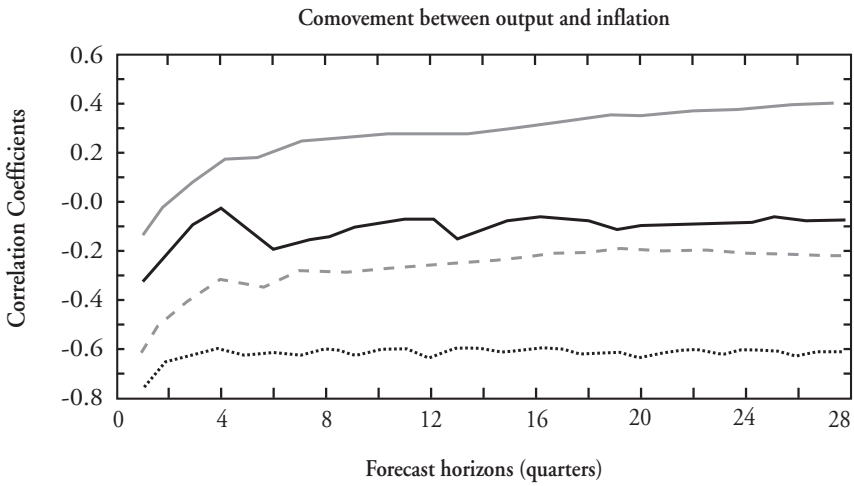


Figure 4.
Comovement between output gap and inflation under the forward-looking Taylor rule

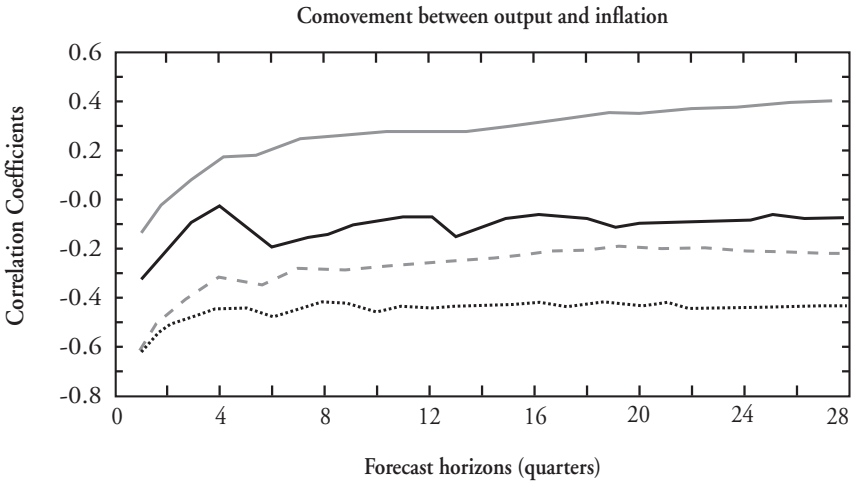


Figure 5.
Comovement between Fed rate and 1-year stock return under the standard Taylor rule

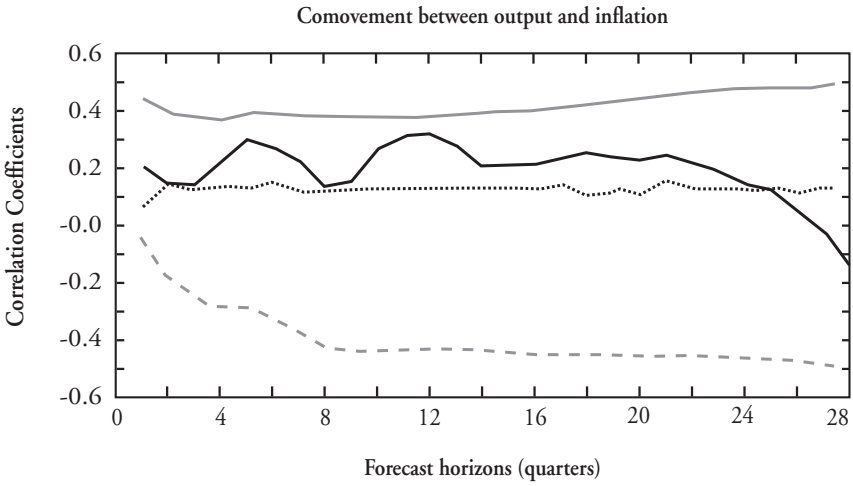


Figure 6.
Comovement between Fed rate and 1-year stock return under the backward-looking Taylor rule

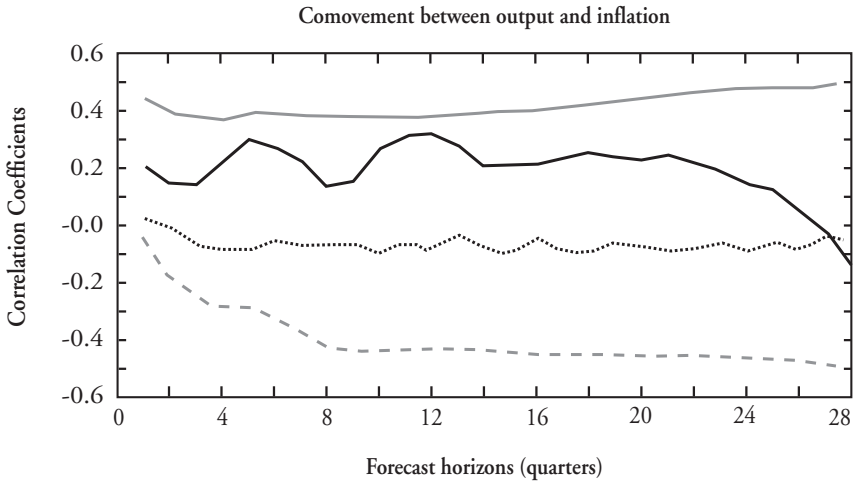
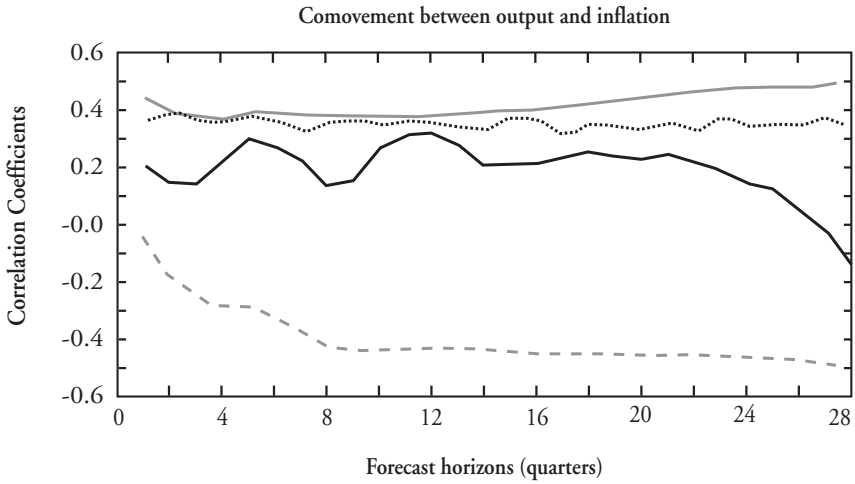


Figure 7.
Comovement between Fed rate and 1-year stock return under the forward-looking Taylor rule



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Comment

Antonio Moreno
Departamento de Economía, Universidad de Navarra

In this paper Jesús Vázquez formulates, solves and estimates a New-Keynesian macro model augmented with bond and stock market returns. The goal of the article is to estimate the impact of the dynamics in the returns of the financial markets on macroeconomic fluctuations. To this end, the author posits a structural Dynamic Stochastic General Equilibrium (DSGE) model in a classical Rational Expectations (RE) framework, where excess bond and stock returns influence the short-term interest rate, detrended output and inflation. The model is estimated via indirect inference techniques and the results show that the Fed responds to stock market returns but not to the bond spread. Financial returns also affect detrended output significantly in the demand equation.

I would like to organize my discussion of the paper in four sections. First I will comment on the importance of the topic. Then I will discuss the macroeconomic context chosen by the author. Afterwards, the estimation strategy and the results obtained will be analyzed. Finally, I will summarize the current state of the related literature and outline some directions to enhance this promising line of research.

1. TOPIC RELEVANCE

I commend Jesús for tackling the complex relations between macroeconomics and the financial markets in the context of a structural DSGE model. This is a very challenging exercise, but one which highlights the intricate mechanisms behind these relations.

The macro-finance literature has made it clear that the causation pathways between both sets of variables run in the two directions. Macro variables influence bond and stock returns because the financial markets price macroeconomic risks, as Ang and Piazzesi (2003) show. Financial variables influence the evolution of present and future macroeconomic outcomes. For instance, Estrella and Mishkin (1998) illustrate the forecasting power of term spreads for future inflation and output dynamics. At the same time, the bond markets, by themselves, can help stabilizing macroeconomic fluctuations because they can enhance or restrict the investing opportunities for firms, and thus they have an impact on output and inflation dynamics. Jesús focuses on one of these two causation pathways, that of returns on macro variables. While he is then foreseeing a relevant part of the story, his model can still provide partial equilibrium type of insights on the finance-to-macro relation.

2. NEW-KEYNESIAN MACROECONOMIC CONTEXT

The framework chosen in the article is the most fashionable now in macroeconomics, a linearized version of the New-Keynesian macro model (see Woodford (2003)). It contains supply, demand and monetary policy equations. The aggregate supply specification or New-Keynesian Phillips curve is very similar to the one formulated by Calvo (1983). The IS or demand equation is the intertemporal Euler equation, but he allows for the separate and direct influence of stock and bond returns on detrended output. While many of us believe that these relations are indeed present in the data, the author does not motivate them from a fully economically founded model so that the intuition behind the relations is a bit blurred. For instance, the way the model is set up suggests that there are three simultaneous IS equations or three demand schedules. If the goal of the paper was to include returns directly, it would have seemed more sensible to

append two non-arbitrage conditions to the IS curve. But even in this scenario, the fact that the finance side of the economy is not explicitly modelled makes the finance-to-macro interpretation difficult.

The interest rate equation is also non-standard. The monetary authority reacts to inflation and detrended output, in a similar fashion to the original prescription given by John Taylor. But then Jesús augments the monetary policy rule by allowing excess stock returns and term spreads affect the interest rate setting. That is, he accommodates a potential stock and bond market watching behavior by the monetary authority. Much has been debated about the potential motives behind this financial market watching scheme. McCallum (1994) was the first author who introduced term spreads in a monetary policy rule, whereas Bernanke and Gertler (2000) estimated monetary policy rules to assess the stance of the US and Japanese monetary authorities' with regard to stock returns. By and large, the inclusion of financial returns in the monetary policy reaction function is completely devoid of a monetary theory. Its motivation has been mainly empirical so far. The author estimates contemporaneous, backward and forward-looking specifications to uncover potential discrepancies. This turns out to be a meaningful exercise, as we report in the next section.

3. ESTIMATION AND RESULTS

Jesús estimates the DSGE model with US data for the post-1987 period via indirect inference techniques. His estimation strategy is based upon minimizing the distance between the implied reduced-form coefficients of the structural model and those of an unrestricted VAR. In other words, the technique used by the author matches some of the moments in the distribution, not all. As a result, there are some identification issues regarding, for instance, the size of the structural shocks. This is in contrast to standard estimation approaches, such as maximum likelihood (MLE) or the generalized method of moments (GMM), which try to match all the moments in the distribution. While I personally prefer these two approaches for standard macro models, it is clear that all these strategies have pros and cons. MLE is the best method if the model is true, but it produces severe biases if the model is misspecified. GMM is advan-

tageous in that the researcher does not have to take a stand on the distribution of the error terms, but its small-sample properties are not good. Outside the frequentist framework, Bayesian techniques are useful because they let the data correct relevant priors, but the disadvantage is that the choice of the prior distributions often determine the estimated posteriors. In this context, minimum distance estimators make sense whenever the researcher is interested in matching a specific set of moments –for instance, a specific impulse response function– but it can be seen as closer to a calibration exercise than the other techniques.

I will now comment on the three most interesting results of the paper. First, the estimates of the Phillips curve parameter in the AS equation and of the output sensitivity to real returns in the IS equations are both large –very close to unity– and statistically significant. This, in itself, would be a noteworthy result, as it is well known that these parameters are typically very imprecisely estimated at very low values (see, Ireland (2001)). The problem is that the estimates are suspiciously close to one across specifications. While other studies, such as Boivin and Giannoni (2003), have obtained large estimates of these parameters in minimum distance frameworks, these estimates seem too high. An interesting robustness check would be to compute the implied inflation, output gap and interest rate volatilities. Given the associated estimate of the monetary policy transmission mechanism, the implied model volatilities would presumably overshoot those in the data.

Second, the estimate of the interest rate response to the term spread is consistently zero across specifications. In other words, there has been no bond watching during the Greenspan era. Third, stock returns affect the short rate significantly with backward and contemporaneous inflation and output gap in the reaction function, but not with forwardlooking macro variables. This is, in my view, the most interesting result of the paper, and one which extends the findings of Bernanke and Gertler (2000) to a simultaneous equations setting. It implies that the Fed only reacted to stock prices to the extent that they predicted inflation fluctuations. While some authors have blamed Alan Greenspan for reacting too late to the stock market bubble of the late 90s, many of us believe that it is not in interest of the monetary authority to react to stock prices unless they inform us about higher future inflation rates or lower future economic activity.

4. WHERE TO GO FROM HERE

Taking the finance side of the economy seriously and modelling the macro-to-finance relation are clearly two desirable features of any macro-finance model. Diebold, Rudebusch, and Aruoba (2006) show that macro-to-finance channel is more relevant than the financeto-macro channel. There are indeed some papers which model the macro-finance interaction explicitly in the context of DSGE models. This emerging literature has proceeded in several steps so far. Hordahl, Tristani, and Vestin (2006) append a New-Keynesian model to a standard affine term structure model, but the finance pricing kernel, while allowing for a time-varying price of risk, is not consistent with that of the finance model. Bekaert, Cho, and Moreno (2005) reconcile both pricing kernels, but then the price of risk is constant. One of the latest efforts, by Doh (2006), improves upon the previous papers by focusing on the second order approximation of the New-Keynesian macro model, yielding time-varying price of risk and a consistent pricing kernel. He cannot however match the historical term premia and the volatility of the macro series. Therefore, much remains to be done in this research area. Progress can be made at both the finance and macro modelling margins. On the macro front, the labor market performance needs to be reconciled with the the output gap and inflation dynamics. The IS equation keeps being difficult to reconcile with the data. On the finance front, affine term structure models should be able to accommodate prices of risk consistent with macroeconomic phenomena. Advances in these areas will surely bring about a better understanding of the structural factors behind the yield curve and stock market dynamics.

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8. Las notas a pie de página deberán aparecer numeradas correlativamente. Los agradecimientos constituirán la primera nota a pie de página, no con un número sino con un asterisco.

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