Kiss Me Deadly:

From Finnish Great Depression to Great Recession[*]

Adam Gulan, Markus Haavio, Juha Kilponen[†]

Very preliminary version
January 31, 2014

Abstract

In this paper we investigate the causes of the Finnish Great Depression and, more broadly, the drivers of the Finnish business cycle over the last quarter century. We assess the importance of real and financial shocks as well as the channels and amplifying mechanisms through which these shocks propagate.

To do this, we estimate a SVAR model, where the shocks are identified through the sign restrictions methodology. We address some of the outstanding issues in the model choice procedure and offer improvements. In the context of partial identification, we argue for a selection criterion based on median historical decomposition.

We find strong evidence for interactions between financial and real variables. Our results suggest that financial factors contribute to macro dynamics not only through shocks, but also as amplifiers of real shocks. The exercise also reveals very diverse causes of the recent recessions in Finland. Whereas in the early 1990s domestic financial factors contributed substantially to the boom-bust cycle, external shocks played a key role during the Great Recession.

Keywords: Financial frictions; Macro-financial linkages; Sign restrictions; Finnish economy; Finnish Great Depression

JEL Classification: E44; C32; O52

1 Introduction

Finnish economy has experienced three major recessions over the last 25 years, all very different in nature. The turn of the century witnessed a burst of the dot-com bubble in a "Nokia economy". The country was also severely hit by a global financial crisis of 2007–2008 and the Great Recession it triggered. However, the foremost episode was the prolonged contraction of the early 1990s. This "Finnish Great Depression" was preceded by major credit and asset price booms and witnessed a collapse of Finnish–Soviet trade, currency devaluation and a full-fledged banking crisis. Between 1989 and 1994 gross domestic product declined by 12.5 percent, stock markets fell by 67 percent while the unemployment rate increased from 3.4 percent up to 17.9 percent.[1] Similarly to the U.S. Great Depression of the 1930s, there has been a multitude of explanations offered on its causes. For example, the "From Russia with Love" argument[2] blames the depression on real external shocks, whereas e.g. Honkapohja and Koskela (1999) point to mistakes in monetary policy. However, the debate remains unsettled in our opinion, since we are not aware of studies which confront these hypotheses and let them compete. Also, the episode received overall relatively little attention beyond the circles of policy makers and Nordic economists.

In this paper we take a more agnostic approach than some of the previous studies on the Finnish Great Depression, both purely narrative and highly structural ones. We allow the data to speak more freely by estimating an SVAR model in which we identify several structural shocks: both real and financial, on both the supply and demand sides. Importantly, we are able to study propagation mechanisms of the shocks and the role of macro-financial linkages.

Our exercise yields several interesting results. We do find a considerable role of the collapse of Finnish–Soviet trade around 1990–1991. However, we find an even stronger impact of shocks which capture a collapsing banking sector and the asset price bust. Moreover, a major asset price boom fueling domestic demand was the main driver of the GDP at the run-up to the crisis. Our counterfactual simulations suggest that without shocks and amplification mechanisms stemming from the domestic financial sector, the collapse of Finnish–Soviet trade would have had a considerably smaller impact on the Finnish economy. It was the eponymous "deadly kiss" of the financial sector that turned the Finnish economy into a true film noir in the early 1990s.

We also have a broader look at the economic developments in Finland over the last quarter century. With a record of two major crises and one recession within just two decades the Finnish experience constitutes an excellent laboratory for the study of business cycles' driving forces, macroeconomic policy choices and, most importantly, the macro-financial linkages.

We find strong evidence for interactions between financial and real variables not only during the Finnish Great Depression. The VAR estimates suggest that financial variables affect the real economy not only in

---

[1]Each number denotes the difference between peak and trough within that period.

[2]See Gorodnichenko et al. (2012).

the form of shocks, but also as amplifiers of real shocks. These mechanisms play an important role during the crisis of 1990-1993. Without a feedback from domestic financial variables to the rest of the economy, the drop in GDP dynamics would have been considerably (approximately three percentage points) smaller. Nevertheless, the Great Recession in Finland was very different than early 1990s. The drop of GDP is attributed solely to external shocks — an increase in global financial stress and a slump in global demand. In fact, the negative external demand shocks were much stronger (although much more short lived) than those associated with the collapse of Finnish–Soviet trade. A comparison of these two episodes lends strong support to the hypothesis that financial crises of domestic origin, possibly including a banking crisis and preceded by inflated asset prices and high debt levels of the private sector, have a protracted effect on the real economy and are followed by slow recoveries.[3]

On the methodological side, we offer some improvements to estimating and selecting sign-restricted VAR models. Our focus is on partially identified models, i.e. ones in which the number of identified structural shocks is smaller than the number of variables. We start with solving the "multiple shocks problem" highlighted by Fry and Pagan (2011). In order to properly identify the shocks defined through sign restrictions, one has to reject all draws of the rotation matrix, for which any of the shocks in the non-identified block delivers impulse responses which are consistent with any of the sign-identified shocks. We refer to this as "FP filter". Secondly, we stress that in partially-identified models there is no one-to-one mapping between impulse response functions and the historical decomposition. In other words, there is a multitude of models that can deliver the same paths of impulse responses. All these models will replicate the same historical data through different paths of (identified) structural shocks. In consequence, a model selected based on its proximity to the pointwise impulse response median delivers no meaningful path of structural shocks and hence historical decomposition. Our proposed remedy to this problem is to construct an alternative pointwise median of historical shock contributions. The final model is then selected based on proximity to this "historical decomposition (HD) median". Finally, we show how the algorithm of searching for suitable rotation matrices can be accelerated. This efficiency improvement can be achieved by permuting the order of columns in every candidate rotation matrix which is to be checked for its conformity with the sign restrictions.

Our work is at the intersection of many literature strands, apart from that on sign-restricted VARs.[4] First, we contribute to the growing empirical research body on financial market imperfections and their role during major economic crises. The early theoretical literature tended to stress the disruptions between lenders and borrowers by tacitly assuming no frictions between intermediaries and lenders (Bernanke and Gertler, 1989 and Kiyotaki and Moore, 1997). Recent debate, in turn, focuses on the role of financial intermediaries and their balance sheets (Gertler and Kiyotaki, 2010). Our empirical exercise allows to shed some light on the

---

[3]See Jordà et al. (2011). These authors do not include Finland in their sample of countries.

[4]We skip the review of papers on sign restrictions methodology and instead refer the reader to Fry and Pagan (2011) who provide a thorough and critical overview of this literature.

relative roles and interactions between borrowers' and intermediaries' balance sheets, theoretically modeled by Holmström and Tirole (1997). In particular, we are able to study phenomena such as a "collateral squeeze" or a "credit crunch" and say more about which financial frictions actually matter.

Our paper also extends this literature on the methodological side. In particular, our selection of variables combined with sign restriction identification schemes allows us to identify loan supply and demand shocks. It is therefore complementary to some recent studies, including Ciccarelli et al. (2010), Lown and Morgan (2006) and Bassett et al. (2010). In distinction to these studies, our analysis focuses on a small open economy which allows us to analyze the degree and channels through which global financial stress or a recession propagate domestically.

Secondly, we contribute to the debate on the Finnish Great Depression and its origins. Financial liberalization that triggered vast capital inflows and fueled stock and housing market bubbles has been pointed to as the initial culprit (Vihriälä, 1997) which led to a Fisherian debt–deflation spiral (Kiander and Vartia, 1996). However, the Finnish downturn was much more severe than that of Sweden after a somewhat similar credit boom. This led many to blame the depression on the breakdown of trade with the USSR in 1991 (Tarkka, 1994). Other authors pointed to the maintenance of a fixed exchange rate with the use of sky–high interest rates (Honkapohja and Koskela, 1999). Many interesting narrative essays on the episode have also been collected in Jonung et al., eds (2009).

However, the period was much less a subject of a comprehensive quantitative assessment. We are aware of three papers that apply structural dynamic frameworks to analyze this episode. Two of them, Gorodnichenko et al. (2012) and Conesa et al. (2007), work within the real business cycle framework. According to the former study, the depression should be blamed on the collapse of the Finnish–Soviet trade and an adverse oil price shock, amplified by a rigid labor market. The latter points to an increase in taxes on labor and consumption combined with higher government spending. Freystätter (2011) instead employs a New Keynesian model with a financial accelerator and considers three scenarios: a lending boom, a trade collapse and an exchange rate devaluation. A common denominator of all these studies is that they are illustrations of how well can different mechanisms account for the actual economic dynamics in Finland under certain calibrations.

This paper is divided into five sections including this introduction. In section 2 we introduce the model. We present the sign restriction methodology and discuss the strategy of identifying structural shocks. In section 4 we explain in detail the data used in estimation. The estimation results are then presented in section 5. We briefly discuss the properties of the estimated model by studying impulse responses. We then move to historical shock decompositions. We have a close look at the Finnish Great Depression. We also conduct some counterfactual simulations which assess the importance of financial factors for business cycle dynamics. Concluding remarks are given in section 6. Appendix 7 documents in detail the impulse response properties of the model.

2 The Model and Shock Identification

Our empirical strategy is to estimate a partially identified VAR model for a small open economy. The 9 variables that we choose can be put into three main groups: a foreign and two domestic. The foreign bloc consists of two variables, i.e. a measure of global financial stress as well as external demand for Finnish exports. The second bloc is the standard New Keynesian monetary VAR variables, i.e. the real output, inflation and an interest rate measure. Finally, we include a group of four financial variables — stock and house prices, the quantity of new loans and loan losses. This set of variables will allow us to identify four domestic shocks: aggregate demand shock, aggregate supply shock, asset price shock and loan supply shock (see subsection 3 for details).

The bivariate foreign block is assumed to be fully exogenous to the domestic part. Shocks to global financial stress and to external demand are identified through Cholesky decomposition, in which stress is ordered first. We additionally impose ex ante zero restrictions on the relevant coefficients of the transition matrix. In particular, the global stress indicator is assumed to be fully exogenous to all other variables in the model, so it is effectively an AR(1) process. Global demand for Finnish exports affects all domestic variables. It is affected by financial stress (on impact and beyond), but not by any of the domestic variables at any time.

Specifically, the reduced–form VAR(1) model is of the following form:

$$y_t = Ay_{t-1} + u_t \tag{1}$$

where y_t is a vector of $N = 9$ variables and the reduced–form errors are $u_t \sim N(0, \Sigma)$. Structural shocks are then linked to the errors through some structural identification matrix W, so that $u_t = W\varepsilon_t$ with $\Sigma = WW'$. Imposing ex ante exogeneity restrictions on the foreign block involves then setting $a_{1,2}, ..., a_{1,N} = 0$ and $a_{2,3}, ..., a_{2,N} = 0$ in the reduced form model.

2.1 Sign restrictions methodology

We apply the sign restriction methodology to identify four shocks in the 7-variate domestic block. The method involves imposing a set of restrictions on the signs of impulse response functions. Based on economic theory one may e.g. postulate that a particular variable should go up on impact (and possibly also in the next p periods) after a given structural shock. This allows to identify up to N structural shocks in an N-variate VAR. In practice, the identification procedure begins with the standard Cholesky decomposition $\Sigma = BB'$. Now, consider a draw of some matrix M from a multivariate standard normal distribution. The QR decomposition of M yields an orthonormal matrix Q, called a rotation matrix, such that $QQ' = I$. Hence,

$$\Sigma = BB' = BIB' = BQQ'B'$$

so that $W = BQ$ and $u_t = BQ\varepsilon_t$. Therefore, any draw of M (or, effectively, Q) gives rise to a different structural model. Now, one has to retain only these draws of Q, which give rise to the desired impulse response patterns and discard all other draws.

At this stage though, the identification is not exact. This is because there exists an infinity of structural models (and Q rotation matrices) that potentially satisfy the sign restrictions imposed by the researcher. This is what Fry and Pagan (2011) refer to as "multiple models problem". They suggest to select the final model from the set of admissible candidates which is closest to the pointwise median of impulse response functions. To be specific, let $\bar{\Theta}_{n,j,t}$ be the median (over all admissible models) of normalized impulse responses of the n-th variable after shock j at time t. In principle, these medians can come from different models for each n, j and t. The chosen model x^* is then one which minimizes the square distance of all its impulse responses to the median:

$$x^* = \arg \min \sum_{n}^{N} \sum_{j}^{J} \sum_{t=1}^{T} (\Theta_{n,j,t}^x - \bar{\Theta}_{n,j,t})^2 \tag{2}$$

where T is the desired impulse response horizon over which the criterion is applied. We set $T = 20$ in our estimations.

The method presented above assumes that the minimization is performed only over the set of identified shocks, whose number is J. If this number is strictly smaller than the number N of variables in the VAR, then the Q rotation matrix can be paritioned into $Q = [Q_{ID}|Q_{NID}]$, where the first block has J columns and generates responses to the identified shocks. Then, however, what the method achieves is only to select some optimal path of impulse responses, rather than an optimal model. This is because there is a continuum of tuples (A, Σ, Q_{ID}) that deliver the same path of impulse responses Θ_{ID}^* for the identified shocks that is closest to the pointwise medians.[5] An important consequence of this multitude of models is that one is still not able to recover a unique historical shock decompostion. To see this, consider two models that deliver the same, optimal path of impulse responses Θ_{ID}^*:

$$\Theta_{ID}^* = (I - A(L))^{-1} BQ_{ID} \equiv \left(I - \tilde{A}(L)\right)^{-1} \tilde{B}\tilde{Q}_{ID} = \tilde{\Theta}_{ID}^* \tag{3}$$

Now, because the matrix BQ_{ID} has dimensions $N \times J$, i.e. is not full rank, then it follows that the mapping from BQ_{ID} to $Q_{ID}'B^{-1}$, which defines the historical decomposition, is not unique. In other words, equation 3 does not imply the following equivalence:

$$\varepsilon_t^{ID} = Q_{ID}'B^{-1}(I - A(L)) y_t \equiv \tilde{Q}_{ID}'\tilde{B}^{-1}\left(I - \tilde{A}(L)\right) y_t = \tilde{\varepsilon}_t^{ID} \tag{4}$$

Therefore, if the researcher is more concerned about some particular historical decomposition than a specific path of impulse responses, as it is in our case, one can consider another model selection criterion.

---

[5]Inoue and Kilian (2013) perform numerical integration over all these observationally equivalent models in the context of Bayesian estimation. This enables them to assess the posterior probability of a particular set of impulse responses, but doesn't pin down a unique (A, Σ, Q_{ID}).

The criterion involves choosing a model that is closest to the normalized pointwise medians of historical shock contributions. To be specific, let $\tilde{\theta}_{n,j,t}$ be the cummulative effect of shock j on variable n until period t, obtained through the vector MA representation. For the purpose of model selection, we take into account only the J identified shocks. Unidentified $N - J$ shocks, initial conditions carried over from period $t = 0$ of the decomposition, as well as the constant of the VAR are ignored. The $\tilde{\theta}_{n,j,t}$ contributions are then normalized by their respective standard deviations $\sigma_{n,j}$, i.e. $\theta_{n,j,t} = \tilde{\theta}_{n,j,t}/\sigma_{n,j}$, where $\sigma_{n,j}$ are computed across all models and periods. The model choice criterion is then

$$x^{**} = \arg\min \sum_n^N \sum_j^J \sum_{t=1}^T (\theta_{n,j,t}^x - \bar{\theta}_{n,j,t})^2 \tag{5}$$

where, as before, the bar denotes a median. In the applied part of our project we restrict ourselves to minimizing the criterion only for the GDP series, rather than for all N variables.

2.2 Multiple shocks problem

The fact that we identify four structural shocks among the seven domestic variables means that the VAR is only partially identified. In general, partial identification with sign restrictions gives rise to the multiple shocks problem, as discussed in Fry and Pagan (2011), sec. 3.1.2. The problem arises because a candidate draw of Q may generate the same impulse response patterns for the unidentified shocks as for the identified ones. To illustrate with an example, consider a 3-variate example model in which we identify two shocks using the following scheme:

$$\begin{bmatrix} + & - & ? \\ + & + & ? \\ + & + & ? \end{bmatrix}$$

Consider now two candidate matrices Q^1 and Q^2 which generate, respectively,

$$W^1 = \begin{bmatrix} + & - & + \\ + & + & + \\ + & + & + \end{bmatrix} \quad \text{and} \quad W^2 = \begin{bmatrix} + & - & + \\ + & + & - \\ + & + & + \end{bmatrix}$$

.

In the case of Q^1, it is not possible to separate the first shock from the third. Importantly for this paper, any variance or historical decomposition based on such Q^1 matrix will be flawed, because the ostensibly identified first shock cannot be disentangled from the third one. To eliminate this problem, we apply another filter, which can be dubbed "FP filter", to the set of Q candidate matrices. In particular, we discard all Q^1-type candidates, i.e. those for which the unidentified shocks are not orthogonal to any of the identified

ones. We retain only Q^2-types. In these cases, although we formally do not identify the third shock, we know that it is orthogonal to the identified ones (the first and the second columns). This guarantees that our identified shocks are not contaminated by any unidentified ones in the decomposition exercises.

3   Domestic shocks

In addition to the two external shocks (financial stress and external demand), we identify the following four shocks using the sign restriction methodology: aggregate demand, aggregate supply, asset prices and loan supply. Table 1 summarizes the response restrictions of the 7 domestic variables that we impose to identify the shocks. The sign of the response is required to hold on impact and for at least $p = 1$ periods after the shock.

Table 1: Sign restrictions for positive domestic shocks.

Variable	Shock type			
	Aggregate demand	Aggregate supply	Asset price	Loan supply
GDP	+	+	+	+
Inflation	+	−	+	?
Stock prices	+	+	+	+
New loans	+	?	+	+
Interest rate spread	+	?	−	−
House prices	+	?	+	+
Loan losses	?	−	−	+

Aggregate demand shock: The postulated reaction of the variables after aggregate demand and aggregate supply shocks is fairly standard. What distinguishes them on the real side is that the price level should go up after a demand shock but drop after the aggregate supply shock. Additionally, we require that interest rate spreads go up after the aggregate demand shock. Therefore, we assume that the reaction of monetary policy is not immediate and so the lending rates go up, while the interbank rates remain unaffected for at least one period after the shock.[6] Stock prices should arguably go up, reflecting higher profitability of firms. This in turn should strengthen collaterals and increase lending, as it is the case in models with a financial accelerator, e.g. Bernanke et al. (1999). House prices are likely to go up as a direct effect of a higher demand for housing

---

[6] The reason why we are able to make this assumption is the fact that Finland was on a fixed exchange rate regime until 1992. Monetary policy focused on currency movements rather than on the domestic demand (as it is the case in the Taylor rule). Similarly, starting 1996, Finland entered ERM2 and later the Eurozone. It is a plausible assumption that the European Central Bank does not immediately react to idiosyncratic Finnish demand shocks.

as well as indirectly, due to a better access to loans. At the same time, we do not impose restrictions on loan losses. Losses may go up if their volume and average quality deteriorates. However, the wealth effects may actually improve private balance sheets (e.g. due to higher stock prices) and reduce the number of insolvencies. This last argument applies both to firms and households.

Aggregate supply shock: According to our specification, aggregate supply shocks should increase stock prices, reflecting higher competitiveness and, in the case of some degree of price stickiness, profitability. However, the impact on lending volumes is less certain. On the one hand, higher productivity may trigger new investment, partly financed by increased lending. On the other hand, it allows firms to operate at lower costs, increase profits and increase equity financing. Since the reaction of loan demand is not clear, it is also hard to argue whether the lending rate (and so the spread) would move. We also assume, as in the case of the aggregate demand shock, that monetary policy reaction will not be effective within two quarters after the shock, so the spread will not be affected though movements in the policy or interbank rate (see footnote 6). However, we think it is plausible that loan losses will fall in the short run, given better conditions of the firms. Finally, the reaction of house prices is unclear. This is because a productivity shock is not likely to affect the housing sector per se. If it did, house prices should fall. It is likely, though, that the supply shock occurs in other sectors of the economy, making housing a relatively more expensive good.

Asset price shock: In our interpretation, an asset price shock is one which occurs on many markets instantaneously, i.e. it would affect both house and stock prices in the context of our VAR. Our asset price shock is intended to reflect asset price movements which are not due to changes in current fundamentals. This may be news about the future or possibly some market exuberance and bubbles. A positive shock will generate responses similar to demand shocks in many dimensions. GDP should respond positively as the shock generates positive wealth effects and stimulates both domestic demand (e.g. by households) and production. Higher demand puts in turn an upward pressure on the general price level as in Bernanke and Gertler (2001), i.e. bubbles may be inflationary, as suggested by the Finnish experience from late 1980s (or in many troubled European countries in the first decade of 2000s) suggests. The shock also translates into higher collateral values. As balance sheets of firms and households improve, lending rates go down, which reduces interest rate spreads. New loan volume should go up and defaults decrease. Loan losses might decrease also because higher price levels reduce the real burden of nominal loan contracts for debtors (e.g. Fisher, 1933).

Note that the impact on spreads allows us to identify the asset price shock from a standard aggregate demand shock. In the former case, the rising collateral values and improved balance sheets have a direct impact and allow borrowers to take on cheaper loans. In the case of a standard aggregate demand shock this channel is only indirect and arguably much weaker. In consequence, the spreads go up because of a directly higher demand for loans.

Secondly, because the shock affects both stock and house prices simultaneously, it will not likely play a

significant role in episodes where the housing and stock markets behaved very differently, e.g. during the dot–com bubble. The advantage of this approach is that, if anything, our historical decomposition results will be biased against the hypothesis that financial shocks play an important role over the business cycle. We discuss this issue further in the results section on the historical decomposition.

Finally, it is worth mentioning, that neither the demand, nor the asset price shock are likely to be contaminated by monetary policy shocks. In Finland, lending rates are flexible so there is a quick pass–through from policy rates to lending rates (see Kauko, 2005). As a result, our spread variable should not react after a monetary policy shock.

Loan supply shock: A positive shock stemming from the sector of financial intermediaries, i.e. a loan supply shock, has arguably a similar effect on most of the variables as the stock price shock. However, a larger quantity of loans available would, ceteribus paribus, increase the amount of bad loans. In fact, the shock may reflect changes in effective lending standards. The variable on loan losses allows us therefore to distinguish between asset price shocks and loan supply shocks. In particular, we are able to identify collateral squeezes (negative asset price shocks) from credit crunches (negative loan supply shocks).

4   Data

In this section we provide more detail regarding the time series used in estimation. The dataset is of quarterly frequency and spans from 3Q 1985 until 3Q 2011. All series are stationary and, where appropriate, deflated by the GDP deflator. All growth rates are computed year over year (YoY).

Stress: The indicator of global stress that we use is the Composite Indicator of Systemic Stress (CISS), constructed by Holló et al. (2012). The index is constructed from 15 individual measures of financial stress, which mainly include volatilities of realized asset returns and risk spreads as well as measures of cumulated losses.[7] These measures give rise to five subindices which describe five segments of the financial market: financial (bank and non–bank) intermediaries sector, money market, bond market, equity as well as exchange rate markets. The CISS index then takes into account correlations between these markets and puts more weight on situations in which the stress prevails on many markets simultaneously to capture the degree to which the stress is systemic. The historical performance of the index is presented in Figure 1. The series picks up all major international financial events since mid 1980s, including stock market crashes and crises. The recent financial crisis triggered by the subprime market collapse clearly dominates the picture. The series is used in levels.[8]

External demand: As a proxy for the external demand for Finnish exports, we use the Export Demand

---

[7]The CMAX measures maximum cumulated losses on a given market over a two–year moving window.

[8]The data on CISS is available only from 1Q 1987 onwards. We extrapolate the CISS data backwards until 1Q 1985 using the Financial Stress Index (FSI) of the IMF.
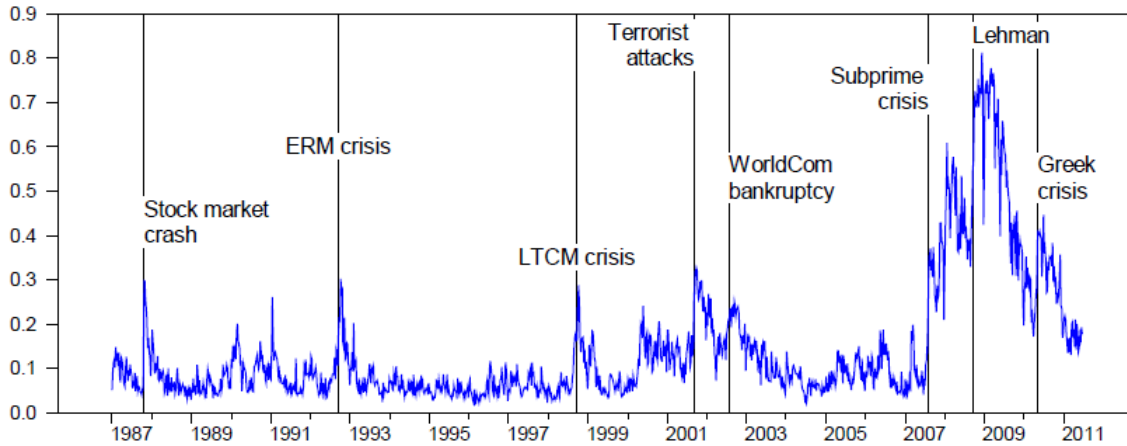
Figure 1: Composite Indicator of Systemic Stress.

Index of the ECB (see Hubrich and Karlsson (2010)). The index is constructed as a geometric average of the import volumes of the trading partners of Finland. The weights are three-year moving averages of the shares of total Finnish exports going to a particular trading partner. We use the growth rate of the series.

New Keynesian VAR components: We use standard measures, i.e. growth rates of total GDP and of the GDP deflator. For the monetary policy stance we use the spread between the lending rate on new non-financial loans and the nominal short-term interest rate (3M interbank rate), rather than the latter series itself. The motivation for this is two-fold. First, our estimation encompasses several monetary regimes (peg to ECU, float, Eurozone) which can generate structural breaks in the interest rate series, whereas the spread doesn't suffer from this problem. Secondly, the spread reflects the actual lending conditions and tightness of credit better than the short-term money market rate alone. Finally, as will be discussed later in more detail, the behavior of the spread will allow us to separately identify domestic demand and asset price shocks.

Financial variables: The final set of variables describes the Finnish financial sector. Our stock market variable is HEX25 index which tracks the performance of the 25 most traded companies on the Helsinki Stock Exchange. The development in the housing markets is measured by the house price index (deflated by the GDP deflator). The index tracks the prices of old dwellings in the whole country. The housing market and the stock market are frequently related. They co-moved quite closely until mid-1990s. Both markets experienced a price bubble in the late 1980s. However, since then the series de-coupled quite substantially. The real housing prices have been growing without major interruptions until 2008 when they fell somewhat. However, they still exhibit level similar to those observed at the peak of the 1980s boom in real terms. The stock market, on the other hand, experiences a major price bubble during the dot com era and the preponderance of the Finnish IT sector, mainly the Nokia company. The market observed another major slump in 2008. Both series are in terms of growth rates.

11

Finally, we include two variables describing the lending market - the growth rate of real new loans to households and firms as well as total loan losses the latter expressed in millions of 2000 Euros (see Pesola, 2007). We focus on new loans (flow) rather than the total loan pool (stock). Here, we take acknowledge the argument of Geanakoplos (2010) that given a large existing volume of loans, the latter indicator will be changing very slowly and will not pick up major changes in lending conditions quickly. In that sense, new loans is a much more up-to-date barometer of the loan market, especially when combined with the interest rate spread for new loans. The data on loan losses, in turn, will enable us to identify loan demand and supply shocks, an issue we turn on to next.

5 Results

The reduced-form VAR is estimated using maximum likelihood. We then take 2,000,000,000 draws of the M matrix to find 304 admissible Q decompositions, i.e. ones which satisfy sign restrictions and are not subject to the multiple shocks problem. This gives rise to 304 structural models. The reported median model of choice is selected using the methodology described in subsection 2.1. We start by reporting impulse response functions to asset price, loan supply and external demand shocks.[9] We then move to historical decompositions and to our findings on the Finnish Great Depression.

5.1 Impulse responses

Figure 2 reports the impact of a positive asset price shock.[10] Because of the exogeneity assumption, neither stress nor external demand are affected. Second, note that the interpretation of the impulse responses is slightly different from that under Cholesky identification. Relative to Cholesky ordering, here all domestic variables are affected even on impact. Since there is no asset price variable in the model, an asset price shock of one unit is interpreted as one after which stock prices go up about 3 percentage points and house price go up by 1.5 percentage points, as the figure shows. Output dynamics (real GDP growth rate) increases by 0.4 percentage points on impact. Inflation goes up by a similar magnitude. The quantity of new loans goes up by 2 percentage points, however, the effect is relatively short-lived and dies out after a 6 quarters. At the same time, the effect on loan losses is rather protracted and reaches its peak only after two years when they are smaller by €(2000) 20 million. Lending rates fall relative to policy rates by over 20 basis points and the effect on spread dies out within 12 quarters. Note also that given our identification scheme summarized in Table 1, there's no uncertainty regarding the initial sign of the reaction. Yet, there's no restriction on the magnitude of the shock and its persistence and path in latter periods.

---

[9]All other impulse responses are reported in the appendix. Bootstrapped confidence intervals will be available in the next version of the paper due to long computation time.

[10]Impulse responses to the stress shock, as well as aggregate demand and aggregate supply shocks are reported in the appendix.
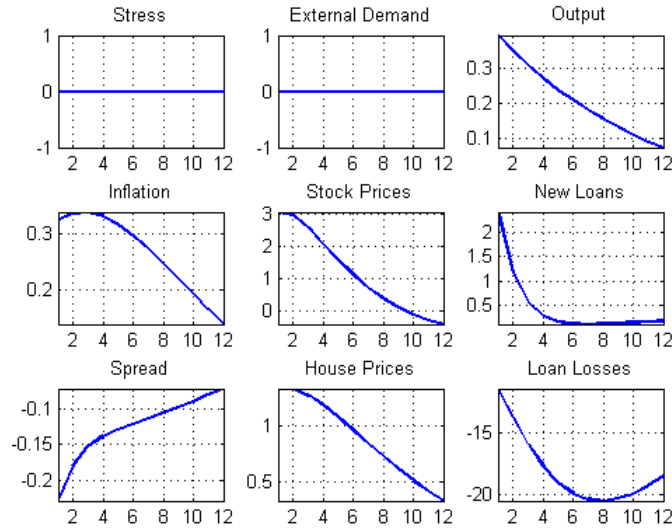
Figure 2: Impulse responses of model variables to an asset price shock.

Next, consider a shock to the loan supply, reported in Figure 3. As implied by sign restrictions, output goes up and the growth rate remains higher for 12 quarters. Both stock and house prices go up for at least three years after impact, the effect persisting somewhat longer than the shock itself. Loan losses go up initially, but they actually start falling five quarters after the shock, which could reflect stronger asset collateral values. The spread remains lower for at least three years, although its dynamics changes over time. Inflation is the only unrestricted variable. However, somewhat surprisingly, it actually goes down despite rising stock and house prices.
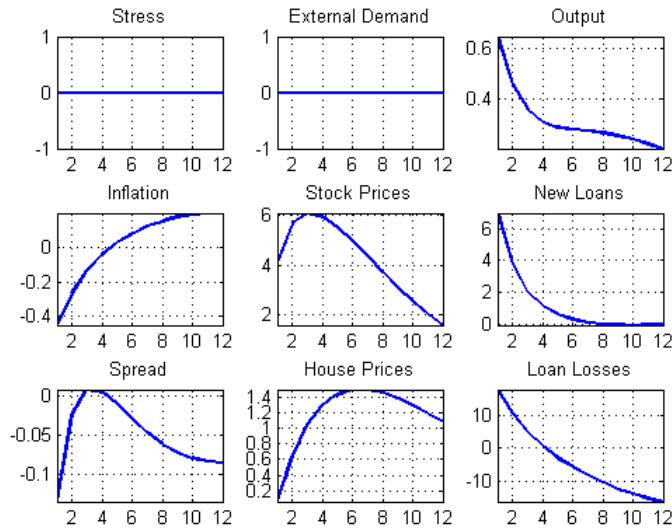

Figure 3: Impulse responses of model variables to a loan supply shock.

Finally, in Figure 4 we report the reaction of the economy to an external demand shock. Recall that this

shock is identified through exogeneity restrictions on the model rather than by sign restrictions. As expected though, output goes up in response to higher demand from abroad. Inflation falls slightly on impact, but then remains higher between second and 7th quarter after the shock. Asset (stock and housing) prices go slightly up on impact, but then actually fall for several quarters. Less surprisingly, higher demand from abroad triggers a higher demand for new loans which is accompanied by a protracted increase in the spread. However, loan losses remain lower for several periods.
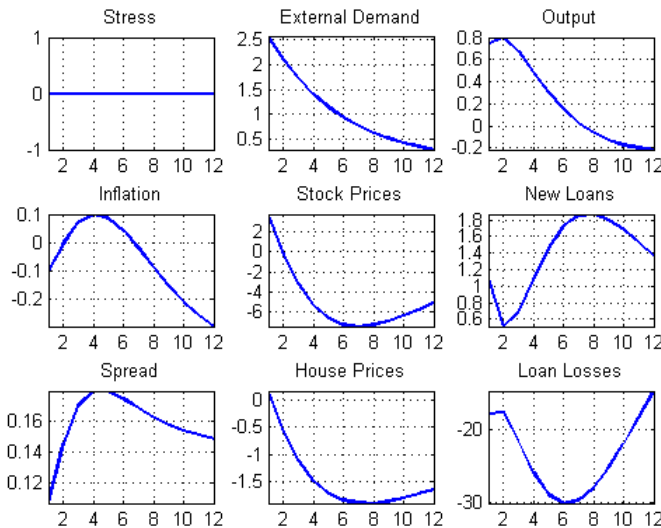
Figure 4: Impulse responses of model variables to an external demand shock.

5.2   Historical Decomposition

In this subsection we perform a shock decomposition of the Finnish GDP growth rate. The results are presented in Figure 5. The exercise allows us to make several observations. First, the accumulation of dark and medium blue bars indicates a strong role for the external shocks. This applies both to external demand, i.e. fluctuations in the demand for Finnish goods, as well as in the transmission of international financial stress to Finland. In fact, the crisis of 2008 (and, to some extent, the mild recession of 2001) was driven predominantly by exogenous factors.

The reason why external demand might play such a large role is not only because Finland is a small open economy, but also because for most of the time in our sample it was on some form of a fixed exchange rate regime, first against a trade-weighted basket and ECU until 1992 and then, from 1996 on in the ERM2 and Eurozone. Therefore it couldn't count on the flexible exchange rate as an automatic economic stabilizer, although it resorted to a devaluation in the midst of the depression. In fact, external demand shocks seem to amplify the cycle rather than dampen it in our decomposition.

Global financial distress played some minor role around 2001. However, in 2008 its impact was very large and it affected the economy even more than the contracting external demand. The recovery was then again driven by subsiding stress and a quick rebounce in external demand. It is worth noting that in neither of the two latest contractions, especially in 2008, did domestic financial factors play a substantial role. In fact, domestic contribution was almost nil during the last recession. If anything, the domestic financial factors mitigated the 2001 recession. This might come as a surprise, as this was the peak of the Nokia economy (if measured in terms of stock market valuations). One would therefore expect a large negative contribution of asset price shocks. The reason why the decomposition does not attribute a large negative role to domestic financial factors during the dot-com bubble bust may be two-fold. First, according to our identification scheme, a negative stock market shock should increase spreads through falling collateral values. However, the interest rate spread was in fact relatively low (below 1 percentage point) from 2000 until 2002. Therefore, the decomposition interprets the stock market crash rather as a negative domestic demand shock. Why didn't the spreads go up? Although the drop in Nokia share price was very pronounced, the company was largely foreign-owned and so the drop affected mainly foreign rather than Finnish balance sheets. Also, the quick pass-through from policy to lending rates in Finland doesn't leave much room for spreads to go up after policy rate cuts.[11] Secondly, it might also be due to our definition of the asset price shock. In particular, the shock should not be market-specific. According to the definition in Table 1, it should also increase house prices. Yet, around the turn of the century housing and stock prices didn't co-move and there was no bubble in the latter. In fact, the real estate market was still recovering from the depression of early 1990s. The two markets were highly correlated but only in late 1980s and early 1990s, i.e. during the boom and the subsequent bust, then they decoupled.

A final observation worth making is that the economy experienced a rather quick recovery after both of the two most recent recessions, despite their strikingly different magnitudes. This stands in sharp contrast to the experience of early 1990s. During the Finnish Great Depression domestic financial factors substantially contributed to the downturn. That contraction was also much more prolonged and hence resulted in a massive total drop in output. We discuss this episode next.

5.3 Finnish Great Depression 1990–1994

There are at least a few alternative hypotheses on the causes of the Finnish Great Depression and the debate has, in our view, not been settled. The primary reason of the multitude of hypotheses is that several negative factors came into play around the time. In the words of Honkapohja and Koskela (1999), it was a "tale of bad luck and bad policies". Our exercise puts a broader light on this debate and attempts to assess the relative importance of different factors that have been at work during and before the crisis. One of the commonly stressed external factors was the collapse of trade with the disintegrating Soviet Union in the first months of

---

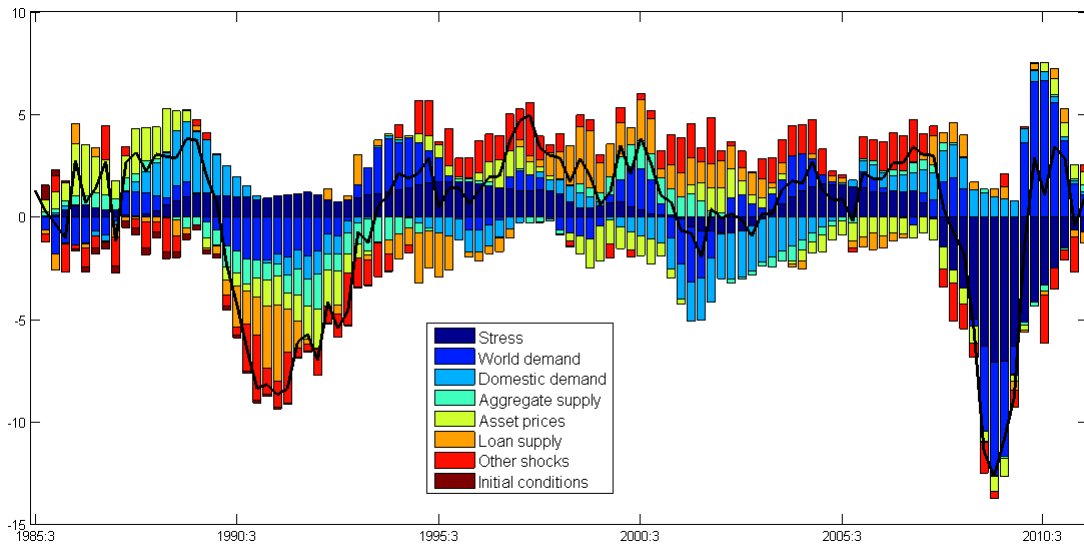[11]The ECB lowered the interest rate from 4.75% to 2% between October 2000 and June 2003.

Figure 5: Historical decomposition of the Finnish GDP growth rate.

1991. Gorodnichenko et al. (2012) argue that this factor, combined with sectoral and labor market rigidities, accounts for the bulk of the story. This is despite the fact that, as argued by Honkapohja and Koskela (1999), the collapse of eastward trade constituted only 10% of total Finnish exports, or 2.5% of GDP at that time. Given that this loss was a one-time and a rather permanent event, it can account for only a fraction of the cumulated drop of real Finnish GDP of 12.5% from its peak in 4Q 1989 to trough in 1Q 1993 or even that of 6% from 4Q 1990 to 4Q 1991.

The collapse of the trade with Soviet Union is not easily interpreted in terms of shocks. On the one hand, one can think of it as a drop in external demand. On the other, the "Soviet" sector of the Finnish economy became largely obsolete after 1991. Most small and medium production plants concentrated on Soviet markets shut down which in turn generated structural unemployment. The largest ones (e.g. in the shipbuilding industry) were partly able to switch their production profiles. This can be thought of as a strong negative domestic supply shock associated with a massive capital depreciation.[12]

The trade breakdown translated also into higher prices for imported energy for Finland since the country enjoyed a *de facto* 10% subsidy on imported crude and natural gas, as stressed by Gorodnichenko et al. (2012). Also, the invasion of Iraq on Kuwait in August 1990 caused an increase of the world price of oil for roughly three quarters. Both of these shocks can be jointly regarded as a deterioration in the Finnish terms of trade. Such drop in international competitiveness would be reflected in our data as an adverse external demand shock.

In sum, the Finnish–Soviet trade collapse may in principle appear both as a negative external demand

---

[12]In general, one could distinguish between the two shocks by looking at the prices. However, these goods, frequently of low quality, didn't find other markets to be sold to and hence stopped being produced.

16

shock or a negative domestic supply shock in our historical shock decomposition. However, both shocks are likely to be contaminated by other factors. Hence, associating the Soviet trade breakdown with both external demand and domestic supply shock will, if anything, generate a bias against an alternative hypothesis that the Depression was driven mainly by financial factors. Figure 5 indeed picks up a drop in external demand peaking at the turn of 1990. It also reveals several quarters of negative impact of domestic supply between 1990 and 1994. Yet, in sum, their total impact is smaller than that of all other factors combined. Interestingly, the decomposition doesn't pick up the other "bad luck" factor, which is the ERM crisis in September 1992 when the UK and Sweden abandoned their pegs to ECU. The financial stress has mildly positive contribution throughout that episode in our decomposition.

The largest part in the decomposition of the 1990–1994 crisis is made rather by domestic financial factors. Most sizable is the contribution of domestic loan supply shocks. The collapse of the asset price bubble also plays a rather important role. Negative loan supply shocks start dragging down the growth rate at the turn of 1990. This coincides with the drop in bank lending which peaked in winter of 1989 and collapsed a year later. To some extent it may reflect credit restriction measures introduced by the Bank of Finland over the course of 1989 as well as a tax on capital gains, which translated into tougher lending standards. The role of this shock starts fading away in 1991. This is because of loan losses which skyrocketed at the turn of that year. This is in line with our identification scheme according to which tighter credit (negative shock) should be associated with a drop in loan losses.

The run-up to the crisis was characterized by a high growth rate. The GDP was pulled up by positive shocks to asset prices, followed by increasing domestic, and to a smaller extent foreign, demand. Hence, the decomposition picks up the bubble on stock and housing markets that followed the financial liberalization in mid 1980s. It also points to strong domestic demand. However, it does not leave any room for loan supply shocks. Why? Looser credit is identified by rising loan losses. Yet, in the data, losses were kept at bay until 4Q 1990. Although our sign restriction horizon is limited to one period after impact, it is likely the case that loan losses start occurring with a lag longer than one quarter after a shock. Credit was becoming tighter already in 1989 which was quickly reflected in higher interest rate spreads, but loan losses were still small. In sum, the decomposition might be overemphasizing the role of aggregate demand shocks relative to loan supply shocks in the boom phase because loan losses react to shocks more sluggishly than interest rate spreads.

To gain further insight into the role of financial factors during the Finnish Great Depression, we construct two counterfactual scenarios. In particular, we ask to what extent was the domestic sector the actual source of shocks and to what extent was it just working as an amplifying mechanism of other shocks buffeting the economy. The results are summarized in Figure 6. The red line depicts the hypothetical GDP growth rate, if the domestic financial shocks, i.e. the asset price and loan supply shocks, were absent.[13] This is

---

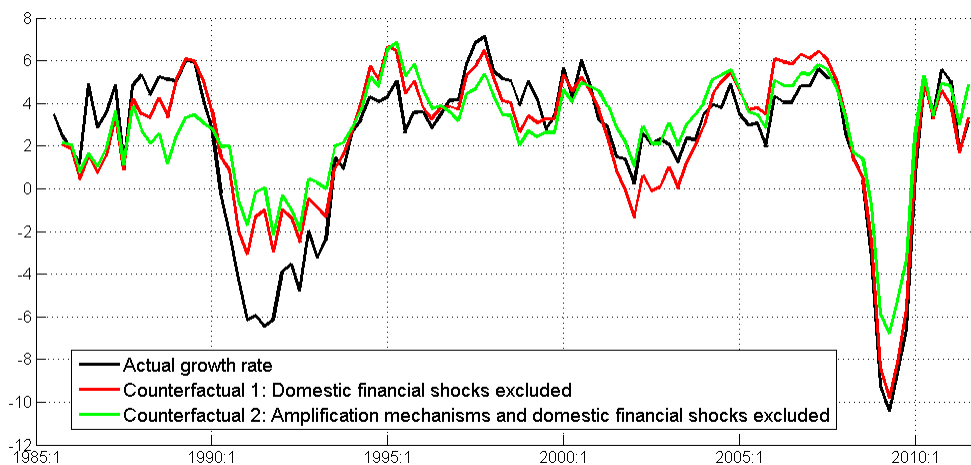[13]Technically this is done by imposing zeros on appropriate columns of the B matrix.

Figure 6: Contributions of different financial factors to the Finnish GDP growth rate.

counterfactual 1. As a result, the drop in GDP in the midst of the depression is halved. In counterfactual 2 we additionally turn off the domestic financial linkages. Technically, we impose *ex post* zero restrictions on the feedback from domestic financial variables (i.e. stock prices, house prices, new loans and loan losses) to the rest of the economy.[14] The picture improves yet further. The recession becomes very moderate between 1990 and 1992. We interpret this result as a strong evidence that financial factors indeed played an important role in deepening the Finnish Great Depression. Although we find a meaningful contribution of the external demand and domestic supply shocks, these factors explain less than a half of the total loss in GDP growth rate over this period. The financial system played at least as important role.

A large role played by domestic financial channels is also clear during the run-up to the crisis, i.e. in late 1980s. Positive financial shocks seem to add around two percentage points to the GDP growth rate in 1987 and 1988. The feedback from the financial sector to the real economy is even higher. This is mainly due to the fact that our historical decomposition attributes a large role to positive domestic demand shocks around that time.

It is also worth noting some differences between the Finnish Great Depression and other episodes over the last quarter century. During the Great Recession, the financial sector acted mainly as an amplifier of negative shocks (green line). However, these shocks were almost exclusively of foreign source (stress and external demand). The role of domestic financial shocks is essentially nil (red line vs. black line). In that sense, the latest recession was very different than the early 1990s.

In sum, we find a significant feedback from financial variables to the real economy. This feedback is most clear during boom and bust episodes. However, the role of finance is not only about shocks generated within the domestic financial sector, but also as a transmitter of real economic shocks, in a similar spirit as the

---

[14]This is done by putting zeros in the appropriate columns of the A matrix

18

Bernanke et al. (1999) financial accelerator.

6   Conclusions

In this paper we conducted an empirical study of the Finnish business cycle, focusing on the Finnish Great Depression 1990–1994. We find a strong role of macro-financial linkages in driving the business cycle, and in amplifying recessions in general, but particularly when the slump is preceded by asset and lending booms. In a counterfactual exercise in which the feedback from financial to real variables is shut down, the drop in GDP is about half of what was actually observed in early 1990s. The financial conditions in the Finnish economy at the eve of the 2007–2008 crisis were, on the other hand, very different. We find no evidence for domestically generated financial shocks around that time. It was in fact an imported recession. Nevertheless, the feedback from the financial sector to the real economy amplified the recession substantially, although to a lesser extent than in early 1990s.

We conclude with a more general comment. It has been correctly remarked by Jonung et al., eds (2009) that the financial crisis in Finland of the early 1990s has received surprisingly little attention beyond the circles of policy makers and Nordic economists, a notable exception being Gorodnichenko et al. (2012). Later crises in emerging economies, e.g. the Tequila and East Asian crises triggered a much larger literature, e.g. on sovereign default and emerging market business cycles. Recent editions of the classic treaty on crises by Kindleberger and Aliber (2011) barely mentions the episode.

We find this unfortunate not only because of both good quality macroeconomic and financial data available for Finland (and Sweden). More importantly, we show that the interactions between the financial sector and the macroeconomy have played a crucial role during the modern crises in Finland. These linkages emanate not only in the form of shocks, but also as amplifiers of real shocks, thus exacerbating the downturns. In consequence, the recession in early 1990s was prolonged and turned into a depression, with negative GDP growth rate lasting for 13 consecutive quarters.

In sum, many of the mechanisms at play in the developed world in 2007–2008 were also present in Finland when the asset price and credit boom came to an abrupt end in 1990. In that sense, what happened in the Nordics following the financial market liberalization was not that different than this time, lending support to the argument of Reinhart and Rogoff (2009). The evidence that financial markets may work as strong business cycle amplifiers even in modern, developed economies has been there for over two decades.

References

Bassett, William F., Mary Beth Chosak, John C. Driscoll, and Egon Zakrajšek, "Identifying the Macroeconomic Effects of Bank Lending Supply Shocks," December 2010. working paper.

Bernanke, Ben and Mark Gertler, "Agency Costs, Net Worth, and Business Fluctuations," *American Economic Review*, March 1989, *79* (1), 14–31.

Bernanke, Ben S. and Mark Gertler, "Should Central Banks Respond to Movements in Asset Prices?," *American Economic Review*, May 2001, *91* (2), 253–257.

_ , _ , and Simon Gilchrist, "The financial accelerator in a quantitative business cycle framework," in J. B. Taylor and M. Woodford, eds., *Handbook of Macroeconomics*, Vol. 1 of *Handbook of Macroeconomics*, Elsevier, 1999, chapter 21, pp. 1341–1393.

Ciccarelli, Matteo, Angela Maddaloni, and José-Luis Peydró, "Trusting the bankers: a new look at the credit channel of monetary policy," Working Paper Series 1228, European Central Bank July 2010.

Conesa, Juan Carlos, Timothy J. Kehoe, and Kim J. Ruhl, "Modeling Great Depressions: The Depression in Finland in the 1990s," in Timothy J. Kehoe and Edward C. Prescott, eds., *Great Depressions of the Twentieth Century*, number 427-475, Federal Reserve Bank of Minneapolis, 2007.

Fisher, Irving, "The Debt-Deflation Theory of Great Depressions," *Econometrica*, October 1933, *1* (4), 337–357.

Freystätter, Hanna, "Financial factors in the boom-bust episode in Finland in the late 1980s and early 1990s," Discussion Papers 1, Bank of Finland 2011.

Fry, Renee and Adrian Pagan, "Sign Restrictions in Structural Vector Autoregressions: A Critical Review," *Journal of Economic Literature*, December 2011, *49* (4), 938–60.

Geanakoplos, John, "The Leverage Cycle," in Daron Acemoglu, Kenneth Rogoff, and Michael Woodford, eds., *NBER Macroeconomics Annual 2009*, Vol. 24, University of Chicago Press, April 2010, pp. 1–65.

Gertler, Mark and Nobuhiro Kiyotaki, "Financial Intermediation and Credit Policy in Business Cycle Analysis," in Benjamin M. Friedman and Michael Woodford, eds., *Handbook of Monetary Economics*, Vol. 3 of *Handbook of Monetary Economics*, Elsevier, October 2010, chapter 11, pp. 547–599.

Gorodnichenko, Yuriy, Enrique G. Mendoza, and Linda L. Tesar, "The Finnish Great Depression: From Russia with Love," *American Economic Review*, June 2012, *102* (4), 1619–44.

Holló, Dániel, Manfred Kremer, and Marco Lo Duca, "CISS - a composite indicator of systemic stress in the financial system," Working Paper Series 1426, European Central Bank March 2012.

Holmström, Bengt and Jean Tirole, "Financial Intermediation, Loanable Funds, and the Real Sector," *The Quarterly Journal of Economics*, August 1997, *112* (3), 663–91.

Honkapohja, Seppo and Erkki Koskela, "The economic crisis of the 1990s in Finland," *Economic Policy*, October 1999, *14* (29), 399–436.

Hubrich, Kirstin and Tohmas Karlsson, "Trade consistency in the context of the Eurosystem projection exercises - an overview," Occasional Paper Series 108, European Central Bank March 2010.

Inoue, Atsushi and Lutz Kilian, "Inference on impulse response functions in structural VAR models," *Journal of Econometrics*, 2013, *177* (1), 1–13.

Jonung, Lars, Jaakko Kiander, and Pentti Vartia, eds, *The Great Financial Crisis in Finland and Sweden. The Nordic Experience of Financial Liberalization*, Edward Elgar Publishing, Inc., 2009.

Jordà, Òscar, Moritz HP. Schularick, and Alan M. Taylor, "When Credit Bites Back: Leverage, Business Cycles, and Crises," Working Paper 17621, National Bureau of Economic Research November 2011.

Kauko, Karlo, "Bank interest rates in a small European economy: Some exploratory macro level analyses using Finnish data," Research Discussion Papers 9/2005, Bank of Finland May 2005.

Kiander, Jaakko and Pentti Vartia, "The great depression of the 1990s in Finland," *Finnish Economic Papers*, Spring 1996, *9* (1), 72–88.

Kindleberger, Charles P. and Robert Z. Aliber, *Manias, Panics and Crashes: A History of Financial Crises*, 6, revised ed., Palgrave Macmillan, 2011.

Kiyotaki, Nobuhiro and John Moore, "Credit Cycles," *Journal of Political Economy*, April 1997, *105* (2), 211–48.

Lown, Cara and Donald P. Morgan, "The Credit Cycle and the Business Cycle: New Findings Using the Loan Officer Opinion Survey," *Journal of Money, Credit and Banking*, September 2006, *38* (6), 1575–1597.

Pesola, Jarmo, "Financial fragility, macroeconomic shocks and banks loan losses: evidence from Europe," Research Discussion Papers 15/2007, Bank of Finland October 2007.

Reinhart, Carmen M. and Kenneth S. Rogoff, *This Time Is Different. Eight Centuries of Financial Folly.*, 1 ed., Princeton University Press, 2009.

Tarkka, Juha, "Ulkoisten tekijöiden merkitys Suomen talouskriisissä," *Kansantaloudellinen aikakauskirja*, 1994, *90* (1), 5–17.

Vihriälä, Vesa, "Banks and the Finnish Credit Cycle 1986-1995," Bank of Finland Studies E:7, Bank of Finland 1997.

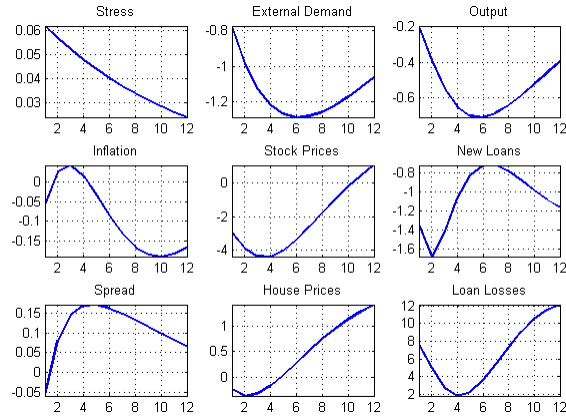# 7 Appendix

7.1 Impulse responses.

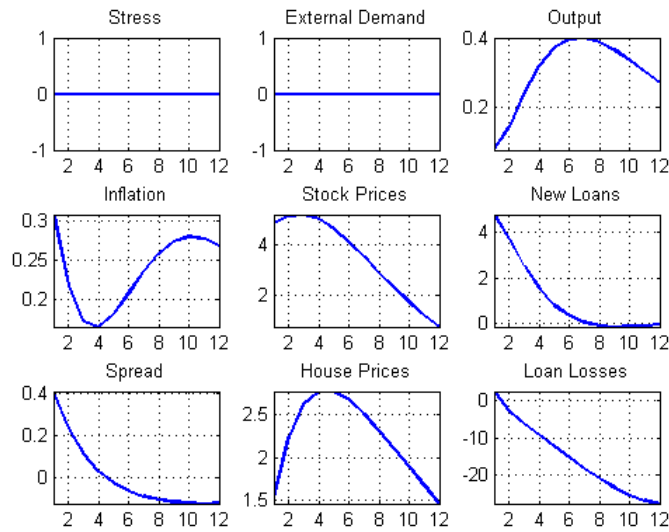Figure 7: Impulse responses of model variables to a stress shock.

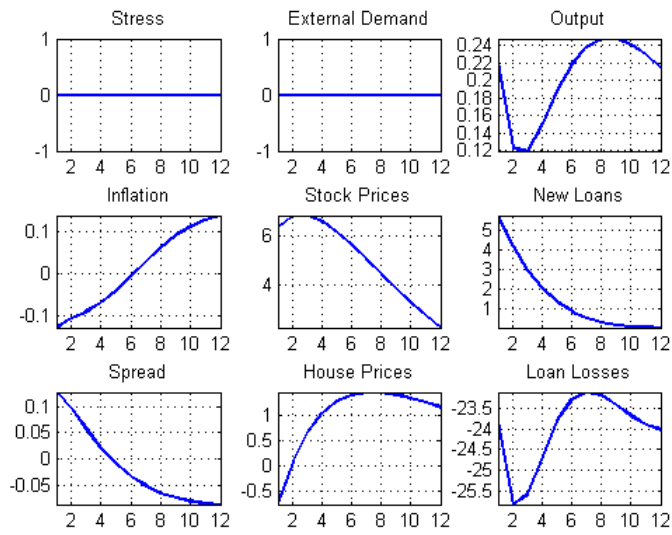Figure 8: Impulse responses of model variables to an aggregate demand shock.

Figure 9: Impulse responses of model variables to an aggregate supply shock.