EXPLORING THE POTENTIAL MACROECONOMIC IMPACTS OF BRANCH BANKING PRACTICES

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Computer Science
June 2014
School of Computer Science
Reykjavík University

M.Sc. RESEARCH THESIS

ISSN 1670-8539

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Research thesis submitted to the School of Computer Science
at Reykjavík University in partial fulfillment of
the requirements for the degree of
Master of Science in **Computer Science**

June 2014

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Abstract

The role that the internal structure of a Bank's ledger, in particular the interaction between ledger operations between its branches and internal rules governing lending plays in determining local lending limits has been generally ignored in economic analysis.

Typically modern banks use a branch banking structure where several branches, in different catchment areas, operate under a single general ledger. We suspect that internal branch banking practices and modern regulatory frameworks are a possible cause of a disparity seen in empirical data from Iceland for 1997 - 2004, which show lending and liability deposits growing slower outside of the capital area than inside it. In this thesis we explore this possibility through a series of simulations, focusing on the impact of a hypothetical branch lending restriction, where a branch is restricted to not lend more than its deposits.

The result of this thesis indicates that internal restrictions surrounding branch banking can contribute to disparities in monetary expansion between catchment areas. The simulations are performed using a double entry bookkeeping level banking simulator Threadneedle, within a simplified economic model in order to isolate the behaviour of the banking system. This may provide an explanation for higher real estate prices being observed in the financial capital in countries where branch banking is dominant and branch banking head offices are concentrated. The general conclusion of this work is that branch banking has been underexplored and needs to be revisited in the light of its interaction with modern regulatory frameworks.

Skoðun á Mögulegum Þjóðhagslegum Áhrifum Starfsháttа Útibúabankakerfisins

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Júní 2014

Útdráttur

Það hlutverk sem innra skipulag höfuðbókar banka, einkum samspil bókfærsla milli útibúa og innri reglur útlána, spilar í að ákvarða svæðisbundin útlán hefur almennt verið hundsuð af hagfræðinni.

Venjulega nota nútímabankar útibúabankaskipulag þar sem nokkur útibú, á mismunandi svæðum, starfa undir einni höfuðbók. Okkur grunar að innri starfshættir útibúa og nútíma regluverk séu möguleg orsök mismunar sem sést í gögnum frá Íslandi 1997 - 2004, sem sýna að útlán og innlán vaxa hægar utan, en innan höfuðborgarsvæðisins. Í þessari ritgerð skoðum við möguleikann á þessu með hermilíkönum, með áherslu á ímyndaða lána takmörkun, þar sem útibú eru takmörkuð til að lána ekki meira en innlán.

Niðurstaða þessarar ritgerðar bendir til þess að innri takmarkanir í útibúabönkum geta valdið misræmi í aukningu fjármagns milli áhrifasvæða þeirra. Hermilíkönin eru gerð á bankahermi Threadneedle byggðum á tvíhliða bókhaldi, innan einfaldaðs hagkerfislíkani til þess að einangra hegðun bankakerfisins. Þetta getur verið ein af skýringum þess að það er hærra fasteignaverð í fjármálahöfuðborgum í löndum þar sem útibúabankar eru ríkjandi og höfuðstöðvar samþjappaðar. Almenn niðurstaða þessarar ritgerðar er að útibúabankar hafa ekki verið rannsakaðir nægilega og þarfnast frekari skoðunnar vegna samspils þeirra við nútíma regluverk.

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Chapter 1

Introduction

The banking system is a fundamental part of the economy, however its internal structure and behaviour is for the most part unknown, and is not well defined or documented. For individuals and businesses the extension of credit, and associated expansion of the money supply by the banks can mean success or failure. The way banks make those decisions, long term, can have a macroeconomic impact. This can be seen clearly when there is a banking crisis, like the Icelandic financial crisis in 2008, where banks seem to have been quite risk prone in their lending. Understandably the focus is often on those complete systematic failures and not the effect of banking, internal structure and behaviour, during "normal" operations on the economy.

In this thesis we examine the internal structure of banks, and in particular how a form of banking known as 'branch banking' is organised and behaves. Using empirical data on branch lending and deposits from the Icelandic banking system, in conjunction with computer simulation we explore the behaviour of internal rules used by banks. The currently available method of considering a single monolithic ledger for entire banks, based on the publicly available quarterly and annual reports, is perhaps too simple and inaccurate. In reality even small banks consist of several branches with individual ledgers and decision making, each with their own catchment area, serving a local economy.

Can the internal structure of banks, specifically branch banks, cause disparities in the expansion or contraction of liability deposits of its catchment areas?
Is the principal cause of this disparity branch manager decisions, acting rationally, based on the internal rules of the branch banks?

We will investigate branch banking specifically, rather than undertaking an analytical explanation of the entire banking system, to see if its structure and behaviour can have a

macroeconomic impact. To achieve this we will conduct simulations of branch banking and analyse empirical data, focusing on possible causes of the disparity in deposits and lending between different catchment areas in Iceland.

There appears to have been very little attention paid to the economic role of branch banking in studies on the banking system, and there is remarkably little recent literature on branch banking. The work that has been done seems to date from two periods: 1900 - 1920 and 1955 - 1965.

There are several recent papers which have applied high level analysis (DEA) on branch efficiency; one such paper Camanoho (1999) uses the number of employees, floor space, operational costs, and number of ATMs for predicting[7]. These inputs are likely to have a spurious relationship with at least these two output variables; value of savings and loans. Their main result is that "It was found that branches' effiency has a positive effect on profits, although high profitability is not necessariliy directly related to high efficency".

Camanho (1999) provides a list of published application of DEA on branch banks is in [7]. Most of the inputs and outputs listed are likely to have a spurious relationship, and many of the papers have only a few data points 14 - 68. The DEA method does not take into account the behaviour of the branch manager, internal rules, or the fundamental level of banking.

One often overlooked resource for banking research in general are late 19th and early 20th century bank bookkeeping manuals, since bank accounting is its own specialisation. "Bank Bookkeeping and Accounts" by Meelboom (1904)[19] is one such manual, which includes information on branch banking, another is "Practical Bank Operation" by Langston (1922)[14].

It is difficult to find data for individual branches deposits and loans, since that level of detail does not seem to be required or provided in the branch banks reports. For 1997 to 2004 in the Financial Supervisory Authority, Iceland (FME) reports[1] we have a seemingly rare glimpse into branch level data for the Icelandic branch banks, Arion, Íslandsbanki and Landsbanki[2] (Appendix A). We use this data to show actual loans and deposit figures for branches in Iceland, segregated into catchment area groups. The data for this period shows a behaviour change within the branch banks in Iceland. Head office starts lending

[1] Explanation of the term FME reports used throughout this thesis can be found in section A.2

[2] Due to name changes of the branch banks, we use their current names to simplify discussion. A more detailed description of this naming convention can be found in section A.1

far more than they had before, and within the capital area and outside we find a noticeable difference in both lending and deposit growth.

There appears to be weak circumstantial evidence for branches trying to keep more deposits than loans, i.e. deposit restricted[3].

We offer a possible explanation based on a suspected branch lending restriction, where a branch is required to have more loans than deposits, while the larger bank is operating according to Basel capital regulation. The result of this is that the head offices have the ability to lend more, and seem to have done this in Iceland 1997 - 2004. This restriction is a simplified version of the internal lending rules and mechanisms branches may actually follow, with possible origins in older regulations such as the gold standard[4], where asset cash was more important as a part of regulatory control. Information of the restriction comes from discussions with members of the Icelandic banking community and the existence of it, or at least a variant, is supported by the FME reports. This restriction is defined in section 5.0.1.

In order to explore the potential effects of this rule we use a double entry bookkeeping simulation framework (Threadneedle[5]) to create a number of experimental simulations of branch behaviour, under different conditions such as different interest rate spreads between branches. A theoretical blind branch manager is described in section 5 and used as a comparison, to explain why a branch manager would follow internal restrictions on his lending, as well as make decisions that negatively affect his catchment area.

The result of these experiments point to branch bank internal rules having a potential effect on macroeconomic behaviour, however this must also be seen in context of a complex and multifaceted system. Although we introduce and use the known branch mechanisms (chapter 4) of the banking system, this is not a full picture, and we leave out many important mechanisms such as interbank lending, the role of the central bank, and bond issuing by various sources. We would expect that these practices may also vary between banks and individual branches.

The conclusion of this work is that internal rules governing branch banking can impact the larger economy and in particular regional money and credit supplies. Consequently this topic needs to be explored and revisited in the light of the interaction with

[3] The evidence of deposit restricted lending and the difficulties with using this type of data to ascertain such as relationship is detailed in 5.0.1.

[4] Iceland was a participant in the Scandinavian Monetary Union, a gold standard, through its relationship with Denmark. Danish coinage act served as the foundation for Iceland, which set its own coinage legislation in 1925.[1].

[5] Threadneedle is a simulation framework developed by Mallett[17] it is described in section 6.1

modern regulatory frameworks, and deserves far more attention than it has hitherto been given.

Chapter 2

Motivation

Today (2014) we have personal computers that are able to calculate, and simulate a large amount of transactions each second. Quickly creating ledger entries that would have taken a bookkeeper a lifetime of work. With the introduction of the double entry bookkeeping simulation framework Threadneedle, we are able to develop and run banking experiments spanning several decades within seconds, using complete reproduction of all associated ledger transactions. It is this constantly improving capability of computers, software and more publicly available data, that allows us to build more accurate and larger models of banking and the economy at the fundamental level it operates on. This ability should be used more to further economics research.

2.1 Empirical Data

Empirical data from the introduction of fractional reserve banking shows that banking systems generally expand total liability deposits over time due to an excess of loan creation over loan repayment, as a result of the associated creation of liability deposits. If consequently lending is geographically unevenly distributed it may have far reaching economic implication for regional development. Figure 2.1 shows that Icelandic monetary expansion was not distributed equally amongst the branches of Icelandic branch banks. The branches shown in this figure are local branches divided into two groups inside the capital area and outside it, with the main branch and head office shown separately in figure 2.2.

We see in the tables in section A.3 that deposits at the local branches outside of the capital area approximately double between 1997 - 2004, while they increase by 2,5 times in the

capital area. This is is circumstantial evidence of higher lending in the capital area. This is then supported by the fact that lending in capital area branches increases 2,5 times, whilst outside it grows only by about a third. Since this data series excluded main branches, and special branches it is also likely that this is skewed to show less deposit and loan growth in the capital area, than in fact occurs.

This provides strong circumstantial evidence that the banking system is expanding money and credit supplies at a faster rate in the capital area, than outside of it. From this comes the inspiration to analyse the behaviour and mechanisms of branch banks, to see if their structure and behavior may be at fault.

During the period 1997 - 2004 there is also a behavioural change within the head offices of the three branch banks where they start lending more as a ratio of the total lending of the branch banks, going from 20% to 72% of total lending. Instead of local branches having majority of the lending, a single office becomes dominant, this is likely to have impact upon the lending decisions and affect the economy of Iceland.

2.2 Banking Basics

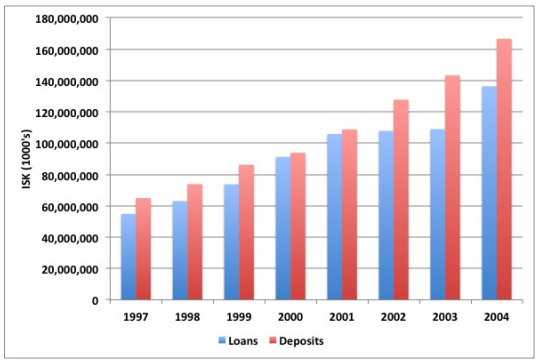
Understanding the behaviour of the banking system, is a critical challenge for economics in order to avoid unintended consequences and ensure desired features such as stability. The actual behaviour of current and past banking frameworks as a system, is poorly understood by many if not all. There are many reasons for this including a high degree of complexity, legal nuances, lack of publicly available data, and incorrect textbooks.

A common example of this is misunderstanding the role of deposit money in lending. When explaining the nature of Banks and financial institutions even the Althingi's Special Commission on the banking collapse gets the relationship between deposits and loans wrong, as we see in the following quote first in Icelandic then a true and faithful English translation by the thesis author.

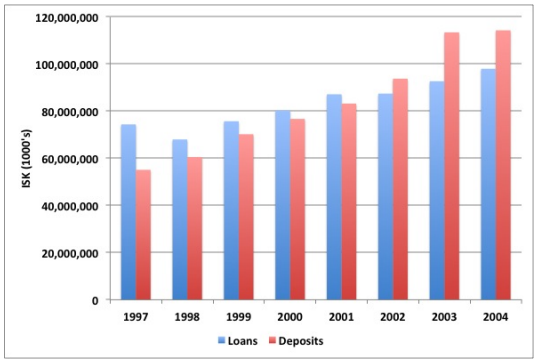
> "Í grunninn byggjast fjármálamarkaðir á sparifé almennings og fyrirtækja og það eru starfsmenn markaðarins sem sinna því mikilvæga og flókna starfi að greiða úr því hverjir geta lánað hverjum fjármuni til mismunandi langs tíma og á hvaða kjörum. Starfsmenn á fjármálamörkuðum þurfa

[1] Capital and Outside of Capital Area Branches 1997 - 2004. The data tables can be found in Appendix A.

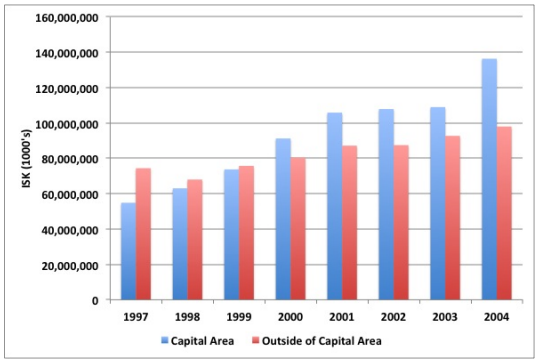
[2] Head office and Main Branch Branches 1997 - 2004. Arion main branch is only separate from head office in 2004, we include it in head office in 2004. The data tables can be found in Appendix A.



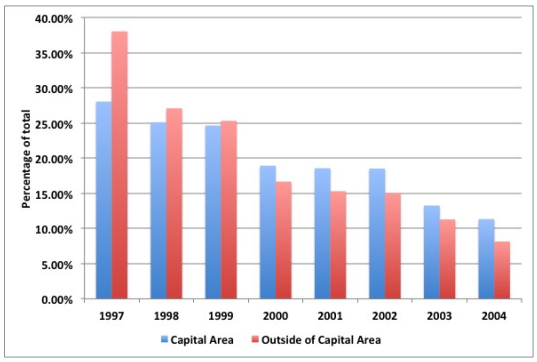
(a) Capital Area Loans and Deposits



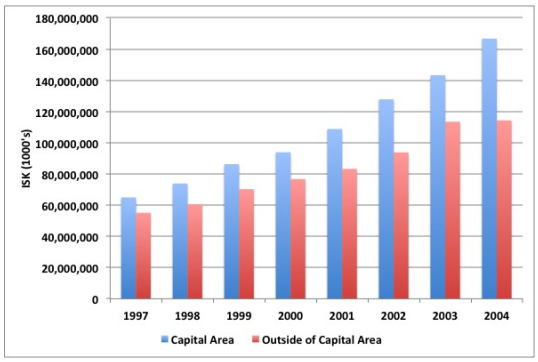
(b) Outside of Capital Area Loans and Deposits



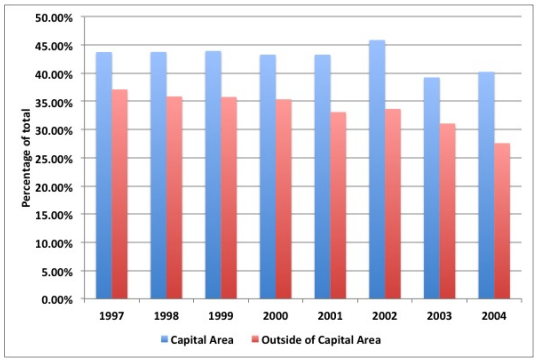
(c) Local Branch Loans



(d) Local Branch Loans Ratio



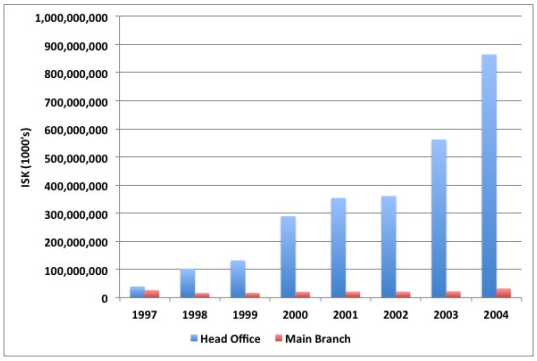
(e) Local Branch Deposits



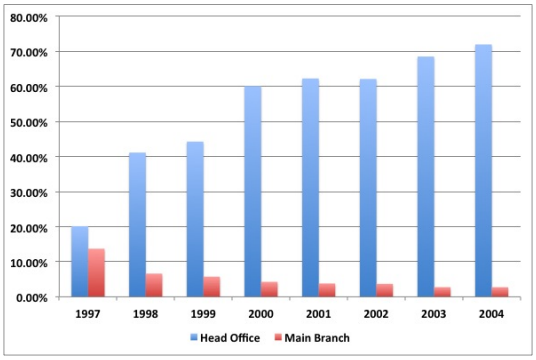
(f) Local Branch Deposits Ratio

Figure 2.1: Local Branch Groups Loans and Deposits [1]

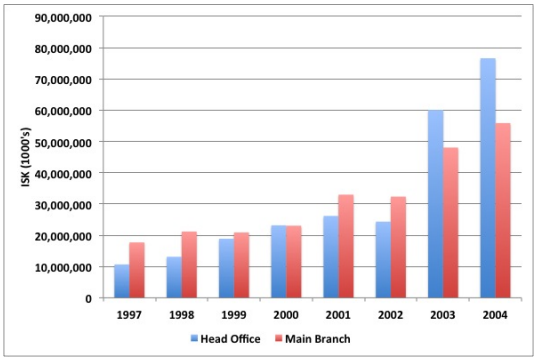
jafnframt að meta á hverjum tíma hvaða skuldarar geta staðið í skilum og leggja mat á hversu áhættusamar lánveitingar eru í ljósi þess hversu miklar líkur eru á að skuldararnir endurgreiði sparifjáreigendum. Það kemur líka í hlut starfsmanna að ákvarða þá vexti sem skuldararnir þurfa að greiða til að tryggja sparifjáreigendum viðeigandi ávöxtun og að þeir geti mætt skuldbindingum sínum í framtíðinni. Sá grunnur sem lagður er að starfi innlánsstofnana sem sýsla með sparifé almennings og fyrirtækja felur í sér að annar en eigandi þessara fjármuna tekur að sér vörslu og ávöxtun þeirra.



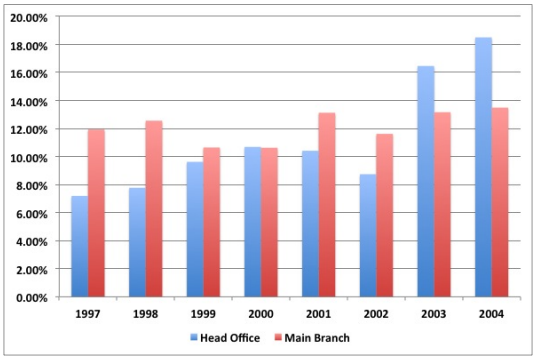
(a) Head office and Main Branch Loans



(b) Head office and Main Branch Loans Ratio



(c) Head office and Main Branch Deposits



(d) Head office and Main Branch Deposits Ratio

Figure 2.2: Head office and Main Branch Loans and Deposits [2]

Eigandi fjármunanna afhendir þá til vörslu í trausti þess að hann geti fengið þá að nýju þegar hann kýs eða hefur samið um. Eigandinn hefur hins vegar sjaldnast upplýsingar um hvernig bankinn stendur að vörslu og þar með notkun innlána til útlána eða annara viðskipta."[20](Page 50. Volume I, Section 3.2).

"The basis of financial markets are public and corporate savings and it is the employees of the market that perform the important and complex work of deciding who can lend whom funds of varying maturities and at what terms. Employees in the financial markets need to assess at each time which debtors can repay and evaluate how risky the lending is in light of how likely the debtors repay the depositors. It is also the role of the employees to determine the interest rates the debtors must pay to insure depositors appropriate yield and that they can meet their obligations in the future.

The bases for the workings of deposit money banks that work with the public and corporate savings involves that someone other than the owner of these

> deposits takes custody of them and their investment. The owner of the funds hands them over in the trust that he can get them back when he so chooses or has agreed upon. The owner has on the other hand rarely information on how the banks stores and thereby uses deposits to loans or other transactions."

This widely distributed and common misconception of the relationship between loans and deposits is perpetuated in much of the general economics literature, despite specialist knowledge to the contrary. This is probably one of the reasons for the issue of a recent explanation from the Central Bank of England[18], which plainly states that these textbook explanations are wrong, deposits are created through bank lending [18]. To further elaborate this point the ledger operations are provided in 2.1 and the double entry book keeping operations are provided in table 2.2, for the results of loan creation and repayment on a bank ledger. The bank starts with 200 in capital and customer 2 deposits money in a long term savings account. A loan of 1000 is given to Customer 1 (2.2b), the customer then repays 120 with 100 going to capital and 20 as interest payment (2.2c). The ledger level mechanisms for branch banking are described in detail in chapter 4. Notice how the measured monetary expansion (broad money) expands when the loan is made and contracts when a loan is repaid.

Operations		
1)	debit Loan Ledger	credit Deposit Customer 1
2)	credit Loan Ledger	debit Deposit Customer 1
	credit Interest Income	debit Deposit Customer 1

Table 2.1: Operations of Loan Creation

This type of deposit expansion was rapid in Iceland between 1997 - 2008. In figure 2.3. we see M3 per person in Iceland. The deposit money supply roughly doubles on a per capita basis, from 1997 to 2004, after which we see an even faster growth in deposits. Icelandic Krone (ISK) for each person living in Iceland goes from 660 thousand in 1997 to five million in 2012.

[3] **Please note:** definitions of money supply statistics can vary between countries.
Definitions of M0, M1, M2, and M3 from Central Bank of Iceland `www.cb.is/statistics/metadata/accounts-of-the-banking-system/`
M0: total notes and coins in circulation, and held as cash by deposit institutes.
M1: M0 in addition to demand deposits.
M2: M1 in addition to sight deposits.
M3: M2, in addition to time savings deposits.

[4] Population data from Statistics Iceland (Population by Sex and Age 1841-2014), M3 data from Central Bank of Iceland (Monetary statistic - Broad money)

Bank Inital

	Assets	Liabilities		Money Supply	
Loans	0	0	Deposit Customer 1	M3	600
		200	Deposit Customer 2	M2	400
				M1	400
Cash & eq	400	200	Capital	M0	400
Total	400	400			

(a)

Bank After Loan Creation of 1000

	Assets	Liabilities		Money Supply	
Loans	1000	1000	Deposit Customer 1	M3	1600
		200	Deposit Customer 2	M2	1400
				M1	1400
Cash & eq	400	200	Capital	M0	400
Total	1400	1400			

(b)

Bank After Loan Repayment of 120

	Assets	Liabilities		Money Supply	
Loans	900	880	Deposit Customer 1	M3	1480
		200	Deposit Customer 2	M2	1280
		20	Interest Income	M1	1280
Cash & eq	400	200	Capital	M0	400
Total	1300	1300			

(c)

Table 2.2: Example of Monetary Expansion through Bank Lending[3][15]

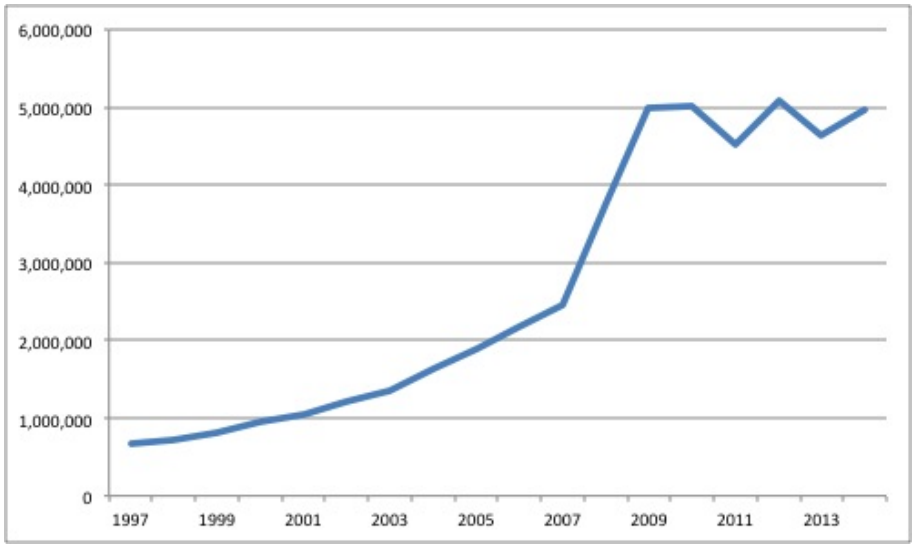


Figure 2.3: M3 in Iceland 1997 - 2014 per capita[4]

Figure 2.4 shows the broad monetary statistic for Iceland 1997 to 2014. There one can see that changes in base money (notes and coins in circulation) do not expand at the same

rate as liability deposits. From 1997 to 2009 an expansion of 9.5 times in deposits is measured. The period covered by the FME reports shows an almost threefold increase from 1. January 1998 to 1. January 2005. It cannot be assumed that this expansion was distributed equally amongst local economies in Iceland, we however only have branch level data up to 2004 and see only a portion of this rapid growth of deposit money at the branch level.

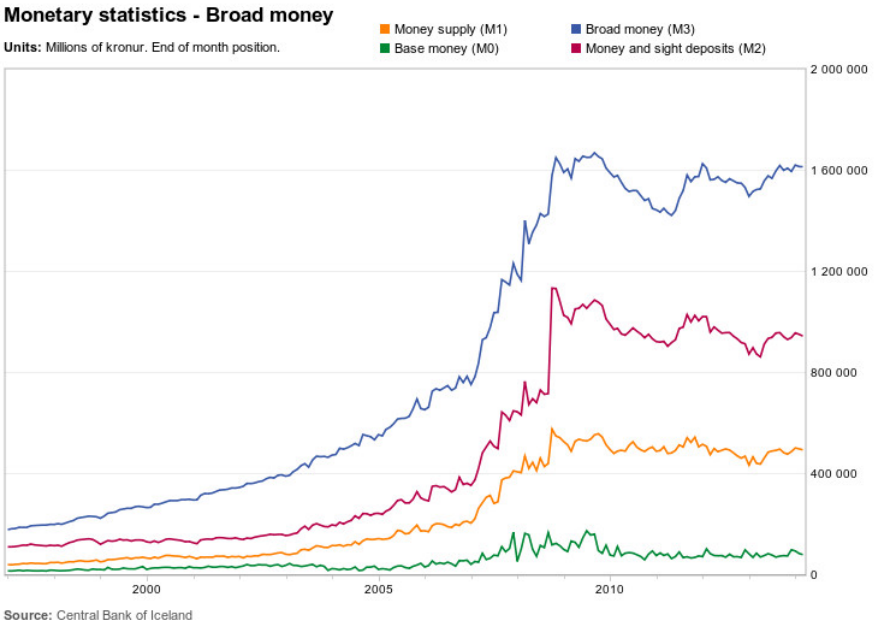


Figure 2.4: Broad Money (M0, M1, M2, M3) in Iceland 1997 - 2014[5]

[5] M3 data from Central Bank of Iceland (Monetary statistic - Broad money)

Chapter 3

Defining Branch Banking

We will begin by explaining the branch banking terms used in the rest of the thesis, and providing an overview of the double entry bookkeeping operations used. We start by explaining double entry bookkeeping (3.1), a system used to manage transactions within the banks, and business entities. It is the fundamental level at which banks operate which is why we use a simulation framework based on double entry bookkeeping, Threadneedle, as the tool of choice. Then as foundation to our branch banking definitions, basic banking concepts (3.2) are introduced, followed by branch banking concepts(3.3) definitions and explanations. A further description of branch banking features can be found in chapter 4 where a listing of fundamental branch operations (4.1) is shown, with a description of the double entry bookkeeping operations behind them. We end with a discussion on the purpose of branch banking.

3.1 Double Entry Bookkeeping

Double entry bookkeeping is a system to track transactions, by entering them twice, into appropriate ledgers, as a debit with a corresponding credit[19]. The ledgers are commonly called T-accounts, the collection of T-accounts then makes up the balance sheet of a company. Figure 3.1 shows an example of T-accounts. Small companies may have only 6 - 8 ledgers, large companies may have hundreds. Ledgers can be split into four categories depending on their nature: expense, income, assets and liabilities[6]. These ledgers are then entered into general ledgers at specific time intervals, every day or every month, which then shows the balance at a specific point in time.

The oldest record of Double entry bookkeeping ledgers is from 1340 in Italy; the oldest known treatise on the subject is "Summa de Arithmetica Geometria Proportioni et Proportionalita" written by Luca Pacioli in 1494. The oldest known law on double entry bookkeeping is from France 1673, which regulated merchants to keep books, publish a balance sheet every other year, and store supporting documents[6].

Cash		Capital		Balance	
Debit	Credit	Debit	Credit	Asset	Liability
100			100	100	100

Table 3.1: Example of T-Accounts cash handling

3.2 Banking

For the purpose of this thesis we will define banks as fractional reserve performing institutes, i.e. their lending creates a liability deposit through the mechanisms provided by double entry book keeping. We saw a simple example of double entry ledgers of a bank performing this type of deposit money creation through lending in table 2.2. The amount of money they can create through this process is normally restricted by a national regulatory framework. Older frameworks based on central bank reserve requirements have been superseded or added to by lending restrictions based on capital controls (Basel)[4], which in practice have never imposed absolute limits. If the bank is constrained in its lending it can increase capital from profits[16], or if it is reserve constrained borrow from other banks or the central bank[18].

To understand banking operating in different areas, especially branch banking, a definition is required to describe the areas they operate in.

Definition 1. *A **catchment area** of a bank, branch, or service point is the geographic area from which it attracts most or all, of its customers.*

Generally customers do banking where it is most convenient, although some may prefer to do their banking at other locations. The definition of a catchment area, is less useful, if it means the area from which all of its customers are derived. The simplest type of a bank is called a "unit" bank (figure 3.1). This definition is the simplest of all the definitions of a unit bank: if one allows the unit bank to have branches the line between branch bank and unit bank becomes arbitrary[1].

[1] An example of an unclear definition can be found on pages 23. in Banking by Somashekar, where a unit bank is described as having branches. In the same book under key terms (p.347) unit banking is described as a single bank with a single office[21].

Definition 2. *A **unit bank** is a "bank" that has only one service point[21].*

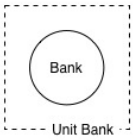


Figure 3.1: Unit Bank

Definition 3. ***Chain banking** a group of banks under some common control[8].*

The common control in the corporate structure of a bank chain can be as little as a single individual voted to the position of president, to majority ownership of banks in the chain[10]. A chain of banks is similar to a branch bank, shares many of its advantages, but each bank is usually operated separately. Interchange of funds between banks in a chain poses additional risk [8]. Transfers between banks in a bank chain, operated separately, are the same as if they were unit banks. An example of a banking chain in Iceland are savings and loans banks that were members of "Samband Íslenskra Sparisjóða (SÍSP)[2].

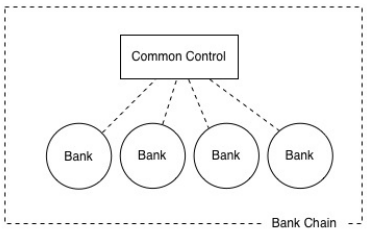


Figure 3.2: Bank Chain

3.2.1 Interest Premiums

Interest premium is the additional interest a customer pays banks, over the base rate. This is more typical for business and non-mortgage lending. In figures 3.2 and 3.3 we see interest rate premiums at two Icelandic banks. Their base rate is above the central bank's rate, with categories from 1 - 10 or 1 - 9 respectively. The customer ranking is determined by the bank, and in a profit maximising context they may very well be 'charging what the market will bear'. Credit-worthiness of the customer may be reflected by the ranking, as well as the area they belong to. As a security is often required as a part of a loan, an area that is known for rising prices may result in a customer getting a lower premium, for a loan collateralized by real estate.

[2] SÍSP is a union of Icelandic savings and loans[11].The SÍSP union was a common control mechanism.
[2] Landsbanki has one category less than Arionbanki

	Landsbanki			Arionbanki		
Categories	Rate	Premium	Change(%)	Rate	Premium	Change(%)
Central Bank	6,75	0,00	0,00%	6,75	0,00	0,00%
(Base) 0	7,10	0,35	5,19%	7,35	0,60	8,89%
1	8,10	1,35	20,00%	7,85	1,10	16,30%
2	9,10	2,35	34,81%	8,10	1,35	20,00%
3	10,00	3,25	48,15%	8,60	1,85	27,41%
4	10,75	4,00	59,26%	9,35	2,60	38,52%
5	11,40	4,65	68,89%	9,60	2,85	42,22%
6	11,90	5,15	76,30%	10,35	3,60	53,33%
7	12,40	5,65	83,70%	10,85	4,10	60,74%
8	12,40	5,65	83,70%	11,35	4,60	68,15%
9	12,40	5,65	83,70%	12,10	5,35	79,26%
10	Intentionally left blank[2]			12,85	6,10	90,37%

Table 3.2: Non-Index linked bonds Bank Interests, Including Interest Premiums[13][2]

	Landsbanki			Arionbanki		
Categories	Rate	Premium	Change(%)	Rate	Premium	Change(%)
Central Bank	3,50	0,00	0,00%	3,50	0,00	0,00%
0(Base)	4,15	0,65	18,57%	4,35	0,85	24,29%
1	5,15	1,65	47,14%	4,85	1,35	38,57%
2	6,15	2,65	75,71%	5,10	1,60	45,71%
3	7,05	3,55	101,43%	5,60	2,10	60,00%
4	7,80	4,30	122,86%	6,35	2,85	81,43%
5	8,45	4,95	141,43%	6,60	3,10	88,57%
6	8,95	5,45	155,71%	7,35	3,85	110,00%
7	9,35	5,85	167,14%	7,85	4,35	124,29%
8	9,60	6,10	174,29%	8,35	4,85	138,57%
9	9,75	6,25	178,57%	9,10	5,60	160,00%
10	Intentionally left blank[2]			9,85	6,35	181,43%

Table 3.3: Index linked bonds Bank Interests, Including Interest rate Premiums[13][2]

3.3 Branch Banking

One of the positive features that branch banking has over unit banking is its ability to provide banking services to large areas, even whole countries, under a single identity. It can be seen as a single bank with services provided close to customers, and the catchment areas of the branches may even be completely disjoint. The same can be achieved through chain banking, which differs in corporate structure. Whereas a branch bank is a single corporation, each bank in a bank chain has its own corporate structure with some common control.

A branch bank is a bank with either a single general ledger, where each branch and the main branch maintain their own ledgers, or where each branch keeps a ledger and the main

branch keeps the general ledger[19]. Presumably lending at the branch level is controlled by both the branch bank head office (i.e. lending rules and the state of the general ledger), and the state of the local branch ledger.

Definition 4. *A **branch bank** is a bank with at least one branch, in addition to its main branch[10].*

The following is the legal definition of a branch from the United States of America Banking act of 1927: "The term "branch" as used in this section shall be held to include any branch bank branch office, branch agency, additional office, or any branch place of business located in any State or Territory of the United States or in the District of Columbia at which deposits are received, or checks paid, or money lent. The term "branch", as used in this section, does not include an automated teller machine or a remote service unit."[3][3]

U.S. courts have had problems defining the exact the meaning of a branch, other than the usual industry meaning that the term "branch" is the relationship between two bank offices operated by a single corporation[3].

Definition 5. *A **bank branch**, also known as branch, branch point, and bank office; behaves like a bank, but does not have a separate corporate structure i.e. its own charter, board, or investor.*

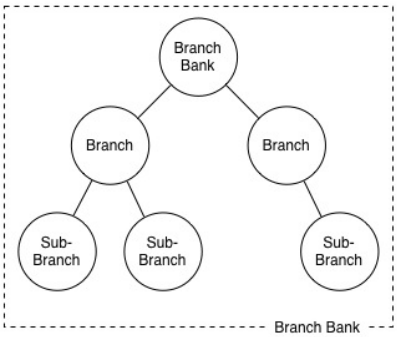


Figure 3.3: Branch Bank

Branch banks have at least in some instances been required to supply branches with capital[10]. Icelandic law does not seem to require capitalization of branches of the Icelandic branch banks operating within Iceland.

We will define a special branch, as a new construct, that can be seen for example in "Credit Institutions, Undertakings Engaged in Securities Services and UCITS (Mutual Funds) 2004" report as:

[3] (Banking act of 1927, 7(c), 44 stat 1228, 12 U.S.C. 36 (c) (1948)) repealed 1996 `http://www.law.cornell.edu/uscode/text/12/36`

Definition 6. *A **special branch**, is a branch that serves a specific purpose; such as lending to a specific type of customer (e.g. businesses, homeowners), a specific types of loans, and/or handling certain transactions (e.g. currency trade, customs).*

Example of such branches are from Landsbanki "transit", and from Íslandsbanki "Ergo.is", "Glitnir", and "Einkafjármál o.fl."(Translation: Personal Finance etc) . These branches are listed in the deposits and loans tables for branches, but are not listed when locations for regular branches are listed. They all fall under the definition above. Figure 3.4, is a capture of the list of branches for Íslandsbanki from the 2004 FME report[4], which shows the before mentioned special branches along with the regular ones.

Utan höfuð-borgar svæðis:	**Útlán ofl.**	**Innlán**
Keflavík	3.593.906	3.537.141
Akranes	576.468	1.229.354
Ísafjörður	3.918.199	1.982.114
Siglufjörður	1.094.860	1.075.817
Akureyri	9.034.236	6.504.233
Húsavík	2.797.516	3.135.030
Reyðarfjörður	694.407	599.699
Vestmannaeyjar	4.397.095	3.762.146
Selfoss	3.747.546	2.761.664
Ergo.is	138.713	318.748
Glitnir	22.855.044	0
Luxemburg	29.509.214	102
Einkafjármál o.fl.	13.668.229	409169
Samtals	*96.025.433*	*25.315.217*

Figure 3.4: Example of Special Branches

In the FME reports we see two variations of head offices, one where the head office is separate from the main branch (Íslandsbanki and Landsbanki), and the main branch and head office combined Arion banki 1997 - 2003, which is shown separate in 2004. The head office is shown as "höfuðstöðvar" (headquarters), and the reports do not contain a branch number for head office when it is shown separately. This suggests that the head office may behave like a special branch i.e. have different lending rules, serve only specific customers, etc. The FME reports do not contain a branch number for the head office if it is separate from the main branch.

Definition 7. *A **Head Office**, is not a conventional branch, engages specific type of customers and is located at the branch banks primary location.*

We will define a main branch, as:

Definition 8. *A **main branch**, is the branch located at the branch banks primary location.*

[3] Arion bank does not have any such special branches listed, meaning that their services where provided either at the local branch level and/or main branch, or not at all.

[4] "Credit Institutions, Undertakings Engaged in Securities Services and UCITS (Mutual Funds) 1997" Icelandic version

They can be seen in the FME reports as branches named "aðalbanki" (0101 and 0301) (Literal translation: main bank) or Íslandsbanki "Kirkjusandur" (0515) the location of the headquarters, the main branches in Iceland did behave similarly to other branches, except in the case of Arion banki which did not show head office separately until 2004.

Here we define two branches that are impossible to define separately, parent and sub-branch, explanation as follows.
Definition 9. *A **parent branch** is a branch from a branch bank that has one or more sub-branches.*
Definition 10. *A **sub-branch** of a bank is a branch of a parent branch, that provides the services of a branch in a portion of the catchment area of its parent branch. It provides some or possible all of the services of the parent branch, but does not report directly to the branch bank itself.*

Examples of the parent branch/sub-branch relationship in Iceland can be distinguished into two different groups. Where a sub-branch shares the same routing number [5] as its parent's branch and where it has a separate routing number. An example of a shared routing number is Landsbanki branch and sub-branch (0140) in Hafnarfjordur, and an example of different routing number is its main branch (0101) and its sub-branches (0121, and 0131). From the shared routing number, and the fact FME reports 1997 - 2004 do not contain deposits and loans for those sub-branches, we assume that the sub-branch ledgers are a part of the parent branches general ledgers.
Definition 11. *A **foreign branch** is a branch that is in another country than the branch bank it belongs to.*

We will use the following definition for local branches.
Definition 12. *A **local branch** is a branch that serves a local community with regular banking services, it is not an head office or a special, sub-, foreign, or main branch.*

3.4 Purpose of Branch banking

There is no single specific purpose behind the branch banking concept. For a unit bank that grows into a branch bank, an increased market share may be the goal.

For shareholders, depositors and borrowers, branching is a more cost effective way of providing banking services[10], as opposed to chain banking or unit banking. However Benston (1965) found branch banking to be more costly[5], and Horvitz(1959) found

[5] In Iceland the first four digits in a bank account number, refer to a specific banks service point. Example: bank accounts starting with 0302 are in Arion banks branch in Akureyri.

small or nonexistent benefits[12][6]. Further Horovitz found unit bankers to be more sympathetic to small local businesses, charging less for unsecured loans and making more such loans, while branch banks focused more on retail or consumer banking[12]. One must be careful of comparing the running costs of a unit bank to that of a single branch, as a portion of the operating costs are accrued at the head office.

Perhaps branch banking mobilises asset liquidity better than unit or chain banks. Bain claims that "Branch banking increases the mobility of capital or credit, permitting a shifting of funds from branches with excess deposits to branches where demand for additional credit exists"[3]. This ability of branch banking may not always be seen as positive, since they could use the mobility to constrain lending where it is needed. It is possible to see branch banks as a way of moving money from rural areas, to financial centers. However branch banks may be the only economical method of providing financial resources to small places. They must however be supervised to ensure that they are providing sufficient financial services in their branches [10].

The author has found no law or regulation restricting the negative features, and effects of branch banking in Iceland. When branch banking was introduced in Iceland it seems to have been without a specific purpose, and no attention has been given to the possible need for safety features restricting disparate monetary expansion between areas.

[6] The cost efficiency of branch banking may have changed over the years with new technology.

Chapter 4

Branch Bank Mechanisms

In this chapter we will define the double entry bookkeeping mechanisms of branch banks. In contrast to our experiments in chapter 7, we will use a simplified Branch bank; consisting of a branch bank, and two branches. The branch bank will have capital, but the branches will have a capital of zero. An assumption is made here that the branch bank keeps the general ledger, and each branch keeps a separate ledger. This is not always the case, as described by Meelboom, where the Head Office (main branch) ledger is the general ledger[19]. If the main branch ledger is the general ledger, they become indistinguishable at the general ledger level.

With double entry bookkeeping mechanisms, one may use intermediary ledgers. In this chapter the steps and entries are kept to a minimum, the author is unaware of any such intermediary or additional steps which would make a difference in the final result. There may be a time sensitivity involved, entries going to a ledger for a certain amount of time, before moving on. An example of this is a mechanism described by Meelboom where interest accrued but not due are added to the ledger [19].

This entire section is based upon, and uses the same notation[1] as the paper "Description of the Operational Mechanics of a Basel Regulated Banking System" by Mallett [15]. That paper shows interbank mechanisms, and the role of the central bank in the banking mechanisms. We will omit the interbank mechanisms, and the central bank.

[1] Here we follow the American convention of showing increases to asset accounts as a debit.

4.1 Fundamental Branch Operations

This is the list of fundamental operations that are specific / important to the branch bank structure:

1. Transfer of money between two customers of the same branch
2. Transfer of a customer from one branch to another
   (a) Customer with a deposit
   (b) Customer with a loan and a deposit
3. Lend money to a branch customer
4. Loan repayment
5. Payment of salary
6. Write off loan

4.2 Initial Position

Table 4.1 shows the example we will use throughout to explain the mechanisms i.e. the starting position. The branch bank (BB) shows the entire bank's ledger, with two branches, bank branch A (Br.A) and bank branch B (Br.B). The bank has four customers, denoted with a C and a number from 1 to 4. From this initial example we will show a table of transactions and the position after the mechanism has been applied. Again this is not meant to be a realistic example of a working bank, only a simplified example to show the transaction mechanisms.

4.2.1 Operations to Derive Initial Condition

To demonstrate how the initial condition in table 4.1. was achieved, the following list and operations are provided.
The bank is started with a capital of 1000 as cash, after which a cash transfer of 200 is made to the reserve at the central bank. Then four customers deposit cash at the bank in the following order; C1 deposit of 150, C2 deposit of 50, C3 deposit of 50, and C4 deposit of 150. Then loans are issued to C2 and C4 totaling 200 each.

Branch Bank			
	Assets	Liabilities	
Loans Br.A	200	400	Deposits in Br.A
Loans Br.B	200	400	Deposits in Br.B
Reserves	200		
Cash Br.A	200		
Cash Br.B	200		
Cash & eq	800	1000	Capital
Total	1800	1800	

(a) Branch Bank (BB)

Bank Branch A			
	Assets	Liabilities	
Loans	200	150	Deposit C1
		250	Deposit C2
Cash & eq	200	0	Capital
Total	400	400	

(b) Bank Branch A (Br.A)

Bank Branch B			
	Assets	Liabilities	
Loans	200	50	Deposit C3
		350	Deposit C4
Cash & eq	200	0	Capital
Total	400	400	

(c) Bank Branch B (Br.B)

Table 4.1: Initial position of bank and branches

Operations			Amount
1)	debit Cash	credit Capital @ BB	1000
2)	credit cash ledger	debit reserve ledger	200
3)	credit Customer account C1 @ Br.A	debit Cash ledger@ Br.A	150
	debit Cash Br.A @ BB	Credit Deposits in Br.A @ BB	
4)	credit Customer account C2 @ Br.A	debit Cash ledger @ Br.A	50
	debit Cash Br.A @ BB	Credit Deposits in Br.A @ BB	
5)	credit Customer account C3 @ Br.B	debit Cash ledger @ Br.B	50
	debit Cash Br.B @ BB	Credit Deposits in Br.B @ BB	
6)	credit Customer account C4 @ Br.B	debit Cash ledger @ Br.B	150
	debit Cash Br.B @ BB	Credit Deposits in Br.B @ BB	
7)	debit loan ledger	Credit Customer account C2 @ Br.A	200
	debit Loans Br.A	Credit Deposits Br.A @ BB	
8)	debit loan ledger	Credit Customer account C4 @ Br.B	200
	debit Loans Br.A	Credit Deposits Br.A @ BB	

4.3 Transfer within a branch

This is the simplest of the mechanisms, it can be shown without the involvement of the branch bank, it does not affect the total of any balances of the branch at the branch bank.

Here C1 transfers 100 to C2. However the branch bank, and its branches need to know that the balance has changed for those two customers if they are able to withdraw at any branch location.

Operations	
1) debit Customer C1	credit Deposit C2

	Bank Branch A		
	Assets	Liabilities	
Loans	200	50	Deposit C1
		350	Deposit C2
Cash & eq	200	0	Capital
Total	400	400	

Table 4.2: Transfer within a branch

4.4 Transfer of a Customer

This section is split into two parts: First part (4.4.1) shows a customer that only has a deposit at a branch being transferred to another branch. This shows the simplicity of a deposit transfer, and also shows the mechanism of transferring money from one deposit account to another i.e. between two customers of the same branch bank. The second part (4.4.2) shows a transfer of a customer, that has both a loan and deposit at one branch moving them over to another branch.

The transfer of a customer (deposit) from one branch to another only involves the two branches and the branch bank account. Therefore it differs from the "transfer between different banks" example presented by Mallett [15], in that the central bank cash account is not involved. It is similar in that the branch bank's ledger is playing an intermediary role like the central bank.

4.4.1 Customer without loan

In table 4.3 we see an example of a transfer of customer C3, with 50 in his deposit account, from branch B to branch A [2]. It is important to point out that Branch B will seem more profitable since it now no longer has to pay interest on customer C3 deposit, however its future lending capacity may be impacted.

[2] **Note:** Icelandic bank account numbers have the branch routing number included, this is not the case in some countries, customers cannot keep their account number if they want to move between branches.

Operations		
1)	debit Deposit C3	credit Cash & Eq @BR.B
2)	debit Deposits in Br.A	credit Deposits in Br.B @BB
	credit Cash Br.A	debit Cash Br.B @BB
3)	credit Deposit C3	debit Cash & Eq @Br.B

Branch Bank

	Assets	Liabilities	
Loans Br.A	200	450	Deposits in Br.A
Loans Br.B	200	350	Deposits in Br.B
Reserves	200		
Cash Br.A	250		
Cash Br.B	150		
Cash & eq	1200	1000	Capital
Total	1800	1800	

(a) Branch Bank (BB)

Bank Branch A

	Assets	Liabilities	
Loans	200	150	Deposit C1
		250	Deposit C2
		50	Deposit C3
Cash & eq	250	0	Capital
Total	450	450	

(b) Bank Branch A (Br.A)

Bank Branch B

	Assets	Liabilities	
Loans	200		~~Deposit C3~~
		350	Deposit C4
Cash & eq	150	0	Capital
Total	350	350	

(c) Bank Branch B (Br.B)

Table 4.3: Transfer of a Customer without Loan

4.4.2 Customer with loan

In this example, we make the assumption that instead of C4 having the loan of 200, C3 will have borrowed and transferred the money to C4. It is C3 we will now move from branch B, to branch A. The deposit transfer, operations are the same as in 4.4.1, the other operations are shown. The opposite of the previous example has happened, branch B has become unprofitable, but the branch bank's income has not changed. It must be noted that branch B's lending capacity has increased.

Operations		
4)	debit Loans	credit Cash & Eq @BR.B
5)	credit Cash Br.B	debit Cash Br.A @BB
6)	credit Loans	debit Cash & Eq @BR.A

Branch Bank

	Assets	Liabilities	
Loans Br.A	400	450	Deposits in Br.A
Loans Br.B	0	350	Deposits in Br.B
Reserves	200		
Cash Br.A	50		
Cash Br.B	350		
Cash & eq	1200	1000	Capital
Total	1800	1800	

(a) Branch Bank (BB)

Bank Branch A

	Assets	Liabilities	
Loans	400	150	Deposit C1
		250	Deposit C2
		50	Deposit C3
Cash & eq	50	0	Capital
Total	450	450	

(b) Bank Branch A (Br.A)

Bank Branch B

	Assets	Liabilities	
Loans	0		~~Deposit C3~~
		350	Deposit C4
Cash & eq	350	0	Capital
Total	350	350	

(c) Bank Branch B (Br.B)

Table 4.4: Transfer of a Customer with a Loan

4.5 Branch Loan

Issuing a loan of 500 to a customer. This loan will have an origination fee of 2% as a complete example of money income from lending, other than interest income. Other fees and taxes may also apply to loan origination, the mechanisms of handling the fee will depend on the type[3]. A tax payment is regarded as a transfer from a customer account to the government, and any further income fee will be handled in the same way as the origination fee shown in our example.

Operations		
1)	debit BR.A loan ledger	credit customer account C1
	Debit BB Loans Br.A	credit Deposti BR.A
2)	credit cash ledger	debit reserve ledger
3)	debit customer account C1	credit income account for branch

[3] In Iceland there was a stamp duty on most form of loans until 1. January 2014, when Act No. 138/2014 superseded Act No. 436/1977.

Branch Bank

	Assets	Liabilities	
Loans Br.A	700	890	Deposit Br.A
Loans Br.B	200	400	Deposit Br.B
Reserves	200 (+20)	10	Income Br.A
Cash & eq	1200 (-20)	1000	Capital
Total	2300	2300	

(a) Branch Bank (BB)

Bank Branch A

	Assets	Liabilities	
Loans	700	640	Deposit C1
		250	Deposit C2
		10	Fee Income
Cash & eq	200	0	Capital
Total	900	900	

(b) Bank Branch A (Br.A)

Table 4.5: Issuing a loan to a customer of a branch

4.6 Loan Repayment

Operations		
1)	debit Deposit C2	credit Loans @Br.A
	debit Deposits in BR.A	credit Loans @BB
2)	debit Deposit C2	credit Interest Income @Br.A
	debit Deposits in BR.A	credit Income Br.A @BB

Branch Bank

	Assets	Liabilities	
Loans Br.A	100	250	Deposits in Br.A
Loans Br.B	200	400	Deposits in Br.B
Reserves	200		
Cash Br.A	200	50	Income Br.A
Cash Br.B	200		
Cash & eq	800	1000	Capital
Total	1700	1700	

(a) Branch Bank (BB)

Bank Branch A

	Assets	Liabilities	
Loans	100	150	Deposit C1
		100	Deposit C2
		50	Interest Income
Cash & eq	200	0	Capital
Total	300	300	

(b) Bank Branch A (Br.A)

Table 4.6: Loan Repayment

A loan repayment of 150, where 100 is towards the capital and 50 is interest. Table 4.1 shows the ledger before and table 4.6 shows the resulting ledgers after the loan repayment. Often a fee is associated with payments, this would result in fee income that is handled

the same way as interest income. Please note that the money supply has now contracted by the amount of the capital payment. The interest part of the payment is no longer a part of the immediate money supply, since it is now classed as income, but once it has been recognized and used to pay salary, dividend, or any other payment the money will once again enter the deposits (broad money).

4.7 Salary Payment

A salary payment of 50, for an employee of a bank branch. Bank employees are usually required to do their banking (deposits/loans) at the bank they work for. In table 4.7. C1 is both a customer of the branch and an employee; a salary payment of 50 is made. This example excludes payroll tax, union fees, and other payroll related payments, such payments would also be transferred from the recognized income, to the appropriate account.

Branch Bank

	Assets	Liabilities	
Loans Br.A	200	350	Deposits in Br.A
Loans Br.B	200	400	Deposits in Br.B
Reserves	200		
Cash @Br.A	200	50	Recongnized Income Br.A
Cash @Br.B	200		
Cash & eq	800	1000	Capital
Total	1800	1800	

(a) Branch Bank (BB)

Bank Branch A

	Assets	Liabilities	
Loans	200	200	Deposit C1
		150	Deposit C2
		50	Recognized Income
Cash & eq	200	0	Capital
Total	500	500	

(b) Bank Branch A (Br.A)

Table 4.7: Salary payment to employee of a branch

The simplified initial example did not have recognized income at Br.A, here an addition needs to be made to the initial example. Br.A has made 100 in recognized income from C2, the example is shown from that point. C1 receives a salary payment of 50 from Br.A. **Note:** Since this branch bank is over reserved, reserve considerations do not apply.

Operations		
1)	debit Deposit C1	credit Recognized Income @ Br.A
	credit Deposits in Br.A	debit Recognized Income Br.A @ BB

4.8 Loan Write-off

An important mechanism is the loan write-off, here we show a possible order of operations. We assume that the branch has a separate ledgers for profit, loss provisions and capital. If the branch bank does not have one or more of these then the corresponding step is skipped.

Operations		
1)	credit loan amount	debit Loss Provision Account @Branch
2)	credit loan amount	debit Recognized Income @Branch
3)	credit loan amount	debit Capital @Branch
4)	credit loan amount	debit Loss Provision Account @Branch Bank
5)	credit loan amount	debit Recognized Income @Branch Bank
6)	credit loan amount	debit Capital @Branch Bank

Chapter 5

Blind Branch Manager

In this chapter we will investigate the branch banking mechanisms from an hypothetical branch manger's view. Here we assume that branches keep track of their profitability, even though that may not always be the case. Branch banks may not keep separate profit and loss ledgers for branches, but rather keep track in the general ledger[19]. We are assuming that branch mangers individually keep track of their profit and losses, and that this influences their decision making.

We assume the hypothetical blind branch manager wants to grow his branch and catchment area, and is either unaware of any negative effects of certain branch bank operations on his catchment area or unable to act on such knowledge, hence blind.

5.0.1 Branch Lending Restrictions

We define a strict branch lending restriction, based on deposit money and not external regulatory control. This is a risk averse restriction, where a cushion of sorts in asset cash is kept at the branch level[1].

The basis of the restriction is that branches try to not lend more than they have on deposit accounts, with the addition that branches can borrow from other sources such as: other branches, pension funds or the branch banks itself. At least one of the Icelandic branches is known to have borrowd from foreign sources.

If a branch has more loans than deposits, without having borrowed from other sources, it was considered to be "overdrawn" towards the branch bank and paid higher interest on

[1] The importance of deposits for branch lending level was raised to the author in discussions with members of the Icelandic banking community.

that amount than other sources. This means that the expansion of credit in an area then depends on deposit levels and the decisions of the branch manager are based on those levels. We will define the restriction as follows:

Definition 13. ***Branch lending restriction:*** *Branches do not lend unless* $deposits > loans + new\ loan\ amount$

If deposits are higher than loans, then the branch is necessarily asset cash positive under normal operations. This may be a result of the branch ledgers being separate from the general ledger of the branch bank. If they are keeping their own profit accounts, profit[2] may exceed cash, as interest and fee income is not in a direct relationship with cash in the same way as deposit money.

The full internal rules of the branch banks are of course more complex than the above, including risk assessment and individual lending limits. Branch lending could also be managed by lending limits assigned by head office, not a direct deposits to loans restriction, this would suggest a very centralised control of monetary expansion of individual areas within Iceland. We can infer that this or some other variation of internal lending rules apply to some branches during the period (some special, and foreign branch), since they have only a small amount of deposits, and are increasing their lending rapidly.

Restricting the lending of individual branches more than regulatory control or differently between areas, can result in more disparate monetary expansion than would otherwise occur. A perfectly even distribution would be nearly impossible to achieve, assuming it would be desirable, even with a strict centralised government.

If this rule does not apply to all the branches, assuming the branch bank maximises lending, then by keeping a cushion between loans and deposits, the blind branch manager is allowing other branches (presumably head office) to lend out more. The size of this cushion may severely effect the deposit money expansion within a branch catchment area. This risk averse strategy can then be used to expand the deposit money supply in a different catchment area. Additionally the branch bank may not be Basel capital controls restricted, by increasing its capital it has the ability to lend more, then either through its head office or branches it can expand lending.

It is also important to consider the importance of deposits at branches as motivation to increase lending. A branch needs to find investment opportunities to cover the interest expense of the deposits, otherwise it will be less profitable as a separate unit. This may

[2] Profits are held in liability ledgers e.g. interest income or fee income

result in increased lending by the branch, and push the branch manager to take more risk.

Evidence of Deposits Playing a Role

It is difficult to positively identify lending behaviour from the FME reports. This is primarily due to the fact they we only have branch level data for eight years, and the data is only showing deposits and loans at a single point of the year. That means there are at most 8 data points for each branch (for some of them we have less), and we are below the Nyquist limit for data analysis of this system. In addition to this the amount of deposits can fluctuate, as customers move money around.

To see if a group of branches is following the rule strictly, that is without borrowing from other sources, we allow for 10% deviation. That means that a branch can have 10% less deposits and loans, and we still consider it to be following the rule. We will focus our analysis on Arion banki branches outside of the capital area, as it shows this behaviour best. In table 5.1 we see total deposits and loans of the branches. Tables for each individual year are shown in A.4, there we see that the majority of the branches are keeping to the lending restriction at each point in time. As a group they always keep a positive ratio. Borgarnes branch behaves differently during the period with a negative loan to deposits ratio. This is weak circumstantial evidence of those branches keeping a positive loan to deposits ratio.

Branch	Loans	Deposits	Difference
Akureyri	23053521	22601803	-1,96%
Egilsstaðir	9985339	14393977	44,15%
Blönduós	12065016	14897222	23,47%
Hella	29493839	33510170	13,62%
Stykkishólmur	9814330	8849277	-9,83%
Sauðárkrókur	29177185	58130358	99,23%
Búðardalur	4955318	8221889	65,92%
Hveragerði	7525139	7188135	-4,48%
Hólmavík	4916597	5380126	9,43%
Vík í Mýrdal	4552035	10267793	125,56%
Grundarfjörður	9838974	7244537	-26,37%
Selfoss	16366768	15901327	-2,84%
Borgarnes	16643674	5822799	-65,01%
Akranes	12627292	12795547	1,33%
Total	191015027	225204960	17,90%

Table 5.1: Arion Bank Branches Outside of Capital Area - Totals 1997 - 2004

5.0.2 Branch Profit

The amount of money the branch profits each year presumably goes to the branch bank, to be used on operating costs, salaries, and finally dividend payments. Assuming the branch in question is not the main branch, or within the local economy of the branch banks headquarters, or a shareholder resides there, then a portion of the income is flowing to a different catchment area. A profit maximizing blind branch manager could inadvertently contract his catchment areas money supply, by increasing his profits.

5.0.3 Index Linked Loans

Bank before Loan Capital Increase

	Assets	Liabilities		Money Supply	
Loans	900	880	Deposit Customer 1	M3	1480
		200	Deposit Customer 2	M2	1280
		20	Interest Income	M1	1280
Cash & eq	400	200	Capital	M0	400
Total	1300	1300			

(a)

Bank After Inflation of 10%

	Assets	Liabilities		Money Supply	
Loans	990	880	Deposit Customer 1	M3	1480
		200	Deposit Customer 2	M2	1280
		20	Interest Income	M1	1280
		90	Non Cash Income	M0	400
Cash & eq	400	200	Capital		
Total	1300	1300			

(b)

Table 5.2: Example of Indexation Calculation of a Loan

This feature of the blind branch manager is only relevant to countries with prevalent lending in inflation index linked loans, Iceland may be unique in this regard. Periods of high inflation will seem positive to a branch manager, his profits go up and the amount his branch has lent out goes up without having to do any work. This type of negatively amortized loan behaves in the following way, during periods of measured inflation, the capital of the loan increases and the banks non-cash income by the same amount[16]. The example in table 5.2, shows a 10% inflation recalculation on loan capital notice how the money supply does not expand. It will not expand until the income is recognized and moved into a deposit account, where some portion may be used to run the branch, the rest will presumably move to the branch bank head office to be used for operating costs or

dividend payments to shareholders. That is to say that money created by the indexation mechanism, is also more likely to at least in part flow to the capital area.

Chapter 6

Simulation Setup

To examine the behaviour of branch banks with respect to their catchment area's money and credit supplies, we will perform several simulations i.e. falsifiable and repeatable experiments. This is done in a simplified economic framework, with some of its features isolated. This chapter describes the simulation method, the simulation setup, two baseline tests without branch banking, and the branch banking baseline. It lists measurements and restrictions of the proposed method, which apply unless otherwise specified in the individual experiment subsections in chapter 7, which details unique aspects of each feature simulated. The experiments explore the behaviour of branch banking with a limitation on the cash ledger, cash money is not moving between catchment areas, a restrictive simplification on the actual economy. The intention is not to simulate a "real" economy, but extract the behaviour of individual branch bank features.

6.1 Threadneedle

The Threadneedle simulation framework is a double entry bookkeeping simulator which provides complete reproduction of all bank ledger transactions. The experiments are therefore repeatable and falsifiable, and it is possible to observe the changes in the general ledger over time as simulations are run. It does require that the double entry bookkeeping mechanisms of the banking system being simulated are known and well defined. The experimenter can then create and visualise the results of different behaviour rules[17]. As a part of this work Threadneedle was expanded to include the ability to simulate branch banking with restrictions on cash flow.

6.2 Simulations

In order to simulate the effect of branch banking features, each feature will be compared to a baseline, and a control experiment. For each simulation we will describe this in detail. The control simulation is the baseline simulation shown in section 6.4.3. This section details the setup, restrictions, and the default parameters of the baseline and experiments.

6.2.1 Setup

The setup of the experiments will consist of three catchment areas, each served by a single branch, that are equivalent in every possible way. Any difference in behaviour will come from either the randomness of order of evaluation, or the specific feature being simulated. Threadneedle is designed to change its evaluation order each round in order to avoid pathological dependencies; in order to achieve repeatability a common programming method of using a random seed is used. This means that knowing the random seed and having the same version of Threadneedle the experiment can be repeated exactly as if it were not random. To repeat the experiment with different randomness, the user must change the random seed. Figure 6.1, shows the experimental setup.

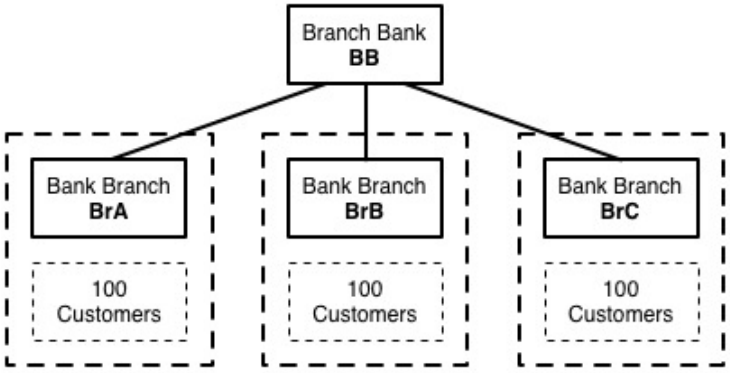


Figure 6.1: Setup of Branch Banking Experiment

Each customer will try to borrow $600,000$ from the branch it is assigned to. They will then "work" for the branch to have salaries to service their debt, only when their deposit has been depleted. They will get exactly the amount of money the need to make due on their loan payments. This simulates a shorter flow of money than the real economy and works to isolate the feature of branch banking being tested. All experiments are setup to have more demand for lending than can be satisfied.

Initial Condition: Each side will have the same amount of lending available, with 100 customers.

6.2.2 Measurements

As output from Threadneedle, a number of graphs will be shown.
Bank Income: Shows the interest income of bank(s), and defaults. Example: Figure 6.3a
Deposits / Debt: Shows total bank deposits, and loans. Example: Figure 6.3b
Bank Lending: Shows the total of new loans each round. Example: Figure 6.3c
Bank Ledgers: Shows the ledgers of bank(s). Example: Figure 6.3d

6.2.3 Restrictions

The model does not include many of the monetary flows that would occur in a real economy. We do this to focus on a single feature's affect, if we include all features of a real economy we will not be able to distinguish between a feature's affect and a combination of features working together for a different result. None of the following features are included, for example:

- Redistribution of wealth through taxation
- Trade transactions between bank catchment areas
- Fee revenue at the bank and branch level
- Lending based multiple of monthly salary payments

Further actual currency, coins and cash in physical circulation are not simulated i.e. actual currency is not withdrawn from the bank(s) in the simulations.

6.3 Experiment Parameters

The default experimental parameters are shown below. One or more parameters may be different for an experiment, which is detailed in the individual experiment description in chapter 7.

Expansion from Initial Condition: Each simulation starts without any loans in the system, therefore it takes the banks a few lending periods to add loans to their books, and reach their lending capacity.

Interest Rates: The simulation does not have interest accruing on deposits accounts. Loans have 2% interest rate on them, simulating an interest rate spread of 2%. This is a simplification of both the banking system, and the economy.

Lending: Each individual will have at most one loan at a time,

Loan Type: The loan we use for simulation is a compound interest loan for 10 years. We did not use index linked loans as they are more complex to simulate, but we have no reason to believe that it would make a difference to the behaviour seen.

Capital Reserves: A 10% capital reserve requirement is used, with a 50% Basel risk weighting on all loans.

Loan Demand: The experiments are designed with full loan demand. Even if two of the branches or banks are not lending, the demand at a single catchment area is sufficient to maximize the lending.

Loan Repayment: Each individual makes loan repayments from its respective deposit account until the account is no longer able to cover the loan. At this point the bank pays the individual a salary to cover loan payments.

Loan Default: The experiment does not use stochastic loan default. For a loan default to occur the bank would have to be unable to pay a salary to the borrower that covers their next loan repayment, i.e. the bank would be illiquid.

Artificial Economy: If the debtors in the economy did not receive wages they will not be able to pay back any more than loan capital, and so would not be able to pay any interest. Therefore they are paid from the bank's income when they do not have sufficient funds to make a payment. Since during the expansion from initial conditions, the bank is not making any payments, it temporarily seems to be highly profitable.

Catchment Areas: the different catchment areas of banks (baseline), and branches do not have money flowing between them. This simplifies the simulation, as cash movement between entities is not required.

6.4 Baseline Experiments

To validate the experimental setup, we will perform three initial tests. One where all 300 borrowers deposit and borrow at one bank. Then we will add two more banks (each bank having 100 borrowers) and compare these two runs. The last baseline experiment is for a branch bank without any lending restrictions on the branches other than capital requirements. That baseline serves as comparison to the simulation experiments with features added.

6.4.1 Single Bank

This baseline experiment differs from the above description, the difference is that instead of having a branch bank, and three branches, there is a single bank with all 300 customers, as shown in figure 6.2. The result of a 20 year run with a a single Basel bank with 300

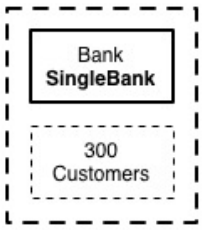
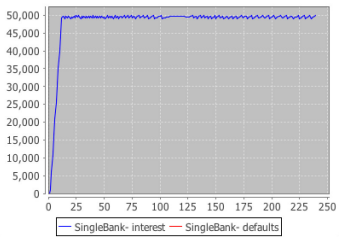


Figure 6.2: Setup of Single Bank Baseline

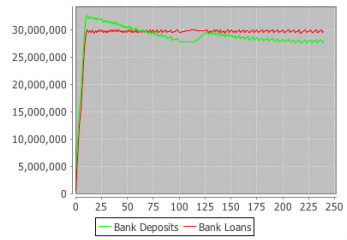
borrowers is shown in table 6.3. Bank income is stable after the initial expansion, bank deposits initially are greater than bank loans, and new lending stabilizes quickly. Initial expansion takes one year, after which the capital requirement is reached, and new lending becomes mostly dependant on capital repayment of loans. In figure 6.3d the capital of the Bank is shown in red, since the bank has reached the capital constraint, and cannot lend until more loan capital has been repaid.

A feature of the simplified test economy is that after a while, loans exceed deposits, and a contraction of deposit money is generated due to the interest income of the bank. The interest income of the bank is not counted towards the deposits of customers, because a customer does not have this money in his bank account. The bank keeps the interest income unless it is needed as a salary for a borrower to meet his repayment obligations. The bank is able to continue lending because it is a capital constrained Basel bank.

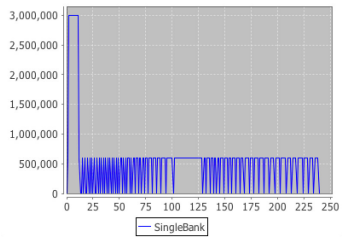
It is important to note that the simulation indicates that the relationship of bank profit and loan repayments is such that, if the bank were not to move its interest income to the



(a) Bank Income



(b) Deposits / Debt



(c) Bank Lending

	Central Bank		
loan	0	5,000	deposit
treasury	0	0	debt
cash	3,005,000	0	interest_income
loss_provision	0	3,000,000	SingleBank
		0	capital
Total	3,005,000	3,005,000	

	Bank	SingleBank..	
loan	29,590,337	0	ib_debt
cash	3,000,000	27,798,893	deposit
reserve	3,000,000	4,495,541	interest_income
loss_reserve	0	295,903	loss_provision
		0	non-cash
		0	retained_earnings
		3,000,000	capital
Total	35,590,337	35,590,337	

(d) Bank Ledgers

Figure 6.3: Baseline: Single Bank

borrower to meet the interest portion of loan repayment the cash required would have to come from other borrowers deposits. In reality the bank profits would be paid out to shareholders, employees, and cover other operating costs[1]. Their purchases would then eventually flow back to the borrowers, that presumably have some income to pay off their loans.

The above mentioned collection of interest income on the ledger of the bank, that it is not returning quickly to deposit accounts, is a simulation artifact. We will refer to this as simulation artifact **A**, and it applies to all subsequent experiments. This artifact is magnifying an existing response in the system i.e. accruing income before returning it into deposit accounts.

6.4.2 Three Banks

This baseline is an expansion of the single bank baseline, by adding two more banks. Simulation artifact **A** also occurs in this experiment.
Each bank has equal number of customers, 100 borrowers, and they are independent of each other, i.e. all lending is occurring within the bank making the loan. The result is mostly similar to the single bank baseline (6.4.1), but there are two differences. First each bank has the ability to make five loans per round, a total of 15; so the capital constraint is reached faster at 4 months. Secondly three banks without interbank lending, and loans

[1] A diagram of the flows can be found in Mallett (2014) [17], p.7 figure 1.

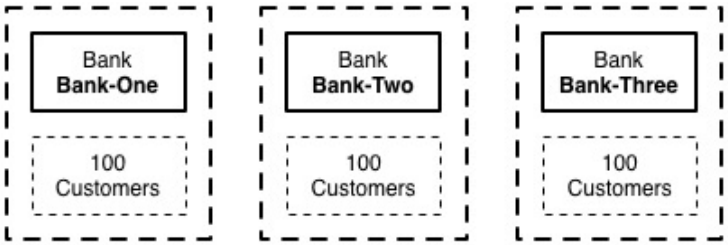


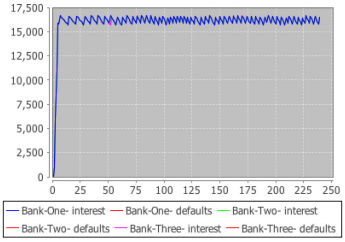
Figure 6.4: Setup of Three Banks Baseline

being 600.000, means the total debt on average is slightly lower due to a simulation artifact. It does not apply to any other experiments, it will therefore not be denoted specifically. This can be seen when comparing the total deposits / debt from the unit bank in test figure 6.3b, versus the same graph in this baseline simulation figure 6.5b. Since the bank's lending limits are separate, the random seed could not cause any difference in lending amounts between the banks.

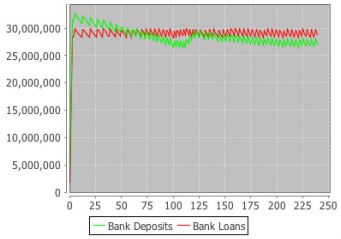
6.4.3 Branch Bank

The branch bank has three branches each of equal size, 100 customers each. Figure 6.6d shows the status of ledgers at 20 years into the simulation. The combined ledger of the bank is shown as "Consolidated ledger of: Branch Bank BB", the branch level ledgers are also shown. Simulation artifact **A** also occurs in this experiment.

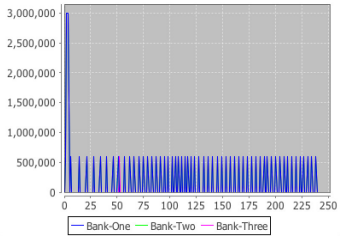
This baseline simulation shows that with the very simplified economy and no internal branch lending rules, the branch bank behaves on the consolidated ledger level as the unit bank in 6.4.1. On the branch level it is quite similar to the 6.4.2, without the reduced lending efficiency seen there. Since the lending rule of the branch bank can be described as first come first served until a branch bank level constraint on lending is reached and we have a random evaluation order of borrowers, one branch may give more loans than another. By running the experiment with a different random seed this varies. Figure 6.7 shows each branch total of deposits and loans, due to randomness and the lack of a branch level lending rule each branch loan total differs. This is a simulation artifact, we will refer to it as simulation artifact **B**.



(a) Bank Income



(b) Deposits / Debt



(c) Bank Lending

	Central	Bank	
loan	0	5,000	deposit
treasury	0	0	debt
cash	3,005,000	0	interest_income
loss_provision	0	1,000,000	Bank-One
		1,000,000	Bank-Two
		1,000,000	Bank-Three
		0	capital
Total	3,005,000	3,005,000	

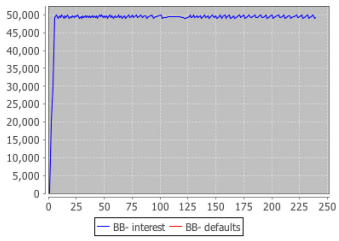
	Bank	Bank-One...	
loan	9,594,290	0	ib_debt
cash	1,000,000	9,023,623	deposit
reserve	1,000,000	1,474,725	interest_income
loss_reserve	0	95,942	loss_provision
		0	non-cash
		0	retained_earnings
		1,000,000	capital
Total	11,594,290	11,594,290	

	Bank	Bank-Two...	
loan	9,594,290	0	ib_debt
cash	1,000,000	9,025,394	deposit
reserve	1,000,000	1,472,954	interest_income
loss_reserve	0	95,942	loss_provision
		0	non-cash
		0	retained_earnings
		1,000,000	capital
Total	11,594,290	11,594,290	

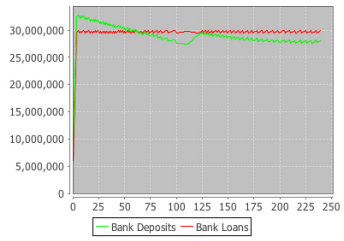
	Bank	Bank-Thr...	
loan	9,594,290	0	ib_debt
cash	1,000,000	9,023,623	deposit
reserve	1,000,000	1,474,725	interest_income
loss_reserve	0	95,942	loss_provision
		0	non-cash
		0	retained_earnings
		1,000,000	capital
Total	11,594,290	11,594,290	

(d) Bank Ledgers

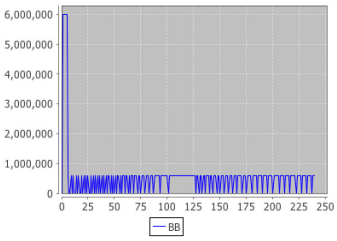
Figure 6.5: Baseline: Three Banks



(a) Bank Income



(b) Deposits / Debt



(c) Bank Lending

	Central	Bank	
loan	0	5,000	deposit
treasury	0	0	debt
cash	3,005,000	0	interest_income
loss_provision	0	3,000,000	BB
		0	capital
Total	3,005,000	3,005,000	

Consolidated	Ledger of:	Branch Bank	BB
loan	29,867,283	0	ib_debt
cash	3,000,000	28,088,687	deposit
reserve	3,000,000	4,479,924	interest_income
loss_reserve	0	298,672	loss_provision
		0	non-cash
		0	retained_earnings
		3,000,000	capital
Total	35,867,283	35,867,283	

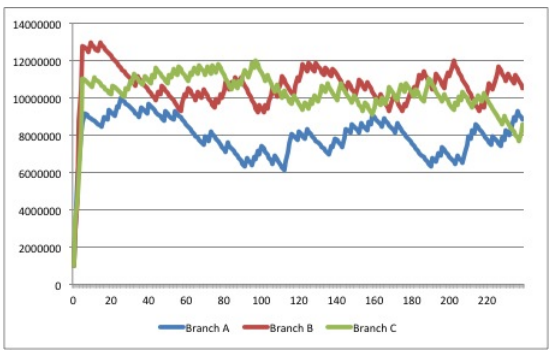
Branch Bank:	BB	Branch:	BrC
loans	9,806,150	9,035,294	deposits
cash	1,000,000		
		1,770,856	interest_income
total	10,806,150	10,806,150	

Branch Bank:	BB	Branch:	BrB
loans	11,086,768	10,348,534	deposits
cash	1,000,000		
		1,738,234	interest_income
total	12,086,768	12,086,768	

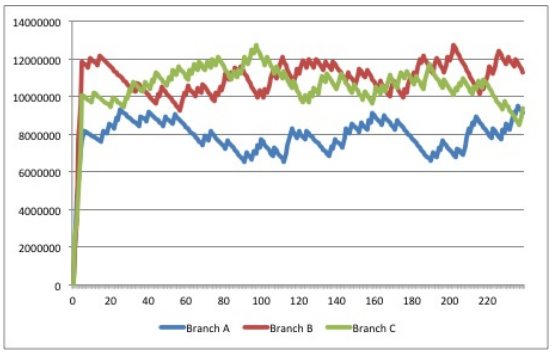
Branch Bank:	BB	Branch:	BrA
loans	8,974,365	8,704,859	deposits
cash	1,000,000		
		1,269,506	interest_income
total	9,974,365	9,974,365	

(d) Bank Ledgers

Figure 6.6: Baseline: Branch Bank with Three Branches



(a) Branch Deposits



(b) Branch Loans

Figure 6.7: Baseline: Branch Deposits and Loans

Chapter 7

Experiments

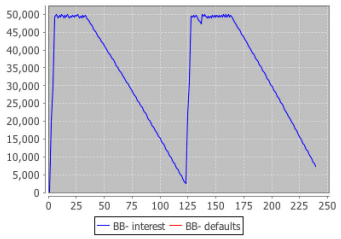
The experiments are designed to investigate the possibility of branch banking having an impact upon the various catchment areas it operates in. If a branch may not participate in monetary expansion, specifically the creation and removal of liability deposits based upon the internal rules and the status of its ledgers, this can have the inadvertent effect of removing liability deposit money from one part of the economy and moving it to another. Three simulation experiments are described here, each has their own section.
The features of branch banking, that will be simulated are:

- Branches do not lend unless deposits > loans + new loan amount
- One branch lends out max
- Different Interest Rate Spread

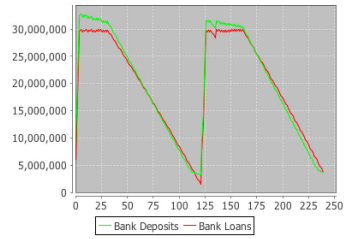
The simulation of each feature will be done in the following way wherever possible, the feature on, a control and without the feature. They will each be described in more detail in their respective simulation section, along with the necessary simulation specific conditions.

7.1 Branch Lending Restriction

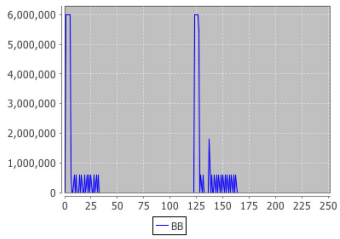
To investigate the behaviour of the branch lending restriction(5.0.1), where the branch does not lend more than deposits, we apply it to all three branches. In comparison to the baseline experiment 6.6, there is no control experiment. Figure 7.1 shows the result from Threadneedle at 20 years. Simulation artifacts **A** and **B** both occur this experiment.



(a) Bank Income



(b) Deposits / Debt



(c) Bank Lending

	Central Bank		
loan	0	5,000	deposit
treasury	0	0	debt
cash	3,005,000	0	interest_income
loss_provision	0	3,000,000	BB
		0	capital
Total	3,005,000	3,005,000	

Consolidated	Ledger of:	Branch Bank	BB
loan	3,713,303	0	ib_debt
cash	3,000,000	3,646,600	deposit
reserve	3,000,000	3,029,570	interest_income
loss_reserve	0	37,133	loss_provision
		0	non-cash
		0	retained_earnings
		3,000,000	capital
Total	9,713,303	9,713,303	

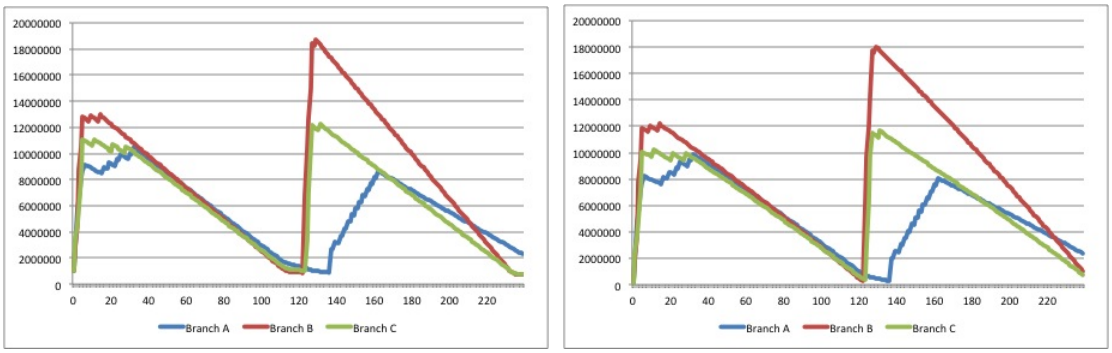
Branch Bank:	BB	Branch:	BrC
loans	625,606	753,128	deposits
cash	1,000,000		
		872,478	interest_income
total	1,625,606	1,625,606	

Branch Bank:	BB	Branch:	BrB
loans	818,156	701,151	deposits
cash	1,000,000		
		1,117,005	interest_income
total	1,818,156	1,818,156	

Branch Bank:	BB	Branch:	BrA
loans	2,269,541	2,192,321	deposits
cash	1,000,000		
		1,077,220	interest_income
total	3,269,541	3,269,541	

(d) Bank Ledgers

Figure 7.1: Experiment: Branch Lending Restriction All



(a) Branch Deposits (b) Branch Loans

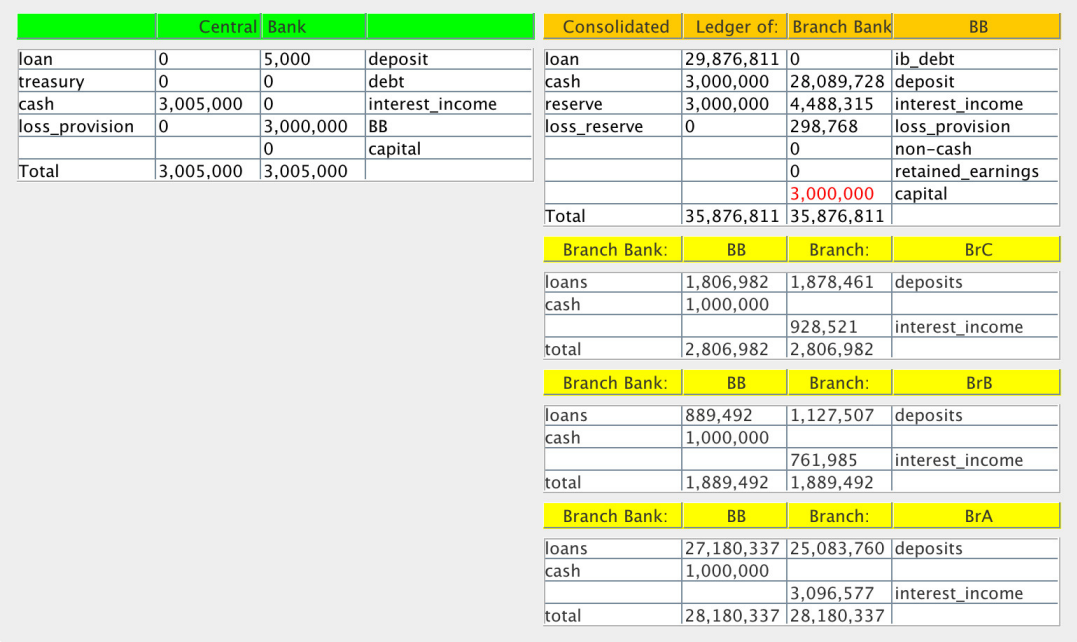
Figure 7.2: Branch Lending Restriction: Branch Deposits and Loans

A branch bank following this rule for all branches, runs the risk of a severe deposit contraction. It is not maximising the bank's potential for lending, as well as causing large swings in the banks income. It is doubtful that any branch bank would follow this rule for all of its branches, but it may be possible to do so if the bank's deposits are somehow increasing as an effect of money transfers into the bank, or if the bank's interest income is quickly moving back into the banks accounts of customers, without simulation artifact **A** through economic activity. In figure 7.2, we see how following the branch lending rule has effected individual branches loans and deposits. The difference between branches is the random evaluation of borrowers, simulation artifact **B**. Repeating the experiment with a different random factor results in the same contraction and expansion pattern of deposits and loans. The branches are able to lend money until bank income has contracted the customer deposits below branch loans, it is not until the branches have started moving income back into deposit accounts that it starts lending again. This second lending round is a simulation artifact, we will denote it as **C**. It is due to banks being evaluated first, paying borrowers enough into their deposit account to cover loan repayments, then borrowers being evaluated applying for loans or making loan repayments.

A combined effect of simulation artifact A, B and C, results in branches at certain times having a large difference in their lending. This is due to branches re-starting their lending in the second lending round (C), at different times due to randomness (B), this effect is exaggerated in the second lending round (A).

7.2 One Lends Maximum

In this experiment two branches follow the branch lending rule, one branch does not follow the rule. The branch that does not follow the rule lends until the branch bank's



	Central	Bank	
loan	0	5,000	deposit
treasury	0	0	debt
cash	3,005,000	0	interest_income
loss_provision	0	3,000,000	BB
		0	capital
Total	3,005,000	3,005,000	

Consolidated	Ledger of:	Branch Bank	BB
loan	29,876,811	0	ib_debt
cash	3,000,000	28,089,728	deposit
reserve	3,000,000	4,488,315	interest_income
loss_reserve	0	298,768	loss_provision
		0	non-cash
		0	retained_earnings
		3,000,000	capital
Total	35,876,811	35,876,811	

Branch Bank:	BB	Branch:	BrC
loans	1,806,982	1,878,461	deposits
cash	1,000,000		
		928,521	interest_income
total	2,806,982	2,806,982	

Branch Bank:	BB	Branch:	BrB
loans	889,492	1,127,507	deposits
cash	1,000,000		
		761,985	interest_income
total	1,889,492	1,889,492	

Branch Bank:	BB	Branch:	BrA
loans	27,180,337	25,083,760	deposits
cash	1,000,000		
		3,096,577	interest_income
total	28,180,337	28,180,337	

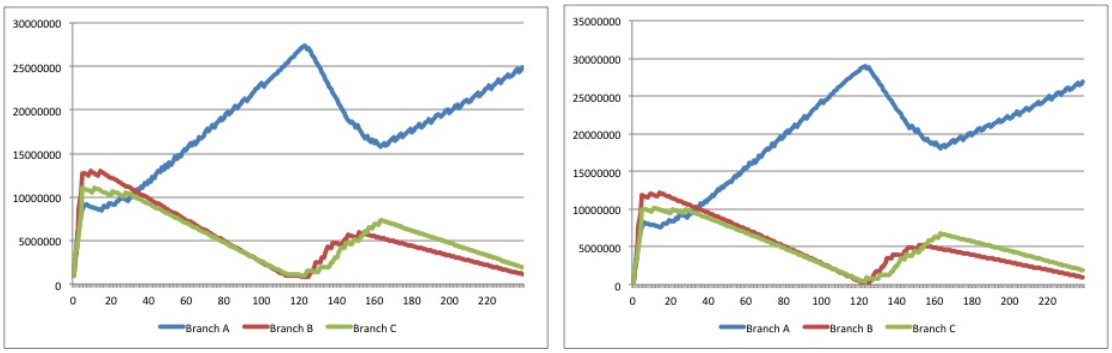
Figure 7.3: Experiment: Branch Lending Restriction All But One

lending becomes capital constrained. Simulation artifacts **A**, **B** and **C** occur in this experiment.

We omit the figures for "Bank Income", "Deposits / Debt" and "Bank Lending" since they are identical to the baseline (6.6), the only major difference are the branch ledgers. Figure 7.4 shows the ledger of the branch bank and branches. The two branches following the rule experience contraction, and will have to "compete" with Branch A for loans once they can start lending again. This on average allows them only to have 2/3 chance of giving out the available loan. Individual branches loans and deposits are shown in figure 7.4, show this behaviour. The contraction in the two branches is due to interest income not going immediately back to the deposit money supply, reducing the deposit money of customers, until the bank starts moving its profits to customers to pay loans. After this the branch, following the lending rule of not lending when loans + new loan is higher than deposits, can lend again.

7.2.1 Control

In this control experiment we reverse the roles from that in section 7.2, the two branches B and C do not follow the rule, but Branch A does. Again we see no sign of the contracting and expanding money supply of individual catchment areas on the consolidated ledger 7.5 of the branch bank, bank income, Money / Debt and Bank lending is the same as



(a) Branch Deposits (b) Branch Loans

Figure 7.4: One Lends Maximum: Branch Deposits and Loans

	Central	Bank	
loan	0	5,000	deposit
treasury	0	0	debt
cash	3,005,000	0	interest_income
loss_provision	0	3,000,000	BB
		0	capital
Total	3,005,000	3,005,000	

Consolidated	Ledger of:	Branch Bank	BB
loan	29,872,067	0	ib_debt
cash	3,000,000	28,104,208	deposit
reserve	3,000,000	4,469,139	interest_income
loss_reserve	0	298,720	loss_provision
		0	non-cash
		0	retained_earnings
		3,000,000	capital
Total	35,872,067	35,872,067	

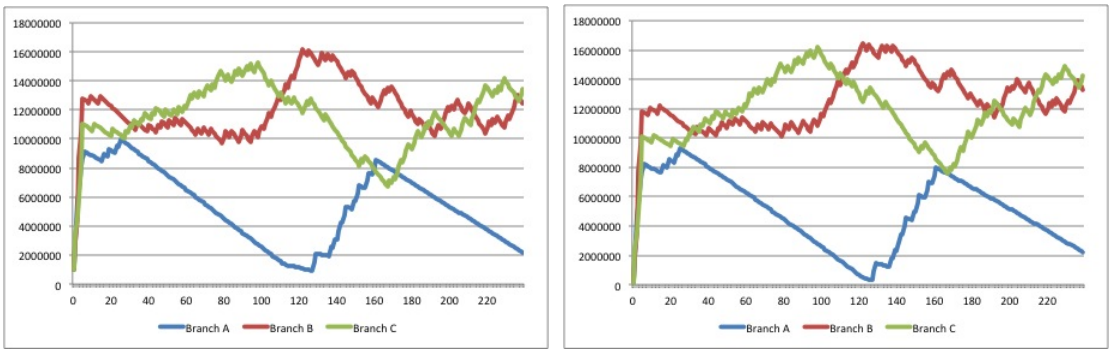
Branch Bank:	BB	Branch:	BrC
loans	14,057,695	13,211,270	deposits
cash	1,000,000		
		1,846,425	interest_income
total	15,057,695	15,057,695	

Branch Bank:	BB	Branch:	BrB
loans	13,710,262	12,819,578	deposits
cash	1,000,000		
		1,890,684	interest_income
total	14,710,262	14,710,262	

Branch Bank:	BB	Branch:	BrA
loans	2,104,110	2,073,360	deposits
cash	1,000,000		
		1,030,750	interest_income
total	3,104,110	3,104,110	

Figure 7.5: Control: "One Lends Maximum" Ledgers

in the baseline (6.6). The individual branch ledgers, and branch loans and deposits are another matter, as can be seen in figure 7.6. Except now there are two branches sharing the total lending capacity the entire time, and Branch A experiences the contraction. The average lending is distributed between branches is: Branch A 17%, Branch B 42% and Branch C 40%. The difference is Branch A is deposit, and Branch B and C are capital constrained. Simulation artifacts **A**, **B** and **C** occur in this experiment.



(a) Branch Deposits (b) Branch Loans

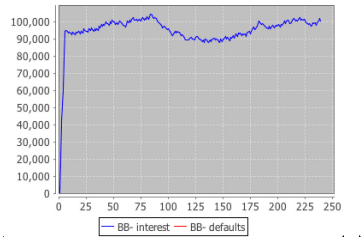
Figure 7.6: Control: "One Lends Maximum" Branch Deposits and Loans

7.3 Different Interest Spread

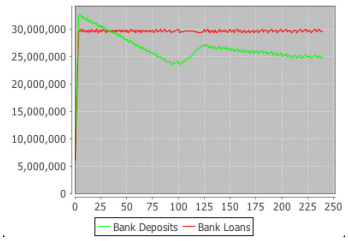
Simulation artifacts **A** and **B** occurs in the following experiment.
These experiments test the behaviour of different interest spreads. There is no branch lending rule in effect. Branch A maintains an interest spread of 6%, Branch B 4%, and Branch C 2%. During the expansion from initial conditions, and the subsequent contraction period of deposit money, due to bank profit not being channeled back out to depositors until they need it to make payments, we notice a sharper decline of deposits where interest spread is higher, after that period the branches with higher spread move more money to the borrowers. Figure 7.7 shows the output of Threadneedle after 20 years. Compared to the baseline (6.6) the branch bank income has doubled, since on average interest income is now 4%, compared to the baselines 2%. Bank income fluctuates slightly more, since there is now a difference which branch lends and it is randomly chosen.
The branch with the highest spread loses the most deposit money, and there is less deposit money available within that area, since the higher profits are effectively moved to head office.

7.3.1 Control

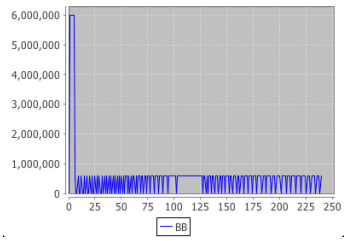
Here we investigate the behaviour of branches with different interest rate spreads. Simulation artifacts **A** and **B** apply to this experiment.
To create a control experiment, each branch has a different interest rate spread than before. Branch A will have 2%, Branch B 6% and Branch C 4%. We observe identical behaviour, with the branches having changed roles, the only difference aside from that is due to randomness. As can be seen in 7.9a income is doubled as before.



(a) Bank Income



(b) Deposits / Debt



(c) Bank Lending

	Central Bank		
loan	0	5,000	deposit
treasury	0	0	debt
cash	3,005,000	0	interest_income
loss_provision	0	3,000,000	BB
		0	capital
Total	3,005,000	3,005,000	

Consolidated	Ledger of:	Branch Bank	BB
loan	29,776,977	0	ib_debt
cash	3,000,000	24,962,296	deposit
reserve	3,000,000	7,516,912	interest_income
loss_reserve	0	297,769	loss_provision
		0	non-cash
		0	retained_earnings
		3,000,000	capital
Total	35,776,977	35,776,977	

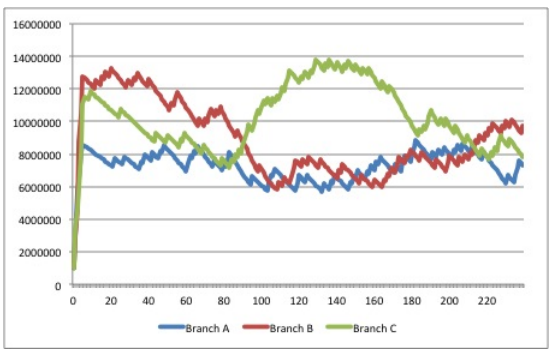
Branch Bank:	BB	Branch:	BrC
loans	8,333,637	7,704,655	deposits
cash	1,000,000		
		1,628,982	interest_income
total	9,333,637	9,333,637	

Branch Bank:	BB	Branch:	BrB
loans	11,689,086	10,148,257	deposits
cash	1,000,000		
		2,540,829	interest_income
total	12,689,086	12,689,086	

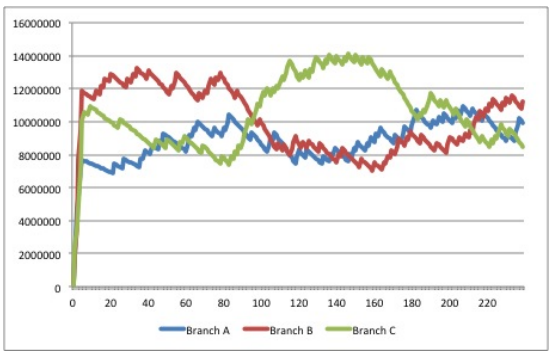
Branch Bank:	BB	Branch:	BrA
loans	9,754,254	7,109,384	deposits
cash	1,000,000		
		3,644,870	interest_income
total	10,754,254	10,754,254	

(d) Bank Ledgers

Figure 7.7: Experiment: Different Interest Spread

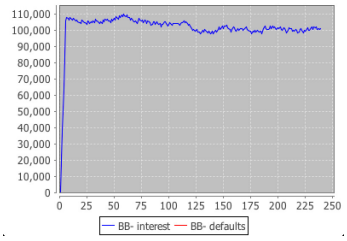


(a) Branch Deposits

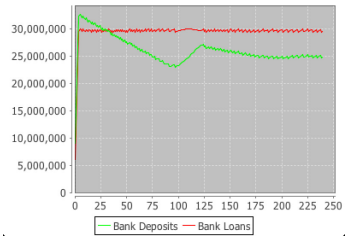


(b) Branch Loans

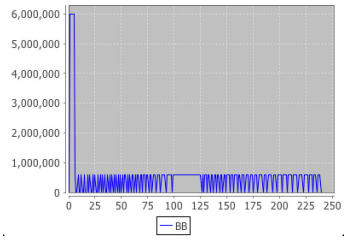
Figure 7.8: Experiment: Different Interest Spread Branch - Deposits and Loans



(a) Bank Income



(b) Deposits / Debt



(c) Bank Lending

	Central Bank		
loan	0	5,000	deposit
treasury	0	0	debt
cash	3,005,000	0	interest_income
loss_provision	0	3,000,000	BB
		0	capital
Total	3,005,000	3,005,000	

Consolidated	Ledger of:	Branch Bank	BB
loan	29,554,466	0	ib_debt
cash	3,000,000	24,786,676	deposit
reserve	3,000,000	7,472,246	interest_income
loss_reserve	0	295,544	loss_provision
		0	non-cash
		0	retained_earnings
		3,000,000	capital
Total	35,554,466	35,554,466	

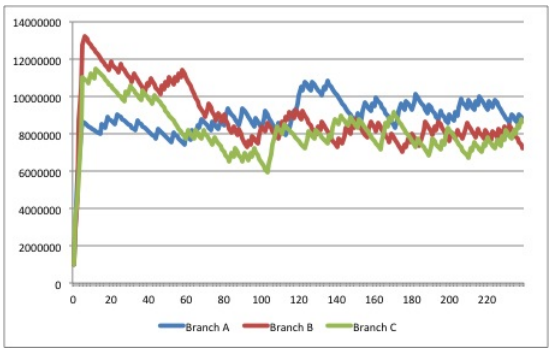
Branch Bank:	BB	Branch:	BrC
loans	9,931,381	8,480,029	deposits
cash	1,000,000		
		2,451,352	interest_income
total	10,931,381	10,931,381	

Branch Bank:	BB	Branch:	BrB
loans	9,969,115	7,108,752	deposits
cash	1,000,000		
		3,860,363	interest_income
total	10,969,115	10,969,115	

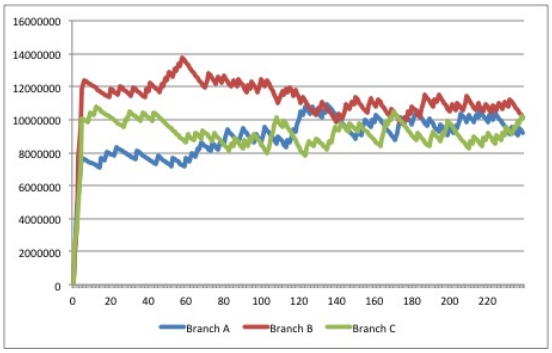
Branch Bank:	BB	Branch:	BrA
loans	9,653,970	9,197,895	deposits
cash	1,000,000		
		1,456,075	interest_income
total	10,653,970	10,653,970	

(d) Bank Ledgers

Figure 7.9: Control: Different Interest Spread



(a) Branch Deposits



(b) Branch Loans

Figure 7.10: Control: Different Interest Spread Branch - Deposits and Loans

Chapter 8

Results and Discussion

The results of these experiments must be seen in their context: they are qualitative, repeatable, and falsifiable experiments, based upon a simplified economy with particular features of banking system isolated. They include simulation artifacts, model only the banking system, and several important aspects of banking are not included such as: foreign exchange and loans, and securitisation. The real world effect of these features may be exacerbated or reduced by other features within and outside of the banking system. To mention a few possibilities of such features; investment decisions by the head office, housing loans supplied and/or guaranteed by the government, redistribution of money through taxation, and outside investment. In other words this is a highly interactive and interconnected system, which is sensitive to many conditions. We have simulated a small part of it in isolation, and the results of these experiments must be viewed as such. They do however give us insights into the behaviour of the banking system, branch banking, deposit constraining lending, and interest rate spread.

For all the experiments it is important to remember they included simulation artifacts and that the economy was quite simple. There were three known simulation artifacts **A**(6.4.1), **B** (6.4.3), and **C** (7.1), in addition to the simulation artifact in the three banks experiment (6.4.2). The banking system experiments in the simulation framework appear to be quite sensitive to change, evaluation order and parameters. This is likely not just a problem with this simulation framework, but the sensitivity issue is probably shared by all economic models and the actual banking system.

The branch lending rule experiments (7.1, 7.2) demonstrate, that it is possible that a branch catchment area may not participate fully in monetary expansion depending on the status of its ledgers and the internal branch bank lending rules that are being applied

by the bank. It also shows that when branches being are subject to different lending rules, they behave differently as a result.

We have also shown that if every branch within a branch bank follows this restriction, the resulting effect is visible within the local money supply, and that the branch bank's profits suffer. It is therefore unlikely that if this restriction or a similar variant is applied by a branch bank to its branches, that it applies to all of its branches. Further we saw that the ledger of a branch bank giving equal ability of lending to all branches(6.6), two being constrained (7.2) by the lending rule and one being constrained(7.2.1), all had near identical results on the branch banks consolidated ledger. The clear implication is that individual branch level ledgers are needed to discern their behaviour in individual catchment areas.

It is possible to draw the following conclusion from the different interest spread experiment (7.3) and its control experiment (7.3.1), that higher interest rate spread reduces the available deposit money in the local economy. This increased profit of local branches is possibly moved out of its catchment area. It may for example be used on operating costs at the head office, dividend payments, or even operating costs of other branches. We already saw different interest rate loan tables for two Icelandic banks, in figures 3.2 and 3.3, if the average loan in one area is ranked only one or two categories lower the rate increase can be substantial 2%, or more. As we saw in the experiments an area with 2% less than the average of 4%, pays only a third of what the area with 2% more does. We can assume that some of this additional profit is then flowing into the capital area, and used there on operating costs, expanding its deposit money supply.

This can be seen in conjunction with Eckhard's description of exactly this behaviour of branch banks in the United States where higher interest were charged outside of cities then in the country side[9], showing that different interest rate premiums are indeed possible. If branch banks are profit maximising, then the branch manager in a worse off area may more easily justify charging higher interest rates. The danger is that this can create a self fulfilling prophecy of the area requiring higher interest rates, through the mechanism of transferring more money out of the local area as income to the branch bank. That income is then partially used on operating costs within the capital area, and then effectively re-enters the money supply in a different region.

Looking at the empirical data we can see that the branch banks in Iceland were in fact expanding lending at a much faster rate in their local branches in the capital, than in those outside of it. The monetary expansion was almost triple during the period, and local branches outside of the capital increased lending only by about a third, whereas the capital branches increase lending by two and half times.

If we accept the assumption that local branches are in some way deposit constricted in their lending, and that the head office lent out more in the capital area without accruing matching deposits. This in combination with the Basel regulatory framework being applied to the entire bank, it then follows that the deposits of branches in the capital area increase more, increasing their the ability to lend more, but also in a way forcing them to find interest income to cover the interest on their increased deposit accounts.

During the period we have data for, the head offices increased their lending almost 22-fold, going from being one fifth of the branch banks lending to more than 70%. This is a behaviour change within the branch banks, in addition to the introduction of various special branches and a foreign branch. The special branches and foreign branch only have negligible deposit collection, 0,18% of the branch banks' total deposits but have almost 6% of the total lending. This behaviour is likely to have a macro economic impact on the economy of Iceland, as a result of unevenly applied expansions in the regional money supplies in the different catchment areas of the branch banks.

Chapter 9

Conclusions and Future Work

9.1 Conclusions from Simulation Experiments

In this thesis we report on a series of simulations of branch banking features, a hypothetical, simplified and restrictive branch lending practice, that shows it is possible that branch banking practices may have macroeconomic impact. This should not be taken as a definitive quantitative analysis on the behaviour of branch banks in Iceland. To do this one would need access to potentially sensitive data, and a full description of all the double entry bookkeeping mechanisms of the branch banks. A limitation on the modelling performed here is the current lack of documentation and real world data for banking mechanisms and their behaviour, although the framework imposed by double entry bookkeeping does restrict this to some extent.

In the FME reports we do see a substantial behaviour change within branch banking, with the introduction of special branches and foreign branch. In addition there appears to be a change in lending practices of the branch banks, where they lend more through the head office than in the beginning of the period. But more importantly the branch banks did not expand their lending equally across their catchment areas. This shows that it is likely that the branch banks, through their branches, had a macroeconomic effect on the economy of Iceland during the period.

We have found that it is important to model the behaviour of branch banks at the ledger level, in order to obtain a complete picture of the state of the economy, and understand regional disparities. The modelling of branch bank lending decisions and terms has the ability to show which areas are likely to contract or expand as a result of their underlying behaviour. It must be pointed out that a particular area may be contracting simply because

there are no viable investments. Fractional reserve banking has the property of reducing the money supply when people are repaying their debt and new lending is less than capital re-payments. Contraction in the money supply for this reason is very rarely seen in the macroeconomics statistics but the wide variation in regional expansion in Iceland and elsewhere suggest it may be happening at the local level. Expansion or contractions in the money supply in different regions will affect the price signal, but because wages are lower it may not be possible to get loans. Government investment project spending may consequently have far smaller impact than intended if the project participants have deposit accounts at branches outside of the area. However, in any region where loan demand is greater than the branches ability to support it the potential exists for the behaviour explored in this thesis.

Our experiments have shown that without branch level data on the balance sheet of a bank, it may be impossible to see if a branch bank is inflating particular areas, at the possible detriment of others. It is more than likely that part of this disparate deposit money supply expansion is due to internal branch bank lending rules, and the behaviour of the branch manager.

9.2 Conclusions about Public Policy and Bank Regulation

It seems advisable that branch banks should be monitored more closely, and we recommend that branch level data should once again be published in Iceland. It may even be advisable to have branch banks publish balance sheets of the individual branches as if they were unit banks. This would allow local residents to see if their branch is lending near the monetary expansion rate or not, and what their interest income is. Problems associated with inflation are possibly shared by the entire country, as prices of products and services go up. A person living in an area where a branch for some internal branch bank reason is not lending, may find themselves in a stagnating local economy. Inversely a local economy may be going through monetary expansion leading to increased prices of services, and real estate, that do not reflect the true state of the economy.

If we consider that branch banking is in fact expanding the money supply faster in the capital area, at the expense of the countryside, then it will presumably effect local real estate prices within that area, and thereby the asset side of all corporate ledgers that own property within that area. If this occurs and such entities appear to be more profitable than their counterparts in the countryside, they will presumably have easier access to loans due

to having an asset as security and a seemingly more profitable balance sheet. This creates a self fulfilling prophecy and an associated feedback loop affecting borrowing within one area, which can result in an asset bubble.

Iceland is a small country with a single growing capital region, and an ever shrinking countryside. This thesis provides evidence that this may be occurring due to branch banking practices, and the current regulatory framework. Double entry bookkeeping simulations of banking are promising investigative tools, that one day may help to prove this beyond a doubt. This may also help address the more important question, what happens to the capital economy, over time, when the countryside is constantly shrinking?

9.3 Future Work

There are several opportunities to extend the scope of this thesis, and further the development of double entry bookkeeping simulation frameworks.

9.3.1 Branch Banking

There are three main areas to investigate further for branch bank research: mechanisms (bookkeeping, internal rules), operating costs of branch banks, and loan types.

Bookkeeping Mechanisms
A critical area to investigate is the branch level profit handling, and the presumed end of year transfer mechanism associated with it. One of the fundamental parts of branch banking that was not simulated in this paper is inter-branch lending. This part of modern banks operating procedures is hidden, at least in Iceland. Does a branch pay interest if it is "overdrawn", at the headquarters, if so how high is the interest rate? More importantly does the reverse apply, when a branch bank "borrows" from a branch, carry the same interest rate? What are the implications of this inter-branch lending protocol for the catchment areas of branches? This functionality both needs a proper description and then implementation in Threadneedle's simulation. Mobility of capital can be seen to be just as important an issue within branch banking as it is between banks. It is one of the many stated purposes of branch banking to move capital from areas where there is less demand for loans, to areas where there is a higher demand.

Operating Costs of Branch Banks
In countries with banking in a financial capital, the operating costs of the banking systems

are concentrated in a single city. For branch banking in countries where it is concentrated it is important to realise that the operating costs are as well.

Capitalisation of Branches
A related subject is the capitalization of branches, which may be legally required(3.3).

- Is the capital of branches increased with the increase of capital of the branch bank itself?
- Does the increased lending capacity of a branch bank that has increased its capital, lead to increased lending at the branch level?
- Moreover is this lending capability distributed evenly among the regions, or in response to centralised lending decisions?

Loan Types
A subject related specifically to Iceland are the Icelandic index linked loans (negatively amortized loans). Is new lending at branches reduced when loan capitals increase due to inflation? In this thesis we used compound interest loans, since index linked loans are more complex to simulate. The measurement of inflation makes the experiment more complex, and this should be investigated further.

The likelihood of similar behaviour of branch banking in other countries where branch banking head offices are concentrated in a city, such as England (London), Japan (Tokyo), and United States of America (New York), should be carefully investigated since there is no reason to believe these issues are confined to Iceland.

9.3.2 Simulation Framework

More realistic economic simulations are a priority, especially those where there are only a few or no simulation artifacts. The development of better baselines and isolation techniques to investigate features of banking are also needed. A range of standardized experiment protocols, would be extremely useful, and time saving. This paper has shown one such isolation technique within branch banking. This is something that can only improve as more papers are written on the subject, in conjunction with the improvement of double entry bookkeeping simulation software.

The sensitivity of banking system experiments are high, and the behaviour of interest and profit are under explored. Adding other types of lending institutions is also important

for a more complete picture, such as government lending institutions (Housing Financing Fund and Icelandic Student Loan Fund).

9.4 Final Remarks

It is important to understand the limits, if they exist, on a system's behaviour. From those limits derive the constraints it functions within and how changes affect them. It is important to know what is the worst that can happen, so as to avoid it, in addition to the current method of using statistical averages to predict likely future outcome(s). Most economic models overlook banking at the ledger level, and the author knows of no model that takes into account branch banking. This thesis demonstrates that modelling the behaviour of branch banking is important and necessary in order to understand the phenomena of higher rates of monetary expansion within capital areas. Countries where branch banking is dominant and branch bank head offices are concentrated, seem to experience higher real estate prices in the financial capital and more economic growth of businesses. In addition to this branch banking may explain slowing, stagnating, or contracting economic activity in some areas where previously there has been no obvious cause.

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Appendix A

Empirical Data

This chapter details where the empirical data for branch level data was derived from, and how it was manipulated. The first two sections, define terms used throughout the thesis, in relation to this data.

A.1 Names of branch banks

Each of the three main Icelandic banks has operated under some other name during the period of 1997 - 2014. To simplify discussion of them we use their current names Arion, Landsbanki and Íslandsbanki. This simplification is needed because of name changes due to mergers, acquisitions, and brand name changes. To follow the individual branch banks from 1997 to 2014. **Arion** has also operated or been known under the names: Búnaðarbanki, Kaupþing Búnaðarbanki, Kaupþing, Kaupþing Banki, Kaupthing Bank, Kaupþing, Nýja Kaupþing hf., Arion Banki
Landsbanki was always known under that name publicly, but after the collapse it is sometimes called Nýji Landsbanki (Translation: New Landsbanki).
Íslandsbanki has also operated or been known under the names: Glitnir, Nýji Glitnir, Íslandsbanki- FBA.

A.2 FME Reports

The data in the following sections is derived from statistical reports of The Financial Supervisory Authority, Iceland. The acronym FME comes from the Icelandic name of that

institution "Fjármálaeftirlitið" The reports are titled "Credit Institutions, Undertakings Engaged in Securities Services and UCITS (Mutual Funds)" in English, and "Efnahags- og rekstrarreikningar lánastofnana, fyrirtækja í verðbréfaþjónustu og verðbréfasjóða fyrir árið" in Icelandic, followed by a year. What we will refer to as the FME Reports will be those reports for the years 1997 - 2004, that contain branch level data. Most of the English versions contain the branch level data it, however 2004 does not, whereas the Icelandic version does. We used the Icelandic version of the reports as the source of the data.

A.3 Branches by Groups

To create these data tables, the main branch and head office when applicable was separated from the capital area, and placed in two groups called "head office" and "main branch". For Íslandsbanki 1997 - 1998 "Fyrirtækjasvið" (Translation: Corporate Banking) a presumably special branch was removed from the capital area and added to the head office, since it seems to merge with it in 1999, and that for the other banks corporate banking was not separate. Two of the banks always showed main branch separate from the head office, Arion only shows it separately in 2004.

This was done for two reasons. First in order not to skew faster expansion of deposits and loans in the capital area, since some corporations and individuals could have been operating outside of the capital area an still do business at the main branch or the head office. Note the catchment areas of the main branches of the three branch banks was within the capital area, providing regular banking services, taking deposits and lending out to regular customers. Secondly and more importantly for the validity of the data, the main branch and head-office are only shown as separate entities for Arion bank in 2004, the main branches could not be shown separately as a group for 1997 - 2003. It could be claimed that most of the deposit and loans growth of the main branches was in the capital area, however we use this data to show the faster growth of the capital area than outside of it. Even without the main branches disparity between lending and deposit growth is noticeable.

All other special branches, and foreign branches were moved to the category other. The branches we reclassified as other are:
Landsbanki - Transit (2000 - 2004) and Heimilislánadeild (2002 - 2004) (Translation: Home lending department)
Arion banki - No branches reclassified
Íslandsbanki - Glitnir (2004), ergo.is - 2000 - 2004, ViB 2001 - 2002, Þróunarsvið

(Translation developement department) (2002), and Luxemburg a foreign branch (2003 - 2004) Similar concerns about skewing the data apply here, it could be claimed that the majority of the lending of some of the special branches was concentrated predominantly in the capital area, it is not needed to demonstrate that the growth was disparate between the two regions. The data in the tables below are from The Financial Supervisory Authority, Iceland "Credit Institutions, Undertakings Engaged in Securities Services and UCITS (Mutual Funds) 1997 - 2004.

	Head Office		Main Branch		Capital Area		Outside Capital Area		Other		Total	
Branch Banks	Loans	Deposits	Loans	Deposits	Loans	Deposits	Loans	Deposits	Loans	Deposits	Loans	Deposits
Landsbanki	13.710.653	1.058.798	24.129.140	13.261.453	14.719.279	23.950.015	42.263.288	26.516.544	0	0	94.822.360	64.786.810
Íslandsbanki	4.122.873	2.555.417	2.662.552	4.447.111	27.020.597	24.584.094	18.188.609	11.637.729	0	0	51.994.631	43.224.351
Arion	21.539.681	7.066.789	0	0	13.112.781	16.409.848	13.925.986	16.946.768	0	0	48.578.448	40.423.405
Total	39.373.207	10.681.004	26.791.692	17.708.564	54.852.657	64.943.957	74.377.883	55.101.041	0	0	195.395.439	148.434.566

Table A.1: Loans and deposits of branch groups in Iceland 1997

	Head Office		Main Branch		Capital Area		Outside Capital Area		Other		Total	
Branch Banks	Loans	Deposits	Loans	Deposits	Loans	Deposits	Loans	Deposits	Loans	Deposits	Loans	Deposits
Landsbanki	51.948.150	1.270.697	11.579.028	12.975.317	20.214.079	28.846.917	31.601.195	30.454.307	0	0	115.342.452	73.547.238
Íslandsbanki	20.412.212	2.484.868	5.009.633	8.210.042	25.611.499	26.158.773	19.992.992	12.507.751	0	0	71.026.336	49.361.434
Arion	30.792.418	9.360.048	0	0	17.199.732	18.843.908	16.391.203	17.575.204	0	0	64.383.353	45.779.160
Total	103.152.780	13.115.613	16.588.661	21.185.359	63.025.310	73.849.598	67.985.390	60.537.262	0	0	250.752.141	168.687.832

Table A.2: Loans and deposits of branch groups in Iceland 1998

	Head Office		Main Branch		Capital Area		Outside Capital Area		Other		Total	
Branch Banks	Loans	Deposits	Loans	Deposits	Loans	Deposits	Loans	Deposits	Loans	Deposits	Loans	Deposits
Landsbanki	64.514.346	611.907	12.096.221	12.809.694	22.181.500	33.204.950	34.680.084	31.492.563	0	0	133.472.151	78.119.114
Íslandsbanki	28.252.037	4.223.062	5.057.455	8.087.962	28.985.209	31.460.889	22.106.814	13.340.052	0	0	84.401.515	57.111.965
Arion	39.538.980	14.050.956	0	0	22.544.804	21.574.614	18.918.727	25.377.564	0	0	81.002.511	61.003.134
Total	132.305.363	18.885.925	17.153.676	20.897.656	73.711.513	86.240.453	75.705.625	70.210.179	0	0	298.876.177	196.234.213

Table A.3: Loans and deposits of branch groups in Iceland 1999

	Head Office		Main Branch		Capital Area		Outside Capital Area		Other		Total	
Branch Banks	Loans	Deposits	Loans	Deposits	Loans	Deposits	Loans	Deposits	Loans	Deposits	Loans	Deposits
Landsbanki	89.858.680	875.214	13.698.838	13.344.564	27.021.473	35.168.799	34.398.713	32.742.547	157	214	164.977.861	82.131.338
Íslandsbanki	141.646.283	7.226.142	6.838.821	9.707.377	35.721.393	35.077.270	22.877.936	15.304.721	32.212	25.532	207.116.645	67.341.042
Arion	57.901.412	15.077.579	0	0	28.460.854	23.627.343	23.044.205	28.664.397	0	0	109.406.471	67.369.319
Total	289.406.375	23.178.935	20.537.659	23.051.941	91.203.720	93.873.412	80.320.854	76.711.665	32.369	25.746	481.500.977	216.841.699

Table A.4: Loans and deposits of branch groups in Iceland 2000

	Head Office		Main Branch		Capital Area		Outside Capital Area		Other		Total	
Branch Banks	Loans	Deposits	Loans	Deposits	Loans	Deposits	Loans	Deposits	Loans	Deposits	Loans	Deposits
Landsbanki	109.150.395	1.035.862	15.033.295	16.069.976	31.509.112	42.664.334	37.030.991	37.875.058	4.145	-13.873	192.727.938	97.631.357
Íslandsbanki	172.816.477	4.600.584	6.653.854	16.913.368	38.898.266	38.366.117	23.547.050	16.721.851	43.905	163.925	241.959.552	76.765.845
Arion	72.603.439	20.538.687	0	0	35.407.932	27.748.852	26.568.018	28.611.364	0	0	134.579.389	76.898.903
Total	354.570.311	26.175.133	21.687.149	32.983.344	105.815.310	108.779.303	87.146.059	83.208.273	48.050	150.052	569.266.879	251.296.105

Table A.5: Loans and deposits of branch groups in Iceland 2001

	Head Office		Main Branch		Capital Area		Outside Capital Area		Other		Total	
Branch Banks	Loans	Deposits	Loans	Deposits	Loans	Deposits	Loans	Deposits	Loans	Deposits	Loans	Deposits
Landsbanki	112.558.689	357.826	15.621.501	17.995.506	29.492.165	46.984.213	33.820.106	41.544.246	3.349.139	7.593	194.841.600	106.889.384
Íslandsbanki	164.496.728	2.666.619	5.899.929	14.362.040	40.592.038	48.914.978	24.048.519	18.480.094	47.835	237.754	235.085.049	84.661.485
Arion	84.318.842	21.325.305	0	0	37.741.365	31.862.921	29.557.888	33.735.663	0	0	151.618.095	86.923.889
Total	361.374.259	24.349.750	21.521.430	32.357.546	107.825.568	127.762.112	87.426.513	93.760.003	3.396.974	245.347	581.544.744	278.474.758

Table A.6: Loans and deposits of branch groups in Iceland 2002

	Head Office		Main Branch		Capital Area		Outside Capital Area		Other		Total	
Branch Banks	Loans	Deposits	Loans	Deposits	Loans	Deposits	Loans	Deposits	Loans	Deposits	Loans	Deposits
Landsbanki	179.430.570	4.555.402	16.424.133	26.295.654	32.290.324	54.252.988	32.453.555	50.265.305	2.830.697	698	263.429.279	135.370.047
Íslandsbanki	201.984.575	10.249.697	6.113.542	21.747.364	43.362.677	56.149.631	24.937.346	22.040.675	31.185.429	160.645	307.583.569	110.348.012
Arion	180.973.000	45.265.000	0	0	33.292.000	32.814.000	35.281.000	41.108.000	0	0	249.546.000	119.187.000
Total	562.388.145	60.070.099	22.537.675	48.043.018	108.945.001	143.216.619	92.671.901	113.413.980	34.016.126	161.343	820.558.848	364.905.059

Table A.7: Loans and deposits of branch groups in Iceland 2003

	Head Office		Main Branch		Capital Area		Outside Capital Area		Other		Total	
Branch Banks	Loans	Deposits	Loans	Deposits	Loans	Deposits	Loans	Deposits	Loans	Deposits	Loans	Deposits
Landsbanki	312.144.365	12.891.330	22.801.498	33.639.254	54.043.745	65.720.113	40.784.006	56.500.994	3.158.946	6.642	432.932.560	168.758.333
Íslandsbanki	279.251.836	21.446.410	10.018.617	22.235.996	53.805.653	63.463.937	29.854.233	24.587.198	66.171.200	728.019	439.101.539	132.461.560
Arion	265.111.000	28.682.000	8.064.000	13.596.000	28.449.000	37.476.000	27.328.000	33.186.000	0	0	328.952.000	112.940.000
Total	856.507.201	63.019.740	40.884.115	69.471.250	136.298.398	166.660.050	97.966.239	114.274.192	69.330.146	734.661	1.200.986.099	414.159.893

Table A.8: Loans and deposits of branch groups in Iceland 2004

A.4 Arion Bank Branches

The difference shown here is a percentage calculated $deposits/loans - 1$, it is shown as red if there are more loans than deposits. The data is from the FME reports 1997 - 2004.

Arion Bank Branches Outside Capital Area

Branch	Loans	Deposits	Difference
Akureyri	1891319	1951995	3,21%
Egilsstaðir	870251	1224540	40,71%
Blönduós	1135211	1589956	40,06%
Hella	1741410	2796283	60,58%
Stykkishólmur	926587	874997	-5,57%
Sauðárkrókur	3104533	2828909	-8,88%
Búðardalur	317444	819634	158,20%
Hveragerði	493430	572338	15,99%
Hólmavík	405105	471016	16,27%
Vík í Mýrdal	267392	690234	158,14%
Grundarfjörður	235429	297473	26,35%
Selfoss	656319	1525948	132,50%
Borgarnes	887092	319576	-63,97%
Akranes	994464	983869	-1,07%
Total	13925986	16946768	21,69%

(a) 1997

Arion Bank Branches Outside Capital Area

Branch	Loans	Deposits	Difference
Akureyri	2127088	2094377	-1,54%
Egilsstaðir	1057054	1297214	22,72%
Blönduós	1287300	1382081	7,36%
Hella	2238293	3024909	35,14%
Stykkishólmur	1037844	864590	-16,69%
Sauðárkrókur	3243426	2726046	-15,95%
Búðardalur	370664	830030	123,93%
Hveragerði	584813	564591	-3,46%
Hólmavík	427992	791369	84,90%
Vík í Mýrdal	302651	679528	124,53%
Grundarfjörður	426599	398483	-6,59%
Selfoss	994068	1525578	53,47%
Borgarnes	1142185	326620	-71,40%
Akranes	1151226	1069788	-7,07%
Total	16391203	17575204	7,22%

(b) 1998

Arion Bank Branches Outside Capital Area

Branch	Loans	Deposits	Difference
Akureyri	2367454	2330990	-1,54%
Egilsstaðir	1227594	1449038	18,04%
Blönduós	1355992	1466758	8,17%
Hella	2787441	3512281	26,00%
Stykkishólmur	1112453	859999	-22,69%
Sauðárkrókur	3219468	8827224	174,18%
Búðardalur	416470	900396	116,20%
Hveragerði	723491	857712	18,55%
Hólmavík	647276	575406	-11,10%
Vík í Mýrdal	326277	760458	133,07%
Grundarfjörður	426642	444778	4,25%
Selfoss	1364011	1753771	28,57%
Borgarnes	1575776	447582	-71,60%
Akranes	1368382	1191171	-12,95%
Total	18918727	25377564	34,14%

(c) 1999

Arion Bank Branches Outside Capital Area

Branch	Loans	Deposits	Difference
Akureyri	2677997	2587594	-3,38%
Egilsstaðir	1364929	1669546	22,32%
Blönduós	1758116	1538333	-12,50%
Hella	3203844	4144133	29,35%
Stykkishólmur	1172764	1075163	-8,32%
Sauðárkrókur	3904199	9303250	138,29%
Búðardalur	554834	931045	67,81%
Hveragerði	906339	922214	1,75%
Hólmavík	623294	555215	-10,92%
Vík í Mýrdal	615030	1433231	133,03%
Grundarfjörður	555762	429270	-22,76%
Selfoss	1898154	1880628	-0,92%
Borgarnes	2116105	585831	-72,32%
Akranes	1692838	1608944	-4,96%
Total	23044205	28664397	24,39%

(d) 2000

Table A.9: Arion Bank Branches Outside of Capital Area 1997 - 2000

Arion Bank Branches Outside Capital Area

Branch	Loans	Deposits	Difference
Akureyri	2994988	2823542	-5,72%
Egilsstaðir	1422775	1859202	30,67%
Blönduós	1668855	1827598	9,51%
Hella	4262409	4741425	11,24%
Stykkishólmur	1463192	1107837	-24,29%
Sauðárkrókur	4294165	6915475	61,04%
Búðardalur	816198	1069267	31,01%
Hveragerði	1075089	998409	-7,13%
Hólmavík	667808	720133	7,84%
Vík í Mýrdal	668247	1578530	136,22%
Grundarfjörður	637589	524059	-17,81%
Selfoss	2131349	1956386	-8,21%
Borgarnes	2728096	800793	-70,65%
Akranes	1737258	1688708	-2,79%
Total	26568018	28611364	7,69%

(a) 2001

Arion Bank Branches Outside Capital Area

Branch	Loans	Deposits	Difference
Akureyri	3404675	3098305	-9,00%
Egilsstaðir	1315736	1971437	49,84%
Blönduós	2153542	1998496	-7,20%
Hella	5074442	4962139	-2,21%
Stykkishólmur	1568490	1263691	-19,43%
Sauðárkrókur	4447394	10356454	132,87%
Búðardalur	873708	1150517	31,68%
Hveragerði	1317977	979871	-25,65%
Hólmavík	733122	709987	-3,16%
Vík í Mýrdal	732438	1622812	121,56%
Grundarfjörður	668953	525474	-21,45%
Selfoss	2535867	2279016	-10,13%
Borgarnes	2783420	970397	-65,14%
Akranes	1948124	1847067	-5,19%
Total	29557888	33735663	14,13%

(b) 2002

Arion Bank Branches Outside Capital Area

Branch	Loans	Deposits	Difference
Akureyri	3840000	3555000	-7,42%
Egilsstaðir	1427000	2259000	58,30%
Blönduós	1793000	2380000	32,74%
Hella	5166000	5242000	1,47%
Stykkishólmur	1322000	1346000	1,82%
Sauðárkrókur	4033000	12182000	202,06%
Búðardalur	851000	1179000	38,54%
Hveragerði	1483000	1130000	-23,80%
Hólmavík	698000	772000	119,04%
Vík í Mýrdal	767000	1680000	119,04%
Grundarfjörður	5785000	3909000	-32,43%
Selfoss	2840000	2243000	-21,02%
Borgarnes	3156000	1150000	-63,56%
Akranes	2120000	2081000	-1,84%
Total	35281000	41108000	16,52%

(c) 2003

Arion Bank Branches Outside Capital Area

Branch	Loans	Deposits	Difference
Akureyri	3750000	4160000	10,93%
Egilsstaðir	1300000	2664000	104,92%
Blönduós	913000	2714000	197,26%
Hella	5020000	5087000	1,33%
Stykkishólmur	1211000	1457000	20,31%
Sauðárkrókur	2931000	4991000	70,28%
Búðardalur	755000	1342000	77,75%
Hveragerði	941000	1163000	23,59%
Hólmavík	714000	785000	9,94%
Vík í Mýrdal	873000	1823000	108,82%
Grundarfjörður	1103000	716000	-35,09%
Selfoss	3947000	2737000	-30,66%
Borgarnes	2255000	1222000	-45,81%
Akranes	1615000	2325000	43,96%
Total	27328000	33186000	21,44%

(d) 2004

Table A.10: Arion Bank Branches Outside of Capital Area 2001 - 2004

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ISSN 1670-8539