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Money demand & futures

by

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ABSTRACT

This paper introduces a micro-model of portfolio utility to look at the effects of futures in the allocation process, starting from Lancaster-type utility model (1991), further developed by Glennon and Lane (1996) on money demand; results underline the role of portfolio substitution and crowding out of inefficient financial assets. The synthetic model can be represented by money and financial innovation, lowering the dimension of the assets from 3 to 2. Statistical evidences confirm the validity of assumptions for the US economy at a static level.

Key Words: futures, money demand model, utility and substitution

JEL Classification: D8, E41, G11

NON-TECHNICAL SUMMARY

The modern theory on money demand incorporates the evolution of financial markets behaviour, and then of households' allocation and preferences in different fashions; innovation in money demand can be considered as an increasing number of liquid assets between which to choose, considering money as a store of value and as a mean of payment; innovation modifies the utility of money holdings, through wealth and substitution effects. Liquidity has to be weighted with risk aversion and profitability to incorporate portfolio innovation properly.

Aim of this paper is to look at the effects of futures' introduction into the demand for money function, expressed accepting the Keynesian -Tobin approach, where substitution effect is present.

The role of exchange traded and OTC futures is complex and a special attention should be given to financial crowding out effect; since OTC futures-forward are off-balance sheet items for banks and firms, not influencing the rating and the ability of raising funds, they could dominate the former asset, offset the neighbour, and offset the need of money, if there are no cash constraints or reserve requirements. Exchange traded futures have higher level of both characteristics, although we cannot refer to crowding out but only to efficiency gain.

Futures speed up the substitution and can crowd out traditional assets in portfolio; this specific effect of derivatives has never been analysed in the literature. A model of portfolio utility is discussed; it starts from the Lancaster utility function, where utility depends on profitability and liquidity, the first being related to risk too. Futures are liquid assets and exhibit the same risk of the underlying, so that the efficient portfolio should include futures instead of the underlying; derivatives crowd out underlying assets and this effect influences money demand parameters. The interest rate elasticity (sign and magnitude) is analysed and discussed as the parameter incorporating the innovation. Some statistical evidences confirm the model coherence and meanings for the US economy.

DOMANDA DI MONETA & FUTURES

SINTESI

Questo paper presenta un modello microeconomico di utilità di portafoglio per analizzare gli effetti dell'introduzione dei future sul processo di allocazione, muovendo dalla funzione di utilità introdotta da Lancaster (1991), sviluppata da Glennon e Lane (1996) per la domanda di moneta; i risultati evidenziano gli effetti di spiazzamento e di sostituzione degli asset inefficienti nel portafoglio. Il modello nella forma semplificata può essere rappresentato dalla domanda di moneta e dell'attività innovativa, diminuendo la dimensione delle attività, da 3 a 2. Le prime evidenze statistiche confermano la validità delle assunzioni per l'economia americana a livello statico.

Parole chiave: futures, domanda di moneta, utilità e sostituzione

Classificazione JEL: D8, E41, G11

CONTENTS

1 INTRODUCTION[1]

The modern theory on money demand incorporates the evolution of financial markets behaviour, and then of households' allocation and preferences in different fashions; innovation in money demand can be considered as an increasing number of liquid assets between which to choose, considering money as a store of value and as a mean of payment; innovation modifies the utility of money holdings, through wealth and substitution effects. Liquidity has to be weighted with risk aversion and profitability to incorporate portfolio innovation properly. Aim of this paper is to look at the effects of futures' introduction into the demand for money function, expressed accepting the Keynesian-Tobin approach, where substitution effect is present. Futures speed up the substitution and can crowd out traditional assets in portfolio; this specific effect of derivatives has never been analysed in the literature. A model of portfolio utility is discussed; it starts from the Lancaster utility function, where utility depends on profitability and liquidity, the first being related to risk too. Futures are liquid assets and exhibit the same risk of the underlying, so that the efficient portfolio should include futures instead of the underlying; derivatives crowd out underlying assets and this effect influences money demand parameters. The interest rate elasticity (sign and magnitude) is analysed and discussed as the parameter incorporating the innovation. Some statistical evidences confirm the model coherence and meanings for the US economy.

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2 THEORIES OF MONEY DEMAND AND FINANCIAL INNOVATION

Money demand is an economic theme, which has fascinated economists over the centuries and no unique result has been ever reached. Money demand, and allocation in portfolio depend on the definition on money and wealth and on the possible combinations, depending on technology available and risk attitude.

Using very simple notation, we can synthesise the evolution of money demand specifications and start with the well known quantitative theory of money (MV=PQ), moving to the Fisher interpretation of it (MV(r)=PQ) and then look at the Keynesian money demand (Md=(r,Y)), where money holdings are not only a function of income (or consumption) but depend also on the alternative investment, following the speculative motive to hold money, together with precautionary and transactional. Tobin introduced the concept of average money holdings M=(2bT/r)1/2 where b is the brokerage charge to convert bonds into money, r is the interest rate and T is the number of transactions. This is known also as the square-root law. Empirical studies on money demand have followed economic theory and tried to find out a stable representation of money demand. Financial innovation and evolving regulation might change the process of allocation of wealth in the form of money or substitutes, and empirical and theoretical studies follow this process and try to find stable and meaningful functions over time and countries.

Money demand and its relationship with growth and inflation are the central themes in modern monetary and financial policy, but a stable money demand function is the basic tool to identify the correct relationship with final targets. Central banks in the last decades have started following monetary rules weighting goals (growth, inflation, unemployment) and relative drawbacks and effects with respect to fiscal policy.

Recent studies on new open macroeconomics (Andres et al, 2004) show that the expansion of one asset's supply affects both the yield on that asset and the risk premium between the returns on that asset, and the alternative. This means that short and long term securities are imperfect substitutes, and that there can be an additional monetary policy channel.

3 A MODEL OF PORTFOLIO SUBSTITUTABILITY: THE ROLE OF FUTURES

The model aims at describing the behaviour of portfolio allocation, using a consumer micro-founded theory and introducing new financial assets to look at crowding out and substitution effects; the model has been originally developed by Lancaster (L, 1971 and 1991) "modern consumer theory" and further applied to money demand by Glennon and Lane (G&L, 1996). G&L consider the effects of changing means of payments and regulation on money demand during the '70s and '80 in the US; these modifications have direct effects on money demand parameters, in particular the interest rate elasticity, and in this paper we will look at the financial innovation, which spreads out world-wide during the '90s and the first years of the new millennium: futures, which represent new assets emerging endogenously on the market[2], and are new goods which can crowd out others. The Lancaster-Glennon-Lane (LGL) model is briefly summarised in appendix A.

Differently from Glennon and Lane, futures are not new means of payments, i.e. new "type" of money, which need to be recognised as such and introduced into the money demand. The money demand function should represent the assets available to substitute money and substitution between assets is the key parameter. Modern monetary policy does not pay attention to quantitative goals (like money supply or compulsory reserves), but to risk-adjusted measures; the money demand function is a behavioural equation useful to understand how liquid assets are allocated.

The first theoretical brick we need is the role of futures in financial markets: we should accept that futures are not zero sum games and then we can include them as independent assets in the utility function. Their micro-effects (low volatility, good price discovery and high liquidity) have been analysed on a single market/instrument basis in the literature, but from a macroeconomic point of view we cannot simply accept the neutrality of futures in financial markets. The principle basing on which single microeconomic results should be valid at an aggregate level has to be denied.

If derivatives were zero sum games, their two-digits annual growth rates would be not rational nor acceptable; derivatives are not a recent innovation in

2 Derivatives cannot be considered exogenous since their origin and first trading can be dated back to Ancient Mesopotamia and their mathematical definition is strictly dependent on the underlying asset, so that they are not "independent".

financial markets, since their official settlements in the US can be dated back to the XIX century, and their trading has been first ruled in the Hammurabi code[3].

If their contributions to finance were simply the ability to shift risks from a subject to another, and the general market risk is not affected anyhow, their attractiveness should be lower than it actually is; if derivatives were used only to shift risks and hedge, there should be some correlation between stock exchange and derivatives growth. Over the period 2001-2002, on the contrary, stock exchanges world-wide did not grow at that speed, and showed a (poor) one-digit rate[4].

The objection that the future contract is a mere replication of the underlying asset and than in the money demand function we should include that asset instead of the future, can be overcome by observing that the financial (and mathematics) equivalences holds in terms of value, but not of basic portfolio characteristics; liquidity and risk-profitability of futures are different from that of the underlying. Some underlying assets, moreover, like Dow Jones Industrial Average (DJIA) is not liquid at all, actually it does not exist and is not traded as an autonomous underlying asset, so that the future contract is more liquid than the underlying asset. Our model is settled on preferences on characteristics so that future (on DJIA, for example) can be preferred to the underlying. Buying or selling a future is not the same as buying or selling the underlying (shares) in the exact proportions of the stock index, in terms of costs for investors. Since costs (and then profits) of the two investments are not the same, although they are equivalent in terms of prices (or value, as you prefer), the substitution between the underlying and the future is not perfect and there can be a preference toward futures. This hypothesis is coherent with the model, which needs substitution, but not a perfect one.

These factual observations of the derivatives phenomenon, and some theoretical analyses confirm that their impact on market is not equal to zero. Von Hagen and Fender (1998) and Vrolijk (1997) observe that derivatives make financial markets more perfect, in the sense that monetary policy cannot any more use the surprise effect for its manoeuvres. These findings are clearly against a zero-sum game macroeconomic theory of derivatives; to be more precise, we can say that derivatives are zero sum games *ex post* but not *ex ante*, since they are used to reach specific goals, which are not achievable using combinations of underlying assets; the consciousness of derivatives'

3 Cf. Swan, 1999, page 45.

4 The Dow Jones Industrial Average Index growth rate has been equal to -21% in 2003, while equity linked OTC grew at 20%.

impact on financial markets by central banks is recent[5], and contributes to underline the importance of the phenomenon.

In the recent literature on derivatives[6] effects on money markets and policy no single conclusion can be taken as general and unique, since moving from a country to another regime, goals and regulation change dramatically so that the analysis and results can be strongly influenced by the environment. Some assert that derivatives increase risks (systemic and not) while others, generalising micro results of better allocation (and then less differentiable risk), sustain the opposite[7]. We know much about microeconomics of derivatives while a lot should be done at a macro level. From a microeconomic point of view the efficiency of derivatives markets is taken as given (lower bid-ask spread, lower noise on market, lower variances of prices of underlying, higher liquidity, better allocation of wealth given more investment combinations possible). At a macroeconomic level, results are difficult to generalise and most has been done on a single country basis. Moreover, the idea that derivatives are zero sum game has probably impeded a more comprehensive approach, taking for granted that they have zero effect, at an aggregate level, on the economy. This model moves from these hypotheses and tries to add a new perspective to the financial and monetary literature. The income tax incentive of derivatives and hedging activity will not be considered since they depend on country specific rules and cannot be generalised.

5 Cf. A. Greenspan speech at Jackson Hole, August 2003.

6 Angeloni and Massa, 1998; Banca d'Italia, 1995; Fender 2000; Gorton and Rosen, 1995; von Hagen and Fender, 1998; Hooyman, 1993; Hunter and Marshall, 1999; Hunter and Smith 2002; Oldani, 2004; Piga, 2001; Savona et al, 2000; Tinsley, 1998; Vrolijk, 1997.

7 The Group of Thirty settled a study group chaired by Paul Volcker, former chairman of the US Federal Reserve, which reached the general agreement over the fact that derivatives do not add new risks, but can exacerbate the existing.

4 DEFINITION OF MONEY, CHARACTERISTICS, AND MAIN DIFFERENCES WITH THE G&L MODEL

The asset x_1, which is the most liquid and less profitable of all, has a coefficient of consumption technology equal or close to one (i.e. $b_{11}=1$, perfect liquidity and lowest profitability in the portfolio) can be defined as a mean of payment in the economic system, and a liquid asset yielding very low return and very low risk. The combination of characteristics gives rise to demand of this liquid asset in the short run. Money is not a risk-less asset, but can be considered as an highly liquid asset with a (low) risk profile. Then, we can say that money in practice takes not the form of cash or coin, but of various means of payments (e.g. credit or debit cards, bank deposits), and exhibits a length of time different from zero to be transformed into cash. Moving back to traditional definitions of money, we can accept the functional definition, i.e. money is made of all instruments accepted by central banks for reserve requirements (Fazio, 1968). Money is then the most liquid, but risky, mean of payment in the economic system and this is the main difference with Cash In Advance (CIA) and Money In the Utility function (MIU) models. Moreover, this definition of money based on asset pricing concepts is coherent with general equilibrium models and can be considered as similar to an overlapping generations hypothesis[8].

The risk of money can be approximated by the exchange or the inflation rate risk, which together or singularly, make money an uncertain yielding asset; money can then be thought as deposits, which can suffer of depreciation over time because of inflation. Money cannot be considered a risk-less asset or a zero return asset, but has the higher liquidity possible in portfolio; liquidity in our model can be defined as the time necessary to convert the asset into cash given the cost of this transaction; the higher the time it takes to convert and the higher the cost, the lower liquidity the asset shows. Bank deposits are highly liquid while 10 years corporate bonds can be considered as exhibiting very low liquidity. The length of time necessary to convert bonds has a risk component, but in our model is proportional to the probability of default of the (issuer of the) asset and is positively related to potential profitability. The default risk can be considered also as the probability for derivatives to go out-of-the-money (i.e. yielding a negative or null return).

In the following paragraphs we will use financial equivalences to show how it is possible to invest, given wealth and income, in futures or in the

8 For further analysis see Walsh, 1998 and Blanchard and Fisher, 1989.

corresponding equivalent underlying, which has the same value, but not the same combination of characteristics (b_{ij}*>b_{ij}), so that we can think of portfolio dominance (starting from financial equivalences). Futures differ from the corresponding underlying because of the leverage effect; moreover, some futures are more liquid than the corresponding underlying and show a lower cost of investment (stock index futures or other financial instruments, like basket of bonds-shares are not much liquid or not traded in that form, while their future contract is liquid and cheap). Since costs (and then profits) of the two investments are not the same, although they are equivalent in terms of prices (or value, as you prefer), the substitution between the underlying and the future is not perfect and there is a preference toward futures. This hypothesis is coherent with the model, which need substitution but not a perfect one.

Main developments of the present model starting from the original application of the Lancaster function of G&L, can be summarised as:

- futures are not only new asset emerging on the market, but also more efficient;
- leverage effect and being off-balance induces a high preference toward futures;
- underlying asset markets can be offset by futures markets, changing the interest rate elasticity of money demand;
- money demand can be, at the limit, zero if markets are efficient and there are no cash-reserve requirement.

5 THE MODIFIED MODEL OF PORTFOLIO ALLOCATION: ASSESSING THE ROLE OF FUTURES

The LGL model can be modified to include this different asset, which, as said before, might change the way the market clears. Given the 5 propositions stated by G&L, we can say that futures can be considered as a new dominating asset emerging on the market. Futures have the leverage, lower costs of investments[9], the same (or even higher) liquidity[10], and show similar return of traditional investments, after controlling for volatility and risks (as for any other financial asset); these characteristics help explain their enormous growth on the market. Since the consumption technology coefficient (b_{ij}) represents the amount of characteristic *i* in a dollar's worth of asset *j*, derivatives show b_{ij}*>b_{ij}; they can replace the former (underlying) asset giving more of the characteristics *i* (liquidity, profitability-risk) for every dollar of asset *j*.

The choice of investors to include a new asset into the portfolio is based on the better liquidity-profitability combination achievable including the new asset and excluding the old one. If futures show to have the same liquidity, but lower costs (i.e. higher potential profits) and similar risks and returns, then their dominance with respect to traditional financial assets should be straightforward (b_{ij}*>b_{ij}). This substitution has been discussed in the next sub-paragraph using financial equivalencies.

Now, the problem is which group of assets futures dominate. If I can find one portfolio combination including the innovation, which gives a higher return and the same liquidity, I can show the dominance with respect to the old asset and with the neighbour, going further with respect to the original LGL model of substitution.

Let's start with exchange-traded futures and use a functional definition of money, i.e. money is made of all instruments accepted by central banks for reserve requirements (Fazio, 1968); this definition, although dependent to the reserve system introduced in the '70s can be easily applied to the reserve ratio system, which is the current system of monetary management and monitoring. Central banks do not accept derivatives (of any kind) as a collateral to close positions and for reserve requirements, so that we can fairly say that futures do not behave like x_1 in the strict sense (using money aggregate, they are not

9 They are represented by margins (initial and maintenance), which are a small percentage of the price (or notional value) and are the base of the leverage effect of derivatives (cf. Hull, 2002).

10 High liquidity is provided by low trading costs associated with smaller bid-ask spread; liquidity depends also on the frequency of price quotes.

M1[11]); this implies also that x_1 cannot disappear from the market and that $b_{11}=1$. Futures, however, can dominate x_2 and x_3 in various forms. The way to extend further the LGL model and demonstrate the dominance of futures, with respect to the former and the neighbouring asset(s), is to use financial equivalencies. Futures can be considered as substitute of the traditional asset at the beginning. The next step is to look at crowding out effect and to effects on money demand.

5.1 Financial Equivalence of Futures in Portfolio

Basic assumptions of our financial market are that we are in a Arrow-Debreu world; there exists a risk-less bond paying a return as a basic financial asset, and profitability is a characteristic of portfolio (i.e. other assets which can be bought and sold show positive risk, but higher return than the risk-less bond).

Given that a bond *B* pays a risk-less return *r*, which is constant over time, the price of the bond default-free pure discount paying 1$ at time *T* will be[12]:

$$B(t,\ T) = e^{-r(T-t)} \tag{5.1}$$

The no arbitrage condition holds so that the above relationship is a restriction; if the interest rate the bond pays is not constant (i.e. stochastic in discrete or continuous time) the relationship will be a little bit more complicated in its representation, but not in the interpretation. We stay with the constant rate over time in order to maintain a simple notation[13].

The equivalent financial strategy of the purchase of the bond is made looking at the same (final) payoff at time *T* (expiry date); buying $e^{-r(T-t)}$$ of the risk-less saving account ($) at *t*, and at *T* will receive 1$. Or buying a T-maturity bond and paying *B(t,T)*$ at time *t*; this investment will give 1$ at time T.

A future contract price (F_t) set at time *t* on an interest rate (r_t), under deterministic and constant spot risk free rate (*r*), risk neutral probability ($\tilde{p}$) and no arbitrage condition, can be described as:

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11 A different definition of money (and money base) can have various effects on the analysis; we do not accept or reject any of the different definitions stated in the literature and remember to the reader the debate, which arose in the ‘70s about off-shore money.

12 Hull (2002) shows how to move from discrete to continuous time simplifying the algebra.

13 Our conclusions should not be influenced by this assumption, since we deal with profitability and liquidity.

$$F_t = E_t^{\tilde{p}}\left[r_t\right] \tag{5.2}$$

if the price of opening the position is zero (no initial margin required), then the value of the contract is zero[14].

By applying this financial equivalency, we can say that buying a bond which pays a constant interest rate r at T, or buying a future is financially equivalent in terms of (potential) profits in an ideal Black and Scholes world, where a risk-less asset exists; but the leverage effects futures can provide can induce a preference toward them; then, using proposition 1, 2 and 3 of LGL:

a. *Fo_t (future on bond) can be preferred by investors*.

   Future requires an initial margin to be paid to the Clearing House, which is proportional to the nominal value, but less then 100% of the (underlying) bond price necessary to enter the spot market at time t.

   If B_t in our LGL portfolio utility model is considered as x_3, a profitable asset but not much liquid, the future contract is a more efficient substitute in portfolio[15]; it follows that:

b. *x_3* (future on bond) dominates its equivalent investment x_3 (the underlying bond) in terms of characteristics of portfolio choice (see graph 1 in the appendix).*

   Using financial equivalencies, we know that buying the bond is financially equivalent to buying $e^{-r(T-t)}$\$ of the risk-less saving account (\$) and at T will receive 1 (\$); payoffs at expiry date (T) are both 1\$ with same liquidity, but with different probability of default (bond incorporates a higher risk than saving account).

c. *If the saving account is x_2, we can say that x_3* can be built as having the same liquidity of x_2 but higher risk (potential profitability)[16] (see graph 2).*

   Using proposition 4 and 5 of G&L we can state that derivatives dominate portfolio substitutes (traditional underlying assets) and this can influence the demand for money (x_1) by wealth holders as a residual. We can then modify proposition 5 and maintain its general results so that:

   Prop. 5 bis if $dx_1=\mu dp_2$, and $\mu>0$, then the relative change in the demand for the money ($\partial x_1/\partial p_2^*$) following a change in the price of the more

14 Introducing positive costs of opening a position is very easy algebraically and imposes that the equation 5.1 is no longer equality, making the value of the future higher.

15 Forward contracts are OTC and then are not directly comparable to bonds in terms of regulation and transparency; this is why we consider exchange-traded futures.

16 See Barone (2004) for the complete discussion of derivatives and portfolio replication.

profitable asset (p^*_2) i. increases as μ decreases; ii. switches sign as μ approach some definite values. These results are discussed in details in the following paragraph.

5.2 Allocation Process with Futures Given Financial Equivalencies

Futures' markets can be considered, at the beginning, as good substitutes of x_3, more efficient[17] than the traditional underlying and showing lower costs of investment. An investment on futures (on a share or bond) is equivalent to an investment in saving account or the underlying asset itself[18], so that we can discuss the properties of futures with respect to the portfolio model:

1. liquidity of futures markets is the same, and in some cases higher, than the underlying traditional asset markets;
2. risk-profitability of futures is higher thanks to the leverage.

Sub. 1 Liquidity of futures markets is higher for those assets, which have not an underlying market, like stock or commodity indexes or heart-quake and natural disasters bonds. In the financial literature there are many evidences of future contracts that, *ceteris paribus*, have a higher liquidity than the underlying (x_3) and then can be considered to be liquid[19].

Sub. 2 The leverage effect of futures is dependent on the margins system[20] and gives the investor the possibility to obtain a higher exposure on markets than with the underlying. Potential profitability (and potential losses) of futures is higher than that of the underlying as a result and then risk lovers should prefer futures[21]. If you buy a future on share with strike price 120, initial margins 5, and spot price 100, supposing the interest rate and maintenance margins are zero, and a wealth of 100 to invest, then you can chose to buy one share in the spot market and spend 100, or buy one future, spending 5 and investing 95 in the alternative asset, e.g. a sight deposit, which actually gives almost no return. At the expiry date, if the share is priced at 120, you earn 20

17 The efficiency is given by those properties, which made these markets very attractive for investors (lower bid-ask spread, high liquidity, lower information asymmetry, low variance of prices, good price discovery).

18 Cf. Hull, 2002.

19 See Shastri *et al*, 1996.

20 The leverage is the highest possible if the margin is equal to zero.

21 Risk neutral investor will not have *ex ante* any special preference, while risk averse should prefer options instead of futures to hedge.

with the spot investment and 20 with the future[22], but if the profit is relative to effective wealth invested in that market, with the spot market you earn 20%, while with the future you earn 400% (invest 5 and get 20!). Losses can occur and be highly leveraged too.

Using G&L propositions 1, 2, 3, and 4 futures are dominating assets on the market (x^*_3) and provide better characteristics' combinations to investors. Going further with G&L model, we can introduce a future on x_2, i.e. a substitute, x_2*, which has, again, leverage, higher liquidity than the traditional investment and better profitability (and risk).

$$x_3^* = x_2^* \qquad (5.3)$$

We can use the financial equivalence argument to show that the liquid asset, like the savings account, can be replicated by futures so that the application of proposition 5 of G&L can be deeper and have various effect on money demand analysis. In G&L model money is considered as $M=(x_1+x_2)$ and calculated by using US weighted monetary indexes on M2 (Barnett, 1997). Now, we are departing and looking at how x_2 can be replicated and then cannot be considered any longer as part of money, moreover if it is defined as instrumental. We can go further and think of x_1 as weighted money (M1), which is consistent with functional definition of money given before.

We observe that since x_3^* is dominating x_3, it actually disappears from the portfolio, and if we use again financial equivalences to show that x_3^* is financially equivalent to x_2^*, geometrically speaking they can be represented with the same vector in the characteristics space (liquidity, risk-profitability); it is not the dominance of x_2^* on x_3^*, but the financial equivalence, which implies that the elementary portfolio can be represented with only two assets: innovation ($x_2^*=x_3^*$) and money (x_1) (see graph 3).

The model collapses to a 2X2 system (x_1, x_2^*).The B matrix becomes:

$$\begin{aligned} b_{11} = 1, b_{12} < b_{11} \\ b_{21} > 0, b_{21} < b_{22} \end{aligned} \qquad (5.4)$$

and the vector of price becomes:

$$P=[1,p^*_2]$$

22 This is true with any kind of exercise (delivery, cash settlement, roll-over).

The market demands are[23]:

$$x_1 = \frac{1}{2}\frac{(p^*{}_2 b_{11} - b_{12})(p^*{}_2 b_{21} + b_{22})}{p^*{}_2 (b_{11}b_{22} - b_{12}b_{21})} \tag{5.5}$$

$$x_2{*} = \frac{1}{2}\frac{(b_{22} - p_2{}^* b_{12})(b_{12} + p^*{}_2 b_{11})}{p^{*2}{}_2 (b_{11}b_{22} - b_{12}b_{21})} \tag{5.6}$$

Then I need to find only the demand for money (*x_1*) in order to find, as a residual, the demand of the other assets (*x_2**), given savings.

The relative change of the demand of *x_1* with respect to a change in the alternative asset return (*p^*_2*) can be found by simply deriving the demand function with respect to the price of the new asset (*p^*_2*) and can be expressed as:

$$\frac{\partial x_1}{\partial p_2^*} = \frac{1}{2}\left(\frac{p_2^* b_{11} b_{21} - \frac{1}{p_2^*} b_{12} b_{22}}{p_2^* (b_{11}b_{22} - b_{12}b_{21})}\right) \tag{5.7}$$

The relative change of *x_1* represents the reaction of the market to the new asset price change ($\partial p_2^*>0$); the algebraic sign of the relative change in money asset in response to a (positive) change in the return of the alternative asset should be negative (i.e. negative interest rate elasticity). Given that *$p_2^*>0$*, and $b_{11}b_{21} > b_{12}b_{22}$ the numerator of 5.7 is greater than zero, while the sign of the denominator is not clear *ex ante*. The denominator should give the negativity to the ratio, and then should be $b_{11}b_{22} < b_{12}b_{21}$. But if the innovation has more of both characteristics, i.e. *$b_{i2}>b_{i1}$*, then 5.7 has an uncertain algebraic sign. The economic theory tells us that the change in the demand for money ($\partial x_1=\mu\partial p_2$) following the substitute asset return' increase should be negative, but this results can be radically modified by portfolio allocation, which can switch the sign and obtain a positive interest rate elasticity.

By substituting $\partial x_1=\mu\partial p_2$ into 5.7 we obtain:

$$\mu = \frac{1}{2}\frac{(b_{11}b_{21} - \frac{1}{p_2^{*2}} b_{12}b_{22})}{(b_{11}b_{22} - b_{12}b_{21})}$$

23 Market demands can be found by simply imposing that the third asset has zero of all characteristics (any b_{ij} with i,j=3 is zero since it is dominated).

and

3. μ increases if $(b_{11}b_{22}-b_{12}b_{21})$ decreases

4. μ increases if $b_{11}b_{21} \succ \frac{1}{p_2^{*2}} b_{12}b_{22}$ which means that the characteristic mix of money is greater than the (weighted) characteristic mix of the other asset (future).

Moreover, observing 5.7 and its economic meaning, we reach:

Prop. 6 If $b_{11}b_{22}>b_{12}b_{21}$, $b_{11}=1$ (maximum liquidity of money) meaning that the profitability of the innovation (b_{22}) is greater (in the sense that its weight in the portfolio allocation is greater) than the product between the liquidity of innovation (b_{12}) and the return of money (b_{21}), then the interest rate elasticity of money is positive. This is a straight result of money as an asset of portfolio.

This intuition, sustained by a simple modification of the LGL portfolio utility model, should be supported by some empirical evidences. Money demand in the last years has lowered in its transaction (liquidity) component (M1 shows a high volatility in the US) thus enhancing the asset function of money and confirming the changing preferences of investors. The difficulties in finding a closed form of preference coefficients to have the expected result (negative interest rate elasticity) is the confirmation of changing markets and behaviour.

Our problem becomes to find a unique price (p^*_2) and 4 coefficients of substitution (b_{11}, b_{12}, b_{21} and b_{22}), given liquidity preference of wealth holders' α, liquidity of assets τ, and risk σ, for the entire economy-market. The liquidity preference of wealth holders (α) can be considered as the percentage of wealth in the form of money and coins; the liquidity degree of assets τ can be represented by its duration (the shorter, the most liquid), and the risk attitude σ can be represented by the volatility of price. The coefficient b_{11} incorporates the liquidity characteristic of the first asset and it should be maximum, i.e. equal to one, if it were cash, but since we have defined money as bringing some (low) risk, we should expect b_{11} to be less than one empirically. The coefficient b_{12} can move from one to zero depending on how much liquid is the asset two. The risk-profit profile of futures (b_{22}) has a value, which depends on the needs and preferences of the investor; if he needs additional means of financing the coefficient is different form zero and moves to one.

We can state that financial innovation can be a good store of value but not a perfect mean of payment, so that money (x_1) is not going to disappear from the portfolio. This has an important effect for monetary policy analysis; the money multiplier, which showed up instability during the last twenty years, is not going to become infinite, as stated by some observing that its coefficients were closed to zero[24]. The effect of futures is then to change the weapons of monetary policy and of market players, but not to play a different game.

6 EMPIRICAL SPECIFICATION OF THE MODEL

The portfolio utility model developed in the previous paragraphs can be synthesise by its 3 main equations:

$$x_1 = \frac{1}{2}\frac{(p^*{}_2 b_{11} - b_{12})(p^*{}_2 b_{21} + b_{22})}{p^*{}_2 (b_{11}b_{22} - b_{12}b_{21})} \tag{6.1}$$

$$x_2{*} = \frac{1}{2}\frac{(b_{22} - p_2{}^* b_{12})(b_{12} + p^*{}_2 b_{11})}{p^{*2}{}_2 (b_{11}b_{22} - b_{12}b_{21})} \tag{6.2}$$

$$\frac{\partial x_1}{\partial p_2^*} = \frac{1}{2}\left(\frac{p_2^* b_{11}b_{21} - \frac{1}{p_2^*} b_{12}b_{22}}{p_2^*(b_{11}b_{22} - b_{12}b_{21})}\right) \tag{6.3}$$

Equations are respectively representing money demand (6.1), futures demand (6.2), and the relative effect of a change in money demand following a change in the return of the alternative asset in portfolio (6.3). Supposing income is uniformly distributed, and the representative agent exists, since we know that W=S+M, and $M=x_1$, x_1 can be approximated by the money aggregate M1, then given savings (*S*) we can find as a residual wealth of the country (*W*), and finally the characteristic mix of portfolio. At a cross section level it could be possible to statistically obtain the values of the *B* matrix for a certain country at a fixed moment of time. Using static variables we avoid the problem of the supply of assets, which is unknown and not defined.

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24 A simple formulation of the multiplier is DEP=(1/α+β+γ)MB; where DEP is deposit, MB is money base and the three coefficients represent the liquidity attitude of banks (γ) and firms (α), and the compulsory reserve coefficient (β), which is going to be replaced by reserve and capital ratios.

Given our simplified model: $S = \sum p_j x_j$, j=1,2, Z=BX, $z_1 = (s/p_1)[b_{11}, b_{21}]$, $z_2 = (s/p_2)[b_{12}, b_{22}]$ and $U(Z) = \tau^{\alpha}\sigma^{1-\alpha}$. The maximisation of utility is however a time series problem since the portfolio allocation is optimal only following some time dependent criteria (on variance, liquidity and risk); we will start with a static analysis of coefficients to check if the model makes sense in a time-less world.

First step is to use equivalencies (*W=S+M*), a proxy of p_1 and z_1, impose $b_{11}=1$ and then find b_{21}. Second step is to look for b_{12}, b_{22} in the same way, and finally check if *W=M+S* is consistent with *S=PX*, which is an indirect method to check for model completeness[25].

This has been done by looking for a year in which data were all available and coherent with the model, 2001; all data are expressed in billion US$, except those referring to futures markets. During 2001 portfolio's shifts and adjustments were taking place since the stock price bubble has been "burst" by the Federal Reserve trough interest rate manoeuvres; in that period preference toward liquidity (i.e. money) should have increased and should be far away from zero, so that the hypothesis that $b_{11}=1$ is not meaningless. Data come from Thomson Financial Datastream and are yearly, except for the Monetary Services Index M1, which is regularly supplied by the Federal Reserve of St. Louis. The price of money (p_1) is given by the log of the Federal Fund rate; z_1 is given by the stock of monetary services index, seasonally adjusted (MSI_M1), and b_{11} is equal to one. We have $z_1 = (s/p_1)[b_{11}, b_{21}]$ which substituting, gives:

$$74.94=(166855.60/0.634729108)[1,b_{21}]$$

and find that $b_{21}=0.000287$, which represents the profitability (or risk) of money (MSI_M1) and is, coherently with the model, very low but not zero. During 2001 the Federal Reserve has increased the Federal Fund rate in order to decrease stock prices, so that we suppose that looking at 1999, for example, when stock prices were rising, the value of b_{21} would be smaller.

z_2 is given by the substitute and more efficient asset (the future) and is chosen as one of the most representative of the US financial market[26]: the open interest of the future on Dow Jones Industrial Average (DJIA); the open interest represents the demand of the asset by investors. p_2 is given by the settlement price of the above-mentioned future contract.

We have $z_2 = (s/p_2)[b_{12}, b_{22}]$ which, after substitution, becomes $34052=(166855.60/10945)[b_{12}, b_{22}]$ such that $2249.883=[b_{12}, b_{22}]$

25 All data are reported in Table 2 for completeness.

26 Other representative assets have been used to check, but provide less intelligible results.

the algebraic linear problem is that we end up with a combination of the two coefficients and not with single coefficients' value.

We know that $b_{22}>b_{21}(=0.000287)$ and we can say that: $b_{22}>0.000287$, and $b_{12}<b_{11}(=1)$, $b_{12}<1$. Substituting the values of parameters we have into equation 6.3:

$$\frac{\partial x_1}{\partial p_2^*}=\frac{1}{2}\left(\frac{p_2^* b_{11}b_{21}-\frac{1}{p_2^*}b_{12}b_{22}}{p_2^*(b_{11}b_{22}-b_{12}b_{21})}\right)=\frac{1}{2}\left(\frac{10945*0.000287-(1/10945)2249.883}{10945(b_{22}-(0.000287*2249.883/b_{22}))}\right)$$

$$\frac{\partial x_1}{\partial p_2^*}=2.935652\,\frac{1}{(10945b_{22}-1453.5279/b_{22})}$$

We can discuss the value of the interest rate elasticity in US, which depends on the profitability-risk of the asset 2 (the future), b_{22}. Imposing the negativity to equation 6.3 (interest rate elasticity) we end up with ${b_{22}}^2 \leq 0.13280291$so that $b_{22}\leq \pm 0.36442134$and from the numerator $b_{22}\leq 0$. Algebraically, the compatible solution to the function can be negative too ($b_{22}\leq -0.36442134$), but this would imply that the future has negative risk-profitability. This result is not acceptable given the definition we gave of the characteristic; the negativity of b_{22} is only a mathematical problem, not an economic and we need to impose the positive values of coefficient(s) in order not to end with funny results. Our solution is that the maximum profitability of the future should be less than one and greater than 0.36442134, and its demand can be compatible with high risk ($b_{22}=1$).

This exercise should be taken as a simple check for general completeness and meaning of the model, and not as looking for THE value of risk preference toward futures; in synthesis, our empirical approach is close in its aim to that of Mehra and Prescott (1985), which gave rise to the well known equity premium puzzle. They tried to compute the risk aversion parameter for the US, starting from stock exchange data and get very funny results. We are underlining the fact that finance is full of puzzles, if simply rejecting (or modifying) the hypothesis of perfect markets (or information or rationality) and accepting financial frictions, like (imperfect) substitution in portfolio.

The values of parameters (b_{ij}), which come out from this simple exercise for the US economy are coherent with the model presented; equations used are:

$B = \begin{matrix} 1 & b_{12} \\ 0.000287 & b_{22} \end{matrix}$, W=M+S, $S = \sum p_j x_j$, Z=BX $z_1 = (s/p_1)[b_{11}, b_{21}]$, $z_2 = (s/p_2)[b_{12}, b_{22}]$ and values are given in the following table. In order to find the demand of assets, we can use ($S = \sum p_j x_j$):

$$166855.6 = 0.634729108 x_1 + 10945 x_2$$

To derive the complete set of values and parameters we need to know more about the demand for money (*x₁*) and futures (*x₂*), but we need to solve the problem of equilibrium between demand and supply before doing that. Specifically, the supply of futures, which represents one asset out of two for the representative investor, is not given; we know only the demand side (open interest) and the price(s) (settlement, opening, average, etc.), which come from (some of) the market(s). It is not possible to close the model and define equilibrium in the futures market. Given the impossibility to describe the equilibrium in the future market (x_2) we cannot check for model internal completeness ($S = \sum p_j x_j$) and then we cannot move to the dynamic utility maximisation problem ($U(Z) = \tau^{\alpha}\sigma^{1-\alpha}$). The lack of data is the main obstacle to an organic analysis of portfolio allocation process.

We have already mentioned the fact that the utility function, $U(Z) = \tau^{\alpha}\sigma^{1-\alpha}$, is time dependent; α depends on liquidity preference, which is a function of wealth and of its behaviour over time. σ is a function of prices which change over time, since markets are not perfect and the equity premium and risk free rate puzzles are there and alive. For τ same arguments hold. Another complication would be tax incentive, which can modify basic equivalencies, like the put call parity or the price discovery and matching prices properties, as shown by Warren (2004) for options, but this feature is country specific and then cannot be generalised and applied to our model.

This model is useful only without any time dimension and dynamic, which implies the very simple specification and the impossibility of finding a closed form solution to the maximisation problem given available data and variables.

7 CONCLUSION

The micro-funded model of portfolio allocation is based on main simplified assumptions: homogeneous investors, 3 assets world, characteristics basing on which investors choose are liquidity and risk-profitability, exists risk-free bond and rate, risk neutral probability, money is an asset in portfolio (no cashless economy), the characteristic mix each investor receives (z_j) is sensitive to relative price (p_j) and the consumption technology coefficients (b_{ij}), futures are not only new asset emerging on the market, but also more efficient; the leverage effect and being off-balance induces a high preference toward futures in portfolio, given financial equivalences; underlying asset markets can be offset by futures markets, influencing the interest rate elasticity of money demand; money demand can be, at the limit, zero if markets are efficient.

The key parameter of the LGL model applied to futures is:

$$\mu = \frac{1}{2}\frac{(b_{11}b_{22} - \frac{1}{p_2^{*2}} b_{12}b_{21})}{(b_{11}b_{22} - b_{12}b_{21})}$$

and we can briefly say that the elasticity of money demand (μ), approximated by monetary services index (x_1), following a change in the alternative asset price change (p^*_2), the future,

1. (μ) increases if $(b_{11}b_{22} - b_{12}b_{21})$ decreases
2. (μ) increases if $b_{11}b_{21} \succ \frac{1}{p_2^{*2}} b_{12}b_{22}$

which means that the characteristic mix of money is greater than the (weighted) characteristic mix of the other asset (future).

Prop. 6 if $b_{11}b_{22}>b_{12}b_{21}$, $b_{11}=1$ (maximum liquidity of money) meaning that the profitability of the innovation (b_{22}) is greater (in the sense that its weight in the portfolio allocation is greater) than the product between the liquidity of innovation (b_{12}) and the return of money (b_{21}), then the interest rate elasticity of money is positive. This is a straight result of money as an asset of portfolio.

The substitution effect of financial innovation has been analysed using a consumer micro-founded theory; money is an asset in portfolio of investors and its demand is influenced by the emergence of other assets (x_j*) in the markets, which can 1. dominate the former asset, 2. offset the neighbouring asset, giving raise to a better portfolio allocation in terms of risk, liquidity and profitability (i.e. crowding out), 3. lowers the number of assets needed to obtain a specified allocation. Futures can be used to replicate every traditional asset, but with a high(er) leverage, liquidity and risk-profitability combinations, so that traditional asset can be offset by innovation. Leverage effect and being off-balance induces a preference toward futures so that underlying asset markets can be offset by futures markets, changing the interest rate elasticity of money demand. We can lower the dimension of the model to a 2X2, with money (x_1) and innovation ($x_2^*=x_3^*$), which replicates every other asset and obtain high utility, since we end up with better combinations of both characteristics. Money demand can be, at the limit, zero if markets are efficient and there are no reserve requirements.

The objection that future on DJIA is a mere replication of the underlying asset and in the money demand function we should include that asset instead of the future, can be overcome by observing that the financial (and mathematics) equivalences holds in terms of value, but not of basic portfolio characteristics; leverage, liquidity and risk-profitability of futures are different from that of the underlying.

The role of exchange traded and OTC futures is complex and a special attention should be given to financial crowding out effect; since OTC futures-forward are off-balance sheet items for banks and firms, not influencing the rating and the ability of raising funds, they could dominate the former asset, offset the neighbour, and offset the need of money, if there are no cash constraints or reserve requirements. Exchange traded futures have higher level of both characteristics, although we cannot refer to crowding out but only to efficiency gain.

The introduction and application, starting from 2005, of the International Accounting Standard n. 39, which imposes the accounting into the balance sheet of futures using the fair value measure, will have two possible effects. First banks and firms will start managing futures investments like the others, and then will have to diminish derivatives trading, or as a second, and we think most probable solution, will give a further push toward new types of "derivatives" having the necessary characteristics of costs and liquidity, which are not directly included in the strict definitions of the IAS 39 and then can be still treated as off-balance. The innovation process of markets will not stop because of some "sand in the wheel", to use Alan Greenspan's words slightly changed, and no way profits of banks and alternative financing means for firms will disappear on the first of January 2005.

The crowding out effect has never been highlighted in the recent literature and confirms the importance, if there were the need, of the Modigliani-Miller principles in corporate finance. Recent crises and bankrupts, which hit European and American financial and banking systems, represent ringing bells of the danger of risk mismanagement in modern financial markets.

These results are contributions to monetary theory considering portfolio allocation, and depart from traditional literature in terms of approach (characteristics of assets and not simply price equivalencies; weighting portfolios and allocation; trying to overcome the economic dichotomy; money as an asset) and results. Conclusions, however, are not different from MIU or CIA models, since money is still an asset necessary to be hold in portfolio because of an *a priori* hypothesis; if we remove that, money can be substituted, replicated and suddenly disappears from portfolio (cash-less economy), since it can be less efficient in terms of characteristics. Money is, again, a veil but its presence or absence does not induce zero interest rates at equilibrium. From this last point of view we can link this model based on characteristic with the overlapping generations model, we were close at the beginning of the model discussion.

APPENDIX: THE LANCASTER-GLENNON-LANE MODEL

The model of consumption demand and allocation set by Lancaster (1971 and 1991) and applied to portfolio theory and money demand analysis by Glennon and Lane (G&L, 1996) can be briefly described as follows. Notation and conclusion are taken from G&L. I will apply the model to futures and underline differences with authors.

The starting utility function of portfolio can be described with a Cobb-Douglas aggregate functional form:

$$U(Z) = \tau^{\alpha} \sigma^{1-\alpha} \qquad \text{(A.1)}$$

where τ is the liquidity of asset, σ is the profitability of asset[27], and α is the liquidity preference of wealth holders (average value)[28].

The general constrained maximization problem can be described as:

$$\text{Max } U(Z) \text{ subject to } Z \in K \qquad \text{(A.2)}$$

where K is the feasible set of characteristics obtainable from holding various combination of assets.

The characteristic space is linked with the asset space according to the following:

$$z_j = (s/p_j)[b_{1j}, b_{2j}] \qquad \text{(A.3)}$$

In this way the characteristic mix each investor receives is sensitive to relative price (p_j) and the consumption technology coefficients (b_{ij}); the consumption technology coefficient represents how much of the characteristic *i* is present in a dollar's worth of asset j.

Demand for money decision follows after savings allocation; wealth (*W*) can be defined as the sum of money (*M*) and savings (*S*).

$$W=S+M \qquad \text{(A.4)}$$

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27 We can think of profitability as being positively correlated with risk under general assumptions, but it is not always true.

28 The original micro-founded model had a α varying for each i-investor; imposing that income is uniformly distributed over i-investors, and supposing an average α exists, lets possible to write an aggregate function.

To simplify the analysis, there exists only 3 assets to be hold in portfolio, $\exists x_1,x_2,x_3$, in order of decreasing liquidity and increasing risk (and then potential profitability). We can say that x_1 is made of cash assets, i.e. money[29].

Each x_j's asset forms a group of financial assets within which substitution is efficient, but not necessarily perfect. The allocation process is set in a risk-averse context (i.e. low risk is preferred to high) and this implies that substitution in each x_j group is efficient but not necessarily perfect. Higher σ means higher profitability and then lower preference in the same group.

Vector of prices *P* of assets is non-negative and x_1 represents money (*M*); so that the portfolio identity (4) becomes:

$$S=\sum p_j x_j \text{ and } j=1,2,3 \quad (A.5)$$

The technical relationship between assets (X) and characteristics (B) is given by:

$$Z=BX \quad (A.6)$$

and B is the consumption technology 2X3 matrix, under conditions:

$$b_{11}=1,\ b_{12}<b_{11},\ b_{13}<b_{12}\ (b_{13}>0) \quad (A.7)$$
$$b_{21}>0,\ b_{21}<b_{22},\ b_{22}<b_{23}\ (b_{23}<1)$$

Glennon and Lane make no special hypothesis on the behaviour and justification of money ($M=x_1$) into the portfolio allocation function except that x_1 is the asset, which can be considered as closer to money, using liquidity and profitability as characteristics. They, moreover, did not give a special definition of liquidity and profitability, and this can somehow be confusing.

Normalising savings (*S*) to one in (4), the price vector that solves the system is:

$$P=[1,p_2,1] \quad (A.8)$$

Solving for each asset *x*, we can find the market demand functions:

$$x_1=\frac{1}{2}\frac{(p_2b_{11}-b_{12})(p_2b_{21}+b_{22})}{p_2(b_{11}b_{22}-b_{12}b_{21})} \quad (A.9)$$

$$x_2=\frac{1}{2}\frac{(b_{22}-p_2b_{21})(b_{12}+p_2b_{11})}{p^2{}_2(b_{11}b_{22}-b_{12}b_{21})}-\frac{p_2(b_{23}-b_{22})(b_{12}+p_2b_{13})}{p^2{}_2(b_{23}b_{12}-b_{13}b_{22})} \quad (A.10)$$

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[29] This means that if the interest rate increases money demand decreases, and if income increases money demand increases too.

$$x_3 = \frac{1}{2}\frac{(p_2 b_{23} - b_{22})(b_{12} + p_2 b_{13})}{p_2(b_{23}b_{12} - b_{13}b_{22})} \quad \text{(A.11)}$$

Demand of each asset depends on wealth holders' efficiency (i.e. substitution coefficient) (b_j) and on relative price of the neighbour (p_i, in this case only p_2) (see graph 1 in the appendix).

G&L showed 5 propositions on the process of deregulation and then introduction of new assets on the market, which can be substitute of the x_j with the same b or can dominate the former asset and neighbour (have a higher b and then are preferred). In the second case the efficient frontier not only shifts but also changes its slope.

The five propositions stated by G&L are:

1. the emergence of x_2 as an efficient asset unambiguously decreases the aggregate holdings of assets within a circle of substitution of x_2;
2. if a new asset x_2* emerges on the market, and it dominates x_2, then the impact on the demand for x_1 (the neighbouring asset) is such that: i. If b_{12}*> b_{12} and b_{22}*> b_{22} then dx1<0; ii. If b_{12}*<b_{12} and b_{22}*> b_{22} then d x_1>0, dx_1<0;
3. an increase in the relative price of the asset x_i increases the demand for those assets within a circle of substitution with x_i;
4. the demand for x_i is more sensitive to a change in the price of its neighbour (x_j), the closer are x_i and x_j in terms of characteristics;
5. if $dp_2=\mu dp_3$, and $\mu>0$ then the relative change in the demand for the composite asset ($\varepsilon M,p_3$ with $M=x_1+x_2$) i. Increases as μ decreases; ii. Switches sign as μ approach some definite values; iii. Increases as the characteristic mix of the composite assets approaches that of non-monied assets ($b_{12}\rightarrow b_{13}$ and $b_{22}\rightarrow b_{23}$) for small values of μ.

Money in G&L is represented by Divisa Index (Barnett, 1997), $M=(x_1+x_2)$. "The introduction of new assets means change in the relationship between the transaction (liquidity) function and the asset (portfolio) function of money." All five propositions hold for the introduction of new assets, which are more or as efficient as the former and then induce a shift in the efficiency frontier because of the price effect, but a different analysis should be developed for financial innovation, namely futures, whose effect is different from a simple change in relative price (p_i) or in the consumption technology coefficient (b_{ij}); futures imply an efficiency gain and a cost saving, so that it could affect both the price (p) and convenience (*b*) at the same time and with a significant magnitude for the substituted asset and neighbour(s). This means that futures could offset the demand of the former asset and neighbour at the same time, and not separately as analysed by G&L, causing a crowding out effect in financial and money market, and influencing money demand. In other words, we can have, at the same time, that the less liquid dominated asset disappears from the portfolio, that the new asset crowds out the neighbouring asset and than the portfolio's dimension lowers.

The change is not only in the coefficient of the consumption technology (*b*), but also in the basic constituents of the model, the 3 assets, which lowers. Finally we can reach the same allocation of wealth with, at the limit, only futures in portfolio.

Tab. 1 MONETARY AGGREGATES DEFINITION

THE FEDERAL RESERVE SYSTEM

The H.6 (Money Stock) release, published weekly, provides measures of the monetary aggregates (M1, M2, and M3) and their components.

M1, M2, and M3 are progressively more inclusive measures of money: M1 is included in M2, which is included in M3.

M1, the most narrowly defined measure, consists of the most liquid forms of money, namely currency and checkable deposits.

The non-M1 components of **M2** are primarily household holdings of savings deposits, small time deposits, and retail money market mutual funds.

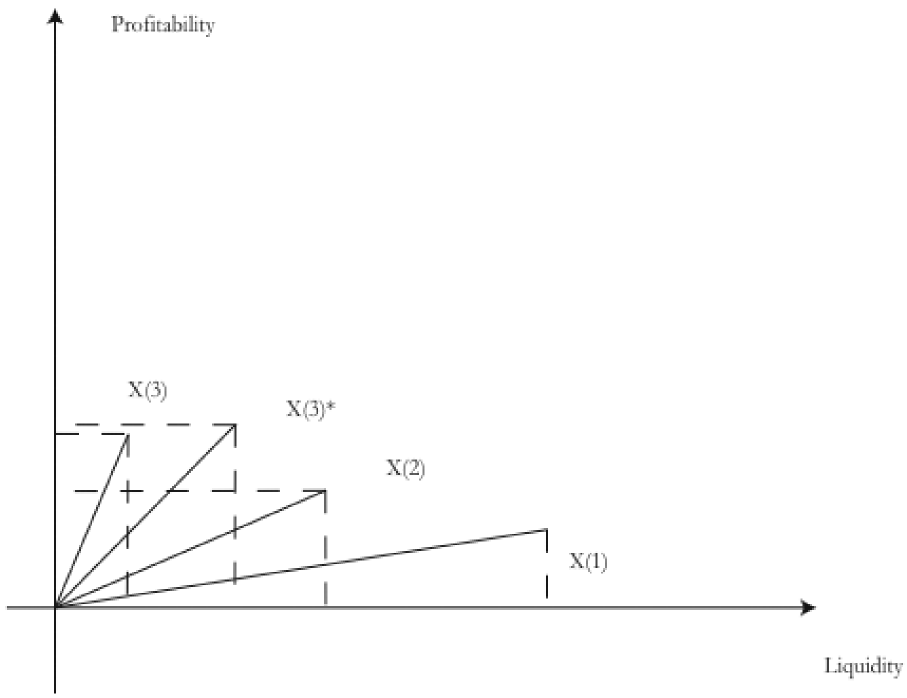
The non-M2 components of **M3** consist of institutional money funds and certain managed liabilities of depositories, namely large time deposits, repurchase agreements, and Eurodollars.

Source: http://www.federalreserve.gov/releases/h6/about.htm

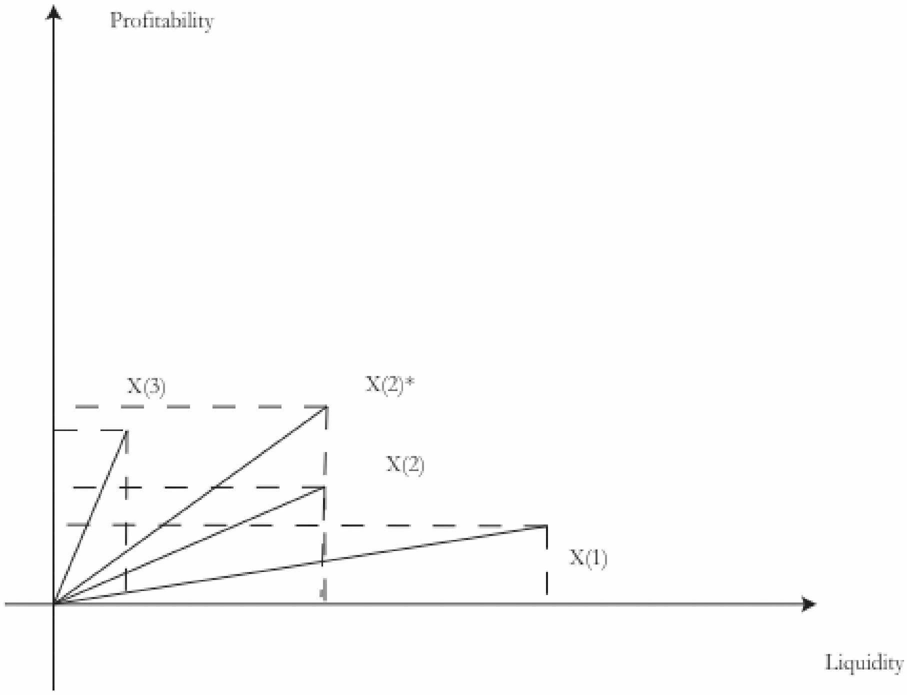
Tab. 2 COMPUTATION OF VARIABLES AND PARAMETERS

USA, 2001, all data in Billion US dollars except fed fund rate and future

S	165652,7	gross national savings
M	1202,9	M1
W=M+S	166855,6	wealth
z_1	74,94	MSI_M1_SA
p_1	0,634729108	log(fed fund rate)
z_2	34052	open interest future contract DJIA
p_2	10945	settlement price future contract DJIA
B matrix		
b_{11}	1	(max liquidity of money)
b_{21}	0,000287	
$[b_{21}, b_{22}]$	2249,883	
$b_{22} \geq$	0,36442134	But less than one



Graph 1
3 assets portfolio with Future, X(3)*, dominating X(3)



Graph 2
3 assets portfolio with Future, X(2)*, dominating X(2) and X(3)

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