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Mahmut Yardimcioglu
Kahramanmaras Sutcu Imam University
Editor

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LETTER FROM THE EDITOR

Welcome to the *Academy of Accounting and Financial Studies Journal.* The *Journal* is the official publication of the Academy of Accounting and Financial Studies, an affiliate of the Allied Academies, Inc., a non profit association of scholars whose purpose is to encourage and support the advancement and exchange of knowledge, understanding and teaching throughout the world. The mission of the *AAFSJ* is to publish theoretical and empirical research which can advance the literatures of accountancy and finance.

As has been the case with the previous issues of the *AAFSJ*, the articles contained in this volume have been double blind refereed. The acceptance rate for manuscripts in this issue, 25%, conforms to our editorial policies.

The Editor works to foster a supportive, mentoring effort on the part of the referees which will result in encouraging and supporting writers. We continue to welcome different viewpoints because in differences we find learning; in differences we develop understanding; in differences we gain knowledge and in differences we develop the discipline into a more comprehensive, less esoteric, and dynamic metier.

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Mahmut Yardimcioglu
Kahramanmaras Sutcu Imam University
Turkey

THE MORTGAGE INDUSTRY'S ROLE IN THE CURRENT GLOBAL FINANCIAL MELTDOWN: HISTORICAL PERSPECTIVE AND RECOMMENDATIONS

Christopher Ngassam, Grambling State University

ABSTRACT

This paper examines the two specific areas where the mortgage industry's transmission of "mispriced" assets into the financial system led to the deterioration of investor's confidence in the entire financial system. These two areas, the regulatory environment that created an asset bubble in mortgage based collateral and the rapid growth of structured instruments (including credit-based derivatives) in our view, significantly impacted the magnitude and scope of the problem. We show that each had a direct impact on the existing credit framework in different ways and adversely affected the risk assessment of mortgage related collateral. The exposure that financial institutions have to this "mispricing" of credit, in a variety of ways, led to the volatility observed in financial markets since the fall of 2008.

We conclude the paper by emphasizing that future credit risk frameworks will require greater emphasis on consistent global standards regarding securities trading and risk management practices. Techniques and methods used for assessing the creditworthiness of financial obligations, collateral, securitizations, and counterparties are required not only to be robust but adhered to by the management of financial institutions and investors in general. We argue that until major reforms in regulation & financial product risk analysis are implemented, investor confidence will not return. Actions that will help the proposed "bailout" achieve its goal of restoring investor confidence and trust in the financial system are hereby suggested.

INTRODUCTION

The scope and severity of the largely unexpected global financial crisis in 2008 have prompted numerous commentaries and heated policy debates. According to Reuters, between January and September, 2008, the stock market index for "emerging markets" lost nearly 55 percent of its value and the index for "developed markets" lost 42 percent. The S&P 500 of US stocks lost half its value from its October, 2007 peak, marking what the Financial Times calls "without question, the worst bear market since the 1930s." Consequences of the global financial meltdown we are currently witnessing are still unfolding in the United States. For example, ten million Americans are out of work, nearly 3 million more than a year ago. The official

unemployment rate rose to 6.5 percent in October, its highest rate in 14 years. 7.3 million American homeowners are expected to default on their mortgages between 2008 and 2010, with 4.3 million of those losing their homes. As of September 30, 2008, one-fifth of American homes with mortgages were "underwater" -- worth less than was owed on their mortgages. National and global efforts to counter the crisis have included cuts in interest rates, support for money markets, and recapitalization of banks. Their total cost as of mid-November has been estimated at more than $4 trillion.

Alan Greenspan, chairman of the Federal Reserve Bank for over 18 years, presided over the longest economic boom in the country's history acknowledged under congressional questioning that he had made a "mistake" in believing that banks, operating in their own self-interest, would do what was necessary to protect their shareholders and institutions. Greenspan called that "a flaw in the model ... that defines how the world works."[1] When the credit risk framework has "flaws" such as the ones Mr. Greenspan describes then a crisis of investor confidence results, asset re-pricing occurs, and depending on the dispersion of those assets it can undermine the global financial system itself. The first global tremor of the Credit Crisis of 2008 was the injection of $150 billion of liquidity by the European Central Bank (ECB) into European capital markets to reduce rapidly rising borrowing costs. That was followed the next day by BNP Paribas freezing redemptions from 3 of its mutual funds due to "The complete evaporation of liquidity in certain market segments of the US securitization market has made it impossible to value certain assets fairly regardless of their quality or credit rating."[2] As a result, BNP Paribas has stopped investors from making deposits or redemptions and suspended calculations of the net asset value of its funds. BNP Paribas said it had taken these drastic measures "to protect the interests and ensure the equal treatment of out investors, during these exceptional times". The bank added that the suspension would be lifted "as soon as liquidity returns to the market allowing net asset value to be calculated".[3]

The inability to correctly value the assets and the suspension of operations in the BNP Paribas mutual funds shook investor confidence significantly. At its core, the proper functioning of the US & global financial market system relies upon the confidence that investors can accurately assess the relevant risks and reasonably estimate risk-adjusted expected returns based on that risk assessment. Traditionally, credit risk refers to the risk that a borrower or counterparty will fail to meet its obligations. Lending, from credit cards to corporate loans, is the largest and most obvious source of credit risk. But credit risk in some form exists throughout a financial institution's activities, both on and off the balance sheet. It's not just banks that are subject to credit risk, fund managers and investors are directly exposed to credit risk in their fixed-income investments. Insurance companies are exposed to it through their credit investments and credit guarantees. Companies are exposed to the risk that trading partners, distributors or suppliers may default or fail to live up to critical obligations. A simple premise that holds together a broad financial system based on the extension of credit. The entire process, from origination of various assets to the trading of their securitized form, should be supported by knowledgeable analysis of

their riskiness as well as factors that influence their intrinsic value and price. Increasingly, the mispricing of credit risk has stressed financial markets worldwide in ways that have threatened the global financial system. The credit risk framework has failed consistently in most recent major market events (Asian Contagion 1997, Russian Bond Default 1998, LTCM 1998, Credit Crisis 2008) with global systemic implications.

The objective of this paper is to examine the two specific areas where the mortgage industry's transmission of "mispriced" assets into the financial system led to the deterioration of investor's confidence in the entire financial system. These two areas, the *regulatory environment* that created an asset bubble in mortgage based collateral and the *rapid growth of structured instruments* (including credit-based derivatives) in our view, significantly impacted the magnitude and scope of the problem. We show that each had a direct impact on the existing credit framework in different ways and adversely affected the risk assessment of mortgage related collateral. The exposure that financial institutions have to this "mispricing" of credit, in a variety of ways, led to the volatility observed in financial markets since the fall of 2008.

In the next Section we describe the mortgage environment that prevailed before the credit crisis. Section three lists some of the government regulatory policies that led to the crisis while Section four explains the role played by structured investments and innovations. Conclusions and recommendations for restoring confidence in the financial system are provided in Section five.

THE PRE-CRISIS MORTGAGE ENVIRONMENT

Several factors led to the meltdown of the US mortgage market in 2007. Many experts believe that the meteoric rise in subprime lending was the major contributor to demise of the US mortgage market. The mortgage crisis began somewhere between 2004 and 2006 when the U.S. housing market bubble burst.

Home ownership rates increased dramatically between 1994 and 2004 to an all time high of 69 percent. Speculation in residential real estate has been a contributing factor. This rise in demand fueled rising house prices and consumer spending.[4] Between 1997 and 2006, the price of the typical American house increased by 124%.[5] During the two decades ending in 2001, the national median home price ranged from 2.9 to 3.1 times median household income. This ratio rose to 4.0 in 2004 and 4.6 in 2006.[6] This housing bubble resulted in quite a few homeowners refinancing their homes at lower interest rates, or financing consumer spending by taking out second mortgages secured by the price appreciation. US household debt as a percentage of annual disposable personal income was 127% at the end of 2007, versus 77% in 1990.[7] Household debt grew from $705 billion at yearend 1974 (60% of disposable personal income) to $7.4 trillion at yearend 2000, and finally to $14.5 trillion in midyear 2008 (134% of disposable personal income).[8]

The credit and house price explosion led to a building boom and a surplus of unsold homes. Easy credit, and the general belief that housing prices would continue to appreciate, encouraged many subprime borrowers to obtain adjustable-rate mortgages. Floating-rate debt was a particularly poor choice since interest rates were universally expected to rise over all terms, short to long term. These mortgages enticed borrowers with a below market interest rate for a "teaser" period, usually one to three years, followed by market interest rates for the remainder of the mortgage's term. Borrowers who could not make the higher payments once the initial grace period ended would try to refinance their mortgages at the time the teaser period ended. Unforeseen in the models of issuers, the credit ratings agencies, or the regulators was the correlation of event risk across all levels of mortgage financing. As economic conditions weakened, the planned refinancing of mortgage rates became more difficult when house prices began to decline. Borrowers discovered that they could not escape higher monthly payments by refinancing and began to default. By September 2008, average U.S. housing prices had declined by over 20% from their mid-2006 peak[9] (See Figure 1).

Figure 1. Falling US Home Prices[10]

This major and unexpected decline in house prices means that many borrowers have zero or negative equity in their homes, meaning their homes were worth less than their mortgages and as such the loans were under collateralized. The common term for this condition is "being upside down" in the loan for the borrower, or "underwater" from the perspective of the lender. Both describe the condition of the market value of the home being less than the outstanding amount due on the loan. As of March 2008, an estimated 8.8 million borrowers (10.8% of all homeowners) had negative equity in their homes, a number that is believed to have risen to 12 million by November 2008. Borrowers in this situation have an incentive to "walk away" from their mortgages and abandon their homes, even though doing so will damage their credit rating for a number of years.[11] US residential mortgages are non-recourse loans. This means that once the creditor has regained the property purchased with a mortgage in default through foreclosure,

the creditor has no further claim against the defaulting borrower's income or assets. The creditor, usually a bank or mortgage company, will have to list the property on its own balance sheet as a REO (Real Estate Owned) and attempt to recoup its losses on the defaulted loan by selling the house in question. As more borrowers stop paying their mortgage payments, foreclosures and the supply of homes for sale increase. This oversupply places downward pressure on housing prices, which further lowers homeowners' equity.

A record level of nearly 40% of homes purchases in 2005 and 2006 were investment properties, not intended as primary residences by the borrower. This represented over $5 billion of mortgages for those two years alone. The National Association of Realtor's stated that the 2006 decline in investment buying was expected as "Speculators left the market in 2006, which caused investment sales to fall much faster than the primary market."[12]

While homes have not traditionally been treated as investments, this behavior changed during the housing boom. In certain areas of the country, it was estimated that 85% of condominium properties purchased in Miami were solely for investment purposes. Local news media widely reported condominiums being purchased while under construction, then being "flipped" (sold) for a profit without the seller ever having lived in them.[13] At the height of the speculation, condos in South Florida were reportedly flipped 2 or 3 times within a week. Some mortgage companies identified risks inherent in this activity as early as 2005, after identifying investors assuming highly leveraged positions in multiple properties.[14]

The boom in the housing market saw home values increase to an astonishing 124% between 1997 and 2006. With home values so high, many individuals decided to take out second mortgages, for a number of reasons, which resulted in US household debt rising to 130 percent of actual household income in 2007. In some cases, piggyback loans (2nd mortgages) were used to self-finance the required down payment on the initial mortgage. In other cases, the proceeds from the second mortgage were used to finance other purchases (cars, boats, etc.) when that the borrower had no other access to credit. This sort of leveraged borrowing exacerbated the "upside down/underwater" problem described earlier. The extension of credit for second mortgages, HELs (home equity loans) and HELOCS (home equity lines of credit) were all based on overvalued home appraisals. When the housing bubble burst, many of these individuals with such high debt levels were not able to make those mortgage payments. As of 2006 the there was an estimate of $1.3 trillion in subprime loans that were outstanding. Experts believe that Wall Street firms even encouraged the excessive risk taking by lenders because they had institutional investors who were looking for large returns on their investment and by bundling subprime loans with securities they were able to create securities with various risk-reward profiles.

Many observers believe that the emergence of new specialized mortgage lenders helped fuel the mortgage crisis. These new lenders are not regulated in the same way as traditional banks. Bank lenders traditionally made up 60 percent of mortgage market lending in the 1970s where as today they only make about 10 percent. Also, with the rise of these unregulated lenders came an increase in the types of subprime loans that were offered in the marketplace. Some of

these loans include, adjustable rate mortgages, IOs (interest only mortgages), Alt-A (near prime), Pick-a-Payment loans with negative amortization options, and stated income or NINJA (No Income, No Job, and no Assets) loans. With a stated income loan, the borrower does not have to provide documentation to prove the income they stated on their application. During the peak of the housing bubble, such loans went from niche products offered to a select set of subprime borrowers to almost standard issue.

Lenders began to offer more and more loans to higher-risk borrowers. Subprime mortgages amounted to $35 billion (5% of total originations) in 1994,[15] 9% in 1996,[16] $160 billion (13%) in 1999,[17] and $600 billion (20%) in 2006.[18] The risk premium required by lenders to offer a subprime loan declined. This occurred even though the credit ratings of subprime borrowers, and the characteristics of subprime loans, both declined during the 2001–2006 period. The combination of declining risk premia and credit standards is common to classic boom and bust credit cycles.[19] In addition to considering higher-risk borrowers, lenders have offered increasingly risky loan options and borrowing incentives. In 2005, the median down payment for first-time home buyers was 2%, with 43% of those buyers making no down payment whatsoever.[20]

That final point described is an important one. Interest not paid being added on the back end to the principal has brought a great deal of criticism of GAAP accounting rules, predatory lending practices, and mortgage fraud. These types of loans essentially removed prudent credit review from the underwriting process. If lenders could choose to ignore the net worth, or the lack thereof, of potential borrowers and still make the loan, who couldn't or shouldn't be extended credit? Additionally, these pick-a-pay loans as they were termed exposed how fragile some bank balance sheets really were. GAAP accounting rules allowed for the recording of the unpaid portion of the interest payment as income. In the case of a Florida lender, BankUnited FSB, reportedly over 80% of its income from operations in 2005 came from negative amortization "earned". Yet, if the borrower was already struggling to make the interest payments, the likelihood of future payments on a higher principal balance should have viewed with serious skepticism by regulators. The issuance of these types of loans with the questionable accounting rules substantially contributed to the demise of Indy Mac Bank, Countrywide Financial, and Washington Mutual.

Also fueling the fire were programs such as seller funded down payment assistance programs. A DPA is a program where the seller gives money to a charitable organization which in turn gives the money to buyers. The Government Accountability Office stated that there is a much higher foreclosure and default rate among mortgages financed by DPAs. In order to recoup their profits, these DPA programs also inflated home values. Due to all these facts, the Department of Housing and Urban Development have banned seller funded DPAs.

Underwriters and mortgage brokers have also help contribute to the crisis at hand. Since they do not lend their own money, there is no correlation between there compensation and the performance of the loan. Adjustable rate mortgages are also favored more by brokers because

they are complex and earn the broker higher commissions. Out of 68 percent of residential loans issued in the U. S. in 2004, 42 percent of them were subprime and Alt A. All brokers were concerned with was their profit and commission and not if the borrowers could actually repay the loans, this left lenders and banks with the resulting defaults. An astonishing 40 percent of all subprime loans were generated by automated underwriting in 2007 where minimal documentation and much quicker decisions (weaker underwriting) occurred. Experts say that lax controls and shortcuts in documentation have led to the approval of borrowers that would not have been approved under a less automated system.

Mortgage underwriting practices have been criticized in the wake of the market meltdown, including automated loan approvals that critics argued were not subjected to appropriate review and documentation.[21] In 2007, 40% of all subprime loans resulted from automated underwriting.[22] The chairman of the Mortgage Bankers Association claimed that mortgage brokers, while profiting from the home loan boom, did not do enough to examine whether borrowers could repay.

THE REGULATORY ENVIRONMENT

Government regulatory policies also contributed to the mortgage crisis. The Community Reinvestment Act (CRA) is a United States federal law designed to encourage banks and savings institutions to meet the needs of borrowers in all segments of their local communities, including low- and moderate-income neighborhoods. The Act requires appropriate federal financial supervisory agencies to encourage regulated financial institutions to meet the credit needs of the local communities in which they are chartered, consistent with safe and sound operation. To enforce the statute, federal regulatory agencies examine banking institutions for CRA compliance.

When we look at some of the long-term regulations that were loosened or overturned that could be responsible for our current banking crisis, the Glass-Steagall Act is one of the first mentioned. The Glass-Steagall Act was created as a response to the Great Crash of 1929, where one in every five banks in the United States failed. The cause of the crash was attributed by most observers to market speculation that banks engaged in during the 1920s. The Glass-Steagall Act was created by Senator Carter Glass and Congressman Henry Steagall of Virginia and Alabama respectively. Glass-Steagall was created to limit the conflicts of interest created when commercial banks are permitted to underwrite stocks or bonds. "In the early part of the century, individual investors were seriously hurt by banks whose overriding interest was promoting stocks of interest and benefit to the banks, rather than to individual investors"[23] ("Long Demise"). Glass-Steagall would ban commercial banks from underwriting securities; this made banks choose between being lenders or underwriters.

The end came in November 1999, when congress passed the Financial Services Modernization Act. It was the final prize after twelve attempts and millions of lobbying dollars

spent during the process. The end of Glass-Steagall had finally come and the results of this decision were on the horizon.

The fact is that Glass-Steagall may not have changed the evolution of the collateralized debt obligations, but it might have helped to identify and isolate the damage. Glass-Steagall would have at least provided something that is now a buzz word for politicians…transparency. This is a concept that is best accomplished when outsiders are the ones looking at the situation. Without an outside point of view, many things are missed or glossed over, which is a problem for everyone. "When banks are being scrutinized and subject to due diligence by third-party securities analysts more questions are raised than when the scrutiny is by the people in the same cafeteria."[24] (Kostigen) Glass-Steagall forced separation to deal with the system of conflicts that arise when sellers, salesmen and evaluators are working together on the same team.

There were also changes in reserve requirements for banks and special sweep accounts that link commercial checking and investment accounts that allowed for greater liquidity, this allowed banks to offer more credit. When the Fed cut rates to 1.24 percent from 6 percent in 2002, the demand for ARMs drastically increased and the housing bubble was born. Unfortunately by 2005, the housing bubble had burst and the federal ineptest rates had risen. Foreclosures of homes bought with subprime loans had increased dramatically and despite warning signs, subprime mortgages still continued to gain popularity. In 2006, there was a 31 percent increase in foreclosure filings as the new specialized lenders foreclose on properties much more frequently than conventional lenders.

THE ROLE OF STRUCTURED INVESTMENTS

One of the greatest innovations in US credit markets in the past 30 years was the creation of the mortgage-backed securities (MBS) market. The securitization of mortgages brought new capital and led to more liquid assets and more efficient market pricing of mortgages. It also led to specialized intermediation of the mortgage market in the form of government and quasi-government entities in conjunction with banks & private investors. Together, these improvements lowered mortgage rates for borrowers, broadened homeownership and eliminated regional disparities in the deployment of capital for home mortgage lending.

The MBS securitization process converted non-rated, illiquid loans into securities that are highly liquid, have low credit risk and offer competitive rates of return. With daily trading volume exceeding $200 billion and outstanding debt more than $5.3 trillion in 2003, the US mortgage-backed securities market today is one of the most liquid in the world. MBS paper offer higher yield than Treasury notes and corporate bonds. This higher yield compensates partially for the higher credit risk, market risk and especially the embedded prepayment option. The mortgage securitization process also helped to stabilize the US housing finance system by shifting the interest rate risk of mortgages from banks and thrifts to numerous investors. Furthermore, much of the credit risk is now held by enterprises like Fannie Mae and Freddie

Mac. These large corporations are highly capable of diversifying credit risk because they package mortgages from across the whole nation, compared to most local banks and thrifts who deal primarily with mortgages from their region.

The major issuers of mortgage-backed securities are Ginnie Mae, Freddie Mac and Fannie Mae. The Federal National Mortgage Association, Fannie Mae, was created by Congress in 1938 to add new capital and liquidity to the US mortgage market. It was initially owned by the federal government through the Reconstruction Finance Corporation (RFC). In 1968, Fannie Mae was split into two corporations: Ginnie Mae, which stayed associated with the government, and Fannie Mae which became a private stockholder-owned corporation.

The role of Ginnie Mae, since 1968, is to provide a secondary market for government-insured mortgages; it is on the federal budget and its programs are backed by the full faith and credit of the US government. The Federal Home Loan Mortgage Corporation, also known as Freddie Mac, was established by Congress in 1970 to be a secondary market in mortgages for the savings and loans industry. It was privatized in 1989 into a private stockholder-owned corporation. Fannie Mae and Freddie Mac, unlike Ginnie Mae, were not backed by the full credit and faith of the US government.[25] The market perceives an implicit guarantee by the US government because its unlikely to let these institutions fail in the event of financial problems. As a result, these institutions pay low credit risk premiums when they borrow in private capital markets.

A major innovation for the MBS market occurred in 1983 when Freddie Mac issued the first Collateralized Mortgage Obligations (CMOs). These new instruments appealed to investors with special maturity and cash-flow requirements but faced complex tax, accounting and regulatory obstacles. Much of those legal issues were resolved with the passing of the Tax Reform Act of 1986 which included the Real Estate Mortgage Investment Conduit (REMIC) tax vehicle, and issuance of CMOs grew rapidly.

Pass-Through Securities

The pass-through or the "participation certificate" (PC) is the most common structure for mortgage-backed securities. The MBS issuer acquires mortgages from original mortgage lenders. The agency then examines the mortgages to ensure that they meet the credit-quality guidelines. Loans with similar characteristics (yield and maturity) are pooled together and the servicer "passes through" a pro rata share of all interest and principal payments to the investors. For example if an investor owns 2% of the pool, she would receive 2% of all the payments of interest and principal received by the pool less fees. The actual packaging or "pooling" can be done by the government sponsored enterprises: Ginnie Mae, Fannie Mae and Freddie Mac, or by private enterprises. Payments to investors are made on a monthly basis. Since not all the mortgages in a pool have the exact same mortgage rate and maturity, a weighted-average coupon (WAC) is calculated for the pool of mortgages backing the pass-through. However, investors

receive what is called net coupon which is the WAC less the fees that the MBS issuer charges for guaranteeing the issue.

Figure 2.[26]

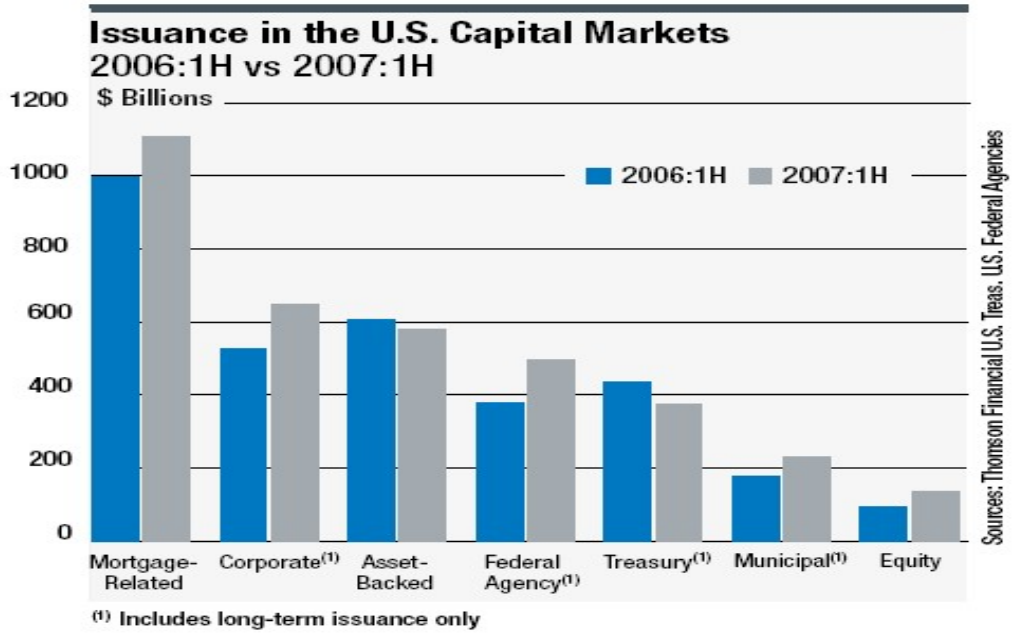
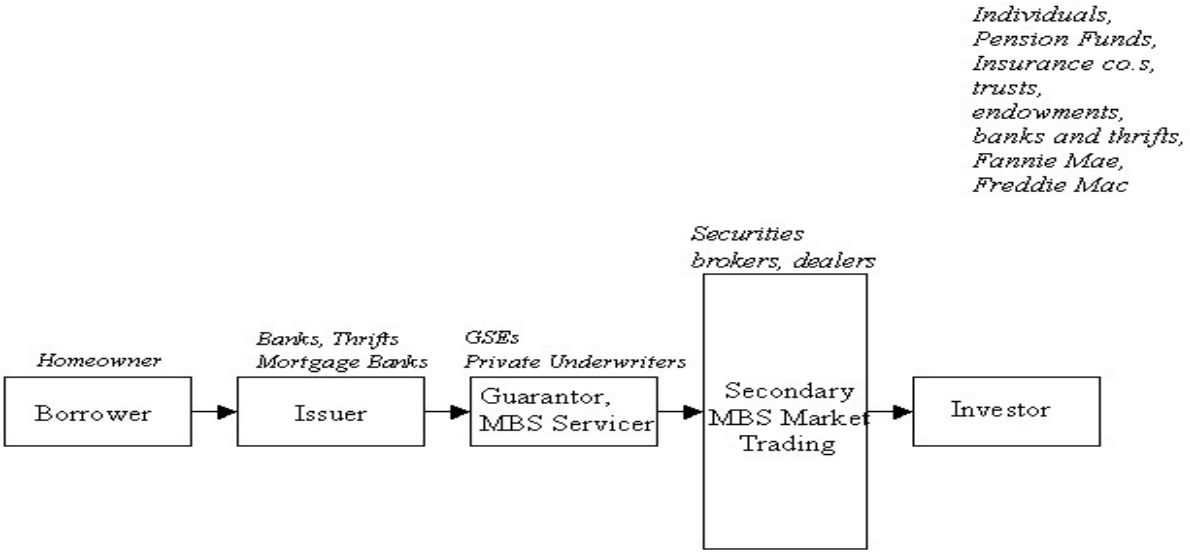


Figure 3. The Mortgage Market Securitization Cycle



Prepayment Risk

One of the features that distinguish mortgage-backed securities from other fixed-income instruments is the embedded prepayment option. Borrowers may prepay their mortgages for a wide variety of reasons, such as moving, default or refinancing to take advantage of lower rates. If the borrower relocates or defaults on the loan, the house is sold and the whole mortgage is paid back. The borrower might also choose to refinance if mortgage rates fall significantly lower than their contract rate. Furthermore, borrowers can choose to overpay their monthly bills, called curtailments, so as to save by retiring their debts early. In all cases, the prepayment results in a reduction of the outstanding balance of principal of the mortgage pool.

The prepayment model published by the Public Securities Association (PSA) is the industry standard and most commonly used. It starts with the assumption of .2% prepayment rate the first month and rises by .2% each month, until it levels off at 6% at 30 months from the beginning of the mortgage contract. This prepayment assumption is referred to as the mortgage's "ramp". Prepayment speed is usually expressed as a percentage of the PSA model. For example, 100% PSA means the speed of prepayment is .2% until the 30th month, while 200% PSA suggests twice as fast speed of .4% monthly increase until it reaches 12% by the 30th month, where it remains until maturity. What makes mortgage-backed securities much more difficult to price than conventional bonds is that the mortgage investor holds a short option on prepayment. Homeowners hold, and should hold, a long option position, because this allows for more flexibility in decisions. It makes moving to another location less difficult. It also gives the chance to refinance.

Credit Risk

Like any debt instrument, mortgages involve credit risk. Credit risk arises from uncertainty over whether the borrower will perform as required to fulfill interest and principal payments. In order to reduce that risk on mortgages, the conventional mortgage contract, which was developed by Fannie Mae in the 1930s, requires borrowers to put down 20% of the house price as downpayment. This is expressed as 80% loan-to-value ratio when value refers to the market price of the home. Thus the collateral for the mortgage, the value of home, amounts to 125% of the debt principal. Mortgage insurance is provided by several federal government programs as well as by private mortgage insurance companies.

Investors in MBSs do not want to hold credit risk on the underlying mortgages, so MBS issuers provide guarantees. When Fannie Mae and Freddie Mac issue MBSs, they charge a guarantee fee that is currently between 20-30 basis points. This is taken from the gross yield on the loan so it is netted to the investor. These corporations are able reduce their risk of mortgage default by diversifying their large portfolios across the nation. Investors in these MBS thus have

not the individual borrower, but Fannie Mae and Freddie Mac as a counter party to their credit risk. Therefore the credit risk of mortgage-backed securities issued by Fannie Mae and Freddie Mac reflects the credit rating of those corporations.

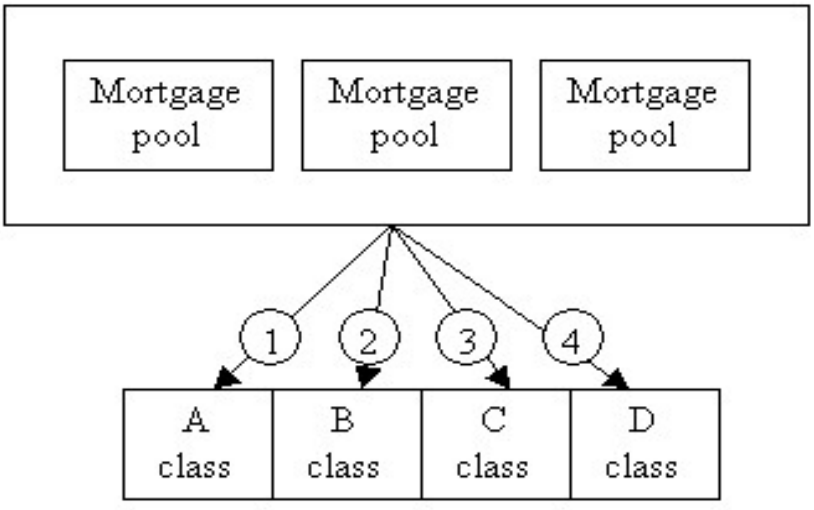
COLLATERALIZED MORTGAGE OBLIGATIONS (CMOS)

Pass-through securities became a popular instrument by the early 1980s, but they held some major drawbacks to investors. The first and most important was that pass-throughs did not offer complete certainty of cash flow. Depending on the actual prepayment from borrowers, investors might end up with a security with different maturity than expected. CDOs reduce the effect of statistical outliers. Lending someone money to buy a house is risky, because that person either defaults or they don't. CDOs turn individual loans into a portfolio in which a default by any single lender is unlikely to have an enormous impact on the portfolio as a whole. By aggregating many different mortgages together into a CDO, investors can own a small percentage of many different mortgages, and therefore the CDO's losses as a result of borrowers defaulting on their obligations usually represent the statistical averages in the market as a whole. Furthermore, pass-throughs did not fully address the different needs of investors for instruments with various maturities. While pension funds and life insurance companies looked for securities with long maturity, banks and thrifts wanted to invest in shorter term instruments. CDOs are created in tranches, portions of the underlying debt that vary in their riskiness, despite being backed by a generic pool of bonds or loans.

Typically, a pool of debt is divided into three tranches, each of which is a separate CDO. Each tranche will have different maturity, interest rates and default risk. This allows the CDO creator to sell to multiple investors with different degrees of risk preference. The bottom tranche will pay the highest interest rate, but will be the first to lose money if some of the loans in the pool aren't repaid. The top tranche will have the lowest interest rate, but will always be the first to be repaid - the bottom two tranches have to be wiped out before the top tranche is affected. This allows bankers to create investments with risk / reward profiles that are very different from the underlying debt in the pool. So, one pool of mortgages can be divided into three CDOs, one with an "AAA" debt rating that pays low interest, one with an intermediate debt rating with moderate interest, and one with a low debt rating with high interest. This is important because some asset manager are only allowed to invest in "AAA" rated debt - dividing a pool of debt that is not AAA rated into three different CDO tranches means at least some portion of that debt is now AAA rated and can be purchased by institutions that can only invest in AAA debt. As an answer to those drawbacks and the demands of different types of investors, Collateralized Mortgage Obligations (CMOs) were created. CMOs provided less uncertainty as to the average life of the investment, and they offered a full spectrum of maturities that appeal to investors with different perspectives.

First issued by Freddie Mac in 1983, CMOs are in essence multiclass securities backed by a pool of pass-throughs or by mortgage loans. The mortgage cash flows are distributed to investors by the MBS issuer based on a set of contractual terms . Some investors will receive their principal payments before others according to the schedule.

Figure 4. Collateralized Mortgage Obligation Diagram



The issuer structures the security in classes, called tranches, which are retired sequentially. With the payments from the underlying mortgages, the CMO issuer first pays the coupon rate of interest to the all investors in each tranche. After that, all the principal payments are directed first to the bond class with the shortest maturity. When the first bond class is retired, the principal payments are directed to the bond class with the next shortest maturity. This process continues until all the tranches are paid fully and if there is any collateral remaining, the residual may be traded as a separate security. In the figure below class A is the class with the shortest maturity. After class A is retired, principal payments go to class B. The last class D has the longest maturity. This structure is commonly known as sequential pay or plain vanilla CMO.

The securitization of mortgages through the issuance of mortgage-backed securities has come to play an important role in the US housing finance system over the past 30 years. The MBS have provided investors with new classes of liquid assets, and in doing so it has helped raise more capital and at a lower costs so as to help American borrowers and the seniority of their loans. The government played an essential role in the development of this securitization process. The government owned Ginnie Mae and the government-sponsored enterprises Freddie Mac and Fannie Mae made the issuance of the first pass-throughs and CMOs possible. After those agency securities entered the market, banks, financial institutions, and private entities were able to also bring mortgage collateral securitizations to the capital markets. Collateralized

mortgage obligations (CMOs) and collateralized bond obligations (CBOs) are examples of CDOs in which the loans that make up the pool of debt in the CDO are mortgages and bonds, respectively. CDOs are structured by investment banks and are bought by all types of asset managers, including hedge funds, insurance companies, banks and pension funds. CDOs can also be purchased through most retail brokerage accounts.

CDOs are created and sold by most major banks (e.g. Goldman Sachs, Bank of America) over the counter, i.e. they are not traded on an exchange but have to be bought directly from the bank. Securities Industry and Financial Markets Association estimates that US$ 503 billion worth of CDOs were issued in 2007. According to data from Securities Industry and Financial Markets Association global CDO issuance increased from $157 billion in 2004, to $503 billion in 2007.[27] The total outstanding CDO is estimated to be over $2 trillion.[28]

Figure 5. Global CDO Issuance[29]

Synthetic CDOs

The term synthetic applies to a CDO in which the underlying assets are credit default swaps (CDS) rather than debt instruments like bonds or loan. Credit default swaps are insurance on default. The buyer of the insurance pays an insurance premium to the seller in exchange for protection from default. Synthetic CDOs played a prominent role in the U.S. subprime crisis, where critics say CDOs hid the underlying risk in mortgage investments because the ratings on CDO debt were based off of misleading or incorrect information about the creditworthiness of the borrowers.

American Insurance Group (AIG), an 89 year old well-capitalized insurance company, decided that it was a better use of cash to write protection against debt instruments rather than owning them. The reason was the anomaly in the pricing of CDS compared to bond yields. The expected action of a insurance firm would have been to buy long-dated assets to match with its long-dated liabilities to run a matched book. If it wanted to buy bonds, *then* it would have

needed to come up with some cash to do so. But writing protection was a way of receiving money, not spending it.

When AIG wrote protection on CDSs it received insurance premiums in return, and considered those premiums to essentially be free money, since (according to AIG's own models, and those of the ratings agencies) the chances of those CDOs defaulting were essentially zero. At AIG, the financial products group booked its profits immediately, without spending any money at all. When their losses arrived, the firm had to scramble to find the cash, since it had never allocated much in the way of capital to the group.

AIG's models said the CDSs couldn't suffer any losses unless house prices fell in all areas of the country simultaneously. Since AIG was only insuring the last-loss CDO tranches, investors with lower-rated tranches took the risk that prices in Florida, or Arizona, or California might fall. AIG would only lose money if prices fell in all those states at once. But AIG, nor its auditors, rating agencies, or regulators, never stopped to think about concentration risk. Within an industry like real estate, the event which could precipitate a payout on one CDS was exactly the same event which would trigger a payout on all the other CDSs as well. AIG could easily afford any given CDS contract by itself, but what about large portfolio? With CDS contracts there was no safety in numbers, only more danger. AIG's biggest mistake was in failing to realize that this business couldn't diversify away the credit risk by doing more CDS business. For most types of insurance, if you insure a house against fire, for example, it's possible to lose much more money if an event occurs than was paid in insurance premiums. But if you insure houses across the country against fire, you'd need a nationwide rise in home fires to lose lots of money. In AIG's case, the nation was ablaze.

AIG was not a singular case of where a financial institution made this bet on credit. Every major bank and Wall Street firm was busy doing the exact same thing as AIG. (See Figure 7.) The sheer volume of the SIFMA new issuance data supports the idea of the involvement of the world's largest financial institutions. The CDS market has seen more growth than practically any market in the history of mankind. It is currently at over $62 trillion, up from under $1 trillion a decade ago. It would not take a very big percentage of that market to fail to leave a very big mark on the world financial system. What the data doesn't show how quickly a firm can become insolvent in the face of collateral calls on its balance sheet.

In March 2008, the Federal Reserve Bank of New York provided an emergency loan to try to avert a sudden collapse of Bear Stearns, but it could not. JPMorgan Chase purchased Bear Stearns for $10 dollars per share on March 16th. An astonishing drop for a company that had been valued at over $133 per share that year. In hindsight, it's clear that those insurance contracts were a fatal liability for many sellers of CDS. A liability big enough that without government help the global financial system would have gone bust. Financial institutions, with support from the US government in the form of the Troubled Assets Relief Program, are fighting to restore stability to their balance sheets despite billions of dollars worth of asset write-downs. It is impossible yet to know the full damage from the credit crisis. Bank write-downs are

estimated at $476 billon by the International Institute of Finance. As of December 2008, $1,600 billion has been cut from the global market capitalization of banks.

Figure 7. Global CDO Issuance.[30]

SECURITIES INDUSTRY AND FINANCIAL MARKETS ASSOCIATION

Global CDO Market Issuance Data[1]

BY ISSUANCE TYPE ($MM)

	TOTAL ISSUANCE	Cash Flow and Hybrid[2]	Synthetic Funded[3]	Market Value[4]	Arbitrage[5]	Balance Sheet[6]	Long Term[7]	Short Term[8]
2004-Q1	24,982.5	18,807.8	6,174.7	0.0	23,157.5	1,825.0	20,495.1	4,487.4
2004-Q2	42,861.6	25,786.7	17,074.9	0.0	39,715.5	3,146.1	29,611.4	13,250.2
2004-Q3	42,086.6	36,106.9	5,329.7	650.0	38,207.7	3,878.8	34,023.9	8,062.7
2004-Q4	47,487.8	38,829.9	8,657.9	0.0	45,917.8	1,569.9	38,771.4	8,716.4
2004 TOTAL	**157,418.5**	**119,531.3**	**37,237.2**	**650.0**	**146,998.5**	**10,419.8**	**122,901.8**	**34,516.7**
2005-Q1**	49,610.2	40,843.9	8,766.3	0.0	43,758.8	5,851.4	45,175.2	4,435.0
2005-Q2**	71,450.5	49,524.6	21,695.9	230.0	62,050.5	9,400.0	65,043.6	6,406.9
2005-Q3**	52,007.2	44,253.1	7,754.1	0.0	49,636.7	2,370.5	48,656.3	3,350.9
2005-Q4**	98,735.4	71,604.3	26,741.1	390.0	71,957.6	26,777.8	88,763.5	9,971.9
2005 TOTAL	**271,803.3**	**260,225.9**	**64,957.4**	**620.0**	**227,403.6**	**44,399.7**	**247,638.6**	**24,164.7**
2006-Q1**	108,012.7	83,790.1	24,222.6	0.0	101,153.6	6,859.1	104,084.0	3,928.7
2006-Q2**	124,977.9	97,260.3	24,808.4	2,909.2	102,564.6	22,413.3	119,986.1	4,991.8
2006-Q3**	138,628.7	102,167.4	14,703.8	21,757.5	125,945.2	12,683.5	135,928.5	2,700.2
2006-Q4**	180,090.3	131,525.1	25,307.9	23,257.3	142,534.3	37,556.0	180,090.3	0.0
2006 TOTAL	**551,709.6**	**414,742.9**	**89,042.7**	**47,924.0**	**472,197.7**	**79,511.9**	**540,088.9**	**11,620.7**
2007-Q1**	184,757.4	138,614.2	27,417.7	18,725.5	155,768.5	28,988.9	177,391.7	7,365.7
2007-Q2**	179,493.0	132,197.3	14,930.2	32,365.5	156,997.7	22,495.3	175,532.6	3,960.4
2007-Q3**	91,529.2	54,663.9	5,211.6	31,653.7	85,410.8	6,118.4	89,475.6	2,053.6
2007-Q4**	29,946.7	21,930.1	3,950.0	4,066.6	22,033.3	7,913.4	29,946.7	0.0
2007 TOTAL	**485,726.3**	**347,405.5**	**51,509.5**	**86,811.3**	**420,210.3**	**65,516.0**	**472,346.6**	**13,379.7**

Source: Thomson Financial
Totals may not foot due to rounding.
**Revised to reflect changes in classification or information submitted after prior cut-off date.

1 Unfunded synthetic tranches are not included in this analysis. SME deals are classified as ABS and are not included in this analysis.
2 Cash flow CDOs are structured to pay off liabilities with the interest and principal payments (cash flows) of their collateral. Hybrid CDOs combine the funding structures of cash and synthetic CDOs.
3 Synthetic CDOs sell credit protection via credit default swaps (CDS) rather than purchase cash assets. Synthetic CDOs use credit default swaps (CDS) to synthetically replicate a cash flow CDO. Funded tranches require the deposit of cash to an SPV at the inception of the deal to collateralize portions of the SPV's potential swap obligations in the transaction; losses result in principal writedowns of the issued notes.
4 Market value CDOs are structured to support liabilities through the value of the collateral.
5 Arbitrage CDOs attempt to capture the mismatch between the yields of assets (CDO collateral) and the financing costs of the generally higher rated liabilities (CDO tranches).
6 Balance sheet CDOs remove assets of the risk of assets of the balance sheet of the originator. Balance sheet CDOs may be cash or synthetic. In cash deals they are used to move assets off of a balance sheet (frequently to reduce regulatory capital requirements, among other reasons, similar to traditional ABS securitizations). In synthetic deals, the risk is moved off balance sheet by the originator's purchasing protection from the SPV through CDS.
7 Long term tranches are defined as tranches with maturities of greater than 18 months.
8 Short term tranches are defined as tranches with maturities of less than 18 months.

SIFMA™ Securities Industry and Financial Markets Association

Figure 8. Writedowns of Major US Financial Institutions[31]

CREDIT RATING AGENCIES

Some of the problems discussed have helped the drive down stock prices were the reactions of rating agencies and the widening of credit default swap spreads. Short sellers were targeting financial firms, which many market observers believe led to the swift declines in share prices of major banks. Short sellers contributed indirectly to the current credit crisis as rating agencies rely more and more on stock prices and credit default swaps to determine credit ratings. "Of late the rating agencies ... seem to be looking at stock prices and the credit default swaps as a guide to what their ratings should be," Wilbur Ross, private financier, told the Reuters Restructuring Summit. "To the degree they do that it makes you wonder if you even need the rating agencies any more," he added, since the prices of the stock and credit default swaps are already public information."[32]

Andrew Feltus, senior vice president and portfolio manager at Pioneer Investments, also said rating agencies should share the same scrutiny as hedge funds. "You've had a dynamic now where people just short, short, and short and it drives down the (stock) price," Feltus said. "Then the rating agencies say, 'There's something going wrong here, the stock's falling, I better downgrade.'"[33] That dynamic of the credit rating agencies following the lead of the stock market price is extremely problematic. In the case of credit default swaps, stock prices that were under attack of short sellers caused their spreads in the credit markets to widen considerably. In the case of financial firms, the declining value of the mortgage related assets on the balance sheet, in conjunction, with declining stock prices creates a bottomless pit of declining capital pushing them to the brink of going out of business. Also, the ability to execute any capital raising strategies is an important part of the ratings process. Standard & Poor stated that the fluctuation in the price of company's securities is one factor that helps determine a company's rating.

Uptick Rule

The problem was further agitated by the removal of the uptick rule for short sellers in 2007. This rule required short sellers to sell stocks at a price which was higher than the last price paid for the stock. This rule had been in effect since 1938 but the SEC repealed it because they felt it was obsolete. Now that the uptick rule is no longer in effect, it permits and encourages large hedge funds to get together and drive a stock down. As demonstrated the short selling in financial shares got so bad that the SEC had to temporarily ban it.

Moral Hazard

Possibly the centerpiece to the disastrous performance of credit rating agencies in assessing the risks of mortgage backed securities was the conflict of interests. Securities issuers

exert influence over the rating agencies in many different ways, including direct compensation. Interests of those issuers become more important than that of the investor. The managing director for credit policy at Moody's stated that, "While the methods used to rate structured securities have rightly come under fire, in my opinion the *business model* prevented analysts from putting investor interests first."[34] Also, Frank Raiter, who was manager of mortgage ratings at S&P stated that, "Profits were running the show."[35] Although millions of investors rely on these rating agencies for independent and objective assessments, profits are more important than presenting accurate information. It is apparent now that the rating agencies that assigned high ratings to securities that contained loans with mortgage delinquencies and defaults were severely underestimating the risk associated with them. Currently Moody's has reduced ratings on more than 5,000 mortgage backed securities while S&P has reduced the ratings of two thirds of its investment grade ratings.[36] Credit rating agencies are now under intense scrutiny. They gave investment grade rating to securitization transactions containing subprime mortgages. Credit rating agencies have downgraded over $50 billion in rated collateralized debt obligations as of November 2007.[37]

CONCLUSIONS AND RECOMMENDATIONS

The breakdown of a properly functioning credit risk framework led to the financial crisis of 2008 the severity of which has been compared to the Great Depression of 1929. Government policy, modern financial innovation, and ethics all played a significant role in the meltdown of the housing market in the U.S. will forever change the face of the banking and securities industries.

From the mortgage market perspective, the precipitous drop in mortgage lending should give all participants the opportunity to address issues concerning underwriting standards, predatory lending, and compensation. We recommend an annual meeting between the big financial institutions and regulators to talk about risk management and the strengthening of prudential oversight of securitization and off-balance sheet exposures through raising Basel II capital requirements for structured products (such as CDOs) and monitoring the effect of these requirements on capital and whether additional capital buffers are required.

At the mortgage origination level more competent oversight of the collateral creation process would remove much of the fraudulent activities that occur in that marketplace. Mortgage brokers and underwriters are truly, in essence, financial advisors and should be regulated as such.

At the institutional level, bank and thrift regulators need to draw immediate attention to rapid growth asset and income creation on the balance sheets. Regulation requiring accounting reforms aimed at bringing off-balance sheet exposures on to balance sheets should be enacted. Early detection of potential asset bubbles and analysis of new asset types and transactions needs to be approached in conjunction with FASB and the credit ratings agencies.

Inclusion of a section on ratings agencies in this paper assumes that the agencies will exist in the future. In our opinion, rating agencies should undergo drastic changes in the way they operate. Federal review should be required of all participants of the ratings industry so that public interest has a voice in the functioning of the industry. We recommend that there be regulation introducing a separate credit rating scale for structured products and generally strengthening oversight of credit rating agencies in a manner that would provide enough information for investors and regulators to make their own assessments of credit risk and be less reliant on credit ratings. Elimination or reduction of the influence that security issuers have over the ratings of financial products should include curbing direct & indirect compensation, regular federal review of ratings decisions, and legal consequences for misrepresentation needs to be paramount. The fiduciary role needs to place the public and investors ahead of issuers in the area of ratings determination.

We strongly advocate new rules regarding the retention of assets created by a financial institution or re-introducing the *Glass-Steagall Act* in some form. Requirements that would make some percentage of asset creation being retained by the originator would reduce the moral hazard and reduce out of control risky investing. This coupled with limits on leverage employed would serve to dampen the rise of speculative asset bubbles forming in the first place.

From a securities market perspective, the most conservative approach to accounting rules, risk analysis, and the ratings of structured financial products. FASB and its global peers, need to coordinate the global regulation of securities trading. Greater transparency in all transactions, whether for income or hedging purposes, needs to be demanded and made available to all investors. Specifically in the area of derivatives usage, new and "naked" transactions need to be assigned much higher risk review. In addition, we recommend adopting standard trade documentation and settlement protocols for OTC derivatives and creation of a clearing house for OTC derivatives as well as investing in technology to confirm and settle trades to determine exposures across all counterparties on a same-day basis.

With regards to the "bailout", we believe that fiscal steps proposed by President-elect Obama will eventually cure the employment problem that afflicts the global recession. Jobs creation will be required for losses in the mortgage market to slow and return to historical norms. Additionally, the modification of the mortgage contracts themselves will most directly solve the rising defaults we have witnessed since 2007. Whether that is accomplished through the Troubled Assets Relief Program (the TARP) and the government purchasing mortgage related securities, or through the FDIC and financial institutions, it must be done. The costs of tearing up contracts and rewriting them may be high but it's nothing to the compared to the continued existence of these contingent liabilities on the balance sheet.

The biggest mistake, thus far, has been how the bailout was presented to the American taxpayer. Current Treasury Secretary Henry Paulson should have stressed that all avenues need to coordinated and need that asset purchases, capital injections, and loan modifications need to be financed. In reality, that is what he said but the current administration's refusal to stress that

point seems to have been influenced by the political environment. The bailout fatigue that now seems to be entering into American sentiment would have been reduced if the selling of the bailout was more detailed and precise when first announced. It should have been stressed that these would only be the first in a series of tactical operations to fix the problem and that a global response would be coordinated amongst the major central banks worldwide.

In our opinion, the decisions about which financial institutions should be rescued should have been put to the elected representatives of Congress, rather than the Federal Reserve. Fannie Mae and Freddie Mac had combined direct and contingent liabilities of roughly US$5 trillion or nearly 40% of US GDP (running at around US$14 trillion) or about 65 times their regulatory capital at the end of March 2008. To put this in some further context, the total US public debt is about US$9.5 trillion. The current debate is around the fact that $5 trillion was notionally added to the national balance sheet by unelected officials in the rescue of Fannie and Freddie. However, US Congress has now effectively endorsed the bail-outs in an effort to increase public confidence in these institutions.

Finally, perpetrators of the mortgage meltdown should be prosecuted. Fraud, masquerading as greed or speculation, must have consequences when fiduciary responsibilities are breeched. The assurance that speculation cannot take precedent over risk review requires it. The industry's ability to bounce back is constrained by new limits on their balance sheets. The market is imposing its own disciplines through asset repricing and regulators are likely to impose others. The near-collapse of the global financial system prompted the biggest government intervention in history for the financial system. Self-regulation, in the words of the Chairman of the Federal Reserve himself has failed and steps incorporating our above recommendations would go a long way towards restoring the confidence of investors in the proper functioning of credit markets.

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ANNUITIES, A REVIEW AND ANALYSIS

Malek Lashgari, University of Hartford

ABSTRACT

Within the framework of spending a fixed percentage of wealth during the retirement time horizon, an investment portfolio consisting of common stock and bonds appears to result in reasonable outcomes in both retirement consumption needs and maintenance of wealth. Simulations are performed in the context of variable annuity contracts in which the money's worth of an annuity as well as the accumulated wealth are shown during the past eight decades in both nominal and real values, adjusted for inflation. While potential payments to the annuitants tend to rise over time, the present value of expected payments on the part of the insurance company issuing the annuity contracts rapidly declines due to the probability of survival and discounting.

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INTRODUCTION

Annuities as financial products are purported for financing consumption expenditures during retirement time horizon. In a "fixed annuity" an insurance company guarantees a constant amount of payment for life during retirement. In a "variable annuity," the periodic receipts during retirement as well as the total available for retirement consumption would vary according to performance of pre-determined benchmarks such as returns on common stock or bonds. A "longevity annuity," would pay a lifetime amount if and only if the individual reaches a certain age. For example, one may choose to receive annuity income after age 70. In all types of annuities the receipts depend on the commencing age, for example 65, the amount accumulated at retirement, life expectancy of the individual annuitant as well as the interest rate used by the insurance company underwriting the contract.

The motive for purchasing an annuity is based on managing the risk of shortfalls during retirement. In the simple form, an insurance company promises to pay a set dollar amount of money as long as the individual lives in return for a lump sum initial payment. The amount of income received by an individual depends on his or her expected number of years to live, and the rate of interest used by the insurance company issuing the annuity contract. The social security system is an example of a life annuity in the U.S., though a highly complex one. The same is the case with defined benefit pension plans offered by private business enterprises.

Brown, Mitchell, Poterba and Warshawsky (2001) explain various types of annuities as follows: a) periodic income for a fixed time horizon or for life-time income; b) single-life annuity for one person only, or multiple life-annuity; c) annuities with bequest for making payment to designated beneficiaries; d) deferred annuities in which the payout phase begins at a later time; e) variable annuities in which periodic payments are tied to the performance of the financial assets underlying the insurance company's investments; f) graded annuities that provide a specified increase in payouts over time; g) inflation- indexed annuities for protection against inflation; h) and flexible premium deferred annuity that permits annuitant to make various cash contributions over time and allows the accumulated value of these premium contributions to be converted to an annuity at a later time.

ANNUITY PARTICIPANTS

Since a rational investor would compare the expected payoff with the cost of an annuity contract, annuities are expected to be on demand among those who are healthy with a better than average life expectancy. Mitchell, Poterba,Warshawsky and Brown (1999) examined both the fixed immediate and deferred annuities using the term structure of interest rates for annuities offered in 1985, 1990 and 1995 and found that the expected payouts were 80-85 cents per dollar of annuity for all individuals and 90-94 cents per dollar of annuity for those purchasing the annuities. This phenomenon, known as the adverse selection, is further shown in the expected yield on the annuity contracts. For example, Friedman (1990) finds the average expected yields on individual annuities were below comparable investments by 4.21 – 6.13 percent during 1968-1983. However, when allowing for adverse selection, it would fall to a range of 2.43-4.35 percent. This is further shown by Abel (1986) who finds that while a mandatory social security system offers a fair rate of return on investment, annuities do not due to adverse selection. Meanwhile, Warashawsky (1988) finds a load factor in the range of 10-29 cents per dollar of actuarial present value for 65-year old individual life annuities, 8-16 cents of which is due to the adverse selection.

Finkelstein and Poterba (2004) studied the mandatory as well as self-selected annuities in the U.K. market and find evidence that individuals differ in their selections with respect to the expected length of time for receipt of the annuity income. Those with better than average life expectancies tend to select an annuity with a higher expected payoff, while shorter than average life expectancy results in an annuity with a death benefit for the estate. Their findings are in support of Abel's (1986) findings that a utility maximizing individual would rely on social security income with little preference to buy private annuities. This is because the expected return on such annuities is less than those of social security. Poterba, Venti and Wise (2010) find a strong relationship between health and wealth in relation to retirement planning. For the healthy, the level of home equity increased up to the age of 70 and declined by only 1.76 percent thereafter. This shows that those individuals are not at the risk of shortfalls during retirement.

Laitner and Juster (1996) analyses results of a survey of annuitants in TIAA-CREF during the fall of 1988 and finds that about half of the respondents plan to leave a portion of their wealth for their children.

A variable annuity is in effect an investment in financial assets together with an insurance contract for receiving lifetime income, contingent upon performance results. The outcome of the investment portfolio underlying the annuity contract is accounted for as annuity units. If the value of these annuity units rises during the consumption phase, then the payouts will rise. In a variable annuity, an assumed interest rate such as 4 percent is used by the insurance company to calculate the potential payouts to the annuitant. A return on investment greater than that of the assumed interest rate, will lead to a higher payout and conversely, a return lower than the assumed interest rate can result in lesser amount. The pitfall for a regular life annuity is when the individual lives far below the statistically calculated average life expectancy, in which case the remaining wealth would accrue to the insurance company; nothing will be left for the estate.

SPENDING RATE CONSIDERATION.

Financial planners suggest a reasonable spending rate policy usually amounting to about 5 percent of accumulated wealth. As the remaining wealth would perhaps earn the same return as that of the spending rate, adequate money should be available for a 20-30 year retirement time horizon. Goodman and Tanenbaum (2008) show the performance of a guaranteed minimum withdrawal benefit variable annuity contract issued by an insurance company as compared to a non-guaranteed contract. Withdrawals however could exceed the minimum amount according to the performance of the underlying assets. In particular, annual withdrawals would be based on 5 percent of the prior year's investment value. The results of simulations using year-by-year returns on S&P 500 stock index return showed no benefit for the guaranteed minimum withdrawal benefit contract during 1980-2007, 1973-2002, and 1955-1984, the only exception was the time horizon 1930-1959, in which the guaranteed minimum withdrawal benefit contract resulted in a much higher benefit. This is because of the extremely large negative returns during 1930-1941 depleting wealth in the face of systematic withdrawals. In which case a guaranteed minimum annuity contract would be quite useful as it provides income in line with the most recent past. While a guaranteed minimum withdrawal benefit contract provides a residual wealth for the estate, there is no such provision in a regular life annuity contract.

PERFORMANCE MEASUREMENT

Using actual data on fixed indexed annuities contracts covering 1997-2010, Marrion, VanderPal and Babbel (2010) show that within a 5-year non-overlapping time horizon, fixed indexed annuity average returns are decent and comparable with S&P 500 index returns in good market conditions. Annuity returns, however, were non-negative whereas during the non-

overlapping 5-year time interval 1997-2010, the S&P500 reached a low of negative 1.05 percent while fixed indexed annuities provided about 5 percent. Marrion, VanderPal and Babbel (2010) note pitfalls of various empirical studies on relative performance of fixed indexed annuities with common stock. They express that stock returns are not normally distributed which would affect the crediting rate. Furthermore, for moderate to strong risk-averse individuals, the fixed indexed annuity is superior to various portfolios of common stock and bonds due to loss avoidance nature of annuity returns.

Lewis (2005) discusses an indexed annuity that is tied to the performance of the financial assets underlying the fund. The investment portfolio consists of bonds together with financial derivative securities. This variable annuity guarantees a minimum of 2.7 percent annual return with upward potential that is either tied to the performance of the underlying assets or a cap set by the insurance company. By employing data during 1947-2003 taken from Ibbotson Associates within a random drawing for 10, 20, and 30 years time horizons, simulations with a guaranteed return of 5 percent and a cap of 9 percent showed that the returns to indexed annuities were about half as much as the stock return with substantially lower risk. Furthermore, the indexed annuities provided a positive return even if the underlying investment produced losses.

ANNUITY PAYOFFS

Mitchell Poterba, Warshawsky and Brown (1999) use the term structure of interest rate in appraising the value of single premium immediate fixed annuities in both nominal and real terms. They compare the expected present value of payouts for immediate annuities with their cost to the annuitant as shown in equation (1).

$$V_b(A) = \sum_{K=1}^{N} \frac{A * P_j}{\prod_{K=1}^{j} (1 + i_k)} \qquad (1)$$

Where V_b is the value of an annuity for an individual at age b, and A denotes the fixed annuity payment, P_j is the expected probability of survival over time, i denotes the spot rate in each time period, K and N denote the number of years for the annuity stream commencing at age b. The continuous probability of survival P_j is calculated as shown in equation (2).

$$P_j = (1 - q_{b,t}) (1 - q_{b,t+1}) \ldots (1 - q_{b,t+N}) \qquad (2)$$

Where $q_{b,t}$ is the mortality probability at age b in time t, and $(1 - q_{b,t})$ $(1 - q_{b,t+1})$ denotes the probability of someone who is alive in time t will also be alive in time t+1.

The authors used data from A.M. Best on nonparticipating (fixed), single premium, immediate, individual life annuity from a commercial life-insurance company and calculated the money's worth of an annuity as the ratio of expected discount value of its future payments to its initial purchase price or the policy premium. Using the mortality tables at age 65, the expected value of annuity payout after taxes was found to be 81.4 cents for men and 85.4 cents for women with the Treasury yield curve as the rate of discount. The results when using the term structure for corporate bond as the rate of discount are lower; 75.6 cents and 78.5 cents for men and women, respectively. Money's worth of less than one means that the individual will expect to get back less than the cost of the policy. The low values for money's worth of an annuity as the expected value of payments to the annuitant are due in part to the impact of the adverse selection. That is, insurance companies appear to assume a longer time span for annuity payouts.

Group annuities provisions may induce inter and intra transfer of wealth among the annuitants. For example, Weil (1973) identifies an intra beneficiary wealth transfer in TIAA-CREF annuities which is due to using an assumed return much lower than the expected return on investment. For example, the 4 percent assumed interest rate in the 1970's when its observed return was around 10 percent. As the later annuity income is based on a higher investment base, it tends to provide more income at a later date, in favor of those who live longer. Weil shows that CREF could have used at least 5.5 percent at the time. Weil and Fisher (1974) further discuss inter and intra beneficiary transfers of wealth in a variable annuity contract that appear to result in higher annuity payments for those who have a better than average life expectancy.

Research Design and Empirical Results

In this empirical work a constant mix investment portfolio consisting of 60 percent in common stock and 40 percent in intermediate government bonds is purported to supply funding for retirement expenditures for a 65-year old individual with 5 percent spending rate policy. Data are taken from Ibbotson Associates during 1926-2011. Table 1 shows the total sum accumulated present value of expected payments to the annuitants for a 65-year old male and female. An immediate variable annuity is formed with an initial premium of $1000. A constant mix portfolio is constructed with 60 percent allocation to common stock and 40 percent to intermediate government bonds. Annuity payments are based on 5 percent of portfolio wealth during a given year, and a constant rate of discount of 4 percent is applied which is commonly used as the assumed rate of return by insurance companies. In addition, probability of survival is included for a 65-year old male and female from the Social Security actuarial tables. Conditional probabilities of survival are then calculated over time. For example, the probability of survival for male is 0.9833 at age 65. If this person lives through 65^{th} year of age, he will have a probability of survival of 0.9654 at age 66. Year by year probabilities are calculated as shown in equation (2).

Table 1 shows the accumulated present value of expected payments to the annuitants starting at age 65 for 54 years hence which is the limit imposed by the Social Security actuarial tables. It further provides an estimate of nominal annuity income commencing at age 65 during

1957-2011 for an initial one time premium of $1000. In the absence of any transactions costs, the $1000 would constitute the initial wealth. Annuity income stream is expected to be at 5 percent of wealth for each year or $50 for 1957 (i.e., 0.05*1000). Given a 60-40 common stock/bonds asset mix for the investment portfolio underlying the variable annuity, the amount of wealth available for consumption is 918.08 (i.e., (1 -0.0336)*950). This is because the remaining $950 wealth would earn -3.36 percent during the first year.

Consequently, the second year income for the annuitant would be $45.90 (i.e., 0.05*918.08). As annuity payments are subject to the survival of the individual recipient, the expected value of payment for a male annuitant during the first year is $49.16 (i.e., 0.983277*50) where 0.983277 is the probability of survival for a 65 year old male taken from the Social Security actuarial tables. Assuming a 4 percent rate of discount, as is typically used by insurance companies as the assumed investment return, the present value of expected payment would be $47.28(i.e., $49.16*(1/(1+.04)^1)$). As shown in Table 1, probability of survival declines over time and as such a general down trend is observed for the expected value of payments to the annuitant. The same decrease in cash flows is further observed in the present value of expected payments to the annuitant. In effect, after about 10 years, the present value of expected payments to the annuitants is about half as much as the initial amount. In about 20 years, the present value of expected payment is about one quarter of the initial amount and in 30 years it reduces to just 5 percent of the initial payment.

As shown in Table 1 the total sum of present value of expected payments to the annuitant during a 54-year time horizon is $680.66 for male and $775.48 for female annuitant per $1000 initial premium. To the extent that these values are less than $1000, there is a net benefit to the insurance company as the issuer of the annuity. The actual dollar values of the expected payments, without discounting, however are greater than $1000 for this period. That is, the total sum of the payments to a male annuitant is expected to be $1048.10 per $1000 premium and $1259.15 for a female annuitant. In addition, Table 1 shows accumulated ending wealth on a year-by-year basis which is subject to the performance of the underlying investment portfolio. For the case of 1957-2011, in a 60-40 stock/bond asset mix, the ending wealth amounts to $6,226.82 for the initial $1000, available to the insurance company, and not the annuitant in a strict sense. Given the investment experience observed during 1957-2011 for a 60-40 common stock/bonds investment portfolio results for a $1000 initial investment, a 65-year old individual could have consumed 5 percent of his or her own wealth till 115 years of age, and further leaving $6,226.82 as bequest.

The results for real annuity income, adjusted for inflation, are shown in Table 2. It is observed that during 1957-2011, the total present value of expected annuity payments are smaller in real terms, adjusted for past inflation. Comparing year by year values in Table 1, and Table 2 further shows a smaller annuity income in real term adjusted for inflation during 1957-2011. As shown in table 2, the inflation adjusted value of expected annuity payments are $552.34 and

$605.40 per $1000 premium for male and female, respectively. As with the nominal annuity case, the share of income for female is greater than male due to a higher probability of survival.

Table 3 shows accumulated value of expected payment for a 65-year old individual during 1926-2011 in non-overlapping time horizon using the same methodology as in Table 1, and Table 2. For example, during 1926-1980, a 65-year old male might have received $620.04 in terms of present value of expected income over 54 years per $1000 initial premium. The corresponding value for female would have been $697.88 per $1000 initial premium. As shown in Table 3, the accumulated present value of expected payments to an annuitant varies over time depending on the initial starting time. For example, an annuity commencing in 1929 would have had $428.51 and $485.83 in terms of accumulated present value of expected payments per $1000 initial premium for male and female, respectively. This is because of the sharp decline in financial asset values during the early decade of the 1930's. In contrast, the results would have been quite favorable for an annuitant starting in 1949, in particular for females, as the accumulated present value of expected payments are $962.09 and $1106.66 for male and female, respectively per $1000 in premium.

Table 4 shows the inflation adjusted present value of expected annuity payments to a 65-year old individual per $1000 in premium for non-overlapping time horizon during 1926-2011. The results are of interest as deflation prevailed during 1926-1932. That is, the rate of observed inflation was negative during 1930-1932; -6.0 percent, -9.5 percent, and -10.3 percent respectively for 1930, 1931, and 1932. Furthermore, the rate of inflation remained quite low for the decade of the 1930's. Thereby, an annuity commencing in 1932 would have resulted in $689.25 and $766.19 in inflation adjusted accumulated present value of expected payments per $1000 in premium for a 65-year male and female, respectively.

A further look at Table 4 reveals the combined benefits of low inflation and high returns resulting from financial assets during the latter part of 1940's and early 1950's. For example, the inflation adjusted present value of expected payment initiated in 1949 would have been $810.26 and $911.22 for a 65-year old male and female, respectively on a $1000 premium. Similar simulations are performed for a 30-70 common stock/bonds asset mix as shown in Table 5 and Table 6 for nominal and inflation adjusted annuity payments. The resulting values are lower, as expected, due to a lower allocation to common stock which has outperformed bonds in the long run. As for example, within a 30-70 stock/bonds investment mix during 1957-2011, the accumulated present value of expected payments would have been $600.27 and $678.57 for a 65-year old male and female, respectively in nominal terms or $493.11 and $537.76 in real terms adjusted for inflation.

Overall, the results for non-overlapping annuities during 1926-2011 are in line with the findings of Goodman and Tanenbaum (2008) regarding a 5 percent guaranteed withdrawal allowance, Lewis (2005) and Weil (1973) regarding expected return on annuities. It appears that the issuer of the variable annuity contract has a reasonable margin of safety in both the expected

profit and preservation of the capital base. Alternatively, if one does not annuitize, the remaining wealth can satisfy the bequest motive.

SUMMARY

In this empirical study cash flows resulting from a variable annuity are estimated according to the performance of the underlying investment portfolio consisting of common stock and bonds within a 60-40 and 30-70 stock/bond investment mix. Data are on large company stock and intermediate government bonds during 1926-2011 taken from Ibbotson Associates. It is assumed that the annuitant would withdraw and spend 5 percent of year by year available portfolio wealth on an annual basis. Using both nominal as well as real inflation adjusted return on investment it is shown that the total accumulated present value of annuity incomes are within a close range over time. In particular, adequate amount of wealth remains at the end of the planning time horizon. Simulations are performed on non-overlapping time horizons covering 1926-2011. It is shown that the cash flows to the annuitant are highly sensitive to the early years of investment experience in the financial markets, perhaps during the initial 5-10 years of the annuity commencement. This is clearly reflected in the results for the late 1920's and early 1930's.

Table 1: Nominal Annuity Income During 1957 - 2011 Commencing at Age 65										
					Male			Female		
Year	Nominal Portfolio Return %	Beginning Wealth	Pmt at 5% Withdrawal	Ending Wealth	Conditional Probability of Survival	Expected Value of Pmt	PV of Expected Pmt at 4%	Conditional Probability of Survival	Expected Value of Pmt	PV of Expected Pmt at 4%
1957	-3.4%	1000	50	950	98.32770000%	49.16385000	47.27293269	98.9302000%	49.46510000	47.56259615
1958	25.5%	918	46	872	96.54265893%	44.31694216	40.97350421	97.7725188%	44.88149703	41.49546693
1959	7.0%	1095	55	1040	94.63767919%	51.80255115	46.05227935	96.5179018%	52.83174302	46.96722717
1960	5.0%	1113	56	1058	92.60599749%	51.54610885	44.06182988	95.1567099%	52.96587972	45.27545597
1961	16.9%	1111	56	1055	90.44022103%	50.22431322	41.28072445	93.6793068%	52.02307992	42.75917956
1962	-3.0%	1233	62	1171	88.12685061%	54.33130405	42.93881879	92.0714888%	56.76322279	44.86079950
1963	14.3%	1136	57	1080	85.65647874%	48.67287183	36.98738232	90.3233275%	51.32473115	39.00257746
1964	11.5%	1234	62	1173	83.02982282%	51.23971279	37.44035625	88.4335828%	54.57450386	39.87705541
1965	7.9%	1307	65	1242	80.25106374%	52.45922207	36.85715359	86.4039437%	56.48129081	39.68300573
1966	-4.2%	1340	67	1273	77.32037514%	51.80957751	35.00069416	84.2311437%	56.44023273	38.12899892
1967	14.8%	1220	61	1159	74.22678693%	45.27479908	29.40964616	81.8971829%	49.95337473	32.44875969
1968	8.5%	1330	67	1264	70.96177325%	47.20476315	29.48395579	79.3862972%	52.80887421	32.98426702
1969	-5.4%	1371	69	1302	67.53013286%	46.28626879	27.79833358	76.6981978%	52.57021197	31.57230701
1970	9.1%	1232	62	1171	63.94158160%	39.39530727	22.74980833	73.8365113%	45.49171258	26.27033049
1971	12.1%	1277	64	1213	60.20521922%	38.44533201	21.34732816	70.7994680%	45.21051642	25.10379491
1972	13.5%	1360	68	1292	56.32457141%	38.28966731	20.44316642	67.5737734%	45.93691949	24.52609688
1973	-7.0%	1466	73	1392	52.31093877%	38.33708992	19.68123629	64.1479182%	47.01205077	24.13472910
1974	-13.6%	1295	65	1230	48.19192314%	31.21050728	15.40638407	60.5244589%	39.19742029	19.34894893
1975	25.4%	1063	53	1010	44.00293661%	23.38541255	11.09970890	56.7131732%	30.14028278	14.30585688
1976	19.5%	1267	63	1203	39.78151488%	25.19441871	11.49840382	52.7285624%	33.39403948	15.24060370
1977	-3.8%	1438	72	1366	35.56718054%	25.57195760	11.22183427	48.5908994%	34.93570194	15.33095992
1978	5.4%	1315	66	1249	31.40357969%	20.64300472	8.71042704	44.3288458%	29.13937145	12.29551475
1979	12.8%	1316	66	1250	27.33973665%	17.98818933	7.29828210	39.9817819%	26.30602742	10.67304805
1980	21.1%	1410	71	1340	23.42974421%	16.51936600	6.44455942	35.6006582%	25.10058569	9.79227749
1981	0.9%	1622	81	1541	19.73044533%	15.99878457	6.00141291	31.2473029%	25.33743457	9.50449743
1982	24.5%	1554	78	1476	16.29709135%	12.66201349	4.56705193	26.9917327%	20.97120746	7.56408873
1983	16.5%	1838	92	1747	13.17857773%	12.11417048	4.20139506	22.9078836%	21.05765982	7.30314535
1984	9.4%	2035	102	1933	10.41282916%	10.59541478	3.53333213	19.0684765%	19.40283609	6.47040871
1985	27.1%	2115	106	2009	8.02306404%	8.48303000	2.72009557	15.5393210%	16.43019741	5.26836604
1986	17.3%	2554	128	2426	6.01570946%	7.68251488	2.36866275	12.3739613%	15.80248219	4.87220026
1987	4.3%	2845	142	2703	4.38695613%	6.24098793	1.85020489	9.6202476%	13.68599258	4.05735289
1988	12.4%	2820	141	2679	3.11116787%	4.38720506	1.25060764	7.2987183%	10.29226810	2.93389274
1989	24.3%	3012	151	2861	2.14661560%	3.23227786	0.88594853	5.4031244%	8.13578326	2.22997078
1990	2.0%	3557	178	3379	1.44248061%	2.56565855	0.67618467	3.9042490%	6.94426661	1.83017598
1991	24.5%	3448	172	3275	0.94565855%	1.63016721	0.41310959	2.7561890%	4.75123808	1.20403723
1992	7.4%	4078	204	3874	0.60366681%	1.23080161	0.29990785	1.8970932%	3.86793718	0.94249531
1993	10.5%	4162	208	3954	0.37443883%	0.77922206	0.18256927	1.2702955%	2.64353528	0.61937198
1994	-1.3%	4371	219	4152	0.22514557%	0.49202462	0.11084598	0.8254088%	1.80381715	0.40637372
1995	29.3%	4100	205	3895	0.13088883%	0.26831363	0.05812226	0.5189873%	1.06389044	0.23046059
1996	14.6%	5035	252	4784	0.07335272%	0.18467636	0.03846606	0.3147606%	0.79245662	0.16506003
1997	23.4%	5484	274	5210	0.03949611%	0.10829520	0.02168914	0.1834674%	0.50305294	0.10075040
1998	21.2%	6429	321	6107	0.02035483%	0.06542763	0.01259972	0.1023476%	0.32898148	0.06335359
1999	11.9%	7404	370	7034	0.00999689%	0.03701077	0.00685322	0.0543797%	0.20132588	0.03727915
2000	-0.4%	7870	393	7476	0.00465543%	0.01831889	0.00326161	0.0273639%	0.10767578	0.01917128
2001	-4.1%	7445	372	7073	0.00204360%	0.00760732	0.00130236	0.0129540%	0.04822113	0.00825538
2002	-8.1%	6783	339	6444	0.00083976%	0.00284795	0.00046881	0.0057230%	0.01940901	0.00319499
2003	18.2%	5922	296	5626	0.00032034%	0.00094848	0.00015013	0.0023367%	0.00691876	0.00109512
2004	7.5%	6648	332	6316	0.00011229%	0.00037328	0.00005681	0.0008711%	0.00289585	0.00044073
2005	3.5%	6787	339	6448	0.00003572%	0.00012121	0.00001774	0.0002920%	0.00099087	0.00014500
2006	10.7%	6673	334	6340	0.00001014%	0.00003384	0.00000476	0.0000862%	0.00028769	0.00004048
2007	7.3%	7019	351	6668	0.00000252%	0.00000883	0.00000120	0.0000218%	0.00007656	0.00001036
2008	-17.0%	7158	358	6800	0.00000053%	0.00000190	0.00000025	0.0000046%	0.00001644	0.00000214
2009	14.9%	5647	282	5364	0.00000009%	0.00000026	0.00000003	0.0000008%	0.00000222	0.00000028
2010	11.9%	6166	308	5858	0.00000001%	0.00000004	0.00000000	0.0000001%	0.00000031	0.00000004
2011	5.1%	6555	328	6227	0.00000000%	0.00000000	0.00000000	0.0000000%	0.00000003	0.00000000
Sum						1048.10079604	680.66307290		1259.15122803	775.47549437

Table 2: Inflation Adjusted Annuity Income During 1957-2011 Commencing at Age 65										
					Male			Female		
Year	Portfolio Real Return %	Beginning Wealth	Pmt at 5% Withdrawals	Ending Wealth	Conditional Probability of Survival	Expected Value of Pmt	PV of Expected Pmt at 4%	Conditional Probability of Survival	Expected Value of Pmt	PV of Expected Pmt t 4%
1957	-6.36%	1000.00	50.00	950.00	0.983277	49.16385	47.272933	0.989302	49.4651	47.562596
1958	23.72%	889.58	44.48	845.10	0.9654266	42.941209	39.701562	0.9777252	43.488239	40.207321
1959	5.54%	1045.56	52.28	993.28	0.9463768	49.474637	43.982772	0.965179	50.457578	44.856603
1960	3.52%	1048.31	52.42	995.89	0.92606	48.53984	41.492059	0.9515671	49.876807	42.634904
1961	16.16%	1030.95	51.55	979.40	0.9044022	46.619618	38.317928	0.9367931	48.289284	39.690271
1962	-4.18%	1137.67	56.88	1080.79	0.8812685	50.129752	39.618271	0.9207149	52.373605	41.391621
1963	12.72%	1035.61	51.78	983.83	0.8565648	44.353438	33.704968	0.9032333	46.769961	35.541326
1964	10.30%	1108.97	55.45	1053.53	0.8302982	46.038988	33.640238	0.8843358	49.035305	35.829617
1965	6.00%	1162.04	58.10	1103.94	0.8025106	46.62744	32.759821	0.8640394	50.202384	35.271529
1966	-7.58%	1170.17	58.51	1111.66	0.7732038	45.239126	30.561932	0.8423114	49.282525	33.293508
1967	11.80%	1027.40	51.37	976.03	0.7422679	38.130323	24.768731	0.8189718	42.070607	27.328264
1968	3.76%	1091.20	54.56	1036.64	0.7096177	38.716821	24.182412	0.793863	43.31325	27.053328
1969	-11.48%	1075.62	53.78	1021.84	0.6753013	36.318374	21.811874	0.766982	41.24905	24.773111
1970	3.60%	904.53	45.23	859.31	0.6394158	28.918594	16.699768	0.7383651	33.393733	19.284049
1971	8.66%	890.24	44.51	845.73	0.6020522	26.798551	14.880284	0.7079947	31.514263	17.498752
1972	10.08%	918.97	45.95	873.02	0.5632457	25.880244	13.817674	0.6757377	31.049073	16.577354
1973	-15.78%	961.02	48.05	912.97	0.5231094	25.135933	12.904116	0.6414792	30.823721	15.824074
1974	-25.82%	768.90	38.45	730.46	0.4819192	18.527448	9.1456693	0.6052446	23.268707	11.486088
1975	18.44%	541.85	27.09	514.76	0.4400294	11.92157	5.6584827	0.5671317	15.365112	7.2929339
1976	14.70%	609.68	30.48	579.20	0.3978151	12.127048	5.5346264	0.5272856	16.073843	7.3358919
1977	-10.56%	664.34	33.22	631.12	0.3556718	11.814361	5.1845387	0.485909	16.140454	7.0829735
1978	-3.64%	564.48	28.22	536.25	0.3140358	8.8632981	3.7399164	0.4432885	12.511305	5.2792127
1979	-0.50%	516.73	25.84	490.90	0.2733974	7.0636785	2.8659204	0.3998178	10.329962	4.1911378
1980	8.66%	488.44	24.42	464.02	0.2342974	5.7220392	2.2322904	0.3560066	8.6944339	3.3918854
1981	-8.04%	504.20	25.21	478.99	0.1973045	4.9740881	1.865864	0.312473	7.8775129	2.9549875
1982	20.64%	440.48	22.02	418.46	0.1629709	3.5892958	1.2946204	0.2699173	5.9446997	2.1441892
1983	12.72%	504.83	25.24	479.59	0.1317858	3.3264625	1.1536723	0.2290788	5.7822792	2.0053902
1984	5.38%	540.59	27.03	513.56	0.1041283	2.81454	0.9385857	0.1906848	5.1541217	1.7187835
1985	23.34%	541.19	27.06	514.13	0.0802306	2.1710045	0.6961357	0.1553932	4.2048694	1.3482973
1986	16.16%	634.13	31.71	602.42	0.0601571	1.9073697	0.5880777	0.1237396	3.9233475	1.2096413
1987	-0.06%	699.77	34.99	664.79	0.0438696	1.5349404	0.4550488	0.0962025	3.3660029	0.9978861
1988	8.00%	664.39	33.22	631.17	0.0311117	1.0335099	0.2946102	0.0729872	2.4245871	0.6911478
1989	19.74%	681.66	34.08	647.58	0.0214662	0.7316322	0.2005361	0.0540312	1.84155	0.5047581
1990	-4.08%	775.41	38.77	736.64	0.0144248	0.5592569	0.1473933	0.0390425	1.5136969	0.398938
1991	21.40%	706.58	35.33	671.26	0.0094566	0.3340939	0.0846646	0.0275619	0.9737404	0.2467609
1992	4.54%	814.90	40.75	774.16	0.0060367	0.2459653	0.059934	0.0189709	0.7729744	0.1883497
1993	7.84%	809.31	40.47	768.84	0.0037444	0.1515177	0.0355001	0.012703	0.5140286	0.1204353
1994	-3.96%	829.12	41.46	787.66	0.0022515	0.0933361	0.0210273	0.0082541	0.3421804	0.0770883
1995	26.78%	756.47	37.82	718.65	0.0013089	0.0495067	0.0107242	0.0051899	0.1962992	0.0425225
1996	11.34%	911.10	45.56	865.55	0.0007335	0.0334158	0.0069602	0.0031476	0.1433892	0.0298664
1997	21.70%	963.70	48.18	915.51	0.000395	0.0190312	0.0038115	0.0018347	0.0884036	0.0177053
1998	19.64%	1114.18	55.71	1058.47	0.0002035	0.0113395	0.0021837	0.0010235	0.0570168	0.01098
1999	9.18%	1266.35	63.32	1203.04	9.997E-05	0.0063298	0.0011721	0.0005438	0.0344319	0.0063757
2000	-3.82%	1313.48	65.67	1247.80	4.655E-05	0.0030574	0.0005444	0.0002736	0.0179709	0.0031997
2001	-5.70%	1200.14	60.01	1140.13	2.044E-05	0.0012263	0.0002099	0.0001295	0.0077733	0.0013308
2002	-10.50%	1075.14	53.76	1021.38	8.398E-06	0.0004514	7.431E-05	5.723E-05	0.0030765	0.0005064
2003	16.28%	914.14	45.71	868.43	3.203E-06	0.0001464	2.318E-05	2.337E-05	0.0010681	0.0001691
2004	4.16%	1009.81	50.49	959.32	1.123E-06	5.67E-05	8.629E-06	8.711E-06	0.0004398	6.694E-05
2005	0.10%	999.23	49.96	949.27	3.572E-07	1.784E-05	2.611E-06	2.92E-06	0.0001459	2.135E-05
2006	8.22%	950.22	47.51	902.71	1.014E-07	4.819E-06	6.781E-07	8.622E-07	4.096E-05	5.764E-06
2007	3.24%	976.91	48.85	928.06	2.517E-08	1.229E-06	1.663E-07	2.181E-07	1.065E-05	1.442E-06
2008	-17.06%	958.13	47.91	910.23	5.3E-09	2.539E-07	3.303E-08	4.593E-08	2.201E-06	2.863E-07
2009	12.24%	754.94	37.75	717.19	9.069E-10	3.423E-08	4.282E-09	7.86E-09	2.967E-07	3.711E-08
2010	10.50%	804.98	40.25	764.73	1.176E-10	4.733E-09	5.693E-10	1.019E-09	4.102E-08	4.934E-09
2011	2.06%	845.03	42.25	802.78	1.013E-11	4.28E-10	4.95E-11	8.779E-11	3.709E-09	4.29E-10
SUM						788.65778	552.34017		890.22396	605.39776

Table 3: Accumulated Value of Expected Payment to an Annuitant, 60-40 Stock Bond Investment Portfolio; 1926-2011				
Time Horizon	Expected Payment		Present Value of Expected Payment	
	Male	Female	Male	Female
1926-1980	926.67	1096.83	620.04	697.88
1927-1981	905.07	1074.56	604.07	681.65
1928-1982	775.89	924.45	516.99	583.90
1929-1983	648.36	776.57	428.51	485.83
1930-1984	696.47	840.54	452.90	516.91
1931-1985	836.83	1016.80	535.80	615.40
1932-1986	1224.20	1494.34	775.64	894.78
1933-1987	1354.57	1655.28	857.58	989.98
1934-1988	1114.80	1362.60	706.65	815.66
1935-1989	1179.60	1443.88	745.31	861.51
1936-1990	978.78	1198.94	617.14	713.99
1937-1991	870.73	1068.71	545.10	632.30
1938-1992	1176.03	1447.45	727.94	847.76
1939-1993	1060.42	1304.73	654.50	762.73
1940-1994	1135.27	1397.08	696.83	813.28
1941-1995	1298.88	1597.29	794.40	927.75
1942-1996	1526.90	1873.96	933.89	1089.78
1943-1997	1488.97	1821.55	914.27	1064.46
1944-1998	1402.99	1710.93	864.90	1004.70
1945-1999	1365.41	1660.33	844.52	979.07
1946-2000	1216.87	1475.67	755.08	873.70
1947-2001	1385.67	1677.10	860.76	994.88
1948-2002	1458.60	1760.59	910.04	1049.52
1949-2003	1533.03	1845.22	962.09	1106.66
1950-2004	1494.72	1794.05	944.83	1083.64
1951-2005	1368.22	1638.40	871.02	996.32
1952-2006	1299.33	1553.69	831.89	949.66
1953-2007	1262.75	1508.96	812.37	926.00
1954-2008	1359.53	1624.62	878.33	1000.12
1955-2009	1114.11	1331.49	723.81	823.06
1956-2010	1012.46	1212.38	658.58	749.17
1957-2011	1048.10	1259.15	680.66	775.48

Notes: Accumulated present value of expected payments to the annuitants is based on an initial premium of $1000.00 and 54 years of survival at age 65. Data on common stock and bond returns as well as inflation are taken from Morningstar-Ibbotson Associates, 2012 yearbook.

Table 4: Inflation Adjusted Accumulated Value of Expected Payments to an Annuitant, 60-40 Stock Bond Investment Portfolio;1926-2011				
Time Interval	Expected Payment		Present Value of Expected Payment	
	Male	Female	Male	Female
1926-1980	1019.24	1174.81	692.03	769.14
1927-1981	977.79	1125.41	668.37	741.36
1928-1982	818.89	941.67	563.16	623.64
1929-1983	672.92	774.33	463.63	513.32
1930-1984	716.31	826.47	491.37	545.05
1931-1985	794.66	919.02	543.46	603.72
1932-1986	1008.28	1167.94	689.25	766.19
1933-1987	983.91	1139.64	676.16	750.82
1934-1988	787.49	912.30	543.77	603.27
1935-1989	819.25	950.96	565.22	627.67
1936-1990	670.84	779.95	462.76	514.25
1937-1991	578.42	674.84	396.36	441.68
1938-1992	775.86	909.85	524.57	587.40
1939-1993	658.31	773.28	443.19	497.08
1940-1994	670.88	790.51	446.96	503.09
1941-1995	741.63	876.13	488.79	552.09
1942-1996	933.03	1103.48	610.09	690.66
1943-1997	959.59	1133.28	626.85	709.44
1944-1998	902.34	1063.53	589.54	666.70
1945-1999	867.76	1020.88	566.29	640.15
1946-2000	763.56	896.63	497.34	562.05
1947-2001	1037.22	1216.73	671.68	759.76
1948-2002	1169.10	1366.18	759.85	857.50
1949-2003	1237.64	1439.43	810.26	911.22
1950-2004	1165.31	1348.37	770.09	862.56
1951-2005	1097.45	1263.79	731.87	816.62
1952-2006	1075.05	1232.55	723.21	804.09
1953-2007	1030.48	1176.50	699.60	775.10
1954-2008	1089.68	1239.34	746.55	824.35
1955-2009	867.36	982.61	600.85	660.98
1956-2010	767.10	866.97	535.02	587.21
1957-2011	788.66	890.22	552.34	605.40

Notes: Accumulated present value of expected payments to the annuitants is based on an initial premium of $1000.00 and 54 years of survival at age 65. Data on common stock and bond returns as well as inflation are taken from Morningstar-Ibbotson Associates, 2012 yearbook.

Table 5: Accumulated Value of Expected Payment to an Annuitant, 30-70 Stock Bond Investment Portfolio, 1926-2011				
Time Horizon	Expected Payment		Present Value of Expected Payment	
	Male	Female	Male	Female
1926-1980	852.53	988.76	578.93	644.93
1927-1981	837.34	971.42	569.16	633.97
1928-1982	770.35	894.18	523.84	583.55
1929-1983	709.47	824.62	481.39	536.78
1930-1984	726.95	846.81	490.69	548.21
1931-1985	780.94	911.58	524.49	587.06
1932-1986	960.30	1122.53	642.85	720.42
1933-1987	984.58	1150.59	660.59	739.87
1934-1988	892.29	1042.28	600.43	671.97
1935-1989	892.33	1042.65	600.78	672.37
1936-1990	792.67	926.50	533.94	597.59
1937-1991	742.06	868.48	498.36	558.41
1938-1992	760.60	890.89	509.77	571.63
1939-1993	798.33	936.62	532.47	598.10
1940-1994	816.26	958.73	542.40	610.02
1941-1995	868.67	1021.18	575.30	647.71
1942-1996	950.04	1117.15	628.12	707.52
1943-1997	941.65	1106.76	623.03	701.54
1944-1998	913.11	1072.78	604.51	680.49
1945-1999	904.71	1062.77	598.86	674.11
1946-2000	853.98	1003.16	565.07	636.10
1947-2001	919.47	1080.68	607.15	683.91
1948-2002	954.70	1122.15	630.38	710.06
1949-2003	987.75	1160.89	652.81	735.12
1950-2004	982.24	1154.25	650.36	731.99
1951-2005	952.03	1118.94	631.44	710.43
1952-2006	942.92	1109.04	625.95	704.26
1953-2007	941.01	1108.08	624.97	703.34
1954-2008	982.69	1159.00	652.74	734.97
1955-2009	891.51	1053.22	592.70	667.61
1956-2010	869.23	1029.93	576.70	650.56
1957-2011	907.90	1079.66	600.27	678.57

Notes: Accumulated present value of expected payments to the annuitants is based on an initial premium of $1000.00 and 54 years of survival at age 65. Data on common stock and bond returns as well as inflation are taken from Morningstar-Ibbotson Associates, 2012 yearbook.

Table 6: Inflation Adjusted Accumulated Value of Expected Payment to an Annuitant, 30-70 Stock Bond Investment Portfolio, 1926-2011				
Time Horizon	Expected Payment		Present Value of Expected Payment	
	Male	Female	Male	Female
1926-1980	940.11	1068.86	645.32	712.20
1927-1981	909.36	1030.62	629.15	692.41
1928-1982	818.87	925.40	571.00	626.74
1929-1983	743.65	838.66	521.63	571.42
1930-1984	758.13	853.92	533.83	584.07
1931-1985	760.57	855.55	538.09	587.89
1932-1986	829.75	932.26	590.12	643.79
1933-1987	757.51	849.65	542.97	591.10
1934-1988	669.80	750.56	483.05	525.07
1935-1989	660.79	740.53	478.05	519.35
1936-1990	582.16	652.61	422.37	458.67
1937-1991	530.73	595.86	384.65	418.02
1938-1992	609.44	686.00	439.59	478.61
1939-1993	533.03	600.75	384.20	418.56
1940-1994	518.33	585.74	371.43	405.51
1941-1995	530.61	601.43	377.23	412.94
1942-1996	613.70	697.54	432.74	474.96
1943-1997	639.56	727.75	449.30	493.72
1944-1998	616.20	701.57	431.72	474.77
1945-1999	600.03	683.72	418.61	460.91
1946-2000	556.34	634.52	385.96	425.59
1947-2001	705.07	805.46	484.67	535.76
1948-2002	781.97	892.46	536.93	593.46
1949-2003	813.23	926.32	559.67	617.85
1950-2004	778.59	884.75	537.90	592.82
1951-2005	777.35	881.46	538.77	592.92
1952-2006	795.45	900.05	553.37	608.04
1953-2007	782.55	883.40	547.07	600.01
1954-2008	801.83	903.21	563.39	616.78
1955-2009	705.17	792.55	498.60	544.71
1956-2010	668.55	750.51	474.30	517.58
1957-2011	693.61	778.20	493.11	537.76

Notes: Accumulated present value of expected payments to the annuitants is based on an initial premium of $1000.00 and 54 years of survival at age 65. Data on common stock and bond returns as well as inflation are taken from Morningstar-Ibbotson Associates, 2012 yearbook.

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DEVELOPING A GREY ACTIVITY BASED COSTING (G-ABC) METHOD TO CAPTURE THE INHERENT UNCERTAINTY IN IDENTIFYING COST DRIVERS' CONSUMPTION RATES

Ramin Raeesi, Persian Gulf University, Iran
Amir Amini, Persian Gulf University, Iran

ABSTRACT

Activity Based Costing (ABC) has been adopted as an efficient cost estimation instrument during the past decades, and several practitioners have verified its efficacy over traditional costing approaches by implementing it in various areas. However, it is occasionally discussed that implementing ABC is not cheap, simple and straightforward and many firms have abandoned the attempt due to rising costs and complexity. The increasing operation costs of implementing ABC systems then, to a great extend originate from the insistence on obtaining accurate data related to cost drivers consumption rates. Not only these data are not easy to obtain, but also they cannot be completely relevant and authentic in all production circumstances, and they carry uncertainty in their nature. To capture this uncertainty grey system theory has been developed and grey data could be assigned. This study introduces a Grey Activity Based Costing (G-ABC) method to develop a more realistic, cheaper, and easier to implement ABC system.

KEY WORDS: Activity based costing (ABC), Grey system theory (GST), Uncertainty

INTRODUCTION

Product cost estimation has always been side by side to product development, and influences many business activities and decisions. Costing is a challenging task, and imperfect methods will lead to loss of customers on one end, and loss of expensive resources cheaply on the other. Traditional cost systems then, used to distort cost information by using traditional overhead allocation methods (Qian & Ben-Arieh, 2008), where the overheads used to be distributed to the products by a single volume cost driver and there was generally only one stage for allocation of the overheads to the cost objects (Baykasoglu & Kaplanoglu, 2008). Those costing systems were only devised to collect indirect costs from departments, and then allocate them to products or services (Tsai & Kuo, 2004).

The introduction of Activity Based Costing (ABC) in the late 80s and early 90s with the studies of Cooper (1988a; 1988b), Cooper and Kaplan (1991), and Johnson and Kaplan (1987),

not only brought about more accurate allocation of overhead costs, but also provided valuable information about the area of waste (Gunasekaran & Sarhadi, 1998). It is an advanced cost calculation technique that allocates resource cost to products based on resource consumption (Demeere et al., 2009). ABC basically assumes that products require activities, activities consume resources, and resources cost money.

ABC has been applied and implemented in several industries and businesses of different size. Demeere et al. (2009) implemented a time-driven ABC system in an outpatient clinic environment. Baykasoglu and Kaplanoglu (2008) applied ABC to a land transportation company. Liu and Pan (2007) developed an ABC system jointly with a large Chinese manufacturing company and examined some key success factors pertinent to ABC implementation within China as a developing country. Tsai and Lai (2007) utilized a mathematical programming approach to develop an ABC joint products decision model which incorporates capacity expansions and outsourcing features.

The implementation of ABC in Small and Medium Enterprises (SMEs) has also been variously justified (Gunasekaran et al., 1999; Baxendale, 2001). However, ABC has received little attention from SMEs in spite of the fact that it has an important role to play in improving their competitiveness (Gunasekaran et al., 1999). This is to a great extend due to the fact that the development and management of ABC is a relatively time and resource consuming activity (Lievens & Kesteloot, 2003; King et al., 1994). High time and cost is required to estimate an ABC model and to maintain it (Kaplan & Anderson, 2004) and many managers have abandoned the attempt in the face of rising costs and employee irritation (Everaert et al., 2008).

Another shortcoming of ABC is that, it implicitly uses severe proportionality assumptions (Noreen & Soderstrom, 1994; Christensen & Demski, 1995), which will be violated in real practice and at best ABC can be considered as an approximate method for decision-making (Balakrishnan & Sivaramakrishnan, 1996; Salafatinos, 1996; Balachandran et al., 1997; Schneeweiss, 1998; Homburg, 2005). ABC has remained a complex and relatively costly method to be implemented (Afonso & Paisana, 2009) due to its insistence on collecting accurate and exact data on cost drivers' consumption rates, because for selecting cost drivers and determining cost driver rates, one often must trade off accuracy against information cost (Homburg, 2005).

In fact, insisting on obtaining accurate, exact, and crisp data about the rates of cost drivers' consumption by each cost object in many cases is a vain attempt. Not only it is very difficult to exactly allocate overhead to each individual activity, but also, in case a good allocation is found, there is no promise that this rate will stay consistent for all future circumstances. In other words, the amount of the recourses consumed by activities, and (or) the amount of the activities required by products is not an exact, unique and unchanging amount in all production conditions and many non-obtainable variables interfere the trends of consumptions. For instance, there is no guarantee that the labor force will spend exactly 2 hours on kitting a component in every circumstance. Many variables may affect this amount to increase or decrease. These effective variables may be worker related (e.g. job satisfaction, physical

condition, personal problems, etc.), component related (e.g. not well processed in the previous station, outsize the modular size, etc.), machine related (e.g. stops working at a particular component, slows down, etc.) and so on. These and many other variables, which are also in many cases interrelated, do not let the determination of an exact rate of consumption. The same thing is also true about requirement of activities by products.

Hence there is an inherent uncertainty in the nature of the data related to the rates at which cost drivers are consumed by cost objects, which is indeed a fundamental requirement to ABC. A more appropriate estimation of these data may be estimation within a range rather than a crisp number. For example, it is more realistic to say the labor force will spend two to two and a half hour on kitting a component. This uncertainty could be well captured by applying grey system theory on ABC system. For the same purpose this paper introduces Grey Activity Based Costing (G-ABC) method, which not only provides a more realistic cost estimation process, but also proposes a cheaper system to be implemented in SMEs by relaxing the expensive process of data collection. This is important because the ABC in SMEs should be kept as small as possible to reduce the overall expenditure of the company (Gunasekaran et al., 1999).

The rest of this paper is structured as follows: since the proposed framework is on the basis of ABC system and grey system theories and operations, section 2 present fundamentals of ABC and grey system theory. Section 3 elaborates on the proposed framework. Section 4 provides a case study. And finally Section 5 presents discussion and conclusion.

FUNDAMENTALS OF ABC AND GREY SYSTEM THEORY

Since understanding ABC and grey system theory and operations is the requisite to develop G-ABC, this section of the paper elaborates on the basics of these two concepts.

ABC cost estimation system developed in the late 80s and early 90s with the studies of Cooper (1988a; 1988b), Cooper and Kaplan (1991), and Johnson and Kaplan (1987), to address the inadequacies of traditional costing systems in dealing with indirect costs (Cooper, 1988a; 1988b), by trying to assign overhead costs to cost objects more accurately (Homburg, 2002). In traditional costing systems, costs were divided into two groups of "variable costs" and "fixed costs", and for manufacturing overhead, the volume measure used, was units produced or one that varied with units produced (Dickinson & Lere, 2003). The trend in ABC, on the other hand, is different. ABC assumes that products consume activities, activities consume resources, and resources cost money. To implement ABC a two-stage procedure is required. In the first stage all activities that consume the resources of the organization are identified (Kaplan & Cooper, 1998) and resource drivers are applied to approximate the consumption rate of each resource by each activity. In the second stage the required activities for the final product are determined and activity drivers are used to estimate the consumption rate of each activity by each product. In this paper we work with two generalized terms which are cost object and cost driver. We define cost object as something which consumes whether activity or resource. Thus the cost objects of the

first stage are activities and the cost objects of the second stage are products. Moreover, we define cost drivers as factors that whether distribute resources by activities, or distribute activities by products, and therefore the cost driver of the first stage is resource driver, and the cost driver of the second stage is activity driver.

According to the foregoing definitions of cost objects and cost drivers, we can now easier say, in ABC cost objects consume cost drivers with a particular consumption rate, which is indeed inherently uncertain and non-deterministic data to be collected. It is often really difficult to exactly determine what amount of a resource is spent by an activity and (or) what amount of an activity is spent by a product. This uncertainty is then tried to be addressed by the introduction of G-ABC in this paper.

Grey system theory (GST) was proposed by Deng (1982) to work within environments with even high uncertainty. A grey system is a partially known and partially unknown system (Trivedi & Singh, 2005). In many decision making circumstances, the decision maker is confronted with imprecision which originates from unquantifiable information, non-obtainable information, incomplete information, or partial ignorance (Huang, 2011). GST works well in these conditions, since it requires only a limited amount of data to estimate the behavior of the unknown system (Deng, 1989). It fits well with multiple meanings (grey) environment, where uncertainty is produced due to the lack of accurate values (Salmeron, 2010). For example, an evaluation like "it takes nearly one to one and a half hour for the painter to paint a component and he spends around 1.5 to 2 liters of white paint to do so", suggests that the act of painting by the painter may take any time in the range of [1, 1.5] hours, and may spend any amount of paint in the range of [1.5, 2] liters. This evaluation then conveys uncertainty and unavailability of accurate values, and a grey system is then confronted.

Moreover, GST outperforms fuzzy set theory (Zadeh, 1965) in this area, since it deals with objective data rather than subjective fuzzy numbers and it does not need any previous information other than the data sets that need to be disposed (Wu et al., 2005; Salmeron, 2010). In GST when the information is completely known and available, the system is a white system; when the information is incomplete, it is a grey system; and when the information is completely unknown, it is a black system (Huang, 2011).

In formal terms (Salmeron, 2010), a grey set G of the universal set U, is defined by its both mappings $\overline{\mu}_G(x)$ and $\underline{\mu}_G(x)$. Then:

$$\begin{cases} \overline{\mu}_G(x) : x \to [0,1] \\ \underline{\mu}_G(x) : x \to [0,1] \end{cases} \tag{1}$$

Where $\overline{\mu}_G(x)$ and $\underline{\mu}_G(x)$ are the upper and lower membership functions to G and $\underline{\mu}_G(x) \le \overline{\mu}_G(x)$. According to definition then, a grey number is a number whose accurate value

is unknown, but the range within which it is included is known. Thus $\otimes G$ with the lower bound $(\underline{G})$ and upper bound $(\overline{G})$ or $\otimes G \in [\underline{G}, \overline{G}]$, where $\underline{G}$ and $\overline{G}$ are both fixed numbers and $\underline{G} \le \overline{G}$, is a grey or (interval grey) number (Liu & Lin, 2006). When $\otimes G$ has only lower bound, it is denoted as $\otimes G \in [\underline{G}, +\infty]$ and when it only has upper bound it is denoted as $\otimes G \in [-\infty, \overline{G}]$ (Liu & Lin, 2006). Moreover we define $\otimes G \in [-\infty, +\infty]$ as a black number for which no information is available, and $\otimes G \in [\underline{G}, \overline{G}]$, $\underline{G} = \overline{G}$, as a white number which suggests complete information.

Now assuming two grey numbers $\otimes P \in [\underline{p}, \overline{p}]$ and $\otimes Q \in [\underline{q}, \overline{q}]$, with reference to Salmeron (2010), the following operations are presented:

$$\otimes P + \otimes Q \in [\underline{p} + \underline{q}, \overline{p} + \overline{q}] \tag{2}$$

$$\otimes P - \otimes Q \in \otimes P + (-\otimes Q) \in [\underline{p}, \overline{p}] + [-\overline{q}, -\underline{q}] \in [\underline{p} - \overline{q}, \overline{p} - \underline{q}], \text{ where } -\otimes Q \in [-\overline{q}, -\underline{q}] \tag{3}$$

$$\otimes P \times \otimes Q \in [\min(\underline{p}.\underline{q}, \underline{p}.\overline{q}, \overline{p}.\underline{q}, \overline{p}.\overline{q}), \max(\underline{p}.\underline{q}, \underline{p}.\overline{q}, \overline{p}.\underline{q}, \overline{p}.\overline{q})] \tag{4}$$

$$\otimes P \div \otimes Q \in [\underline{p}, \overline{p}] \times \left[\frac{1}{=q}, \frac{1}{\underline{q}}\right] \in \left[\min(\underline{p}.\frac{1}{=q}, \underline{p}.\frac{1}{\underline{q}}, \overline{p}.\frac{1}{=q}, \overline{p}.\frac{1}{\underline{q}}), \max(\underline{p}.\frac{1}{=q}, \underline{p}.\frac{1}{\underline{q}}, \overline{p}.\frac{1}{=q}, \overline{p}.\frac{1}{\underline{q}})\right], \quad \text{Where } \otimes Q^{-1} \in \left[\frac{1}{=q}, \frac{1}{\underline{q}}\right] \tag{5}$$

$$\lambda \cdot \otimes P \in \left[\lambda \cdot \underline{p}, \lambda \cdot \overline{p}\right], \text{ where } \lambda \text{ is a positive real number} \tag{6}$$

Also let $M(\otimes) = \left[\otimes m_{ij}\right]_{n \times m}$ be an $n \times m$ grey matrix where:

$$M(\otimes) = \begin{bmatrix} \otimes m_{11} & \otimes m_{12} & \dots & \otimes m_{1m} \\ \otimes m_{21} & \otimes m_{22} & \dots & \otimes m_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ \otimes m_{n1} & \otimes m_{n2} & \dots & \otimes m_{nm} \end{bmatrix}$$

The elements of this matrix could be completely or partially grey numbers, and some elements could be white numbers.

Multiplication of grey matrices then can be done like follows:

$$\text{If } R(\otimes)=\begin{bmatrix}\otimes r_{11} & \otimes r_{12} & \otimes r_{13}\\ \otimes r_{21} & \otimes r_{22} & \otimes r_{23}\end{bmatrix} \text{ and } S(\otimes)=\begin{bmatrix}\otimes s_{11} & \otimes s_{12}\\ \otimes s_{21} & \otimes s_{22}\\ \otimes s_{31} & \otimes s_{32}\end{bmatrix}, \text{ then:}$$

$$R(\otimes)\cdot S(\otimes)=\begin{bmatrix}(\otimes r_{11}\cdot\otimes s_{11})+(\otimes r_{12}\cdot\otimes s_{21})+(\otimes r_{13}\cdot\otimes s_{31}) & (\otimes r_{11}\cdot\otimes s_{12})+(\otimes r_{12}\cdot\otimes s_{22})+(\otimes r_{13}\cdot\otimes s_{32})\\ (\otimes r_{21}\cdot\otimes s_{11})+(\otimes r_{22}\cdot\otimes s_{21})+(\otimes r_{23}\cdot\otimes s_{31}) & (\otimes r_{21}\cdot\otimes s_{12})+(\otimes r_{22}\cdot\otimes s_{22})+(\otimes r_{23}\cdot\otimes s_{32})\end{bmatrix} \quad (7)$$

Another important notion in GST is whitenization, which is the transformation process of grey numbers in white ones (Liu & Lin, 2006). The whitenization value of an interval grey number is calculated as follows (Salmeron, 2010):

$$\hat{\otimes} G=\delta\underline{G}+(1-\delta)\overline{G}\ \ |\delta\in[0,1] \quad (8)$$

If $\delta=1/2$ the whitenization value is called equal weight mean whitenization (Liu & Lin, 2006).

THE PROPOSED FRAMEWORK OF G-ABC

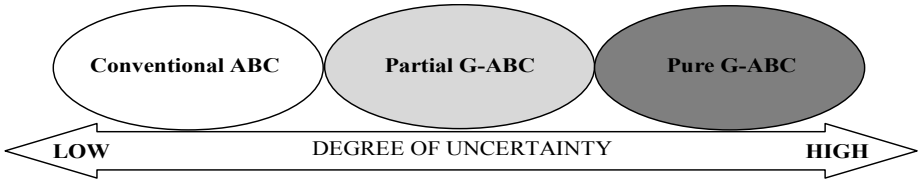
As earlier discussed, this paper develops a novel method, namely G-ABC, which bases in grey system theory, to account for some drawbacks of conventional ABC method. Some of these drawbacks, which could be overcome with the use of this method, are as follows:

1. ABC is often a complex and relatively costly system to be implemented. This basically originates from the high insistence of ABC on acquiring exact information related to the consumption rate of cost drivers. This drawback (maybe the toughest one) often prevents SMEs from adopting ABC.
2. Some cost objects (products or activities) in some industries, inherently consume variable amount of cost drivers (resources or activities). For example, for painting each car (cost object: activity) of the same type in a company, various liters of paint (cost driver: resource) are consumed. Or for assembling different components into the final product (cost object: product), different hours of labor work (cost driver: activity) are required.
3. In manual production lines, unlike automotive production (e.g. FMS), the consumption rate of cost drivers is often more variable and hence ABC is less likely to be implemented.

The origin of all these drawbacks is in disregarding the underlying uncertainty in the consumption rates of cost drivers. These data are often variable and get different values in different circumstances. Thus, instead of exact number allocation, a more reliable approach is approximating the range within which the data is included. This way the cost of acquiring exact information will be reduced and ABC implementation would be relaxed and facilitated.

Grey numbers are really suitable for our purpose and could be integrated to ABC framework. Prior to introducing the stepwise framework of G-ABC, it should be noted that with the introduction of this method, we could define a decision making range, in which conventional ABC is on one end, and Pure G-ABC is on the other (Fig 1). Thus according to the industry characteristics, availability of data, activity and products nature, and generally the degree of uncertainty, the decision maker decides to adopt whether conventional ABC, partial G-ABC, or pure G-ABC. Evidently when there is an exact estimation of the required data, conventional ABC works the best, but when some data are harder to decide upon partial G-ABC could be the best alternative. In rare cases, where there is no certainty in the related data pure G-ABC is the final measure then.

Figure 1
Decision making continuum for the suitable ABC method based on the degree of uncertainty



The following lines of this section propose a pure G-ABC method; however, it is clear enough that it also includes partial G-ABC and conventional ABC in itself. If all the grey numbers of the framework convert to white numbers, then we have a conventional ABC framework and if parts of the numbers be grey and parts white, then we are working with a partial G-ABC method.

In order to compute final product costs with G-ABC method the following steps are required to be taken:

Step 1: Identify all direct and indirect resources: In this step all direct resources that are used by the product (e.g. material, machines, labor, etc.), as well as all indirect resources (overhead) are identified and listed.

Step 2: Determine the resource drivers: In this step resource drivers (cost driver of the first stage) for each identified resource of the first step, are determined. These resource drivers are usually some kinds of units of measurements (e.g. meters, hours, liters, etc.). Allocate the index $j \in \{1,2,\ldots,n\}$ to these resources drivers.

Step 3: Determine the cost of resource drivers: Let c_j be the cost of the jth resource driver. It is possible to consider the costs also as grey numbers, but since it is not very often likely to happen we consider the costs as exact numbers here.

Step 4: Identify all required activities: In this step all activities which are required to produce the products (e.g. machining, assembling, order collecting, transporting, supervising, etc.) are identified and listed. This should be done in careful details.

Step 5: Determine the activity drivers: In this step activity drivers (cost objects of the first stage and cost drivers of the second stage) for each identified activity of the third step, are determined. Allocate the index $i \in \{1,2,\ldots,m\}$ to these activity drivers.

Step 6: Identify all related products: In this step determine which products are the costing objectives. Also let $p_k, k = \{1,2,...,o\}$, be the *k*th product.

Step 7: Determine the consumption rate of resource drivers by activities: Let $\otimes A_{ij} \in [\underline{a}_{ij}, \bar{a}_{ij}]$ be the grey number approximating the consumption rate of the *j*th resource driver by the *i*th activity. Note that this amount could also be zero or a white number.

Step 8: Determine the consumption rate of activity drives by products: Let $\otimes P_{ki} \in [\underline{p}_{ki}, \bar{p}_{ki}]$ be the grey number approximating the consumption rate of the *i*th activity driver by the *k*th product. Note that this amount could also be zero or a white number.

Step 9: Compute the consumption rate of resource drivers by products: Let $\otimes T_{kj}$ be the grey number for the consumption rate of the *k*th product from the *j*th resource. Then it is calculated using the following equation:

$$\otimes T_{kj} \in \sum_{i=1}^{m} (\otimes P_{ki} \times \otimes A_{ij}), \qquad k \in \{1,2,...,o\}, \qquad j \in \{1,2,...,n\} \tag{9}$$

Note that in this equation:

$$(\otimes P_{ki} \times \otimes A_{ij}) \in \left[\min(\underline{p}_{ki} \cdot \underline{a}_{ij}, \underline{p}_{ki} \cdot \bar{a}_{ij}, \bar{p}_{ki} \cdot \underline{a}_{ij}, \bar{p}_{ki} \cdot \bar{a}_{ij}), \max(\underline{p}_{ki} \cdot \underline{a}_{ij}, \underline{p}_{ki} \cdot \bar{a}_{ij}, \bar{p}_{ki} \cdot \underline{a}_{ij}, \bar{p}_{ki} \cdot \bar{a}_{ij}) \right]$$

Step 10: Compute the final cost of the products: To calculate the cost of the *k*th product, i.e. C_{p_k}, the following equation could be used:

$$\otimes C_{p_k} \in \sum_{j=1}^{n} (c_j \cdot \otimes T_{kj}), \qquad k \in \{1,2,...,o\} \tag{10}$$

Of course it should be noted that, this equation will provide us with a range in which the real cost is included. Thus, to obtain the whitenization value, as the final feasible cost, equation (8) could be employed. Now let us consider $\otimes C_{p_k} \in [\underline{c}_{pk}, \bar{c}_{pk}]$, then the final acceptable cost for the *k*th product is:

$$\hat{\otimes} C_{p_k} = \delta \underline{c}_{pk} + (1-\delta)\bar{c}_{pk} \mid \qquad \delta \in [0,1] \tag{11}$$

The value of δ is determined with the expectations of the decision makers. The greater is the value of δ in the range [0,1], the closer is the final cost to the lower bound in the cost range of the product.

A CASE STUDY

To show the proposed methodology in a practitioner case and demonstrate the efficacy of G-ABC, its implementation in a volunteered small size Iranian furniture company is presented.

Using the accounting system of the company and after several interviews, surveys, observations, and evaluations, the findings were sufficient for applying G-ABC. Most of the activities were manual and thus human error was inevitable. For example, during different observations, it was seen that different amount of MDF was used in different circumstances, for the same product. Thus, most of the data needed to be considered as grey numbers, however, pure G-ABC was not needed, since some data were exact and a partial G-ABC could suffice.

Two products were under study, namely prod.1 and prod.2. To implement the accounting system, steps of G-ABC were taken as follows:

Step 1 and 2: All direct and indirect resources and their resource drivers were identified as in Table1. This was done through a meeting with the business owners where with a Delphi approach they were asked to brainstorm every resource they may think of. Simply put, resources are every wealth and property of the company which cost it money, and resource driver is the quantifier used for each resource.

Table 1
ALL DIRECT AND INDIRECT RESOURCES AND THEIR RESOURCE DRIVERS

Labels	Resources	Resource drivers	Costs (US$)
res.1	Labor force	Each working hour	2.33
res.2	Designing tools	Each hour of using	0.8
res.3	Space	Each meter square	0.03
res.4	Transportation	Each travelled kilometer	0.12
res.5	Wood shearing machines	Each hour of using	1.28
res.6	Electricity	Each kilo-Watt hour	0.04
res.7	MDF	Each meter square	210.72
res.8	Cutting blades	Each one	27.95
res.9	Glue	Each liter	13.51
res.10	Rims	Each meter	0.19
res.11	Drilling machines	Each hour of using	0.09
res.12	Screws	Each one	0.14
res.13	Electronic screwdrivers	Each hour of using	0.04

Step 3: The cost of each unit of resource drivers was calculated. These costs are converted from Iranian Rials (IRR) to U.S dollars (USD) and presented in Table 1.

Step 4 and 5: All required activities and their activity drivers were identified as in Table 2. This was done with the same strategy used in step 1 and 2. Moreover, observations on the factory floor where carried out.

Table 2
ALL REQUIRED ACTIVITIES AND THEIR ACTIVITY DRIVERS

Labels	Activities	Activity drivers
act.1	Order collection	Each one
act.2	Designing	Each hour
act.3	Raw material procurement	Each vehicle loading
act.4	Cutting MDF planes	Each hour
act.5	Riming	Each hour
act.6	Assembling	Each hour
act.7	Quality control	Each hour
act.8	Order delivery	Each vehicle loading

Step 6 and 7: The consumption rates of resource drivers by activities were identified and presented in Table 3. These data were collected with numerous observations on the factory floor. For example, it was observed that activity 2, which is designing, requires designing tools for 1 hour and spends 0.5 to 0.7 kilo-Watt hour electricity.

Table 3
THE CONSUMPTION RATES OF RESOURCE DRIVERS BY ACTIVITIES

	act.1	act.2	act.3	act.4	act.5	act.6	act.7	act.8
res.1	[0.33,0.58]	1	[0.5,0.66]	1	1	1	1	[0.41,0.75]
res.2	0	1	0	0	0	0	0	0
res.3	0	15	0	45	20	35	25	0
res.4	0	0	[30,35]	0	0	0	0	[15,20]
res.5	0	0	0	[0.75,1]	0	[0.16,0.25]	0	0
res.6	0	[0.5,0.7]	0	[4,4.8]	[1.2,1.4]	[3.2,3.75]	[0.4,0.52]	0
res.7	0	0	0	[2.5,2.55]	0	0	0	0
res.8	0	0	0	[0.01,0.08]	0	0	0	0
res.9	0	0	0	0	[0.01,0.03]	[0.1,0.2]	0	0
res.10	0	0	0	0	5	3	0	0
res.11	0	0	0	0	[0.16,0.25]	[0.75,0.84]	0	0
res.12	0	0	0	0	0	35	0	0
res.13	0	0	0	0	0	[0.5,0.66]	0	0

Step 8: In this step the consumption rates of activities by products were calculated and presented in Table 4. These data were also collected through direct and actual observations on the factory floor. For example, it was seen that to produce prod.1:

1. Order is collected.
2. Designing takes 30 to 40 minutes.
3. One vehicle is sent to take the required amount of raw materials.
4. Cutting raw materials according to the design takes 1 hour.
5. Riming MDF planes edges takes 30 to 40 minutes.
6. Assembling the planes takes 1 hour to 1 hour and 12 minutes.
7. Final controlling of the product takes 1 hour to 1 hour and 12 minutes.
8. The final product is delivered to customer.

Table 4
THE CONSUMPTION RATES OF ACTIVITY DRIVERS BY PRODUCTS

	act.1	act.2	act.3	act.4	act.5	act.6	act.7	act.8
prod.1	1	[0.5,0.66]	1	1	[0.5,0.66]	[1,1.2]	[1,1.2]	1
prod.2	[1,1.5]	[0.75,0.91]	2	[1,1.1]	[0.58,0.66]	[0.8-0.9]	[1.5,1.7]	1

Step 9: In this step the consumption rates of resource drivers by products were calculated using equation 9 and grey operations. For brevity, only the computation procedure of one resource for one product is randomly selected and presented, then it is clear that the same process is exercised for all the other entries in Table 5.

For $\otimes T_{19}$ (the consumption rate of res.9 by prod.1) we have:

$$\otimes T_{19} = (\otimes P_{11} \times \otimes A_{19}) + (\otimes P_{12} \times \otimes A_{29}) + (\otimes P_{13} \times \otimes A_{39}) + (\otimes P_{14} \times \otimes A_{49}) + (\otimes P_{15} \times \otimes A_{59}) + (\otimes P_{16} \times \otimes A_{69}) + (\otimes P_{17} \times \otimes A_{79}) + (\otimes P_{18} \times \otimes A_{89})$$
$$= (1\times 0) + ([0.5, 0.66]\times 0) + (1\times 0) + (1\times 0) + (([0.5, 0.66]\times[0.01, 0.03]) + ([1,1.2]\times[0.1, 0.2]) + ([1,1.2]\times 0) + (1\times 0)$$
$$= 0+0+0+0+[0.005, 0.0198] + [0.1, 0.24] + 0 + 0 = [0.105, 0.2598] \approx [0.11, 0.26]$$

That is, prod.1 consumes at least 0.11 liter and at most 0.26 liter of glue.

Table 5
THE CONSUMPTION RATES OF RESOURCE DRIVERS BY PRODUCTS

	prod.1	prod.2
res.1	[5.24,6.71]	[6.37,8.21]
res.2	[0.5,0.66]	[0.75,0.91]
res.3	[122.5,140.1]	[133.35,150.35]
res.4	[45,55]	[75,90]
res.5	[0.91,1.3]	[0.88,1.33]
res.6	[8.45,11.31]	[8.23,11.1]
res.7	[2.5,2.55]	[2.5,2.81]
res.8	[0.01,0.08]	[0.01,0.09]
res.9	[0.11,0.26]	[0.09,0.2]
res.10	[5.5,6.9]	[5.3,6]
res.11	[0.83,1.17]	[0.69,0.92]
res.12	[35,42]	[28,31.5]
res.13	[0.5,0.79]	[0.4,0.59]

Step 10: The final cost range of the products are computed using equation 10. Thus for prod.1 we have:

$$\otimes C_{p_1} = (2.33\times[5.24,6.71]) + (0.8\times[0.5,0.66]) + (0.03\times[122.5,140.1]) + (0.12\times[45,55]) + (1.28\times[0.91,1.3]) + (0.04\times[8.45,11.31])$$
$$+(210.72\times[2.5,2.55]) + (27.95\times[0.01,0.08]) + (13.51\times[0.11,0.26]) + (0.19\times[5.5,6.9]) + (0.09\times[0.83,1.17]) + (0.14\times[35,42]) + (0.04\times[0.5,0.79])$$
$$= [12.21,15.63] + [0.4,0.53] + [3.67,4.2] + [5.4,6.6] + [1.16,1.66] + [0.34,0.45] + [526.8,537.34]$$
$$+[0.28,2.24] + [1.49,3.51] + [1.05,1.31] + [0.07,0.11] + [4.9,5.88] + [0.02,0.03] = [557.79,579.49]$$

And for prod.2 we have:

$$\otimes C_{p_1} = (2.33\times[6.37,8.21]) + (0.8\times[0.75,0.91]) + (0.03\times[133.35,150.35]) + (0.12\times[75,90]) + (1.28\times[0.88,1.33]) + (0.04\times[8.23,11.1])$$
$$+(210.72\times[2.5,2.81]) + (27.95\times[0.01,0.09]) + (13.51\times[0.09,0.2]) + (0.19\times[5.3,6]) + (0.09\times[0.69,0.92]) + (0.14\times[28,31.5]) + (0.04\times[0.4,0.59])$$
$$= [14.84,19.13] + [0.6,0.73] + [4,4.51] + [9,10.81] + [1.13,1.7] + [0.33,0.44] + [526.79,592.12]$$
$$+[0.28,2.52] + [1.22,2.7] + [1.01,1.14] + [0.06,0.08] + [3.92,4.41] + [0.02,0.02] = [563.2,640.31]$$

Therefore, the cost range of prod.1 is [557.79, 579.49] and the cost range of prod.2 is [563.2, 640.31]. A review on the data related to the observations on the factory floor, convinced us that the frequency in which these data occurred to be closer to the upper bounds is higher than the lower bound. Thus, it would be more logical to approximate the final costs closer to the upper bound. After negotiating this with the business owners, $\delta = 0.25$ was accepted. Hence the final costs of the products were calculated by equation 11 as follows:

$$\hat{\otimes} C_{p_1} = (0.25\times 557.79) + (0.75\times 579.49) = 574.065 \approx 574.07$$
$$\hat{\otimes} C_{p_2} = (0.25\times 563.2) + (0.75\times 640.31) = 621.0325 \approx 621.03$$

That is, the production cost for the first product is 574.07US$, and for the second product is 621.03US$.

To validate the estimated cost by the application of G-ABC and to see how it may outperform ABC in this particular case, a post-costing observation session was held. First, the cost of each product was estimated with the use of traditional ABC, as well. To do so and to provide ABC with required crisp data on consumption rates of resource drivers we relied on the mean (average) of our previously obtained data from the observations on the factory floor (a dominant strategy in traditional ABC). The estimated costs by traditional ABC are presented in Table 6 next to those estimated by G-ABC.

Afterwards, we held a two-month observation session, during which actual costing of a sample of 50 products of each prod.1 and prod.2 was done through the direct study of consumed resources by each product. To do this we measured exact amount of resources consumed by each

individual product and did not use any external data. The statistical outcome of these observations is presented in Table 7.

Table 6
ESTIMATED COSTS BY G-ABC AND TRADITIONAL ABC

Costing Strategy	Estimated cost for Prod.1	Estimated cost for Prod.2
G-ABC	574.07	621.03
ABC	585.09	640.10

Table 7
STATISTICAL PRESENTATION OF OBSERVED COSTS IN THE POST-COSTING OBSERVATION SESSION

	Prod.1	Prod.2
Sample size	50	50
Mean of observed costs	573.64	624.2
Standard deviation	11.97064	11.55819
Variance	143.29633	133.59184

As the statistics in Table 7 show, the estimation by G-ABC is closer to the mean obtained by observations than the estimation by traditional ABC and it is one way to demonstrate the efficacy of the proposed G-ABC.

DISCUSSION AND CONCLUSION

ABC has gained increasing attention in the past decades and several successful implementations of ABC systems have been reported in the literature. As opposed to traditional costing methods, ABC has proved more accuracy in allocating all direct and indirect costs to the final product. Nonetheless many SMEs are unable to adopt and implement ABC, because ABC is considered to be somewhat costly and complex. This is not the only shortcoming of ABC, though. Indeed some fundamentals of ABC are in contradiction with the production nature of some particular products.

ABC insists on collecting exact information about the consumption rates of cost drivers by cost objects. This insistence is not only very time consuming, difficult, and expensive, but also attributing exact numbers to cost drivers' consumption rates, is not valid in many cases. There exists an inherent uncertainty in these types of data. This uncertainty originates from unavailability of data, industry traits, product features, interfering variables, and etc. Less in automotive production lines, and more in manual ones this could be noticed. Neglecting this uncertainty, in many cases might lead to unauthentic cost estimations.

This study proposed the application of grey system theory (GST) as a way to face with this uncertainty. GST, by defining grey numbers, as interval numbers with two specific bounds, can provide a better approximation of consumption rates of some cost drivers. This way instead

of attributing an exact number to a variable consumption rate, in different circumstances, a range is applied to address the fluctuation of this amount. In some cases also, the less fortunate organization will not have to let go of ABC for the cost of information obtaining, and they may simply rely on some interval estimations with two distinct bounds.

The G-ABC proposal of this paper facilitates the implementation of ABC accounting system and provides a more authentic framework to estimate cost of some particular products in some special industries. However, the final cost which is achieved by this method is an interval cost and denotes that the actual cost of the product is included in which range. This may raise a question about the notion of "cost control". As we earlier discussed it is very clear that the more precise our knowledge of a system is, the more reliable our cost estimation procedure will get. At the same time, the more information we need to obtain to increase our control on a system, the more we need to spend. There is no doubt that when data are deterministic and unchangeable (a white system) nothing performs better than traditional ABC, but without violating the truism of this axiom we claim that G-ABC is the appropriate tool to encounter uncertain conditions. Moreover, G-ABC, just like ABC, is not only a cost estimation method, but also a management information system. When the lower and upper bounds of the final obtained cost interval are too apart, it is an implication for the management that controlling processes are not well exercised and accuracy in work flow and production operations is not acceptable.

In this study we only assigned interval grey numbers to consumption rates of cost drivers. Interval grey numbers are only good for continuous variables like working hours. While in some cases variables are discrete and another kind of grey numbers which denote a set of values, are needed. Future studies may add this concept to G-ABC.

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CAPITAL STRUCTURE CHOICES AND SURVIVAL IN A DEREGULATED ENVIRONMENT

Arthur J. Francia, University of Houston
Christian S. Kuiate, University of Houston
Thomas R. Noland, University of Houston
Mattie C. Porter, University of Houston-Clear Lake

ABSTRACT

We examine the impact of capital structure choices for survival in a deregulated industry. Financial leverage in particular has been identified by numerous prior studies as a major determinant of the probability of survival in most industries. In the course of a deregulation, the debt overhang effect stemming from high leverage negatively affects the ability of existing firms to survive when a regulatory shock occurs (Zingales, 1998). Following such a regulatory shock, and consistent with the tradeoff and debt overhang theories of capital structure, firms are more likely to reduce their level of leverage (Ovtchinnikov, 2010). This causes the expected costs of financial distress to rise higher and we can expect a negative association between leverage and survival in a deregulated industry. However, in a highly competitive setting, firms may signal their level of quality by contracting for more debt instead of equity (Ross, 1977). This signaling perspective can therefore induce the existence of a positive association between leverage and survival in a deregulated context. Using a sample of private trucking firms, we test this hypothesis and find a negative association between leverage and survival. In a refined analysis aimed at distinguishing high "quality" versus low "quality" firms, we adopt the "excess capacity" approach of De Vany and Saving (1977). Consistent with our initial findings, we find that the negative association between leverage and survival increases with the level of excess capacity.

INTRODUCTION

The U.S. interstate trucking industry was deregulated by Motor Carrier Act of 1980 (MCA 1980). With deregulation, the barriers to entry were lowered and, in the 1980s, many new trucking firms entered the market. We focus on the private trucking firms that either survived deregulation or were created after that regulatory shock and examine the association between a trucking firm's choice of capital structure and its chances of survival after deregulation. Contrary to other studies focusing on the same question that rely on samples of publicly traded firms, we

only look at private firms. Our reliance on private firms allows us to examine the effect of constrained capital choices whereby a deviation from optimality is particularly detrimental for the survival of these firms.

DEREGULATION IN THE TRUCKING INDUSTRY

From 1935 to 1980, the Interstate Commerce Commission (ICC) federally regulated interstate motor carriers in the U.S. The ICC was created in 1887 to regulate railroads that were perceived to be monopolistic and were practicing rate discrimination. As other modes of transportation evolved in the 1900s, the ICC eventually was empowered to regulate all common carriers. The ICC approved licensing, rates (tariffs), and routes. Because of the restrictive ICC controls, entry into these regulated markets was very difficult. In addition, the regulations led to inefficacies in the operations of the carriers (Moore, 1993). Since the ICC regulated rates and routes, carriers could operate with inefficient cost structures and still earn a market return on investment.

Beginning in the 1950s, the criticisms of the effects of regulation led to efforts to begin to deregulate the controls over common carriers. In 1977, the ICC began to change their policies related to the trucking industry (Zingales, 1998). Barriers to entry eased and increased rate competition was encouraged. The passage of the MCA 1980 solidified these steps towards deregulation of interstate common carriers.

While the MCA 1980 did not completely remove interstate trucking companies from regulation, it did ease the economic restrictions of the regulations. As a result, dramatic changes in the trucking industry occurred and influenced segments of the trucking industry differently. As noted by Zingales (1998), the interstate trucking business has two distinct segments: the truckload (TL) segment which includes carriers which transport full loads of 10,000 pounds or more from point to point, and the less than truckload (LTL) segment carriers which transport loads of less than 10,000 pounds and need to consolidate loads to move efficiently from point to point. Because of the logistics and equipment required to pick and deliver smaller loads, the LTL segment requires greater capital and equipment to create the terminals and networks needed to combine loads and deliver efficiently across the country. The TL segment requires somewhat less capital investment (i.e., one independent trucker can pick up and deliver a load directly to the end point) but many firms in the TL segment rely on leverage via equipment financing to enter the market.

LEVERAGE AND SURVIVAL IN THE TRUCKING INDUSTRY

In the trucking industry, inventories of any kind are a very small part of total assets and usually consist of parts for repairs and tires. The majority of the fixed assets are equipment which is financed. Financing in the trucking industry is easier than in many industries because

there are many platforms to finance tractors and trailers and there is a ready market for the vehicles in the event of a default. The availability of lenders covers a broad spectrum with financial instruments limited only by the imagination of the lender and the needs of the borrowers. The basic lenders that are available are dealer financing, third party equipment financers, operating leases and financial leases.

Borrowing is necessary for growth because the industry is capital intensive and each individual carrier needs critical mass to survive. Milano (2011) notes that at the end of 2010, the total gross operating assets in the industry amounted to over $700 billion, more than twice the revenue generated that year. Critical mass may be one tractor for an owner-operator or thousands of units for a large carrier. The industry is basically pure competition and the profit margins hover around three to six percent of sales with a two plus turnover of assets. Financial leverage can cause pressure on firm survival because of the revenue/margin pressures from competition in a deregulated environment. It is not unusual for trucking companies to reduce their rate for services (prices) to generate short term cash flows to service debt. These pressures can lead to firm bankruptcy.

By 1989, deregulation had effectively been completed in the U.S. trucking industry and a new era of competition began. The economic barriers to entry in the TL segment were significantly reduced and competition increased as new carriers entered the market. These new carriers were predominately private, non-union, low cost carriers who competed on rates (tariffs). Henrickson and Wilson (2008) using firm-level data find that surviving union firms did not experience the benefits from the reduction in average compensation that new entrants obtained after deregulation. Actually, the compensation premium at the union firms increased rather decreased. This increase in compensation premium was potentially one of the reasons why many union firms exited the industry after deregulation. As free competition increased in the TL segment, freight rates became competitive bids established in an open market. In a deregulated market, TL carriers have to be price and service competitive and control costs in order to have a sufficient profit margin and cash flow to survive. However, leverage is frequently used as the vehicle for entry of these private TL firms.

THEORETICAL FOUNDATIONS AND HYPOTHESES DEVELOPMENT

The literature on the association between financial leverage and the probability of bankruptcy is extensive. Baxter (1967) outlines the basic finding that excess leverage and the associated increase in the cost of capital are events heightening the risk of bankruptcy. Altman (1968) identifies financial leverage as one of the main factors to be considered for a discriminant analysis upon which the Z-score is based. Closely related to our work, is Zingales (1998). This study examines whether financial leverage is a determinant of survival in an industry that is made more competitive because of a major regulatory shock. The findings support the notion that highly leveraged trucking firms in the pre-deregulation period are less likely to survive the

regulatory shock. Viscusi, Vernon and Harrington (2005) note that deregulation in the trucking industry was instituted by releasing both the barriers to entry and the barriers to exit. Doing so led to both a reduction in industry-level profitability (Ying and Keeler, 1991, estimate a growing reduction in rates following deregulation from a range of 15-20% by 1983 to a range of 25-35% by 1985) through increased competition, and also through an easing of the exit of less efficient firms through bankruptcies. Indeed, Madsen and Walker (2007) examine competitive pressures from entrants and incumbents in the trucking around deregulation. They find that competitive pressures from entrants are a driving factor of the exit rate in the industry after deregulation. Among the reasons cited, they mention the stock of experience of entrants rather than that of incumbents. We could interpret their findings from a financial perspective to note that entrants are less likely to be as financially leveraged as incumbents, thus their greater competitiveness.

We follow up on Zingales (1998) and examine whether or not financial leverage in the trucking industry remains a major determinant of survival even after the participants in this industry have adapted to the new competitive environment.

First, the debt overhang perspective developed by Myers (1977) predicts a negative association between survival and the level of contracted leverage. From this perspective, a debt-ridden borrower is not able to raise new funds to take advantage of new profitable opportunities. This inability to raise funds could be due to the decrease in the net worth of the firm because of the claims of the current creditors, leaving too few net assets which can be pledged in favor of the future lenders. The second explanation has to do with the level of profitability of the new ventures to be financed with new debt. With regards to the trucking industry, the first explanation can be supported by the high prevalence of equipment financing whereby the lien on the financed equipment is retained by the first lender, leaving nothing for the new creditors. The second explanation however, may not be fully supported as carriers can often extract substantial rents from new customers with specialized loads.

Following the angle of the tradeoff theory of capital structure, Ovtchinnikov (2010) examines the capital structure choices of firms in industries that went through deregulation. Not only does he find increases in the growth opportunities of these firms, but more important, these firms reduce their reliance on debt to finance these new operations. His results are consistent with the need for trucking firms to reduce leverage in order to survive in the period post-regulation. His study is different from ours because he relies on a sample of publicly traded companies whereas we examine a set of private trucking firms. Access to equity financing is not as easy for private firms as it is for public firms. Therefore, debt may be the only option for these private firms. This peculiarity renders the findings from our tests even more interesting as they will apply to a larger portion of the economy. Furthermore, Jensen (2005) notes that debt and the associated level of leverage can serve as an efficient monitoring mechanism. Firms saddled with debt implicitly give power to their creditors who can intervene in their strategic choices. The creditors are not interested in halting the operations of the debtors, but in finding a way for them to meet their contractual obligations. As such, even if they hold a lien against the equipment of

the trucking firm, the creditors are likely to suffer a haircut on the value of their loan in the event of bankruptcy. It is therefore to the advantage of the creditors to negotiate with the indebted trucking firm to avoid bankruptcy and take advantage of the growth opportunities that arose from deregulation. Since it is not clear how current leverage will affect the ability of acclimated trucking firms to survive in a deregulated environment, we state the first variant of our research hypothesis as the following null:

H1a: There is no association between current leverage and the probability of survival for trucking firms in a deregulated environment.

We conduct an additional examination of our research hypothesis by considering the pricing power of trucking firms providing high quality service to their customers. Ross (1977) provides an analysis of the signaling theory from the perspective of capital structure choices. Starting from the Modigliani-Miller irrelevancy propositions, he analytically shows that in a situation whereby a manager of a firm of high quality has private information about the prospects of that firm, that manager can contract for a level of debt that can be used by market participants to infer the quality of that firm and separate it from its competitors. One of his empirical predictions is that we could observe the counterintuitive positive association between the probability of bankruptcy and the quality of the firm. High quality firms in the trucking industry have the potential to command higher rates from shippers because the said firms can handle specialized shipments which are not subject to the competitive pricing structure of the rest of the industry. This observation is supported by the findings of Li and Lee (1994) who develop an analytical model to show how firms with higher processing rates in a competitive environment always enjoy a price premium over competitors. In their model, just as in the trucking industry, customers are concerned not only with price, but more importantly with delivery speed which is an indication of the service quality of the firm. Since it is not clear whether it is going to be the pricing power of a high quality firm or its excess leverage due to signaling which will prevail as the main the determinant of survival, we then formulate our second variant of our research hypothesis as the following null:

H1b: There is no association between current leverage and the probability of survival for trucking firms in a deregulated environment regardless of the quality of service provided by the trucking firm.

DATA AND RESEARCH METHODOLOGY

Sample Selection

We start our data collection process with the Motor Carrier Financial and Operating Information filings made by trucking firms with the Federal Motor Carrier Safety Administration (FMCSA) of the Department of Transportation for the years 1989 through 2003 (The analyses

are limited to this time period as the Department of Transportation stopped releasing these reports in an electronic format after 2003). We only focus on a sample of full truckload companies to make sure that we analyze homogeneous firms. Our starting sample consists of 12,305 firm-year observations pertaining to 3,314 unique companies. The next step consists in manually identifying the years of incorporation and bankruptcy of these companies. We are able to obtain that information for 1,400 companies of which 107 are identified as bankrupt. We delete the observations pertaining to public firms as they have access to other sources of capital not available to private firms. This step results in a sample of 6,137 firm-year observations for 1,384 unique companies. To remove the effects of outliers from the data, we drop observations above (below) the 99th (1st) percentile for our independent variables (Kothari and Zimmerman, 1995). Our final sample consists of 2,246 firm-year observations for 795 individual firms.

Table 1 Sample Selection

	# of firm-year observations	# of unique firms
Full truckload firms with reports filed with FMCSA from 1989 to 2003.	12,305	3,314
After identifying years of incorporation and years of bankruptcy	6,313	1,400
After deleting firms with publicly traded equity capital	6,137	1,384
After deleting outliers	2,246	795

Research Design

We are interested in analyzing the extent to which leverage plays a role in the ability of a firm to survive in the period following a regulatory shock. We rely on the design developed by Zingales (1998) and model the probability of survival as a function of firm-specific characteristics among which the degree of financial leverage in the firm's capital structure. Our probit model is as follows:

Pr(survival up to 2003) =
f(NDTC, COV, ROA, REV, LABCOST, CAP, COSTDEBT, OPRATIO, TRAIL–TRACT) (1)

Where:
NDTC = Net debt to capital ratio: (Total debt - cash reserves)/ (Total debt + equity)
COV = Interest coverage ratio: (Earnings before interest, taxes and depreciation)/Interest expense
ROA = Return on assets: (Earnings before interest, taxes and depreciation)/Total assets; this ratio is later decomposed into: (1) MARGIN = (Earnings before interest, taxes, and depreciation)/Total revenues; (2) TURNOVER = Total revenues/Total assets
REV = Log of total revenues; LABCOST = (Wages +benefits)/Operating expenses;
CAP = Ratio of trailers to tractors; COSTDEBT = Interest expense/ Total debt;
OPRATIO = Ratio of total expenses to total revenues;
TRAIL-TRACT= Ratio of trailers to tractors;

We do not include a variable to control for the level of intangibles as Zingales (1998) did because it will severely restrict our sample size. In this model, we are interested in the coefficient on NDTC which serves as a proxy for leverage. In the second part of the analysis, we examine the signaling hypothesis of Ross (1977). To proxy for product quality, we adopt the excess capacity perspective of De Vany and Saving (1977) and we sort firms into three groups depending on how many trailers they have for each tractor in their fleet. De Vany and Saving (1977) note that carriers who can minimize wait time for the shippers are rated higher than others in terms of service quality. To minimize wait time, the carrier must invest in more capacity. Capacity is well defined based upon the number of loads a carrier can move. Dollars of revenues and ton/miles would be a surrogate for the ability to move loads. The number of tractors is a measure of capacity because a carrier cannot move a trailer without a tractor. The ratio of trailers to tractors becomes an important measure of capacity because trailers can increase the efficiency of tractors. Freight can be preloaded by the shipper and the incoming driver can drop an empty trailer and hook up to a loaded trailer. Loading time becomes meaningless under a drop-and-hook system. Based on this characterization of service quality using available capacity, we then estimate model (1) for each of these groups.

RESULTS

Descriptive Statistics and Univariate Analyses

The descriptive statistics in Table 2 (Panel A for surviving firms, Panel B for the non-surviving ones and Panel C for the univariate tests of differences in means across the two groups) indicate that non-surviving firms are on average larger than the surviving ones. There are statistically significant differences in the size of the asset package (9.49 million for surviving versus 11.61 million for non-surviving), and the magnitude of their operations as evidenced by the revenues generated (21.99 million for surviving versus 25.43 million for non-surviving). These differences in size are in line with the difference in leverage with the non-surviving firms being more leveraged than the surviving ones. A potential explanation for these findings is that the non-surviving firms have over-stretched their operations and are in dire need of external financing to support these operations.

We do not observe any difference in the cost of debt across these groups of firms. This no-difference situation is an indication of their equal access to lending from creditors or lenders with an average cost of debt around 20%. We observe that surviving firms generate a higher level of income compared to non-surviving to cover their interest payments on contracted debt (interest coverage ratio of 5.69 for surviving versus 3.21 for non-surviving). The differences in ROA and Margin provide additional evidence that surviving firms are more successful at turning revenues into profit than their non-surviving counterparts. Furthermore, it is an early indication that the expected positive association between firm quality and financial leverage predicted by

models of capital structure choices and signaling may not be verified. Indeed many studies have not found evidence consistent with the predictions of these models (see Harris and Raviv, 1991 for a review of these findings).

The absence of a statistically significant difference in the labor costs faced by these two groups of firms is in line with the nature of the industry. This finding is consistent with those of Henrickson and Wilson (2006) who point out that the changes in labor costs after deregulation evolved in different steps. Initially, firms with unionized labor forces before deregulation did not experience much of the expected decrease in labor costs that should come with deregulation. However, the new entrants in the industry automatically enjoyed the benefits of non-unionized labor forces. But as more and more firms with unionized labor forces vanished away, the labor market in that industry became more competitive with more homogeneous labor costs even though qualified drivers are a very scarce resource. With the increased competition in the labor market, companies also experience high rates of turnover among their drivers, thus making the pay scale transparent between companies. The absence of a difference in the ratio of trailers to tractors is another finding that depicts the nature of the industry. Deviating from the benchmark of 3 trailers to 1 tractor has to be justified by strategic reasons otherwise it is a strong indication of managerial inefficiency.

Table 2: Descriptive statistics

Panel A: Surviving firms

Variables	N	Q1	Mean	Median	Q3	Standard deviation
Revenue	2109	10.68	21.99	15.61	27.88	16.51
Assets	2109	3.24	9.49	6.47	12.09	9.13
Net debt-to-capital	2109	0.29	0.73	0.56	0.76	2.34
Cost of debt	2109	0.07	0.21	0.09	0.12	1.08
Coverage	2109	2.29	5.69	4.28	7.73	6.70
ROA	2109	0.09	0.17	0.17	0.24	0.15
Margin	2109	0.03	0.07	0.07	0.11	0.07
Turnover	2109	1.73	3.34	2.60	4.19	2.51
Labor Cost	2109	0.05	0.25	0.29	0.41	0.18
Ratio of trailers to tractors	1808	1.61	2.93	2.32	3.55	2.16
Operating Ratio	2109	0.95	0.97	0.97	0.99	0.05

Table 2: Descriptive statistics

Panel B: Non-surviving firms

Variables	N	Q1	Mean	Median	Q3	Standard deviation
Revenue	137	11.5	25.43	17.85	30.03	19.89
Assets	137	3.58	11.61	6.37	16.75	11.81
Net debt-to-capital	137	0.53	0.95	0.75	0.91	3.27
Cost of debt	137	0.07	0.20	0.10	0.19	0.29
Coverage	137	0.86	3.21	2.75	4.66	7.59
ROA	137	0.05	0.11	0.14	0.21	0.20

Table 2: Descriptive statistics						
Panel B: Non-surviving firms						
Variables	N	Q1	Mean	Median	Q3	Standard deviation
Margin	137	0.02	0.06	0.06	0.10	0.06
Turnover	137	1.78	3.39	2.72	3.90	3.08
Labor Cost	137	0.00	0.24	0.31	0.40	0.20
Ratio of trailers to tractors	137	1.68	3.15	2.23	3.61	2.56
Operating Ratio	137	0.94	0.98	0.98	0.99	0.04

Table 2: Descriptive statistics		
Panel C: univariate tests of differences of means (Surviving minus non-surviving)		
Variables	Difference of means	p-value
Revenue	-3.44	0.019
Assets	-2.12	0.009
Net debt-to-capital	-0.22	0.048
Cost of debt	0.01	0.929
Coverage	2.48	<0.001
ROA	0.06	<0.001
Margin	0.01	0.0024
Turnover	-0.05	0.8236
Labor Cost	0.01	0.6042
Ratio of trailers to tractors	-0.22	0.2989
Operating Ratio	-0.01	0.0933

Multivariate Analyses

We conduct our multivariate analyses in two phases. First, we pool observations across the two groups of firms and estimate a logistic regression to model the probability of survival. In Table 3, from the baseline model (model 1), we find a statistically significant negative association between the degree of financial leverage and the likelihood of survival (coefficient of -0.03 with p-value of 0.03). This finding is consistent with the debt overhang hypothesis predicting a negative impact of leverage on the operations of deregulated companies. In this same model, the positive coefficient on the interest coverage ratio reinforces the importance of contracting for sustainable levels of debt. Interestingly, even though the two types of firms in the analysis do not exhibit significant differences in the level of labor costs, the negative and statistically significant coefficient on labor costs (-1.44, p-value <0.01) indicates that deviating from the industry norm can be very detrimental for survival.

In model (2), we account for the effects of excess capacity using the ratio of trailers to tractors as it could be an indication of high quality operations or alternatively of a very poor operational strategy. Consistent with the poor operational strategy argument, we find a negative

and statistically significant association between excess capacity and the probability of survival. This effect seems to subsume the one stemming from leverage as the coefficient on that variable becomes statistically insignificant. An explanation for this finding is that the non-surviving firms use debt financing to acquire these excess trailers which generate revenues but not in a timely fashion. As the payback period for the financing of these excess trailers extends into the future, the highly leveraged firms become more sensitive to periodic economic shocks that can endanger their ability to survive. In model (3), we decompose ROA into MARGIN and TURNOVER and we also include a variable to control for the cost of debt. Our results are not significantly affected by these changes. In all three models we control for year fixed effects to account for economy-wide conditions.

Table 3: The effect of leverage on the probability of survival

	Model 1	Model 2	Model 3
Independent variables	Estimate (p-value)	Estimate (p-value)	Estimate (p-value)
Intercept	2.75	3.74	3.92
	(0.01)	(<0.01)	(<0.01)
Net debt-to-capital	-0.03	-0.01	-0.02
	(0.03)	(0.64)	(0.35)
Log(1+coverage)	0.25	0.31	0.32
	(<0.01)	(<0.01)	(<0.01)
ROA	-0.12	-0.40	
	(0.82)	(0.47)	
Log(Revenues)	-0.12	-0.21	-0.25
	(0.17)	(0.02)	(0.01)
Labor costs	-1.44	-1.45	-1.27
	(<0.01)	(<0.01)	(0.01)
Ratio of trailers to tractors		-0.04	-0.03
		(0.09)	(0.13)
Cost of Debt			-0.01
			(0.97)
Margin			0.53
			(0.70)
Turnover			-0.03
			(0.46)
N	2,246	2,246	2,246
Likelihood ratio	59.59	61.27	58.66
	(<0.01)	(<0.01)	(<0.01)
Year Fixed effects	YES	YES	YES
Pseudo R-squared	0.088	0.11	0.11

In the second phase of our analyses, we test the signaling hypothesis by estimating our model for three groups of firms ranked by the ratio of trailers to tractors. The low, median and high excess capacity firms respectively exhibit trailers to tractors ratios of 1.6, 2.2, and 3.5. In Table 4 we present the results of the estimations. Leverage appears to negatively affect the chances of survival for the two extreme groups and not for the middle one. This finding is consistent with the existence of best practices and standards in this industry with respect to the composition of the asset package. Any deviation above or below the standard could be detrimental for survival. Not enough trailers for the available tractors indicate a need to outsource some of the loads, thus cutting the margin generated by the load. A higher than normal ratio of trailers to tractors indicates incurrence of debt to finance these acquisitions and also the incurrence of maintenance costs and fuel costs to support the fleet.

Table 4: The effect of leverage on the probability of survival--test of the signaling hypothesis

	Low excess capacity	Median Excess capacity	High Excess capacity
Independent variables	Estimate (p-value)	Estimate (p-value)	Estimate (p-value)
Intercept	8.48	0.75	4.95
	(0.73)	(0.98)	(0.01)
Net debt-to-capital	-1.06	0.01	-0.35
	(<0.01)	(0.88)	(0.07)
Log(1+coverage)	0.49	0.46	0.36
	(0.79)	(0.01)	(0.04)
ROA	0.07	-0.02	-1.06
	(0.95)	(0.98)	(0.40)
Log(Revenues)	-0.58	0.17	-0.29
	(<0.01)	(0.46)	(0.10)
Labor costs	-0.42	-0.92	-2.89
	(0.64)	(0.30)	(<0.01)
Cost of Debt	0.08	-0.10	-0.12
	(0.96)	(0.34)	(0.61)
N	586	587	586
Likelihood ratio	47.93	32.43	58.66
	(<0.01)	(<0.01)	(<0.01)
Year Fixed effects	YES	YES	YES
Pseudo R-squared	0.24	0.19	0.16

CONCLUSION

Deregulation in the U.S. trucking industry occurred in the 1980s. By 1989, many new trucking firms emerged as the barriers to industry from regulation were removed. We focus on private trucking firms that survived deregulation or were created after the regulatory shock occurred and examine the effect of leverage on its chances of survival. Contrary to other studies focusing on same question that rely on samples of publicly traded firms, we only look at private firms. This sample allows us to examine the effect of capital choices on a large number of private firms. Consistent with the debt overhang and capital structure tradeoff theories, we found a negative association between the degree of financial leverage and survival of trucking firms. Furthermore, this negative association persists even when we consider the quality of the services provided by these trucking firms. Overall, despite the necessity for private trucking firms to use debt financing to take advantage of the growth opportunities created by deregulation, this form of financing has to be used carefully to minimize the risk of bankruptcy.

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OWNERSHIP AND CONTROL RIGHTS' ALLOCATIONS AND INCOMPLETE CONTRACTS: EMPIRICAL ANALYSIS OF DRUG DEVELOPMENT PARTNERSHIPS

Lilia Hyttinen
HANKEN School of Economics

ABSTRACT

Asset ownership and control allocations within pharmaceutical drug development collaborations are examined through lenses of incomplete contracting. The subject of contractibility puts some constraints on corporate financing possibilities and then, decision and control rights become an issue. Because technology ownership and revenue rights, generated by a new technology are contracted separately, within the drug development's partnership they are analyzed independently, as well.

The findings suggest that the ownership of technology (IP rights) are transferred ex-ante only in 4% of all partnerships, while in the majority of deals have been contracted only the licenses to commercialize a new drug. To minimize a partner's risk exposure, license fees are paid upon validation of a drug target and not upfront when a partnership contract has signed. In the sample, over half of all projects began as licensing option contracts. These contracts are contingent upon the favorable state verification i.e. an outcome of clinical trials.

In previous research, academic scholars have viewed equity stake transfers as an option to acquire a firm in future. I have examined the alternative hypothesis of replacing cash outright payments by an acquisition of a minority equity stake. My results suggest rather the credit rationing and minimizing the risk exposure.

INTRODUCTION

As a rule, pharmaceutical firms commonly outsource new drug innovations to biotechnology firms. Yet, because biotechnology firms are often small to medium size, and do not have the resources to conduct larger scale clinical trials, promising drug targets are further developed in collaboration with larger pharmaceutical corporations. Strategic alliances have become an increasingly common vehicle for organizing corporate investment (Palia, Ravid and Reiser, 2008). The motivation for this analysis is the observation that while considering the partnering a development of a new drug, counterparts have to decide, either to buy a technology , or only to license commercialization rights; they must also decide how they go about contract

design. A few new trends have emerged, yet many of these developments are currently only corroborated by anecdotal evidence; I have documented empirical evidence to support the industry observations. To my knowledge, there are no empirical papers yet, that have examined the transfer of control of the cash flow rather than transfer of pharmaceutical assets' ownership.

This paper investigates how and at what stage of a drug development process the ownership or control over an asset and a cash flow generated by that asset are allocated within a partnership, using the data from pharmaceutical and biotechnology industries. Furthermore, I take a closer look at the design of partnership contracts and the ways partners use contractual provisions, such as an option to license a new drug, or, an acquisition of minority stake in the partner's equity.

At the outset not all possible future contingencies can be included in the contract, since they are simply too difficult to describe in advance. If the initial contract does not outlay all the future contingencies, the key question becomes how future decisions are made? And, more importantly, how they are reflected in the choices of parties at ex-ante stage.

In contract theory research (Grossman and Hart, (1986) and Hart and Moore (1990)), the view taken to incompleteness: even if a contract does not specify all contingencies in the contract ex ante, it is possible to agree ex ante on the decision –making process. The question is who should have decision and control rights, since they are the keys to decisions and actions when unforeseen contingencies arrive. How should decision rights and cash flow rights be allocated in the initial contract between the parties? Contracts that employ real option features are becoming increasingly common in pharmaceuticals universe.

Additionally, because 62% of partnerships in the sample are cross-border, I have examined whether the *international* factor contributes to an ownership transfer or a contract design, possibly, because of the monitoring and costly state verification issues (Diamond, (1991); Winton, (1995)). In the area of financial contracting under moral hazard ("hidden action"), the critical issue is what are the variables that are observable and verifiable and thus, contractible. In most moral hazard problems in economics, the main trade-off is identified as between risk sharing and incentives (Jensen and Meckling, (1976); Leland and Pyle (1977); Myers and Majluf, (1984)).

At first, the prediction is examined that within a framework of drug development partnerships, it is not the ownership of the assets, but, rather, the revenues generated by the assets are important. Following works of Aghion and Bolton (1993), Kaplan and Stromberg (2003), Robinson and Stuart (2007), and Dessein (2005), I distinguish between the technology *ownership* determined by who holds a title on a drug's patent, and the *control rights* that establish who holds commercialization rights. For example, Amgen has developed a drug *Apanesp* and hold patent title (ownership) of the drug, while Johnson & Johnson has licensed the rights to manufacture and market the drug (controlling the drug). Commercialization (i.e., revenue) rights are transferred by means of an exclusive license and are asset specific.

The findings in this paper are consistent with the theories that emphasize not the asset ownership, but the value of residual rights of control in situations where parties write incomplete contracts. The results suggest that pharmaceutical firms have predominantly acquired the license to commercialize a drug but not the technology itself. The ownership of an asset – a drug's patent title, often remains with a developer (a biotechnology firm) and has not been transferred. Moreover, the commercial rights are often transferred, often, only after a drug is validated, in other words, the efficacy has been established. Because drug development partnerships are driven by the outcome of the clinical data, the new drug targets successful progression through clinical trials serves as the validation of a drug (favorable state verification theory). Further analysis shows that the majority of contracts has been structured as option contracts (70% in the sample); where the license has been acquired and licensing fees are paid later in the course of partnership.

The majority of partnerships in the sample are international (over 60%), so, the monitoring becomes an issue (moral hazard, "hidden action" theory), while the inclusion of an equity stake in partnership contracts, as hypothesized, intends to mitigate the moral hazard problem. The study is also supporting the hypothesis that partners aim to minimize outright cash disbursement, and the risk' exposure, for example, when pharmaceutical has acquired a minority stake in a biotech partner's equity.

Further, the paper proceeds as follows. In part II, I shed light on the theoretical contributions of the research. In part III, I describe the hypotheses and underlying theories; it follows by the empirical design in IV. Part V reports the empirical results. Part VI concludes.

THEORETICAL CONTRIBUTIONS OF THE RESEARCH

First, the key issue of the paper is contractibility issue, i.e. contractual incompleteness of partnership agreements and, hence the decision and control rights distribution. This analysis extends the research on ownership and control allocation within a framework of financing contracts. Lerner and Merger (1998) have found that in the early stages of a project more control has been assigned to a financing firm. Kaplan and Stromberg (2003) have noted that R&D partnership contracts often have been structured as VC contracts; a financier wants to receive ownership and control over the assets upfront, as collateral. My findings corroborate Lerner and Merger (1998) and Kaplan and Stromberg (2003) on the equity stake transfer's part, but not on the assets' Intellectual Property (further, IP) rights or the revenue rights (licensing) allocation aspects. The results also give empirical support to corporate finance theories of contingent ownership and contingent control rights allocation. For example, Aghion and Bolton (1992) argued that co-ownership is typically sub-optimal relative to contingent ownership, and Dessein (2005) noted that contingent control rights were allocated upon 'verifiable measures of performance'.

Robinson and Stuart (2006) have observed that the reputation of a partner is important in the allocation of control in alliances. My findings suggest the phases of development, and, particularly, completing of a Phase IIb, is the pivotal point upon which the commercial rights are often contracted. The evidence agrees with Guedj and Scharfstein (2004) who have noted the phase of development as the critical determinant in investment decisions.

Furthermore, Froot, Schrfstein and Stein, (1993) point out that the variability in cash flows disturbs investment and financing plans; thus, hedging can reduce the variability in cash flows and is optimal when the supply of external financing is inelastic. Research and Development (R&D) in the biotechnology and pharmaceutical industries is expensive, thus alliances are often formed at the stage that requires significant contributions of resources by the parties involved. Palia et al. (2007) have viewed collaborations as a risk minimizing technique while financing/co-financing projects. My findings are corroborating their hypothesis. Yet, this research focus is, specifically, on *contract design as an additional risk management strategy*, such as an exclusive licensing instead of technology transfer, a licensing contract's initiation as an option contract; and equity stake inclusion as a replacement of cash outright in contracts. The majority of drug targets fail during the clinical trials; my results also show that the firms use contracts design to avoid commitment of waste resources upfront.

In addition, this study extends the earlier research of the use of real options in contracts. For example, Ziedonis (2007) has investigated the use of options in technology licensing. His research points out that "the option only corresponds to small initial investment that creates the opportunity to make a larger subsequent investment in the event the findings generated by the initial investment are favorable. The price of the option corresponds to the initial expenditure, and the exercise price corresponds to the cost of the follow-on investment" (Ziedonis, 2007, (p.2)). There is evidence that firms use an option provision as the risk mitigating technique to avoid committing larger funds ex-ante, since, the option fees are significantly lower than the fees for exclusive licenses.

This essay also provides the empirical evidence to the theories of trade-off between risk sharing and incentives; such as, moral hazard and credit rationing (Akerlof, 1970; Stiglitz and Weiss, 1981; De Meza and Webb, 1987); and moral hazard and limited liability (Innes, 1990).

THEORY AND HYPOTHESIZES

The objective is to study how the ownership and control over assets are allocated within drug development partnerships; and how contracts are designed to incorporate contingency provisions, such as a drug failure in clinical trials and monitoring problems.

I have built upon limited liability theory (Innes, 1990) that posit that an entrepreneur does not internalize the loss in low states, as well as ,on the strategic management literature that advocates risk reduction as a motive for alliance formation, i.e. the firms are reluctant to finance

high-risk projects internally. (See, for example, Mody, 1993; Bleeke and Ernest, 1993; Nanda and Williamson, 1995; Folta and Miller, 2002).

Under the limited liability theory, alliances may be structured as a real option when firms do not want to commit substantial recourses until additional information becomes available. The option becomes more valuable as the risk of the environment increases. Earlier research provides different characterizations of frictions that may lead to hedge, such as, that the firms may want to reduce their risk exposure because of managerial risk aversion (Stultz, 1984; Smith and Stultz,1985; Tuffano, 1996; Ravid and Basuroy, 2004). Under the assumption of perfect capital markets, the financial economics literature would suggest that firm-level risk reduction activities are not optimal. However, under different market frictions, though, the risk reduction might be valuable for shareholders. Alliances where cost and revenues are shared can serve a hedging purpose; in the biotechnology and pharmaceutical industries, projects are often terminated before completion; thus, Palia et all, (2008) predict a positive correlation between project risk and alliance formation. Earlier, Froot at all (1993) have pointed out the benefit of hedging. The hedging adds value to the extent that it helps ensure that a corporation has sufficient internal funds available to take advantage of attractive investment opportunities.

I have examined the proposition that larger pharmaceuticals take licensing *options* in order to avoid paying licensing fees upfront and to be able to participate in multiple projects. Ziedonis (2007) also pointed out that option fees are substantially smaller than licensing fees. I posit that a pharmaceutical firm avoids investing in an unproven technology and is only interested if a drug target has been validated through clinical tests. The pharmaceutical firm wants to hedge the external drug development, while the biotech firm pursues the outside financing because the wealth constraints and risk-aversion. Thus, the objectives of the pharmaceutical firm and biotech firm are aligned by means of partnerships (financial) contracts.

Because drug development is characterized by a high failure rate, the empirical analysis examines how the partners, using contract provisions, mitigate the risks of potential drugs failures. Since, the majority of partnerships in the sample are international (over 60%), the monitoring could become an issue. First, the factors that determined the control reallocation via licensing are identified. Second, the licensing initiation as an option contract is examined. Earlier, Kaplan and Stromberg (2003) have studied VC investments and found out that venture capitalists separately allocate cash flow and other control rights and that these rights are often contingent upon observable measures of financial and non-financial performance.

Following Robinson and Stuart (2007), two types of control are identified: *ownership*-based control, vs. *contract*-based. To design an empirical testing I have selected three types of assets. First asset is the technology ownership (IP Rights), the second asset is the (commercial) rights to the cash flow generated from this technology (a license), and the last one is an acquisition of minority equity stake that is included in a contract.

I have examined the hypothesis that in R&D collaboration, while the IP rights (patent) is owned and controlled by a biotech firm (and are never contracted upon), the pharmaceutical firm

has control over the final product of the development, the new drug, and its commercialization rights. In exchange, a pharmaceutical firm provides the R&D funding and will take over the development process at more advanced stage. For a small biotech firm, it is also beneficial to retain the control of a drug as long as possible and to delay an out- licensing, in order to receive higher valuations later in the course of the development. If a biotech avoids a premature out-licensing, later, when a drug is approved, the biotech can share the value it helps to create.

Lastly, I have examine equity stake transfers as an attempt to coordinate corporate investment and financing policies, as in Froot at all, (1993). Under moral hazard and credit rationing theory, the entrepreneur bears the costs of moral hazard since they are priced in the cost of external financing. The ownership concentration (partial) comes with costs, notably reduced risk sharing, as in Admati, (1994); and may lead to excessive monitoring, thereby stifling managerial initiative ex-ante, as in Burkart, (1997).

The scope of this research is limited, predominantly, to the licensing of commercialization rights, i.e. cash flow (revenue rights) allocation under the umbrella of a partnership, and not the technology transfer, per se. Extensive research exists on the technology transfers, for example, from university to industry. (See, for example, Henderson, Jaffe and Trajtenberg, 1999; Thursby, Jensen and Thursby, 2001; and Ziedonis, 2007).

Since, in the drug development collaboration, it is, predominantly, the transfer of revenue rights that has been contracted upon, while only 4% is technology transfer (in my data set), I have not studied in depth the sale of the technology.

The analysis is based on the assumption is that a pharmaceutical firm is not interested in buying a whole company, especially if a biotech has no earnings; it only wants to invest in a particular technology, preferably in an area of its own research interest. A biotech firm has cash constraints and has the pressure to sell a technology to a highest bidder, or, out-license with more cash up-front. One might suggest that cash starved firms or firms with low valuations hold weaker bargaining positions and have to issue higher equity stakes, or even sell out their most valuable and sometimes only asset, the IP right on a technology. However, I posit that the purpose of a partnership formation is to develop, and, later, to commercialize a particular drug target by means of a licensing, and not to invest in or buy an entire firm. Co-development agreements are negotiated on the merits of a particular target, and a drug's earning potential. Only the cash flow from that new drug and not an entire firm's cash flow can be connected to a partnership's success. Hence, in this analysis, I have utilized partnership-level, not firm level, or patent level data.

The theory ((Grossman and Hart, 1986); and Hart and Moore (1990)) predicts that the ownership of productive assets is allocated to the party requiring the most protection against ex-post opportunism, and, the owner of a firm has the right to exclude others from using the firm's assets. In previous research, Lerner and Merger (1998) and Kaplan and Stromberg (2003) have examined ownership and control allocation within the collaboration framework and have found that the control assigned to financing partner earlier in collaboration.

Two types of control are examined: the *ownership* of the technology (IP rights/patent), and the *contract based* control (revenue rights) that is transferred via licensing, as in Robinson and Stuart (2007).

I posit that in the pharmaceutical world, the ownership of an asset (molecule) is allocated to a biotech firm (not transferred); only the revenue rights are contracted upon via licensing. Thus, the prediction, if confirmed by the findings, will support the theory that ownership of productive assets (a patent) is allocated to the party requiring the most protection (a biotech firm).

H1 *Ownership of IP rights (a patent) remains with the biotech firm and not transfer; only revenue rights are transferred by means of commercialization license.*

Furthermore, the control over the development process also stays with the biotech firm at the early stage. Later in the course of the partnership, if the clinical trials are successful, the control will be transferred to a pharmaceutical firm (contingent contracts theory). In addition, the biotech firm may choose to participate in the commercialization and share the revenues, or, to forfeit commercial rights, and receive royalties only. In my sample most of the partnerships (83%) have royalty provision, while holding an option to participate in commercialization process; this fact also speaks for the contingent contract design theory. The earlier research, (for example Gallini and Wright, 1990; Beggs, 1992) have viewed a technology/patent transfer through lenses of asymmetric information, and, thus , explored the staggered/royalty based fees. My goal is different; the focus is on the incomplete contracts and contingent contracts design and credit rationing theories. In pharmaceutical drug development, even a patent holder itself does not have information whether the drug target will be eventually approved.

In theoretical corporate finance literature, the contingent control allocation is seen as a way of mitigating the opportunistic behavior of agents. However, Kaplan and Stromberg (2003) noted that the contractual provisions are not always enforced; in the VC model, the financing is dispersed in rounds and the funding is contingent on financial and non-financial performance milestones (see also Gompers, 1997; Gompers and Lerner, 2000; and Lerner, 2001). Drug development characterized by a high failure rate even in later stages of development. Thus, ventures are structured in a way that, first, a new drug should meet the endpoints, or milestones, established before the clinical trials begin in order to get a research reimbursement or additional funding (verification of favorable state theory). Ziedonis (2007) studied the use of *real options* as valuable managerial tool in the university technology licensing, because option fees are significantly lower than the actual licensing fees.

I have examined the use of the option features in the drug development partnerships: the license outright acquisition ax-ante, when a partnership contract is signed; or, only option to licensing has been acquired upfront. Due to the option feature of a contract, partners do not internalize losses in bad states (limited liability theory) (see Innes, 1990).

H 2 *To avoid the possibility of making substantial investments (licensing fees) and discontinuing the project latter, the partnerships agreements are structured in the way that, ex-ante, the pharmaceutical firm acquires a licensing option; this option will be exercised later, contingent upon verification of favorable state(limited liability theory).*

In finance literature, scholars view the equity stake ownership as the transfer of the company's assets and as a step towards merger (Robinson, 2008, p.33). Folta and Miller (2002) suggest that large pharmaceuticals that hold minority stakes in biotechnology firms, in essence hold the option on future acquisition. They have found that holders of these stakes are more likely to acquire the biotech company (i.e., exercise the option) when uncertainty of the target is low. The alternative suggestion is that VC's need to support the firm's equity until IPO (Kaplan and Stromberg, 2003).

I posit that the pharmaceutical firm's limited capacity to absorb a new investment affects the contract's provisions; an equity stake is included in a contract to minimize the cash outright disbursement ex-ante to minimize the risk (avoid bad types), and be able to participate in several projects (moral hazard and credit rationing theory). (See also: Akerlof, 1970; Jaffe and Modigliani, 1969; Stiglitz and Weiss, 1981; Meza and Webb, 1987; and Bolton and Dewatripont, 2005).

Ultimately, the entrepreneur (biotech firm) bears the cost of moral hazard, since the cost (equity stake) is priced in the cost of external finance. For a biotech, it is better not to have to give up (diluting) equity in exchange for cash at all, unless it is offered a larger premium; if the biotech firm is private, its equity is the most expensive. Furthermore, the longer a biotech firm is able to preserve its own independence, the better, because the equity valuations are going to be much higher after a product has advanced to the later stages of development.

H3 *The pharmaceutical firm acquires an equity stake in lieu of an outright cash payment, possibly, to minimize the risk exposure (moral hazard, credit rationing theories).*

EMPIRICAL DESIGN

The sample consists of 777 observations of international and domestic drug development partnerships from 29 countries. Many partnerships, particularly smaller ones, have only reported totals of deals' valuations and have not broken down to upfront payments, license fees and milestones, while few have not been disclosed financial terms at all. For partnerships that have reported specific financial terms, I have also run separate regressions N=341 (small sample). All data has been manually collected from Lexis Nexis Academic database; the following search terms were used: Collaborations, Partnerships, Licensing, Upfront, Milestones, Biotechnology firm, and Pharmaceutical firm, years 1999-2008. In addition, the data was cross-referenced with official press releases on firms' web sites, and 10Q, 10K. To my knowledge, the cross-sectional

data set is comprehensive and includes most of active domestic and international drug development partnerships and collaborations for that period. The majority of firms in the sample are public companies, and only a few of them are privately owned. I have collected the following information regarding an each partnership: the announced total value of a project, including upfront payments, licensing or licensing option fees, milestones, future royalties and minority investments in the partner's equity. In addition has been gathered information whether a technology has been transferred (sold), whether a licensing option has been taken instead of a licensing outright, and, if an equity stake has been acquired. The partners names and a countries of domicile, the date when the partnership's contract was signed, the disease indication of a partnered new drug and the phase of a development drug currently is, are also collected.

The general framework is followed Ziedonis (2007).To test ownership and control rights allocation (incomplete contracting theory), I have constructed a dummy variable IPRIGHTS to serve as a proxy for the ownership right, i.e. technology (patent) has been sold. On a contrary, licensing is a contractual arrangement, when rights to use a technology (to manufacture and marketing the drug) have been licensed for a specified period, for example, until expiration of a patent.

I have used the definition of a *patent assignment* posted on the US Patent office website as a basis for that variable.

> *"Assignment is defined as transfer of rights in intellectual property. An assignment of a patent, for example, is a transfer of sufficient rights so that the recipient has title to the patent. The assignment can be a transfer of all rights of exclusivity in the patent, of an undivided portion, (for example a 50 % interest), or of all rights within a specific location (for example a certain area of the United States). Transfer of anything less is considered to be a license." (usinfo.state.gov)*

If a patent has been assigned (ownership transferred) ex ante the dummy equals zero. Conversely, if only the commercial rights were licensed (control rights) a dummy equals 1.

At the outset, the partners have to decide whether the patent (IP rights) ownership will be contracted upon (sold), or not. My hypothesis is that within the drug development collaboration only the revenue rights are contracted upon, while a technology title remains with the biotech. I posit that the financier (Pharma) is only interested in the revenue rights and not in the asset ownership per se.

$$IPRIGTS= \alpha_0 +\alpha_1 PHASE +\alpha_2 DISEASE +\alpha_3 INTERNTN +\alpha_4 IPINDEX +_{\alpha 5} LNDEALSIZE + e \quad (1)$$

The key independent variables are: PHASE, DISEASE and INTERNATIONAL. Following the logic of Danzon, Nicholson and Pereira (2005), Robinson and Stuart (2006), Lerner and Merger (1998), Guedj and Scharfstein (2004), the PHASE variable is included as the independent variable. The PHASE is a proxy for favorable state verification, and is expected to

correlate positively with the dependent. (I have isolated the phase IIb as the most critical in the drug development process because it is recognized as the validation of the new drug, so called, the "proof-of-concept". The dummy for the PHASE is coded as 0 if a contract is signed earlier than Phase IIb and as 1 if a contract is signed after the successful completion of Phase IIb). That is, only commercialization rights will be contracted upon, though, the early stage targets more often will be acquired.

Following the same logic, the DISEASE variable is expected to correlate positively with the dependent; the unmet needs category commands higher premiums, thus more likely only the revenue rights will be contracted upon. Yet, the other plausible prediction is that a pharmaceutical firm is more likely to acquire the technology rights on a drug that belongs to 'unmet needs' category. The INTERNATIONAL variable controls for the difficulty of monitoring of international partnerships (moral hazard, monitoring theory), thus, negative coefficient is expected. This variable might affect the decision to buy a technology rather than licensing commercial rights.

I control for IPINDEX and LNDEALSIZE. Two samples are tested: N=777 and N= 341.

Pharmaceutical firms have developed an expertise in particular disease categories and often are only interested in potential targets for these indications. The unmet medical need categories, such as cancer, diabetes, cardio-vascular, or infections, have higher revenues potential and, therefore, command higher premiums. (FDA defined an unmet medical need as 'medical need that is not addressed adequately by an existing therapy' (FDA website)). Since a disease category is important in its own right, and serves as a proxy for a potential market size, I have included in the regression a variable DISEASE category, similar to Guedj and Scharfsein (2004), Danzon et al., (2005), Lerner and Malmendier (2010). INTERNATIONAL. Sixty-two percent of collaborations in the sample are international. Intuitively, the international partnerships are more difficult and costly to monitor due to different accounting rules, geographical distance, and incoherent laws (Oxley, 1998; Folta and Ferrier, 2000). The fact that one of the partners is domiciled abroad, as hypothesized, might have been an important determinant of the decision to acquire a technology, versus only licensing of commercialization rights (difficult to monitor theory). Furthermore, a partner's country of domicile might determine a contract's design (outright licensing or an option), and an inclusion of equity stake into a contract provision

Ex-ante, not all possible contingencies can be included in the contract, since they are too difficult to describe in advance. To avoid internalizing losses in a bad state (limited liability theory, Innes, (1990)) many partnership deals ex-ante only contracting an option to license. To identify the determinants of the *option* as a contingency provision, the *license* definition is employed to construct the dependent variable in the second specification - LICENSE. The definition of *a license* on the US Patent office website is:

> *"License is a permission to use an intellectual property right, under defined conditions—as to time, context, market line, or territory. In intellectual property law, important distinctions exist between 'exclusive licenses' and 'nonexclusive licenses.' An exclusive license does not necessarily mean that this is the one and only license granted by the licensor. In giving an exclusive license, the licensor promises that he or she will not grant other licenses of the same rights within the same scope or field covered by the exclusive license. However, the owner of rights may grant any number of nonexclusive licenses of the same rights. In a nonexclusive license, title remains with the licensor. A patent license is a transfer of rights that does not amount to an assignment of the patent." (usinfo.state.gov)*

I designated the dummy as 1 if a license is purchased ex-ante, and as zero if only an option contract has been purchased. The key variables of interest are PHASE, DISEASE and INTERNATIONAL, and all are expected to correlate negatively with the dependent variable.

$$LICENSE = \beta_0 + \beta_1 PHASE + \beta_2 DISEASE + \beta_3 INTERNATNAL + \beta_4 LNDEALSIZE + u \quad (2)$$

Dessein, (2006) recognized the importance if the "favorable state verification". Following his logic, I view the PHASE variable as the contingency provision, upon which the license can be taken. Moreover, the later stages projects could capture higher average valuations of a licensing deal. Multiple disease indications drugs are command higher valuations than single disease's, and are predicted to begin as an option, simply to minimize cash outflow. The INTERNATIONAL variable controls for the moral hazard and monitoring problem. Ex-ante monitoring is inefficient, or not contractible (Burkart, Gromb and Panuzi, (1997); Pagano and Roell, (1998) and Myers (2000)), therefore, the international partnership is predicted to begin as a contingent contract (an option), and therefore a negative coefficient is justified.

I am arguing that a contract's design as contingent is related to the low probability of success of a project and not as much to its valuation. Therefore, a project's total value (DEAL SIZE) has been included only as a control variable. (If license fees are paid ex ante, when partnership contract is signed, the upfront payment will be affected, however, the total deal size will remain constant. Thus, it does not make the variable deal size endogenous; in fact, the total deal size might be smaller because the option fees are avoided).

In earlier research, Nicholson at al. (2002); Danzon et al. (2005); Kaplan and Stromberg (2003), have included the deal size, as one of the regressors. The empirical approach is described in Ziedonis (2007). The decision to acquire an option versus the license outright - node (d 2), is sequential and conditional on the decision to contract only revenue rights - node (d 1), and forgo the ownership right transfer.

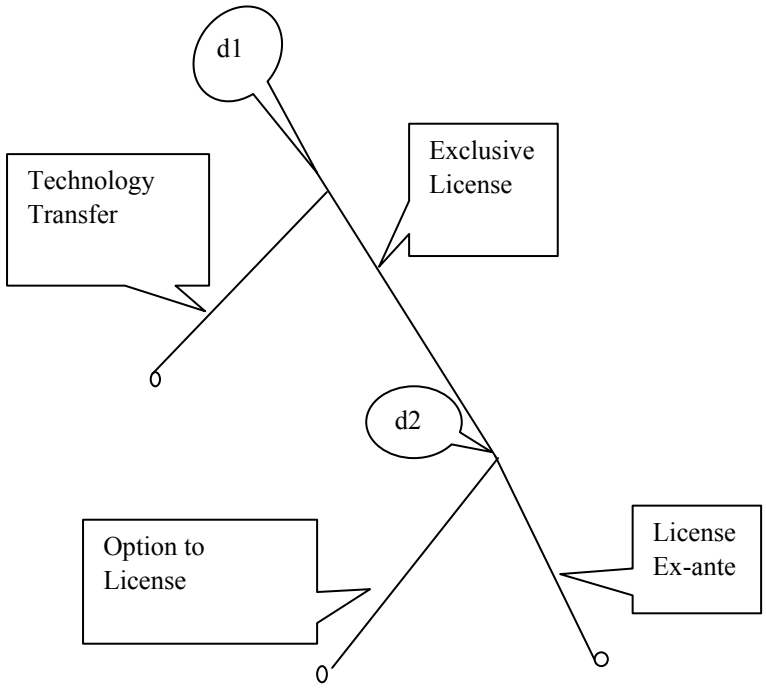
Therefore, the partnerships that have transferred (sold) the technology rights ex-ante are excluded from the samples in the second specification; the two samples have been reduced in the second test to N=749 from larger original sample of 777, and to N=319 from 341(sub-sample) (see Figure 1). The joint choice probabilities can be expressed as a product of marginal (Eq. 1)

and conditional (Eq. 2) probabilities. (For details, see also Wooldridge (2001): equations (15.84) and (15.85), as well as Ziedonis (2007).

$$P_{\text{Option to license}} = P(\text{Option} \mid \text{Licensing}) \cdot P(\text{Licensing})$$

Figure 1.
The decision process of the pharmaceutical agreement.

d1 corresponds to the decision tested in the 1st specification: IP RIGHTS(Technology Transfer) or COMMERCIAL RIGHTS (LICENSE). d2 corresponds to the decision tested in the 2nd specification: OPTION to LICENSE or ex-ante LICENSE purchase.



Because of conflicts of interests between the party making the operating decisions (biotech) and outside investors (Big Pharma), the outside financing involve costs due to moral hazard, such a monitoring; thus, the financing often have restrictions that limit the use of funding to particular technology. The monitoring is particularly important for the international partnerships; because the outside investors do not know the quality of the projects, or the reputation of a counterpart, as in Akerlof (1970), Bolton and Dewatripont (2005), and Robinson and Stuart (2006). Furthermore, the pharmaceutical firm's capacity to carry on several

development projects is limited; thus, not all valuable projects can be financed. To minimize ex-ante cash outright disbursement, and to prevent insider (biotech) from deviations from product maximizing, as hypothesized, the equity stake is included as the contract provisions (credit rationing theory).

The dependent in the third specification is the EQUITY stake dummy. If equity stake is transferred as a portion of upfront payment (or, in lieu of), it is often has carried a substantial premium (up to 30%) to motivate a seller (biotech). If a partnership contract included an equity stake, I have designated dummy equal 1, and zero otherwise. Because in the third test I am studying the likelihood of equity inclusion in the partnership agreements, I have used logit estimation. I have examined the determinants of the contract (key variables of interest) that are the partnership centered: DEAL SIZE and INTERNATIONAL; unlike the earlier tests that are mainly focused the product characteristics: PHASE and DISEASE.

$$EQUITY = \gamma_0 + \gamma_1 LNDEALSIZE + \gamma_2\ INTERNTNL + \gamma_3\ PHASE + \gamma_4\ DISEASE + \gamma_5 IPINDEX + \gamma_6 EFFJDST + \mu \quad (3)$$

The outside investor (Big Pharma) does not know perfectly the quality of the project or an entrepreneur; thus, if the hypothesis supported, the coefficients of the DEALSIZE, INTERNATIONAL, will be positively correlate with the dependent (moral hazard, monitoring theory). The later the stage of development is, the more funding needed, and the valuations are higher in the advanced clinical phases, thus the more likely equity will be included in a contract. One might argue that the Deal Size is endogenous. I have not been able to test for endogeneity because of lack of suitable instruments. (Note: the royalties variable potentially could be a good instrument; however, because the majority of partnership agreements have only report "potential royalties', but have not disclosed its magnitude, the variable royalty is inferior and have not been used in the analysis).

Furthermore, in this analysis I have only examined the likelihood of inclusion of equity in the contracts and not the equity stake magnitude. I hypothesized that the Deal size has been established first; there after the equity inclusion has been negotiated in lieu of a cash payment only and not in addition to the total deal size. Thus, while deal size might have effect on the equity stake inclusion, the reverse relationship is not likely.

I controlled for PHASE, DISEASE and IPINDEX. In addition, the Efficiency of Judicial System variable has been included as a control for a country's investor protection strength. Two samples are tested: N= 341 (sub-sample), and N=777.

In the event that a drug target attracts multiple bidders, the partnership valuations can rise even higher. The distribution of the deal size variable is right skewed. To correct the problem, I took the natural logarithm of the variable DEAL SIZE and performed the regressions with LNDEAL SIZE. Some of the observations are missing detailed financial information and only

stated, for instance that "buyer will pay upfront payments, milestones and royalties". In the large sample, which contains all observations, I have added $1.00 to all observations to be able to take Log of the Deal Size variable.

The level and quality of IP rights protection in a country might influence the structure of a partnership. Following Oxley (1998), I control for the variable IPINDEX, composed by Ginarte and Park (1997). In the event that two partners have different scores (as in a majority of cases in the sample), I have assigned a lower score to a partnership because of the assumption that the country with the lover score will be more likely to deviate or engage in opportunistic behavior.

The rule of law in the country might affect the propensity of the partners to invest in the R&D project, and, particularly, to acquire a stake in a partner's equity. Similar to LaPorta, Lopes-de-Silanes, Shleifer and Vishny (1998), I have used a score of the 'Efficiency of Judicial System'. The variables descriptions reported in Table 1.

Variables	**Table 1. The Description of the Variables**.
IP RIGHTS	If contract includes Intellectual Property Rights (assets) transfer, the assignation of a patent or sale of the technology ex-ante Dummy equal 0. If only the commercialization rights in the form of the exclusive license are transferred, Dummy = 1.
LICENSE	This variable is a proxy for the licensing of a drug's commercialization rights. If a license is purchased ex-ante, a dummy designated 1 and 0 if only an option has been taken to commercialize a drug.
EQUITY STAKE	The Dummy = 1, if the equity stake has been purchased ex-ante, usually with substantial premium in lieu of cash payment outright, and 0 otherwise.
DEAL SIZE	The total value of a partnership or a collaboration project, computed as a sum of upfront payment, research re-imbursement, milestones, and royalties. This variable also assumes warrants, or convertible debt securities. LNDEALSIZE. Deal value variable right skewed. To correct I have taken natural log of Deal Value variable.
PHASE	The dummy variable was created for the Phase of development. In order to be approved, the drug has to successfully complete several clinical trials: Pre-clinical Phase, Phase I, II, III, and often Phase IV. The Phase IIb is the pivotal point in the drug development process. The dummy defined as 1 if post Phase IIb, and 0 if before the Phase IIb.
DISEASE	The disease category variable is critical to gauge the patient population and, therefore, market potential. Unmet need drug categories, such as oncology, central nervous system, cardio-vascular diseases command highest premiums and have highest patient populations. I have clustered above categories in to one group, dummy equals 1. The other group consists of orphan drugs and medical devises, diagnostics with much smaller market, dummy equals 0.
INTERNATIONAL	This dummy variable identifies the international or cross-border alliances. If both partners domicile in different countries, Dummy designated as 1 (international), and 0 otherwise.
UPFRONT	The funding that is paid upon the signing of a contract. Usually consists of the research funding and/or payment for licensing or option to license. The unconditional payment that depends on how many products/or technology platform a biotech bring in the collaboration, and the drug's disease category.

Variables	**Table 1. The Description of the Variables**.
LNMILESTONES	This variable is a proxy for the contingent type of contracts. The milestones are payments that are conditional on the occurrence of specified events, such as the successful results of clinical trials, for instance. Regulatory milestones are paid upon filing the drug application, or drug approval by FDA, for example. The sales milestones are paid if a drug achieves a certain sales threshold.
ROYALTIES	Drug's inventor might out-license a drug candidate and opt out participation in the commercialization process, in exchange for royalties. Dummy is designated as 1, if royalties are included in contractual provisions, and 0, if a partner participates in a commercialization process/profit share arrangement.
IP INDEX	IP (Intellectual Property) index has been developed by Ginarte and Park (1997). Park and Ginarte developed the measure IPINDEX by examining five categories of the patent law: the extent of coverage, the membership in international patent agreements, the provisions for loss protection, the enforcement mechanisms, and the duration of protection. It assigns the values to intellectual property law in selected countries. Index varies from lowest 1.48 (India) to highest 4.52 (US).
EFFICIECY OF JUDICIAL SYSTEM	This is measure, that was first introduced by LaPorta, Lakonishok, Shleifer, Vishny in the paper 'Law and Finance', 2000. Index measures the protection of a small investor in selected countries. Scales from 0 to 10. The index is published by the rating agency 'Business International Corporation'.

EMPIRICAL RESULTS

The descriptive statistics are reported in Table 2 (To save the space, I have only reported the statistics of larger sample). For the each hypothesis testing, I have reported results of both samples, though more weight is given to the statistical results of the larger samples.

The majority (68%) of drugs in the samples are in earlier stages, i.e.only 32% of investigated drugs in the samples have completed Phase IIb clinical testing. Additionally, 70.5% of all contracts are option contracts, in which the exclusive license will be acquired only after the validation of a drug, the rest(29.5%) are the contracts when the license acquired ex-ante.

The licenses outright acquisition suggests that the contract is the front-loaded, vs. back-loaded (option to license), which means it is contingent on the development success, and payments are disbursed in the form of milestones. The deal size in the smaller sample varies from $105,000.00 to $1.05 billion, while nearly half of the observations were under $50 million dollars. The development milestones and royalties are an inherent part of the licensing contract, and most of the contracts have these provisions, though the data limitation has not allowed investigating this relationship in depth. The majority of partnerships contracts (83%) in the sample have a royalty provision that often stated as "potential royalties". Because the royalties are part of the cash flow rights, and because they are relevant only if a drug has been approved and is already marketed, the royalties are not included tests. The scope of the analysis is the contingent (incomplete) contracts design and control allocation, while the drug is still in the

development phase and partners are facing the uncertainty of the investigational drug's success, defined as the FDA's approval. In the larger sample, 61.90% of partnerships are international; the INTERNATIONAL variable controls for the difficulty of monitoring throughout the analysis.

Table 2. Summary Statistics of the larger sample.
This table presents summary statistics of the larger sample of cross-sectional observations, N=777; the time frame is 1999 to 2008. Many observations are missing some contract data. In order to take logs of values and use these entries in the tests and I have added $1.00 to all observations.

Variables	Min	Max	Mean	St. Deviation	Number	Frequency(%)
IPRIGHTS	0	1	0.9640	0.1865	749	96.40
LICENSE	0	1	0.2952	0.4564	209	29.50
EQUITY	0	1	0.1340	0.3408	104	13.40
DISEASE	0	1	0.4723	0.4995	367	47.20
PHASE	0	1	0.3205	0.4669	249	32.00
INTERNATINL	0	1	0.6190	0.4859	481	61.90
ROYALTIES	0	1	0.8328	0.3735	478	83.30
DEALSIZE	1.0	1,050.00Mln.	6.9984E7	1.69967E8		
LNDEALSIZE	0	20.77	7.7729	8.87654		
IPINDEX	1.48	4.52	3.8887	0.65052		
EFF.JUD.SYSTEM	3.25	10.00	9.4259	1.14444		

All observations in the sample are cross-sectional, time period is 1999-2008. The dependents in all specifications are dichotomous, thus, the regressions were tested using logit estimates.

The decision process consists of two steps. First, ex-ante the partners have to make a decision to buy the technology, or only to license commercial rights (d1). In the second step (d2), in the event that only the commercialization rights have been chosen, the partners have to make a decision to acquire a license ex-ante, or latter in course of a partnership by exercising an option (see Figure 1).

Because decisions (1) and (2) are made simultaneously and with same available data, and the decision at (d2) in conditional on the decision at (d1), I have applied the Nested Logit model two-step procedure (Woodridge, 2001). First, I have estimated equation 2 and saved predicted probabilities to integrate the response probabilities (λ). Then the response probabilities (λ) have been plugged into the first equation as an additional estimator. The two-step conditional MLE is consistent and asymptotically normal under general conditions. The 3rd equation is estimated independently.

The results give support to the contractual incompleteness theory (Grossman and Hart (1986) and Hart and Moore (1990)) and ex-ante asset allocation to the party who needs the protection the most (biotech firm). All independent variables coefficients are weak. Though it is possible to find support to the first hypothesis just by looking at the data sample without

regression estimates; only a small fraction (6% in the smaller sample and 3.6% in the full sample) are the transfers of an ownership, the two-step nested logit model calls for an estimation. Coefficient of *(*λ) is not equal to zero, indicating that the two-stage estimation is justified. The patent title/ technology ownership remains with the biotech and not transferred. Intuitively, the weak coefficients imply that the licensing is a norm, and is not determined by product characteristics. Pharmaceuticals do not necessarily want to buy a technology, but only to take advantage of the drug revenues if success. As a rule, only the commercial rights have been licensed. If a pharmaceutical firm is getting all rights over a technology, it is like buying a whole firm, but it is not a pharmaceutical firm's objective. Results are reported in Table 3.

Table 3. Estimation of the ownership v.s. control allocation hypothesis.

In columns 1 are reported results of the smaller sample N=341, and in column 2 are reported results of the larger sample N=777; the time frame 1999 to 2008. The dependents in all specifications are IPRIGHTS. The independent variables are defined in Table 1. p-values are reported in parentheses. Variables that are statistically significant at 1, 5, or 10% levels reported in Bold.

Variables	IP RIGHTS (N=341)	IP RIGHTS (N=777)
LNDEALSIZE	-1.216 (0.377)	0.017 (0.832)
PHASE	0.678 (0.563)	1.194 (0.523)
DISEASE	0.146 (0.771)	-0.292 (0.467)
INTERNATIONAL	-0.561 (0.458)	-0.105 (0.887)
IPINDEX	0.304 (0.586)	0.092 (0.833)
RESPONSE PROB.(λ)	8.916 (0.420)	3.838 (0.516)
CONSTANT	19.000 (0.314)	1.033 (0.808)
Chi-square Significance	2.342 0.886	4.212 0.648

The Kaplan and Stromberg (2003) suggest that a less successful venture will see control being transferred from the founder to the VC. My evidence suggests otherwise; in drug development partnerships, if a drug is not successful, the pharmaceutical partner will seize the financing but is not necessarily interested in controlling the technology further, unless specified in a contract. The separation of the cash flow rights (licensing) and the ownership of assets (a patent's title), as hypothesized, has allowed the financier to minimize the cash outflow and undertake more projects, to achieve better investment diversifications and to mitigate a potential drug failure.

In the testing of the second hypothesis, the observations that correspond to the technology that has been transferred (sold) ex-ante were excluded from the samples, thus, the remaining samples sizes are N=749 and N=319. The evidence supports the contingent contracts' hypothesis.

The key variables coefficients of PHASE and DISEASE are negative, as expected, and significant. Phase of development is the critical determinant the contingent contract (a favorable state verification theory). The further along in development a drug is, the higher are valuations.

Therefore, to minimize the cash outflow ex-ante, the licensing will be delayed; instead, the option to license will be taken and option premium will be paid. Though the results appear to be counterintuitive, it is important to remember that pharmaceuticals have limited capacity to fund multiple projects. By delaying payment of licensing fees, and thus postponing substantial cash upfront payments the pharmaceutical firm is able to partake in multiple projects. Unmet need category drugs command higher premiums also because of higher valuations and due to larger patients populations, therefore, the DISEASE category variable is negatively correlated with the dependent variable LICENSE.

Theory suggests that ex-ante monitoring is inefficient; thus, in the international collaborations, the license is less likely will obtained ex-ante. The INTERNATIONAL coefficients are significant and negative (in the larger sample), as predicted, supporting the argument that if the partners domicile in different countries, it is more likely that an option contract will be taken and a licensing decision will be made later, after the verification of the favorable outcome.

The LNDEALSIZE coefficients are significant and negative (in larger sample) as expected. The LNDEALSIZE and INTRENATIONAL signs of coefficients are change signs, possibly, because in the smaller sample a substantially larger number of licenses (45.8%) were acquired ex-ante, vs. only 29.5% in the larger sample. The results of the larger sample have been given more weight. The results of the second specification estimates are reported in Table 4.

Table 4. Contingent contract's design and limited liability.

The first column report results of the test of the smaller sample (N= 319). In column 2 are reported results of the estimations of the full sample; number of observations is =749, the period is 1999 to 2008. The dependent variable in all estimates is LICENSE. The License dummy equals 1, if the license is acquired outright, ex-ante, and equals 0, if only an option acquired. The independent variables are defined in Table 1.Statistically significant coefficients at 1, 5, or 10% level reported in Bold. (p-values are in parentheses).

Variables	LICENSE (N=319)	LICENSE (N=749)
LNDEALSIZE	0.581 (0.000)	-0.074 (0.000)
INTERNATIONAL	0.020 (0.937)	-0.479 (0.012)
PHASE	-0.436 (0.114)	-1.646 (0.000)
DISASE	-0.016 (0.949)	-0.024 (0.895)
CONSTANT	-10.574 (0.000)	0.963 (0.000)
Chi-square Significance	66.805 0.000	123.517 0.000

If the valuation of the project is high (product platform, for instance), the financing partner more likely acquires an *option* to an exclusive license. To check the robustness of the results, I have run the regression of the small sub-sample, replacing the LNDEALSIZE variables with the detailed provisions of the deals: LNUPFRONT, LNMILESTONES, and ROYALTIES. The results are similar and not reported.

The results corroborate Kaplan and Stromberg (2003, p.33) findings that "contracts commit a significantly larger amount of financing, of which, on average, half is released subject to future performance", and Ziedonis' (2007, p.1) suggestion that "the options were taken until more information is obtained" (contingent contracts, limited liability theories).

In the last section, I examined the partnership characteristics as the determinants of the contingent contract. Dependent, the EQUITY stake is included in 13.4% of all partnership (23.2% in the small sample) contracts. Hypothesis is that equity is included to alleviate the monitoring costs, and/or to replace the cash outright with equity (risk minimizing, credit rationing theories) is supported by evidence. The key variables coefficients LNDEAL SIZE and INTERNATIONAL are positive and significant along with the expectations. The LNDEALSIZE coefficient suggests that the larger the deal size, the more likely the equity stake will be included in the contract in lieu of cash outright disbursement ex-ante. In the event, that a biotech is not willing to sell equity at times when the firm's valuation is low, the investor has to offer a substantial premium to the share price. If a partnership is international, equity stake inclusion is also more likely (monitoring theory); the positive and significant coefficient validates the prediction. The further in development the drug candidate is (PHASE), the higher the valuations and, thus, the more likely that the minority equity purchase would partially replace cash outright payments, the phase coefficient is, also, positive and significant. The results corroborate Kaplan and Stromberg's (2003) finding, when uncertainty about a venture [a new drug's approval], and a founder [a biotech firm, if collaboration is cross-border, for instance] is high, a financier will demand more equity and control as a compensation for providing more funding. In addition, Pharma (financier) may want to keep small biotech firm afloat while externally developing a new drug. Results are reported in Table 6.

Table 6. The determinants of an inclusion of the equity stake in the contract.

The dependent variable in all specifications is EQUITY STAKE. The independent variables are defined in Table 1. In the 1st column are reported results of the smaller sample estimates (N=341). In the 2nd column are reported results of the full sample estimates, number of observation=777, the period: 1999 to 2008. p-values are in parenthesis. In Bold are statistically significant results at 1, 5, or 10 percent levels.

Variables	EQUITY	EQUITY
PHASE	0.651 (0.038)	0.611 (0.020)
LNDEALSIZE	0.185 (0.017)	0.092 (0.000)
INTERNATIONAL	0.888 (0.034)	0.544 (0.106)
DISEASE	0.387 (0.159)	0.350 (0.122)
IPINDEX	-0.905 (0.005)	-0.393 (0.137)
EFF.JUD.SYSTEM	0.271 (0.126)	0.232 (0.116)
CONSTANT	-4.617 (0.027)	-4.378 (0.003)
Chi-square Significance	20.533 0.002	68.248 0.000

CONTRIBUTIONS

Guedj and Scharfstein (2004) compare the likelihood of the early stage [biotech] vs. mature [pharmaceutical] companies to move drugs through clinical phases and suggest that the small companies have less promising clinical results and are less likely to advance to Phase III and receive FDA approval. They found that among drugs in Phase III, only 13.6% has been credited to small biotech, vs. 34.9% to the mature firm.

I posit that small biotech companies do not have the resources to conduct large-scale clinical trials. In the pharmaceutical/biotechnology field, the earlier stages' trials expenses are generally reimbursed by a financing partner. After discovering a promising drug candidate, a small biotech firm must seek the 'buyer' in order to initiate a partnership and proceed with the development. Nearly all validated drugs have been developed in collaborations. The ownership of the final product (a drug) and control of the commercialization process upon validation shifts to the larger pharmaceutical firm. The transfer of control, possibly, explains why the Phase III "sponsors", predominantly, are the larger mature companies. At the same time, because the pharmaceutical firm externalizes the research to the lean biotech firm to achieve more cost effective results, the development and control over earlier stages attributed to a small biotech firm. After the validation, and only if a drug target shows promising results, will the mature pharmaceutical firm take control over the clinical trials and commercialization and, thus, control the final product of the collaboration. The *transfer* of control by means of the license has frequently occurred after Phase IIb, as my results suggest, thus, giving support to the prediction that PHASE variable plays critical role in that decision.

The Kaplan and Stromberg (2003) suggest that a less successful venture will see control being transferred from the founder to the VC. My evidence suggests otherwise; in drug development partnerships, if a drug is not successful, the pharmaceutical partner will seize the financing but is not necessarily interested in controlling the technology further, unless specified in a contract. The separation of the cash flow rights (licensing) and the ownership of assets (a patent's title), as hypothesized, has allowed the financier to minimize the cash outflow and undertake more projects, to achieve better investment diversifications and to mitigate a potential drug failure.

The study attempts to examine and provide empirical evidence to the current trends within pharmaceutical/biotech industries that yet not been explored. To the best of my knowledge, the sample is a comprehensive cohort of partnerships for the observed period. Yet, the major challenge of the research is the data limitations, i.e. missing of incomplete information of the terms of partnerships agreements that might have affected the estimations results. Several other problems might influence the robustness of the results, such as the dummy variables' coding could be arbitrary. The results might be noisy due to the unobserved variables' effects. For instance, multiple bidders can drive valuations of a partnership higher. Similarly, the low

cash position of a biotech firm can weaken its bargaining power and, possibly, make it more agreeable to the lesser valuations.

CONCLUSIONS

The objective of the research is to investigate how and at what stage of a drug development process, the ownership and/or control over assets (molecule) are allocated within drug development partnerships and how these contracts are designed to incorporate contingency provisions, such as a drug failure in clinical trials. I have analyzed 777 drug development partnerships that were formed within the period from 1999 through 2008. Seventy percent of all drugs in the sample are in early stages, pinpointing that a majority of the partnerships are initiated at an early stage of drug development.

There is evidence that *the revenue rights* are the asset of interest within a partnership, and not the ownership of technology. The phase of development serves as the verification of a favorable state, therefore, the license to commercialize a new drug will be acquired, as results suggest, only after the validation of a drug target. Examining the partnership contracts suggests that contracts have been designed often as a contingent contract with an option provision. The option will be exercised and licensing fees are paid later in the course of a partnership, conditional on the drug's success. Findings corroborate Ziedonis (2007), who suggests that a licensing option will likely purchased for inventions characterized by greater technological and commercial uncertainty.

The fact that majority of the partnerships are international has allowed to test monitoring hypothesis. The found evidence helps to explain the equity stake inclusion in the contract. As suggested, because of monitoring difficulty, unpredictability of the drug development results, and the limited capacity of a financing partner to carry on multiple projects, an equity stake is partially replaced the cash disbursement.

Lastly, the results are interesting even within a broader setting. The governance of the partnerships does not rely solely on a contractual type of control: exclusive or non-exclusive licensing; nor on assets' ownership: technology ownership or equity stake based control — but, often, on the combination of both. What type of asset ownership and control provides the better governance? As the data suggests, the emphasis was given to the licensing and revenue (commercial) rights, and not to the ownership of an asset.

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DO ANALYSTS REMOVE EARNINGS MANAGEMENT WHEN FORECASTING EARNINGS?

Jason C. Porter, University of Idaho
Marla A. Kraut, University of Idaho

ABSTRACT

A large body of research finds that analysts are rewarded when their forecasts are accurate (Mikhail et al,. 1999; Stickel, 1992). Accuracy is the deviation of a forecast from reported earnings. If analysts attempt to accurately forecast earnings, then forecast error should be symmetrically distributed around zero. However, Abarbanell and Lehavy (2003) find that this is not the case. The distribution of analyst forecast errors shows a higher number of small positive than small negative values, and the left tail of the distribution is longer and thicker than the right tail. Abarbanell and Lehavy speculate that these asymmetries arise because analysts are removing the effects of earnings management from their forecasts. On the other hand, Burgstahler and Eames (2003) show that the distribution of analysts' forecasts matches the distribution of earnings, including the discontinuity around zero documented by Burgstahler and Dichev (1997). They argue that the similarity of these two distributions arises because analysts forecast reported earnings. This paper investigates which of these disparate views is more consistent with the data.

To address the issue of how earnings management impacts analysts' forecasts, a sample of annual I/B/E/S consensus forecasts from 1988-2004 were collected. This sample was used to replicate the analysis of Abarbanell and Lehavy (2003) and Burgstahler and Eames (2003) and found results consistent with these studies. Next, a Voung (1989) test was used to determine whether analysts' forecasts are more strongly correlated with managed or unmanaged earnings. If analysts include the effects of earnings management in their forecasts, then analysts' forecasts will be more highly correlated with managed earnings than with unmanaged earnings, and vice versa if analysts remove the effects of earnings management. The results of this analysis suggest that analysts remove the effects of earnings management, providing an additional service to those traders who use their forecasts.

INTRODUCTION

A large body of research finds that analysts are rewarded when their forecasts are accurate (Mikhail et al., 1999; Stickel, 1992). Accuracy is the deviation of a forecast from reported earnings. If analysts attempt to accurately forecast earnings, then forecast error should be symmetrically distributed around zero. However, Abarbanell and Lehavy (2003) find that this

is not the case. The distribution of analyst forecast errors shows a higher number of small positive than small negative values, and the left tail of the distribution is longer and thicker than the right tail. Abarbanell and Lehavy speculate that these asymmetries arise because analysts are removing the effects of earnings management from their forecasts. On the other hand, Burgstahler and Eames (2003) show that the distribution of analysts' forecasts matches the distribution of earnings, including the discontinuity around zero documented by Burgstahler and Dichev (1997). They argue that the similarity of these two distributions arises because analysts forecast reported earnings. This paper investigates which of these disparate views is more consistent with the data. Note that no attempt was made to differentiate between accrual manipulations and 'real' manipulations of earnings.

To be sure, a forecasting target other than reported earnings is inconsistent with analysts' incentives for accuracy (i.e. matching reported earnings). However, research suggests that analysts are also rewarded when their forecasts are informative (Barth et al., 2001; Huang et al., 2005; Irvine, 2004; Lang et al., 2004). Informativeness is the ability of the forecast to provide insight into future firm performance. Analysts may be willing to sacrifice accuracy for informativeness, and vice versa. For example, an accurate forecast of next year's reported earnings might not be informative if reported earnings contain large transitory elements. An analyst in this situation must assess whether the personal benefits of accurately forecasting next year's reported earnings exceed the benefits of providing information by removing the transitory elements.

There is already evidence that analysts focus on the more persistent components of earnings when making their forecasts (Bradshaw & Sloan, 2002). The question is whether analysts also attempt to remove the *manipulated* component of earnings from their forecasts, as suggested by Abarbanell and Lehavy (2003). Earnings management is difficult to assess, even by market participants as sophisticated as analysts (Fischer & Verrecchia, 2000). However, to the extent that analysts anticipate managerial incentives and opportunities to manage, they can make their forecast more informative by estimating and removing earnings management. On the other hand, analysts may simply incorporate their knowledge of earnings management into their earnings forecasts in order to improve their forecasting accuracy, as suggested by Burgstahler and Eames (2003).

To address the issue of how earnings management impacts analysts' forecasts, a sample of annual I/B/E/S consensus forecasts from 1988-2004 were collected. This sample was used to replicate the analysis of Abarbanell and Lehavy (2003) and Burgstahler and Eames (2003) and found results consistent with these studies. Next, a Voung (1989) test was used to determine whether analysts' forecasts are more strongly correlated with managed or unmanaged earnings. If analysts include the effects of earnings management in their forecasts, then analysts' forecasts will be more highly correlated with managed earnings than with unmanaged earnings, and vice versa if analysts remove the effects of earnings management. The results of this analysis suggest

that analysts remove the effects of earnings management, providing an additional service to those traders who use their forecasts.

The rest of the paper proceeds as follows. Section II describes the basic method. Section III describes the data, including the sample selection procedure. Section IV presents the results for the primary analyses. Section V presents the results of several sensitivity tests and Section VI offers concluding remarks.

METHOD

Determining which earnings number, managed or unmanaged, is more highly associated with analysts' forecasts is difficult, since direct comparisons of adjusted R^2 are not statistically sound. To address this issue, a Vuong (1989) test as described by Dechow (1994) is used to compare the predictive value of the following two equations:

$$\text{Analysts' Forecasts}_t = \lambda_0 + \lambda_1 \text{Managed Earnings}_t + \delta_t \quad (1)$$

$$\text{Analysts' Forecasts}_t = \varphi_0 + \varphi_1 \text{Unmanaged Earnings}_t + \tau_t \quad (2)$$

Although the primary question is how well analysts' forecasts predict earnings, it is only by holding the dependent variable constant that we can statistically compare the strength of the association between analysts' forecast and managed earnings to the strength of the association between analysts' forecasts and unmanaged earnings. After running the regressions, the Voung (1989) test computes a z-statistic to compare the sum of squared residuals from the two equations. The equation with the lower sum of squared errors is the better predictor of analyst forecasts, and therefore the more likely goal of analysts' forecasting efforts.

Analysts' Forecasts_t is defined as the mean consensus analyst forecast of earnings per share at time t (Abarbanell & Lehavy, 2003) and Managed Earnings_t as reported earnings per share before extraordinary items at time t (Compustat data Item 58). Estimating Unmanaged Earnings_t is more difficult because earnings management is unobservable. Thus, two alternative proxies are used for estimating Unmanaged Earnings_t.

First, restated earnings per share before extraordinary items (Compustat data Item 119) is used as a proxy for Unmanaged Earnings_t. This proxy is based on the assumption that restated earnings have been purged of the earnings management included in the original earnings announcement. This assumption is consistent with Erickson et al. (2004), Jones et al. (2006), and Palmrose et al. (2004).

Second, nondiscretionary accruals are used as a more traditional proxy for Unmanaged Earnings_t. Nondiscretionary earnings per share are calculated as reported earnings per share (Compustat data Item 58) less discretionary accruals per share. Discretionary accruals are calculated using the modified-Jones model proposed by Kothari et al. (2005), estimated for each two-digit SIC code and year combination with at least five observations (Xie, 2001):

$$TA_t = b_1\left(\frac{1}{A_{t-1}}\right) + b_2\Delta REV_t + b_3 PPE_t + b_4 ROA_t + \varepsilon_t \quad (3)$$

where, TA_t is total accruals for year t calculated at the difference between earnings before extra items (Compustat annual data Item 123) and cash flows from operations (Compustat annual data Item 308 less Compustat annual data Item 124), A_{t-1} is lagged total assets (Compustat annual data Item 6), ΔREV_t is the change in sales less the change in accounts receivable (Compustat data Items 12 and 2, respectively), PPE_t is gross property plant and equipment (Compustat annual data Item 8), and ROA_t is return on assets (Compustat annual data Item 172 divided by lagged total assets). TA_t, ΔREV_t, and PPE_t are also deflated by lagged total assets. The residuals from Equation 3 are deflated by total shares outstanding (Compustat annual data Item 58) to get discretionary accruals per share.

This method is based on two basic assumptions. First, it is assumed that analysts convey their understanding of earnings management in their analyst forecast, rather than in other disclosures. This assumption is consistent with Schipper (1991). Second, it is assumed that analysts do not issue separate forecasts of pre-managed earnings. This assumption is consistent with Abarbanell and Lehavy (2003), Burgstahler and Eames (2003), and Liu (2005).

Based on these assumptions, if analysts include earnings management in their earnings forecasts then their forecasts will be more highly associated with reported earnings than they are with restated earnings (supporting the conclusion of Burgstahler and Eames, 2003). The converse will also be true. If analysts exclude earnings management from their forecasts, then analysts' forecasts will be more highly associated with restated earnings than they are with reported earnings (supporting the Abarbanell and Lehavy, 2003).

SAMPLE SELECTION

The initial sample consists of all mean annual earnings forecasts for December year-end, U.S. firms from the I/B/E/S summary database from 1988-2004. Mean analysts' forecasts were used to maintain consistency with Abarbanell and Lehavy (2003). Abarbanell and Lehavy's (2003) and Burgstahler and Eames' (2003) distribution tests were replicated by using samples of median consensus forecasts, last available forecasts, quarterly consensus forecasts, and individual forecasts from I/B/E/S. Overall, the results are qualitatively similar.

From the initial sample, any I/B/E/S consensus forecast formed more than 30 days prior to year end were removed in order to reduce the risk of including stale forecasts (Brown, 1997; Brown & Han, 1992). Since consensus forecasts include all outstanding analysts' forecasts, this control will not completely eliminate the risk of stale forecasts. However, the results are quantitatively similar using individual forecasts made within 30 days prior to year end. Outliers were controlled by winsorizing earnings per share, analysts' forecasts, and analyst forecast errors

to the 1st and 99th percentile of each distribution, consistent with Abarbanell and Lehavy (2003). The resulting sample of 34,990 firm-year observations is used to replicate the distribution analyses of Abarbanell and Lehavy (2003) and Burgstahler and Eames (2003). This set of observations is referred to as the 'full sample.' Table 1 presents a summary of the sample selection procedure.

Table 1: Sample Selection	
Panel A: Determining the Full Sample	
Initial sample of annual EPS forecasts for US firms,	
with a December year end from 1988-2004	429,576
Less: Not last available forecast	(390,184)
Less: Made more than 30 days before the period end	(4,402)
Full Sample	34,990
Panel B: Determining the Restatement Sample	
Full sample	34,990
Less: Observations missing reported or restated EPS data	(13,543)
Less: Observations reporting merger or acquisition activity during the year	(9,700)
Restatement Sample	11,747
Panel C: Determining the Accruals Sample	
Full sample	34,990
Less: Observations with insufficient data for calculating DACC	(18,397)
Less: Observations missing reported EPS and 3 of shares outstanding data	(2)
Restatement Sample	16,591

For the Vuong (1989) tests, the full sample is restricted to those observations having the necessary data to calculate each proxy for unmanaged earnings. This results in two sub-samples. The first, which is referred to as the 'restatement sample,' consists of only those observations from the full sample with data available from Compustat for both reported and restated earnings per share. Compustat gives four reasons for restated earnings: discontinued operations, mergers and acquisitions, earnings management, and errors in managers' original estimates. Since income from continuing operations is used, restatements due to discontinued operations are already excluded from my sample. Those observations that reporter mergers and acquisitions during the year are removed to control for restatements due to those reasons. These restrictions reduce the sample to 11,747 firm-years. Even with these restrictions, the sample may still contain restatements made due to errors in estimates rather than earnings management. Unfortunately, Compustat does not differentiate between restatements made due to errors in estimates and those made due to earnings management, so there is not a way to eliminate this bias, except by using nondiscretionary accruals as an alternative proxy for unmanaged earnings.

The second sub-sample, which is referred to as the 'accruals sample', consists of those observations from the full sample that contain all of the necessary information for calculating equation 3. The most restrictive of these requirements is that each observation be part of a two-

digit SIC code and year combination with at least five observations. These data requirements reduce the sample size from 34,990 to 16,593. Two observations missing data for reported earnings per share or number of shares outstanding are removed.

Table 2 presents summary statistics for all three samples. Panel A of Table 2 presents results for the full sample, Panel B for the restatement sample, and Panel C for the accruals sample. Several points are worth noting. First, the full sample consists of larger firms than both of the restricted samples (average total assets of $7,227.8 versus $3,266.8 million and $6,135.6, respectively). Second, the analyst following is lowest for the restatement sample and highest for the accruals sample. Third, the EPS and nondiscretionary EPS values for the accruals samples are virtually identical. It is only at the third or fourth decimal place (unreported) that any differences are observed. This pattern is consistent with the small discretionary accruals values from equation 3 originally demonstrated by Kothari et al. (2005).

Table 2: Sample Selection Criteria

Panel A: Full Sample (n=34,990)							
	Mean	Std Dev	Minimum	25th %tile	Median	75th %tile	Maximum
Total Assets	7,227.8	43,016.6	0.0	143.1	598.4	2,566.0	1,484,101.0
Number of Analysts	7.0	7.0	1.0	2.0	4.0	10.0	50.0
EPS	1.57	46.40	-68.33	0.03	0.92	1.88	5,309.00
Analyst Forecast	0.84	1.33	-3.68	0.20	0.76	1.48	5.50
AFE	-0.66	4.17	-29.86	-0.25	0.01	0.20	9.09
Panel B: Restatement Sample (n=11,747)							
Total Assets	3,266.8	26,774.0	0.0	68.5	235.7	1,017.0	1,009,569.0
Number of Analysts	5.8	6.0	1.0	2.0	4.0	8.0	46.0
EPS	0.44	1.95	-53.55	-0.52	0.40	1.35	80.83
Restated EPS	0.28	1.86	-7.74	-0.49	0.35	1.18	5.67
Analyst Forecast	0.50	1.42	-3.68	-0.20	0.44	1.20	5.24
AFE	-0.90	4.89	-29.86	-0.45	0.00	0.29	9.09
Panel C: Accruals Sample (n=16,591)							
Total Assets	6,135.61	32,980.75	0.21	170.16	630.12	2,601.88	1,179,017.47
Number of Analysts	8.71	7.58	1.00	3.00	6.00	12.00	50.00
EPS	0.99	1.96	-5.85	0.06	0.94	1.92	7.46
Restated EPS	0.99	1.96	-5.85	0.06	0.94	1.92	7.46
Analyst Forecast	0.86	1.27	-3.13	0.22	0.75	1.47	5.26
AFE	-0.27	2.82	-29.86	-0.15	0.02	0.18	9.09

Table 2 presents summary statistics for the full and restricted samples. The variables are defined as follows: total assets is Compustat data Item 6; the number of analysts is the number that participated in creating each consensus forecast, as reported by I/B/E/S; EPS is basic EPS before extraordinary items, Compustat data Item 58; the analyst forecast is the mean consensus forecast reported by I/B/E/S; and AFE is analyst forecast error, calculated as actual earnings per share less the analyst forecast, deflated by beginning of the period stock price and multiplied by 100. Panel A presents summary statistics for the full sample used in replicating the distribution tests of Abarbanell and Lehavey (2003) and Burgstahler and Eames (2003). Panel B presents statistics for the restatement sample and Panel C for the accruals sample. In Panel B, restated EPS is Compustat data Item 119, restated basic EPS before extraordinary items. In Panel B, restart EPS is reported EPS less discretionary accruals estimated using equation 3

In addition, Table 2 provides evidence supporting the results of both Abarbanell and Lehavy (2003) and those of Burgstahler and Eames (2003). Abarbanell and Lehavy (2003) found evidence of two asymmetries in the analyst forecast error distribution. First, they found a higher than expected number of small positive forecast errors caused by a number of firms meeting-or-beating earnings by a small amount. Second, they found evidence of a longer and thicker left tail caused by a group of firms reporting earnings considerably lower than the analyst forecast. These patterns are consistent with earnings management and suggest that analysts are omitting earnings management from their forecasts. Consistent with their results, Table 2 reports that the mean analyst forecast error is, in fact, negative for all three samples while the medians are positive or zero (in the case of the restatement sample). Similarly, the negative tail is larger than the positive tail, as shown by the more extreme minimum AFE values relative to the maximum values in all three samples and of the 25^{th} percentile values relative to the 75^{th} percentile values for the full and restatement samples.

Burgstahler and Eames (2003) find that the distributions of earnings and analysts' forecasts are similar, with both including the discontinuity above zero identified by prior research as evidence of earnings management (Burgstahler & Dichev, 1997). This similarity suggests that analysts include the effects of earnings management in their forecasts. Consistent with their results, the positive mean and median values in all three samples, as well as the positive 25^{th} percentile values in the full and accruals samples, indicate a discontinuity above zero in the distributions of both earnings and analysts' forecasts, consistent with the results of Burgstahler and Eames (2003).

Prior to testing the alternative hypotheses proposed by Burgstahler and Eames (2003) and Abarbanell and Lehavy (2003), The distribution tests described in both papers was replicated by using the full sample, comparing the earnings and analyst forecast distributions and examining the analyst forecast error distribution. The results, not reported, of comparing the earnings and analyst forecast distributions suggest that analysts include the effects of earnings management when issuing their forecasts, consistent with the results of Burgstahler and Eames (2003). Based on this finding, it was expected that the analyst forecast errors to be caused by random error, leading to an analyst forecast error distribution that is symmetric around zero. Instead, the forecast error distribution has its own discontinuity above zero and a fat left tail, consistent with the results of Abarbanell and Lehavy (2003), who claim that analysts remove the effects of earnings management from their forecasts. In the next section is an attempt to resolve this discrepancy.

RESULTS

Before performing the Voung (1989) test, simple correlations between the analysts' forecasts and managed earnings and unmanaged earnings were replicated. For the restatement sample, the correlation between reported earnings and analysts' forecasts is 0.6860, and the

correlation between restated earnings and analysts' forecasts is 0.8179. The results are similar, although not as strong, for the accruals sample (0.7410 and 0.7411 for reported earnings and nondiscretionary earnings, respectively). The correlation between analysts' forecasts and unmanaged earnings is higher than the correlation between analysts' forecasts and managed earnings for both samples, consistent with analysts removing earnings management from their forecasts.

Table 3 presents the results of estimating Equations 1 and 2. Panels A and B report the coefficients, adjusted R^2 values, and observations for Equations 1 and 2, respectively. In both the restatement sample (Column 1) and the accruals sample (Column 2), the adjusted R^2 values are higher for unmanaged earnings than managed earnings. In addition, the coefficient on unmanaged earnings (Panel B) is closer to one than the coefficient on managed earnings (Panel A) for both samples. Panel C reports the results of the Vuong test, which is used to assess the statistical significance of the differences in both adjusted R^2 and coefficient values. If analysts include earnings management in their forecasts, then their forecasts should be more highly associated with managed than unmanaged earnings and the z-statistic from the Vuong test will be negative. If, on the other hand, analysts remove earnings management from their forecasts, their forecasts should be more highly associated with unmanaged than managed earnings and the z-statistic from the Vuong test will be positive.

Table 3: Vuong Test Statistics

Panel A: $AF = \lambda_0 + \lambda_1 EA_{Reported} + \delta$				
	Restatement		Accruals	
Intercept	0.355	**	0.385	**
gamma1	0.366	**	0.478	**
adj. r-squared	0.4706		0.5490	
Number of observations	11,747		16,591	
Panel B: $AF = \phi_0 + \phi_1 EA_{Restated} + \iota$				
Intercept	0.323	**	0.384	**
phi1	0.624	**	0.479	**
adj. r-squared	0.6690		0.5493	
Number of observations	11,747		16,591	
Panel C: Vuong Test of Association (reported vs. restated)				
Z-statistic	7.24	**	6.85	**
T-stat (from SAS)	7.24		6.85	
Number of observations	11,747		16,591	

Table 3 presents the results from estimating equation 1, regressing analysts' forecasts on reported earnings (Panel A), and equation 2, regressing analysts' forecasts on restated earnings (Panel B). Panel C presents the Vuong test of association which compares the size of the error terms. A negative statistic suggests that reported earnings is more closely related to analysts' forecasts than restated earnings and vice versa. AFt is defined as the mean consensus forecast reported by IBES. Managed Earningst is EPS before extraordinary items (Compustat dataItem 58). Unmanaged Earningst is restated EPS before extraordinary items (Compustat data Item 119). For the accruals sample, Unmanaged Earningst is EPS before extraordinary items less discretionary accruals (Equation 3).
*# significance at the 5% level, * significance between 5% and 1%, and ** significance at less than 1%.*

Consistent with the informal results already discussed, the z-statistic is 7.24 for the restatement sample and 6.85 for the accruals sample. These significantly positive results suggest that analysts' forecasts are more highly associated with unmanaged earnings than they are with managed earnings, suggesting that analysts remove the effects of earnings management in their forecasts consistent with the conclusions of Abarbanell and Lehavy (2003). One alternative explanation for these results is that analysts, after the end of the year, will of course forecast the more up-to-date restatements instead of the originally reported earnings. To control for this explanation the original sample was limited to analyst forecasts made prior to the end of the fiscal year. It is unlikely that analysts would be forecasting an earnings restatement *before* the original earnings announcement was made.

SENSITIVITY TESTS

The tests using two alternative samples were replicated. First, both the restatement and accruals samples to firm years after 1993 to control for changes in the I/B/E/S database (Cohen et al., 2007) were restricted. Second, a sample of median analyst forecast values was used to ensure that the results are not dependent on mean consensus forecasts. The results for both of these replications are qualitatively similar to those previously reported.

Next, the tests were replicated after breaking both the accruals and restatement samples into subsets of observations more likely to manipulate earnings and those less likely to manipulate earnings. More specifically, the likelihood to manage observations is defined as those with analyst forecast errors greater than 0 but less than 0.03 and then, as a separate test, to observations with deflated earnings in the same range. Total earnings before extraordinary items (Compustat data Item 18) was deflated by the product of common shares outstanding (Compustat data Item 25) and ending stock price (Compustat data Item 199), following Burgstahler and Dichev (1997).

Both of these benchmarks, meeting the analyst forecast and showing a profit, are well documented as management goals (see, for example, Brown & Caylor, 2005). The results of this analysis are presented in Table 4. In panel A, the results for the restatement sample are consistent with the Abarbanell and Lehavy (2003). This is especially true around the analyst forecast benchmark, where the Voung test is significantly positive for the subset of firm years in the likely to manage earnings and insignificant for the subset of firms years less likely to manage earnings. Around the profit benchmark, the Voung test is statistically significant for both subsets, likely and less likely to manage earnings, but the p-value is much lower for the likely to manage subset.

The results for the accruals subsets, shown in panel B of Table 4, are exactly the opposite. The difference between predictive values of equations 1 and 2 are not significant for the likely to manage subsets but are significant for the less likely to manage observations. While

these results are not consistent with those of the restatements sample, the most likely explanation is that the larger sample size for the less likely to manage sample is compensating for the relatively small differences between reported earnings and restated earnings observed in panel C of Table 2. The almost identical correlations in all four subsets reported in panel B of Table 4 provides some support this explanation and suggest that the restatement proxy is more appropriate for the current analysis.

Table 4: Summary Results for Subsets of Likely and Unlikely to Manage Firms

Panel A: Restatement Subsets								
	Analyst Forecast				Profit			
	Likely to Manage		Less Likely to Manage		Likely to Manage		Less Likely to Manage	
Correlation between the analyst forecast and Reported EA	0.7436	**	0.8082	**	0.5376	**	0.8150	**
Correlation between the analyst forecast and Restated EA	0.8892	**	0.8153	**	0.5900	**	0.8244	**
Z-statistic from Vuong (1989) test	5.782	**	1.930		3.009	**	2.530	*
Number of observations	350		11,397		1,553		10,194	
Panel B: Accruals Subsets								
Correlation between the analyst forecast and Reported EA	0.5657	**	0.7514	**	0.4105	**	0.7511	**
Correlation between the analyst forecast and Restated EA	0.5657	**	0.7516	**	0.4106	**	0.7512	**
Z-statistic from Vuong (1989) test	0.310		6.860	**	1.930		6.880	**
Number of observations	1,134		15,457		2,402		14,189	

Table 4 presents correlations and Voung (1989) test results for subsets of the restatement (Panel A) and accruals (Panel B) samples. Observations in the Likely to Manage subsets have analyst forecast errors or deflated earnings in the range (0, 0.03]. All other firm years are included in the Less Likely to Manage subsets. Analyst Forecast Errors are calculated as actual earnings per share less the analyst forecast, deflated by beginning of the period stock price and multiplied by 100. Deflated earnings are calculated as earnings before extraordinary items (Compustat data Item 118) divided market value of equity (the product of common shares outstanding, Compustat data Item 25, and ending stock price Compustat data Item 199), following Burgstahler and Dichev 1997.
*# indicates significance at the 5% level, * indicates significance between 5% and 1%, and ** indicates significance at less than 1%.*

One alternative explanation for the results presented is that the stronger association between analysts' forecasts and unmanaged earnings is the results of 'last minute' earnings manipulations by managements rather than analysts intentionally removing the effects of earnings management from their forecasts. However, the use of company restatements, which should remove *all* earnings manipulations and not just *last minute* earnings manipulations, provides some evidence that the results are not due to last minute manipulations. As an additional control for this alternative explanation, the tests were replicated using new samples of

the last available analyst forecasts. A sample of all individual forecasts from the I/B/E/S detail database was used. The results from this sample are also qualitatively consistent with those presented in Table 3. Again, this sample cannot completely control for the last minute manipulations explanation, but the qualitatively similar results from testing this sample reduces the likelihood that the observed relationships are due solely to last minute manipulations.

Finally, the primary tests were replicated after truncating the analysts' forecasts and reported and restated earnings distributions at the 1st and 99th percentiles, instead of windzorizing. The results from this iteration are qualitatively similar to those presented Table 3.

CONCLUSION

Recent studies by Abarbanell and Lehavy (2003) and Burgstahler and Eames (2003) produce conflicting implications regarding how analysts incorporate earnings management into their forecasts. Burgstahler and Eames (2003) suggest that analysts include the effects of earnings management in order to more accurately forecast reported earnings, while Abarbanell and Lehavy (2003) argue that analysts remove the effects of earnings management in order to forecast pre-managed earnings. The purpose of this paper is to determine which of these results is supported by the data.

Using a Vuong (1989) test, the relationship between analysts' forecasts and earnings as originally reported, a proxy for managed earnings, and between analysts' forecasts and restated earnings and nondiscretionary accruals, proxies for unmanaged earnings were examined. The evidence suggests that analysts' forecasts are more closely related to unmanaged earnings, consistent with analysts removing the effects of earnings management when forecasting earnings. Additional sensitivity analyses, overall, support these results.

With so many different targets, benchmarks, and motivations for earnings management, it is difficult, even in hindsight, to anticipate earnings management. However, because of their close relationships with managers and their in-depth knowledge of company goals, bonuses, etc., analysts have perhaps a greater ability to anticipate earnings management than other investors. Therefore, by anticipating the effects of earnings management and removing these effects from their forecasts, analysts provide a significant service to both the investment houses they work for and for the other investors that use their estimates. Additional research is needed to determine how investors price the earnings management information provided by analysts and to determine the incentives given to analysts to encourage this service.

The results of this study are subject to three major caveats. First, earnings management and unmanaged earnings are unobservable. Thus, any proxy variable is subject to considerable noise. It is possible that the results are due to this noise rather than to the hypothesized relationships. Similarly, the results of the Vuong test are limited by the possibility that the earnings restatements are due to reasons other than earnings management.

Second, the results in Table 3 are much weaker for the accruals sample than for the restatement sample The differences between the adjusted R^2 values, the coefficient values, and even the correlations reported above are relatively minor, even though consistent with the results of the restatement sample. This is even more evidence in Table 4. This difference between the samples is most likely due to the weaknesses inherent in all of the discretionary accrual models (see McNichols, 2000). It could also suggest that most earnings management is relatively small (see Das and Zhang, 2003). Finally, it could suggest that while there is a difference in the associations between analysts' forecasts and managed and unmanaged earnings, the difference has little practical importance.

A final caveat is that the tests are exclusively based on archival data taken from the I/B/E/S and Compustat databases. Although this data provides an overall picture of analysts and their forecasts, information obtained from actual analysts in a survey or experimental setting might be useful for addressing the research question from another perspective.

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RECONCILING COST CALCULATIONS AND MANAGEMENT CONTROL TOOLS IN MUNICIPAL SERVICES: AN EMPIRICAL STUDY

Donatien Avelé, University of Moncton

ABSTRACT

Municipality control has not always led to conclusive results. This is particularly true for the municipalities of the emerging countries of francophone Sub-Saharan Africa. Thus local managers are increasingly faced with the difficulties related to controlling the costs of their various services. In this context, how can cost calculations and management control tools be reconcile for a better control of municipal performance? To achieve this, an empirical study was carried out in Cameroonian municipal public services, in francophone Sub-Saharan Africa, in the third quarter of 2007. Based on a principal component analysis (PCA) and a typology trial of management tools, the results show the existence of necessary control tools to monitor the municipal performance of these local entities.

Key words: Cost calculations, management controls, municipal services, principal component analysis

INTRODUCTION

Generally, management controls in local communities and particularly in municipalities has no specific theoretical foundation. However, it is possible to identify two groups of authors that provide a reference on which to base ourselves: One group made up of traditional works in management control (Bouquin, 1986; Anthony, 1965; Anthony & Young, 1988), and one other group for which the writings are more specific, if not to municipalities, then to not for profit organizations (Hofstede, 1981; Gibert, 1995; Burlaud, 1995). Hofstede's (1981) reflexions provide a typology composed of six types of controls (from routine controls to political controls) that can be grouped into two categories: cybernetic controls that globally apply to situations where the goals of the activities are identifiable and their results are measurable, and non cybernetic controls used when the goals of the activities are vague and the results immeasurable. In the first instance, control tools, such as balance scorecards, costing and ZBB (zero-based budgeting), can be applied.

In the second case, the use of these techniques will lead to management errors. Hofstede (1981) thus proposes to apply political analysis and public policy evaluation techniques. H. Bouquin's works on management controls are not specific to not for profit organizations, but he also proposes a control typology that is not based on the same criteria as Hofstede. The criterium

used is that of strategic nature and not of the decisions that are made in the organization. There are two types of controls: a routine control for non strategic decisions and for which ZBB, balanced scorecards and cost calculation-type tools apply, and strategic controls for which "strategic" controls would apply.

A reconciliation of cost calculations and management control tools supposes the establishment of a cost calculation system in municipalities, allowing the perfect control of charges and the proper pricing of services to users. However, municipalities have several information systems at their disposal: public accounting (financial and obligatory), analytical accounting (more or less developed), balance scorecards, etc. Public accounting is more so a means to control the regularity of municipality management by public power than a management tool that can finely guide municipal choices. A clear-cut opposition can be made between public accounting on the one hand as it is mostly produced for external users and for auditing purposes, and the more or less developed components of management controls on the other hand, which are produced for internal users and aim at facilitating local public management. Public accounting has its peculiarities: it accounts for inflows and outflows and is not of the patrimonial accounting type (Avelé, 2011; Meyssonnier, 1991). It makes a distinction between operating and financing activities. It does not account for amortisation (Meyssonnier, 1991; Griffiths, 1988). Public accounting is often seen is as restricting. According to Hofstede (1981), when the goals are ambiguous because of conflicts of interest or values, of a lack of knowledge regarding ends-means, or of a turbulent environment, then the control problem causes serious difficulties. Having said that, would it be possible to reconcile cost calculations and management control tools in municipal services? Could a hierarchical ascending classification allow proper structuring and a good readability of the management control tools being used in the visited municipalities? This article thereby aims at providing a description of the state of the current municipal practices so as to contribute to the knowledge of the management control tools necessary to the monitoring of these local entities' performances. This study uses data collected via surveys completed by the 60 visited services that compose the sample. Theoretic contributions and methodology will first be presented; empirical results will then be analyzed and discussed.

LITERATURE REVIEW

Management control went from being an auditing and sanctioning role to an advising and monitoring of decisions and actions role (Colton, 2001; Betard, 1994; Mévellec, 1995). The job of a controller has evolved from a traditional technical function to an advising and communications one (Hrisak, 1996; Sponem and Lambert, 2009). Its human qualities are indispensable to legitimizing its position and inciting various services to cooperate with him. The reconciliation of cost calculations and management control tools in municipalities involves empowering local managers, but also an effective system of performance measures (Ahrens &

Chapman, 2000). Management control is explicit in this empowering approach (Anthony, 1988; Indjejikian and Matejka, 2006). In the literature, the crossover between management control and accountability refers, on the one hand, to the appropriation and mastery of performance (Matic, 2012), and on the other hand, to the animation system that allows one to set and attain goals (Stephen et al., 2007; Gregg et al., 2007). The measure of performance can be achieved with the help of animation controls stipulating accountability (Kopel, 2001). According to this view, supervision plays a key role (De Lancer Julnes and Holzer, 2001). On the other hand, accountability is one of the steps of establishing management control, and comes after fixing goals and before operational management (Van Ryzin and Immerwahr, 2004). Some of these objectives must be set before all local managers can manage performance (Golooba-Mutebi, 2003). Accountability concerns them so that decisions can be coherent in regards to strategic objectives (Melkers and Willoughby, 2005). This is one of the classic missions of organizational control (Bouquin, 1997). To do this, persons in charge must be aware of the objectives and be encouraged to abide by them (Golooba-Mutebi, 2003; James, 2007). Management control allows all staff to be aware of the need to preserve public funds, and to better monitor spending. This measure imposes the concept of truth of cost and prime cost. Public service must not longer be achieved at all costs (Golooba-Mutebi, 2003; James, 2007). Herein lays an answer that, until now, had not been provided to accusations of irresponsibility being levelled against (Bouquin, 1988). This language enables to engage the personnel of the municipality by improving their image on the inside and on the outside. We have noticed that a municipality is a heteregeneous organization, composed of multiple activities with different goals and workings; sometimes they are even opposing (Avelé, 2011). The adaptation of management control tools must take this complexity into account Roussarie, 1995). Drawing on the works of Ouchi (1979), which discuss the process of goods and services fabrication and the nature of the goods produced goods, we propose a simple table, which will display management control tool classification as according to the service activity. This will allow us to retain two criteria: the possibility of measuring outputs (can we identify goods and services, account for them?) and the presence or absence of the gratuitousness of the service or product (is it a public or merchant good?). These two characteristics are easy to measure. They enable us to link the goods' characteristics and fabrication process. Depending on the case, the cost calculation methods must be different, as seen in the table below.

Table 1: Adaptation of Management Control Tools

	Measurable Outputs	Non Measurable Outputs
Paying Good or Service	full cost	variable cost
Free Good or Service	direct cost	nothing

Where it is possible to identify the products or services and they are charged to users, full cost accounting is the best option. It allows for a sound analysis of each charge and the determination of the production cost, margin or deficit per product. For a paying service for

which each product's identification is delicate, it is better to globally monitor fixed charges for services and to calculate the evolution of variable charges commensurate with the activity (Hrisak, 1996; Sponem and Lambert, 2009; Byrne and Pierce, 2007). It would also be possible to consider a rational allocation of fixed cost from an activity indicator, which cannot have a good effect on the quantity produced (Waterhouse, 1999; Kaplan and Norton, 2001). In contrast, if products are identifiable, but not chargeable, it is not necessary to calculate a full cost (Anthony, 1988; Bouquin, 1998; Kaplan and Norton, 2001). A follow-up of the direct charges per product and of the indirect charges for the entire service are sufficient (Hoffmann-Martinot, 1988; Anthony, 1988; Melkers and Woulloughby, 2005). After a brief presentation of the state of the art, it is now time to present the research methodology.

RESEARCH METHODOLOGY

All research works rely on a certain vision of the world, use a methodology, and propose results to predict, dictate, understand or explain. An explanation of the epistemological presuppositions allows one to control the research process, to increase the validity of the knowledge in question and to provide it with a combined nature. For this purpose, a survey was conducted among local elected officials (mayors) and officials responsible for municipal public services in Cameroonian cities.

Survey Development and Pre-Testing

To answer the question posed, we decided to use the survey as the principal means of collecting data. The use of this technique seemed appropriate and unavoidable because the exploratory nature of the study did not allow us to have the maximum information sought without resorting to the administration of a questionnaire. Thus, during the first quarter of 2007, the first survey was administered in two dozen heads of various departments of the city of Douala. The statements that seemed to cause confusion were reformulated. The errors detected during this pre-testing were corrected, so the development of the modified questionnaire seemed plausible. The new survey, just like the first one, was tested on about twenty elected officials and service heads of the city of Yaounde. The second pre-test did not bring forth any major anomalies in the surveys, so it confirmed its validity. The final phase of the administration of the survey could therefore begin.

Data Collection

During the data collection, surveys were sent to Cameroonian municipal elected officials and service heads. The details related to relative response rates of sent, returned, usable and non-usable surveys are presented in the table below.

Table 2: Global Response Rate of the Quantitative Study		
	Totals	Percentages
Questionnaires sent	250	100 %
Questionnaires returned	150	60 %
Non Usable Questionnaires	40	16 %
Usable Questionnaires	**110**	**44 %**

Verification of the validity and reliability of the measuring instrument

By recognizing the necessity to adapt the rule to each research study's specific context, Perrien et al. (1984), Evrard et al. (2003) and Usunier et al. (1993) estimated that for exploratory research, an alpha coefficient between 0.5 and 0.6 is acceptable. Thus, within the framework of this study, all elements that did not attain this threshold were simply excluded so as to obtain much more reliable results. With that being said, the method of internal consistency was used to measure the reliability of the measuring instrument for this quantitative study. Cronbach's alpha was estimated to verify the homogeneity of the items involved in the measurement of variables related to management control tools needed to monitor the performance of the municipal services of the cities in Cameroon. The various Cronbach's alphas obtained are presented in the table below:

Table 3: Cronbach's Alpha	
Variables	Cronbach's Alpha
Q202_CSM : Cost calculation for municipal service pricing Q203_CUC : Cost calculation for user pricing	0.853
Q21_RTB : Creation of balanced scorecards	0.794
Q322_CAU : Analytical accounting to users Q321_CC : Cash-based accounting	0.756
Q323_TBE : Balanced scorecards for follow up on spreads Q324_CAI: Internal analytical accounting	0.873
Q153_OGP : Existence of management planning Q26_PA : Activity forecasting	0.714
Q325_CB : Budgetary control Q326_TBA : Activity balanced scorecards Q327_CMC : Zero-based budget	0.721
Q201_CMC : Cost calculation to control charges;	0.472

Almost all of Cronbach's alphas are above 0.6 and meet the reliability criteria. The only one with a low value (0.472) is the one linked to variable *Q201_CMC*. Also, a correlation analysis between this variable and the other variables of management control tools was done. All of the model's variables were measured with a Likert squale of five or seven points. Lastly, we used the Statistical Package for the Social Sciences (SPSS) version 13.00 to process the data in this study.

MAIN RESULTS AND DISCUSSION

Management accounting has been the subject of much attention in the community in its use by local elected officials. The results of this study are striving to show whether the use of management accounting in Cameroonian municipal public services is still very basic or even inexistent. For this sample, the same findings show that 86.7% of services studied do not use management accounting, compared to 13,3% that do. That's not at all surprising because in view of the relevant texts and regulations in force pertaining to municipal accounting in Cameroon, there is no mention of the use of cost accounting. The frequency of costing is relatively low or almost zero, for 96% of councils have no management accounting. However, most municipalities simply calculate the direct costs (materials used and personnel costs) of departments providing services to the population. Depreciation, which would require a calculation and allocation, absolutely do not appear in municipal accounting in Cameroon.

Calculation of Operating Costs

Ten municipal services among the twenty visited said that they determine the operating costs of their main activities, against ten that do not.

In regards to full costs, the results of the study simply show that the determination of this type of cost is a lot more widespread in technical services than in financial or administrative services.

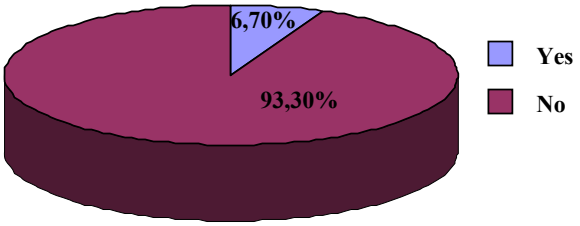
The Calculation of Full Costs

From the below diagram, the results show that only 4 services, which is 6.7% of the visited services, determine a full cost, compared to 56 or 93.3% that do not. This leads us to believe that the notion of cost calculation, or at least full cost calculation, is not yet anchored in Cameroonian cost management. In contrast, the distinction between fixed and variable costs is almost never made; we can thus conclude without a doubt that it has not yet penetrated the Cameroonian municipal sector since only four services in Douala and Yaounde think in these terms.

Cost Comparison

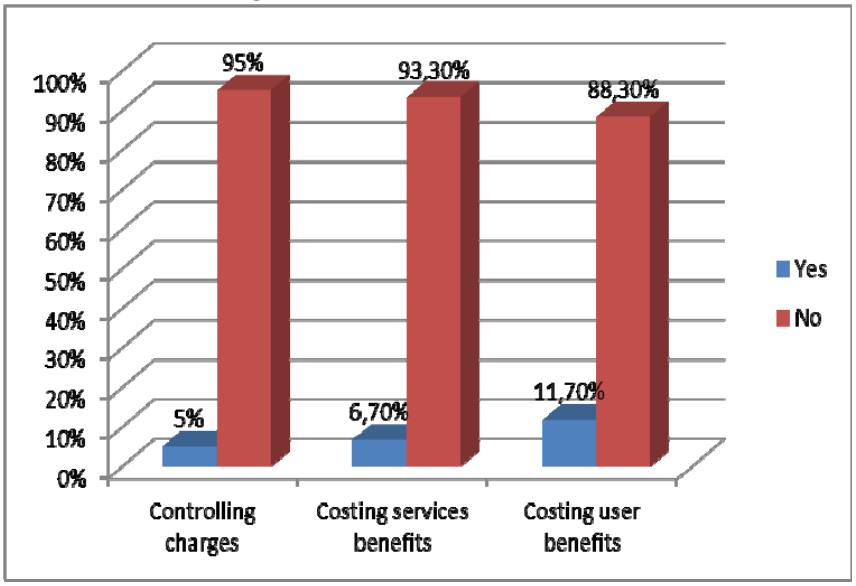
In regards to the cost comparison that was calculated in the different services, only 10 services out of the 60 visited declared that they compare costs. In addition, we asked respondents to tell us how calculated costs are used in the different services studied by distinguishing whether they were used to determine the cost of a good or a service provided.

Figure 1. Full Costing



In view of the results obtained in expense control in the different departments visited, we soon realized that municipal officials in Cameroon do not seem to attach importance on controlling expenses related to their activities. Out of about sixty departments visited, only 5% calculate costs in order to control them; 11.7% to price benefits to users and 6.7% for services delivery.

Figure 2. Use of cost calculations

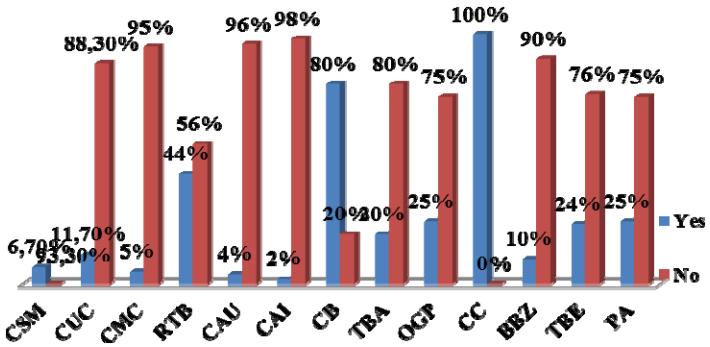


Other municipal service cost calculations

The descriptive statistics calculated from the data collected during this quantitative study reveal that the management control tools used by the Cameroon's municipal departments are of little significance and remain very basic in all 60 visited services to make up this sample.

Apart from the cash accounting that remains widespread in all municipalities based on the results of the first phase of this study, the results of the quantitative survey are very insignificant compared to other management control tools used in these municipalities. The analysis of municipal performance or control activities within municipalities in Cameroon can often be exercised directly or informally without actually requiring sophisticated management tools, from what we can gather from this study.

Figure 3. Cost Calculations and Management Control Tools in Cameroonian Municipal Services



Ultimately, we have observed as shown in the figure above that cash accounting (CC) is widespread throughout the visited services. In practice, the ZBB is an adaptable and flexible method of mobilizing services. It allows one to advance all services at the same time or work in groups. Finally, depending on the financial standing of the city, it is possible to focus on controlling costs and improving the quality of services. The interest of the method lies in the rigor and formalization of different stages that allow the department's general manager to properly control the action and the fact that it builds on the general managers' support. The ZBB is becoming common language in town halls. Thus, the study's results show that 90% of councils studied did not use ZBB as a method of preparation of municipal budgets, compared to 10% that did use it to prepare their budgets. Other tools of management control are also of little significance with only 6.70% of the services which use costing for pricing municipal services (CSM), 44% carry out the implementation of scorecards (RTB), 4% use analytical accounting for users (CAU) and only 2% for internal cost accounting (CAI). In contrast, 80% of visited services conduct budgetary control.

To obtain a global vision and a broader analysis of the variables already analyzed, it is important to use an approach that builds on multivariate analysis. The next section will expand on the results to finally lead to identifying management control tools used in the municipalities studied and necessary to tracking municipal performance. We therefore appeal to component factor analysis and to ascending hierarchical classification (AHC), which will lead to a typology of management control tools.

PRINCIPAL COMPONENT ANALYSIS AND TYPOLOGY TRIAL OF MANAGEMENT TOOLS NEEDED TO CONTROL THE PERFORMANCE OF MUNICIPAL SERVICES

Principal component analysis (PCA) is one of the multivariate descriptive analyses. The goal of this analysis is to summarize as much information as possible while losing as little as possible in order to make the interpretation of the large quantity of initial data easier and to make the reduced data more meaningful. In most situations, there are several observations on each individual making up population studied. Thus, p variables per individual must be taken into account, p always being greater than 1. The separate study of each of these variables gives some information, but is insufficient because it ignores the connections between them, which are often what you want to study. As noted by Evrard (2003), *« it is the role of multivariate statistics to analyze data as a whole, while taking all variables into account »*. In existing work, there are two different PCA approaches:

It can be presented as a search for a smaller set of uncorrelated variables, linear combinations of the original variables accurately summarizing data (Anglo-Saxon approach).

Another interpretation is based on the representation of initial data with a scatter plot in a geometric space. The objective is to find sub-spaces (right, plane) that best represent the initial scatter plot. It is this latter approach that we have used. The PCA therefore reduces large tables sizes in a small number of variables (2 or 3, usually) while retaining a maximum of information. Baseline variables are called "metrics". In analyzing the results of the PCA, we reached the following conclusions.

First of all, by observing the correlation matrix (see Table 4), we noted that many variables are correlated at more than 0.5.

Table 4 Correlation Matrix

	Q202_CSM	Q203_CUC	Q201_CMC	RTB	CAU	TBA	CB	TBE	CC	BBZ
Q202_CSM	1.000	.040	.268	.089	.334	.801	.627	.402	.503	.557
Q203_CUC	.040	1.000	.578	.694	.313	.449	.178	.501	.653	.661
Q201_CMC	.268	.623	1.000	.274	.231	.442	.486	.686	.601	.159
RTB	.589	.494	.274	1.000	.039	-.124	.375	.009	.091	.339
CAU	.634	.613	.231	.039	1.000	.072	.287	.460	.623	-.077
TBA	.801	.449	.642	.524	.072	1.000	.385	.440	.240	.439
CB	.627	.378	.486	.375	.287	.385	1.000	.161	.255	.239
TBE	.702	.501	.686	.689	.660	.740	.161	1.000	.484	.325
CC	.503	.453	.601	.391	.623	.240	.255	-.084	1.000	-.151
BBZ	.357	.661	.159	.539	.577	.439	.389	-.125	.551	1.000

Secondly, we observed the KMO index (Kaiser-Meyer-Olkin) tends towards 1. To assess this index, it is generally advisable to use the following scale:

- 0.5 and less : miserable
- Between 0.6 and 0.7 : mediocre
- Between 0.7 and 0.8 : medium
- Between 0.8 and 0.9 : meritorious
- More than 0.9 : marvellous

Finally, we used Bartlett's test of sphericity to see if significance tends towards 0.000, is inferior to 0.05, or is between 0.05 and 0.10.

Table 5. KMO Index et Bartlett Test

Kaiser-Meyer-Olkin sampling precision measurement		.725
Bartlett's test of sphericity	Approximate Khi2	346.798
	ddf	72
	Significance	.000

As it can be seen on Table 5 above, the result of the KMO test is greater than 0.7; it thus shows a good ability of data to be factored. The Bartlett test of sphericity confirms this because it is very significant (tends towards 0.000). As the PCA meets these conditions, the data could therefore be factorized. After this step, we had to keep a number of factors, but had to determine which to choose. Three rules are generally applicable:

- Kaiser's rule suggests that we only keep the factors with eigenvalues larger than 1.
- For the second rule, we chose the number of axes in accordance with the minimum return information that is desired. For example, we want the model to reproduce at least 80% of the information.
- Finally, there is the Scree-test. The graph of eigenvalues is observed and the values at the left of the inflexion point are retained. Graphically, starting from the components that bring the least (to the right), the points that are almost aligned are connected and only the axes that are under this line are retained.

Thus, according to Kaiser's criterium (Gianneloni & Venette, 1995), we retain three factorial axes (or principal components) for which the eigenvalues were above 1. These three factorial axes allowed us to summarize the initial information on the 12 variables that represent the management control tools used to measure the performance of public municipal utilities of Cameroonian cities in Sub-Saharan Africa. To retain the eigenvalues of these three axes, based on the first two rules stated above, we examined the total explained variance (see Table 6). The eigenvalues of the three factorial axes were 3.596, 2.914 and .820, and explained 29.963%, 24.281% and 16.836%, respectively, of the variable in the initial scatter plot. This is a good

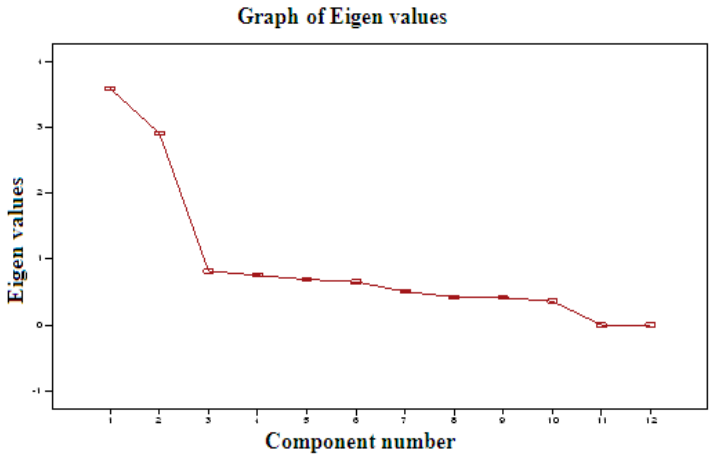
representation, given that the overall factorial plane returns nearly 71.080% of the total inertia of the scatter plot. In this case, the PCA does not highlight a number of axes greater than 2, which does not lead us to study several schemes. The importance of each axis is given by the percentage of explained variance. However, the graph of the eigenvalues is a graph that shows the order of importance of the eigenvalues associated with the factors (the first one always being associated with the largest). Looking at the chart below, factor 1 has an eigenvalue of 3.596 and factor 2 meanwhile has an eigenvalue greater than 2 (2.914). All this can be verified by their total variance. In contrast, factor 3 should be eliminated because it carries less than 1% of the information, that is to say less than a variable taken in isolation.

Table 6: Total Explained Variance

	Initial Eigenvalues			Sums of Squares Loaded			Sums of squares for the rotation		
Component	**Total**	**% of variance**	**% accrued**	**Total**	**% of variance**	**% accrued**	**Total**	**% of variance**	**% accrued**
1	3.596	29.963	29.963	3.596	29.963	29.963	3.596	29.963	29.963
2	2.914	24.281	54.244	2.914	24.281	54.244	2.914	24.281	54.244
3	.820	16.836	71.080	.820	16.836	71.080	.820	16.836	71.080
4	.755	9.628	80.708						
5	.693	9.112	89.820						
6	.658	5.487	95.307						
7	.509	2.576	97.883						
8	.426	1.885	99.768						
9	.415	.223	99.991						
10	.363	8.556	100.000						
11	-1.010E-16	-8.417E-16	100.000						
12	-4.060E-16	-3.383E-15	100.000						

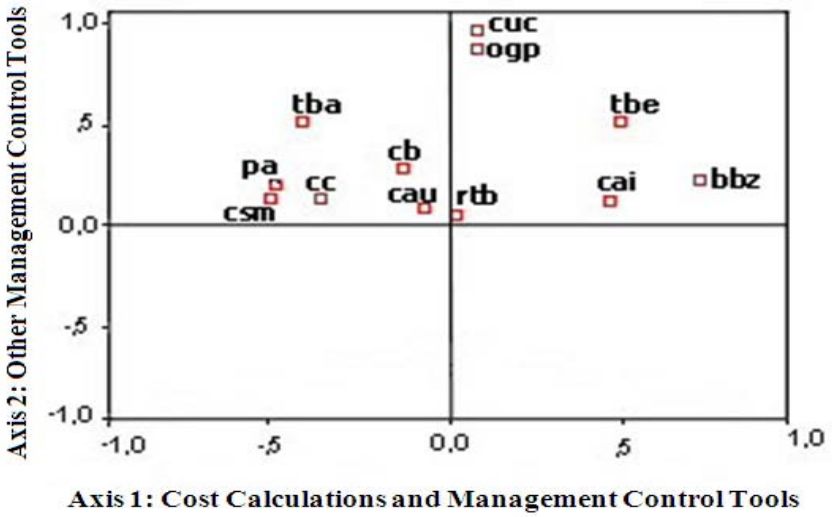
Extraction Method: Principal Component Analysis.

Figure 4: Graph of Eigen Values



To view the positioning of the explanatory factors of management control tools needed to monitor the performance of municipal utilities, all variables were projected onto factorial planes 1 and 2 (see Figure 5).

Figure 5. Positioning of Variables Characterizing the Management Control Tools needed to Monitor Municipal Performance



All variables positioned in the two factorial axes are shown in Table 7 below.

Table 7. Variables related to management control tools	
CSM	Cost calculation for municipal service pricing
CUC	Cost calculation for user pricing
RTB	Creation of balanced scorecards
CAU	Analytical accounting to users
CAI	Internal analytical accounting
CB	Budgetary control
TBA	Activity balanced scorecards
OGP	Existence of management planning
CC	Cash-based accounting
BBZ	Zero-based budget
TBE	Balanced scorecards for follow up on spreads
PA	Activity forecasting

TYPOLOGY TRIAL OF MANAGEMENT CONTROL TOOLS

The cluster analysis which we have used to obtain a comprehensive view of management control tools used for monitoring municipal performance is known as "cluster analysis". This is a generic term used to describe a variety of techniques of statistical analysis (Scheibler and Schneider, 1985). These methods are usually used to group objects, people, concepts, or "stimuli" into homogeneous groups based on their similarity. These classification techniques are particularly useful in the context of exploratory investigations to identify general trends in the data and suggest avenues for future analyses (Kos and Psenicka, 2000). The objective here is to identify the structure of representations, the cluster (classification), in order to organize classes of elements of the scope of representations. Finally, we try to make the comparison to organize connections between elements. The Ward Method is often used to analyze the ordinal data. It maximizes the homogeneity of the classes. Otherwise, the method of "Between-group linkage" can also be used. The latter seems more appropriate for binary data. In all cases, it was worthwhile to compare the different solutions and choose on the basis of their "interpretability". Thus, the hierarchical classification was based on squared Euclidean distances using Ward's algorithm. Ascending hierarchical classification of the set of variables related to the management control tools used to monitor the performance of municipal services is analyzed in the tables below.

Table 8: Hierarchical Classification

Summary of Observation Calculated (a)

Valid Observations		Missing Observations		Total Observations	
N	Percentage	N	Percentage	N	Percentage
60	100.0%	0	.0%	60	100.0%

a Square of the Euclidian distance used

Table 9: Mean Distance (between classes)

Aggregation Chain

	Class Grouping		Coefficients	Step of occurrence of the class		Next step
Step	Class 1	Class 2		Class 1	Class 2	
1	10	11	4.000	0	0	2
2	9	10	5.000	0	1	3
3	2	9	6.667	0	2	4
4	2	4	9.000	3	0	5
5	2	5	12.800	4	0	7
6	6	8	17.000	0	0	7
7	2	6	18.167	5	6	12
8	1	7	20.000	0	0	9
9	1	3	26.000	8	0	10
10	1	13	30.000	9	0	11
11	1	12	30.000	10	0	12
12	1	2	36.975	11	7	0

The analysis proceeds in stages. The table below shows the construction of classes (the empty boxes have been put in gray). The highest bar between accounting providing the cost of delivered services and the development of balanced scorecards (RTB) indicated the first step of the analysis, with cost calculation for municipal service pricing (CSM) and analytical accounting to users (CAU) on one side, and all other variables on the other. The second step was between RTB and all of the other variables, etc. We finally retained four groups representing the four management control tools used to monitor public municipal service performance.

Table 10. Stalactite vertical

Observations																				
Number of classes	EGP		TBA		CB		CAI			CAU		RTB		PA		TBE		ZBB		CC
1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X
3	X	X	X	X	X	X	X	X	X	X		X		X	X	X	X	X	X	X
4	X	X	X	X	X	X	X	X	X	X		X		X		X	X	X	X	X
5	X	X	X	X	X	X	X	X	X	X		X		X		X		X	X	X
6	X	X	X	X	X	X	X	X	X	X		X		X		X		X		X
7	X	X	X		X	X	X	X	X	X		X		X		X		X		X
8	X		X		X	X	X	X	X	X		X		X		X		X		X
9	X		X		X		X	X	X	X		X		X		X		X		X
10	X		X		X		X		X	X		X		X		X		X		X
11	X		X		X		X			X		X		X		X		X		X
12	X		X		X		X			X		X		X		X		X		X

We will now observe the characteristics of the individuals belonging to each class by giving each of them a suggestive name.

- The "adapted", which contain fifteen services. Based on our observations, these services attempt to transpose management control tools from private companies with the same peculiarities as the municipal service. This group puts a strong emphasis on cost calculations needed for costing municipal services. They represent 25% of the sample (all 60 visited municipal). We observed a relatively high level of training for each of the officials of the various services. It is also our opinion that this reflects the efforts made by them to try to mapt the management tools used in private companies on local communities.

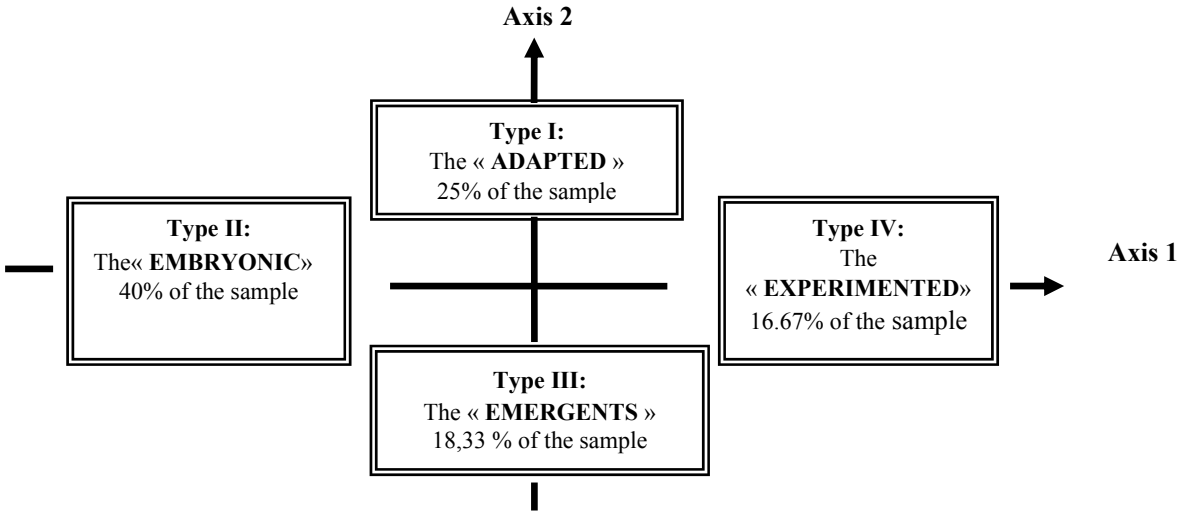
- The "embryonic". They include services that, until the date of the survey, had not yet used the management tools needed to monitor the performance of their activities. Management is mostly manual. We have seen willingness on the part of those responsible for putting in place a number of tools for management control, but this is still in a precarious stage. The level of computerization of activities is relatively low for these services. The embryonic are the most

important among the four groups we identified because they represent 40% of the sample with 24 services. Basically, the service management of this group remains rudimentary overall.

- The "emergents" include the services that are converging toward modern service management. They rely on traditional management tools but are also trying, like the first group, to adapt tools from private companies to the municipal sector. They represent 18.33% of the sample for a total of eleven (11) services. We observed that the "slow" emergence of management control tools in these services is due to low levels of computerization of activities.

- The "experimented" include services that tend towards real development on the use of the management control tools for monitoring municipal performance. They use a variety of management tools and services are mostly computerized unlike some previous groups. They are found particularly in the large city councils of Douala and Yaounde. There are 10 in all and represent 16.67% of the sample. Apart from cash accounting, which is prevalent in all groups, the experimented make use of scorecards to monitor variances between forecast and actual values. Cost accounting in these services are used both for controlling investment costs, and the pricing of services to users. It is also in this group that we found a high level of training of officials from Bac + 3 to Bac + 5. The results of the construction procedures of the groups allow us to establish the following graph:

Figure 6: Typology of Management Control Tools used in Municipal Public Services for Performance Monitoring



CONCLUSION

The conclusions drawn in this study are mainly based on calculations of cost and management control tools needed to monitor municipal performance. To obtain a comprehensive picture and a broader analysis of the variables studied previously, we felt it was important to use a multivariate analysis-based approach. This approach known as principal component analysis (PCA) allowed us to enrich the results eventually leading to the identification of management control tools needed to monitor performance. For this purpose, we have used factorial component analysis and clustering (agglomerative hierarchical clustering). The aim is to identify the structure of the representations in order to organize classes of elements of the scope of representations. Thus, the hierarchical classification was based on squared Euclidean distances using Ward's algorithm. The latter revealed four types of the management control tools used in visited municipalities.

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