AN OVERVIEW OF THE LITERATURE ABOUT DERIVATIVES

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1. Introduction

A derivative is defined by the BIS (1995) as "a contract whose value depends on the price of underlying assets, but which does not require any investment of principal in those assets. As a contract between two counterparts to exchange payments based on underlying prices or yields, any transfer of ownership of the underlying asset and cash flows becomes unnecessary". This definition is strictly related to the ability of derivatives of replicating financial instruments[2].

Derivatives can be divided into 5 types of contracts: Swap, Forward, Future, Option and Repo, the last being the forward contract used by the ECB to manage liquidity in the European inter-bank market. For a further definition of contracts, which should although be known by the reader, see Hull (2002).

These 5 types of contracts can be combined with each other in order to create a synthetic asset/liability, which suits any kind of need; this extreme flexibility and freedom widely explain the incredible growth of these instruments on world financial markets.

In section 2 I will look at some micro-economic results about derivatives; in section 3 the issue of risk is addressed; in section 4 monetary policy results about derivatives are shown, and in section 5 fiscal policy results are shortly presented. In a brief statistical appendix some relevant data are presented.

2. Some micro-economic results about derivatives

Derivatives are financial instruments widely used by all economic agents to invest, speculate and hedge in financial market (Hull, 2002). These functions are strictly related with the financial and mathematical definition of instruments and do not consider the economic contents of financial assets.

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[2] See S. Neftci (2000) for maths details.

We will focus on economic functions of derivatives in the following parts of this research project (Savona, 2003).

From a micro-economic point of view, we can shortly sum up results about markets and instruments widely accepted in the literature.

Researches and analysis have focused on the properties of derivatives to influence the underlying markets and the new derivative market itself.

With regard to the underlying markets, the influence on volatility and information asymmetry are of central importance; whereas looking at the derivatives markets, issues are liquidity, transparency and risk.

Generally speaking, the introduction of exchange traded derivative products 1. increases information about the underlying; 2. does not seem to increase volatility and risks of and on the underlying market; 3. price discovery effect improves; 4. bid-ask spread and the noise component of prices both decrease[3].

The exchange-traded derivatives' markets satisfy all requirements of transparency, liquidity and risk monitoring and are looked at and controlled by the Exchange Trade Authority and the Clearing House (BIS, 1995). The BIS and IMF set out the rules for safe and sound markets structure. Some central banks have also imposed modified capital ratios for banks and financial institutions to include derivatives. Nowadays these markets do not pose any particular safety problem most of all after 1987, when a crash of exchange traded options gave rise to the control and monitoring activities.

Moreover, derivatives (e.g. options) are excellent substitutes of complex investment strategies at a lower cost (Haugh and Lo, 2001) thus completing markets for investors. Firms actively using derivatives show to have different (few) risk exposure than non-using (Hentschel and Kothari, 2001), and banks using interest rates derivatives experienced a greater growth in their commercial and industrial loan portfolios than non-using (Brewer, Minton and Moser, 2000). A size barrier to the use of OTC derivatives has been underlined by Hogan and Malmquist (1999), which, however, is consistent with profit-maximisation. Peek and Rosengren (1996) cast doubts about the derivatives trading activities of troubled banks, most of all because there seemed to be a risk loving behaviour (and then an increase in unmonitored moral hazard).

Many of the available statistics and analyses look at exchange traded derivatives; on the contrary, the growth of Over The Counter (OTC) derivatives has an exponential pace (see BIS for some aggregate data) and

[3] See B. Cohen (1999); J. Conrad (1989); A. Craig et al. (1995); M. Massa (2002); R. Violi (2000) and many others on the Journal of Derivatives.

might pose some systemic problems, given the impossibility to quantify and control the risks related[4].

The continuous creation of different types of derivatives by financial institution, in absence of any patent protection, confirms that the return on this investment is high for the "creator" of the innovation, and pays back the R&Ds expenditures too (Herrera and Schroth, 2002).

Micro-economic results about derivatives can be summed up also looking at the single instrument:

a. Future contracts increase market efficiency (by lowering trading costs and information asymmetry) and liquidity (given all expiration dates and daily setting of margins). Transparency depends on the international and national laws and is generally very high. Futures are widely used to hedge and speculate, both on financial and commodity markets. Notional value of future contract does not represent the exposure of the two counterparts, as long as they settle their position each day through margins.
b. Option contracts have the same effects of futures on markets. The only drawback can be the unclear effect on volatility of the underlying, because futures tend to lower underlying asset's volatility, whereas option do not give unique empirical results. The option notional value is not a proxy of the exposure, but the premium paid to open/close the position represents resources invested.
c. Swaps are generally OTC contracts with a longer duration than futures and options, and satisfy the need of a single client of the bank (a firm or financial institution). They tend to create new investment opportunities in order to hedge against any type of risk or speculate (currency, interest rate, hearth-quake, credit default, and so on). In these contracts the notional value of the contract do not represent the risk taken by the two (or more) counterparts, but periodical payments.
d. Forwards are OTC future contracts, not standardised and created on the client needs. They showed to have almost the same properties of futures.
e. Repos are time financing operations between the ECB and the European inter-bank system; they are used to finance liquidity and not to speculate or hedge, so that the inclusion of them is given only to their structure of time operations, but not to their financial function.

The legal risk related with the absence in some countries of a strong market regulation, both for exchange traded derivatives, underlying markets and OTC, is somehow solved using codes of conduct and self-regulation

[4] P. Barrieu and N. El-Karoui (2002) look at illiquid markets, from a utility maximisation point of view, where derivatives on earth-quake and other catastrophic events are traded, but no certain data about exchanges and risks are given.

agreements. This is sustainable as long as a monetary authority acts as a lender of last resort for the entire financial system.

3. **Derivatives and risks**

The introduction of derivatives by completing information of markets on prices of the underlying on the expiring date of the contract satisfies the price discovery property, that is the expiring date derivative price can be approximated with the capitalised today spot price, given constant risk free interest rate.

$$F_{t+n} = S_t(e^{r(t+n)}) \tag{3.1}$$

Liquidity of derivatives and underlying markets has increased according to the wide use of these instruments by firms, financial institutions and banks (see Statistical Appendix).

The introduction of derivatives might affect the risk of financial markets: from a macroeconomic point of view risk can be divided in systemic and not systemic. The first can be diversified and thus lowered; the second is not affected by portfolio diversification and is a characteristic of the market and country[5]. Systemic risk can be lowered by portfolio diversification and derivatives play a central role in this process, given the absence of exogenous shocks; in the presence of shocks, they behave like other financial instruments, and can exacerbate the effects of shocks for traders, brokers and markets as a whole.

From a macro-prudential point of view, risks related with international exchange traded derivatives is settled by the BIS regulations, whereas risks related with OTC derivatives is settled basically by codes of conduct and self-regulation[6].

Capital ratios and regulation, facing the Basle Capital Accords, have been partially adjusted with derivatives in order to let them emerge in the balance sheets of banks and financial institutions. The Balance of Payments has an enter in the Financial Account with the sum of all margins of international derivatives in order to give a rough idea of trading on these instruments. Some central banks impose further (in or off-balance) information on banks and financial institutions about derivatives' investments.

The role of international institutions in quantifying the phenomenon is of central importance in our analysis, but the general lack of data about OTC instruments might limit our ability to get to a unique conclusion[7].

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[5] See W.C. Hunter and D. Marshall (1999) for a broader definition of systemic risk.
[6] R.S. Kroszner (1999).
[7] V. Bhasin (1996); BIS (1996); M.R. Darby (1994) and F.R. Edwards (1995).

Donmez and Yilmaz (1999) state that "a mature derivatives market on an organised exchange leads to a better risk management and better allocation of resources in the economy". This is confirmed also by Hunter and Marshall (1999), who affirm "derivatives trading may increase informational efficiency of financial markets and provide instruments for more effective risk management".

In the current literature, there seems to be no clear evidence about an increase of risk, either systemic or non-systemic, in the absence of shocks; in presence of exogenous shocks, they tend to exacerbate the effects, according to their different risk propensity. Hunter and Marshall (1999) and Hunter and Smith (2002) underline the important relationship between systemic risk and derivatives, given that the presence of systemic risk needs the central bank to act as a liquidity supplier for financial markets. In the following section I will discuss about some key elements of monetary policy, strictly related with this issue.

4. **Macro-economic results about derivatives: monetary policy**

With the introduction of derivatives, markets are more perfect thus influencing monetary policy actions (Vrolijk, 1997); the surprise effect is no longer a way to influence markets because of the impossibility to counterbalance their huge liquidity (von Hagen and Fender, 1998).

Financial innovation influences the structure and behaviour of the central banker, and the process of development of financial markets goes together with the process of changing of monetary theory and policy[8].

The classical channels of modern monetary policy are credit and bank (money) (given the impossibility of financing the Treasury in most countries and the existence of floating exchange rates).

The credit channel relies its power on market imperfections, either on the information side or the money side; with derivatives it gradually looses its importance. Credit can be substituted by derivatives, as shown by Fender (2000) and Gorton and Rosen (1995).

The money channel is the principal mean to influence markets and their liquidity, although cash can be substituted by daily rolled-over derivatives. The ECB uses Repos as the mean to finance the European banking system with 15 days duration, confirming that the money channel is the first instrument of modern monetary policy.

An important policy function of the monetary authority is the lender of last resort. The Long Term Capital Management's failure in 1998 posed a

[8] See I. Angeloni and M. Massa (1994); Banca d'Italia (1995a and b); Deutsche Bundesbank (1994); C.A.E. Goodhart (1995); L. Hentschel and C. W. Jr Smith (1997); C.J. Hooyman (1993); T. Latter (2001) and M. Pawley (1993).

liquidity problem to the Federal Reserve System, which had to intervene as a counterpart to avoid a credit crunch. Other important failures, like Enron, MetallGesellSchaft and Barings, just to mention the most famous, posed safety and liquidity problems to monetary authorities acting to the detriment of the liquidity of the monetary and financial system. Donmez and Yilmaz (1999) analysed many dramatic incidents involving derivatives markets concluding, "they do not seem to create new risks, but only change the type, structure and nature of the existing". With derivatives the lender of last resort function is not changed in its scope, but in its concrete management. Hunter and Marshall (1999) and Hunter and Smith (2002) confirm this intuition, saying that -given no consensus about the model of systemic risk- the role of derivatives on financial markets is not disruptive, since they increase the efficiency of markets. However, derivatives tend to make the conduct of monetary policy more difficult, and to complicate the regulatory process.

Looking at emerging markets, there seems to be no certain evidence about the real danger coming from derivatives markets; moreover, Morales (2001) says that derivatives tend to incorporate news faster than the spot markets, and that the introduction of restrictions on emerging financial markets increases risk, by increasing the costs of investing and moving capital abroad. The introduction of derivatives in emerging capital markets increases international substitutability, attracting foreign investors (e.g. Tesobono swap in Mexico).

Central banks in certain circumstance use derivatives as a substitute of the channels of monetary policy; Tinsley (1998), Rossetti (1998), and others explain which are the advantages for central banks in using derivatives to manage the exchange and interest rates, most of all in the absence of a liquid primary market, like in Switzerland.

Financial innovation might influence the degree of substitution between financial assets in the portfolio of economic agents. We treat this property in a Tobin's framework (Savona, 2003). Given more perfect financial market, the substitutability between financial assets and liabilities increases, thus making the traditional demand for money function unstable in its parameters, which do not include innovation. A part of the recent literature has analysed the impact of financial innovation on the demand for money parameters, and has come up with some interesting points to focus on[9]. The introduction of derivatives on world markets decreases asymmetries, transaction and investment costs, thus contributing to increase the possibilities for portfolio diversification. The degree of substitution with traditional and new investments increases, making money aggregates less meaningful[10].

[9] See M.I. Biefang-Frisacho et al. (1994); D. Glennon and J. Lane (1996); P. Ireland (1995) and S.S. Sriram (1999).
[10] See A. Estrella and F.S. Mishkin (1997).

The definition of money base used by monetary authority influences directly the composition of money aggregates; using the analytic definition of the money base (Fratianni and Savona, 1972) and given the econometric results on derivatives and their property of reacting with interest rates, the inclusion of derivatives into money aggregates should be straightforward. The analytic definition of money base states that if the supply of a financial instrument has a negative reaction on interest rate, it behaves like money base and then is part of the base of the multiplication process of money and deposits[11].

Savona and Maccario (1998), Savona, Maccario and Oldani (2000) and Oldani (2002) have tested this reaction property and concluded that for certain instruments the inclusion into the aggregates should be meaningful.

The instability of the deposit and money multiplier experienced in the last years in developed countries can be explained by looking at the simple deposit multiplier coefficients:

$$DEP = \frac{1}{\alpha + \beta + \gamma} \qquad (4.1)$$

Where α is the liquidity propensity of the private sector (firms and households), β is the compulsory reserve coefficient, and γ is the liquidity propensity of banks.

The coefficient β is set at a low level in many developed countries (2% in Europe); the coefficient γ is low because cash is a costly asset for banks and they manage to substitute it with daily rolled-over financial instruments, like derivatives; the coefficient α in a mature financial system is quite low given that households tend to use electronic money, and firms manage to minimise cash in order to lower its costs, by using financial innovation and daily rolled-over investment strategies.

The 3 coefficients are lower than 20 years ago[12], and the multiplier tends to increase and becomes unstable because there seems to be no built in stabiliser; but capital ratios of banks, modified to include financial innovation, should act as built in stabiliser in the international financial system. Firms are still out of control in this mechanism[13].

[11] If the reaction has a positive sign, the instrument is considered as money (and not money base).
[12] See M. Pawley (1993); D. Glennon and J. Lane (1996).
[13] See G.W. Brown and K.B. Toft (2002); S.D. Makar and S.P. Huffman (2001).

5. **Macro-economic results about derivatives: fiscal policy**

Studies about the relationship between derivatives and the fiscal policy can be divided into two main categories: the first analysing the impact of using derivatives to lower the cost of debt, and the second looking at the tax rules about derivatives for investors and at tax savings.

The use of derivatives by the Government (or a Public Agency) to manage debt and lower its cost is a very important field of study, especially in Europe. Unfortunately, data about this trading/hedging activity are not available and the study of Piga (2000) on the use of swaps by some Government is the only available at the moment. His conclusion are quite encouraging, because the use of derivatives (especially swaps) decreases the cost of the debt service and lowers the need for further debt rollover. There seems to be no direct effect on risk, which is a very important policy issue related with public debt management and credibility. It seems to be a debt management strategy coherent with the need to lower the burden of public debt on European economies in the next future.

The advantages of using derivatives for tax savings are difficult to describe in general. With regard to banks and firms, many countries try to treat differently derivatives' losses/gains if they come from hedging or speculation. The tax saving is greater for hedging, and then firms and banks might tend to declared losses and gains in this form rather than speculation (Hull, 2002, Wong, 2000 and Anson, 2002).

In general, the problem of derivatives being off-balance sheet items poses many barriers to a complete analysis of fiscal effects for all economic agents. Breuer (2000) has measured off-balance sheet leverage for financial institutions in order to give complete information about risks' exposure and capital adequacy, although at an aggregate level (market or institution).

The tax-saving effect is an important incentive to invest in derivatives markets, and the books series on this topic by Wiley and Sons is a very useful tool for practitioners and individual investors.

6. **Conclusions**

Derivatives are the widest financial innovation of the last 30 years and their impact on financial markets and operators, investment strategies and risk management, money and fiscal policy are very important theme to look at for economists. Here a short survey of the recent literature about derivatives and their effect is briefly presented and some interesting under-developed areas of the analysis are discussed. Monetary and fiscal policy lack some deep and complete treatment, which should look at financial innovation as a way to change traditional management of risks and effects; financial literature has developed some mathematical tools for analysing effects of financial innovation, but a behavioural analysis is still needed.

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STATISTICAL APPENDIX

Tab. 1 – Derivatives Financial Instruments Traded on Organised Exchanges by Instruments and Location

(Notional principals in billions of US dollars)

Instruments/Location	Amounts Outstanding			
	1999 dec.	2000 dec.	2001 dec.	2002 sept.
FUTURES				
All Markets	8305,8	8359,5	9672,5	10687,7
Interest rat	7924,8	7907,8	9265,3	10326,8
Currency	36,7	74,4	65,6	37,6
Equity index	344,2	377,3	341,7	323,3
North America	3553,3	4283	5906,4	6249,6
Europe	2379,9	2322,8	2444,9	3118,5
Asia and the Pacific	2160,6	1502,8	1240,8	1225,6
Other Markets	211,9	250,9	80,4	94,1
OPTIONS				
All markets	5299,9	5918,5	14125,5	17929,9
Interest rat	3755,5	4734,2	12492,8	16142
Currency	22,4	21,4	27,4	30,9
Equity index	1522,1	1162,9	1605,2	1757,1
North America	3377,3	3884,8	10292,5	11605,9
Europe	1644,3	1894,9	3734,6	6216,6
Asia and the Pacific	240,7	103,4	67,6	79,2
Other Markets	37,7	35,3	30,8	28,3

Source: BIS Quarterly Review, December 2002

Tab. 2 – Derivatives Financial Instruments Traded on Organised Exchanges by Instruments and Location
(Notional principals in billions of US dollars)

Instruments/ Location	Turnover					
	2000 Year	2001 Year	2001 Q4	2002 Q1	2002 Q2	2002 Q3
FUTURES						
All Markets	318201,8	446358	117647,6	119053,6	123990,6	138910,3
Interest rat	292204,3	420934,2	111133,3	112417,2	116679,3	130868,3
Currency	2416,8	2499,3	675,1	577,3	689,1	633,4
Equity index	23580,9	22924,5	5839,2	6059,2	6622,2	7408,7
North America	150916,5	243993,9	65119,9	69656,7	71750,9	74375,5
Europe	111591,4	154490	40516,5	38973,4	40584,6	51939,9
Asia and the Pacific	52440,2	43369,7	10210,4	9500,2	10545,7	11927,1
Other Markets	3253,8	4504,4	1800,8	923,4	1109,4	667,8
OPTIONS						
All markets	66459,8	148547,9	46139	42851,9	45047,3	53574,9
Interest rat	47378,9	122765,9	38722	34912,5	36134,3	43520,9
Currency	211,8	355,9	97,5	102,8	124,8	104
Equity index	18869,1	25426	7319,6	7836,7	8788,2	9949,9
North America	43999,9	107679,5	33240,6	30418,7	33408,8	35136,5
Europe	17704,1	33655,8	10168,3	9217,3	7631,2	14112,2
Asia and the Pacific	4165,8	6533,7	2538,3	3035	3845,4	4192,9
Other Markets	590	678,9	191,8	180,9	162	133,3

Source: BIS Quarterly Review, December 2002

Tab. 3 – Amounts Outstanding of Over-The-Counter (OTC) Derivatives by Risk Category and Instrument
(in billions of US dollars)

Risk Category/ Instrument	Notional Amounts					Gross Market Values				
	2000 June	2000 Dec.	2001 June	2001 dec.	2002 June	2000 June	2000 Dec.	2001 June	2001 dec.	2002 June
Total Contracts	94008	95199	99755	111115	127564	2572	3183	3045	3788	4450
Foreign Exchange	15494	15666	16910	16748	18075	578	849	773	779	1052
Interest rate	64125	64668	67465	77513	89995	1230	1426	1573	2210	2468
Equity linked	1645	1891	1884	1881	2214	293	289	199	205	243
Commodity	584	662	590	598	777	80	133	83	75	78
Other	12159	12313	12906	14375	16503	392	485	417	519	609
Gross Credit Exposure	-	-	-	-	-	937	1080	1019	1171	1316

Source: BIS Quarterly Review, December 2002

Tab. 4 - Amounts Outstanding of OTC Foreign Exchange Derivatives by Instrument and Counterpart
(in billions of US dollars)

Risk Category/ Instrument	Notional Amounts				
	2000 June	2000 Dec.	2001 June	2001 dec.	2002 June
Total Contracts	15494	15666	16910	16748	18075
Outright Forward and Foreign Exchange Swaps	10504	10134	10582	10336	10427
Currency Swaps	2605	3194	3832	3942	4220
Options	2385	2338	2496	2470	3427
Risk Category/ Instrument	Gross Market Values				
	2000 June	2000 Dec.	2001 June	2001 dec.	2002 June
Total Contracts	578	849	773	779	1052
Outright Forward and Foreign Exchange Swaps	283	469	395	374	615
Currency Swaps	239	313	314	335	340
Options	55	67	63	70	97

Source: BIS Quarterly Review, December 2002