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**Working Paper**

## Kiss me deadly: From Finnish great depression to great recession

Bank of Finland Research Discussion Papers, No. 24/2014

**Provided in Cooperation with:**

Bank of Finland, Helsinki

*Suggested Citation:* Gulan, Adam; Haavio, Markus; Kilponen, Juha (2014) : Kiss me deadly: From Finnish great depression to great recession, Bank of Finland Research Discussion Papers, No. 24/2014, ISBN 978-952-323-001-9, Bank of Finland, Helsinki, <https://nbn-resolving.de/urn:nbn:fi:bof-201411193261>

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Adam Gulan – Markus Haavio – Juha Kilponen

# Kiss me deadly: From Finnish great depression to great recession



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# Kiss Me Deadly: From Finnish Great Depression to Great Recession\*

Adam Gulan, Markus Haavio, Juha Kilponen<sup>†</sup>

*October 15, 2014*

## Abstract

We investigate the causes of the Finnish Great Depression, 1990-1993. We find that the collapse of the overheated financial and banking sectors starting in 1989 was the trigger of the economic crisis. Foreign shocks, which include the collapse of trade with USSR in 1991, can account for at most about half of the slump, and these shocks occurred only when the economy was already in free fall. Also, the deleveraging and restructuring process of the financial system substantially prolonged the subsequent recovery.

Our methodology involves estimating a structural VAR model with sign and exogeneity restrictions. Importantly, we are able to distinguish between financial shocks affecting the demand for intermediated loans and those shifting the loan supply curve. Hence we also contribute to the discussion on which financial shocks actually matter.

*Keywords:* business cycles; great depressions; financial shocks; sign restrictions; Finland

*JEL Classification:* E32; E44; O52

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\*The opinions in this paper are solely those of the authors and do not necessarily reflect the opinions of the Bank of Finland or the European System of Central Banks. We received fruitful comments from Martin Ellison, Seppo Honkapohja, Esa Jokivuolle, Niku Määttänen, Emi Nakamura, Antti Ripatti, Pentti Saikkonen, Juha Tarkka, Fabio Verona as well as conference and seminar participants at CEF, Dynare, EEA, EUI, FEA, Finnish Ministry of Finance, HECER, HMRAD, IAAE, IDB, MMF, Philadelphia FED, PT, University of Jyväskylä, University of Manchester and University of Turku. We thank Eero Savolainen and Matti Virén providing us parts of the data. Any errors or shortcomings are ours.

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# 1 Introduction

In early 1990s Finland witnessed a protracted economic contraction, one of the most severe experienced by an industrialized economy since World War II. This “Finnish Great Depression” started at the beginning of 1990, after several years of rapid economic expansion. The cumulative decline in real GDP from its peak in 4Q 1989 to the trough in 1Q 1993 was 12.6 percent in absolute terms, and the pre-crisis level of income was achieved again only in 4Q 1996. Recession lasted for four years. It was preceded by major credit and asset price booms which came to an abrupt end in late 1989. The episode also witnessed a collapse of Finnish–Soviet trade in 1991, a currency devaluation and a full-fledged banking crisis. In the same time period stock markets fell by 67 percent while the unemployment rate increased from 3.4 percent to 17.9 percent.

Generally, the literature provides two main competing explanations of the depression. The first focuses on the collapse of trade with the disintegrating Soviet Union in the first months of 1991. Before the crisis USSR was, alongside Sweden, a major trading partner of Finland. According to Gorodnichenko et al. (2012) this shock translated into higher production input costs for Finland and was further amplified by sectoral and labor market rigidities. The second emphasizes the role of financial liberalization of the 1980s, which led to sharp credit expansion and exploding house and stock prices. The asset bubble burst was followed by major financial and banking crises, similar to those observed in many countries after 2007. As a result, the economy was left with a large pile of debt (see e.g. Honkapohja and Koskela (1999), Kiander and Vartia (1996) and others), which prolonged the recovery.

In this paper we put these two main explanations on equal footing and assess their relative importance, alongside other commonly cited causes. We estimate a structural VAR of a small open economy, in which we identify a range of shocks using the sign restrictions methodology and exogeneity assumptions. The three foreign shocks include export demand, Finnish terms of trade and global financial stress shocks. We also identify two financial shocks, one originating in the entrepreneurial sector (asset price shock) and one stemming from financial intermediaries (loan supply shock). Finally, two other domestic shocks affect the real demand and real supply. We analyze the historical decomposition of Finnish GDP and construct counterfactuals which help us understand the interactions between the foreign, real and financial sectors.

We find that developments in the domestic financial sector played a large independent role in several phases of the crisis. First, a major asset price and lending boom fueling domestic demand was a key driver of GDP in the run-up to the crisis. Then, the crisis burst out as a result of shocks which capture the collapse of the banking sector and a bust in asset markets. Finally, the restructuring of the financial sector proved to be a heavy drag in the recovery phase. The collapse of Finnish–Soviet trade around 1991 played a considerable role in aggravating the crisis. Our counterfactual simulations also show that this shock was endogenously amplified by the financial sector. However, it can account for no more than a half of the drop in GDP dynamics. It also occurred only in 1991, when the economic crisis was already in full swing.<sup>1</sup> Without

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<sup>1</sup>The fact that the end of Soviet trade was largely unexpected, as stressed by e.g. Gorodnichenko et al. (2012), means that

transmission by the ravaged domestic financial system and the shocks originating within it, the collapse of Finnish–Soviet trade would have had a considerably smaller impact on Finnish GDP. 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 take a broader look at the Finnish business cycle. Apart from the 1990s, the country experienced two other major recessions during the last quarter century, all of them 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 the global financial crisis of 2007–2008 and the Great Recession that followed. Therefore, 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 macro-financial linkages and driving forces of business cycles. Relative to all previous studies, we have the advantage of hindsight, which allows us to compare different occasions on which Finland was hit by strong external shocks.

The Great Recession in Finland was very different than the early 1990s recession. The drop in GDP is attributed solely to external shocks, i.e. an increase in global financial stress and a slump in global demand. In fact, the negative export demand shocks around 2008 were much stronger (although more short lived) than those that explain the collapse of Finnish–Soviet trade. However, on that occasion the initial condition of the domestic financial system was much more robust and no financial crisis unfolded. As a result, the economic recovery was much faster and the overall reduction in output smaller. 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, creditless recoveries.<sup>2</sup>

Our work is at the intersection of many literature strands. First, we contribute to the debate on the Finnish Great Depression and its origins. The financial liberalization that triggered vast capital inflows and fueled stock and housing market bubbles has been pointed to as the initial culprit by Vihriälä (1997). According to Kiander and Vartia (1996), when the bubble burst a Fisherian debt–deflation spiral unfolded. Many interesting narrative essays on the episode, some of them stressing financial factors, have also been collected in Jonung et al., eds (2009). However, the Finnish downturn was 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, e.g. Tarkka (1994) and the aforementioned paper by Gorodnichenko et al. (2012). In the words of Honkapohja and Koskela (1999) in turn, the episode was a “tale of bad luck and bad policies”. The bad luck, was, apart from the vanishing Soviet trade, the recession in the OECD area and the ERM crisis. Bad policies included the defense of the fixed exchange rate regime during the crisis, which elevated real interest rates to double-digits. Working within the real business cycle framework, Conesa et al. (2007) point to increases 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

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it was not priced into asset prices nor did it trigger the credit contraction.

<sup>2</sup>See Jordà et al. (2013). These authors do not include Finland in their sample of countries.

lending boom, a trade collapse and an exchange rate devaluation.

We also contribute to the burgeoning empirical research on financial market imperfections and the role of financial shocks in driving business cycle fluctuations.<sup>3</sup> In constructing our shock identification scheme we are guided by the theoretical literature which stresses the disruptions between lenders, intermediaries and borrowers.<sup>4</sup> This, combined with a proper selection of variables, allows us to distinguish between two types of financial shocks. The loan supply shock is akin to a shock in monitoring costs, considered e.g. by De Fiore et al. (2011), and it may reflect exogenous changes in lending standards and regulatory environment. Our work is in this dimension complementary to recent empirical studies by Bassett et al. (2010) and Helbling et al. (2011) who analyze similar shocks to the supply of credit.<sup>5</sup> An asset price shock in turn includes bubbles, exogenous changes in borrowers' wealth, as well as risk shocks à la Christiano et al. (2014). Hence, we are able to shed some light on the relative roles and interaction between borrowers and lenders and to say more about which financial frictions actually matter.

This paper is divided into six sections including this introduction. In Section 2 we provide an empirical sketch of the Finnish economy in the 1980s and 1990s. First, we describe the evolution of the financial system and the dynamics of the crisis. Secondly, we zoom in on Finnish exports and discuss the role of the Soviet trade. In Section 3 we introduce the model and discuss the identification of structural shocks. We then present the sign restriction methodology and model selection issues. In Section 4 we explain in detail the data used in estimation. The estimation results are 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 take a close look at the Finnish Great Depression. We also conduct some counterfactual simulations to assess the importance of financial factors for business cycle dynamics. Concluding remarks are given in Section 6.

## 2 Finland before and during the depression

### 2.1 Financial liberalization and its aftermath

Back in the 1970s the Finnish financial and banking systems were still tightly regulated.<sup>6</sup> Capital market was relatively small and the money market virtually non-existent. Banks were at the center of credit creation in the economy. Loan expansion was tied to the inflow of deposits. Banks were not allowed to borrow

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<sup>3</sup>See e.g. Jermann and Quadrini (2012) and Gilchrist et al. (2009).

<sup>4</sup>Early contributions, e.g. Bernanke and Gertler (1989) and Kiyotaki and Moore (1997), focused on frictions between lenders and borrowers. More recently, the debate moved the role of financial intermediaries and their balance sheets, e.g. Holmström and Tirole (1997) or Gertler and Kiyotaki (2010).

<sup>5</sup>Using bank survey data, Ciccarelli et al. (2010) also distinguishes between shocks to credit demand and supply, although their definitions are not guided by a theoretical framework and the specifications of shocks do not coincide with ours.

<sup>6</sup>Detailed accounts of the liberalization and economic events in the 1980s and 1990s can be found in Vihriälä (1997), Kuusterä and Tarkka (2012) and Jonung et al. (2009), from which this subsection draws.

from abroad. Both deposit and lending rates were very low in real terms, due to tight regulations and also because bank borrowing was subject to tax deductions. The overall result was a shortage of credit and credit rationing. Lack of price competition generated a costly and inefficient banking sector structure with relatively low profitability. Finally, savings and cooperative banks were not allowed to raise capital through equity.

A flip side of the highly regulated banking sector was its very high effective leverage. According to the 1970 banking law reform, the capital adequacy requirement was set at two percent of equity for savings and cooperative banks and four percent for commercial banks, with a transition period of as much as ten years. Yet, banks had chronic problems in adhering to even these very lenient levels. In 1978 the period was extended by another five years and the requirements were further watered down by changing legal definitions.

Since the mid-1980s the existing system was gradually transformed. The key changes came into effect between 1985 and 1987. The link between deposits and lending was broken and rules regarding the lending rates were abolished. A genuine liquid money market was created in which certificates of deposit issued by banks were used by the central bank as instruments of open market operations. Foreign banks obtained access to the market as well. All this enabled banks to raise short-term funding on the interbank market and allowed for much more vigorous credit creation. Firms and households were both allowed to borrow abroad, but domestic banks remained the main supplier of credit in the economy. At the same time, however, the banking system still relied on outdated risk management practices. Savings and cooperative banks were organized in groups around a common commercial bank. The system provided *de facto* guarantees for individual member banks and idiosyncratic risk was shared by bank-group specific mutual insurance funds. However, this arrangement was not designed for dealing with systemic risk.

Soon, the financial reform resulted in an explosion of credit. The ground for a credit boom was fertile all the more so given that interest payments on loans were tax-deductible. Figure 1 shows the credit expansion dynamics, measured by the value of new loans (in millions of €<sub>2000</sub>). New credit began to expand steadily already in the years 1985-1986. Then it shot up, and remained at elevated levels between 1987 and 1989. It subsided again in 1990-1991 to pre-boom levels before reaching a prolonged trough between 1992 and 1998.

Easy access to bank lending was quickly reflected in house and stock prices, as banks started to actively invest in the non-financial corporate sector and to expand mortgage lending. This in turn triggered an asset price boom, which, via rising collateral values, allowed for further credit expansion. This is shown in Figure 2. With relatively inelastic housing supply, house prices exploded between 1987 and 1988, although the boom was rather short-lived. Stock prices in turn rose sharply after the beginning of 1986.

A good example of the excesses of the “casino economy” in the late 1980s’ Finland was the activity of SKOP, the umbrella institution of the savings banks group. The bank borrowed heavily short-term and took to aggressive lending and investment. In early 1987 when the easy credit policy started, SKOP took over Tampella, one of the largest Finnish manufacturers at that time. By late 1990, months before the USSR trade collapse, Tampella was already on the brink of bankruptcy, and it ultimately took SKOP down as well.

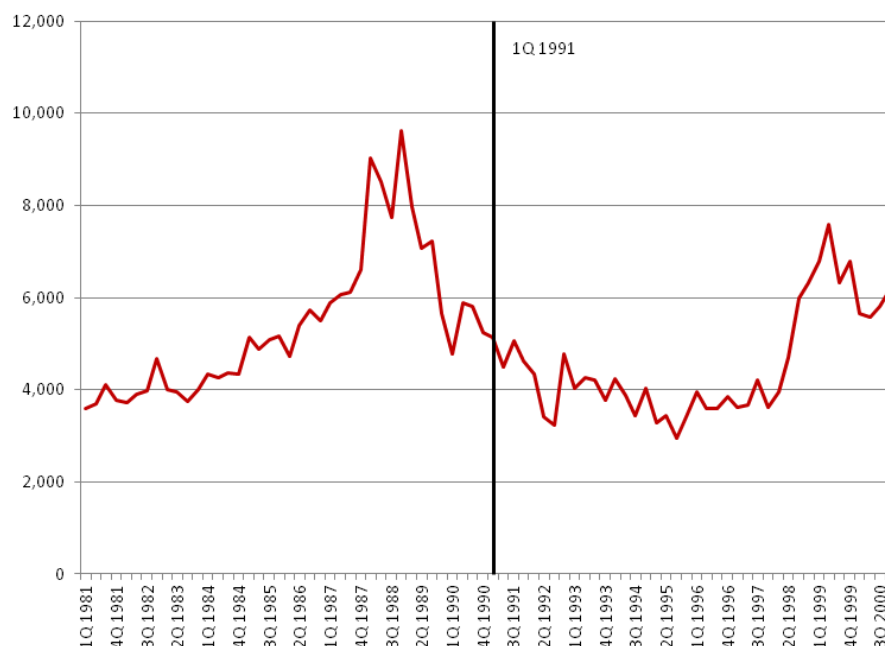


Figure 1: New bank loans issued, 1981-2000.

*Notes:* New bank loans to the private sector, deflated by the GDP deflator, millions of €<sub>2000</sub>. The black vertical line indicates the quarter of the Soviet trade collapse. Source: Bank of Finland.

By late 1988 the credit boom became apparent and raised the concerns of policy makers. A tax reform, due in 1Q 1989, included broader and higher taxes for capital gains, in anticipation of which the credit and price dynamics peaked in 4Q 1988. Other indirect taxes were also raised early the next year. However, given a healthy government surplus in 1989, the support for spending cuts was very limited. Such cuts would also probably have been ineffective, as fiscal profligacy was not the driver of the preceding boom.

Monetary policy in turn was caught in the impossible trinity. The asset boom was fueling demand and inflation. Yet, the central bank also had to maintain a fixed rate on the Markka, to which it was strongly committed, in accord with the "strong Markka" doctrine. With a liberalized financial account and already strong capital inflows, bold interest rate hikes were precluded. Although base rates were increased in spring 1988, the move was partly reversed at the turn of 1989. However, higher domestic rates could not affect the cost of borrowing in foreign currencies, which were the more attractive, the wider the differential grew. Interest rates rose sharply only in late 1989 and early 1990 when the exchange rate peg was put under pressure. Interest rates skyrocketed again in late 1991 before the devaluation and in late 1992 before the peg was finally abandoned altogether. The fall of the Markka further squeezed currency borrowers. Nor did the central bank have the prerogative of imposing reserve requirements; instead it had to rely on discrete agreements with banks. Such a new deal, including targeted limits for credit expansion, was eventually implemented in March 1989, but largely ignored by the savings banks group and SKOP.



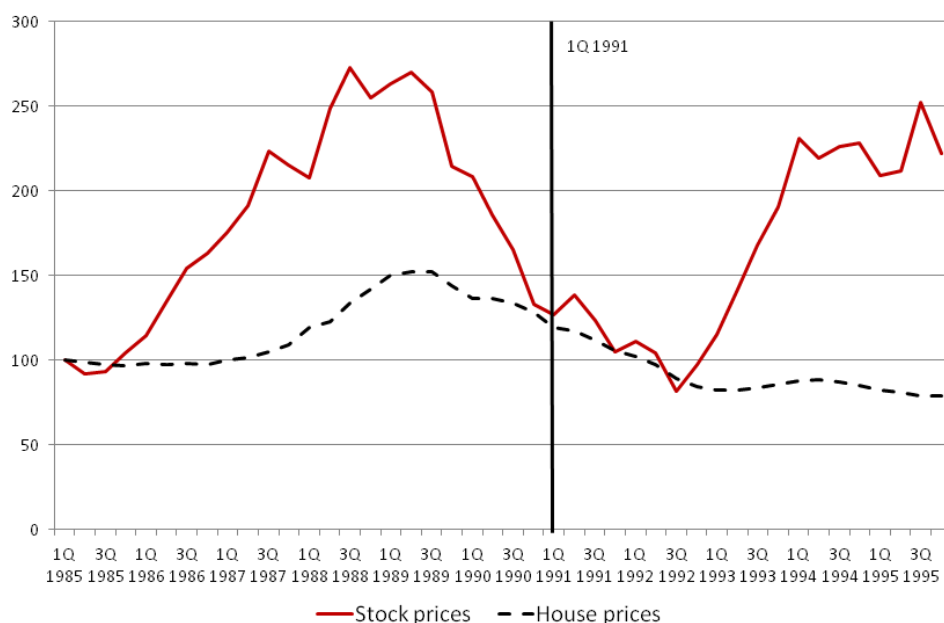


Figure 2: Stock and house prices, 1985-1994.

*Notes:* All series are real indices, 1Q 1985 = 100. Stock prices is the capped OMXH stock market index. House prices is an index of old dwellings in the whole country. The black vertical line indicates the quarter of the Soviet trade collapse. Sources: Bank of Finland.

The growth of new credit subsided, as policy actions had some effect, but the stock of loans still grew at double digit rates. In parallel, the economic climate started to change. Over the course of 1989, the country witnessed a bankruptcy of the major shipbuilding company Wärtsilä Marine and the suicides of the CEOs of Nokia and SKOP. The stock market peaked in 2Q 1989 and by the end of 1990 lost almost 50 percent of its peak value. Falling stock prices affected in the first place the most highly leveraged financial institutions, predominantly the savings banks group and SKOP. In September 1991, SKOP had to be taken over by the Bank of Finland. The following year the government had to earmark funds for capital injections and established a new institution, the Government Guarantee Fund (GGF), with the task of stabilizing the banking sector. Dozens of savings banks were merged into the Savings Bank of Finland (SBF). Ultimately, the assets of SBF and SKOP were split up, with the healthy parts being sold and the toxic parts recycled via the special purpose vehicle Arsenal. In 1993 the banking crisis was still in full swing. The GGF budget was increased and government guarantees were extended beyond deposits to all bank liabilities. As the crisis started to subside, a major restructuring of the industry unfolded and cost-efficiency measures were undertaken. The largest commercial bank KOP, after being rescued as well, was merged with its main competitor SYP in 1995. The whole sector shrank, the numbers of branches and employees each contracting by half relative to the boom years. The Bank Inspectorate was also shut down and replaced by the new, government-independent Financial Supervision Authority.

To conclude, financial liberalization in Finland was not accompanied by parallel introduction of modern safety measures in the financial sector. Throughout the 1980s the country failed to implement regulation which would require banks to keep more equity. To be sure, new rules were debated, and in 1986 an interinstitutional working group made some proposals.<sup>7</sup> However, in 1987 the Basel Committee on Banking Supervision issued its own, much tougher recommendations, which made the parliamentary work largely obsolete. In effect, no law was passed until the financial crisis was in full swing. In consequence, the banking sector entered the credit boom era highly leveraged and vulnerable to negative shocks, which hit them in 1989 and 1990.

Concurrently with Finland, Sweden also experienced a boom-bust cycle which shared many features with the Finnish one, including financial liberalization, asset price and credit booms, a subsequent banking crisis and a prolonged (albeit much shallower) recession. Despite many similarities, there were some differences between Finland and Sweden throughout the 1970s and 1980s. One important difference involved bank equity buffers. The book-value of equity-to-asset ratios were around 2 – 2.5 percent in the former compared to 3.5 – 4.5 percent in the latter. As pointed out by Kuusterä and Tarkka (2012), another important difference was that, whereas in Finland the capital adequacy ratios were defined relative to liabilities, in Sweden they were measured relative to the asset side. The latter allowed to introduce risk-weighting. As a result, Sweden’s capital requirement regulation before the credit boom incorporated many elements of future Basel I regulation (Englund and Vihriälä, 2009). Finally, Swedish banks had, relative to Finland, large loan loss reserves, possibly because of their tax-deductibility (Drees and Pazarbaşıoğlu, 1998). Finland ultimately implemented the Basel-based higher adequacy ratios in 1991, but the banking system was already in trouble by that time. As the implementation was already overdue at that point, the new policy ended up being strongly procyclical, aggravating the credit contraction during the sharp downturn.

It is even more instructive to compare the situation in Finland from the late 1980s with that in Finland itself in the run-up to the Great Recession. By the turn of the millennium the stock and housing markets had partly decoupled, after being highly correlated in the late 1980s and early 1990s. The housing market did not experience any obvious booms prior to the dot-com bubble bust or in mid-2000s. Around the turn of the century the real estate sector was in fact still recovering from the depression, and in real terms house prices in 2001 were around the level observed at the peak of the 1980s boom. Broadly speaking, after the depression of the 1990s house prices rose without major interruptions and fell only slightly in 2001 and in 2008. The stock market on the other hand, experienced a major price bubble during the era of dot-coms and of the preponderance of the Finnish IT sector. Between these two episodes, it enjoyed robust growth, although the dynamics were somewhat more subdued than in the late 1980s and late 1990s.

Between 2001 and 2007, real credit to the private sector grew steadily at an average rate of 11.9 percent per year. Interest rate spreads increased only moderately following the dot-com bubble burst, although they

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<sup>7</sup>The proposals were still quite liberal, suggesting a four percent capital adequacy ratio based on risk-weighted assets across the whole banking system.

widened noticeably following the Lehman Brothers collapse. However, between 3Q 2004 and 2Q 2008 they persistently fell. This reflects the gradually evolving environment of the banking industry. In the mid-2000s the ECB Bank Lending Surveys reported squeezing margins on loans, especially mortgages, as a result of tightening competition. Also, the summer of 2004 brought the news regarding the implementation of new Basel II recommendations on bank capital requirements. These regulations implied increased risk-weighting sensitivity of capital adequacy ratios. Therefore they created an incentive for banks to expand balance sheets by rebalancing portfolios towards assets classified as safer.<sup>8</sup> In Finland this led to increased mortgage lending, as these loans had relatively low default rates. Indeed, between the dot-com bubble and collapse of Lehman Brothers the real growth rate on loans to households was on average higher than for the entrepreneurial sector.

Notwithstanding the fact that credit expansion accelerated in Finland after the year 2000, it started only a few years after the system had been fundamentally transformed in the mid-1990s. The fresh memory of the crisis of the early 1990s kept the degree of risk aversion relatively high as compared to other European countries. The exposure to US asset-backed securities was minimal. The industry remained relatively well capitalized with equity-to-assets ratios of 9-10 percent for the major banks in 2006. Compared to the late 1980s, banks were much less leveraged and adhered to much more restrictive (Basel I and II) safety regulations (see also Jokivuolle et al., 2014).

## 2.2 Trade with USSR

The main characteristic that distinguished Finland from other Western European market economies during the Cold War period was its large volume of trade with the USSR.<sup>9</sup> The trade was based on a clearing principle, although the arrangement allowed for short-term imbalances, within bounds. Finnish exports to the Soviet Union were rather diversified. They consisted mainly of manufactured goods, including paper, metallurgical products, ships and clothing. Imports, on the other hand, were dominated by crude oil and other energy products, priced at world market prices.<sup>10</sup> These features, combined with a small elasticity of demand for energy made the volume of trade largely dependent on fluctuations in global oil prices. In consequence, the trade peaked following the Second Oil Shock. Sales to the USSR reached 25 percent of Finnish exports in 1981. In mid-1980s, as oil prices subsided, the share started to fall. On the eve of the Finnish Great Depression (in 1989), the Soviet Union was a recipient of around 15 percent of total Finnish exports. Then, between 1991 and 1992, the share collapsed to below 3 percent.

Figure 3 plots the dynamics of Finnish exports of goods and GDP between 1Q 1985 and 4Q 2000. In December 1990 the Soviets gave Finland a notice of termination of the clearing agreement, which resulted in a collapse of bilateral trade in 1991, as marked by the solid orange line and the vertical black line. However,

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<sup>8</sup>See Shin (2012) for a formal discussion of this mechanism.

<sup>9</sup>For details of Finnish-Soviet trade see Sutela (2014)

<sup>10</sup>For this reason Soviet trade provided a buffer for Finland during the two oil crises relative to other western economies.

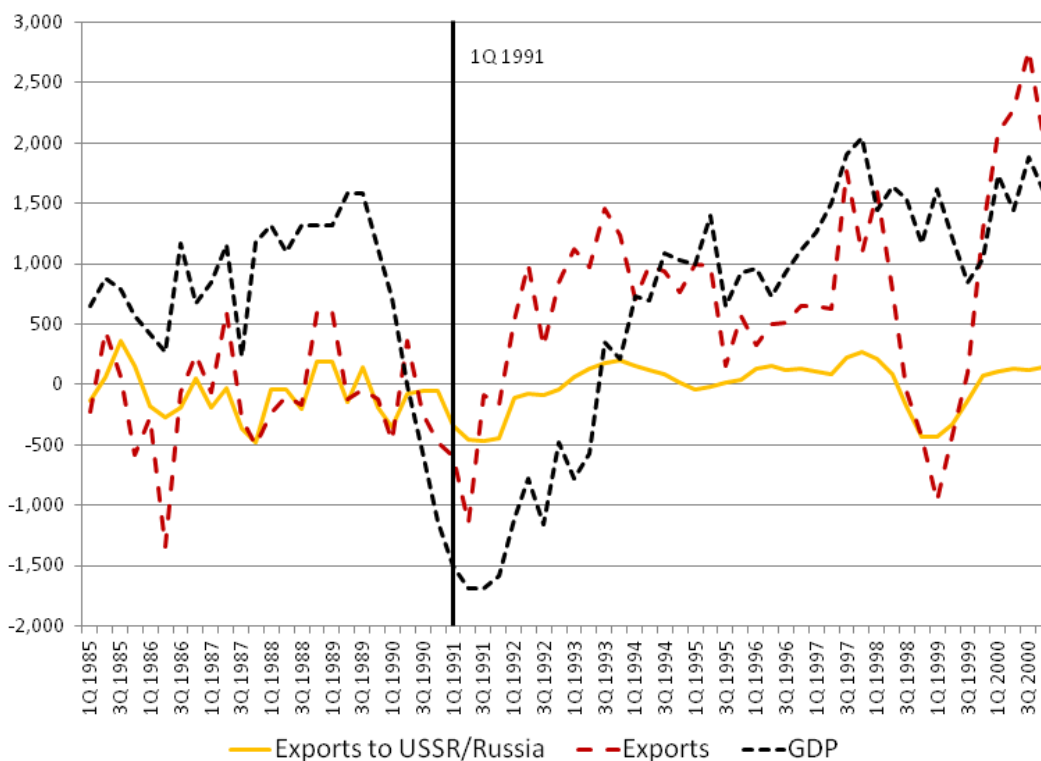


Figure 3: Dynamics of Finnish exports and GDP, 1985-2000.

*Notes:* All series are in millions of €<sub>2000</sub>. Exports to USSR/Russia is exports of goods (not services). Exports is total Finnish exports of goods (including USSR/Russia). Dynamics is measured as year-over-year difference. Sources: Bank of Finland.

real GDP started to fall earlier, already in 1990. Total exports were already shrinking in tandem with GDP, partly due to the recently revalued Markka and worsening international economic conditions. However, by late 1991 the contraction of exports was over and total sales abroad bounced back in the following quarters, restoring the real pre-crisis level already in 1992, despite the vanished eastern market. This was at least partly due to the devaluation in November 1991 and the abandonment of the peg in September of the next year.

Two other important remarks are in order. The first relates to comparing the solid orange with the dotted black line of Figure 3. Soviet trade constituted less than 2.5 percent of Finnish GDP in 1989-1990, much less than the total experienced output loss of 12.6 percent. Finland's GDP contracted from peak to trough by 3,465 mln €<sub>2000</sub> whereas trade with the USSR plummeted by 457 mln €<sub>2000</sub>, i.e. 13 percent of that number. Even in the year of the trade collapse (4Q 1990 to 4Q 1991) the drop in GDP was 1,586 mln €<sub>2000</sub> (−6 percent), whereas Soviet trade shrank by 442 mln €<sub>2000</sub> (28 percent of that number). The second notable fact is that Finland recorded similar declines, both in total exports and in sales to the USSR, on two other occasions. Back in 1985-1986, lower eastward exports was due to falling world oil prices, which meant that

the Soviets had less revenue to pay for their imports and balance the exchange. Another large drop occurred in 1998-1999, following the Russian default and the financial crisis in August 1998. What is striking though is that the corresponding GDP dynamics around these two events were very different than during the Finnish Great Depression. In 1991 Finland was already in free fall, whereas in 1986 and 1999 it reported only a moderate slowdown in growth.

USSR was a peculiar trading partner for Finland, not only because the trade was largely cleared (at least until the mid-1980s) but also because it was effectively a goods-for-oil scheme. According to Kajaste (1992), this part of exports was sold for a hefty markup relative to world prices. As argued by Gorodnichenko et al. (2012), this constituted an implicit energy subsidy for Finland and made Finnish terms of trade exceptionally favorable. The collapse of Soviet trade translated *de facto* into an increase in energy prices of more than 10 percent and could therefore be regarded as a negative terms of trade shock. In Figure 4 we plot the Finnish terms of trade alongside the corresponding series for Sweden. Both countries experienced improved terms of trade starting in 1986 and running until the early 1990s. In the Finnish case the increase and subsequent drop were more pronounced. The relative price of exports also dropped abruptly in 1991 with the end of Soviet trade. Nevertheless, the drop was not a shift from some constant previous level, but rather a correction of a four-year boom. This correction was also at least partly due to the global rise in crude oil prices in the second half of 1990, which was triggered by the Gulf War. More generally, the fluctuations reflect to some extent changes in the prices of oil, of which both countries were importers. The first oil crisis of 1974 can be traced out for Sweden, but not for Finland. Yet, the second crisis of 1979-1980 is strongly reflected in the Finnish series. In fact, the deterioration in the terms of trade at the time was at least as strong as a decade later. However, we do not observe any particular change around 1985, as we did in the dynamics of exports. This suggests that terms of trade might have played an autonomous role as a transmitter of the Soviet collapse shock, in line with the narrative of the “From Russia with Love” paper by Gorodnichenko et al. (2012). Finally, Finland might have been more sensitive to energy price movements than Sweden because it has been a less energy-efficient economy.<sup>11</sup>

### 3 Model Basics and Identification

In Section 2 we gave an account of the main economic events in Finland between the late 1980s and early 1990s. The fact that the financial crisis and Soviet trade collapse occurred largely in parallel leads to the natural question of which factor, if any, was dominant in driving the collapse of domestic output. To answer this question we decompose the dynamics of Finnish GDP into series of orthogonal, structural economic shocks. To this end, we estimate a partially identified VAR model of a small open economy. In selecting the variables for the model we are motivated by the objective of remaining agnostic and identifying the possibly

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<sup>11</sup>Energy efficiency is defined as PPP output per kilogram of oil equivalent. In fact, Finland has been also less energy-efficient than e.g. the United States.

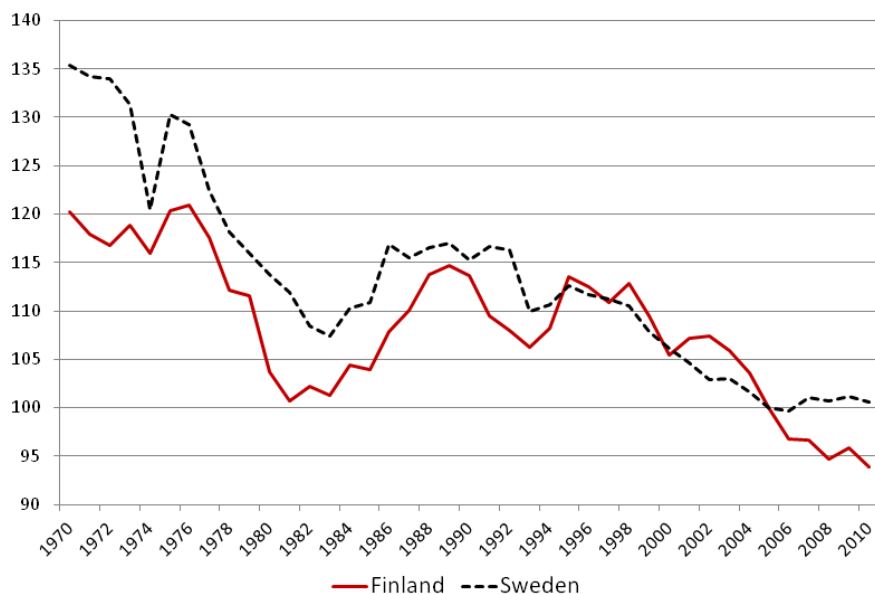


Figure 4: Terms of trade in Finland and Sweden, 1970-2010.

*Notes:* Terms of trade is defined as price of exports over price of imports. Index, 2005=100. Source: Bank of Finland.

most potent sources of disturbances which we discussed in the previous section.

### 3.1 The model and the shocks

The 9 variables that we choose can be put into three main groups: one foreign and two domestic. The foreign bloc consists of three variables: world trade volume, Finnish terms of trade and a measure of global financial stress. The second bloc is the standard New Keynesian monetary VAR variables: the real output, inflation and an interest rate measure. For the latter, we use the spread between the lending rate and the money market rate, rather than the short-term policy rate itself. The motivation for this is threefold. 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 does not 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. Thirdly, as will be discussed in detail below, the behavior of the spread will allow us to distinguish between real aggregate demand and asset price shocks. The financial variables consist of asset prices, new bank loans to the private sector and bank loan losses. Details on the series are provided in Section 4.

The trivariate foreign block is assumed to be fully exogenous to the domestic part. This is done by imposing ex ante zero restrictions on the relevant coefficients of the transition matrix. As discussed in Subsection 2.2, the volume of Soviet trade was closely linked to the price of oil. More generally, Finland has

been a small open economy characterized by a diversified exports structure and energy goods constituting a considerable share of imports. Therefore it can be plausibly assumed that Finnish terms of trade were largely exogenous from Finland’s point of view. We use Cholesky decomposition in this part of the covariance matrix. World trade is ordered first, terms of trade second, and stress is third. It is conventional to order financial variables after real variables, given that the former tend to be fast-moving and that prices may move faster than quantities. Nevertheless, we do not attempt to identify two separate real structural shocks from the world trade and terms of trade series. Ultimately we are interested in the joint effect of real external demand fluctuations on Finnish GDP. As argued by Gorodnichenko et al. (2012) the Soviet trade shock worked through two separate channels: an absolute drop in exports and a collapse in terms of trade. The two variables in the VAR are intended to jointly capture the collapse of exports. However, to the extent that Finnish terms of trade do not react on impact to global financial stress, we are able to identify a separate external financial shock (as opposed to the real external shocks).

Our set of 6 domestic variables allows us to identify four domestic shocks: aggregate demand shock, aggregate supply shock, asset price shock and loan supply shock. For that purpose, we use the sign methodology. 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 increase on impact (and possibly also in the next  $S$  periods) after a given structural shock. This enables us to identify a maximum of  $N_d$  shocks in an  $N_d$ -variate domestic block. Our model is therefore partially identified in the sense that the number of sign-identified shocks is less than the number of variables in the domestic block, as  $N_d = 6$  in our case. The unidentified block is a linear combinations of all other possible shocks that we do not try to identify and which are orthogonal to the four identified ones. In particular, this includes the monetary policy shock. We discuss this block in detail in the paragraph on “*Other shocks*” below.

Table 1 summarizes the response restrictions of the 6 domestic variables that we impose to identify the shocks. The sign of the response is required to hold on impact and for at least  $S = 3$  periods after the shock (four periods altogether). The signs highlighted in red circles denote the minimum set of restrictions necessary to make the structural shocks identifiable from each other. All black signs are motivated by economic theory but are not strictly necessary to distinguish the shocks from each other. Question marks denote cases in which the shock impact on the variable is either not clear or in which economic theory delivers opposing mechanisms that may offset each other.

*Aggregate demand shock:* The postulated reaction of the variables after an aggregate demand shock is fairly standard. On the real side, the price level should go up along with an increase in the GDP growth rate. The shock should also increase the demand for credit and hence the interest rate spread.<sup>12</sup> Asset prices,

<sup>12</sup> It is plausible to assume that the reaction of the central bank is not immediate after the demand shock so that the policy rates do not immediately follow the lending rates. The reason why we are able to make this assumption is that Finland was on a form of fixed exchange rate regime for most of the sample period. Until 1992 the Markka was pegged to a basket of currencies and monetary policy focused on exchange rate movements rather than on domestic demand, as is the case in the standard Taylor

Table 1: Sign restrictions for positive domestic shocks.

Variable	Real shocks		Financial shocks	
	Aggregate demand	Aggregate supply	Asset price	Loan supply
GDP	⊕	⊕	⊕	⊕
Inflation	⊕	⊖	⊕	?
Asset prices	+	+	+	+
New bank loans	+	?	+	+
Interest rate spread	⊕	?	⊖	⊖
Loan losses	?	⊖	⊖	⊕

proxied by a weighted average of stock and house prices, should arguably rise after the shock. This reflects higher profitability of firms and increasing household income. This in turn should strengthen firm collateral and household wealth and increase lending, as is also the case in models with a financial accelerator, e.g. Bernanke et al. (1999), hence further pushing up the demand. Finally, we do not impose restrictions on loan losses. Losses may rise if lending volume and average quality deteriorate. However, the wealth effects may actually improve private balance sheets, due to higher stock or house prices, and reduce loan losses in the private sector.

*Aggregate supply shock:* What distinguishes a supply shock from a demand shock is that here prices go down, rather than up. A positive shock increases asset 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 inside equity, which would then finance the expansion of assets.<sup>13</sup> Since the reaction of loan demand is not clear, it is also hard to say in which direction the lending rate, and therefore the spread, would move.<sup>14</sup> We think it is plausible that loan losses will fall in the short run, given the improved condition of firms.

*Asset price shock:* The asset price shock is intended to reflect asset price movements and demand for credit which are not due to changes in current fundamentals. In one interpretation, this may reflect market exuberance or bubbles, as in Bernanke and Gertler (1999). GDP should respond positively as the shock generates positive wealth effects and stimulates both domestic demand and production. Higher demand in

rule. Similarly, in 1996 Finland entered ERM2 and later the Eurozone in 1999. Arguably, the European Central Bank does not immediately react to idiosyncratic Finnish demand shocks.

<sup>13</sup>Alternatively, firms would have an incentive to issue new outside equity or corporate bonds, as in Holmström and Tirole (1997).

<sup>14</sup>As was argued in Footnote 12 in the context of the aggregate demand shock, it is likely that the 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.



turn puts upward pressure on the general price level. The positive shock automatically translates into higher collateral values. As balance sheets of firms and households improve, loan losses and lending rates go down, which reduces interest rate spreads. Narrower spreads should in turn increase the amount of new loans. A positive asset price shock will therefore generate responses largely similar to a demand shock. What allows us to distinguish the two is the impact on spreads. In the former case, the rising collateral values and improved balance sheets have a direct impact and allow borrowers to take out cheaper loans. In the case of a standard aggregate demand shock, this channel is only indirect and arguably much weaker. In consequence, the spreads expand because of the directly higher demand for loans.

More generally, the asset price shock can be thought of as one directly hitting the entrepreneurial sector in the financial accelerator mechanism proposed by Bernanke and Gertler (1989). In the spirit of that original paper, it may be an effect of wealth redistribution between lenders and borrowers, as in the debt-deflation mechanism.<sup>15</sup> A positive shock, because of being inflationary, reduces the real burden of nominal loan contracts for debtors. This in turn further amplifies the reduction in loan losses. This interpretation is useful for our analysis also because it captures the argument of Kiander and Vartia (1996) who argued that the Fisherian effect was at the heart of the Finnish Great Depression. Our specification also encompasses the risk shock proposed by Christiano et al. (2014), i.e. a change in the distribution of idiosyncratic entrepreneurial productivity.

Finally, it remains an open issue whether the shock may reflect information about future productivity, be it true or false signals. The answer depends on whether such news is inflationary or deflationary, as in Christiano et al. (2010a). In their model, an expected future reduction in marginal cost due to news about higher productivity in the future outweighs its current increase; hence prices fall. However, the effect on inflation in initial periods is not clear and depends on the policy rule specification. A similar shock is analyzed in Gilchrist and Leahy (2002), where it drives prices up. Therefore, to the extent that news is inflationary, it will be reflected in the asset price shocks. If it is deflationary, it will be picked up by the real aggregate supply shock. The hypothesis that booms can be inflationary seems to be in line with the Finnish experience from the late 1980s and that of many troubled European countries in the first decade of 2000s, although not with the U.S. experience in the run-up to the financial crisis of 2007-2008.

*Loan supply shock:* A loan supply shock stems directly from the sector of financial intermediaries. However, it is not supposed to capture shocks in banks' assets, which ultimately originate in the borrowers' sector. Rather, it captures changes in effective lending standards or regulatory environment. In a theoretical framework, such a shock can be thought of as one capturing innovations in the monitoring costs describing the loan contract in a financial accelerator. Financial liberalization and looser credit can be interpreted as a reduction of monitoring costs. Higher safety requirements and tougher lending standards would in turn be captured by higher monitoring cost. Examples of studies that analyze this shock include De Fiore et al.

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<sup>15</sup>Other papers that analyze direct shocks to borrowers' wealth include e.g. Nolan and Thoenissen (2009) and Fuentes-Albero (2013).

(2011) and Fuentes-Albero (2013). What makes the shock distinct from other financial shocks is its impact on default rates of borrowers and loan losses of lenders. For example, a drop in monitoring costs is clearly expansionary. As the availability of bank loans increases, lending rates fall, hence reducing the spread and stimulating credit. Loan expansion stimulates output and consumption. However, as opposed to, for example, risk or net worth shocks, at the same time it also increases default rates and loan losses. Therefore, including the latter variable in the VAR allows us to distinguish this shock from an asset price shock.

Yet, it may be plausibly argued that there is a considerable time lag between an increase in loan availability and a surge in actual banks' loan losses. Empirically, loan losses tend to be a lagging variable. For that reason we impose a zero restriction on the impulse responses in the benchmark setting. Loan losses are expected to go up only in the first period after the shock, not on impact. In fact, this is also the dynamics in De Fiore et al. (2011). We do not make assumptions on which sectors of the economy will benefit from lower lending rates. If it is the entrepreneurial sector, real supply and profits should go up. If it is households, then the shock would fuel the domestic demand. In both cases both the GDP and asset prices should go up. However, the two channels would generate opposite movements in prices and therefore the impact on inflation remains unclear. However, looking through a New Keynesian model with a financial accelerator, its effect is inflationary.

Our understanding of the loan supply shock is also similar to that in Bassett et al. (2010), who define a credit supply shock as a change in lending standards which is orthogonal to bank-specific and macroeconomic factors. Whereas they identify the shock using loan officers' surveys, we rely on the theoretical model's predictions regarding loan loss dynamics.<sup>16</sup> In that sense, our methodology is an alternative to study this shock.<sup>17</sup> A somewhat similar strategy is adopted by Helbling et al. (2011) who also use sign restrictions to identify a credit market shock. They use default rates rather than loan losses and work without any restrictions on the dynamics of macroeconomic variables, which makes their definition broader and harder to interpret.

*Other shocks:* Since we define only four shocks in the domestic block, there remains an unidentified part that includes all other possible shocks orthogonal to the ones identified above. One clear candidate is the shock to monetary policy, i.e. an exogenous policy easing and hence a fall in market rates. Since this shock is associated with higher real demand and higher prices, one could argue that it is likely to be confounded with the aggregate demand shock defined above. If the pass-through from policy to lending rates was weak, one should observe an increase in spreads after an expansionary monetary policy shock. However, since the lending rates and hence loan volumes would not react on impact, demand should not really pick up

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<sup>16</sup>Ciccarelli et al. (2010) and Lown and Morgan (2006) also use surveys to identify shocks in lending standards, but in their specification the shock is not orthogonal to bank-specific factors, making it a more broadly-defined financial shock that may overlap with our asset price shock.

<sup>17</sup>Although these authors study macroeconomic consequences of credit supply shocks, they do not report their impact on loan losses.

instantaneously either. Yet, as documented by Kauko (2005), lending rates in Finland tend to be flexible. The pass-through from policy rates to lending rates has been quick ever since 1993. Nevertheless, it could have been much slower prior to 1993 when policy rates were much more volatile and were reacting promptly to currency market fluctuations. This suggests that our model may partly interpret monetary policy shocks as demand shocks prior to and during the Finnish Great Depression. Otherwise, though, monetary shocks are a part of the set of unidentified shocks.

Another caveat is related to the reactions of new bank loans after positive aggregate demand and asset price shocks. In principle one could argue that rising asset prices would increase the incentive to switch from bank financing to bond financing, in the spirit of the Holmström and Tirole (1997) framework.<sup>18</sup> However, the corporate bond market in Finland has been relatively shallow (as compared, for example, with the US) and entrepreneurial activity is predominantly financed by bank credit rather than by outside equity or debt issuance. Yet, to the extent that our sign restrictions are too strict, some fraction of aggregate demand and asset price shocks will be reflected in the block of unidentified shocks.

### 3.2 Model selection issues

We now discuss the details of the sign restriction methodology that we apply to identify the domestic shocks. Consider a reduced-form VAR(1) model of the form

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

where  $y_t$  is a vector of variables and the reduced-form errors are  $u_t \sim N(0, \Sigma)$ . Structural shocks are then linked to the errors through a structural identification matrix  $W$ , so that  $u_t = W\varepsilon_t$  with  $\Sigma = WW'$ . In our case, the total number of variables  $N = 9$ . There are  $N_x = 3$  foreign (exogenous) variables and  $N_d = 6$  domestic ones.

Shocks in the international block are uniquely identified by the Cholesky decomposition and ex ante exogeneity restrictions on the transition matrix, as discussed in Subsection 3.1. This involves setting  $a_{1,4}, \dots, a_{1,N} = 0$ ,  $a_{2,4}, \dots, a_{2,N} = 0$  and  $a_{3,4}, \dots, a_{3,N} = 0$  in the reduced-form model. To identify the  $J = 4$  structural shocks in the 6-variate domestic block, we apply the sign restriction methodology. To facilitate the exposition we proceed by focusing only on the domestic block and treat it as a complete VAR for the rest of this subsection. In practice, the identification procedure begins with the MLE estimation of the reduced-form model and the standard Cholesky decomposition of the covariance matrix  $\Sigma = BB'$ . Now, consider an orthonormal matrix  $Q$ , called a rotation matrix, such that  $QQ' = I$ . Hence,

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

so that  $W = BQ$  and  $u_t = BQ\varepsilon_t$ . Obviously, there exists an infinity of matrices  $Q$ , which give rise to different

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<sup>18</sup>A similar mechanism occurs in Christiano et al. (2010b), where a positive wealth shock decreases the volume of total loans.

structural models.<sup>19</sup> The practical task of the researcher is then to consider a multitude of rotation matrices  $Q$  and to retain only these rotations which give rise to the desired impulse response patterns and discard all others.<sup>20</sup>

While collecting admissible models that satisfy the sign restrictions for the identified block, one has to keep track of the multiple shocks problem, initially described by Fry and Pagan (2011). Because the model is only partially identified, the shocks in the unidentified block (generated by the latter columns of  $Q$ ) have to be orthogonal to all of the identified shocks. In other words, the set of impulse responses generated by any of the non-identified shocks has to have a sign pattern that is distinct from all the identified structural shocks' impulse responses. We discard all rotations that do not pass this additional orthogonality requirement and refer to this procedure as “FP filter”.

At this stage though, the identification of the model is still not exact because in principle there exists an infinity of structural models (and  $Q$  rotation matrices) that satisfy the sign restrictions. This is what Fry and Pagan (2011) refer to as “multiple models problem”. One then needs to select the ultimate model from the set of admissible candidates based on some optimality criterion. These authors suggest selecting the final model which is closest to the pointwise median of impulse response functions.

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. The modified criterion involves choosing a model that is closest to the normalized pointwise medians of historical shock contributions. To be specific, let  $\tilde{\theta}_{n,j,t}^x$  be the normalized cumulative effect of shock  $j$  on variable  $n$  up to period  $t$ , obtained through the vector MA representation of model  $x$ . 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 model choice criterion is

$$x^* = \operatorname{argmin}_n \sum_j \sum_{t=1+p}^T (\tilde{\theta}_{n,j,t}^x - \bar{\theta}_{n,j,t})^2 \quad (2)$$

where the  $\bar{\theta}_{n,j,t}$  denotes the median over all model candidates,  $p$  is the number of lags in the VAR (in our case  $p = 1$ ) and  $T$  indicates the length of the sample.<sup>21</sup> An advantage of this criterion selection, relative to the one based on IRFs, is that it is not sensitive to the chosen impulse response horizon. Instead, the minimization is naturally based on the whole available data sample. As a final remark, it is important to observe that in the context of our model the minimization is done only over the domestic block. The international block is by

<sup>19</sup>The rotation procedure applies only to the domestic block; the international block is the same same over all  $Q$ 's.

<sup>20</sup>It is a matter of computational speed how to generate candidate  $Q$  matrices quickly. An efficient method based on Householder's transformation has been postulated by Rubio-Ramírez et al. (2010). The procedure involves drawing a matrix  $M$  from a multivariate standard normal distribution. The QR decomposition of  $M$  then delivers an orthonormal matrix  $Q$ . Also, while drawing the rotations, we must impose the additional condition that loan losses do not react on impact following the loan supply shocks. To this end, we modify the drawing algorithm, following Arias et al. (2014).

<sup>21</sup>The  $\theta_{n,j,t}$  contributions are normalized by their respective standard deviations  $\sigma_{n,j}$ , i.e.  $\tilde{\theta}_{n,j,t} = \theta_{n,j,t}/\sigma_{n,j}$ , where the  $\sigma_{n,j}$  are computed across all models and periods.

assumption fully exogenous and the rotation matrices do not affect the magnitude and relative contributions of international shocks.

## 4 Data

In this section we provide more details regarding the time series used in estimation. The dataset is of quarterly frequency and spans from 1Q 1986 until 4Q 2012. All series are stationary and, where appropriate, deflated by the GDP deflator. We use year-over-year (YoY) growth rates of the series, unless indicated otherwise.

*External variables:* To proxy world trade volume, we use the sum of global exports and imports. The deflator is the world GDP deflator. The data are from IFS. Finnish terms of trade is defined as price of exports divided by price of imports. Finally, 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 cumulative losses. 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, as well as equity and exchange rate markets. The CISS index then takes into account correlations between these markets and puts more weight on periods in which the stress prevails on many markets simultaneously to capture the degree to which the stress is systemic. Because of this feature, the series exhibits by far the most pronounced dynamics around the recent financial crisis and the subprime market collapse. Nevertheless, the series also picks up all major international financial events since the mid-1980s, including stock market crashes and crises. However, by construction, they are given much less weight.<sup>22</sup>

*New Keynesian VAR components:* We use standard measures, i.e. growth rates of total GDP and of the GDP deflator. For the measure of credit market tightness we use (the level of) the spread between the lending rate on new non-financial loans and the nominal short-term interest rate (3M interbank rate), as discussed in Subsection 3.

*Financial variables:* The final set of variables describes the Finnish financial sector. The series on asset prices is constructed for the purpose of this paper. It is the first principal component (PC) of stock- and house-price growth rates. The primary reason why we use the hybrid series is because treating the series separately increases the number of sign restrictions (and hence the computational burden) without helping to identify any of the shocks.<sup>23</sup> Both series are normalized, i.e. divided by their standard deviations, before extracting the PC. This allows us to dampen the effect of the stock price series, which would otherwise

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<sup>22</sup>The indicator is used in levels. The data on CISS are available only from 1Q 1987 onwards. We extrapolate the CISS data backwards to 1Q 1986 using the Financial Stress Index (FSI), which was kindly provided to us by Selim Ali Elekdag and Subir Lall.

<sup>23</sup>Nevertheless, the results do not change qualitatively if the two series are handled separately.

dominate the PC due to its very high relative variance. Given that stock prices are more volatile by nature, a one percent increase in house prices may contain more economic information than a corresponding increase in stock prices. The stock market series is the capped OMXH index of the Helsinki Stock Exchange.<sup>24</sup> The house price index tracks the prices of old dwellings in the whole country.

Finally, we include two variables describing the lending market: real new loans to the private sector (households and non-financial firms) and the total loan loss provisions of the banking sector.<sup>25</sup> We focus on new loans (flow) rather than the total loan pool (stock). Here, we 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 are from Pesola (2011) and from Vihriälä (1997).

## 5 Results

In this section we discuss the results of our model estimation. We start with a quick look at the performance of the final model in terms of impulse responses. In the next two subsections we discuss the historical shock decomposition of the Finnish GDP growth rate. This is the key empirical exercise of this paper, as it allows us to identify the driving forces of the last three recessions and in Finland and what factors contributed to the Finnish Great Depression. Since the last question is of particular interest, we devote the last subsection to answering it. In Subsection 5.2 we offer some more general remarks and point to the different natures of these episodes.

We generated 5,000,000,000 draws of the  $Q$  matrix.<sup>26</sup> To improve efficiency, the columns in the  $Q_{ID}$  block were additionally permuted with respect to sign, in the spirit of Rubio-Ramírez et al. (2010). This increased the number of candidate matrices by the factor of  $2^{N_{ID}} = 16$ . We found 2,700 matrices that satisfy the sign restrictions and pass the FP filter. The reported median model of choice was selected using the methodology described in Section 3.2.

In the Appendix, we also report the results from models estimated on two subsamples. In the first, we only use the data from 1Q 1986 until 4Q 2004. This check assures that our conclusions are not driven by the financial crisis of 2007-2008 and the Great Recession. In the second estimation we end the sample at 4Q 1998, to discard the period of membership in the Eurozone. Both of these checks deliver a qualitatively very similar picture to the one reported in the paper.

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<sup>24</sup>The index is capped, which means that the capitalization of a single company cannot exceed a 10 percent share in the index. This allows us to mitigate the impact of Nokia and get a broader view of Finnish corporate performance.

<sup>25</sup>The latter variable is differenced, not log-differenced, relative to the corresponding quarter of the previous year. This is to eliminate the strong base effect which occurs when the crisis explodes and boosts the growth rates to extremely lofty levels.

<sup>26</sup>The computations were parallelized using the Techila technology.

## 5.1 Impulse responses

Figure 5(a) reports the impact of a positive asset price shock. Black lines denote responses of the median model selected according to the criteria described in Subsection 3.2. Dashed red lines denote 90 percent bands.<sup>27</sup>

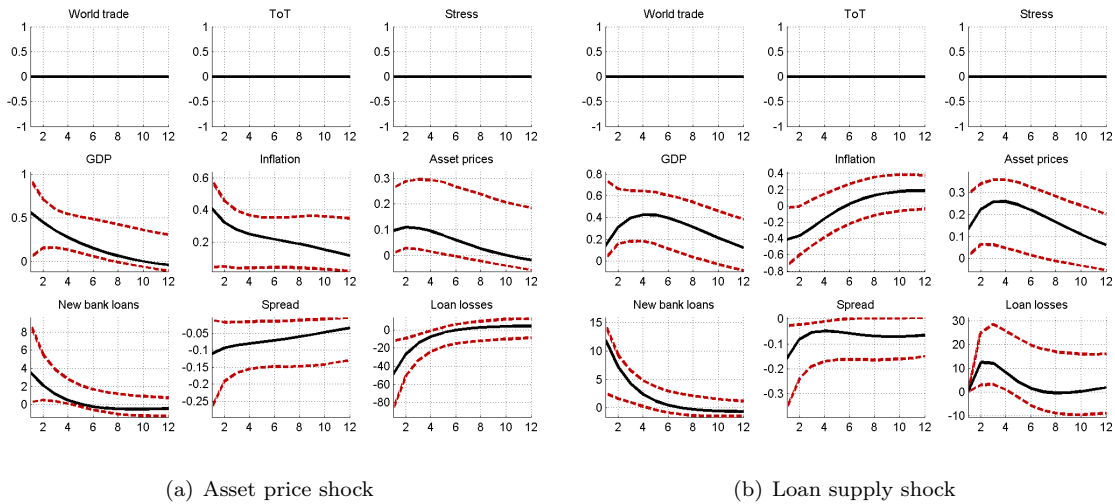


Figure 5: Impulse response functions following domestic financial shocks

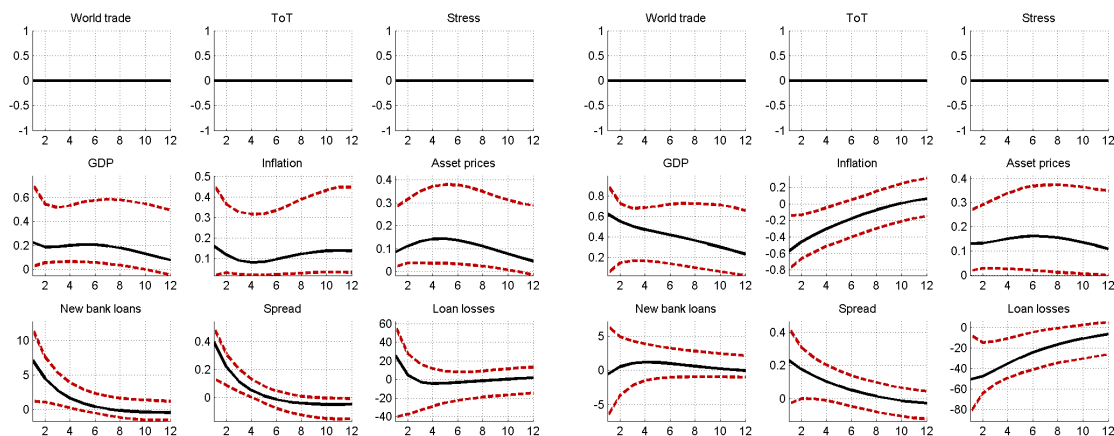
Because of the exogeneity assumption, neither stress nor external demand are affected. All domestic variables are affected on impact, as the rotation matrix  $Q$  kills the Cholesky triangularity. Given our identification scheme summarized in Table 1, there's no uncertainty regarding the direction of the reaction on impact and three periods after the shock in any of the domestic variables. Yet, the magnitude of impact, persistence of the responses and the paths in latter periods are all unrestricted. An increase in the first principal component of asset prices of 0.096 percentage point translates into an increase in the stock price dynamics of 8.74 percentage points and in house price dynamics of 2.38 percentage points. Output dynamics (real GDP growth rate) increase by 0.56 percentage point on impact. Inflation goes up by 0.41 percentage point. The quantity of new loans goes up by 3.54 percentage points; however, the effect is relatively short-lived and largely dies out after a 6 quarters. At the same time, loan losses drop on impact by €<sub>2000</sub> 48.97 million per quarter. The gap between lending rates and policy rates shrinks by almost 11 basis points.

Next, consider a shock to the loan supply, reported in Figure 5(b). As implied by sign restrictions, output rises and the growth rate remains higher for at least 12 quarters. Asset prices behave in a very similar fashion.

<sup>27</sup>The bands were constructed pointwise (i.e. for every variable, shock and period), across all admissible structural models. The bands reflect both the standard sample uncertainty of the estimates of  $A$  and  $\Sigma$ , as well as model uncertainty related to the draws of  $Q$ . We generated 2,000 draws of  $(A, \Sigma)$  pairs and 10,000,000 draws of  $Q$  for each pair (times the permutations), which gave 3,973 models. As stressed by Fry and Pagan (2011) these bands should not be treated in a probabilistic sense (i.e. they are not genuine confidence intervals). This is because each rotation comes from a uniform distribution and is equally likely. They merely illustrate the diversity of dynamics of admissible models.

Loan losses are by construction not allowed to increase on impact. Instead, they rise in the following periods and die out within seven quarters after the shock, around the same time as the increase in new bank loans. The spread remains lower for at least three years, initially by around 15 basis points, and later by 5 points. Inflation is the only unrestricted variable in our identification scheme. The fact that it drops suggests that new credit has more of an effect on the supply side of the economy (entrepreneurs) than on the demand side (households).

Figure 6(a) shows the responses following a domestic aggregate demand shock. Real variables exhibit rather protracted reactions. Financial variables, on the other hand, are shorter lived and largely die out within a year after the shock. Loan losses, the only variable not restricted by sign, rise on impact. This suggests that the volume of new loans climbs enough to deteriorate the overall quality of loans. This effect initially dominates the positive wealth effects of stronger balance sheets and higher asset prices.



(a) Aggregate demand shock

(b) Aggregate supply shock

Figure 6: Impulse response functions following domestic real shocks

Following a positive supply shock, depicted in 6(b), a rise in GDP is accompanied by a decrease in prices. New bank loans actually drop somewhat on impact (although not much, and the 90 percent bands are very wide), but they start to grow in latter periods. This may suggest that firms initially use higher retained earnings to expand their assets but then also take out more loans. However, the interest rate spread widens already on impact.

Finally, in Figure 7 we report the reaction of the economy to the external stress shock. We do not report here impulse responses to world trade and Finnish terms of trade shocks because, as discussed in Subsection 3.1, these shocks are only block-identified. Because the stress shock is identified through exogeneity restrictions and Cholesky decomposition rather than by sign restrictions, there is no variation due to different rotations of  $Q$ .<sup>28</sup> As expected, domestic output declines following an increase in foreign financial stress. So

<sup>28</sup>The construction of the 90 percent bands in Figure 7 reflects the fact that the stress shock is identified via zero rather than



does world trade, as well as domestic asset and goods prices. Weaker balance sheets raise loan losses. Interest rate spreads go up in total and new bank loans drop, although the initial reaction of these variables is somewhat counterintuitive.

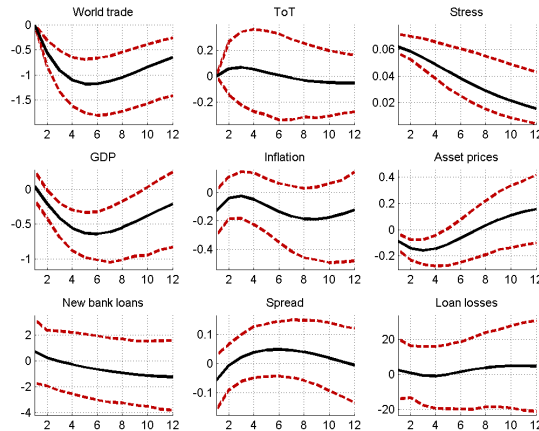


Figure 7: Impulse response functions following global stress shock

## 5.2 Historical Decomposition

We now move to the central exercise of the paper, i.e. the decomposition of Finnish GDP dynamics into shocks. The results are presented in Figure 8. A first glimpse allows us to make several observations. First, the accumulation of dark and medium blue bars indicates an overall strong role of external shocks. This applies both to fluctuations in real variables (world trade and terms of trade), as well as in the transmission of international financial stress to Finland. In fact, the crisis of 2008 and the recession of 2001 were driven predominantly by these exogenous factors. This stands in contrast to the early 1990s, when domestically-originated shocks dominated, as will be discussed in depth in the next subsection. The impact of global financial distress was negligible around 2001. However, in 2008 it was very large, and it affected the economy even more than the contraction of external trade. The recovery was then driven by subsiding stress and a rebound in world trade.<sup>29</sup>

The significant role played by real external shocks might be attributed to two factors. Firstly, Finland is a small open economy in the sense that its exports constitute a relatively large share of GDP. Secondly, for most of the time in our sample it had 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 the Eurozone. Therefore it could not inequality restrictions, as was the case with the domestic shocks. Therefore these bands capture only the sampling uncertainty related to estimates of the  $A$  and  $\Sigma$  matrices.

<sup>29</sup>Between 2006 and 2010 Finnish terms of trade were largely constant, as reported in Figure 4. Therefore, it is fairly safe to attribute the real external shocks to world trade fluctuations around that time.

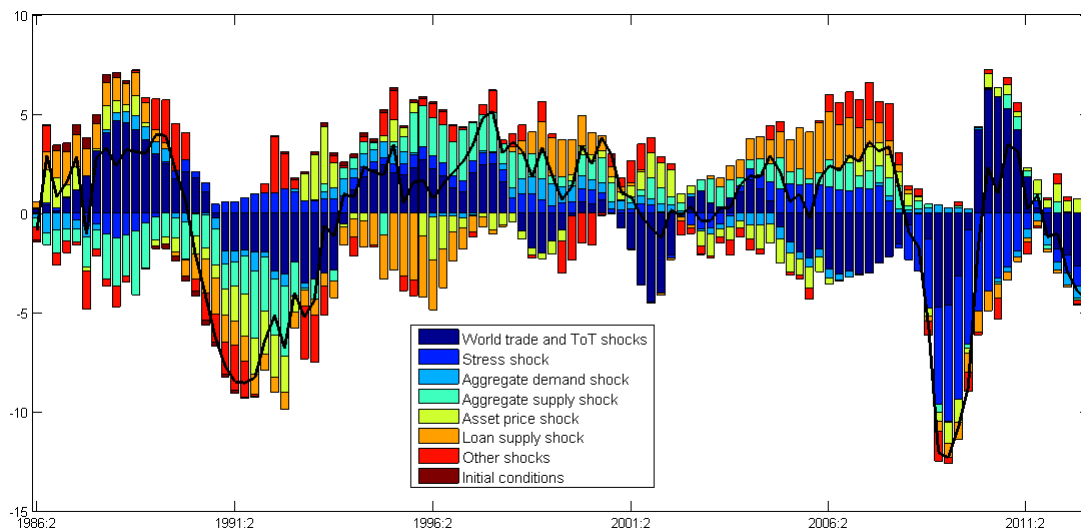


Figure 8: Historical decomposition of Finnish GDP growth rate.

count on a flexible exchange rate as a shock absorber, although it resorted to a devaluation in the midst of the depression of the early 1990s. In fact, these shocks seem to amplify the cycle rather than dampen it in the sense that they are positive in the time of high growth and negative in the times of recessions and slowdowns.

Secondly, we find that a large role was played by domestic financial shocks, especially loan supply shocks. Large positive loan supply shocks can be observed in the run-up to all three contractions. Strikingly however, whereas negative shocks occurred twice during the Finnish Great Depression (in the early stage of the bust and then again in the recovery phase), they did not contribute to any of the last two recessions. This reflects the simple fact that the only domestic financial and banking crisis experienced in Finland over the last quarter century occurred in the early 1990s.

The large role of domestic financial shocks can also be traced back to the behavior of the interest rate spread, new loan volumes and asset prices. According to our identification scheme, a negative domestic financial shock should increase the spreads. In the case of the asset price shock this would occur due to falling collateral values; for the loan supply shock it would reflect higher monitoring costs due to upgraded lending standards. Empirically, as discussed in Subsection 2.1, the interest rate spreads have been gradually diminishing since the recession of 2001, which reflects increasing market competition and changes triggered by Basel II standards. This is reflected in the significant role of the positive loan supply shocks in the run-up to the Great Recession.<sup>30</sup>

<sup>30</sup>As shown by Diamond and Rajan (2012) in a theoretical model and confirmed empirically by Maddaloni and Peydró (2011), bank lending standards may weaken due to low policy rates. This gives rise to a “risk-taking channel” in which a monetary policy shock drives down monitoring costs and shifts the loan supply curve outwards. To the extent that this mechanism is operative in Finland, it would also be accounted for by the loan supply shock in our decomposition.

Why does the historical decomposition not attribute a large role to asset price shocks? Our asset price measure only partially reflects the stock market booms and busts. The first reason is the decoupling of stock and house prices, discussed in Subsection 2.1, and the stable dynamics of house prices since the mid-1990s. The second reason is that the stock market series used in the index is capped. Therefore it can only fractionally be associated with the dynamics of Nokia corporation. The reason for using a capped series is that Nokia was largely foreign-owned already in 2000 so that the fall in its share prices affected mainly foreign rather than Finnish balance sheets.

A final key observation is the economy's rather quick recovery after both of the two most recent recessions, despite their strikingly different magnitudes. As discussed before, these downturns were driven predominantly by adverse foreign shocks. This stands in sharp contrast to the experience of the early 1990s. During the Finnish Great Depression domestic, and in particular financial, shocks substantially contributed to the slump. They also dragged the economy down during the recovery phase. As a result, that contraction was much more prolonged and hence resulted in a massive decline in total output. We discuss this episode in detail next.

### 5.3 Finnish Great Depression 1990–1993

The Finnish Great Depression began at the start of 1990, after several years of rapid economic expansion. The contraction lasted for almost four years. The cumulated decline in real Finnish GDP from peak in 4Q 1989 to trough in 1Q 1993 was 12.6 percent, making it one of the biggest contractions experienced by an industrialized economy after World War II. As was the case with many other major recessions, several hypotheses have been proposed to explain the collapse and the debate is, in our view, not settled. The primary reason of the multitude of explanations is that several factors came into play around the time, many of which could explain a large share of the Finnish Great Depression. In the words of Honkapohja and Koskela (1999), it was a “tale of bad luck and bad policies”. Our exercise attempts to confront some of these views and to assess the relative importance of different factors that have been at work during and before the crisis.

The historical decomposition presented in Figure 8 allows us to make an assessment of how much the Soviet trade collapse contributed to the decline in Finnish GDP. The drop in demand from the USSR is in the first place attributed to innovations in external trade and terms of trade. We indeed see a large positive role of these shocks in the run-up to the crisis, and then negative contributions, especially after 1991. Nevertheless, as discussed in Subsection 2.2, the terms of trade boom of the late 1980s had largely a temporary effect driven by low world oil prices. This boom was wiped out in the early 1990s, partly because global energy prices rose and partly because Finland lost the implicit energy subsidy from the USSR.

Secondly, a considerable part of the sectors exporting eastwards became obsolete after 1991. The largest firms (e.g. in the shipbuilding industry) were partly able to switch their production profiles. However, most

small and medium-size production plants had to shut down which in turn generated structural unemployment. Hence, the collapse of eastern trade can also be thought of as capital obsolescence or depreciation and interpreted by the model as a negative shock to domestic capital stock. Therefore, the end of Soviet trade may in principle appear in the historical decomposition, both in the foreign real block and as a negative domestic supply shock. In principle one could distinguish between these external demand and domestic supply effects by looking at price series. However, these goods, frequently of low quality, did not find other markets and hence largely stopped being produced.

Finally, one could also argue that the Soviet shock is partly reflected in the global financial stress series. The link is nevertheless only implicit and the interpretation rather far-fetched. The causality chain would start with a crumbling Soviet block giving a green light to German unification. The surge in government spending in the former GDR increased inflationary pressure in Germany and resulted in interest rate spikes generated by the Bundesbank. This in turn put under pressure the exchange rate pegs throughout Europe (including Finland, Sweden and the UK), culminating in September 1992.<sup>31</sup> Interestingly, however, the decomposition does not link the depression to the financial turbulence in Western Europe, although the ERM crisis is clearly picked up by the CISS series. In fact, financial stress shocks appear to make mildly positive contributions throughout the early 1990s. This might be due to Cholesky being an unsatisfactory identification approach. It is very important to note, however, that, if anything, a failure to properly identify the financial stress shock overestimates the contribution of real external shocks. This is because of the exogenous nature of the external block of the VAR. Regardless of the decomposition of the covariance matrix  $B$ , the sum of all structural shocks in the foreign block in a given period will always be the same. Therefore, if our identification of the stress shock wrongly attributes a positive role to Finnish GDP dynamics in the early 1990s, then it also overestimates the negative contribution of the other shocks in the foreign block.

The more one is willing to treat the recession and crisis in Western Europe as an event independent of the collapse of the USSR, the more the shocks in the external block will reflect factors unrelated to the end of Soviet trade. For example, innovations in world trade will not only capture the drop in exports to USSR, but also to Sweden, UK and other countries. Given all the above considerations, the cumulative contribution of the two real external shocks and the domestic supply shock constitutes an upper bound for the Soviet trade collapse shock. Hence, if anything, such a proxy generates a bias against alternative hypotheses on the causes of the depression.

Another large part of the decomposition is attributable to domestic financial factors, including both the asset price shock and the loan supply shock. The collapse of the asset price bubble plays an important role between 1990 and 1992. Negative loan supply shocks also contribute negatively, especially in 1990. They also played a dominant role around 1994-1995 and dragged down the economy in the recovery phase. This reflects two empirical effects. The first is the lagging nature of loan losses and the fact that lending was

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<sup>31</sup>In any case, these events unfolded when the Finnish crisis was already in full swing and can therefore potentially explain only a fraction of its depth.

still depressed long after the recession officially ended. In fact, new lending did not pick up until 1998, which makes the episode a good example of a creditless recovery.<sup>32</sup> On the other hand, the banking sector underwent considerable restructuring. An independent Financial Supervision Authority was established in October 1993. Banks were required to recapitalize, and the main two commercial banks, KOP and SYP, were merged. The total sector shrank considerably, especially after 1993, and by 1996 the total number of employees in the industry fell to 30,000 compared to 55,000 in late 1980s.<sup>33</sup>

The run-up to the crisis was characterized by a high growth rate. On the domestic side, the GDP was pulled up by positive shocks to the loan supply. Hence, the decomposition picks up the credit expansion that followed the financial liberalization in the mid-1980s. However, it does not leave much room for asset price shocks. This suggests that the increase in asset prices was largely an endogenous process, ultimately triggered by greater availability of credit.

Figure 9 zooms in on the depression episode. It gives a comparison of the roles of external factors (including Soviet trade collapse) and of domestic financial shocks. The sum of the shocks to world trade, terms of trade and domestic aggregate supply is a proxy for the Soviet trade impact, or, more precisely, an upper bound for this proxy. Domestic financial shocks are asset price shocks and loan supply shocks. We see a large role for external factors. In particular, negative contributions of USSR-related shocks constitute 52.7 percent of all negative shocks between the peak in 4Q 1989 and the trough in 1Q 1993. Domestic financial shocks, however, play a considerable role as well. Their share for that period is 41.7 percent. They also play an important positive role during the run-up to the crisis and, importantly, are the major hindrance to the recovery. If we analyze the period from 4Q 1989 to 4Q 1996, the quarter in which the economy regained the pre-crisis peak, then the shares are 44.6 percent and 40.6 percent, respectively.

In Figure 10 we examine the extent to which the financial crisis was driven by the collapse of Soviet trade. According to Gorodnichenko et al. (2012), the financial and banking crisis was an endogenous result of this real shock originating abroad. To this end, we perform two counterfactual simulations of GDP. In Counterfactual 1, depicted by the solid red line, we only turn on the USSR-related shocks.<sup>34</sup> We then construct Counterfactual 2, depicted by the dashed orange line, in which we additionally shut down the feedback from domestic financial variables (i.e. asset prices, spread, new loans and loan losses) to the rest of the economy (all variables in the domestic block).<sup>35</sup> Therefore, the difference between the two counterfactuals can be treated as a proxy for the endogenous amplification of USSR-related shocks due to the domestic financial sector. The figure suggests that such amplification was indeed at work. However, it became fully

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<sup>32</sup>See Claessens et al. (2009) and Calvo et al. (2006).

<sup>33</sup>Ex ante, however, it was not clear what ultimate form the restructuring of the financial and banking sector would take. The bank mergers and the overhaul of financial supervision were discrete decisions chosen from several options, some of which might not have involved equally drastic downsizing of the banking sector. Therefore it is natural to think about them at least partially as shocks, rather than endogenous responses of the financial system. See Kuusterä and Tarkka (2012) for details.

<sup>34</sup>Technically this is done by imposing zeros on appropriate entries of the  $B$  matrix.

<sup>35</sup>Technically, we impose *ex post* zero restrictions on the appropriate entries of the  $A$  matrix.

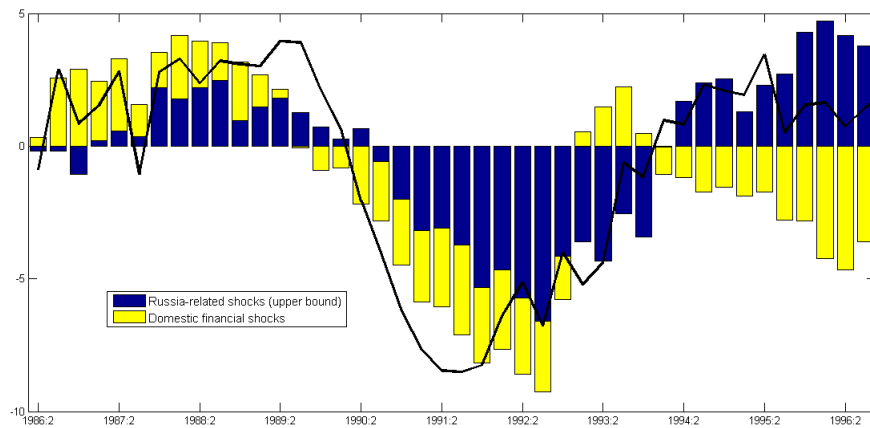


Figure 9: USSR-related versus financial shocks during the Finnish Great Depression.

operative only around 1992 and died out by the end of 1993. Therefore, the endogenous exacerbation of the financial crisis due to the Soviet trade shock was too weak and came too late to explain the full depth of the financial crisis, especially its first stage in 1990 and 1991. More generally, the comparison of Counterfactual 1 with the actual GDP makes it clear that the Soviet shocks cannot account for the whole (or almost whole) depression, especially not for its initial phase.

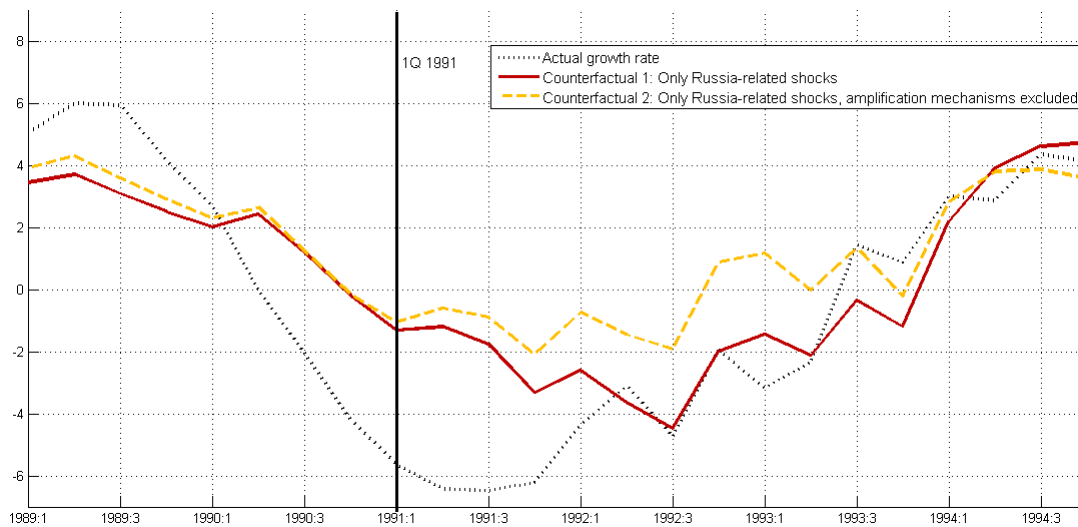


Figure 10: USSR-related shocks and their amplifiers during the Finnish Great Depression.

To gain further insight into the role of financial factors during the Finnish Great Depression, and over the business cycle more generally, we construct two additional counterfactual scenarios. In particular, we ask to what extent was the domestic financial system the actual source of shocks and to what extent was it just an amplifying mechanism for other shocks buffeting the economy. The results are summarized in Figure 11. The dashed red line depicts Counterfactual 3, i.e. the hypothetical GDP growth rate, if the domestic financial

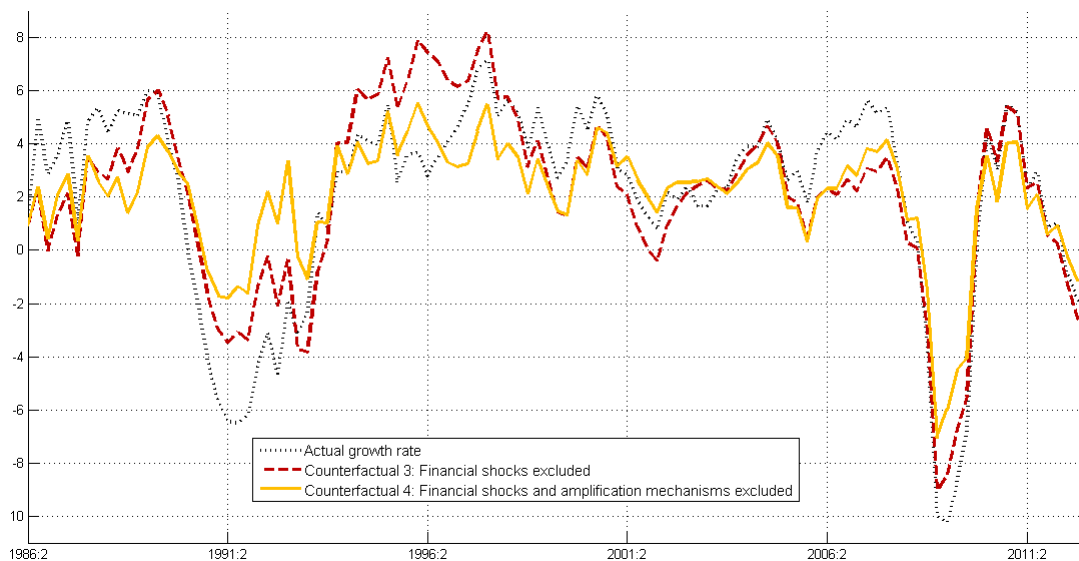


Figure 11: Contributions of different financial factors to the Finnish GDP growth rate.

shocks, i.e. the asset price and loan supply shocks, are shut off (all other shocks are on). As a result, the negative GDP growth rate in the trough of the depression (3Q 1991) is almost halved. In 1992 and 1993 the difference is equally striking, and without these shocks, the economy would have experienced only a rather mild recession. In Counterfactual 4 (solid orange line) we additionally turn off the channels from domestic financial variables to the rest of the economy. The picture changes yet further. The recession turns into a moderate recovery between 1992 and 1993. We interpret this result as further evidence that financial factors indeed played an important role in deepening the Finnish Great Depression. A large role played by domestic financial factors is also clear during the run-up to the crisis, i.e. in the late 1980s. Positive financial shocks add two to three percentage points to the GDP growth rate in 1987 and 1988. Amplification effects make this impact even more pronounced. In contrast to that, the relative role of financial shocks in 2008 was much smaller.

## 6 Conclusions

We conducted an empirical study of the Finnish business cycle, focusing on the Finnish Great Depression of 1990-1993. We find a strong role for financial factors in driving the business cycle in general, and in amplifying recessions in particular. The origins of the depression in Finland were very different than of the Great Recession in late 2000s. The former was associated with a bust of the lending and asset price bubbles followed by a financial and banking crisis with exploding bankruptcy and loan loss rates. In consequence, the decline was prolonged and turned into a depression, with negative GDP growth rate lasting for 13 consecutive quarters. In a counterfactual exercise in which the feedback from financial to real variables is shut down,

the decline in GDP is about half of what was actually observed in the early 1990s. The crisis of 2008-2009 was, on the other hand, very different. We find no evidence of domestically generated financial shocks that contributed to the contraction at 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 the early 1990s. The very different nature of the two episodes is largely explained by the initial state of the financial sector. In 2008 banks were on average less leveraged than in the late 1980s, and the credit expansion was made within the regulatory framework in place at the time. In contrast, Finnish banks entered the lending boom of the late 1980s with outdated safety regulation, very low equity levels and no proper fire-prevention measures that would allow policy makers to act quickly.

Our exercise also sheds some more light on the question of which financial shocks actually matter and have contributed to the Finnish business cycle. Relative to some earlier studies which stressed the role of asset price movements (Vihriälä, 1997 and Drees and Pazarbaşıoğlu, 1998), we find a dominating role for shocks moving the loan supply curve. This should not be very surprising *per se* given the central role played by commercial banks in the Finnish financial system, although our study is the first to reach this conclusion.

Our overall results do not deny a considerable role for the collapse of Soviet trade in the making of the Finnish Great Depression. The breakdown of exports to USSR was clearly a strong exogenous shock that aggravated the Finnish situation relative to Sweden. Nevertheless foreign shocks, also those not related to Russia, tell only half of the story. The second half is the one about the “casino economy”, starting with financial liberalization and triggering a credit-fuelled boom which collapsed over a year before the USSR stopped importing from Finland.

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# Appendices

## A Robustness checks

### A.1 Estimation until 2004

In this appendix we report the results based on shorter subsamples. In the first check we use the subsample from 1Q 1986 until 4Q 2004. The results are plotted in Figures 12-15. This check assures that our conclusions are not driven by the financial crisis of 2007-2008 and the Great Recession. The historical decomposition is qualitatively very similar to the benchmark case and picks up the key episodes discussed in the paper, although here we see a stronger role for unidentified shocks. Also, the robustness check does not reveal any positive contributions of the stress shock during the early 1990s, as was the case in the benchmark. The sum of the negative shocks to world trade, terms of trade and domestic aggregate supply constitute 42.4 percent of all negative shocks between 4Q 1989 (first quarter of a fall in GDP) and 1Q 1993 (last quarter of a fall in GDP). In this timeframe domestic shocks constitute 29.4 percent of all negative shocks. For the period from 4Q 1989 to 4Q 1996 (when GDP reached the pre-crisis peak level), the shares are 34.5 percent and 35.8 percent, respectively.

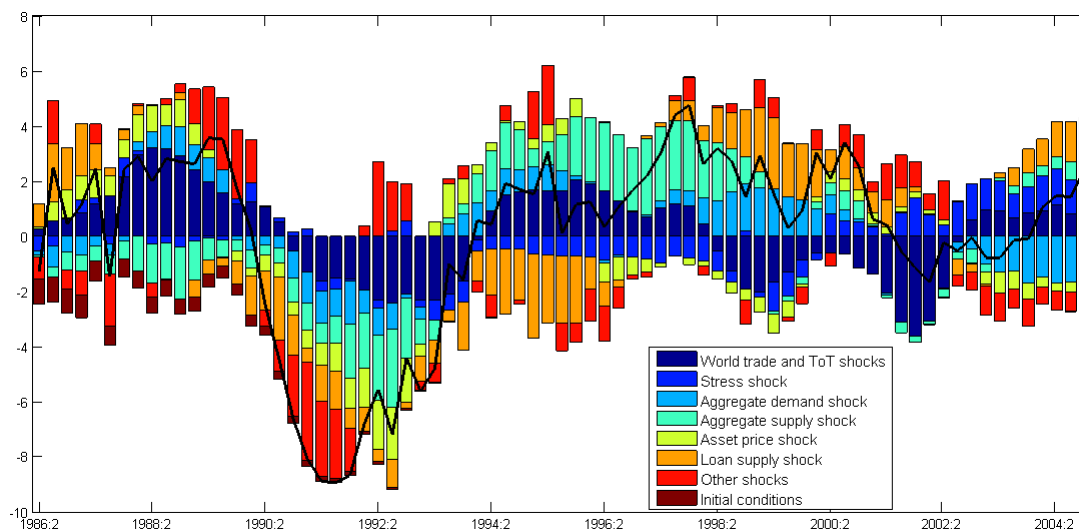


Figure 12: Historical decomposition of Finnish GDP growth rate.

*Notes:* The decomposition is based on the model estimated on sample 1Q 1986-4Q 2004.

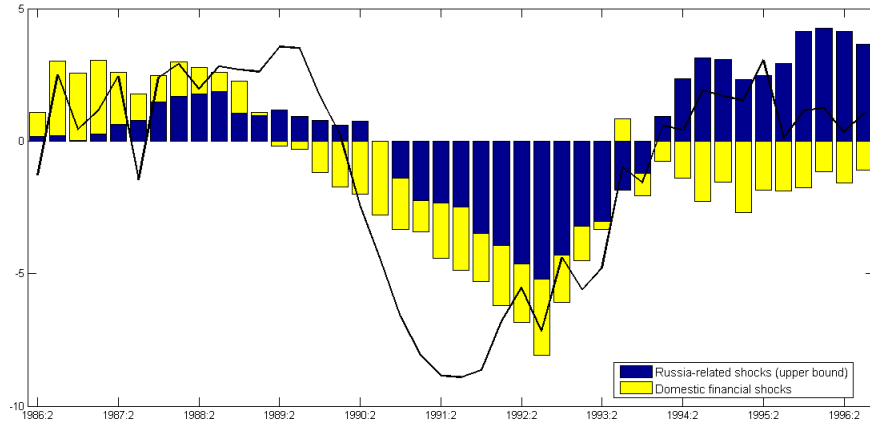


Figure 13: USSR-related versus financial shocks during the Finnish Great Depression.

*Notes:* The decomposition is based on the model estimated on sample 1Q 1986-4Q 2004.

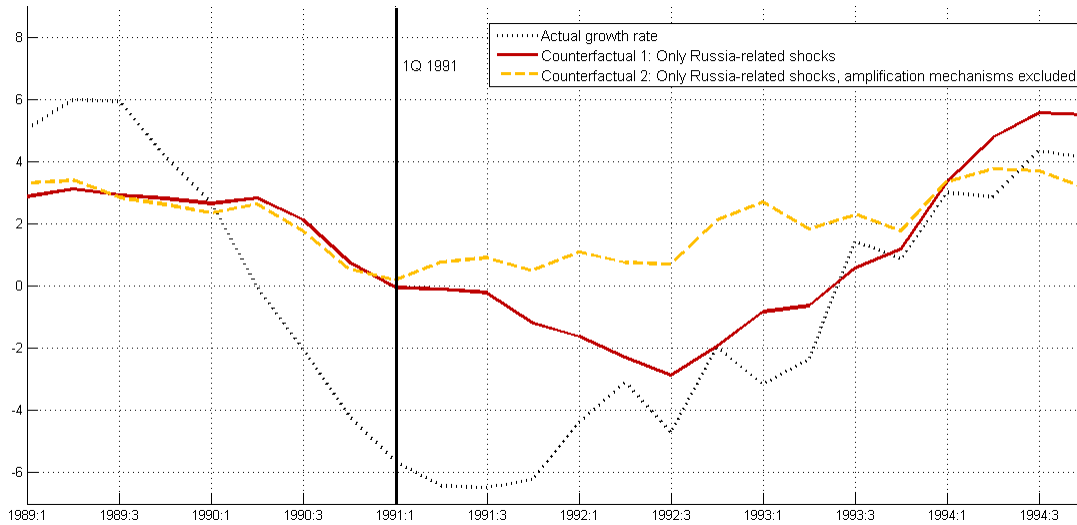


Figure 14: USSR-related shocks and their amplifiers during the Finnish Great Depression.

*Notes:* The decomposition is based on the model estimated on sample 1Q 1986-4Q 2004.

## A.2 Estimation until 1998

In the second robustness check we end the sample at 4Q 1998, to discard the period of membership in the Eurozone. The results are plotted in Figures 16-19. The picture is again qualitatively similar to both the benchmark case and the first robustness check. Between 4Q 1989 and 1Q 1993 the contribution of negative shocks to world trade, terms of trade and aggregate supply is 44.5 percent of all negative shocks, whereas for domestic financial shocks the number is 25.4 percent. Looking wider (from 4Q 1989 until 4Q 1996) the numbers are 40.7 percent and 27.5 percent, respectively.

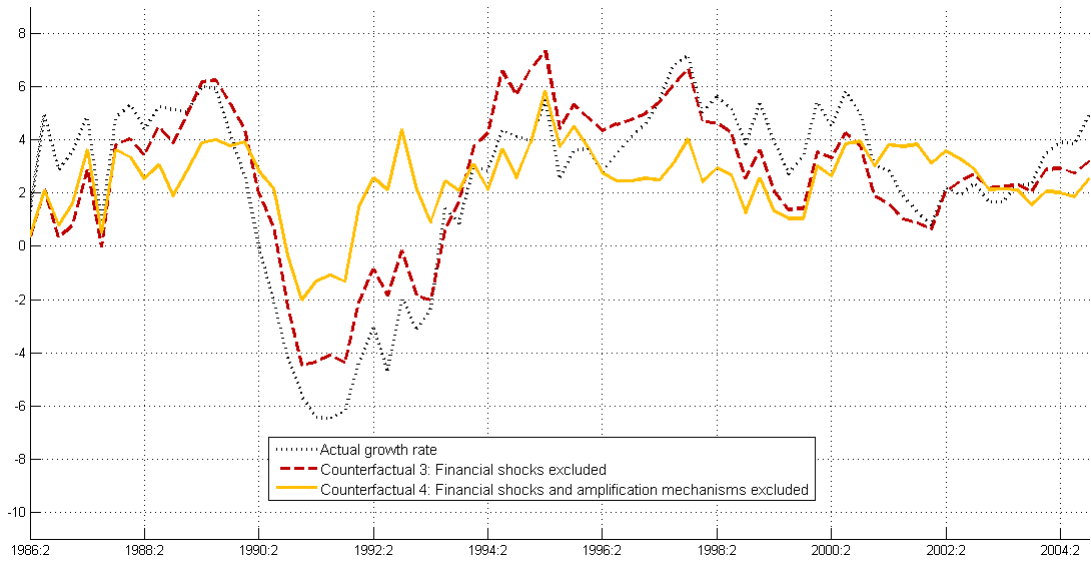


Figure 15: Contributions of different financial factors to the Finnish GDP growth rate.

Notes: The decomposition is based on the model estimated on sample 1Q 1986-4Q 2004.

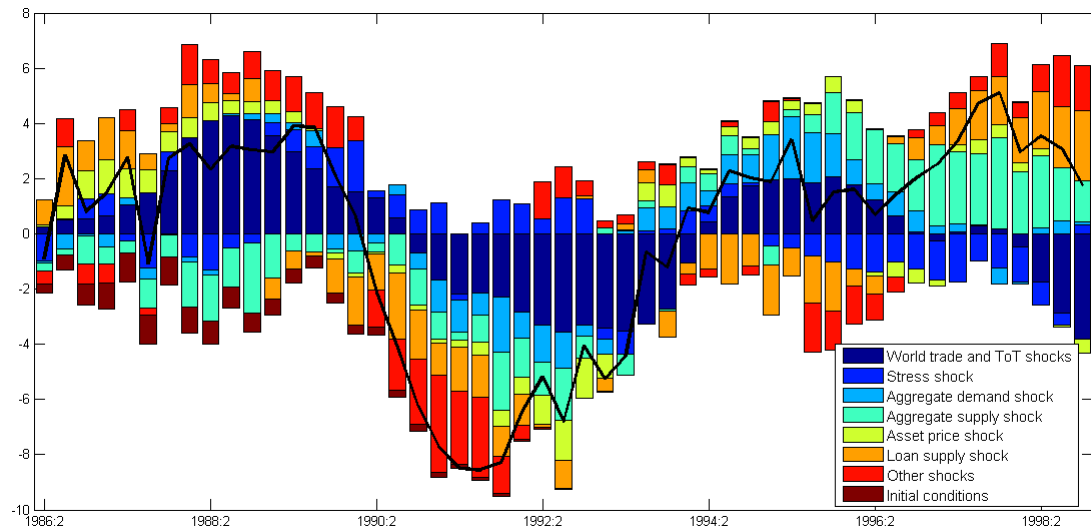


Figure 16: Historical decomposition of Finnish GDP growth rate.

Notes: The decomposition is based on the model estimated on sample 1Q 1986-4Q 1998.

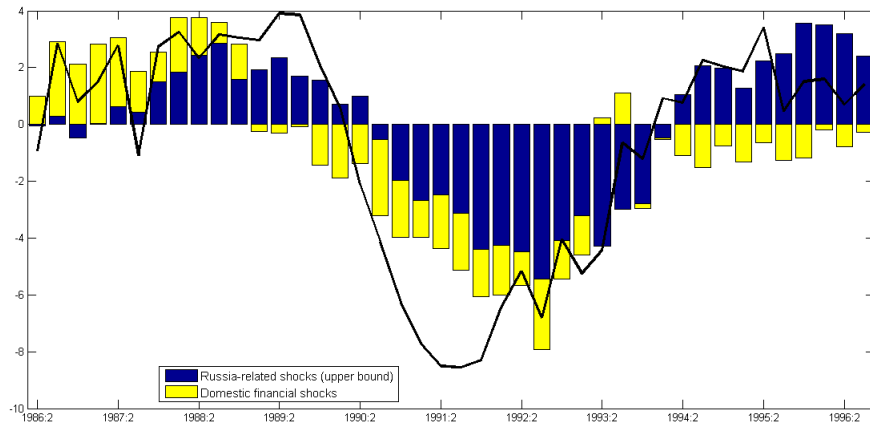


Figure 17: USSR-related versus financial shocks during the Finnish Great Depression.

*Notes:* The decomposition is based on the model estimated on sample 1Q 1986-4Q 1998.

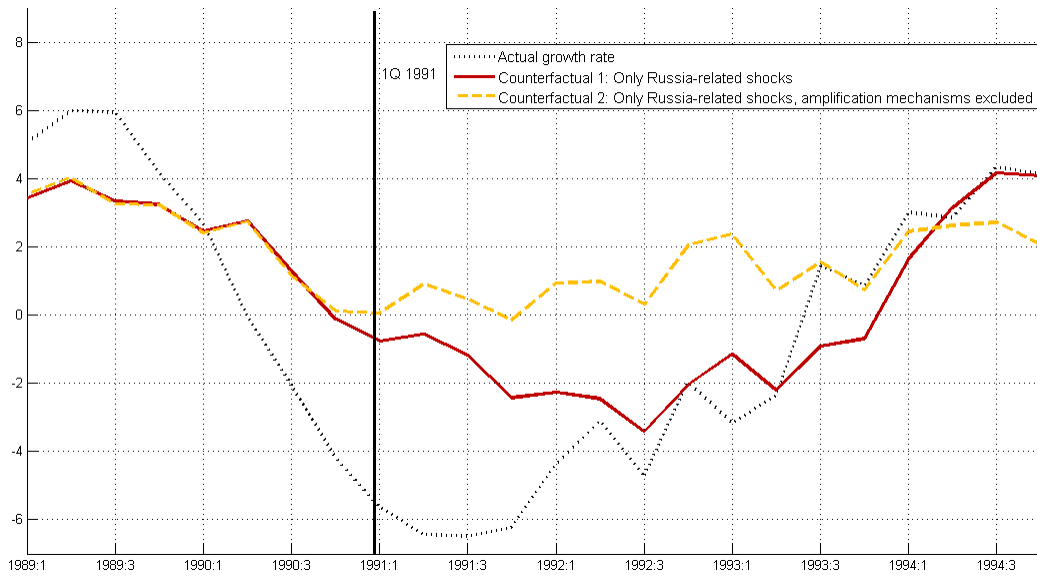


Figure 18: USSR-related shocks and their amplifiers during the Finnish Great Depression.

*Notes:* The decomposition is based on the model estimated on sample 1Q 1986-4Q 1998.

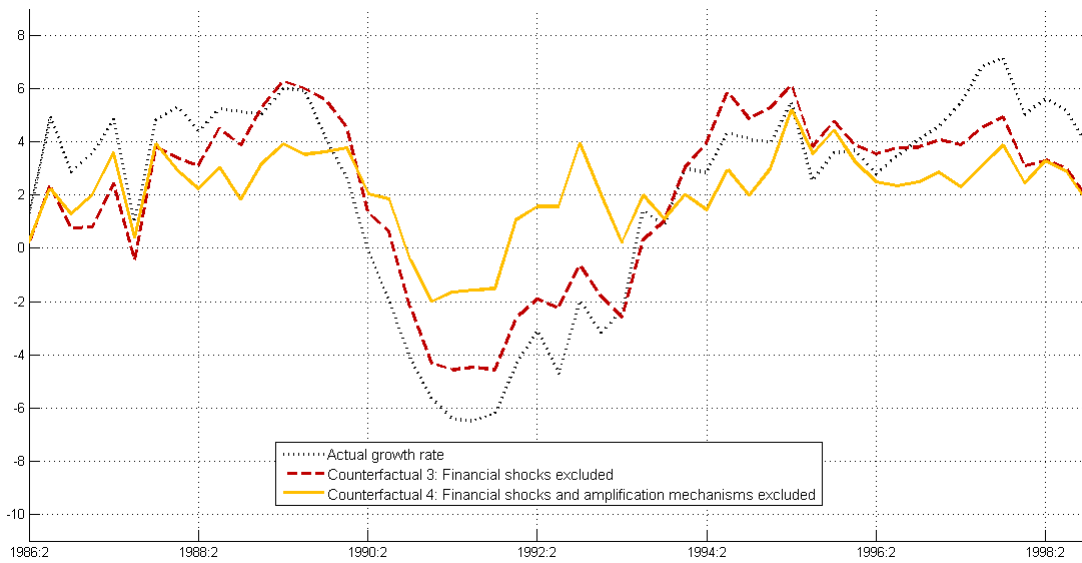


Figure 19: Contributions of different financial factors to the Finnish GDP growth rate.

*Notes:* The decomposition is based on the model estimated on sample 1Q 1986-4Q 1998.



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