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Consequences of Information Asymmetry on Corporate Risk Management

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Consequences of Information Asymmetry on Corporate Risk Management

By

Howard J. Merrill III

An Abstract of a Thesis
in
Applied Economics

Submitted in Partial Fulfillment
Of the Requirements
For the Degree of

Master of Arts

May 2017

State University of New York
Buffalo State
Department of Economics and Finance

Abstract

This paper will demonstrate the impact information asymmetry has on risk management. There is a noticeable impact within the context of consumer credit risk. If a firm is able to recognize this, they can make improved credit decisions that will reduce the consequences. The theoretical impact will be presented while depicting areas of risk management that are susceptible to information asymmetry. We find a direct impact on the development of scoring models, credit policies, and origination volume. These results hold for banks with portfolios consisting of consumer credit products and small business loans. Once known, banks can better tailor their credit policies and underwriting guidelines to reduce the impact. This will provide the blueprints for empirical research into the fiscal consequences, particularly concerning loss provisioning and the charge-off of consumer loans.

State University of New York
Buffalo State College
Department of Economics and Finance

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Dedication

To my wonderful fiancée Michelle, and my family. Thank you for the endless support that made this contribution possible.

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1. Introduction

Risk is the future uncertainty of deviation from the expected. It is the responsibility of risk managers to understand the specific risks facing a bank. The results of analyses are accepted for monitoring this risk. The techniques used are as boundless as the number of unique firms that employ them. A large public bank will have different credit risk priorities than a privately owned local insurance company. Information asymmetry is a concept about situations with two transacting parties, with one party always knowing more information than the other. This is clear in the lender-borrower and principal-agent relationship at a bank. Credit transactions are going to have some form of information asymmetry.

Credit risk is the risk of default that banks face from its portfolios of loans. This area of study became important in 2007 with the collapse and bailout of some of the largest names in banking. These included Bear Sterns and Lehman Brothers. Some wondered if information asymmetry alone could have caused the collapse of asset backed securities and institutions that fostered them. Beltran and Thomas constructed a model that priced asset-backed securities under asymmetric information through a Monte-Carlo simulation. As you move down the securitization chain, the payouts and values of the securities become increasingly dispersed. They admit this is hardly the sole reason of the collapse. The collateral debt obligations only became foul once pessimism about the economic future set in (Beltran and Thomas 2010, 29).

George Akerlof laid the groundwork for modern discussions on information asymmetry by relating quality and uncertainty. In his paper *The Market for "Lemons"*:

Quality Uncertainty and the Market Mechanism, Akerlof discusses the used car market and the analogy of a 'lemon'. He demonstrated that because of information asymmetry, it pays the seller not to disclose all the information he knows about the used car he is selling. This will have effects from transaction to transaction, and eventually lead to all the worthwhile market participants exiting the market. This will shrink the market and begin to make it disappear. While that does not truly happen, the logic is easy to follow and we begin to see the need for some form of market intervention.

Joseph Stiglitz has built upon what Akerlof started. In his paper *Information and the Change in the Paradigm in Economics*, Stiglitz discusses the change in the economics of information paradigm and that we need to devote energy to thinking of information as imperfect. A separate paper from this work dives into solving an equilibrium for the purchase of information to move the situation to as near perfect information as possible. This task proved quiet difficult and Stiglitz did not land on a result that he was completely confident in.

Andrew Michael Spence contributed to the theories of labor markets with his work *Job Market Signaling*. He ties the conceptual ideas of market phenomena such as promotions within a company, loans and consumer credit to the job market and discusses the impact of market signaling (Spence 1973, 356). Hiring, acquiring education, and obtaining credit will all have some form of signaling, by both the principal and the agent. Information gaps are cited in all three scenarios.

We can broadly view these as investing under uncertainty. You hire a candidate not knowing their full output abilities. A student is seeking education not knowing the payout later in life. A bank lends credit without the full knowledge of default and loss. At

the going wage rate, the market creates certain productive capabilities given observable attributes. The employer in Spence's model has come to expect a certain level of output based on past signals. A general equilibrium between the offered wage rate and signals will form (Spence 1973, 360). Akerlof, Spence, and Stiglitz were awarded the Nobel Prize in Economic Science in 2001 for their works relating to information.

Neoclassical economics uses many mathematical models to create these situations in a way that many can understand. Math is the universal language, and if we can present something in a way that everyone can follow, that will have a deep impact on the study of the subject. Assumptions play an important role in creating these universal models. Equilibrium models use the assumption that the economic agents contributing are maximizing their utility. To maximize utility, the economic agent must have perfect information and know all risks and possibilities of a specific action.

We know that not every agent vets and works through the scenarios of a transaction. Most go ahead with what they think is the best course of action, and often the transactions are impulse. It would take a great amount of time to think through every scenario before purchasing groceries at the store. We see the more important the purchase or action, as in buying a house, the more time and energy is expended on the task.

At a bank, there is a relationship between the lender (the bank) and the borrower (economic agent). This is the foundation of what classifies an institution as a bank. Our focus will be on those relationships that are based on credit. This can be a mortgage, credit card, small business loan, or some other installment or revolving line of credit. Mortgages and automobile loans are secured by collateral, but the borrower still needs a reputable credit rating. Each one is consistent in that it is credit granted from the

institution to the economic agent. Here is where information asymmetry affects the firm. An information disconnect can form between the principal and agent. The data knowledge will be positively skewed towards the customer. This is simply because they will know more about themselves than others.¹

Credit risk studies the relationship between the borrower and the lender, and looks for ways to improve the credit quality of a given portfolio. The bank wants the most credit-worthy borrowers, and to protect themselves from the most prone to default. It becomes a sort of balancing act, even when the threshold for accepting or denying credit is clear-cut. Banks take some form of risk; this is just a fact. Without risk, there would be no competitive advantage between banks. Borrowers could pick any bank and get the same product. Consumers are aiming for the lowest interest rate, and the bank would like to charge the highest. Where this interest rate falls for a specific product forms an equilibrium. Information asymmetry may distort where this interest rate falls.

If a bank has more complete credit information on the borrower, they can more accurately allocate the risk value, away from the higher interest rate to a better value product for the customer. Real value can be added when borrowers who were denied originally, can now be accepted. If done correctly, here the bank can begin to add to the bottom line.

Neoclassical economics once used the assumptions of perfect information and rationally acting economic agents. In the neoclassical school of thought, everyone involved in a transaction or potential transaction had a perfect understanding of the

¹ We will also see a situation where the borrower does not know everything about themselves, and what can be done in this situation.

inputs, events, outcomes, and alternatives. Economists knew this was not true, but many imagined that the perfect information universe worked nearly as well as one without perfect information. This has been proven not true. The neoclassical model has changed, and new literature has been put together demonstrating this new understanding.

This paper was born from the lack of connection of theories of information asymmetry to real-world credit risk management within a bank. I chose this topic to close the dichotomy, and to provide insight and analysis to anyone interested in this field. This thesis will accomplish this by summing the literature relevant to information asymmetry, and depicting the relationship it has with risk management while highlighting the theorized impact. The paper is organized as follows: Section two will cover information asymmetry and its ideology. Section three presents risk management, analysis techniques and the components specific to our discussion. Section four is devoted to the evidence of the effects of information asymmetry on risk management. Section five concludes.

2. Theories of Information Asymmetry

Economists have long theorized what to do in the presence of imperfect information. The foundation of early neoclassical assumptions portrayed information as perfect. This thinking was used in the various models and scenarios these economists would use to display a structured representation of the real world.

Perfect information is a situation where each acting economic agent fully understands the ramifications of his or her actions. This can be during some form of transaction, either using money or bartering. The agent has thought about and laid out how this will effect himself, those around him, his future wellbeing, and even the environment. The economic actor understands the information about the object being purchased or bartered for. Both acting parties fully understand all the attributes associated with the object. This will eventually lead to an equilibrium market price. If something were to interfere with this process, a market failure is present.

Information asymmetry is the difference between what the seller knows and what the buyer knows. In contract theory, information asymmetry deals with the study of decisions in transactions where one party has more or better information than the other. This has the potential to create an imbalance of power, resulting in the transaction causing a market failure. Examples of the failure are adverse selection, moral hazard, and information monopoly. For the purpose of this work, we will focus mainly on the principal-agent perspective, using supporting views from the firm and aggregate level.

A Pareto optimality is when you cannot make someone better off without making someone worse off. A Pareto improvement is improving the situation of both parties,

without making one of the parties at least worse off (Stiglitz 253, 1981). Welfare theorem states in a competitive environment with no externalities, prices adjust so that the allocation of resources are Pareto optimal. For the environment to be competitive, characteristics of the products must be equally observed by all agents. When information is asymmetric and these assumptions fail, prices become distorted and allocations are not Pareto optimal.

Here, we are discussing information asymmetry in the context of the transaction. The object being transacted either using money or being bartered is more known to the seller. Most likely, the seller held the object for some time before deciding to sell, or at minimum had more of an opportunity to learn the attributes. This object can be anything of value: a car, baseball card, house, or electronic device. The seller has the advantage of knowing more than the buyer knows. Here is where haggling can alter the price agreed upon for the transaction. If this is spread across the market for the particular item, an equilibrium price is established and buyers can expect to pay within this range for similar quality.

We begin to see where information asymmetry can be detrimental to the market that is formed from these grouping of transactions. If information asymmetry is prevalent enough, there becomes a market failure. Because of this, many professions have been established to help understand and reduce the presence of information asymmetry. When buying a house, the prospected buyer has to order an inspection, and some form of appraisal is made. This helps the buyer understand what needs improvement on the home, but does not give the entire picture. Only the homeowner fully understands the characteristics of the home.

Economists realized that the impact from imperfect information, and particularly information asymmetry is worthy of extensive research and literature. People understood that information was not perfect and not every economic agent perfectly understood every aspect of a transaction. Beginning in the 1970's, literature was presented showing where this market failure can be found and what impact it may have.

George Akerlof was the economist who brought the idea of information asymmetries into mainstream thought. In reality, this concept has been debated for centuries. The assumption of perfect information that neoclassical economists used to swear by rejects any idea of asymmetrical information. In order for the original models to work, economic agents had perfect information of the possible outcomes in each unique transaction. People understood that this was next to impossible to achieve, no matter how efficient the discussed market seemed to be. Thus, it was pivotal to begin analyzing situations where information was not perfect. To quote Akerlof:

There are many markets in which buyers use some market statistic to judge the quality of prospective purchases. In this case there is incentive for sellers to market poor quality merchandise, since the returns for good quality accrue mainly to the entire group whose statistic is affected rather than to the individual seller. As a result there tends to be a reduction in the average quality of goods and also in the size of the market. (Akerlof 1970, 48)

Akerlof discusses the market for used cars to demonstrate that poor quality would drive out the good quality in a market. This driving force was fueled by the disconnect between the borrower and the lender, and the relationship between quality and uncertainty (Akerlof 1970, 488).

The used automobile market gives the context to highlight the true difference in information. When the car is new, the dealer and the potential customer understand almost the same amount of data points about the car. The amount of mileage will be relatively low and there has been no maintenance work done to the car yet. The amount of information asymmetry here is low, and as the vehicle ages, this asymmetry will grow in favor of the car owner. There is a positive relationship between the life of the vehicle (aging) and the knowledge the owner has (maintenance records, general characteristics). When it comes time to sell this now used car, the current owner will have the clear advantage.

There is where Akerlof builds his Nobel winning idea of lemons driving out the good quality cars, and concludes that poor credit will drive out quality credit. This was built off Gresham's concept of bad money driving out the good.² Akerlof explains that it may not be as simple as the bad driving out the good, but the bad driving out the not so bad, driving out the medium quality, driving out the not so good, ultimately driving out the good (Akerlof 1970, 490). This can be derived from utility theory. There will be an equilibrium in the used car market, which is comprised of price and average quality of the used vehicles. As the price falls, one would expect the quality of the vehicles to fall as well. Akerlof demonstrates, using utility theory and two traders that are Von Neumann-Morgenstern maximizers, it is possible for the price to continuously fall, bringing down the quality, until there are no vehicles being traded in the used car market.

² For a complete discussion on Gresham's law, see Sargent and Smith (2012).

This concept of the poor quality cars driving out the good quality cars, to the point where there is no market at all, creates a potential for a market failure. The chance of this happening in a real world market economy is minuscule. There would be profound impacts on other markets that have been built around automobiles, including insurance agencies, repair shops, and new car dealerships. This relationship of poor quality driving out good quality raises further questions. There can be an extra cost incurred by dishonesty (Akerlof 1970, 495). We can think of this as one of the roots of information asymmetry. When someone goes to buy a used car, the seller may be telling the potential buyer everything, and she may not be. The seller may even be lying about the history of the car. Maybe it had many problems that the owner had not taken care of properly, but is communicating to the buyer that she has.

Stiglitz noticed the true effect of imperfect information early in his career, and began to study the topic in the mid 1960's. He traveled to developing economies for other research agendas, but realized what was going on. Stiglitz noted that current neoclassical models that dominated the paradigm in the twentieth century did not hold in the presence of imperfect information, and were even more lacking in the underdeveloped countries that he was visiting, such as Kenya (Stiglitz 2002, 461).

Stiglitz's work in information asymmetry covered a range of topics that could be affected, such as wages and incentives. A prospect employee knows his abilities and has to convey this to the interviewer and new employer. The employee can do this through signaling. To reduce the information asymmetry, the employer may request references, previous works, or a transcript from the alma mater. Incentives are an interesting topic. He set out to understand the claim that paying higher wages or offering performance

incentives would entice the employees to work harder (Stiglitz 2002, 464). Stiglitz points out that if the higher wage were paid, it would benefit all firms to raise their wages. If the employee were fired for whatever reason during theoretical full employment, the employee would have no trouble finding another job elsewhere. In this situation, the employer would net no positive gain, and neither would the employee.

Ultimately, information asymmetry is the idea that different people know different things. Workers know more about their abilities, people buying insurance know more about their health or driving habits, the owner of a car knows more than the potential buyer in a used car market (Stiglitz 2002, 470). Depending on your own intuition and how you view the economic landscape, this is the very fundamental principal of imperfect information. It is incredibly costly and time consuming to try and fully inform somebody in an industry about what is happening, how healthy each individual firm is, and so on. Each firm should be concerned with other markets, as shifts in the stability of the complementary markets will have some effect on the market being discussed.

What is tricky is the idea that the information is not obtainable, but that some firm managers may not want the information disclosed at all. What about those who are quiet credible, but cannot reveal this information for whatever reason to an insurance agency or potential employer? This comes down to the theoretical market structure deciding between choosing imperfect competition or imperfect information (Stiglitz 2002, 471).

Stiglitz further provides a few mechanisms that attempt to eliminate or reduce information asymmetry. It is unsafe to assume everyone fully understands their own abilities, or that they are in the position to reveal themselves. There may arise a situation

where it would be beneficial to conceal certain pieces of information. Stiglitz suggests the simplest method for doing so would be some form of a test or exam. The abler would be revealed, often at the expense of the less able (Stiglitz 1974, 194). If we establish that one particular individual is deserving of a higher wage, we essentially say that the next person is deserving of lower wages, hence why the wage increase is at the expense of others.

Firms may choose to try to purchase information to help determine the credit worthiness of a potential borrower or entrepreneur. The firm may choose to transition from credit rationing to credit screening. Rationing is a situation where the lender limits the supply of credit, even when the borrowers are willing to pay the higher risk premium. Screening is the act of reviewing applicant's qualities and history. This will ideally lead to more profits as the lender is now involved with more borrowers, which have been deemed credit worthy through the screening process. Either direction, there will be friction between the borrowers and lenders. Friction will have an adverse effect on the accumulation of capital.

Bose and Cothren demonstrate that once the threshold is crossed and the firm moves from rationing to screening, which is accomplished by reaching a certain percentage of economic growth, loans may be originated to eliminate information asymmetries between the borrowers and the lenders (Bose and Cothren 1997, 424). The result is a growing financial market with loanable funds flowing through the market that ultimately leads to productivity. This pushes the economy down a capital accumulation path.

They begin their study by using a neoclassical growth model in which the borrower knows his risk type but the lender does not. The lender segments these

borrowers into two types, which are designated by the act of rationing credit or screening methods for granting credit. They show that in developing markets, the favored firms have wide access to the credit markets, while others (those who wish to join the market) must rely on internally generated funds or pass the screening (Bose and Cothren 1997, 425).

Through the model developed by Bose and Cothren, the screening contract will yield a higher capital accumulation path and a higher steady state level of capital per firm. This is in stark contrast to the firms that take the credit-rationing route (Bose and Cothren 1997, 433). The reasoning is that the screening removes the information asymmetries that may exist and ultimately credit is granted to those who are creditably sound and have the ability to repay.

Treating the structure of the loan contract as an endogenous variable helped Bose and Cothren demonstrate how capital accumulation evolves financial markets (Bose and Cothren, 1997, 437). When you have a low level of capital accumulation, firms will separate borrowers by limiting credit to a percentage of borrows, and ration credit. A positive relationship forms between capital accumulation and the purchasing of information on potential borrowers to assist with the screening process. The relationships displayed here are important as they put the loan contract in new light, and is the fundamental reason why banks exist.

Because the contracts are thought of endogenously, changes in the economic landscape will affect the lending equilibrium that Bose and Cothren reached (Bose and Cothren, 1997, 437). This is to be expected. Markets are designed this way. If lending

markets and the economy where entirely separated, then there would be no cause for study when it comes to information asymmetry and the structure of loan contracts.

The Bose and Cothren model is intriguing because it is dynamic enough to analyze policy changes on lending contracts. They use the example of a government program to improve the informational structure of the loan market. This policy could be in any form, including minimizing the cost to complete this screening. The European Central Bank is pushing a project called AnaCredit, short for analytical credit database, compiling granular loan level data to be accessible for any bank that contributes data (European Central Bank, 2017). This data would be anonymized, such not to give away portfolio strength or possible profits of peers, and would be a benchmark that other banks can use to see how they compare to the industry. It would be interesting to see specifically how much a reduction in the marginal cost of screening would affect the stated loan contract equilibrium.

In the United States, there is a voluntary program through the Risk Management Association that collects data points from participating banks, compiles, and distributes back to the contributing banks. This serves as a benchmark for other banks to compare to and see how their peers of various sizes are doing (RMA, 2017).

Information asymmetry can become a policy question. Vining and Weimer decided to tackle this issue utilizing a risk analysis and policy point of view. The reason being that at first thought, government intervention should be able to help reduce or nearly eliminate any form of information asymmetry in a specific market. The details would vary, but one should be able to adapt a certain policy to fit a market in need. The

idea can be broken down to Pareto improvements. There will be a point where the markets are no better off with the addition of another unit of information.

Vining and Weimer use a graph depicting social surplus and showing why the market is inefficient. The uninformed demand schedule shifts as the consumer learns more information about whatever product is being analyzed. The uninformed schedule intersects the supply schedule. We can see a deadweight loss, triangle *abc*, associated with information asymmetry (Vining and Weimer 1988, 283). The structure of this model resembles information as a public good. Their figure demonstrates a couple points. First, we get to see equilibriums reached from the uninformed and informed demand schedule. The supply schedule does not change. This particular figure signals information asymmetry if the producer could have informed the purchaser of the true make and quality of a specific product. To bring this to a consumer point of view, we can flip the ideology, and say this would happen if the consumer underestimated instead of overestimated the make and quality of the specific product (Vining and Weimer 1988, 284). In the case of underestimation, the result is a higher price that will increase producer surplus. Here, it pays the producer to provide information, thus reducing information asymmetry.

Vining and Weimer portray information as a public good in the sense that more than one person can consume the same unit of information. Once one consumer knows the information, they can easily pass the unit along at minimal to no cost to anyone in the market. The difference between information as a public good and simply information asymmetry creates two methodologies about how to go about supplying the missing pieces of information (Vining and Weimer 1988, 284). As a public good, the supplier

lacks the incentive to further produce appropriate information. When in the context of asymmetry, the supplier simply does not provide the information to the consumer, for one reason or another. Market failures can arise, and Vining and Weimer agree with Akerlof's description on the process for this to happen.

Vining and Weimer's 1988 paper is a response to information asymmetry from a policy standpoint (Vining and Weimer 1988, 292). They discuss the primary markets that have been formed to deal with imperfect information, the mechanism that the primary market uses, and the limitations associated with each mechanism. For the primary market, responses include informative advertising and warranties. Advertising reduces underestimation of the quality of a specific product, but can create a problem of homogenous goods. Low quality producers skimp on quality, and piggyback off the advertising of similar strong brands. Warranties are another primary market response. Warranties help redistribute risk between producers and the consumers. Consequently, market prices rise and moral hazard problems can surface as well. This is where a person may take extra risk now because they know the product or item they have purchased can be covered, creating unnecessary risk. This can place more cost back onto the producer (Rowell and Connelly 1051, 2012).

There are responses to information asymmetry in the secondary market. Agents and insurers dominate this list. Agents, as in a realtor when buying a home, help provide further information about the product and more samples for you to choose from. The limitation for agents is that they may be unavailable for inexpensive goods. The positive of this limitation is that it would never be true for buying a car or a home, so the product being purchased is most likely not a life changing purchase. Insurers provide information

to reduce losses, such as car insurance. Again, the limitation is few inexpensive consumer goods are covered.

To counteract information asymmetry from a policy point of view, Vining and Weimer suggest a varying list of public interventions. The most direct is consumer education (Vining and Weimer 1988, 295). An agency would decide what information should be revealed to consumers. This would be provided through some form of advertising or means of distribution. The limitation may be that the selected agency is facing the same information asymmetry that the consumer is facing. In this case, capital would be spent and no one would necessarily be better off. One of the suggested interventions may be able to help control for both the agency and consumer facing information asymmetry. Regulation of the content being advertised may help to limit advertising for specific products. Here, deceptive or false pretense and tactics would be restricted so that the information being conveyed is accurate and cannot be taken out of context.

The highest rate of inefficiency is present when there is a dual market failure, or when information asymmetry is combined with a public goods problem. Any one of the interventions can be utilized to reduce the presence of information asymmetry. This analysis was done from a policy point of view, and can be decomposed to a more granular level. It would be interesting to see what it would take to provide interventions to the smaller consumer goods. Vining and Weimer stated that these consumer goods are so small they are not covered by insurance or have their own agents. A certain level of insurance on a personal line of credit or on a home improvement loan may help reduce the probability of default. Inadvertently, this would be another form of screening.

Hughes et al. contributed to the literature involving the relationship of information asymmetry and the cost of capital. This important relationship demonstrates how the presence of asymmetric information can affect a firm's expected return. In neoclassical theory, risk premiums are determined by exposure to systemic risk. In other words, it is the product of betas and risk premiums on systemic risk factors. Knowing what these factors are and if they are beginning to become real is imperative to pricing in the correct amount of risk premium. Information risk will create a bias when creating these premiums and when estimating risk-return ratios (Montavani 2011, 146). A firm can diversify away some of the risk factors by reducing concentration risk. Focusing too narrowly on one specific market will leave the firm incredibly vulnerable to the movements in that specific market (Hughes et al. 2007, 706).

Hughes et al. show that for large economies, private information about systematic factors affects factor risk premiums, and it will not have an effect on individual firm betas. Further, *ceteris paribus*, factor risk premiums increase as information asymmetry about these systemic factors increases. High (low) measurement of information asymmetry leads to high (low) cost of capital. This is holding total information constant, for measurement sake. An important feature of their information model is the private signals are informative about systemic factors as well as idiosyncratic shocks (Hughes et al. 2007, 707). This follows the work of Seyhun (1992), Lakonishok and Lee (2001). This particular information model can be viewed as a foundation for the Easley and O'Hara (2004) model.

Even though the context for the work is of investing in nature, the intuition provided by Hughes et al. is complementary to previous literature and can be applied to

other areas concerning information asymmetry. If less is known about which direction the market or economy is moving or going to move, firms must price this into their product offerings, either through the interest rate being charged or some other sort of advance. While Hughes et al. discussed the relationship of investors to firms; the same thinking can be applied to consumers and producers, or borrowers and lenders. Hughes et al. conclude that a more in depth look into the effect of information asymmetry at the aggregate market level could contribute invaluable knowledge. The difficulties in modeling anything economy wide however, is that the movements or shocks are exogenous in nature.

Easley and O'Hara further the relationship between information asymmetry and the cost of capital for firms. It comes down to information being treated as a good, and whether or not that good is public or private. Those that are able to attain a higher degree of private information will demand a higher return. Quality and quantity of information affect asset prices within the firm while in equilibrium (Easley and O'Hara 2004, 1553).

The main scope is the idea that the greater the uncertainty about the assets value (we can spin this to be a potential borrower), the greater the risk premium (Easley and O'Hara 2004, 1562). In our scenario, the potential borrower may be forced to pay a higher interest rate or supply some form of collateral. This is quiet similar to how the investing market would price in the risk. The premium paid to the investing firm or investors is a direct relationship between the amount of information known, how comfortable the people doing the investing are with the information given, and what kind of returns are to be expected. From a consumer standpoint, the less we know about the

portfolio as a whole moving forward, the more we have to price into the structure of the loan contract.

Easley and O'Hara graph the expected returns given one risky asset and one riskless asset in an economy in equilibrium, *ceteris paribus*. They label this the efficient frontier for a specific trader. The relationship is between mean returns and standard deviations for this pair of asset characteristics. When the trader is exposed to more private information, there is more precision. The expected value depends on what information the trader has received (to become more informed) and what the uninformed traders infer from price (Easley and O'Hara 2004, 1556).

Figure 2 from Easley and O'Hara (2004, 1576) diagrams the efficient frontiers for both informed and uninformed traders within their model. Since the informed trader knows more about the asset, he faces a lower risk-return tradeoff. X^I and X^U represent the average portfolio choices for each informed and uninformed trader. We see the uninformed traders optimal level is lower than the informed, because the uninformed trader faces greater risk holding the asset (Easley and O'Hara 2004, 1557). If we observe two firms that are identical, except for the amount of private information, we will see that the expected return per share is higher for the firm with more of the private information.

If we knew more about a particular asset or knew where to find out more information, we would expect to earn more and would want to pay less in regards to a risk premium. We swap investors for analysts in our scenario. The more we know about the portfolio the better we are able to analyze the health and credit quality of the portfolio. If we have missing data or people were extended credit without a thorough

credit review and underwriting, then we have the potential for the yield of the portfolio drop.

How information is collected and communicated to the market is a common theme amongst the literature. The Securities and Exchange Commission is in charge of what is disclosed and to what audience. Some suggest that more regulation on what is disclosed during initial public offerings and to specific analysts might help bridge the gap between uninformed and the informed. It is not the goal to reveal everything about a company. This would take away the competitive advantage firms have over others. It would be beneficial to the market as a whole to expose just the right amount of information.

An interesting discussion is raised by Easley and O'Hara regarding the number of analysts. One analyst can forecast what direction the value of the asset might move, and whether or not to take a long or short position dependent on this direction. However, many analysts with a combined averaged forecast should be more precise (Easley and O'Hara 2004, 1573). At minimum, they will collectively raise questions about the given situation. One analyst can inspect the portfolio and forecast the movement in overall credit quality. In risk management, multiple analysts can raise questions as well as average out the movements of the portfolio. Predictive performance metrics such as month-on-book and credit score migration are of importance for analysis.

Homes et al. looked at the possibilities of improving access to credit. They cite the difficulties that can arise when an individual transitions from being on welfare to working. Transportation is one of the biggest issues. They cite that without access to transportation, this transition can be close to impossible. The same can be said about

getting access to new credit. Their study analyzes how to cost-effectively provide access to credit to those who might not qualify had they gone to a brick and mortar establishment.

In the context of information asymmetry about credit history or credit tendencies, *ceteris paribus*, those with an established relationship with a bank are severely less likely to default (Holmes et al. 2005, 329). Their analysis focused on welfare recipients who did not have access to credit, and how a relationship already established with a bank improved their access. They attempt to tackle a conundrum: if income cannot be obtained without transportation, and transportation cannot be obtained without income,³ what is someone to do when they cannot have access to credit? Holmes et al. show that a relationship with the bank would help alleviate this issue.

They cite a fine line with granting credit to welfare recipients or those who have just been removed from welfare. Asymmetric information between the lender and borrower can lead to excess demand in conventional credit markets (Stiglitz and Weiss 1981, 393). Price rationing may lead to a situation of adverse selection. If the bank raises interest rates to include the risk premium demanded by information asymmetry, the average riskiness of the borrower will increase. Those who are credit worthy understand that they can get a better deal elsewhere, and will move on. Those remaining are riskier, and because the bank is always searching for more customers, will lend to this population. A bank optimal interest rate will be used that is below what is needed for the market to be in equilibrium, but above what is required to reach the profit per dollar lent.

³ They are specifically talking about rural areas, where carpooling and public transportation are not efficient (Holmes et al. 2005, 330).

The 2005 paper by Holmes et al. is inspired by Akerlof's work. We see without the bank optimal interest rate the good credit would be completely driven out of the market. It will take some form of intervention to overcome the barrier that the welfare recipients face to prevent this from happening. Commercially available credit scores are heavily relied upon in the consumer credit markets as a way of judging consumers credit worthiness. Those who do not have a relationship with a bank already will most likely not have the established credit history required to obtain access to new credit.

Holmes et al. analyze the various factors that were considered in the loan approval process. They analyzed a pool of applicants in the Working Wheels, and broke their analysis out by grouping those who had credit scores and those who did not. They show that income and debt to income are significant when it comes to the approval process for both groups of applicants (Holmes et al. 2005, 341). Expected bankruptcy severely reduces the likelihood of obtaining a loan, even if there was documented credit history surrounding the bankruptcy.

When there is no credit history, Holmes et al. find that age and gender play a significant role when deciding credit approval. The impact from age is to be expected. The older an applicant is, the more likely they are to have experience in some sort of credit, or are more mature and can handle the responsibility of payments. These supporting characteristics can be easily observable at the time of application. A simple check of the driver's license will help mitigate some of the presence of information asymmetry. Holmes et al. also find that being female helps somewhat when applying for a first time loan, specific to the Working Wheels program.

Default is the ultimate determinate of whether or not the loan officer, underwriter, or automatic decision tree made the right decision when granting credit. Twenty-five percent of the approved clients without a credit score defaulted on the car loans granted by the Working Wheels program, compared to the thirteen percent that defaulted that had a credit score (Holmes et al. 2005, 344). They concluded that the months of the relationship play the most statistically significant role in determining the probability of default amongst these Working Wheel's borrowers.⁴

Information asymmetry at a firm level can be troublesome to signal. If you already have accomplished the screening process for a customer, and they want another product within the bank, you know their payment habits for the first product they hold. Once paired with a credit score and internally generated scorecard that demonstrates the probability of default, the lender will have a much better picture of the borrower compared to a new customer.

Berger and Udell demonstrate that small firms seeking financing are better off when they already have an established relationship with the bank (Berger and Udell 1995, 352). Their reason for this analysis was the other theories of informative advantages by banks. Loan interest rates should decline as the relationship lengthens. Similarly, collateral requirements will decrease.

Francis et al. built upon the literature on relationship banking and added a focus on entrepreneurs. Innovation can lead to exciting revelations, and startup companies can be some of the most analyzed and scrutinized in the banking sector. Innovation can be

⁴ Or any relationship. Previous applicants had a reduced probability of default in both samples.

difficult to finance in an open competitive market. Their financing problems arise primarily because of information asymmetry (Binks and Ennew 1996, 18). Lending to a new company, or an individual who is working to patent his latest idea and build around it, may have a tough time getting access to credit.

They show that innovation and patenting activities can directly reduce the presence of information asymmetry between the borrower and the lender (Francis et al. 2012, 160). Patenting requires an extensive amount of work, and through the process, an individual has to reveal a lot of information about oneself to the patent office. This information can be obtained by the bank during the application and screening stages.

If a particular applicant is in the process of patenting an idea or invention, the possible completeness of credit histories can be extensive. They are both young and coming into their first needs of credit, or established at one firm and are seeking to branch out and create their own path. Francis et al. find that the patenting benefit generally reduces information asymmetry problems and borrowers with better-patented innovations benefit from a lower cost of debt and better loan terms (Francis et al. 2012, 160). Future cash flow will benefit from these innovations.⁵

Banks who are heavily involved in innovative financing (as Francis et al. call it) face varying levels of information asymmetry, leading them to end up charging a higher loan spread. It becomes imperative that innovating firms or individuals seeking credit mitigate the information asymmetry that may be present. Patenting activities are a positive way of mitigating this issue. It is because this activity is an output of innovation

⁵ If someone is innovative now, she can expect to earn greater cash flow in the future. The better term and cheaper cost of the debt will further add to this positive cash flow.

activities that this can have an effect on the presence of information asymmetry (Francis et al. 2012, 181). Reducing the cost of debt can be critical to future cash flows. This can be a guessing game early on; someone cannot be sure of the exact amount that will be financed. Reducing the amount of asymmetric information, which will theoretically reduce the loan spread and the risk premium that is priced in the loan structure, will save dividends down the road as the firm expands monetarily.⁶

Francis et al. ties in with the literature on the cost of capital. Reducing the cost of capital can help free up profits for the firm, whether it be the innovative firm with patents pending, or the lending institution such as a regional bank. Relationship lending can be beneficial here as well. Private information can be revealed throughout the relationship, such as payment tendencies or desire to open more accounts with the lender.

Adverse selection, and conclusively Akerlof's idea of poor credit driving out good credit, comes from credit rationing in various financial markets.⁷ Lenders must execute some scale of credit rationing, or else everyone would be able to obtain credit. This would quickly take all markets out of equilibrium. Supply would skyrocket, quickly outpacing demand, pricing banks out of the equation. If this were coupled with a severe increase in defaults, the banking industry would move to near collapse.⁸

Stiglitz and Weiss take a closer look at credit rationing in markets with imperfect information. They reinforce that some form of credit rationing is required. This may even occur in equilibrium. Those who are lending are concerned about interest rates, and the

⁶ Or 'Lemon Premium'; coined by Akerlof (1970).

⁷ For a complete discussion on adverse selection, see Vercammen (2002).

⁸ The defaults would most likely be worse. Supply would slow when those that are left without credit are those who do not need or think about it. Defaults would cause the most damage to a bank's balance sheet.

rate the bank assesses on the customer may affect the riskiness of the pool of loans. This can be done by the sorting of potential borrowers, or affecting the actions of borrowers.⁹ Both of these effects derive from the residual asymmetric information that is present after the lender has evaluated the loan applications (Stiglitz and Weiss 1981, 393).

Stiglitz and Weiss' graph demonstrates the existence of an optimal interest rate that the bank should charge to maximize profits (Stiglitz and Weiss 1981, 394). This graph is similar to a bell curve, where beyond a certain point it is no longer profitable to continue raising interest rates and will be experiencing diminishing marginal returns. Since banks are not able to control the actions of the borrower, the bank must construct the loan such that the borrower will act as the bank prefers (Stiglitz and Weiss 1981, 394).

Increasing the interest rate will increase the rate of return, but beyond the bank's optimal rate, the rate of return will begin to decrease. This concept demonstrates credit rationing. Supply and demand help make up the structure of the loan in the particular market, but we can see where this concept may degrade. There may be excess demand, and unsatisfied borrowers would offer to pay the higher interest rate to the bank, thus bidding up the rate, until supply equals demand (Stiglitz and Weiss 1981, 394). However, the bank will not accept the higher interest rate because these borrowers may be perceived as higher risk.

Here is a supportive example of how information asymmetry could drive good credit out. Someone who is beyond credit worthy may have been turned down, and feeling discouraged, exit the loan market. This process would continue until there

⁹ This is often referred to as the 'Incentive Effect'.

becomes a market inefficiency. Some argue that the very fact that someone who wants a loan could not get a loan already dictates that a market inefficiency exists.

The discussion on screening is furthered by Stiglitz and Weiss. Banks will use interest rates as the screening device. The assumption is that banks have internally identified groups of consumers who they feel are good and bad risks. The interest rate charged to these groups reflect this decision. The return the bank can expect to make becomes a function of the interest rate charged (to a good or bad group of risks), if some sort of collateral was tied to the loan, and the probability of success with the project being borrowed for (Stiglitz and Weiss 1981, 396). This project could be in the form of a small business loan, mortgage, or an entrepreneur seeking funds for a patent and development of a project.

From this relationship, the expected rate of return of a loan to the bank becomes a decreasing function of the riskiness of the loan. There is a direct effect of increasing the interest rate to increase the return to the bank. There is also however, an indirect, adverse selection acting in the opposite direction, which may outweigh the direct effect (Stiglitz and Weiss 1981, 397).

One of the many theorems covered by Stiglitz and Weiss is the effect of collateral. We can view collateral as another screening device. Those who cannot provide some form of collateral will be deemed riskier, and may not be approved for a loan. Because of this, requiring collateral for a certain group of borrowers will increase the return to the bank (Stiglitz and Weiss 1981, 404). However, there may be another adverse selection effect when the collateral requirements are increased. This effect follows the same characteristics of increasing the interest rate on the return to the bank.

Information asymmetry is in part because of the principal agent problem.¹⁰ The principal and agent relationship has been present throughout history. The return function described by Stiglitz and Weiss is applicable to any situation where there is some form of transaction. This can be traced back as early as mercantilism. Where the risk falls is important in this relationship. Fixed-fee contracts in credit markets may impose a heavy risk on the agent (borrower). If the agent is risk adverse, they may not be a desirable borrower for the bank. Stiglitz and Weiss point out a faulty assumption that is used when designing these fixed-fee contracts. There is no guarantee the agent will repay, even if the project return and the value of collateral outweigh the amount to be repaid in the loan contract (Stiglitz and Weiss 1981, 408).

The sharing of information is thought to help alleviate the presence of asymmetric information. This sharing could be between the borrower and the lender, the bank and another bank, or the government and an institution. Information associated with default is considered black information. Sharing information may not always lead to economic advances. An increase in lending may accompany this sharing (Dell'Ariccia and Marquez (2006), Pagano and Jappelli (1993)). This lending boom will eventually peak, resulting in the loosening of credit requirements to find more borrowers in an already saturated credit market.

At first crack, it appears that sharing borrower information will benefit all firms involved. Credit bureaus help by providing a credit score that lenders can use to determine how a borrower might perform over the life of the loan or the line of credit.¹¹ It

¹⁰ For a complete discussion on the Principal-Agent theory, see Eisenhardt (1989).

¹¹ Section III will elaborate.

is believed that this will limit the adverse selection problem. If we know more about a borrower, the lender could screen less at application, and can use these resources towards other borrowers who they do not know as much about. Dell'Ariscia and Marquez (2006) conducted an analysis that ultimately shows how increased sharing of information may water fall into a credit crisis. This is in contradiction to much of the literature presented. Reducing information asymmetry is thought to help all involved, but the idea that it may deteriorate lending standards warranted further investigation.

Dell'Ariscia and Marquez begin by studying a credit market in which banks have information on some borrowers, and these borrowers are in two groups: known and unknown. To distinguish these two groups, banks will use collateral to screen for good or bad borrowers, or choose to not use collateral as a requirement. Information asymmetry will be present and will provide the incentive to screen the applicants (Dell'Ariscia and Marquez 2006, 2512).

They show that when the amount of unknown grouped borrowers is relatively low to the total population, banks will screen using a higher collateral requirement than if the number of unknowns is low. This is apparent when the credit market becomes saturated. Those who needed a loan already have one, and were credit-worthy to begin with. Since there is less credit worthy borrowers to keep expanding the credit market, the bank may seek out those who do not necessarily need credit, or who were previously rejected by the competition. This eventually leads the proportion of unknown borrowers to become high (high information asymmetry), and to continue expanding profits banks will screen with no collateral requirements. This is the basis for Dell'Ariscia and Marquez's explanation of the deteriorating lending standards.

Reducing collateral will help raise profits by undercutting competitors in the credit market (Dell'Ariscia and Marquez 2006, 2512). As the competitors switch to the same profit earning technique, collateral standards lower, the credit box expands, and the probability of a banking crisis increases. Dell'Ariscia and Marquez state that there is a positive relationship between reduction information asymmetry and the likelihood of a credit crisis, as well as a tradeoff between overall output and banking stability (Dell'Ariscia and Marquez 2006, 2513).

The interaction between banks revolving around informational creates an intriguing link. The relationship is formed by the market structure, aggregate amount of credit in the economy, bank portfolio quality and profitability (Dell'Ariscia and Marquez 2006, 2524). This relationship is crucial for understanding the role information plays in determining aggregate economic well-being. Information or cost structures are able to change any of the four mentioned by Dell'Ariscia and Marquez.

Banks by nature will have some degree of uncertainty even before the introduction of information asymmetry. This is noticeable in maturity transformation, which is when the bank takes its short term deposits and turns them into long term loans.¹² Maturity risk arises out of this transformation. The bank has uncertainty of the amount of deposits it will have on hand to facilitate the maturity transformation.

Dell'Ariscia and Marquez's model assumes banks have potentially unlimited liability, and that they will fail if profits fall below zero. This makes it simple to model the way in which banks would stay alive. Keeping profits above zero is the goal of the

¹² Think mortgages.

model, as the lending boom begins to happen. Again, as lending increases, the proportion of unknown borrowers increases. This expansion of lending also increases the banks' exposure to the cost of capital (Dell'Ariccia and Marquez 2006, 2525).

In the model presented by Dell'Ariccia and Marquez, information plays the be-all-end-all role. Information creates the very banking model that it helps support, and has the power to send it into crisis. It is interesting to note that this literature came out before our most recent recession in 2007. Most economists agree that there was a loosening of credit standards, particularly in the housing industry. Mortgage backed securities were built off the glut of mortgages. When banks needed more borrowers to keep up with the pace of growth and expansion, they started lending subprime loans and exotic products. These went into default, and the securities that were propped up by the mortgages fell through as well.

We know the cause of the recession of 2007, or at least agree the general area in which it started. It would be interesting to see if the sharing of information played any part, particularly if the model proposed by Dell'Ariccia and Marquez holds up in the real economy. It may not be beneficial to share granular data, rather aggregate performance data amongst peers.

Pagano and Jappelli support Dell'Ariccia and Marquez stance by stating expanding information and sharing between institutions could hurt bank profits, and move the industry closer to a crisis. They began their research by presenting a model of adverse selection, and studied where information sharing arose endogenously (Pagano and Jappelli 1993, 1693). They modeled in an environment where lenders could share

information between each other, and the amount of information exchanged depended on reciprocity. This creates an incentive for lenders to participate.

Pagano and Jappelli initially state that sharing of information could lead to increased competition within the credit markets, improve efficiency in the allocation of credit as well as the volume of lending (Pagano and Jappelli 1993, 1694). This sharing may also lead to policy implications.

The model they present is a great compliment to Dell'Ariscia and Marquez because they use historical international data and supports Akerlof's idea that those with good credit or are deemed as a 'safe' borrower have the possibility to get priced out of the market. When this happens, the volume of lending will increase to fill the void and keep profits on par. This will lead to more information sharing as more borrowers enter who were previously unable to do so.

It can be argued that the incentive to create such a means of sharing information (what we know as a credit bureau) is greatest in a developing country where lenders face large amounts borrowers where they have limited information. Here, competition welcomes the sharing of information to make it easier to shield the institution against poor credit quality. It is observed, when the country becomes developed beyond a certain point, that there is no longer the strong incentive to share information, and it becomes a competitive advantage to not share. Information sharing creates a natural monopoly. It is not cost effective for lenders to try to share information across each other's platform, so a central database or repository institution is set up to facilitate the exchange and distribution of information.

Pagano and Jappelli's model shows there can be situations where increased sharing of information does not necessarily lead to increased lending activity. This increase in activity happens when the good quality borrowers exit the market due to adverse selection. Here is where the possibility of a credit crisis arises. The increase in lending is to the less credit quality borrowers because the 'safe' borrowers have been priced out. Even though the lender may have performed the same vetting process as if the borrower was of good credit quality, the probabilities of default will still be higher.

Today's credit bureaus take the form of an oligopoly. In the United States, we have a few bureaus that make up the credit scoring market. This should not be challenged, as it would be inefficient to have multiple credit bureaus. Data and information on the borrowers would become mixed, and the consistency of metrics would be diminished. One company would dominate a certain aspect such as credit scoring, while another would be better at collecting past defaults or bankruptcy's.

Chen contributes that it is not enough to only require collateral from customers, and that screening must be used. The cost of screening can be lowered by liberalization of the entire banking market (Chen 2005, 109). Removing the barriers to entry can be done by reducing information asymmetry. This lack of initial customer information hinders any new lending institution. The bank is more susceptible to the movements of the collateral pricing if they do not perform screening.

Becoming dependent on the asset valuation can become costly and lead to increased exposure if the direction of the asset values reverse. When the prices are inflated (deflated), customers borrowing ability increases (decreases), leading banks to lend excessively (rationed). If the asset prices fall sharply, banks' credit-portfolio

performance worsens and the customer's liquidity risk increase. Chen describes this as the ideology for his logic behind screening being superior to simply requiring collateral. Removing barriers to entry would thus lead to a stabilization in the relationship between bank performance and asset price changes.

Marquez models and demonstrates that reducing information asymmetry can increase the odds of positive profits on *new* loans and entering an existing market (Marquez 2002, 918). How you handle the loans already on the books will determine the profit ability and yield on current loans. If you can extend these profits to create new book volume, overall profit margins will rise. Marquez supports the position that information asymmetry causes a barrier to entry for new banks.

Similar to Chen, Marquez suggests that if a new bank does not add enough aggregate capacity to the market, increasing the number of these banks may force interest rates up. This is caused by the decreased in efficiency of screening applicants, resulting in the push on interest rates. Since the bank is not as efficient at screening as its larger competitors, there is more necessary risk based pricing built into the structure of the loan.

Hoff and Stiglitz discuss the size of the community, which can be modeled as an economy, in a discussion about rural credit markets. The size of the community can lead to more or less information asymmetry. The larger the size of the community by number of people, the more information asymmetry there will be, and vice versa (Hoff and Stiglitz 1990, 237). The people in the small village are easily able to observe each other, so someone who lent land or money to another villager can know what is going on with what they lent. This is not possible in large modern economies. Banks have no way of observing the people they lend money to, and thus cannot observe characteristics that

may affect their probabilities of repayment. They cite how the advances in theoretical understanding of credit markets help bring light to disconnects that exist from imperfect information.

They discuss how the interest rate lands at the equilibrium that it does. Freimer and Gordon analyzed this concept early on. They show that there will not be infinite demand created for the credit that is offered with higher interest rates. In other words, you cannot expect borrowers to simply accept the higher interest rates (Freimer and Gordon 1965, 415). The bank would like to charge the highest rate possible, while the customer wants the lowest. This helps the equilibrium form. Even if all the good borrowers become priced out of the market by higher interest rates, it does not make sense for the banks to continually increase the rates. At some point, the rate becomes so high that the poor credit borrowers are guaranteed to default (Hoff and Stiglitz 1990, 239). They attest to Adam Smith:

If the legal rate... was fixed so high... the greater part of the money which was to be lent, would be lent to prodigals and profectors, who alone would be willing to give this higher interest. (Smith [1776] 2007, 279)

The increase in defaults and the losses from these borrowers will severely outweigh the gains from the risk premium charged to the consumer. This builds off Stiglitz and Weiss earlier work.

One of the most important ways of limiting and reducing information asymmetries is by purchasing information (Hoff and Stiglitz 1990, 244). This ties in with the barriers to entry idea proposed by Chen. One of the biggest barriers is acquiring a base of information on customers in a region and being able to market and properly lend

to them. If you reduce this barrier, there can be more entrants. How do you remove a barrier that must be purchased (the information proposed here by Hoff and Stiglitz)? It is a sort of chicken-egg scenario on which would be able to happen first. Banks spend an incredible amount of energy and capital on screening applicants. If that were to be reduced, other market participants could enter and set up operations at a much more feasible cost.

Keynes first introduced the difference between borrower and lender risk and why the relationship is so important (Keynes 1936, 144). Stigler takes this relationship and importance and applies it to the credit and capital markets. He builds out a scenario where the borrower may not be entirely truthful, even with themselves. If the borrower is unsure of what his habits and repayment probabilities will be like, that will not bode well for the lending institution. It is not cost effective to try to acquire information that would allow the lender to classify the borrower into a more homogenous risk class (Stigler 1967, 291).

This creates an interesting interpretation of risk. The borrower may be uneducated about risk factors and credit scores, and may believe she is more credit worthy than the bank is leading to believe. On the other hand, the bank understands the risks involved much more than the borrower. There will be a spread between what the borrower perceives as risk and what the lender thinks is risky. Stigler points out that this contributes to the inefficiencies of markets (Stigler 1967, 292). Writing during the height of the post-Keynesian era, Stigler shows that it is important to begin to think about how to improve the efficiency of markets, especially the credit and capital markets.

Stiglitz worked with Rothschild at the apex of his attempt to show the effects of information on our understanding of the economy. They specifically focused on a market

where the characteristics of commodities are not fully understood and how the costs of communication and imperfect knowledge would affect the market reaching equilibrium. Their analysis was focused in the context of a competitive insurance market. They state that the concepts can be applied to any principal-agent scenario (Rothschild and Stiglitz 1976, 629),

High-risk individuals create an externality in the market, impacting the population seeking insurance or having insurance. Low risk individuals would be better off if these high-risk buyers would exist the market (Rothschild and Stiglitz 1976, 629). Because there are high-risk individuals, risk premiums are increased. This has a negative impact on the low risk bucket of buyers who would otherwise enjoy a lower risk premium.¹³

Competition in markets with these information characteristics does exist, and an equilibrium may be reached. Pareto optimal fee structures need to be related to the risk attitude of the principal (borrower) and the agent (banker) (Shavell 1979, 56). However, there may be strange properties surrounding the equilibrium, and it may not be Pareto optimal. This can lead to a further question of whether or not true equilibrium exists, and if the market is competitive. Economic theory says that as long as the market is competitive, then equilibrium will be met. How are we able to say the market is in equilibrium if the participants are not acquiring the exact product they entered the market for? Here is a direct impact of information asymmetry.

Dell'Araccia gives insight from the point of view for the borrower, in particular those who are stuck with one bank because they cannot signal their quality to other

¹³ Over the long run, the cost for screening would decrease, thus further reducing the negative externality brought upon by the high-risk individuals.

competitors. This situation applies to borrowers with weak credit histories. Since they were approved with one bank, they must stay with the same bank that they first got a credit product with. This locks them into a bank-client relationship that could force them to pay a higher interest rate than they could in a competitive market place (Dell'Ariccia 1998, 4).

Dell'Ariccia gives credit to the power of information asymmetry and its effect on the credit industry by stating it is the defining characteristic of the credit markets. There is a lending-by-learning experience that happens when banks enter the market. Some argue this is just another addition to the long list of barriers to entry. As banks lend, they learn proprietary information about the borrowers. A way to reduce the barrier to entry of a particular region is to acquire a lender in that area. It may not be beneficial for the bank to try to set up operation, in say the North East, if they are a southern bank. However, if they acquire a smaller regional bank that already has a presence, it will make for an easier transition to that region.

Banks face an enormous sunk cost if they were to enter a market and acquiring information is expensive (Dell'Ariccia 1998, 18). Economies of scale play an important role. Lending to small firms involves a higher cost per dollar borrowed per unit of information. You may expend bountiful resources to acquire and validate the same information of a small firm, as you would have done for a large firm.

Dell'Ariccia's contrasts his later work by saying that reducing these barriers to entry would help increase competition. He summarizes by showing the effect of information would be threefold. First, the competition for borrowers already deemed credit worthy would increase. Decreasing competition for new borrowers would follow.

Finally, information barriers would fall, leading to more competition as institutions are free to enter and exist as they wish.

The literature presented highlights the areas asymmetric information effects within the banking industry. The majority of these areas can be classified by valuation that is assessed and assigned. We are concerned with the risk premium that is assigned to the potential borrower at the time of origination, as well as the downstream effects on risk management. Section three will highlight these principals.

3. Risk Management

Banks want their portfolios to perform well. This requires low delinquency while originating new loans with quality credit. The teams that overlook these portfolios perform an array of analysis on how the portfolios are trending. The umbrella that covers these various teams makeup risk management.

It is important to understand the trends of the portfolio. If too many customers begin to become delinquency on their loans, the bank may become short on revenue needed to sustain day-to-day operations. This is an extreme example and would take a large number of people to offset how much money banks earn. To some degree it has happened in the past, as recently as 2007. Caused from the housing bubble, large banks were on the brink of collapse, and a few filed for bankruptcy and where dissolved. Others were bailed out by the federal government. These banks were thought of as ‘Too big to fail’.

If the team performing risk analysis can understand what is happening early enough, there may be time to correct the particular business actions within the bank to avoid such an event. Risk analysts rely on internal data representing the portfolios owned by the bank. It has become useful to compare internal characteristics to those throughout the industry. This data is often provided by Equifax, Experian, or the Risk Management Association and is an aggregate meant to help show how the industry is doing.

Internal data is the pillar of risk analysis. The data is generated at origination when the customer applies for the loan. Servicing and performance data¹⁴ is gathered

¹⁴ Also referred to as behavioral values.

over the course of the life of the loan. Attributes such as payment schedule and pre-payment habits impact portfolio performance.

The bank, ideally wants the best credit quality customer, or at least someone who will not default. The loan officer will pull a credit report for the new customer, and ask various questions about monthly income and expenses. Someone coming to the bank for either a mortgage or line of credit is going to want the best interest rate possible, and end up paying the least amount of money in interest. Based on these characteristics, the customer will pay the rate offered by the bank.

Information asymmetry is present in this initial process. It mirrors the buyer-seller and principal-agent scenario presented earlier. Here, the buyer would be the bank not knowing everything about the product they are purchasing, even if they have properly screened (the new customer not revealing everything to the bank). Even though it is the bank doing the selling of a product, the bank must be on the offensive because they need to know more about the customer than the customer particularly needs to reveal.

In literature published just before our most recent credit crisis, Pesaran et al. discuss credit risk and how it is the dominant source of risk facing banks. The legitimacy of this claim was solidified following the events that occurred a few years after publication. To build upon credit risk analysis, Pesaran et al. propose a model that helps show how global macro-econometric models can be linked to firm specific return functions, thus assisting each firm in realizing they can increase profits under various economic conditions (Pesaran et al. 2006, 1212).

Their goal was to help firms detach themselves from the current business cycle, and determine their own unique business cycle. The notion of separating out the firm from the economy separates Pesaran et al. from the previous literature on credit and portfolio risk. This helps demonstrate the effect of macroeconomic factors such as worldwide asset prices, oil prices, and interest rate spreads changing over a given time period. They conclude by calculating firm specific default threshold-equity ratios. This allows the modeler to require two pieces of publicly known information: market returns and credit ratings (Pesaran et al. 2006, 1213).

When modeling credit risk, management is concerned about the properties of the loss distribution of a given credit portfolio. The portfolio can be anything from mortgages to commercial loans, or bonds and stocks. You can have two views: a loan-by-loan basis or the total return to the entire portfolio or yield.

Probability of default and loss given default are two variables that are important to understand and monitor. Pesaran et al. point out that they are not explicitly conditioned on business cycle variables. We know that losses are greatest during a recession. They cite that capital reserves should be twenty-five to thirty percent higher during a recession compared to an expansion (Pesaran et al. 2006, 1216). To overcome the same information asymmetries that the previous literature presented, they use a credit rating of a firm in their model.

The point of using the credit rating is that these agencies have access and incorporate some form of private information that otherwise would not be exhibited to typical consumers and firms. Public information such as balance sheet size, assets and expected profits play a role in calculating the credit rating. Pesaran et al. are able to

calculate default threshold-equity ratios by utilizing credit rating bands (Pesaran et al 2006, 1220).

The individual firm default-threshold model allows you to come to a few conclusions. First, the lower the credit rating, the smaller the default threshold is. This does not mean that immediately the bank is close to default, but the threshold is small in terms of how much the returns on capital lent can drop. Second, the more volatile the equity returns, the more likely the firm may cross the threshold. If the firm is confident in the expected return, it better positions itself for a reduction in the portfolio return, thus having a larger threshold. The opposite holds true if the expected volatility of the returns is high. Third, the higher expected return, the farther the firm is away from default.

Credit risk has become the subject of intense regulatory oversight and policy debate. This increase in scrutiny comes in the wake of the Great Recession and the passage of the Dodd-Frank Wall Street Reform and Consumer Protection Act.¹⁵ Basel II, which was initially published in 2004, had been amended and extended since the recession to further strengthen capital requirements of banks and the cadence for which banks were to be tested (Sarma 2007, 3364). It set to create a positive relationship between the amount of risk a bank faced and the amount of capital it would be required to hold. The goal was to sustain a bank through stressed economic scenarios while safeguarding its liquidity and stability.

Basel II was implemented just before the crisis, with amendments and changes coming after. When Basel III was being discussed and negotiated, the information behind

¹⁵ Commonly referred to as 'Dodd-Frank'.

the crisis was at the leading edge of all relevant discussions. The idea of ‘Too big to fail’ was not holding much water in the eyes of regulators and economists. Banks were required to increase their risk management presence in the aftermath of the crisis. This was accompanied by increasing capital requirements per risky assets, modeling to understand how much reserve capital is sufficient, monthly and yearly submissions for Comprehensive Capital Analysis and Review (CCAR), and building out a risk management culture that would help oversee all of the new regulations.

Dodd-Frank was enacted as well as multiple additions to Basel II to help ensure that a crisis like this will never happen again. Strict regulations coupled with increased risk management presence will help banks understand the requirements for capital in the occurrence of another banking crisis. ‘Living Wills’ are submitted every year to the Federal Reserve to make sure that banks are complying with the regulations. Those who do not pass are given strict rules to quickly follow up and make the necessary changes to comply.

One of the many ways banks conduct their risk analysis and management is by creating and maintaining internal credit scorecards. These scorecards are developed through data gathering and analysis in a statistical package such as SAS or MATLAB. The scorecard generally provides a probability of default of a customer. Typically, the higher the customer falls in the scores range, the less likely they are to default.

Scorecards do not necessarily have to be limited to default probabilities. They can be designed to attempt to give some sort of quantitative estimate to any other type of behavior, including delinquency, bankruptcy, or pre-payment. Default and bankruptcy are the worst situation for both the borrower and the lender. The borrower’s credit score will

be damaged and the lender will miss cash flow. If the lender is able to determine how the customer may act given certain situations that arise, credit metrics, or characteristics that the lender can observe, the bank will price the risk into the interest rate, minimum monthly payment, loan term, or collateral conditions. All of this is possible if the bank is able to observe these credit characteristics. If there is information asymmetry and the borrower is not revealing all relevant information, the bank may be short on pricing in the risk and may lose more money than originally reserved.

Siddiqi examines the need for increased efficiency in modern scorecards. Risk managers are now tasked with producing risk assessment that adequately preserve losses while minimizing the per-unit processing cost. All of this needs to be accomplished while keeping in mind the turnaround time for the customer. The cards need to be robust enough to handle all of this processing. They are no good if they turn down borrowers who are creditworthy but for some reason the card did not bucket them accordingly.

The increase in movement towards in-house scorecards undoubtedly comes from the advancements in computing technology. Data mining can be done internally rather than sending data to the scorecard vendor. This reduces costs immediately, and can be coupled with the savings from the reduction in infrastructure needed to compute these cards.

Segmentation is a tactic for bettering the performance of a scorecard (Siddiqi 2006, 3). The segmentation reveals new information about the borrowers that may have not been sighted before. Analysts can further delve into the data points and come to refined conclusions (Siddiqi 2006, 4). This compliments Easley and O'Hara's view that more analysts can cover more data points, and at minimum will raise more questions

amongst each other. This creates a deeper knowledge base within the risk management culture.

Some example characteristics are demographic, existing relationship with the bank, credit bureau statistics, and real estate data. The bank can observe these at the time of application and during the underwriting process. The more characteristics that can be collected and used as input into the card can increase the accuracy and efficiency of the decision. The observable metrics are the characteristics, and the actual values are attributes. Each attribute is assigned points. Across the characteristics, the attributes sum to the final score for the customer. These points are generated through statistical analyses (Siddiqi 2006, 7). You can use these breakouts to create a spectrum for your bad loans, and see which attribute or group of attributes leads to the highest percentage of overall losses. Siddiqi labels these as bad loans, and they are usually classified by those who are characterized as bankrupt, fraudulent, delinquent on their payments, and charged-off loans.

Siddiqi stresses the importance of pairing these scorecards with other bank policies. A well-executed origination strategy will increase revenue by including more borrowers that may have otherwise been declined. Now that the bank is lending to the correct borrowers, they should see the overall credit quality of the portfolio increase. This will decrease losses, furthering the increase in revenue.

Huang and Scott continue the discussion of the scorecard and stress that it is the foundation for credit risk management. They point to how it is important to carefully design and validate modern scorecards. The scorecards may appear to perform quiet well on the development sample and the validation sample, but deteriorate dramatically once

deployed in production (Huang and Scott 2007, 2). You can create a number of scorecards for the duration of the products lifetime. Application scorecards are used to see how new customers may behave in the future, given a set of characteristics that are observable. This allows you to see how your through-the-door population may perform. Performance scorecards have the limitation that they only are based off data obtained from *approved* borrowers. You do not know how the borrower performs with a competitor.

More recently, credit institutions have been able to build out the suite of scorecards to model for abuse of available credit, liquidity risk and becoming overburdened with debt (Huang and Scott 2007, 2). Risk managers could turn to rejected inference techniques. There is a shortage of conclusive evidence around this technique especially in discussions on its effectiveness for determining expected lifetime losses and profitability.

Huang and Scott performed a root-cause analysis to find the reason why the performance deteriorated when sampled on an out-of-time or production sample. These are real borrowers who were accepted. They found that the difference comes from the validation sample being taken before the card goes live, and that when the card is set into production, there are possibilities for policy and lending habits to change. If you were able to see what customers you declined and how they perform at other institutions, the new scorecard would be able to adequately reflect these characteristics.

These scorecards are used to assign customers to classes or buckets based on the values produced by the card. Thresholds are designated to determine an acceptable level of risk for the given characteristics. Hand explains the difference between simply taking

action on those borrowers beyond the threshold, and applying a multiplier to the action based on how *far* they are from the designated threshold (Hand 2005, 1109). The scorecards use plenty of retrospective information and assign values based off this information. No weight is given to numbers that may be misclassified or misrepresented. Irrelevant information may degrade the performance of the scorecard (Hand 2005, 1110). Once this is coupled with information asymmetry surrounding the borrower at application, doubt is cast upon the statistical significance and validity of the scorecard.

Hand proposes a different way of judging the validity of a card. You want to be able to group the borrowers accurately so that the truly bad are turned away and the medium risk are charged the correct premium. Unfortunately, only the passage of time will tell what happens. Once you have performance data of a group of applicants who were accepted you could see the predictive properties of the card. He refers to this as the ‘bad rate amongst accepts’ in his model (Hand 2005, 1111).

Risk managers should use current performance data to judge previous scorecards, and use the knowledge gained from the process when developing in the future. They should look at the proportion of applicants who were above the threshold, accepted, and ultimately went bad. You can even breakout the ‘bad’ by the severity of performance. This can include delinquency of varying lengths, default, and foreclosure (if the collateral is secured by a property, dwelling, or automobile). This will give a full view of how the scorecard performs. You may notice that those just above the threshold are the most common group to go bad, so maybe the credit policy needs to be adjusted to exclude those in the future.

Determining the threshold is critical to implementing an effective scorecard. One ratio to use is the cost of ‘goods’ to the cost of ‘bads’, or C_G / C_B , with $C_G + C_B = 1$. This fundamentally compares the money the bank makes off those that were accepted and are performing well versus those that were accepted and are now delinquent or worse. The bank will take a loss on these bad customers. This ratio helps determine which scorecard and which threshold to set into production. Hand suggests using the Gini coefficient to help determine which threshold to set, since the future performance is unknown (Hand 2005, 1113).

The Gini coefficient measures the inequality amongst variables of a given distribution. Gini made this measure popular when discussing incomes amongst various groups. We can apply the variance in the metrics to the credit portfolio. If a certain bucket of borrowers is having a high Gini coefficient for becoming delinquent on their loans, we would want to look deeper at that specific group.¹⁶

Banasik et al. look to identify *when*, not if a borrower will default. They take the worst-case scenario point of view. The reasoning is that someone’s credit status must be thought of as dynamic rather than static (Banasik et al. 1999, 1186). It can change valuation as the borrower progresses through the life of the loan. This validates the importance of ongoing performance monitoring.

It is here that information asymmetry can reemerge and distort the findings from the scorecard or monthly risk analysis. In a best-case scenario, the lender obtained a good amount of information from the borrower at the time of application. This is not always

¹⁶ For an application of the Gini coefficient, see Wretman et al. (1988).

the case, as we have demonstrated there may be a gap in known information. As time goes on, the borrower's habits and credit situation will change. This can be partially countered by utilizing refreshed bureau data.

Viewing credit this way can lead to estimating when the borrower will go delinquent and the lender can begin to figure out profitability over that estimated period. You can estimate how many loans will go bad in a given time period, and adjust the loss reserves accordingly (Banasik et al. 1999, 1185). Based on the results of the estimation, the structure of future loans can be structured based on how well certain credit characteristics perform, and when they are expected to go into default.

A lot can be accomplished by thinking of credit status as dynamic and understanding that scenarios change. You can look for predictive characteristics, such as debt to income (DTI) and high loan to value (LTV) ratios. You could analyze past borrowers who had a high LTV and low monthly income to see if they become delinquent sooner, and how many move into a worse credit status from there. If there is a striking number who do, the lender can tighten the credit policy to remove these borrowers from being accepted in the future.

Malik and Thomas explain the importance of following macroeconomic trends when performing ongoing monitoring on a credit portfolio. They state that there is a positive relationship between the default intensities of the credit portfolio and the movement of key macroeconomic factors (Malik and Thomas 2010, 411). They stress the importance of studying and attempting to score whether a borrower will go default within the first year. Bad loans are classified as going ninety or more days delinquent (missing up to three or more cycles of payments or bill statements).

Using application and behavioral scoring in tandem can generate a significant view into the likelihood of default of borrowers. Behavioral scoring can be thought of as capturing the idiosyncratic risk of the borrower. Malik and Thomas contribute an addition to the Cox Proportional Hazard model that incorporates macroeconomic variables to influence the scorecards to the real world factors (Malik and Thomas 2010, 413). The factors they include are forecasted out one year ahead of application and approval. It is important to realize this difference from currently measured factors. They are worth having knowledge of now, but if you want to predict who will default within the next year, variables such as the unemployment rate, inflation, and asset prices of all classes need to be forecasted. For their model, Malik and Thomas use four variables: Percent change in consumer price index, Sterling inter-bank lending rate, average yield in the stock market, and growth in gross domestic product.

The methodology behind these variables is concerned with growth. They measure the consumer price index to demonstrate a tightening on a consumer's buying power. A growing stock market may lead to an increase in purchasing of financial products, taking away from consumer credit products. A positive sign of any of the coefficients indicates the increase in the risk of default (Malik and Thomas 2010, 414). They decided to discard the unemployment rate because there is a consensus that changes in employment conditions does not have the instantaneous effect on default rates,¹⁷ and thus would not affect their model's one-year default window.

¹⁷ See Figlewski et al. (2007) for the complete model and discussion. This paper also influenced their weighting for the hazard model.

Malik and Thomas support Banasik et al. by stating that the scorecard and the relationships that help model the probability of default for given customers changes over time. They further add that because of this dynamic banks should include macroeconomic variables and vintage analysis when designing the scorecard. A figure depicted by Malik and Thomas presents supporting evidence for including the vintage variables (Malik and Thomas 2010, 414). From their dataset, we see the highest probability of default is within the first twenty-four months, and trends downward overtime. The addition of these variables allows you to get point-in-time probability of default estimates.

Im et al. also agree that credit status is dynamic and adjust the proportional hazards survival model to incorporate time dependencies (Im et al. 2012, 306). Economic factors are included to make their maximum likelihood logistic regression model time dependent. This falls in line with the literature for bettering the significance of default probabilities and their estimates.

One important variable that Malik and Thomas did not include that Im et al. considered is the movement of interest rates. This can have an immediate impact on the repayment abilities of some borrowers. This will especially affect those with high outstanding balances on variable rate loans. Accounting and modelling for the Federal Reserve's decisions to move interest rates will further add to the impact the time dependent proportional hazard model presented by Im et al. will have.

The structure of debt on a bank's balance sheet matters for future performance. Banks with more unused credit lines have less cash and lower equity, but have greater overall investment. At some point, you may see line utilization percentages increase, but

this depends on exogenous factors that are not under the banks control. A bank with more term loans will have more cash and investment with lower equity risk (Liu 2006, 296).

Data quality and governance is the backbone that forms risk management cultures. We see where information asymmetry will affect data and what that implication can have on downstream processes. A bank will never know everything about a borrower. However, if you include the right exogenous variables you can better model and interpret a specific portfolio. We have now established the relationship information asymmetry has with credit risk management, and proceed to the impact. This will be accomplished using the theories and ideas presented in section two and the areas of risk management here in section three.

4. Impact

We now have a complete narrative of the possible affected areas in banking from information asymmetry. We see how encompassing imperfect information can be. Banks perceived to be sheltered from exogenous shocks may be able to position themselves for protection. This can only be done once they understand what may affect them.

Perfect information is unattainable. Risk management will help a bank understand where its portfolios stand. Analysts will criticize every possible credit metric and data point. When there is lack of data the analysis can degrade. False conclusions may be reached and there will be downstream consequences. It begins with the performance of accepted loan applicants. These can be individual consumers or a small business, with the credit products ranging from basic lines of credit to the funding needed to start a new small business.

The breakdown in information knowledge between the lender and the borrower, created by the principal agent problem, begins at application. If the bank knew perfectly how this customer had performed in past with regards to repayment of credit, the bank would be able to charge the appropriate interest rate, require the correct amount or form of collateral, and the term of the loan may be more favorable to what the customer originally desired. Instead, we see the bank pricing in the risk premium into the term of the loan, as well as the interest rate being higher. Banks will bucket customers into groups that are predetermined by how the bank thinks they will perform. These groups collectively get charged a pooled interest rate. This is meant to reduce the screening costs associated with the new applicants. If banks can reduce these screening costs, they will be able to improve the bottom line.

The term of the loan is equally important as the interest rate. If the borrower is perceived to be riskier, either by commercially available credit scores, internal lending relationship, or some other form of shared black information, then the loan term will be shortened. The intuition here is that the bank does not want a risky borrower on the books for too long, giving them less time to go delinquent. Shortening the term to maturity, or equivalently the amount that is allowed to be drawn on a line of credit, will help reduce the risk exposure of this bucket of borrowers.

Fraud may be detectable through performing risk analysis, and a new trend in reverse occupancy fraud is worthy of discussion. This is a situation where an applicant for a mortgage states the property will be used as an investment property, but they are using it for their primary residence. The borrower is able to list the 'rent' proceeds as income to qualify for the mortgage, when in fact they themselves are living at the property.

There are risk metrics that can be used to spot this activity. These include a large commitment and liquid assets held by the customer coupled with a large down payment. The borrower may be a first time homebuyer with little or no established credit (Fannie Mae, Mortgage Fraud Program Alert). A red flag should appear when there are such significant liquid assets and the borrower has weak or no established credit.

Lenders must be careful for these situations, because if the loan is fraudulent, they may take a complete loss on the deal. Underwriting is the best line of defense, and carefully examining where the assets come from. It is important to use verified income rather than stated. A borrower may improperly state on the application the monthly

income he or she earns. Using a W-2 form or recent payment records are a more reliable source of information.

If the correct information is known about the borrower, this activity could be halted during the underwriting process. However, if there exists asymmetric information where the lender does not know the credit history of the potential borrower or the source of the liquid assets, this should raise suspicion for the underwriter.

Risk analysis performed on booked and declined loans could help spot these activities on accounts where fraud has already taken place. This work can be used to design a high-risk scorecard around potential fraudulent borrowers. We see here one of the impacts on risk analysis from information asymmetry. Neoclassical economics would say to buy this information, either from a bureau or from other banks. While it is possible to buy information from a credit bureau, it is not currently a policy practiced in the United States. Even from the bureau, it may be difficult to gather the characteristics that would help predict or spot something like reverse occupancy fraud. Fannie Mae points out that it is people with minimal credit history.

Changes in accounting for losses are expected to be implemented by 2021. This is a move by the Financial Accounting Standards Board, and is updating standards around losses and charge-offs to a Current Expected Credit Loss model. This will require the reporting of expected risk in addition incurred losses. The impact will be on the allowance for loan and lease losses (ALLL or 'A-triple-L'). Banks will need to work to reduce information asymmetry to comply with the expected portion of this requirement.

Another impact is apparent when performing root-cause analysis. This is a method of problem solving used for identifying the root cause of a problem (Andersen

and Fagerhaug 2006, 5). At a lending institution, this can be performed on a credit portfolio to discover why the overall credit is deteriorating or the yield on the portfolio is declining. Once performed, the analyst may realize that the delinquency on the portfolio is increasing because a certain demographic of borrowers is becoming late on their payments. They could have had low credit scores at origination. Further analysis reveals that they also had a lot of other outstanding debt, and may have not fully qualified for this product. The loan could have been granted because the product guidelines have not been updated to the new credit metrics. We have found two reasons here why the credit quality of the portfolio has declined. Updating the guidelines companywide will ensure that everyone is adhering to them when granting credit and that low scoring, high debt carrying individuals do not get the same product.

Having improper or incomplete information could lead to a false conclusion. If the bank did not have the credit score on this borrower, or the knowledge that they carried other debt, they may have concluded that it is the product guidelines. The bank would then change these guidelines, under the false pretense that they are not strict enough. This would lead to reduced profits.

Internally generated risk scores are directly affected by the presence of information asymmetry. Banks use these techniques to come up with the risk score, and it is based off current customer data as well as historical behavioral characteristics. If the bank assigns the incorrect rating to a certain group of borrowers, this will only further the problem. Analysts will be looking in all the wrong corners for why the number of approved loans are going down. The analysis being performed will not be optimal if there is a presence of imperfect information. This can have a cascading effect for risk

management. Bank policies are modeled after this data, and if the incorrect assumptions are being made, then credit policies will be adjusted in the incorrect direction, causing the bank to screen out the wrong candidates.

We can see Akerlof's idea of bad credit driving out good credit when you look at the situation from this perspective. The bad credit coming into the bank is bad for a reason. It may be that they have a history of late payments, default, or minimal credit history. This causes the bank, as we have seen, to charge in a risk premium for the unknown, and is driven by the missing information. We do not assume perfect information in the financial industry when it comes to extending credit. A market failure arises because of the bad driving the good out of the market. This alone will likely never be enough to allow complete failure of a credit or capital market. Nevertheless, Akerlof's idea is now visible in the consumer credit market.

Lenders now know the consequences of information asymmetry and the effects on risk management. Risk is not isolated to just one department within a bank; it is spread throughout. Managing this risk becomes everyone's job. Management must work across cultures to bring together one complete risk view.

This is one of the steps to dissolving the effects from information asymmetry. People know information will not be perfect and you cannot possibly get every bit of information out of a borrower. How you structure your credit and origination policies will have a direct effect on the outcome of the bottom line. Policies and credit standards need to include verbiage or some metric to give value to the information that is not disclosed. Implementing macroeconomic variables as Malik and Thomas did will help when analyzing the credit strength of a portfolio. These variables will have a clear effect on

scorecards. When performing a root-cause analysis, it is beneficial to look at exogenous factors facing the bank. To give an example, this may be the reason why management is noticing an uptick in delinquency rates, but not necessarily bankruptcies.

It is important to capture all the relevant credit metrics at origination of the loan. It may not tell a story at that point, but further along analysts will benefit from having more complete data points. Often, credit bureau scores come in a file, and contain the individual attributes. Leverage these attributes into the modeling process and scorecard development for increasingly superior views. Even if you are not concerned with modeling, these attributes can be another analysis point for management to look at.

Scorecards also need to be robust enough to change more frequently. It is not effective to have an outdated scorecard. With today's available automation of data mining and scheduling, it is easy enough to set up a process where all the analyst needs to do is update the parameters. Huang and Scott demonstrated the advantages of having an adequate scorecard, and Hand reinforces the necessity for tracking the performance of accepted loans. The quicker steps like this can be taken care of, the faster validation can begin. This is especially important when a new credit product is going to be introduced, deployed, or changed. You may have to revamp the card more frequently in the early stages of the product.

Consumer's credit status is dynamic and changes over time. Banasik et al. demonstrate the importance of modeling and performing analysis on the portfolio while holding the credit status dynamic rather than static. This will culminate to a more complete risk management presence that reduces the consequences of information asymmetry. We can learn a lot about a consumer by analyzing how they use credit over

time. From this analysis, we can determine those customers that should and should not be cross-marketed.

The processes that are vital to risk management will be affected. This will directly reshape metrics such as risk-adjusted rate of return, loan-loss reserves, and yield of owned portfolios. How these variables perform lead to decisions by management will and future policy implementation. Credit policies will be also affected based on the information being collected.

5. Concluding Remarks

This paper examined components of information asymmetry, and identified the negative consequence on risk management within consumer credit markets. The observable credit characteristics of the potential borrowers matter to the performance of the bank. Whether or not the borrower had to secure some sort of collateral will affect the risk premium they ultimately pay. Credit scores, internal policies, scorecards, and analysis play an important role for grappling with the effect of information asymmetry. Analyzing credit status in a dynamic state can further assist the analysis.

Further research should focus on the yield of a portfolio in the presence of information asymmetry. Now that we see where it can effect risk management, the next step would be to see the monetary effect. It would be interesting to try to quantify the effect asymmetric information has on the charging-off of loans. Studying banking relationship data along with these charged off loans might reveal a positive relationship between the two. The longer the established relationship with the bank and number of relationships would likely lead to a sharp decrease in the annualized net charge-off rate. It would be interesting to see, holding that the borrower is acting rationally, if it is possible for the borrower to disclose all information, as there may be a situation where it favors the borrower not to.

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