Economic Stability under Alternative Banking Systems: The Case for 100 Percent Reserve Banking

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Abstract

In this paper we show that in an economy where investors hold rational expectations, output is generated by a linear homogeneous production function, and real investment is allocated across sectors according to the CAPM, a fractional reserve banking system characterized by deposit creation and investing is not Pareto efficient and leads to excessive risky productive investment that in turn amplifies future business cycles. Bank regulation should go even further than the Volcker rule by restricting bank investments to currency and deposit accounts on the central bank. Nonbank financial institutions should then carry out the financial intermediation function now carried out by banks.

Key Words: Economic Stability, 100% reserve banking, CAPM, Business Cycles, Pareto Optimality

JEL classification: E32, E44, E52, G1, G18, G21

I. INTRODUCTION

The world-wide crisis that began in 2007 raises a number of fundamental questions regarding the role of bank and non-bank financial institutions within the financial systems and their effect on the real economies of financially developed countries. Before the crisis most financial economists and policymakers favored deregulating banks in order to promote one-stop shopping for financial products and encourage competition and innovation in the financial services industry. The prevailing view then was to let the innovative human capital in lightly regulated financial institutions operating in relatively efficient financial markets guide the savings of society into productive real investment. The end result was supposed to be an efficient allocation of resources and optimal economic growth. Since the crisis this view of financial institutions and markets is now being questioned. It has been argued (eg., Stiglitz, 2011 and many others) that some financial products invented by this innovative human capital have contributed to the severity of the financial crisis in that they have proven to be opaque and difficult to assess their underlying risk. Moreover large financial service companies have proven to be too unwieldy to manage efficiently and some are now in the process of being partially dismantled. They along with other large financial institutions unleashed a significant moral hazard problem in that some financial supermarkets became too big and interconnected to fail. Repeal of parts of the Glass-Steagall Act and the Investment Company Act that occurred in the Gramm-Leach-Bliley Act in 1999 is now viewed by many economists and even some former bankers as a regulatory mistake. In response to the crisis Europe and the U.S. are now in the process of re-regulating the markets and institutions of their financial systems.

One very fundamental regulatory question that has received relatively scant attention from policymakers during the most recent financial crisis is the following: Why should privately owned banks whose checking account liabilities constitute an important component of the medium of exchange be allowed to accept and facilitate the creation of checking account money and engage in risky financial intermediation in the first place? This paper is concerned with this fundamental question. In section II we begin the discussion by considering one influential economic argument favoring the combining of deposit-taking and lending in the form of loan commitments within a single financial institution. This analysis abstracts from the problems of real investment allocation and deposit insurance, and focuses on the provision of liquidity services to depositors and borrowers. The conclusion of this analysis is that present day banks are the most efficient liquidity providers. In section III the question is examined from the perspective of efficient real investment allocation abstracting from liquidity considerations and deposit insurance. In this section we pose a thought experiment in the sense of Gilboa et al. (2014) and especially Maki (2005, 2009) for a hypothetical model economy that is considering two types of banking systems: i) a 100 percent reserve banking system and ii) a fractional reserve banking system. We then compare the investment allocations for the two systems. We find that a fractional reserve banking system that combines deposit-creation with risky lending to firms results in a misallocation of real productive investment. The misallocation we have in mind is that the marginal rate of transformation of expected return for risk generated on the real investments of firms does not equal the marginal rate of substitution of expected return for risk in the preferences of household savers at the optimal level of savings. This misallocation takes the form of overinvestment that produces too much risk per unit of expected return consistent with the preferences of household savers. We also find that this overinvestment financed by deposit creation within a fractional reserve banking system amplifies the volatility of the real economy. Section IV concludes with a short summary.

II. THE CASE FOR A DEPOSIT-TAKING AND LENDING BANKING SYSTEM

Until recently the strongest argument for combining deposit creation and risky lending/investing in banks is that it has always been so for many hundreds of years and over many different countries. The conventional text book view is that those goldsmiths and money-changers who provided safety deposit box and foreign exchange services to merchants eventually realized that only a fraction of the coins deposited with them for safe-keeping would be withdrawn at any one point in time. It would therefore be relatively safe and profitable to lend/invest a certain proportion of "other people's money" although it probably took much skill and experience to determine what that proportion for a specific money-changer might safely be. This quest for profit of money-changers and modern day banks is aptly summed up in an interview with Professor Raghuram Rajan at the Minneapolis Federal Reserve Bank by Ron Feldman (2009, p.22) when it is asked: "…what business are the banks in? They're not in the business of being plain-vanilla entities, because they *can't make any money that way."* While trying to avoid making money (literally as we will argue below) in a plain-vanilla way is the argument of the money-changer/banker as to why banking evolved in the way it did, economists also want to know whether the way banks make money is socially optimal.

Kashyap, Rajan, and Stein (2002) extending Diamond and Dybvig (1983) provide an important economic argument for the social usefulness of present day banking that combines deposit-taking and loan commitments to borrowers. Their argument is based on the notion that deposit-taking and loan commitments represent demands for liquidity by owners of demand deposits and borrowers. Both of these demands for liquidity require the providing institution to hold a stock of liquid assets themselves that in turn can be used to service these demands from both sides of the bank's balance sheet as they occur through time. From this observation they conclude that if these two demands for liquidity are not perfectly correlated, it makes economic sense to combine deposit-taking and loan commitments in the same financial institution, namely, present day banks. The reason is that a smaller quantity of liquid assets can service both demands for liquidity when they are provided by the same financial intermediary compared to the case when they are provided by separate intermediaries as proposed by 100 percent reserve banking. Liquid assets (eg., cash, reserve accounts with the central bank, Treasury securities, high grade commercial paper, etc.) in their model represent "costly overhead" that is required to service the normal demands for liquidity by depositors and lending commitments to borrowers. They argue this overhead is costly for three reasons: i) cash and until recently reserve accounts yield a zero nominal return; ii) short-term riskless and near riskless securities yield a nominal return but this return is subject to double taxation since banks are required to use the corporate form of business organization; and iii) borrowing ideas from the corporate finance literature they argue that large stocks of liquid assets create agency costs in that they can quickly be transformed into perks and empire building. For these reasons it is desirable that this costly overhead be reduced to a minimum which it will be if deposit-taking and lending are combined in the same institution and if the two demands for liquidity are not perfectly correlated. In other words present day banks are low cost producers of liquidity services precisely because they service both demands.

III. Investment and Business Cycles under Alternative Banking Systems

The argument of Kashyap et al. (2002) that a given stock of liquid assets can support a larger volume of normal liquidity needs when deposit-taking and lending are combined into a single entity is an interesting rationale for present day banking. It does however assume an absence of runs induced by pending bank failure which presumably would affect both sides of the balance sheet of banks at the same time and move the correlation coefficient between the two liquidity needs towards unity. But in any event is minimizing the stock of liquid assets relative to liquidity needs the only criteria for judging a social optimum for a banking system? The most important social function of a financial system is the transfer of financial resources from expected utility maximizing household savers to value maximizing investing firms. It would therefore seem that another and perhaps more important criterion is whether a financial system based on 100 percent reserve banking allocates savings to investment better (in the Pareto sense) than a fractional reserve universal banking system. By "better" we mean will the level of investments in the economy generate the risk/return trade-off that maximizes the expected utility of household savers who finance the investment with their savings. In this paper we argue that in a 100 percent reserve banking system it does, whereas it doesn't in a fractional reserve banking system.[1]

To see this we will abstract from deposit insurance and the liquidity considerations of Kashyap et al. and look for a model that generates a risk/return tradeoff in the capital market. The workhouse model in finance that does this is the well-known 2-paremeter capital asset pricing model, CAPM. Suppose then a modified version of the CAPM allocates investment in a purely private and closed economy. As originally developed by Sharpe (1964) and Lintner (1965), the CAPM takes the total stock of real capital as fixed and given. It then derives a set of relative market prices for the financial claims on the individual firms that comprise an efficient market portfolio that is optimal in the sense that it maximize the excess expected return (over and above the riskless return) on that portfolio for a given amount of portfolio risk. In doing this the model generates the expected return/risk trade-off on the market portfolio. This paper derives an expected return/risk tradeoff in a CAPM type model linked to a Cobb-Douglas production function where the stock of capital is a choice variable and therefore subject to change. Towards this end we assume that the individual productive units or capital assets are components (or divisions) of a single representative firm that underlies the market portfolio. The managers of these individual productive units or divisions are allocated capital by the market portfolio manager in the optimal CAPM way of maximizing excess expected return on the portfolio per unit of

[1] The case for 100 percent reserve banking is not particularly new. Early English writing proponents of 100 percent reserve banking include Simons (1934) and Fisher (1935); and later Friedman (1959), Tobin (1985), and Allais (1987) among others. Their arguments in favor of 100 percent reserve banking were different than ours and focused on preserving the safety of the banking system. These arguments include: i) that it will stabilize the banking system; ii) enable the central bank to more tightly control the M1 stock of money; and iii) when coupled with a fixed percentage money growth rule leads to more stable prices and real economic activity. For a review of the older traditional and non-traditional literature on fractional and 100 percent reserve banking see de Sota (2009) especially chapter 9. Recent advocates and discussion include among others Benes and Kumhof (2012), Kotlikoff (2010), Lucas (2013), and the review by Pennacchi (2012). For different proposals on how to transition from a fractional reserve system to a 100 percent reserve system see Krainer (2013) along with Benes and Krumhof (2012) and Kotlikoff (2010).

portfolio risk. The question is how much financial capital should that representative firm get from saver/investors to allocate to its separate productive units or divisions. We then ask the question whether the stock of this productive capital underlying the market portfolio is Pareto efficient in a financial system with fractional reserve banking versus 100 percent reserve banking.

Consider then the following thought experiment where a privately owned deposit-taking narrow bank is only allowed to invest in a risk-free reserve asset. We also hold constant the size of the balance sheet of the central bank. Assume also that households can only hold risk-free deposit money (for cash-in-advance reasons) with a zero return and invest long in the representative firm/ market portfolio. In this set-up there is complete separation between deposit banking and financial intermediation which in turn is carried out within the market portfolio. The manager of the market portfolio accepts savings from the representative household. For any given level of savings the market manager then allocates the savings among the separate productive units or divisions of the representative firm to buy real capital in the CAPM way that generates the highest expected return on the portfolio for a give level of portfolio risk measured as the standard deviation of the return on this portfolio. The problem solved by the market portfolio manager for each and every level of household saving is to allocate capital to the various divisions j of the representative firm so as to maximize:

$$\frac{E(R_M)}{\sigma(R_M)} = \sum_j x_j \, E(R_j) \, [\sum_j x_j^2 \, \sigma^2(R_j) + 2 \sum_j \sum_k x_j \, x_k \, \sigma(R_j R_k)]^{-1/2} \qquad 1)$$

Subject to

$\sum_j x_j = 1.0$

Where

X_j = the share of capital allocated to division j within the representative firm.

$E(R_j)$ = The expected rate of return on division j.

σ^2 (R_j) = The variance of the rate of return on division j.

$\sigma(R_j R_k)$ = the covariance of the rate of return between division j and division k.

$E(R_M)$ = the expected rate of return on all divisions j that make-up the firm.

$\sigma(R_M)$ = the standard deviation of the rate of return on the representative firm.

In maximizing (1) the market portfolio manager adjusts the proportionate allocations of capital, x_j, to each division j so that:

$$\partial[\frac{E(R_M)}{\sigma_{(R_M)}}]/\partial x_j = E(R_j) - \frac{E(R_M)}{\sigma^2(R_M)} [x_j \sigma^2 (R_j) + \sum_k x_k \sigma(R_j R_k)] = 0 \quad 2)$$

The second order conditions for a maximum are satisfied since:

$$\partial^2[\frac{E(R_M)}{\sigma(R_M)}]/\partial x_j^2 = - \frac{E(R_M)}{\sigma^2(R_M)} \sigma^2(R_j) < 0 \quad 3)$$

Next, we consider the case for a variable K. The return generating process of the linear homogeneous production technology of the representative firm that describes the expansion path for the efficient market portfolio is known to the market portfolio manager and its general form is assumed to be the following[2].

$$E(Y) = f(K) \qquad f'(K)>0 \qquad f''(K)<0 \quad 4)$$

and

$$\sigma(Y) = g(K) \qquad g'(K)>0 \qquad g''(K)\geqslant 0 \quad 5)$$

where

K = Physical productive capital.

E(Y) = Expected income on the productive capital underlying the market portfolio.

σ (Y) = Standard deviation of income generated on the productive capital of the market portfolio.

[2] See Stiglitz (1972, p.39) for this set of assumptions on the production of risk and return in the CAPM. Stiglitz provided no evidence or economic rationale on why risk should be increasing in the level of real investments. Theoretical reasons and empirical evidence for this assumption can be found in Krainer (2009,pp. 6-7).

Together equations (4) and (5) reflect the fact that real capital investment generates a probability distribution around an expected diminishing returns income, and the spread of this distribution increases with capital investment. Equation (4) taken separately is well established in the literature. Economic theory is silent on equation (5) which has risk going up as capital investment goes up. Nature is stingy in this model economy in that the investment attributes of expected income and risk both deteriorate at the margin as capital investment increases.

To further clarify these ideas consider the following stylized economy where K represents a fixed amount of land initially owned by the government. The government stands ready to buy or sell units of this land at a fixed price per acre to the single corporate farm which can then be sub-divided into individual plots producing food. Land not purchased by the corporate farm remains the property of the government and is available to the general public for various recreational activities free of charge. Consumption consists of food and recreation. To buy land from the government the corporate farm must raise money from household investors. The saving and investment process in this economy is implemented through a single non-bank financial intermediary, namely, the market portfolio of the CAPM. Household savers earn an income from providing factor services in the previous period. After making an initial food consumption decision (and implicitly a recreation consumption decision) turn their savings over to the market portfolio, and the market portfolio manager then allocates the savings/investment to the corporate farm to purchase land from the government and form individual plots in a way so as to maximize the ratio of expected income, E(Y), to risk, σ(Y) for the entire corporate farm. Land used for farming and food production is subject to diminishing returns and increasing risk as in (4) and (5). For example, the next parcel of land available for purchase by the corporate farm might be part marsh with lower average productivity and increased risk. If the weather is good, (i.e., not too much rain) the land will yield a large return; but if bad (too much rain causing flooding) it would yield a small return.[3]

Since economic theory is silent on equation (5) and the fact that it plays an important role in the analysis, some justification is necessary in order to pass Solow's "smell test" or more recently Pfleiderer's "real world filter." To begin with there is statistical evidence that *future* earnings variability is an increasing function of *current* capital investment (Kothari et al.2002 and Suurmeijer et al. 2013). In this connection, Kothari et al. (2002) with a sample in excess of 50,000 firm-year observations for Compustat industrial firms provide regression evidence that increases in current investments in year t in plant and equipment, R&D, and advertising are associated with an increase in the standard deviation of future corporate earnings both before and after corporate taxes. We supplement the Kothari et al. micro evidence with some macro evidence from the nonfinancial corporate business sector in the U.S. Towards this end we regress the standard deviation of future corporate profits before tax on current capital expenditures for the U.S. nonfinancial corporate sector. Since financial leverage in principal can also increase the volatility of before tax earnings, we also include a leverage variable. Finally, using a Cochrane-Orcutt procedure to correct for autocorrelated residuals the regression results for the period 1977-2010 are as follows.

$$\text{Log (Stdev Profits,BT)}_{t-t+4} = -4.86 + 1.38 \log(\text{Cap Expend})_t + 9.85 \ \Delta(\text{Liab/A})_t \qquad 6)$$

$$(-2.17/.00) \ (4.07/.00) \qquad (1.74/.09) \qquad \overline{R}^2 = .80 \quad AR(1) = .67$$

Where

Log (Stdev Profits,BT) = the log of the standard deviation of before tax corporate profits in the nonfinancial corporate sector computed over the 5 year period from t to t+4.

[3] In this example the supply of land while fixed is infinitely elastic over some relevant time interval and the amount farmed depends on the demand for food from the saver/investors that invest in the CAPM market portfolio.

Log (Cap Expend) = the log of capital expenditures (fixed investment, change in inventories, and nonproduced nonfinancial assets) for the nonfinancial corporate sector.

Δ(Liab/A) = The change in the ratio of total liabilities to assets in the nonfinancial corporate sector.

$\bar{R}^2$ = Adjusted coefficient of determination.

AR(1) = Estimated autoregressive coefficient.

Newey-West t-scores/P-values are given beneath the estimated coefficients.

All variables obtained from the Federal Reserve Financial Accounts (Table F102) of the United States at www.federalreserve.gov/releases/z1...b102

The regression says that a 1 percent change in capital expenditures is associated with a 1.38 percent change in the standard deviation of future before tax corporate profits. Do capital expenditures cause future earnings volatility or is the causation reversed? To answer this we carry out a pairwise Granger causality test. The Granger Causality test for lags of 2 years indicates that we can reject the hypothesis that log(CapExpend) does not Granger cause log(StdevProfits,BT) at the 1 percent level of significance since the F-statistic is 5.49 with a Prob of .01; but we cannot reject the hypothesis at the 5 percent significance level that log(StdevProfits,BT) does not Granger cause log(CapExpend) since the F-statistic is 2.20 with a Prob. of .12. Finally the leverage effect on future profit volatility is positive as predicted by finance theory and statistically significant at the 10 percent level. Both the micro and macro evidence is consistent with the assumption that increases in current investment are associated with increases in the volatility of future investment returns as indicated in the derivatives in equation (5).

Further evidence on the derivatives in equation 5 comes from bank financing of investment projects. This evidence indicates that credit standards for bank lending vary counter cyclically (see Cunningham and Rose (1994), Weinburg 1995, and Keeton (1999) for the U.S.; Hoggarth et al. 2002 for 47 developing and developed countries; Berger and Udell 2003; Jimenez and Saurina (2006 for Spain); Drehmann et al. (2011); and Caporale et al. 2013 for Italy). In periods of rapid capital accumulation financed in part by bank lending, the true risk on the underlying investment projects is underestimated as bankers think the good times will continue into the indefinite future. This well-documented phenomenon in the bank loan market has led to a regulatory response that takes the form of a countercyclical capital buffer in Basle 3. This countercyclical buffer allows bank regulators to increase tier 1 capital requirements by up to 2.5% of risk-based assets when credit relative to some metric like GDP exceeds its long-run trend. Further evidence comes from financial markets (reflecting the real economy) and the cyclical movement of the Sharpe ratio. Brandt and Kang (2003) find that in and around NBER troughs of recessions (when real investment is low), mean returns on stocks are rising and the volatility of stock returns is falling. Conversely in NBER peaks of expansion (when real investment is high), mean returns are falling and the volatility of returns are rising. The end result is that the Sharpe ratio, $E(R_M)/\sigma(R_M)$, is countercyclical.[4] This empirical evidence on the Sharpe ratio is consistent with the return generating process in equations (4) and (5). In addition to this empirical evidence several economic arguments support our assumptions on the return generating process in (4) and (5). One argument is that a large increase in K will increase supply relative to demand. To which sector will the demand go with this increased supply? Each individual productive unit will then experience an increase in risk just as adding more players to the game of musical chairs increases the risk for each individual finding a chair when the music stops. A second argument is that when the capacity-increasing investment is allocated unevenly across the separate productive units by the market portfolio manager in response to changes in taste and technology, relative prices of output in those sectors will become more variable. An increase in the variability of relative prices, according to the New Classical theory (Lucas, 1973), makes it more difficult for the managers of the separate divisions to estimate profits and plan production thereby increasing the underlying operating risk of the representative firm. A third argument is that with a fixed supply of

[4] Other empirical studies finding a countercyclical movement in the Sharpe ratio include Harrison and Zhang (1999), Campbell and Diebold (2009, Lettau and Ludvigson (2009),Ludvigson and Ng (2007), and Lustig and Verdelhan (2012) among others.

experienced managers/workers, an increase in capital investment will require the firm to use less experienced managers and workers and/or spread the experienced human capital more thinly across the different divisions within the firm. How these relatively new and inexperienced managers/workers will perform is uncertain, and this uncertainty contributes to the increased operating risk associated with the new investment. Alternatively spreading the experienced human capital more thinly throughout the firm will also contribute to an increase in operating risk. "Too big and too complicated to manage" is becoming an increasing reality for financial as well as nonfinancial enterprises in the industrial advanced countries. A fourth and related argument is that a rapid expansion in productive capacity that comes with increased real investment may make it more difficult to maintain the quality of the firm's product thereby creating a new but lower quality product. Will the firm/division be able to profitably sell this new but lower quality product in the market place at a profitable price? Will the lower quality product result in expensive suits and government fines? Recent examples of the problems associated with rapid capacity expansion and maintaining product quality is the automobile manufacturers Toyota and GM, and the hustle program of mortgage lending by Countrywide bank during the Great Crisis. Perceived quality changes that often accompany a rapid expansion in real investment pose an additional risk confronting the representative firm. This evidence would also be consistent with the assumptions on the derivatives in equation (5).

With these assumptions on the derivatives of (4) and (5) we can derive a CAPM return/risk frontier for different levels of K between E(Y) and σ(Y) based on their separate relationships to K in the production function. In this connection note that as K varies [σ(y), E(Y)] describes a locus of points with equations (4) and (5) constituting a parametric representation of the locus. Eliminating K between equations (4) and (5) defines E(Y) implicitly in terms of σ(Y) as in the CAPM. On the assumption that f and g are continuously differentiable functions of K we can then express the derivatives of E(Y) wrt σ(Y). Begin by noting that the total differentials of (4) and (5) are:

$d[E(Y)] = f'(K)dK$ and 7)

$d[\sigma(Y)] = g'(K)dK$ 8)

Dividing (7) by (8) the derivative of E(Y) wrt σ(Y) is thus

$$\frac{dE(Y)}{d\sigma(\mathrm{Y})} = \frac{f'(K)}{g'(K)} > 0 \qquad 9)$$

indicating that E(Y) is a positive function of σ(Y). To compute the second derivative to test for concavity we have:

$$\frac{d^2E(Y)}{d\sigma(Y)^2} = \frac{d}{d\sigma(\mathrm{Y})} * \frac{dE(Y)}{d\sigma(\mathrm{Y})} = \frac{dE(Y)'}{d\sigma(\mathrm{Y})} \qquad 10a)$$

where $E(Y)' = \frac{dE(Y)}{d\sigma(\mathrm{Y})}$. Taking the total differential of E(Y') and σ(y) and then dividing as above we get

$$\frac{d}{d\sigma(Y)} * \frac{dE(Y)}{d\sigma(\mathrm{Y})} = \frac{d}{dK} * \frac{dE(Y)}{d\sigma(\mathrm{Y})} * \frac{dK}{d\sigma(\mathrm{Y})} \leq 0 \qquad 10b)$$

Equation (10b) is negative since d/dK • dE(Y)/dσ(Y) contains f''(K) which according to diminishing returns is assumed to be negative in (1) above. E(Y) is therefore a concave function of σ(Y) implying that the marginal rate of transformation of expected income for risk on real capital investment is diminishing[5].

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[5] An alternative derivation based on the Inverse Function Theorem is to write:

i) E(Y) = f (K)

ii) σ(Y) = g (K)→ K=g^{-1}[σ(Y)]

That is, the inverse function g-1(σ(Y)) exists on any interval where g is monotonic with either g'(σ(Y)>0 or g'[σ(Y)]<0.

Since g'(K) >0, g^{-1}[σ(Y)] exists, and

It is then the case that:

iii) E(Y) = f(K) = f[g^{-1} σ(Y)] and

iv) $\frac{dE(Y)}{d\sigma(\mathrm{Y})} = f'[\mathrm{g}^{-1}\sigma(\mathrm{Y})] * \frac{d}{d\sigma(\mathrm{Y})} g^{-1}\sigma(\mathrm{Y})$ or

v) $f'[g^{-1}\sigma(\mathrm{Y})] * \frac{1}{g'(K)} > 0$

The relationships between E(Y), σ(Y), and K from the above equations are described in Figure 1. Quadrants 2 and 3 in Figure 1 respectively describe the relationship between E(Y) and σ(Y) as functions of K. Capital investment generates both expected return and variability of return. In quadrant 2 the productive opportunity curve PO describes E(Y) as a concave function of capital investment K indicating diminishing returns while in quadrant 3 the capital investment risk curve KR describes σ(Y) as a linear or convex function of K. Together they imply the CAPM's concave risk-return transformation curve TC in quadrant 1 which describes the efficient tradeoff between expected income E(Y) and risk σ(Y) generated on the capital of the representative firm in this economy.

(Put Figure 1 here)

Next we describe the representative saver/investor in this economy. Saver/investors are endowed in the beginning of some hypothetical time period t=0 with a given stock of wealth (claims on the market portfolio) along with money, the result of providing factor services to the representative firm in the previous period t=-1. With this money they pay for the pre-ordered consumption goods in t=-1 to be consumed in the current period t=0, and reinvest the remainder in the market portfolio at the beginning of the current period. Cash-in-advance and money-in-the-production function (to overcome frictions) are the motivations for households and the representative firm for holding money in this economy. The manager of the representative firm/market portfolio will then use the money obtained from households to invest in real capital and money balances spread across the separate divisions of the representative

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vi) Using the quotient rule the second derivative is

$$\frac{d^2E(Y)}{d\sigma(Y)^2} = f''[g^{-1}\sigma(Y)] * \frac{1}{[g'(K)]^2} + f'[g^{-1}\sigma(Y)] * \frac{-1}{[g'(K)]^2} * g''(K) < 0$$

Since both terms on the rhs are negative, vi) is negative. Thus the relationship between E(Y) and σ(Y) is concave just as it is in the CAPM. My thanks to Katherine Kovarik and Donald Schuette for pointing out this inverse function proof of concavity. Stiglitz (1972, p.39) shows that all that is needed for concavity is $[g''(K)g(k)]/[g'(K)]^2 + 1.0 \geq 0$.

firm underlying the market portfolio where it will become part of the capital stock in the next period.[6] Our focus will be on the representative agent's savings decision in the market portfolio and set aside their consumption decision. The assumption that consumption goods are pre-ordered at the end of t=-1 closes the consumption goods factory and store for new orders during period t=0 as they are in the standard CAPM. The investment goods store and factory (with excess capacity) are now open and ready to do business.[7] To complete the model it is necessary to describe the preferences of the representative saver/investor in terms of expected income, E(Y), and risk, σ(Y), on their savings. The standard expected utility function for the representative risk averse saver/investor (assuming non-satiation) is then given by:

$$E(U) = U[E(Y), \sigma(Y)] \qquad U'[E(Y)] >0 \qquad U''[E(Y) \leq 0 \qquad U'[\sigma(Y)] <0 \qquad U''[\sigma(Y)] \leq 0 \qquad 11)$$

Taking the total differential of expected utility in (7) and setting it equal to zero yields an indifference curve in terms of E(Y) and σ(Y); namely,

$$dE(U) = U'E(Y)*dE(Y) + U'[\sigma(Y)]d\sigma(Y) = 0 \qquad 12)$$

The slope of this indifference is positive since

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[6] To continue with the above agrarian example, think of households as receiving money from the representative farm at the beginning of t=0 for factor services provided over the period t=-1. At the beginning of t=0 they use this money to pay for the food consumption goods pre-ordered at the beginning of t=-1 that will be consumed during t=0. The remaining money if any is invested in the CAPM market portfolio for land purchases from the government. They also pre-order the consumption goods to be produced in t=0 but paid for at the beginning of t=1 and consumed over period t=1. Money is held by households (cash-in-advance motive) at the beginning of a period, and by the representative firm and government (money-in-the-production function) during the period.

[7] These assumptions are made to facilitate a comparison of a 100 percent reserve banking system and a fractional reserve banking system on the allocation of productive investment without the added complications of inflation. We want to show that even in the absence of full-employment and inflation, money creation results in a suboptimal allocation of investment. With consumption predetermined and the investment goods factory (with excess capacity) open, we eliminate any inflation associated with a transition to a fractional reserve banking system and restrict the analysis to emphasizing the increased volatility in future output that is set in motion when banks facilitate the financing of risky investment with newly created money. This point is graphically illustrated in Figures 2 and 4 below. If the investment goods factory were closed (i.e., full employment) then money creation by banks would obviously result in inflation in the store selling investment goods. This would then result in a redistribution of the ownership shares on the market portfolio towards banks and away from household saver/investors reducing the latter's expected utility even further.

$$\frac{dE(Y)}{d\sigma(\mathrm{Y})} = -\frac{U'\sigma(\mathrm{Y})}{U'E(Y)} > 0 \qquad 13)$$

It is traditional to assume that indifference curves in [σ(Y), E(Y)] space are convex as displayed by IC in quadrant 1 of Figure1. Convexity implies that savers/investors require ever higher amounts of expected income in compensation for incremental increases in risk in order to keep their expected utility constant.[8]

With these assumptions on tastes and technology consider first in this thought experiment a financial system where banks are initially required to maintain 100 percent reserves against their deposit obligations and households alone through their saving/ investment in the market portfolio provide the financing for the risky capital investment in the economy. With the return generating process of the firm given by (4) and (5) and household preferences given by (12) and (13), the initial allocation of real investment, the production of expected income, and the production of risk are given by K_0', $E(Y)_0'$, and $\sigma(Y)_0'$ for the beginning of the period t=0 in Figure 1. This equilibrium stock of private risky capital K_0' of firms is seen in the figure to be Pareto optimal in the sense that the marginal rate of transformation (given by the slope of TC) of risk for expected income generated by the real investments of the representative firm underlying the market portfolio is equal to the marginal rate of substitution (given by the slope of IC) of risk for expected income in the indifference curve of the representative saver/investor at M'.

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[8] An intuitive demonstration of convexity of indifference curves is the following. Consider a point A on an upward sloping indifference curve involving relatively small amounts of σ(Y) and E(Y). Since E(U) is assumed to be a negative function of σ(Y) with a negative second derivative while E(U) is a positive function of E(Y) with a negative second derivative, the derivative dE(Y)/dσ(Y) at point A follows - U'σ(Y)/U'E(Y) ~ "small"/"large" ~ "small". In other words, dE(Y)/dσ(Y) is relatively small at point A and the indifference curve while upward sloping is relatively flat. Next consider a point B further up the positive sloped indifference curve involving large amounts of σ(Y) and E(Y). Again we have dE(Y)/dσ(Y) = -U'σ(Y)/U'E(Y) but now -U'σ(Y)/U'E(Y) ~ "large"/"small" ~"large" and the indifference curve is relatively steep. Thus as we move along an upward-sloping indifference curve from A to B in a northeast direction the value of d(EY)/dσ(Y) increases indicating that investors require ever increasing amounts of E(Y) for every unit increase in σ(Y) to keep their expected utility constant.

Does this version of the CAPM have anything to say about future economic volatility? To answer this question observe that the beginning of the period capital stock K_0' generates a probability distribution (assumed for convenience to be normal) with mean $E(Y)_0$ and standard deviation $\sigma(Y)_0$. On the assumption of rational expectations, it will be from this probability distribution that the actual end of period income Y_1' to saver/investors will be drawn. The spread of this probability distribution describes both the utility maximizing potential future fluctuations of saver/investor income Y_1', and future total output Q_1' when Q is generated by a linear homogeneous production function with constant factor shares. In this model economy saver/investors in maximizing their expected utility freely choose the volatility of future economic activity when they choose the level of current savings to finance the capital investment K_0 of the representative firm. This is graphically described in Figure 2. In part A of the figure we reproduce quadrant 1 from Figure 1 with the normal distribution drawn in at the initial equilibrium of M' generating $E(Y)_0'$ and $\sigma(Y)_0'$ in period t=0. In part B we plot the possible realized Y_1' as a linear function against the realized total output Q_1 generated by a Cobb-Douglas production function, $Q_1 = A[\, K_0^{\alpha}\, N_0^{1-\alpha}\,]$, where N is fixed and A>0 represents total factor productivity. The slope of the line translating Y_1 into Q_1 is α, or, capital's share in total output. The horizontal dashed lines represent kσ(Y) standard deviations on both sides of the mean of Y_1 which when reflected back to Q_1 via the construction line with slope α represents the magnitude of future fluctuations in total output Q_1. Thus the distance between Q_1' and ${}^{r}Q'_1$ represents the varying degrees of future recession outcomes associated with K'_0 while the distance between Q_1' and ${}^{e}Q'_1$ represents the future cyclical expansions within the kσ(Y) bands. A rotation of the saver/investor indifference curve reflecting changes in risk aversion in this static model will change these bands and the associated probability distributions describing business cycles.

(Put Figure 2 here)

From this initial Pareto efficient equilibrium now consider in this thought experiment an artificial parallel economy where the privately owned banks succeed in obtaining a reduction in their legal reserve requirement from 100 percent to something less; for example, 10 percent of deposit obligations. We still assume the size of the central bank's balance sheet is fixed and ignore the costs of implementing a government deposit insurance scheme and regulatory structure. The private banks now have money in the form of excess reserves which in this CAPM model they will invest in the market portfolio since the other asset (money/reserves) in the system yields a zero nominal return. Total capital investment of the representative firm underlying the market portfolio will now be financed with the money income saved by household savers and new deposit money created by banks. The main difference between the banks and households is that households generated their savings by providing factor services in some previous period whereas bank deposit creation was not the result of a prior expenditure of factor services but instead a change in regulation. With a lower cost of capital the representative firm in quadrant 2 of Figure 1 will now increase their capital investment from K_0' to something like K_0' +ΔK = K_0^*. The effect on the financial system of this additional financing that allows risky capital accumulation to grow to K_0^* is described in Figure 3. There it can be seen in quadrants 2 and 3 of the figure that the additional productive investment generates an increase in expected income to $E(Y)_0^*$ and an even greater increase in risk to $\sigma(Y)_0^*$. Since the additional risky investment generates more expected income but even more risk, the economy moves further along the efficient concave expansion path/ transformation curve TC to some point like M^* in quadrant 1. At point M^* the indifference curve of the representative saver/investor will no longer be tangent to the efficient transformation curve but will lie everywhere below the indifference curve that is tangent to TC at point M'. In other words, when investment is K_0^* the representative firm is generating too little expected income per unit of risk in their productive investment decisions than saver/investors require in their personal trade-off between expected income and risk as reflected in their indifference curve.

(Put Figure 3 here)

Could the representative saver/investor undo this excessive risky capital investment financed by new deposit money at M* by simply reducing their personal investment in the market portfolio and get back to their expected utility maximum at M'? It would depend on the extent to which they owned and controlled the deposit creating banks. If they completely owned and controlled the deposit creating banks, there would be no incentive in the first place to become fractional reserve banks and invest ΔK in the market portfolio. Moreover if unlike this parallel economy here we considered the real world expenses associated with deposit insurance and government regulation that would be necessary in a fractional reserve banking system, the answer would be a decidedly No. On the other hand if banks were privately owned and outside the market portfolio (which they originally were and to a certain extent continue to be), or, more likely management controlled due to agency problems associated with the separation of ownership and control, the answer would still be a decidedly No.[9] That is because at the new market portfolio M* household savers and bankers would share the E(Y) and σ(Y) in the same proportion as their relative share of investment in the market portfolio. To see this let γ (for $0 < \gamma \leq 1.0$) be the proportionate share of investment in the market portfolio put up by household savers and (1-γ) be the share put up by the privately owned banks. On the assumption that risk increases linearly with investment, this sharing is then represented by a point somewhere along a ray emanating from the origin of quadrant 1 of Figure 3 to the new M*> M' on curve TC. This sharing of E(Y) and σ(Y) is illustrated in Figure 3A. Points on the ray 0A in the figure lying closer to the origin would represent a relatively smaller share of investment in the market portfolio (ie., small γ) owned by the representative

[9] Management control that included the granting of excessive compensation agreements linked to risky investments has been well-documented in the Great Crisis literature; see Stiglitz (2011) and Prager (2012). Bonus plans in some banks take up as much as one-half the after-tax profits of the bank making manager's implicitly large equity holders. Moreover under "hustle" programs bankers were compensated in terms of the number and dollar amounts of mortgage deals they arranged with little regard for the quality of the credit extended.

saver/investor while points closer to M* would represent a relatively larger share of the market portfolio. In the figure γE(Y) and γ[σ(Y)] would then be the shares of expected income and risk belonging to the representative household saver/investor with indifference curve IC* when total investment in the market portfolio is M*. The indifference curve IC* touching or going through the sharing point lying on ray 0A is now everywhere below the curve IC'.

(Put Figure 3A here)

In any event the larger amount of capital investment K_0^* while increasing the expected income of firms in the economy also increases the amplitude of future business cycles even more. This can be seen in parts A and B of Figure 4. In part A of the figure the probability distribution at point M^* associated with K_0^* capital investment is now more spread out than the distribution at point M' associated with $the\ K_0'$ level of investment. Through the Cobb-Douglas production function this greater variability in expected income going to household saver/investors and banks as owners of the capital underlying the market portfolio is reflected in greater variability of realized output Q_1 at the end of the period. This can be seen in part B of the figure where the distance between ${}^rQ^*_1$ (or ${}^eQ^*_1$) and Q_1^* associated with K_0^* is greater in magnitude than the fluctuations in Q associated with the Pareto efficient capital investment of K'_0 described in Figure 2.

(Put Figure 4 here)

This non-optimal and excessive level of capital investment by firms in t=0 is not the result of Basle-type capital regulations for banks, or changes in the risk perceptions and risk aversion of the banks, or changes in the value of collateral and/or net worth by borrowing firms, or changes in bank stock valuations, or mark to market accounting; arguments in the literature that link present day bank lending to increased amplitude of the business cycle. The problem in a financial system with fractional reserve banking is more fundamental. It is the ability of fractional reserve banks to finance productive investment in the market portfolio with newly created deposit money that causes a negative externality for household savers/investors in this economy. In this CAPM world saver/investors draw up an investment plan in t=0 that maximizes their expected utility. Embedded in that plan is a probability distribution from which under rational expectations future investor income and aggregate output is drawn in period t=1, 2, 3,… . In this sense the future fluctuations in income and output are the natural result of saving and investment in a risky economic environment where productive investment is allocated according to the 2-parameter CAPM. In other words, business cycles are a freely chosen and natural outcome of a private utility maximizing saving/investment decision when the risky capital investments of firms are financed with the saving of households. Households generate an income from the sweat of their brow and/or the sweat of their abstinence. Out of this income they save and invest in the market portfolio. Banks generate new deposit money with a stroke of a pen. With this deposit money they invest in the market portfolio. When financing is provided by the savings of households and the money creation of banks, the real capital investment underlying the market portfolio creates a probability distribution around future expected income and output that has a greater variability than the utility maximizing distribution chosen by saving/investing households alone when banks are subject to 100 percent reserves. In this sense fractional reserve banks financing risky productive investments create excessive risk in the form of business cycles with greater amplitude. Of course introducing a government subsidized deposit insurance scheme would provide an additional incentive for banks to invest in the risky market portfolio that in turn would further amplify business fluctuations because of the put option embedded in the deposit insurance. Our argument is that even in the absence of deposit insurance fractional reserve banks create excessive risk for household savers whenever they finance risky capital with newly created deposit money.

Banks in a fractional reserve system are not the only vehicles for excessive risk creation and volatile fluctuations in an open economy. Countries with large trade surpluses (the so-called global savings glut) that in turn invest their surpluses in the risky sector of deficit countries can create the same externality for domestic saver/investors in the deficit countries. Trade deficits can amplify domestic business cycles. Indirectly domestic saver/investors in the deficit countries choose this increased amplitude in the business cycle when they freely choose to consume foreign produced products. Moreover the foreign saver/investors of surplus countries bear part of the cost of exporting business fluctuations to the deficit countries due to the repercussion effect of the greater volatility of their future exports and GDP. The U.S. has been somewhat lucky in this regard in that many Asian countries with substantial trade surpluses in the past have chosen to invest their surpluses in the risk-free sector[10].

IV. Summary and Conclusions

To conclude, it has long been known that the maturity transformation that is the business of present day fractional reserve banks exposes the system to potential financial and economic instability. In good times optimistic banks fund too many marginal projects, and in bad times their flight to safety precludes the funding of projects that in more normal times they would fund. Many economists attribute this amplification of bank lending and economic activity to a number of factors including herding, procyclical changes in monetary policy, countercyclical changes in risk perceptions and risk aversion, procyclical changes in the value of collateral and borrower net worth, procyclicity in lending induced by various Basle Accord capital requirements, and procyclical changes in bank share valuations that change the

[10] There were some indirect effects of Asian and OPEC trade surpluses that contributed to the recent U.S. crisis even though these countries primarily invested their surpluses in Treasury securities. There is evidence that Asian and OPEC surpluses were partly invested in European bank deposits. These deposits provided the financing for European investments (particularly in asset backed securities) in the U.S. in the run-up to the crisis. A second indirect effect was that the massive inflows of capital into Treasury securities by Asian and OPEC countries lowered interest rates which in turn spread throughout the U.S. economy stimulating investment in housing. For an excellent review and discussion of the role capital imports from various groups of countries played in the run-up to the U.S. crisis see Bertaut et al. (2011).

composition of bank portfolios. These factors can and do amplify fluctuations in bank lending and economic activity. However our criticism of the present day fractional reserve banking system is more fundamental. Any bank lending/investing whether it be abnormally large or small or anywhere in-between in magnitude with created deposit money is suboptimal. In this paper we show in a thought experiment how changes in the institutional arrangements of going from a 100 percent reserve banking system to a fractional reserve banking system with or without government deposit insurance will increase the available funding for increasingly risky productive investments. These investments will increase growth. However, they will also amplify the business cycle.[11] To the best of our knowledge this is the first time a chain of hypothetical economic models made up of: i) a CAPM description of real investment allocation; ii) saver/investors hold rational expectation; and iii) a linear homogeneous production function like the Cobb-Douglas have been brought together to describe a parallel (to reality) economic system of an expected utility maximizing business cycle. Ex-ante business fluctuations are described in this parallel economy by the spread of a probability distribution. When households choose to invest their savings in the market portfolio, they choose the return/risk combination that maximizes their expected utility and the probability distribution from which future business fluctuations will be drawn. To highlight this result in the strongest possible way we assumed the supply schedule for capital is infinitely elastic over some relevant range, which implies that prices are fixed when fractional reserve banks create money and invest in the market portfolio. The idea behind this assumption is to isolate the causally significant relationships between bank credit creation, real investment, and future economic

[11] There is some evidence that both economists and non-economists in the U.S. are prepared to give up cyclical expansions in order to eliminate recessions. In this connection a survey study of economists and non-economists by Shiller (1996, pp.22-23) found that 83 percent of non-economist endorsed a counter-cyclical policy that would eliminate recessions but also eliminate expansions. For professional economists 84 percent favored a counter-cyclical policy that equally eliminated recessions and expansions. This is a high degree of agreement for both groups and one of the few questions in the survey where economists and non-economists were in very close agreement. What is also interesting is that the survey was not taken in a recessionary period with high unemployment rates as we have had in the crisis of 2007-2012; but instead taken in a period of good times when the U.S. economy was experiencing better than average real GDP growth of 3.7 percent, an unemployment rate of 5.4 percent and falling, and a labor participation rate of 66.9 percent and rising (all data taken from the Economic Report of the President).

volatility that we emphasize in this paper, from the many other relationships (eg, the relationship between money and prices) that characterize a complex real economy. Moreover, introducing price inflation would make the misallocation even worse for households by redistributing financial resources towards banks and away from householder saver/investors. Productive investment generates a "good" (expected return) and a "bad" (variability of return). This excessive productive investment associated with fractional reserve banking generates a lower return to risk ratio than the ratio associated with the maximum expected utility reflected in the indifference curves of saver/investors at the optimal level of savings and investment when banks are subject to 100 percent reserves. More importantly excessive productive investment today will sow the seeds of greater variability in income and output tomorrow.

Of course moving to 100 percent reserve banking in the real world would not eliminate the financial amplification of the business cycle, a point emphasized by Simons back in the 1930's. Non-bank financial institutions and individual savers investing in speculative asset markets are subject to the same swings in risk perceptions and risk aversion as today's fractional reserve banks. In our model this is represented by a clockwise or counter clockwise change in the indifference curves of investors. The only difference is that with 100 percent reserve banking, household savers *choose* with their portfolio decisions based on their taste for risk and expected return the volatility in future real economic activity that maximizes their expected utility. The goal of 100 percent reserve banking presented in this paper is the same as it was in the original "Chicago Plan"*;* namely*,* to safeguard deposit money at a relatively less expensive cost than current regulation but more importantly, *moderate* the amplifying effect of the banking system on the real economy. However whether or not the policy of dampening expansions as well as recessions by separating deposit banking from financial intermediation is one that will be supported by the legislative branches of government subject to outside political pressures remains to be seen.

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REFERENCE

Allais, M. 1987. "The Credit Mechanism and its Implications." In G. Feiwel, ed., *Arrow and the Foundation of the Theory of Economic Policy.* Washington Square, NY: New York University Press.

Benes, J. and M. Kumhof. 2012. "The Chicago Plan Revisited." IMF Working Paper, WP/12/202.

Berger, A. and G. Udell. 2003. "The Institutional Memory Hypothesis and the Procyclicality of Bank Lending Behavior." *Journal of Financial Intermediation* 13, 458-495.

Bertaut, C., L. DeMarco, S. Kamin, and R. Tryon. 2011. " ABS Inflows to the United States and the Global Financial Crisis." International Finance Discussion Papers, Board of Governors of the Federal Reserve System.

Brandt, M. and Q. Kang. 2003. "On the Relationship between the Conditional Mean and Volitility of Stock Returns: A Latent VAR Approach." *Journal of Financial Economics* 72, 217-257.

Campbell, S. and F. Diebold. 2009. "Stock Returns and Expected Business Conditions: Half a Century of Direct Evidence." *Journal of Business and Economic Statistics* 27, 266-278.

Caporale, G., S. DiColli, and J. Lopez. 2013. "Bank Lending, Procyclicality, and Credit Quality during Financial Crises." Unpublished Discussion Paper Number 1309, DIW Berlin, available at http://www.diw.de/discussionpapers

Cunningham, D. and J. Rose. 1994. "Bank Risk Taking and Changes in Financial Conditions of Banks' Small and Midsized Commercial Customers, 1978-1988 and 1988-1991." *Journal of Financial Research Services* 8, 301-310.

De Sota, J. M. 2009. *Money, Bank Credit, and Economic Cycles.* Auburn Alabama: The Ludwig von Mises Institute.

Diamond, D. and P. Dybvig. (1983). "Bank Runs, Deposit Insurance, and Liquidity." *Journal of Political Economy* 91, 401-419.

Drehmann, M. and C. Borio, and K. Tsatsaronis. 2011. “Anchoring Countercyclical Capital Buffers.” *International Journal of Central Banking 7,* 189-240.

Feldman, R. 2009. “Raghuram Rajan, An Interview.” *Banking and Policy Issues Magazine.* Minneapolis Federal Reserve Bank, 19-29.

Fisher, I. 1935. *100 Percent Money*. New Haven: The City Printing Company, 1935.

Friedman, M. 1959. *A Program for Monetary Stability*. New York: Fordham University Press, 1959.

Gilboa, I., A. Postlewaite, L. Samuelson, and D. Schmeidlier. 2014. “ Economic Models as Analogies.” *Economic Journal* 124, F 513-533.

Harrison, P. and H. Zhang. 1999. An Investigation of the Risk and Return Relation at Long Horizons.” *Review of Economics and Statistics.* 81, 399-408.

Hoggarth, G., R. Reis, and V. Saporta. 2002. “Costs of Banking System Instability: Some Empirical Evidence.” *Journal of Banking & Finance* 26, 825-855.

Jimenez, G. and J. Saurina. (2006). “Credit Cycles, Credit Risk, and Prudential Regulation.” *International Journal of Central Banking* 2, 65-98.

Kashyap, A., R. Rajan, and J. Stein. 2002. “Banks as Liquidity Providers: An Explanation for the Co-Existence of Lending and Deposit-Taking.” *Journal of Finance* 57, 33-73.

Keeton, W. 1999. “Does Faster Loan Growth Lead to Higher Loan Losses?” Federal Reserve Bank of Kansas City *Economic Review,* 57-75.

Kothari, S., T. Laguerre, and A. Leone. 2002. “Capitalization versus Expensing: Evidence on the Uncertainty of Future Earnings from Capital Expenditures versus R&D Outlays,” *Review of Accounting Studies,* 7, 355-382.

Kotlikoff, L. 2010. *Jimmy Stewart is Dead: Ending the World’s Ongoing Financial Plague with Limited Purpose Banking.* Hoboken, N.J. Wiley.

Krainer, R. 2009. “Portfolio and Financing Adjustments for U.S. Banks: Some Empirical Evidence.” *Journal of Financial Stability* 5, 1-24.

Krainer, R. 2013. “Towards a Program for Financial Stability.” *Journal of Economic Behavior & Organization* 85, 207-219.

Lettau, M. and S. Ludvigson. 2009. “Measuring and Modelling Variations in the Risk-Return Tradeoff. In Ait-Sahalia, Y. and L. Hanson (Eds), *Handbook of Financial Econometrics, Elsevier, 617-690.*

Lintner, J. 1965. “Security Prices, Risk, and Maximal Gains from Diversification.” *Journal of Finance* 20, 587-615.

Lucas, R. 1973. “Some International Evidence on Output-Inflation Tradeoffs.” *American Economic Review* 63, 326-334.

Lucas, R. 2013. “Glass-Steagall: A Requiem.” *American Economic Review: Papers and Proceedings* 103, 43-47.

Ludvigson, S. and S. Ng. 2007. “The Empirical Risk-Return Relation: A Factor Analysis Approach.” *Journal of Financial Economics* 83, 171-222.

Lustig, H. and A. Verdelhan. (2012). “Business Cycle Variation in the Risk-Return Trade-off.” *Journal of Monetary Economics* 59, S35-S49.

Maki, U. 2005. “”Models Are Experiments, Experiments are Models.” *Journal of Economic Methodology* 12, 303-315.

Maki, U. 2009. “Realistic Realism about Unrealistic Models.” In Kincaid, H. and D. Ross (Eds), *Oxford Handbook of Philosophy of Economics*, New York: Oxford University Press, 68-98.

Pennacchi, G. 2012. “Narrow Banking.” *Annual Review of Financial Economics 4,* 141-159.

Pfleider, P. 2014. “Chameleons: The Misuse of Theoretical Models in Finance and Economics.” Unpublished Working Paper available on the SSRN.

Prager, J. 2012. “The Financial Crisis of 2007/2008: Misaligned Incentives, Bank Mismanagement, and Troubling Policy Implications.” Available at http://ssrn.com/abstract=2094662.

Sharpe, W. 1964. “Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk.” *Journal of Finance* 19, 425-442.

Shiller, R. 1996. “Why do People Dislike Inflation.” Cowles Foundation Discussion Paper No. 1115.

Simons, H. 1934. “A Positive Program for Laissez-Faire: Some Proposals for a Liberal Economic Policy.” Public Policy Pamphlet No. 15. Chicago: University of Chicago Press.

Stiglitz, J. 1972. “On the Optimality of the Stock Market Allocation of Investment.” *Quarterly Journal of Economics* 86. 25-60.

Stiglitz, J. 2011. “Rethinking Macroeconomics: What Failed and how to Repair it.” *Journal of the European Economic Association* 9. 591-645.

Suurmeijer, P. Smid, and H. von Eije. 2013. “Research and Development and Firm Risk.” Unpublished Working Paper Available at SSRN: http//ssrn.com/abstract=2350270.

Tobin, J. 1985. “Financial Innovation and Deregulation in Perspective.” *Bank of Japan Monetary and Economic Studies 3*, 19-25.

Weinberg, J. 1995. “Cycles in Lending Standards?” Federal Reserve Bank of Richmond *Economic Quarterly* 1-17.

Figure 1

Pareto Efficient Investment in a CAPM Model

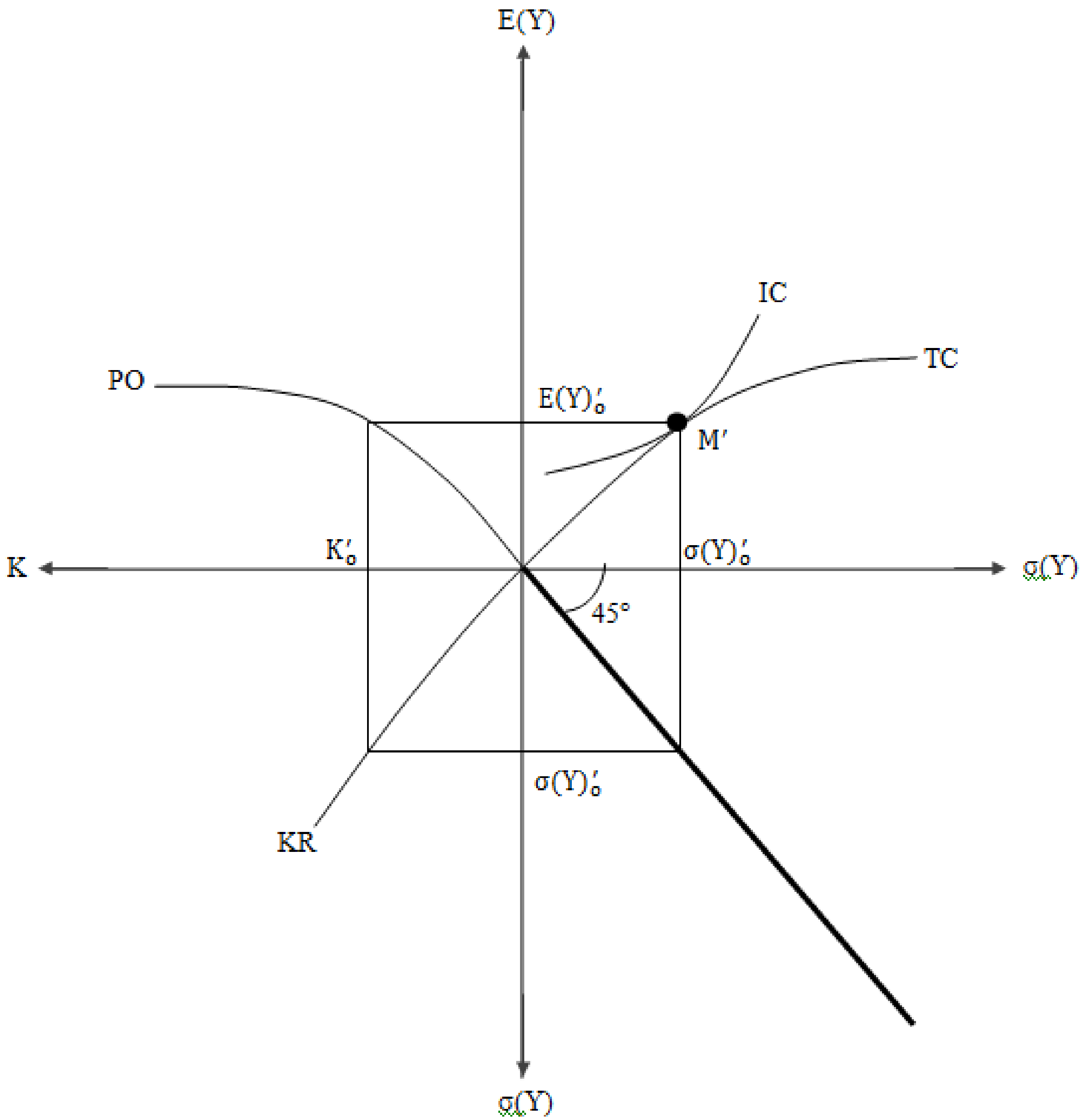
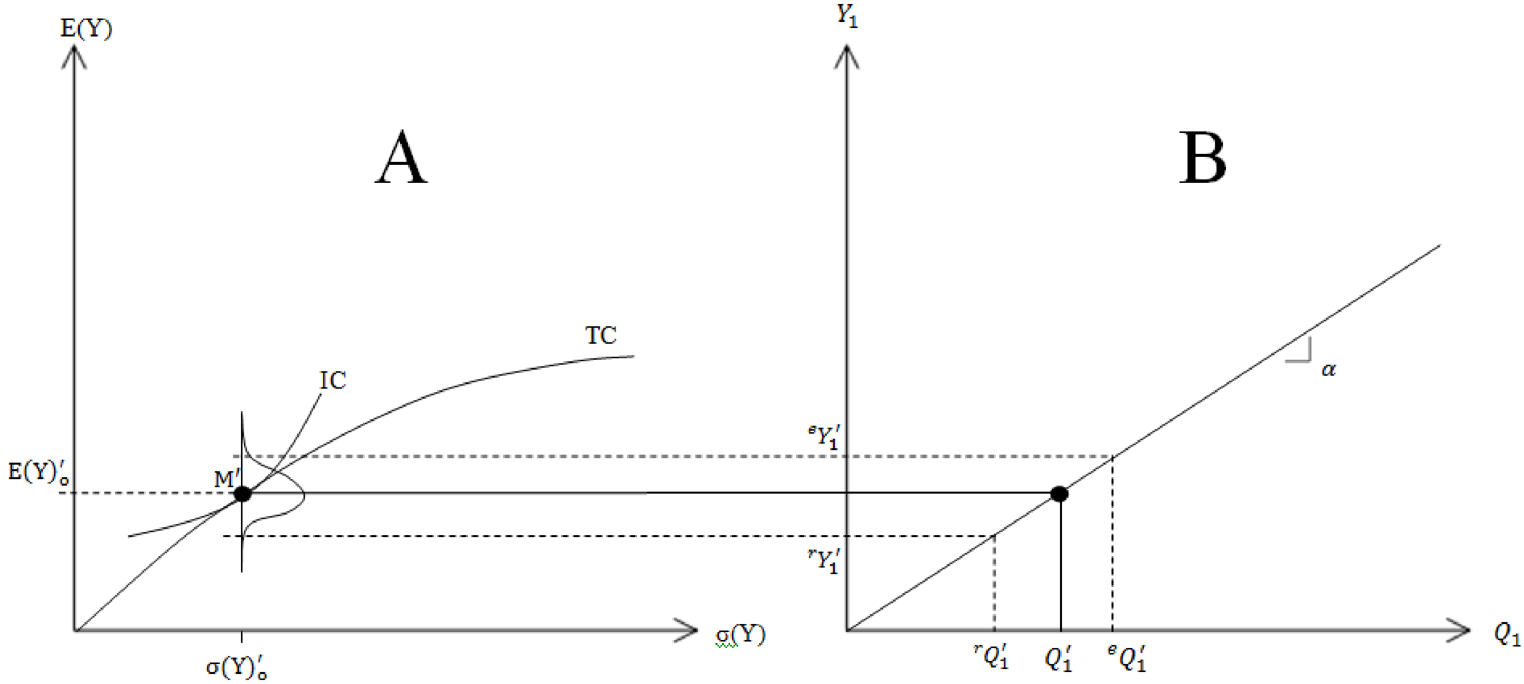


Figure 2

Business Cycles in a CAPM Model



$$Q_1 = A\ [\ K_0^{\alpha}\ N_0^{1-\alpha}]$$

Figure 3

Pareto Efficiency under Alternative Banking Systems in a CAPM Model

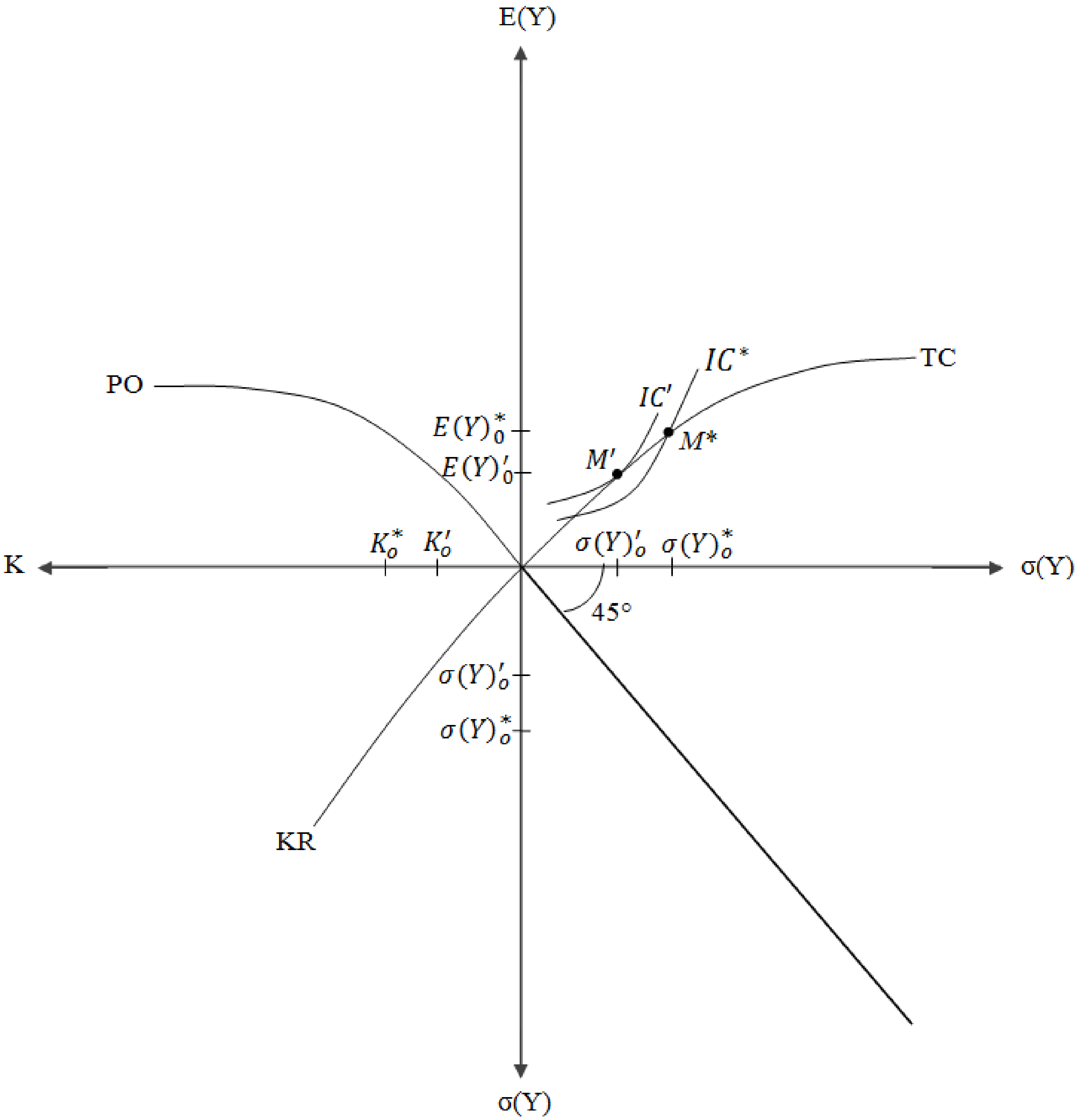


Figure 3A

Pareto Efficiency under a Fractional Reserve Banking System

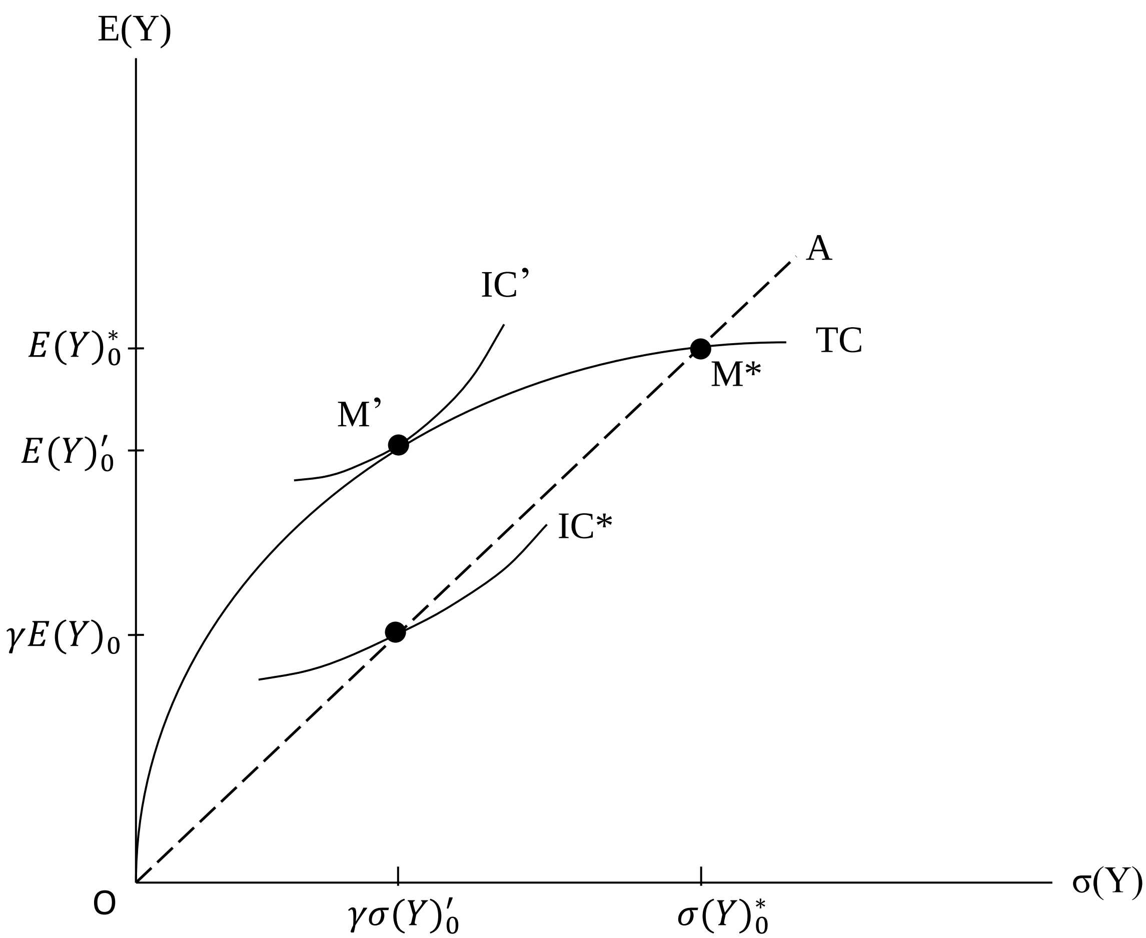
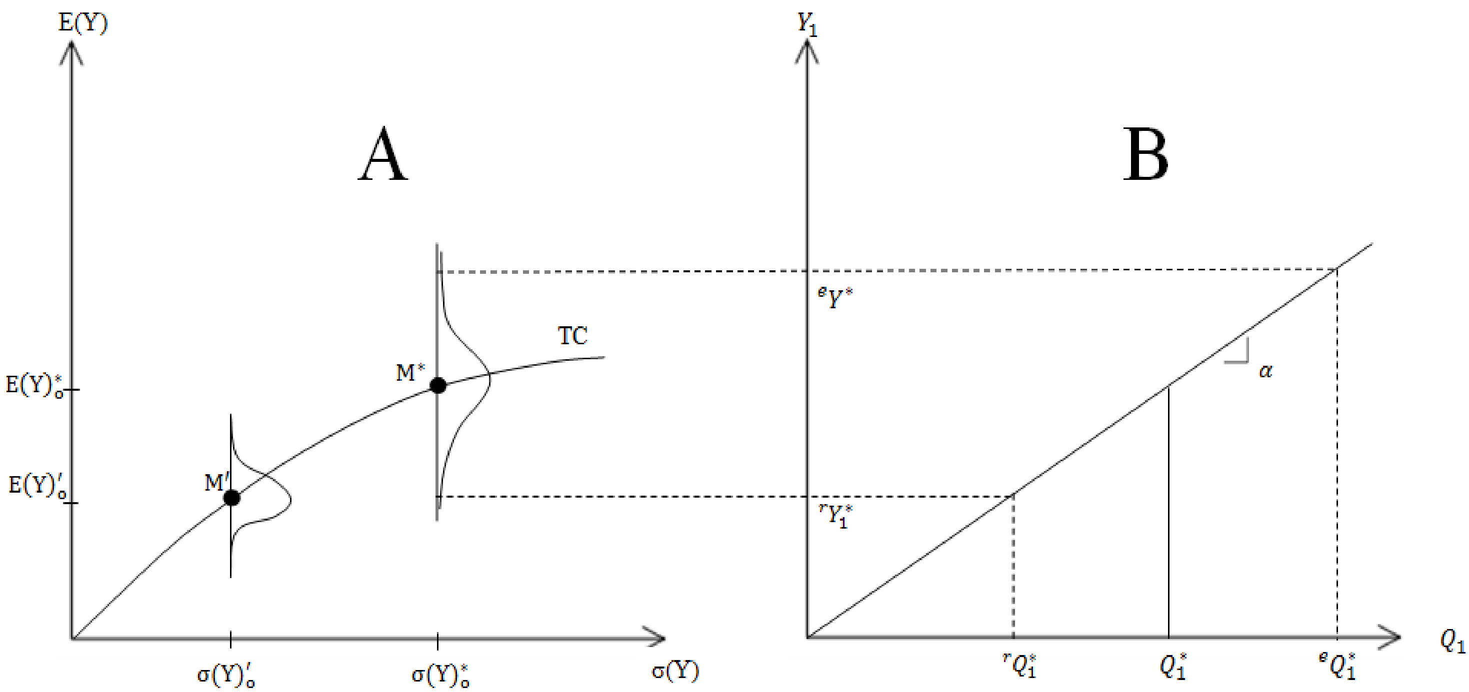


Figure 4

Business Cycles under Alternative Banking Systems in a CAPM Model



$Q_1 = A\ [K_0^{\alpha}\ N_0^{1-\alpha}]$