Bank of Finland Research Discussion Papers
9 • 2019

Adam Gulan – Markus Haavio – Juha Kilponen

Can large trade shocks cause crises? The case of the Finnish-Soviet trade collapse

Bank of Finland
Research

Bank of Finland Research Discussion Papers
Editor-in-Chief Esa Jokivuolle

Bank of Finland Research Discussion Paper 9/2019
5 June 2019

Adam Gulan – Markus Haavio – Juha Kilponen
Can large trade shocks cause crises? The case of the Finnish-Soviet trade collapse

ISBN 978-952-323-274-7, online
ISSN 1456-6184, online

Bank of Finland
Research Unit

PO Box 160
FIN-00101 Helsinki

Phone: +358 9 1831

Email: research@bof.fi
Website: www.suomenpankki.fi/en/research/research-unit/

Can large trade shocks cause crises?
The case of the Finnish-Soviet trade collapse*

Adam Gulan, Markus Haavio, Juha Kilponen†

This version: June 3, 2019

Abstract

We study macroeconomic consequences of a major trade disruption using the example of the Finnish-Soviet trade collapse in 1991. This is a rare case of a well-identified large trade shock in a developed economy. We find that the shock had a significant effect on Finnish output. While the direct trade channel effect was rather moderate, the shock led to significant tightening of financial conditions. It was therefore endogenously amplified due to the propagation through the domestic financial sector. Even so, the trade collapse was insufficient to generate an all-out economic crisis. It can account for only a part of the Finnish Great Depression (1990 – 1993). The crisis was triggered and prolonged by the meltdown of the overheated financial and banking sectors since 1989. We show that the financial system remained a major independent source of shocks throughout the depression.

Keywords: trade shock; natural experiment; financial propagation; crisis; great depressions; small open economy

JEL Classification: E32; E44; O52

---

*This is a revised version of a paper circulated earlier under the title "Kiss Me Deadly. From Finnish Great Depression to Great Recession". 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 benefited from discussions with Gene Ambrocio, Christiane Baumeister, Giovanni Caggiano, Fabio Canova, Martin Ellison, Yuriy Gorodnichenko, Eleonora Granziera, Seppo Honkapohja, Esa Jokivuolle, Mikael Juselius, Manfred Kremer, Niku Määttänen, Nigel McClung, Enrique Mendoza, Haroon Mumtaz, Emi Nakamura, Evi Pappa, Antti Ripatti, Jean-Charles Rochet, Pentti Saikkonen, Pekka Sutela, Juha Tarkka, Linda Tesar, Fabio Verona as well as conference and seminar participants at CEF, Dynare, EEA, ESWC Montreal, EUI, FEA, Finnish Ministry of Finance, HECER, HMRAD, IAAE London, Inter-American Development Bank, MMF, MMM Miami, Magyar Nemzeti Bank, Philadelphia FED, PT, T2M Berlin, University of Jyväskylä, University of Manchester and University of Turku. We thank Lauri Esala for excellent research assistance as well as Eero Savolainen, Reijo Siiskonen and Matti Virén providing us parts of the data. Any errors or shortcomings are ours.

†All authors: Monetary Policy and Research Department, Bank of Finland, Snellmaninaukio, PO Box 160, Helsinki 00101, Finland, email: firstname.lastname@bof.fi

1 Introduction

What are the economic consequences of large trade disruptions? How do such shocks propagate? Are they able to trigger a full-scale economic crisis? We study these questions using the example of the Finnish-Soviet trade collapse in 1991.

Prior to the collapse, the USSR was Finland's major trading partner. Trade was based on a clearing principle, an exceptional arrangement for a market economy. Finland sold a variety of manufactured goods, often paid for in advance and at hefty markups, while importing predominantly fossil fuels. It was effectively a goods-for-oil scheme. This peculiar bilateral trade came to an abrupt end in December 1990 when Soviet officials unilaterally canceled the deal. As a result, Finnish exports to the USSR all but vanished overnight, falling from 2.4 to 0.8 percent of GDP.

Could such major trade shock cause a severe economic contraction and explain the Finnish Great Depression (Gorodnichenko et al. 2012)? The deep recession experienced by Finland in the early 1990s remains one of the most severe experienced by an industrialized economy since World War II. The cumulative decline in real GDP from its peak in 3Q 1989 to the trough in 2Q 1993 was 12.1 percent (a deviation of 17.9 percent from the trend), and the pre-crisis level of income was achieved again only in 4Q 1996.

In this paper, we provide evidence that the Soviet trade collapse had a considerable negative impact on the Finnish economy. However, despite its abnormal depth, it can account for only a fraction of the overall drop in the GDP. Based on our analysis, the initial loss of exports translated into $3.3-3.8$ percentage points of accumulated loss in GDP over the next two years, depending on the assumed end of the shock. We show that the impact of the trade shock came mainly from the fact that it heavily tightened borrowing conditions for the corporate sector. The GDP loss shrinks to $1.6-2.1$ percentage points when we do not allow for the tightening of the interest rate spread in the counterfactual simulations, a number only slightly larger than the initial drop in exports eastwards.

In other words, the Soviet trade shock alone could not generate the massive economic downturn witnessed by Finland in the early 1990s. We show that shocks originating from the financial sector, unrelated to the trade shock, were the second-most important driver of the Finnish Great Depression. These shocks can be traced back to the consequences of the financial liberalization and exploding credit, followed by collapsing asset prices and a banking crisis akin to the traditional financial boom-bust cycle literature. The depression was further deepened and protracted by the monetary contraction in Europe and the Exchange Rate Mechanism crisis in 1992.

Finnish exports to Russia experienced large exogenous drops on three more occasions (in 1998, 2008 and 2014). Smaller declines also occurred in the 1980s. This record makes Finland an excellent laboratory for the study of trade shocks and macro-financial interactions. Neither of these events triggered, with all caveats, a proportional contraction.

Our paper speaks to research that analyzes macroeconomic implications of external trade shocks (Mendoza

1995; Kose 2002). Recent contributions show how an exogenous drop in the prices and/or demand for export goods may tighten the collateral constraint and therefore propagate through the financial system (Céspedes et al. 2004; Mendoza 2010; Manova 2013; Aoki et al. 2018). This research is predominantly focused on emerging economies, which are believed to face strong fluctuations in their terms of trade and world prices. Our study of the Finnish Great Depression suggests that that these financial frictions can be well at work in a developed country with strong institutions, making the message of this literature much more universal. In line with this conclusion, Fernández et al. (2017) find that world trade shocks are equally important regardless of the country's level of development and whether it is a net commodity importer or exporter.

Apart from wars (Glick and Taylor 2010), major trade disruptions are rare. One event studied in more depth was the Smoot-Hawley Act which sharply raised U.S. tariffs and triggered a trade war in 1930 (Crucini and Kahn 1996; Irwin 1998; Perri and Quadrini 2002). An active debate unfolded also around a reverse mechanism, namely the role of financial shocks in triggering the sharp contraction in global trade in the aftermath of the Global Financial Crisis (Amiti and Weinstein 2011; Chor and Manova 2012). A detailed review of the literature on the Finnish Great Depression itself is delegated to the Appendix.

2 Finland before and during the depression

2.1 Trade with the 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 (Sutela 2014). The trade was peculiar. First, it was based on a clearing principle, but 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.[1] These features, combined with a small elasticity of demand for energy, made the volume of Finnish trade with the Soviets largely dependent on fluctuations in global oil prices.[2] In consequence, Finnish-Soviet trade peaked following the Second Oil Shock, reaching 25 percent of Finnish exports in 1981. As oil prices subsided in the mid-1980s, 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.

Another peculiarity of exports to the USSR was how profitable it was regarded by Finnish industry. On the one hand, Finnish goods were sold for a hefty markup relative to world prices. Perhaps more importantly,

[1] Soviet trade provided therefore a buffer for Finland during the two oil crises relative to other Western economies.

[2] The increasing volatility of world oil prices also meant that the clearing account was rarely in balance, especially in the 1980s.

however, big orders, e.g. ships, were paid for largely upfront. This implied interest-free, often multi-year, loans for Finnish exporters (Sutela 2014). That money could then be lent domestically at a fat premium. In practice, large Finnish firms in the Soviet sector worked domestically as shadow banks.[3] This constituted an additional channel of financial propagation. When orders from the Soviets were high, subsidized credit provided additional stimulus to the economy. Although privately beneficial, it is nevertheless unclear whether the mechanism was socially optimal. This is because the cost of foregone interest was borne by the Bank of Finland, which was the official clearing house in the process.

In December 1990, the Soviets gave Finland a notice of termination of the agreement, which, as shown in Figure 1, resulted in a collapse of bilateral trade in 1991 by 67 percent. The shock meant that a considerable part of the sectors exporting eastwards became obsolete. 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 because their output, frequently of low quality, did not find other markets. The collapse of Soviet trade also meant a loss of the markups and can therefore be regarded as a negative terms-of-trade shock. It also put an end of the implicit financial subsidy by the Bank of Finland which had kept the cost of corporate borrowing artificially low.

Figure 1 also reveals other important facts. First, the shock in 1991 ended up being rather temporary. GDP largely returned to the pre-collapse levels already in 1994 and surpassed the level from 4Q 1990 again in 2Q 1995, albeit on different terms. In fact, Finland recorded major declines in sales to its eastern neighbor on other occasions as well. Back in 1985 – 1986, lower 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. Other large drops occurred following the Russian default and the financial crisis in August 1998 (−38 percent), in 2008 (−53 percent) and finally in connection to the slowdown of the Russian Economy since 2013 and subsequent Western sanctions and Russian counter-sanctions due to the annexation of Crimea (−33 percent). All these events can be plausibly treated as exogenous, demand-side disturbances from the Finnish point of view. They add to the exogenous variation of Finnish exports eastwards and allow us to strengthen the identification of trade shocks and their domestic propagation. The terms-of-trade collapse in turn is less clear due to the timing. Admittedly, the pre-crisis terms of trade were highly elevated and subsequently experienced a substantial drop. However, the decline largely occurred already in mid-1990, due to the Gulf War and soaring oil prices.

2.2 Financial liberalization and its aftermath

The Soviet trade collapse was not the only shock that hit the Finnish economy in the early 1990s. Concurrently, the country experienced a bust of the financial and banking system. This suggests that the domestic

[3]The phenomenon of non-financial corporations acting as banks has also been observed recently in emerging markets with restricted access to credit or high spreads (Allen et al. forthcoming; Bruno and Shin 2017).

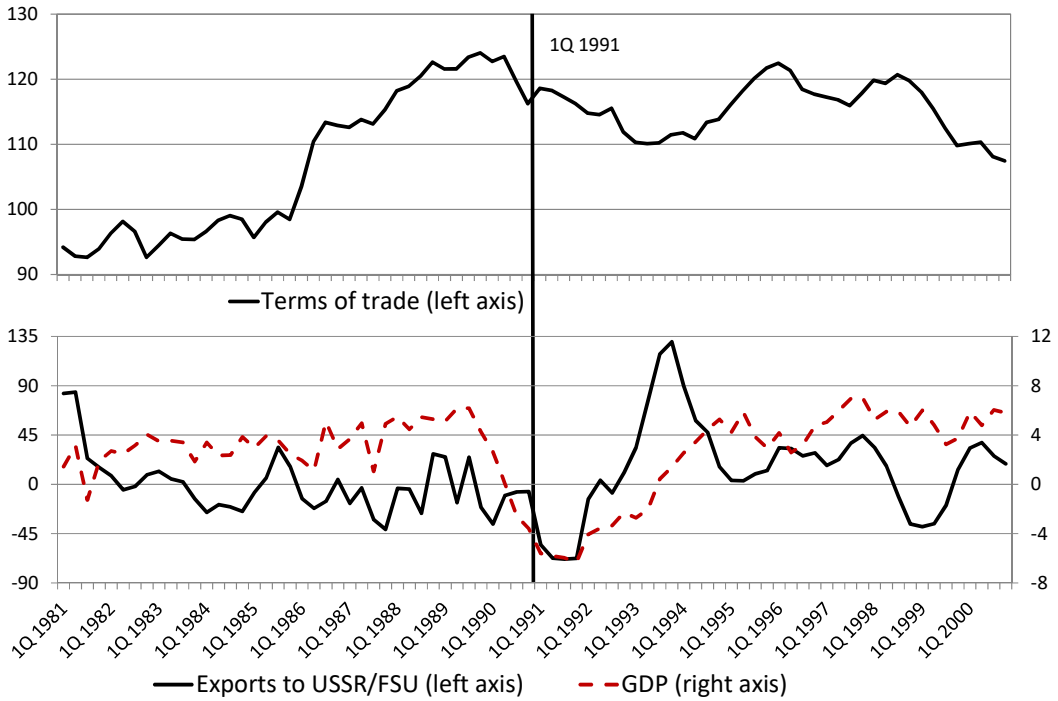

Figure 1: Finnish GDP, exports of goods to the USSR/FSU and the terms of trade, 1981 – 2000.

Notes: FSU stands for Former Soviet Union. Exports and GDP are deflated by the 2010 GDP deflator and expressed as year-over-year growth rates in percent. Terms of trade is defined as price of exports over price of imports and normalized to 1Q 1980 = 100. Sources: Bank of Finland and International Financial Statistics.

financial market could act not only as a propagator for the trade shock but also as independent source of disturbances.

Back in the 1970s, the Finnish financial and banking systems were tightly regulated. The capital market was relatively small and the money market virtually non-existent. Banks were at the center of credit creation. Loan expansion was tied to the inflow of deposits and banks were not allowed to borrow from abroad. The overall result was a credit shortage and rationing. This lack of competition generated a costly and inefficient banking sector.

A flip side of high regulation was a very low effective capitalization of banks. Capital requirements were set at two to four percent of equity for savings and cooperative banks and four percent for commercial banks, yet these banks had chronic problems adhering even to such lenient levels.

In the mid-1980s, the system was transformed. The link between deposits and lending was broken. A genuine liquid money market was created. Foreign banks obtained access to the market as well. Firms and households were allowed to borrow from abroad, although domestic banks remained the main supplier of credit. The financial liberalization shock occurred, however, while the banking system still relied on outdated risk management practices, that only protected against idiosyncratic, and not systemic, risk.

Soon, the financial reform resulted in an explosion of credit as reported in Figure 2. New lending started to grow in 1985, then began to expand very rapidly in 1987 and remained at elevated levels until the end of 1989. Easy access to bank lending was quickly reflected in stock and house prices. The asset price boom, via rising collateral values, allowed for further credit expansion. The banks borrowed heavily short-term and took to aggressive lending and investment. For example, SKOP, a major commercial bank, took over Tampella, one of the largest Finnish manufacturers.

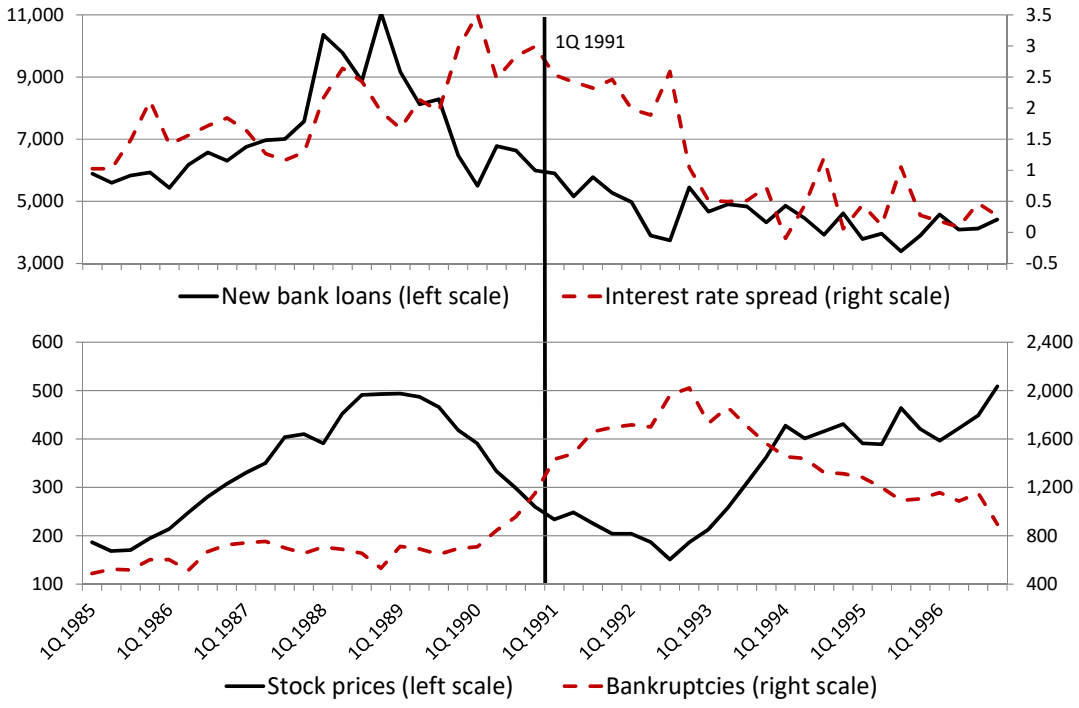

Figure 2: Credit and asset prices, 1985 – 1996.

Notes: New bank loans to the private sector are in million of euros. Interest rate spread is the lending rate for non-financial corporations less euro area 3M nominal interbank rate, in percentage points. Stock prices are defined as the capped OMXH stock market index, normalized to 1Q 1981 = 100. Bankruptcies are in number of filings. Stock prices and new bank loans are deflated by the 2010 GDP deflator. The black vertical line indicates the quarter of the Soviet trade collapse. Sources: Bank of Finland, International Financial Statistics and Statistics Finland.

In late 1988, the credit boom forced policy-makers to pass higher taxes on capital gains. As a result, credit and price dynamics peaked in 4Q 1988. Nevertheless, the stock of loans still grew at double-digit rates. Given that the markka exchange rate was pegged, monetary policy was caught in the impossible trinity. And the central bank lacked the prerogative to impose reserve requirements.

In 1989, the economic climate started to change. The stock market peaked in 2Q 1989 and by the end of 1990 lost almost 50 percent of its peak value. The country first witnessed the bankruptcy of the shipbuilder Wärtsilä Marine, followed by heavy-industry manufacturer Tampella in late 1990. Bankruptcies and loan losses increased further in 1991, after the Soviets canceled the trade agreement. Falling stock prices and

rising bankruptcies affected in the first place the most highly leveraged financial institutions, notably SKOP. As a result of the unfolding economic crisis, the pressure on the markka grew sharply and domestic interest rates skyrocketed in late 1991 before the devaluation. A new, pan-European wave of turbulence following Black Wednesday collapse of pound sterling in September 1992 forced the central bank to abandon the peg altogether. New credit dynamics reached a prolonged trough that would last until the late 1990s.

In reaction to the crisis, the Bank of Finland took over SKOP in September 1991. In the following year, a new institution, the Government Guarantee Fund, was created with the task of stabilizing the banking sector. Dozens of banks were merged. Bank assets were split up and their toxic parts recycled. The whole sector shrank, the numbers of branches and employees each contracting by half relative to the boom years. The Bank Inspectorate was replaced by the new, government-independent Financial Supervision Authority.

In sum, 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. The banking sector entered the credit boom era highly leveraged and vulnerable to negative shocks. In effect, no law was passed until the financial crisis was in full swing. Basel-based higher adequacy ratios were ultimately implemented only in 1991, making the new policy strongly procyclical.

3 Methodology

3.1 General structure

In this section, we describe the structural VAR model of a small open economy that we use to tackle our questions from the introduction.[4] The 8 variables that we choose can be put into three main blocks. The first foreign block describes the euro area, which also serves as a proxy for the rest of the world. This block is assumed to be exogenous from the point of view of the rest of the system. The second foreign block captures Soviet (or, after 1991, former Soviet) trade. This block is also exogenous to Finland, but not to the first foreign block, capturing the idea that USSR/FSU (Former Soviet Union) is a small economy relative to Europe. The third block is the domestic one. Technically, the exogeneity restrictions on the transition matrices can be summarized as

$$A^i = \begin{bmatrix} A^i_{1,1} & 0 & 0 \\ A^i_{2,1} & A^i_{2,2} & 0 \\ A^i_{3,1} & A^i_{3,2} & A^i_{3,3} \end{bmatrix} \quad \forall i = 1 \dots p \tag{3.1}$$

We specify a two-stage foreign block not only because we want to identify shocks originating in the USSR/FSU. Equally importantly, we account for the fact that the structure of trade with the Soviet Union

[4] Details on all data sources and robustness results are provided in the Appendix.

(and arguably also with the FSU) differs substantially from the one with the West. As argued in Subsection 2.1, Finnish exporting industries have been quite segmented and the elasticities of substitution have been small, which has hindered their efforts at redirecting exports to other markets.[5] Treating USSR/FSU as a separate variable allows us to account for these differences.

Second, this specification allows us to carefully decouple USSR-originating shocks from global shocks in e.g. oil prices. For example, discovery of a new oil deposit in the North Sea drops oil prices and, implicitly, also reduces Soviet imports from Finland. But it also affects the euro area economy, and hence is picked up by innovations in the euro area block. On the other hand, the loss of the profitable Soviet market in 1991 does not affect the euro area block and hence is picked up by innovations in the Soviet trade block.

Turning to the variables used, the euro area block is a standard New Keynesian VAR and includes GDP, the GDP price deflator, and the 3M nominal interbank rate. The selection of variables in the Soviet trade block is motivated by the work by Gorodnichenko et al. (2012), who argue that the Soviet trade shock worked through two separate channels: an absolute drop in exports and a collapse in the terms of trade. Accordingly, our Soviet block includes total real exports of goods by Finland to the USSR/FSU as well as Finnish terms of trade, defined as price of exports divided by price of imports. As a first pass, the exogeneity of this series can be justified by the nature of the Finnish-Soviet trade as discussed in Subsection 2.1. In particular, the volume of Soviet imports in the 1980s (and more generally) was closely linked to the global price of oil. Also, all major disruptions in this series can be attributed to shocks on the demand-side and hence clearly exogenous to Finland.[6]

The assumption that terms of trade are largely exogenous can be justified by Finland's trade structure and is widely made in macroeconomic literature (Mendoza 1995; Schmitt-Grohé and Uribe 2018). Finland has been a small open economy characterized by a diversified exports structure with no clear dominating power on any market. On the other hand, a considerable share of its imports have been energy goods, which are priced on the global market.

The domestic block is again a version of the New Keynesian VAR, except that the interest rate is replaced by the spread between the lending rate on new loans for non-financial corporations in Finland and the euro area nominal short-term rate. The motivation for this is threefold. First, our estimation encompasses several monetary regimes (peg to ECU, short period of floating, ERM2, and finally the euro) which could generate

[5] Limited elasticity was not limited to Soviet times. For example, Russia's food embargo in 2014 hit the Finnish dairy industry particularly hard.

[6] To address the endogeneity concerns, we perform two robustness checks. In the first, we use total USSR/FSU imports instead of Finnish exports to the USSR/FSU. This is a satisfactory proxy because Soviet trade collapsed in 1991 across the board, heavily affecting other countries in the communist bloc, notably Hungary and Poland (Tarkka 1994). In the second robustness check we construct an instrument by regressing Finnish exports to the USSR/FSU on total USSR/FSU imports, Hungarian exports to the USSR/FSU, as well as dummies capturing the peculiarity of Finnish-Soviet trade arrangements. Neither specification overturns our results.

structural breaks in the interest rate series itself. The spread, on the other hand, is immune to this problem given the quick pass-through from policy rates to lending rates (Kauko 2005). Second, the spread reflects the actual lending conditions and tightness of credit better than the short-term money market rate alone. Third, the behavior of the spread allows us to distinguish between the real aggregate demand and the domestic financial shock.

3.2 Identification of shocks

We do not separately identify shocks within the European block. Shocks in the Soviet block are also treated jointly for most of the analysis, although in auxiliary exercises we use Cholesky orthogonalization to distinguish between a Finnish-Soviet/FSU trade shock (ordered first, being a quantity) and a terms-of-trade shock (ordered behind, being a price).

We identify three domestic shocks: shifters of real aggregate demand and supply, as well as a financial shock. We do so by imposing a set of sign restrictions on the impulse response functions, by which a variable is postulated, on impact, to go up (↑), down (↓) or remain unrestricted (?).

Aggregate demand shock [$y \uparrow$, $\pi \uparrow$, $(i - i^*) \uparrow$]: The restrictions are fairly standard. The inflation rate π should go up along with an increase in the GDP growth rate y. The interest rate spread $i - i^*$ should also rise because, *ceteribus paribus*, higher corporate demand for credit (or crowding out by higher government spending) should increase the lending rate. On the other hand, the reaction of the central bank to the shock is not immediate. For the first part of the sample monetary policy targeted some exchange rate peg rather than inflation. For the euro area period it is safe to assume that the European Central Bank does not immediately react to idiosyncratic Finnish demand shocks.

Aggregate supply shock [$y \uparrow$, $\pi \downarrow$, $(i - i^*)$?]: What distinguishes a supply shock from a demand shock here is that prices go down, rather than up. A positive shock increases output and asset prices, reflecting higher competitiveness and profitability. However, the impact on lending volumes is less certain. On the one hand, higher productivity may trigger new investment, partly financed by increased bank lending. On the other hand, it allows firms to retain higher earnings, or issue new equity or corporate bonds (Holmström and Tirole 1997) to finance expansion of the balance sheet. Since the reaction of loan demand is not clear, it is hard to say which direction the lending rate, and therefore the spread, will move. Accordingly, we leave the response of the spread unrestricted.

Financial shock [$y \uparrow$, $\pi \uparrow$, $(i - i^*) \downarrow$]: Our interpretation of financial shock is rather broad. It may reflect shifters in the demand for credit and hence originate in the non-financial corporate sector. A shock to the demand for credit may capture asset price movements due to exuberance and bubbles (Bernanke and Gertler 1999). In Bernanke and Gertler (1989), it redistributes wealth between lenders and borrowers, as in the debt-deflation mechanism. Our specification is also consistent with the risk shock (Christiano et al. 2014), i.e. a change in the distribution of idiosyncratic entrepreneurial productivity.

A positive financial shock should push GDP up. By generating a positive wealth effect, it stimulates domestic demand and puts upward pressure on the general price level. Being inflationary, it also reduces the real burden of nominal loan contracts for debtors. This Fisherian effect was at the heart of the Finnish Great Depression according to Kiander and Vartia (1996). Moreover, the shock translates into higher collateral values. As balance sheets of firms improve and lending rates go down, interest rate spreads are reduced.

In sum, the financial shock generates 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 demand shock, this channel is only indirect and arguably much weaker.

Second, the financial shock may capture shifts in the supply for credit and originate in the financial sector. It may reflect changes in effective lending standards or regulatory environment (Lown and Morgan 2006; Bassett et al. 2014; Ciccarelli et al. 2015). Seen through the lens of the financial accelerator model (Bernanke et al. 1999) financial liberalization and looser credit can be interpreted as a reduction of monitoring costs (De Fiore et al. 2011; Fuentes-Albero forthcoming). Such a drop is clearly expansionary. As the availability of bank loans increases, lending rates fall, reducing the spread and raising credit. Loan expansion, in turn, stimulates output, consumption and hence prices, as in a New Keynesian model with a financial accelerator and the empirical literature on financial shocks (Helbling et al. 2011; Gambetti and Musso 2017; Furlanetto et al. 2019). However, if looser credit impacts predominantly entrepreneurial production, the prices are less likely to go up. In this case, the mechanism would be picked up mainly by the supply shock. Therefore, our specification potentially underestimates the impact of financial shocks to the benefit of aggregate supply shocks.

3.3 Specification details

In our model, all nonstationary series are expressed in quarter-over-quarter growth rates. We work with a stationary model because our primary objective is to obtain a historical shock decomposition that allows measurement of the impact of various shocks at particular points in time. As shown by (Kilian and Lütkepohl 2018), historical decompositions are available only for models with a stationary MA representation.

We use the sample from 1Q 1985 until 4Q 2016. Using earlier data is problematic due to its scarcity and the fact that the financial market was strongly regulated. The benchmark specification is a $VAR(2)$. We estimate the model using MLE. To implement the sign restriction identification, we follow Rubio-Ramírez et al. (2010) by first drawing a VAR from its estimated distribution and then drawing one rotation matrix from the uniform distribution for that particular VAR. The resulting structural model enters our set if it satisfies the sign restrictions. This was the case for $3,041$ out of 100 thousand draws.[7]

We report the results for the whole set of admissible models, given that sign restrictions allow to achieve

[7]The computations were parallelized using software from Techila Technologies Ltd.

only set identification. This, as argued by Fry and Pagan (2011) and Baumeister and Hamilton (2015), is because the selection of a single model from the admissible set involves somewhat arbitrary criteria.

4 Results

In this section, we discuss the results of our model estimation. We ask how important was the trade shock from the east in accounting for the Finnish Great Depression. We also investigate whether the shock was propagated by the domestic financial sector, i.e. the extent to which the financial crisis was an endogenous effect of the trade collapse. Finally, we compare the role of the Soviet trade shock with other independent factors, the domestic ones (both financial and real) as well as the ERM crisis. The overall message is that the impact of the trade collapse played a significant, but partial role in the crisis. It was also propagated strongly through the domestic financial system. This provides suggestive evidence that major trade disruptions can have significant repercussions for the financial sector. Nevertheless, as large as the trade shock was, it could not *per se* generate a severe economic depression. Equally important were the financial boom and bust cycle, as well as the ERM crisis in the latter phase. A further look at more recent trade disruptions with Russia (reported in the Appendix) confirm this message.

To address these questions, we run a historical decomposition of Finnish GDP using our set of admissible models. We define Soviet trade shocks as innovations in the Soviet block that occurred over a pre-specified time interval. The beginning of the trade collapse is, given the discussion in Subsection 2.1, clearly identified to be 1Q 1991. Given that the end of the trade shock is less clear, we consider four dates, 1Q 1991, 2Q 1991, 4Q 1991 and 2Q 1993, the last quarter of GDP decline. Having determined the shock interval, we compute the cumulative effect on GDP due to these shocks as of 2Q 1993.

In the second step, we ask how strong was the propagation of these shocks through the domestic financial system. Here we perform a counterfactual simulation in the spirit of Bachmann and Sims (2012) and Ciccarelli et al. (2015). The idea is to take the actual path of Soviet trade shocks and to shut down financial propagation by generating an artificial series of domestic financial shocks such that the interest rate spread remains constant. The cumulative effect on GDP thus includes both trade shocks and counterfactual financial shocks. For any given model, the difference between the two simulations (one with, one without the artificial financial shocks) can be interpreted as the strength of the endogenous domestic financial propagation of the trade shocks. All reported results pass the univariate and multivariate (Leeper and Zha 2003; Adolfson et al. 2005) modesty tests. Figure 3 summarizes the results.

The gray histograms illustrate the cumulative loss in GDP due to the Soviet trade shock. The median is −3.3, −3.8, −3.5 percent for the first three subplots, respectively. This effect is considerably larger than what the direct trade channel effect would suggest. In the fourth subplot, the median is shifted to the right (at −1.4 percent) which suggests lower overall impact of the trade collapse. This is because the considered shock range is substantially longer and captures some of the recovery of Finnish exports to the FSU. Further

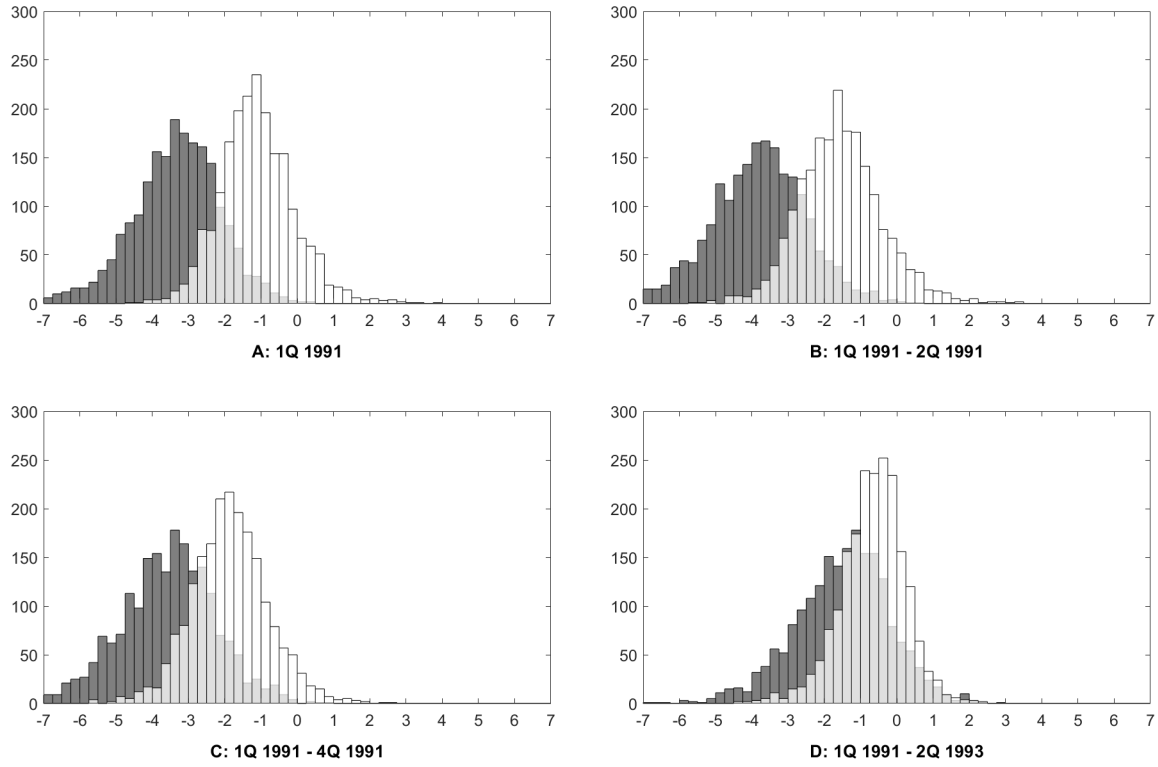

Figure 3: Distribution of cumulative GDP loss due to the Soviet trade shock, with financial propagation (gray) and without (white).

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D).

results, based on the Cholesky identification described in Subsection 3.2, suggest that a large majority of the decline was due to decline in trade volume, with the drop in the terms of trade having a much smaller impact.[8]

The white histograms illustrate the counterfactual scenario. They answer the question of how large would the cumulative loss due to the trade shock have been if the financial channel was shut down or, more precisely, if the interest rate spreads did not go up. Regardless of the shock range considered, the picture is similar. The white histograms lie to the right of their gray counterparts, indicating that the total loss would have been smaller. The medians of the model-wise differences (with and without financial propagation) are 2.1, 1.9, 1.6 and 0.8 for subplots A, B, C, and D, respectively. Again, in the last case the overall endogenous financial effect is slightly smaller and the distribution gets also somewhat more concentrated. In sum, these

[8] The muted role of the terms of trade holds throughout our sample. This result echoes the recent findings of Schmitt-Grohé and Uribe (2018) for a large panel of countries. Declines in the volume of exports in 1998, 2008 and 2014 had notable impacts, but even they did not lead to full-scale recessions.

results show that the financial channel was indeed strongly at work and that the trade shock was able to generate strong endogenous financial turbulence. Our results suggest that a trade shock may tighten access to and cost of credit through widely known mechanisms based on financial frictions.

Figure 4 shows the mechanism behind this result more precisely. It plots the responses of GDP and the spread to the Soviet collapse shock, with and without the financial channel. Given that the results are similar regardless of the length of the Soviet shock (as Figure 3 made clear), we present here only case A, in which the Soviet shock lasts for one period (1Q 1991). This exercise differs from the standard impulse response analysis in that the shock we feed in is not a single structural shock of some normalized size, but a linear combination of the two actual shocks in the Soviet block recovered from the data using the historical decomposition. Following the shock, GDP falls by 3.3 percent by 2Q 1993. Most of the loss is already realized by this time, although its ultimate value reaches asymptotically 4.2 percent, i.e. considerably more than the drop in the volume of Soviet exports would suggest. The interest rate spread shoots up on impact, lifting the interest rate by 40 basis points. This reaction suggests a strong endogenous propagation of the trade shock through the domestic financial system. The effect decays gradually, disappearing almost completely by the end of 1996. Importantly, the reactions of the GDP and the spread indicate that the Soviet shock would also meet the sign restrictions of a negative domestic financial shock. Therefore, in order to shut down the financial propagation of the Soviet shock, one has to feed in a series of positive financial shocks. These artificial financial shocks not only nullify the rise of the spread but also boost GDP. As a result, the negative impact of the Soviet shock is alleviated. This can be seen in the right subplots of Figure 4. The reaction of the spread becomes zero by construction. The reaction of output falls to roughly one percent and dissipates much faster.

Overall, the trade shock had a clearly negative impact on the Finnish economy. However, given that the total cumulative loss in GDP was 12.1 percent (with 17.9 percent deviation from the trend), it is able to account for only part of the depression and it could not have been the only major factor. Therefore, in Figure 5 we report similar histograms for the other groups of shocks. Here, it is more difficult to define a clear time range for the shocks, so we proceed with the most natural choice and consider the range from 3Q 1989 until 2Q 1993, i.e. from peak to trough of the GDP level. The overall message is that shocks stemming from the domestic financial sector played the largest role, with a median contribution of −7.1 percent. What explains the substantial loss of the GDP loss due to financial shocks is the length of the boom-bust cycle. The financial crisis was not characterized by a large one-time disturbance, as was the Soviet trade collapse. Rather, it was a prolonged sequence of negative shocks that reflect the fact that the domestic financial system was in distress for almost four years. Shocks originating in Europe were also significant (−3.0 percent). They became a major negative contributor in 1992, reflecting capital flight in the fall of 1991 and, most importantly, the ERM crisis in September 1992. These were strong shocks, but they came too late to account for the depth of the depression. Finally, the decomposition attributes a relatively small role to real domestic shocks shocks

(−2.1 percent).[9]

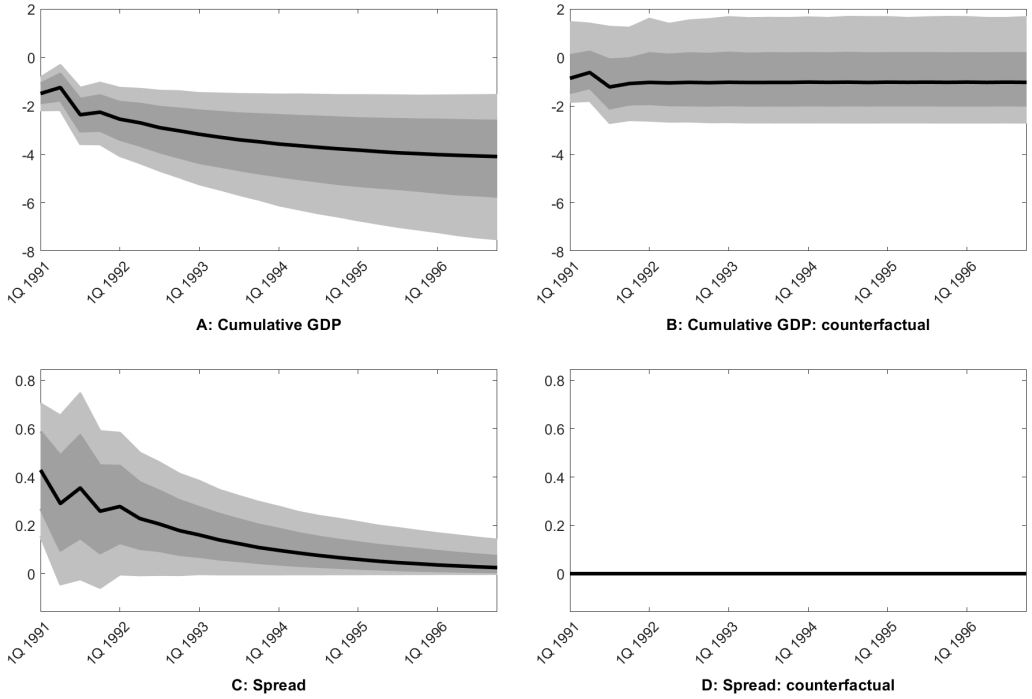

Figure 4: Impulse responses of cumulative GDP and the spread following the Soviet shock in 1Q 1991.

Notes: Black line is the period-wise median. Shaded areas indicate the period-wise 90 percent (light gray) and 66 percent (dark gray) impulse responses.

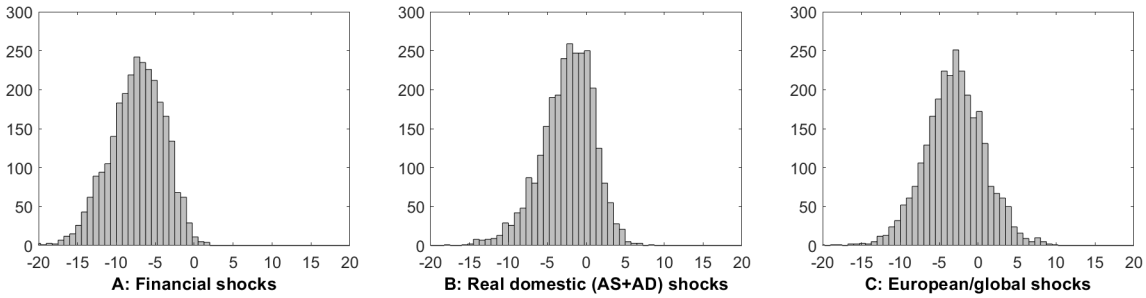

Figure 5: Distribution of cumulative GDP loss due to financial, real, and European/global shocks.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to financial (panel A), real (B) and European/global shocks (C) occurring from 3Q 1989 to 2Q 1993.

[9]One should not expect the median cumulative losses from different shocks to add up to the 17.9 percent cumulative deviation from the GDP trend for several reasons. First, the total deviation was partly driven by pre-3Q 1989 shocks dying out. Second, Soviet shocks are computed over a different time interval than shocks in Figure 5. Third, the medians may correspond to different models from the admissible set.

5 Conclusions

We close with some discussion regarding the generalization of the findings from this natural experiment. First, our study shows that the trade shock increased lending spreads and tightened financing conditions. However, the true financial effect could have been even stronger because the extensive margin was potentially also at work. Many firms in the Soviet sector went bankrupt or were cut off from credit completely. The actual lending rates are, instead, constructed based on actual credit transactions, i.e. among firms that actually survived the shock in tolerable condition.

Second, modern trade networks and production chains are much more complicated than they were thirty years ago. Finnish firms participating in the Soviet trade were required to have, instead, at least 80 percent domestic input (Sutela 2014) and were therefore quite isolated. A similar large shock today could potentially trigger much stronger second-round effects, as it was the case in 2008 (Levchenko et al. 2010). On the other hand, modern trade networks offer more possibilities for finding substitute markets.

Finally, the Soviet trade shock could be also amplified given that it put an end to the peculiar financial subsidy mechanism by which the involved Finnish firms lent the prepayments to the domestic non-financial sector, thereby acting as shadow banks. Similar schemes have been observed more recently in emerging markets but seem to be rare in developed economies.

References

Adolfson, Malin, Stefan Laséen, Jesper Lindé, and Mattias Villani, "Are Constant Interest Rate Forecasts Modest Policy Interventions? Evidence from a Dynamic Open-Economy Model," *International Finance*, December 2005, *8* (3), 509–544.

Allen, Franklin, Yiming Qian, Guoqian Tu, and Frank Yu, "Entrusted loans: A close look at China's shadow banking," *Journal of Financial Economics*, forthcoming.

Amiti, Mary and David E. Weinstein, "Exports and Financial Shocks," *Quarterly Journal of Economics*, 2011, *126* (4), 1841–1877.

Aoki, Kosuke, Gianluca Benigno, and Nobuhiro Kiyotaki, "Monetary and Financial Policies in Emerging Markets," December 2018. working paper.

Bachmann, Rüdiger and Eric R. Sims, "Confidence and the transmission of government spending shocks," *Journal of Monetary Economics*, 2012, *59* (3), 235–249.

Bassett, William F., Mary Beth Chosak, John C. Driscoll, and Egon Zakrajšek, "Changes in bank lending standards and the macroeconomy," *Journal of Monetary Economics*, 2014, *62* (C), 23–40.

Baumeister, Christiane and James D. Hamilton, "Sign Restrictions, Structural Vector Autoregressions, and Useful Prior Information," *Econometrica*, September 2015, *83* (5), 1963–1999.

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

_ and _ , "Monetary policy and asset price volatility," *Economic Review*, 1999, (Q IV), 17–51.

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

Bruno, Valentina and Hyun Song Shin, "Global Dollar Credit and Carry Trades: A Firm-Level Analysis," *Review of Financial Studies*, 2017, *30* (3), 703–749.

Caldara, Dario, Michele Cavallo, and Matteo Iacoviello, "Oil price elasticities and oil price fluctuations," *Journal of Monetary Economics*, 2019, *103*, 1 – 20.

Canova, Fabio and Matthias Paustian, "Business cycle measurement with some theory," *Journal of Monetary Economics*, 2011, *58* (4), 345–361.

Cavallo, Michele and Tao Wu, "Measuring Oil-Price Shocks Using Market-Based Information," IMF Working Papers 12/19, International Monetary Fund January 2012.

Céspedes, Luis Felipe, Roberto Chang, and Andrés Velasco, "Balance Sheets and Exchange Rate Policy," *American Economic Review*, 2004, *94* (4), 1183–1193.

Chor, Davin and Kalina Manova, "Off the cliff and back? Credit conditions and international trade during the global financial crisis," *Journal of International Economics*, 2012, *87* (1), 117–133.

Christiano, Lawrence, Roberto Motto, and Massimo Rostagno, "Risk Shocks," *American Economic Review*, January 2014, *104* (1), 27–65.

Ciccarelli, Matteo, Angela Maddaloni, and Jose Luis Peydro, "Trusting the Bankers: A New Look at the Credit Channel of Monetary Policy," *Review of Economic Dynamics*, October 2015, *18* (4), 979–1002.

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

Crucini, Mario J. and James Kahn, "Tariffs and aggregate economic activity: Lessons from the Great Depression," *Journal of Monetary Economics*, December 1996, *38* (3), 427–467.

De Fiore, Fiorella, Pedro Teles, and Oreste Tristani, "Monetary Policy and the Financing of Firms," *American Economic Journal: Macroeconomics*, October 2011, *3* (4), 112–42.

Fernández, Andrés, Stephanie Schmitt-Grohé, and Martín Uribe, "World shocks, world prices, and business cycles: An empirical investigation," *Journal of International Economics*, 2017, *108* (S1), 2–14.

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

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

Fuentes-Albero, Cristina, "Financial Frictions, Financial Shocks, and Aggregate Volatility," *Journal of Money, Credit and Banking*, forthcoming.

Furlanetto, Francesco, Francesco Ravazzolo, and Samad Sarferaz, "Identification of financial factors in economic fluctuations," *Economic Journal*, 2019, *129*, 311–337.

Gambetti, Luca and Alberto Musso, "Loan Supply Shocks and the Business Cycle," *Journal of Applied Econometrics*, June 2017, *32* (4), 764–782.

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

Glick, Reuven and Alan M. Taylor, "Collateral Damage: Trade Disruption and the Economic Impact of War," *Review of Economics and Statistics*, February 2010, *92* (1), 102–127.

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

Hamilton, James D., "What is an oil shock?," *Journal of Econometrics*, April 2003, *113* (2), 363–398.

Helbling, Thomas, Raju Huidrom, M. Ayhan Kose, and Christopher Otrok, "Do credit shocks matter? A global perspective," *European Economic Review*, April 2011, *55* (3), 340–353.

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

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

Irwin, Douglas A., "The Smoot-Hawley Tariff: A Quantitative Assessment," *Review of Economics and Statistics*, May 1998, *80* (2), 326–334.

Jonung, Lars, Jaakko Kiander, and Pentti Vartia, eds, "The Great Financial Crisis in Finland and Sweden. The Nordic Experience of Financial Liberalization," 2009.

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

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

Kilian, Lutz, "A Comparison of the Effects of Exogenous Oil Supply Shocks on Output and Inflation in the G7 Countries," *Journal of the European Economic Association*, March 2008, *6* (1), 78–121.

_ and Helmut Lütkepohl, *Structural Vector Autoregressive Analysis*, Cambridge University Press, April 2018.

Knüpfer, Samuli, Elias Rantapuska, and Matti Sarvimäki, "Formative Experiences and Portfolio Choice: Evidence from the Finnish Great Depression," *Journal of Finance*, February 2017, *72* (1), 133–166.

Kose, M. Ayhan, "Explaining business cycles in small open economies: How much do world prices matter?," *Journal of International Economics*, March 2002, *56* (2), 299–327.

Kuusi, Tero, "The Finnish Great Depression of the 1900s: reconciling theory and evidence," *B.E. Journal of Macroeconomics*, forthcoming.

Kuusterä, Antti and Juha Tarkka, *Bank of Finland 200 Years. Parliament's Bank*, Vol. II, Otava Publishing Company Ltd, 2012.

Leeper, Eric M. and Tao Zha, "Modest policy interventions," *Journal of Monetary Economics*, November 2003, *50* (8), 1673–1700.

Levchenko, Andrei A., Logan T. Lewis, and Linda L. Tesar, "The Collapse of International Trade during the 2008-09 Crisis: In Search of the Smoking Gun," *IMF Economic Review*, December 2010, *58* (2), 214–253.

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

Manova, Kalina, "Credit Constraints, Heterogeneous Firms, and International Trade," *Review of Economic Studies*, 2013, *80* (2), 711–744.

Mendoza, Enrique G., "The Terms of Trade, the Real Exchange Rate, and Economic Fluctuations," *International Economic Review*, February 1995, *36* (1), 101–137.

_ , "Sudden Stops, Financial Crises, and Leverage," *American Economic Review*, December 2010, *100* (5), 1941–66.

Perri, Fabrizio and Vincenzo Quadrini, "The Great Depression in Italy: Trade Restrictions and Real Wage Rigidities," *Review of Economic Dynamics*, January 2002, *5* (1), 128–151.

Rubio-Ramírez, Juan F., Daniel F. Waggoner, and Tao Zha, "Structural Vector Autoregressions: Theory of Identification and Algorithms for Inference," *Review of Economic Studies*, 2010, *77* (2), 665–696.

Schmitt-Grohé, Stephanie and Martín Uribe, "How Important Are Terms-Of-Trade Shocks?," *International Economic Review*, 2018, *59* (1), 85–111.

Sutela, Pekka, *Trading with the Soviet Union: The Finnish experience, 1944-1991*, Kikimora Publications, 2014.

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

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

Appendix

Table of contents:

A Data

European/global block:

- The series are for the euro area. The short-term interest rate is the 3 month EURIBOR. GDP, GDP deflator and short-term interest rate come from the Area-Wide Model Database (update 17). The series in the dataset originally stem from publicly available data reported by the ECB's Statistical Data Warehouse (SDW) and Eurostat.
- Euro area consumer price index comes directly from ECB SDW. It is the HICP overall monthly index (changing composition).
- Oil prices are for Brent. Source: Bloomberg. The series is deflated by U.S. GDP Price deflator 2010=100. Source: International Financial Statistics.
- Stress series is based on CLIFS (Country-Level Index of Financial Stress). The series used is a simple average between CLIFS indices (quarterly data) for France, Germany and the UK. Source: ECB SDW.

USSR/FSU block:

- Terms of trade series are price of exports divided by price of imports (both for goods and services). Source: Statistics Finland.
- Finnish exports to the USSR/FSU is exports of goods to the USSR/FSU, where the data for Former Soviet Union is the sum over all 16 republics. Sources: Bank of Finland and Finnish Customs Uljas Statistical Database.
- Hungarian exports to the USSR/FSU is CIF USSR/FSU imports of Hungarian exports of goods. Source: IMF Direction of Trade Statistics (DOTS). This series is deflated by "world deflator" YWD from AWM database (update 17).
- Total USSR/FSU imports is CIF USSE/FSU imports of goods from the rest of the world. Source: IMF DOTS. This series is deflated by "world deflator" YWD from AWM database (update 17).

Domestic block:

- GDP, GDP price deflator and the consumer price index are all taken from Statistics Finland.
- Lending rate - interest rate on new loans to non-financial corporations. Source: IFS: From 1Q 1985: Financial, Interest Rates, Harmonized Euro Area Rates, New Business, Loans, Non-financial Corporations, Other Than Bank Overdrafts, Over EUR 1 Million, Floating Rate and up to 1 Year, Percent per Annum 1Q 1980-4Q 1984 Source: IFS, Financial, Interest Rates, Lending Rate, Percent per annum The two series were spliced using a level shift of the old data (adjustment factor based on average of 4 quarters in 1985)

- Stock prices - we use the NASDAQ OMX Helsinki 50 index. Data from 1Q 1996 onwards uses the capped portfolio version of this index. Source: Reuters.
- New bank loans are drawdowns of new bank loans to non-financial corporations. The data is constructed based on raw data from Statistics Finland (1Q 1981 - 1Q 2012) and the Bank of Finland (2Q 2012 - 4Q 2016).

All data has been seasonally adjusted using the X-13 seasonality filter in Eviews 10.

B Literature on the Finnish Great Depression

We discuss here other notable references on the Finnish Great Depression, beyond those mentioned in the main text. The literature on the Finnish Great Depression can be broadly divided into two groups, one stressing the role of the finance, the other focusing on the collapse of the USSR and other real factors. 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). Kuusterä and Tarkka (2012) provide an extensive account of the crisis from the central bank's point of view.

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. Kuusi, forthcoming instead stresses the role of involuntary unemployment and taxes on investment. Freystätter (2011) employs a New Keynesian model with a financial accelerator and considers three scenarios: a lending boom, a trade collapse and an exchange rate devaluation. The episode inspired also several researchers beyond macroeconomics. For example, Knüpfer et al. (2017) find that people who, as young adults, were adversely affected as workers, tend to be more risk averse in their investment strategies.

C Additional figures for benchmark specification

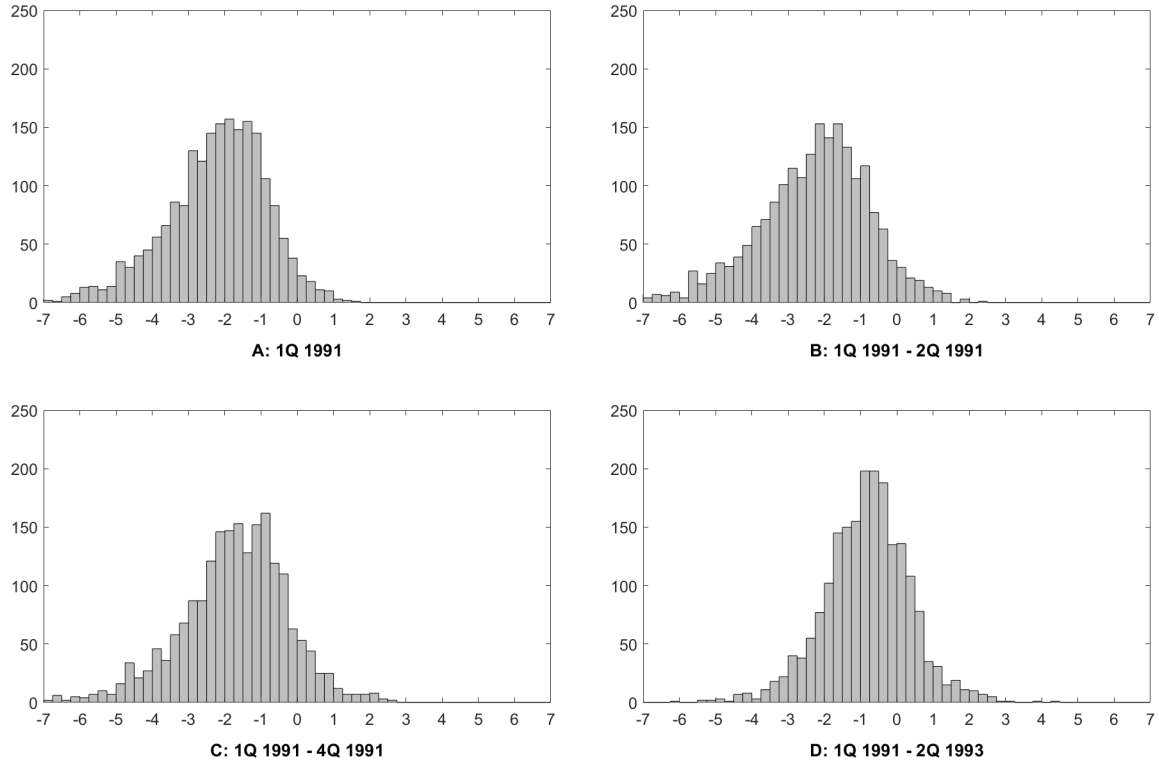

Figure 6: Distribution of cumulative GDP loss due to financial propagation of the Soviet trade shock.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D). The effect of the propagation is the difference between the actual GDP loss and the GDP loss when the financial channel is shut down.

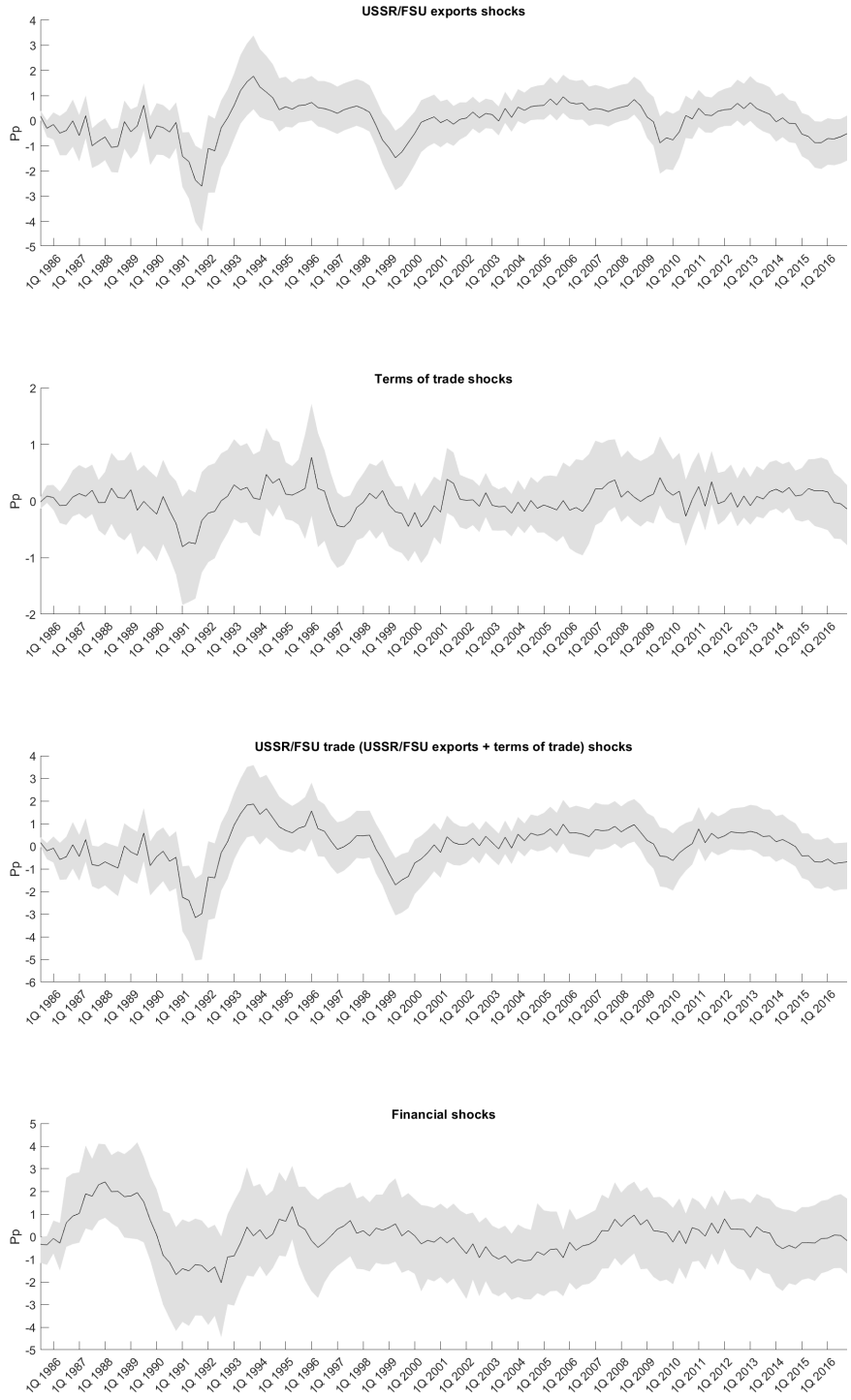

Figure 7: Historical decomposition of the Finnish business cycle.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

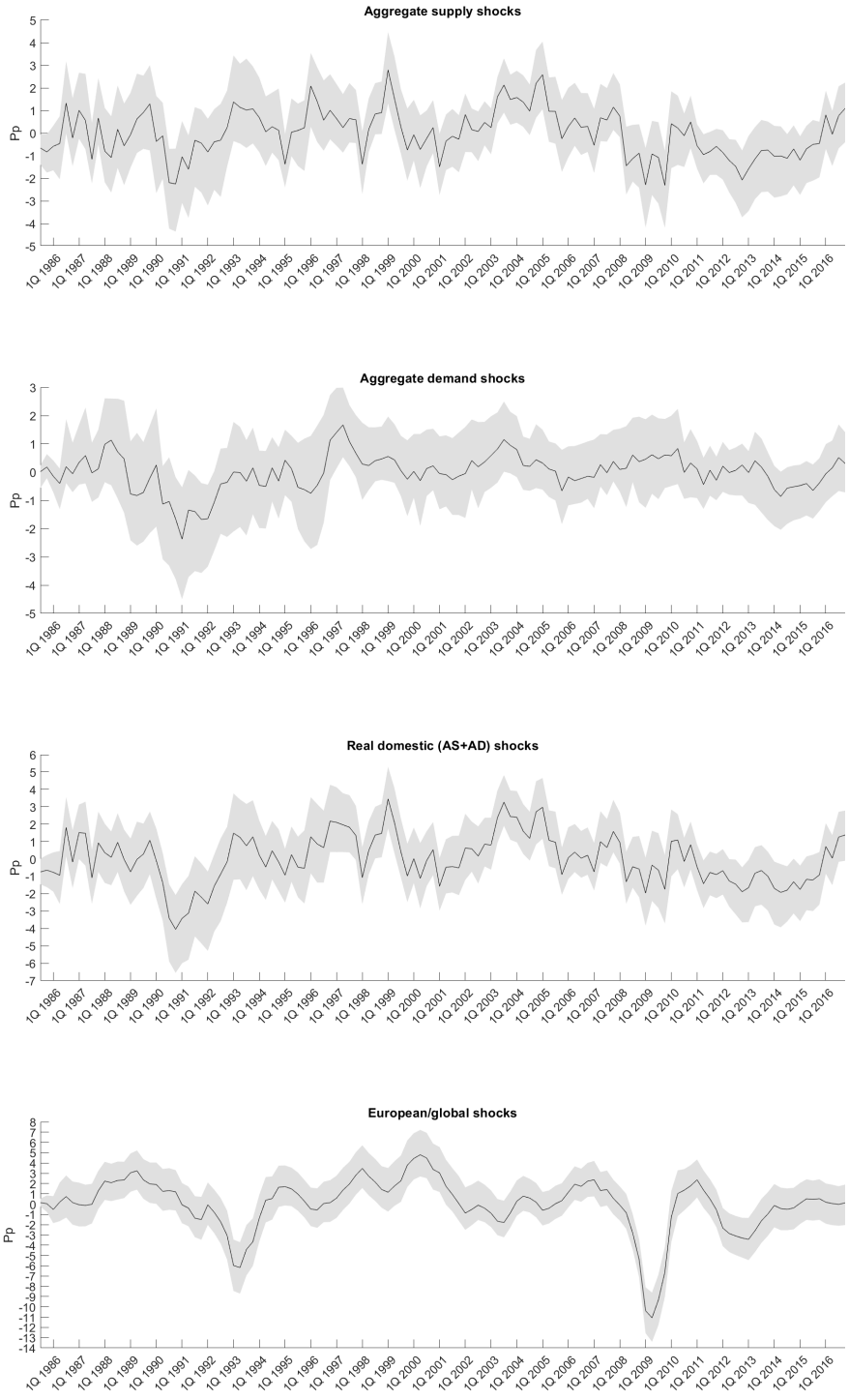

Figure 8: Historical decomposition of the Finnish business cycle (cont.).

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

D Robustness checks

In this section, we report the series of robustness checks for our results. We start with two summary tables. Table 1 summarizes the cumulative loss of GDP, measured in 2Q 1993. The overall message is that the table confirms the results reported in the main text. First, for most specifications the overall loss from the trade shock is similar to the benchmark, 3 to 4 percent. Secondly, the loss is not too sensitive to the way we define the length of the trade shock, as long as it ends in 1991. For all specifications the shock lasting until 2Q 1993 (column 5) is significantly smaller, since it picks up the recovery of exports to the USSR/FSU. Third, for most specifications the contributions of autonomous financial shocks is larger (or at least as large) as that of the trade shock. Fourth, the role of European/global shocks is comparable to that of the Soviet trade shock. Fifth, the role of real domestic shocks is relatively modest.

There are a few exceptions to this big picture. For example, when working with the shorter sample, the role of the Soviet trade collapse actually declines (and the role of European shocks goes up). This means that the effect of the Soviet shock is not "diluted" by adding more recent data in which the Finnish economy might have undergone some structural changes. The fact that for the shorter sample the Soviet shock decreases in cumulative effect is therefore supportive for our main message. The role of the Soviet shock increases slightly when we use CPI data or work with an Akaike-based VAR with 4 lags. Nevertheless, even these numbers do not overturn the big picture. The role of the Soviet shock is in turn smaller if we use total USSR/FSU imports as a proxy for Finnish-Soviet trade. This signals that the role of Soviet trade was especially significant for Finland and motivates the use of dummies when constructing our instrument in robustness exercise 11.

In Table 2 we report the numbers for the endogenous financial propagation of the Soviet trade shock. Again, the numbers are of similar magnitude for different specifications. They are somewhat smaller when we use shorter data, although this is largely due to the fact that the overall loss is also smaller for these specifications. In all specifications the financial propagation remains very sizable as share of the overall loss.

Finally, even though we do not explicitly provide numbers for the cumulative loss at dates different than 2Q 1993, it can be clearly seen from the impulse response figures that most of the loss of the Soviet trade shock has realized by that date, regardless of the specification. The same applies to the cumulative impact of other shocks. As discussed in the main text, 2Q 1993 is a natural end point for the depression for two reasons. First, it was the last quarter of falling GDP. Secondly, it was the quarter in which the deviation of GDP from its deterministic, VAR-generated trend was largest.

Table 1: Cumulative GDP loss for various model specifications.

Specification	**Soviet**				**Financial**	**Real domestic**	**European \global**
	1Q 91	**1–2Q 91**	**1Q–4Q 91**	**1Q 91–2Q 93**			
Benchmark	3.29	3.78	3.50	1.40	7.14	2.13	3.01
until 2Q 2007	1.20	1.87	2.28	1.04	6.77	1.13	4.29
until 4Q 1998	0.84	1.72	2.29	0.90	3.56	0.29	7.17
since 2Q 1981	3.19	3.82	3.87	1.51	4.74	3.10	3.48
Sign 2 periods	3.19	3.70	3.43	1.32	7.37	1.99	3.16
Sign 4 periods	3.24	3.71	3.48	1.41	7.38	1.81	3.03
VAR $p = 1$	1.87	2.30	2.30	0.69	6.55	2.67	2.73
VAR $p = 4$	4.70	5.79	4.75	2.34	4.68	1.17	1.03
VAR with oil	3.52	4.12	3.61	1.16	7.23	2.01	2.76
VAR with stress	3.03	3.57	3.50	1.60	7.46	2.50	2.87
VAR with real R^*	3.37	3.86	3.59	1.70	7.07	2.36	2.32
Instrument	3.86	3.73	2.67	2.03	6.28	1.89	3.14
Total imports	0.92	1.18	0.61	0.42	7.05	2.22	3.09
Larger finance	2.73	3.12	2.92	0.99	3.10	1.54	3.92
CPI	4.34	5.28	5.63	2.39	6.22	3.58	2.73

Table 2: Cumulative GDP loss due to financial propagation of the Soviet trade shock for various model specifications.

Specification	**1Q 91**	**1–2Q 91**	**1Q–4Q 91**	**1Q 91–2Q 93**
Benchmark	2.07	2.14	1.64	0.79
until 2Q 2007	0.48	0.60	0.65	0.33
until 4Q 1998	0.97	1.41	1.72	0.93
since 2Q 1981	1.66	1.63	1.30	0.67
Sign 2 periods	2.01	2.04	1.53	0.73
Sign 4 periods	2.00	2.02	1.49	0.78
VAR $p = 1$	1.14	1.34	1.26	0.50
VAR $p = 4$	1.86	2.07	1.57	1.01
VAR with oil	2.09	2.24	1.75	0.56
VAR with stress	1.86	1.94	1.53	0.81
VAR with real R^*	2.17	2.14	1.59	0.86
Instrument	1.52	1.29	0.63	0.66
Total imports	0.96	0.89	0.04	0.42
Larger finance	1.48	1.45	1.03	0.70
CPI	2.33	2.49	2.40	1.18

D.1 Estimation until 2Q 2007

This robustness check assures that the benchmark results are not driven by the Global Financial Crisis of 2007-2008. We do it by dropping the data from 3Q 2007 onwards.

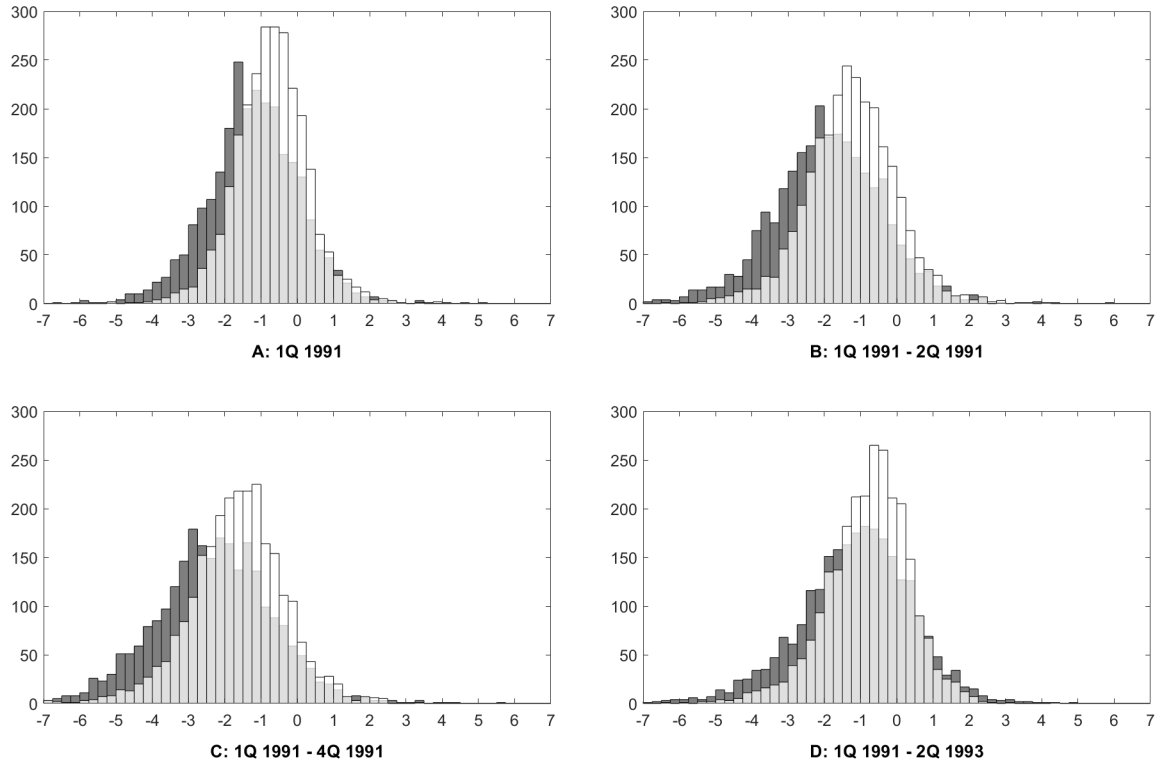

Figure 9: Distribution of the GDP loss due to the Soviet trade shock, with financial propagation (gray) and without (white). Estimation until 2Q 2007.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D).

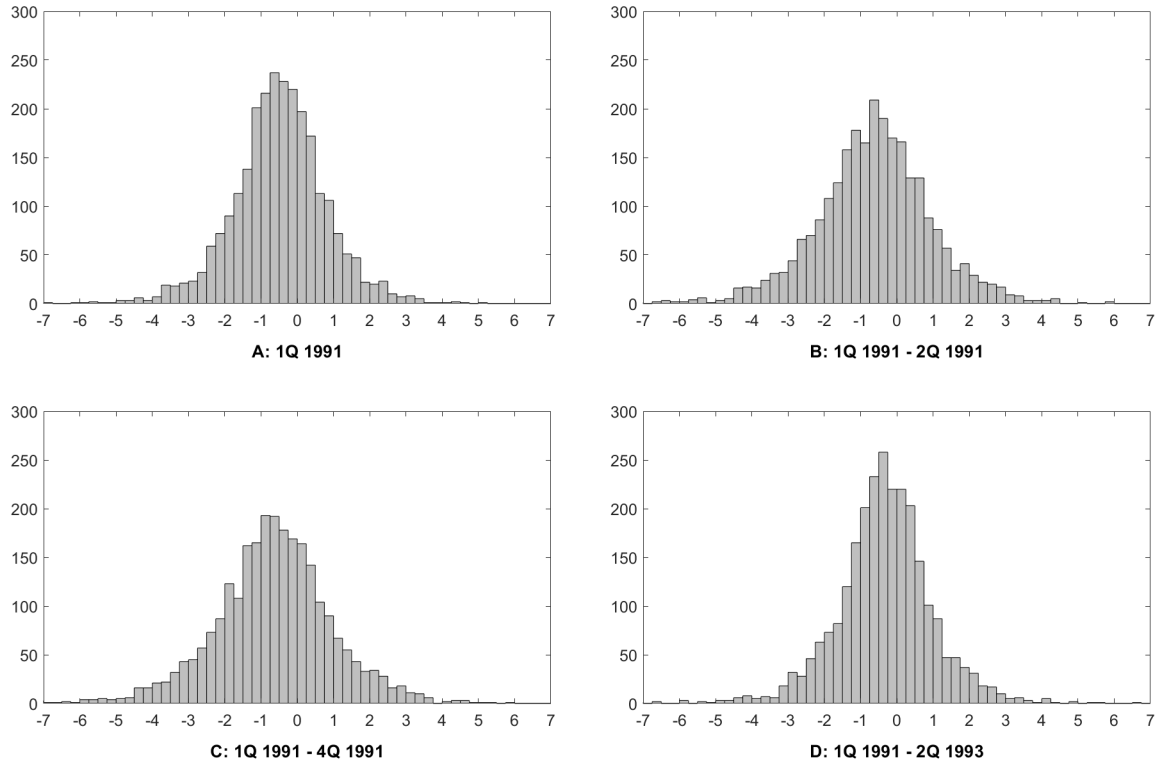

Figure 10: Distribution of cumulative GDP loss due to financial propagation of the Soviet trade shock. Estimation until 2Q 2007

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D). The effect of the propagation is the difference between the actual GDP loss and the GDP loss when the financial channel is shut down.

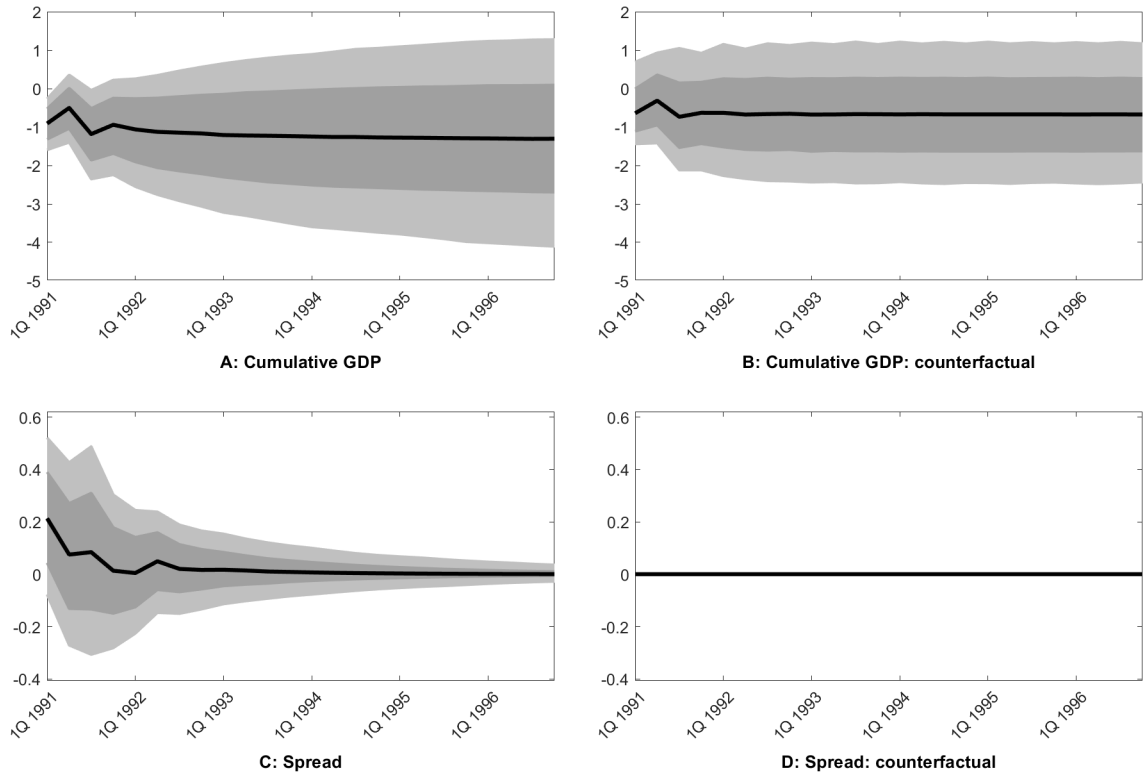

Figure 11: Impulse responses of cumulative GDP and the spread following the Soviet shock in 1Q 1991. Estimation until 2Q 2007.

Notes: Black line is the period-wise median. Shaded areas indicate the period-wise 90 percent (light gray) and 66 percent (dark gray) impulse responses.

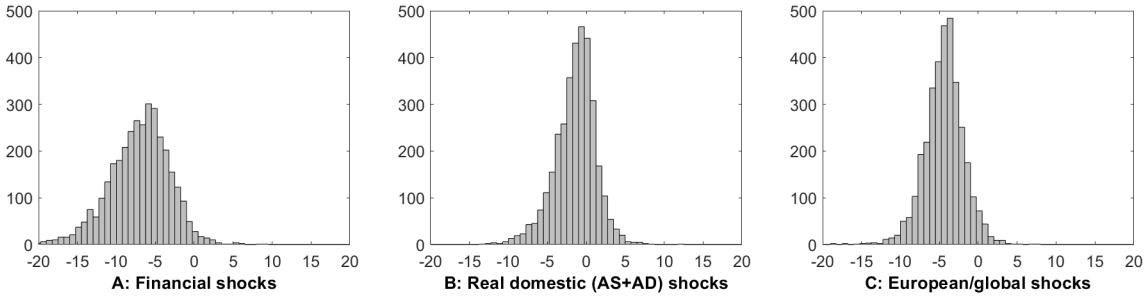

Figure 12: Distribution of cumulative GDP loss due to financial, real, and European/global shocks. Estimation until 2Q 2007.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to financial (panel A), real (B) and European/global shocks (C) occurring from 3Q 1989 to 2Q 1993.

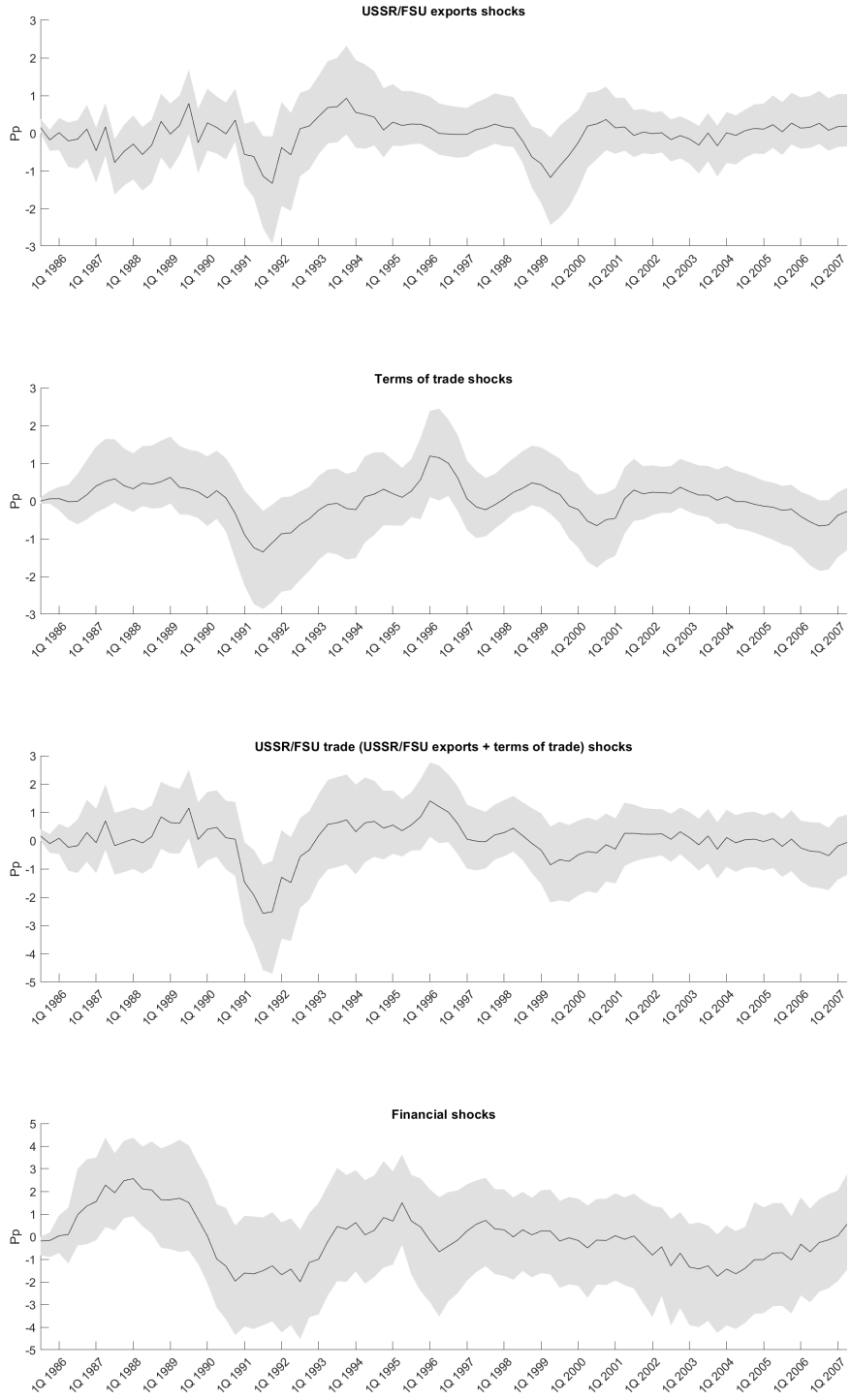

Figure 13: Historical decomposition of the Finnish business cycle. Estimation until 2Q 2007.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

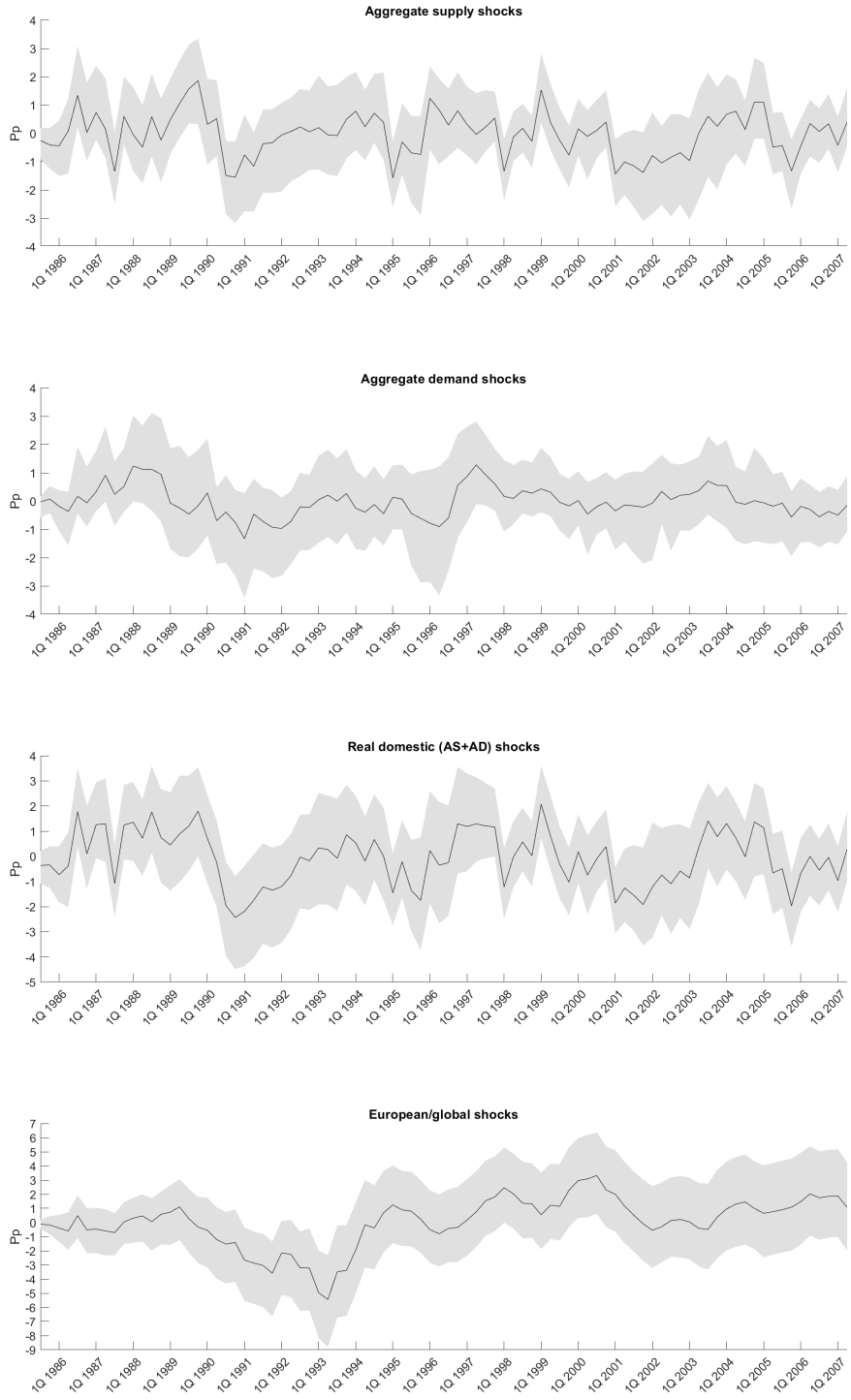

Figure 14: Historical decomposition of the Finnish business cycle (cont.). Estimation until 2Q 2007.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

D.2 Estimation until 4Q 1998

This robustness check assures that the benchmark results are not driven by the participation in the euro area or the dot-com bubble. We do it by dropping the data from 1Q 1999 onwards.

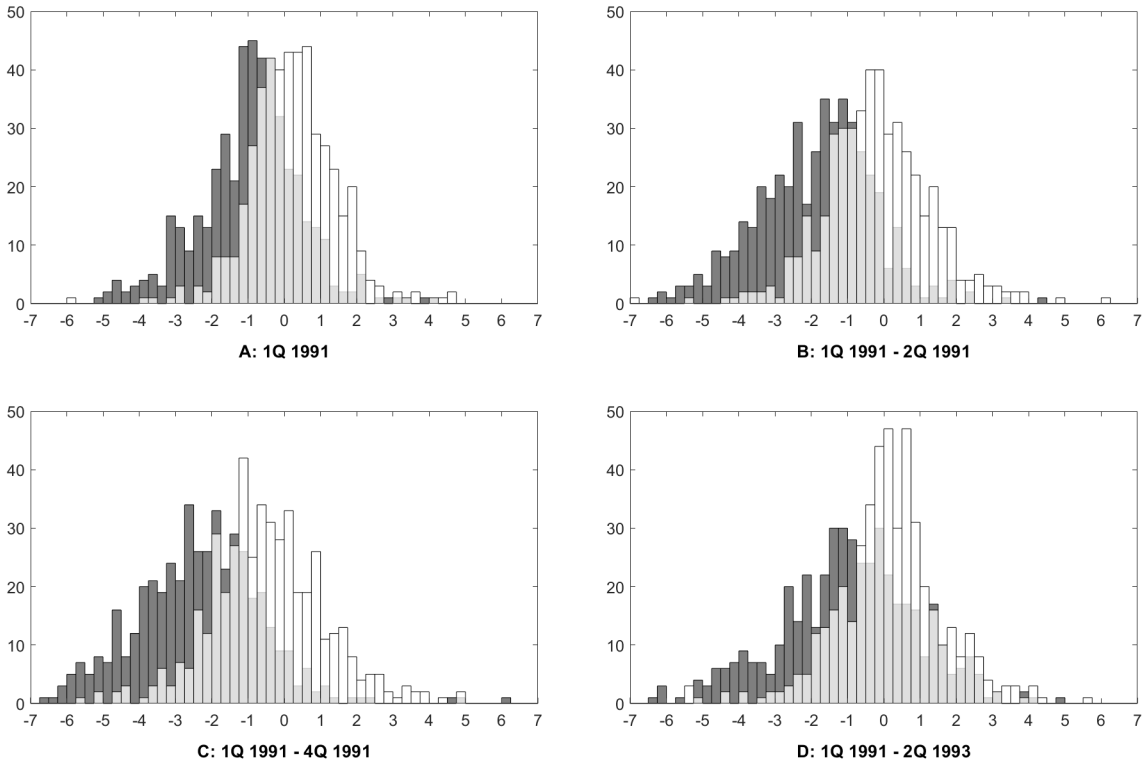

Figure 15: Distribution of the GDP loss due to the Soviet trade shock, with financial propagation (gray) and without (white). Estimation until 4Q 1998.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D).

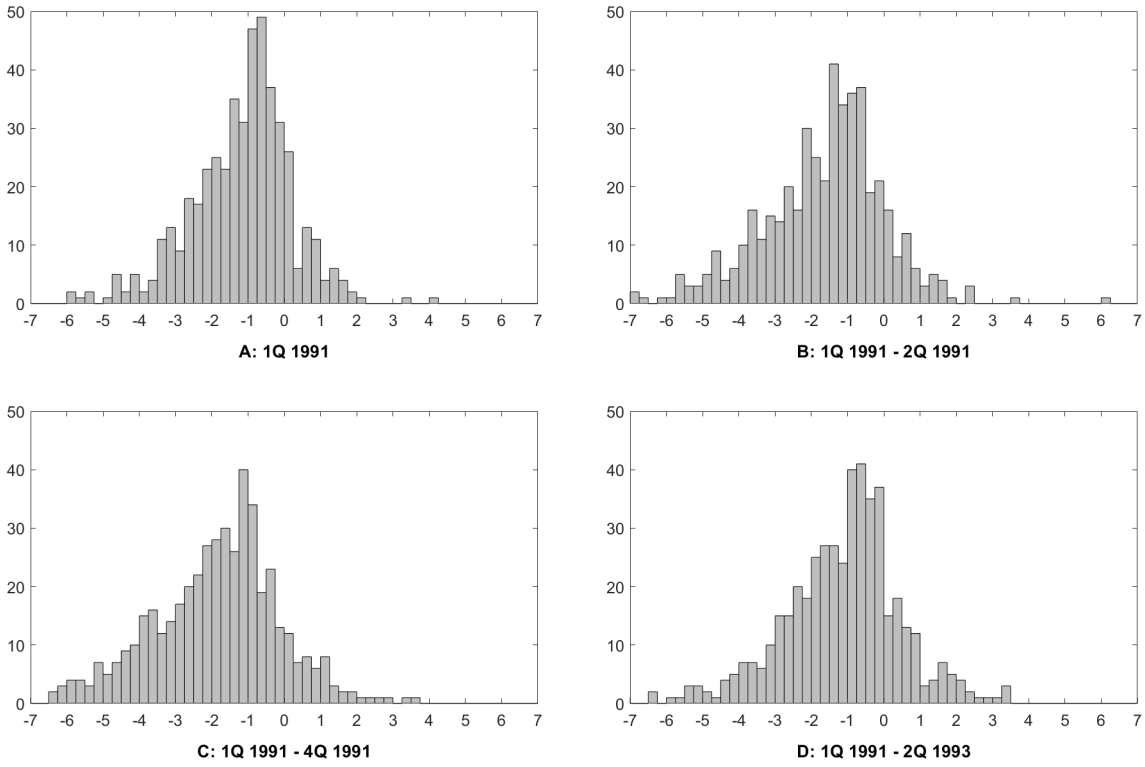

Figure 16: Distribution of cumulative GDP loss due to financial propagation of the Soviet trade shock. Estimation until 4Q 1998

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D). The effect of the propagation is the difference between the actual GDP loss and the GDP loss when the financial channel is shut down.

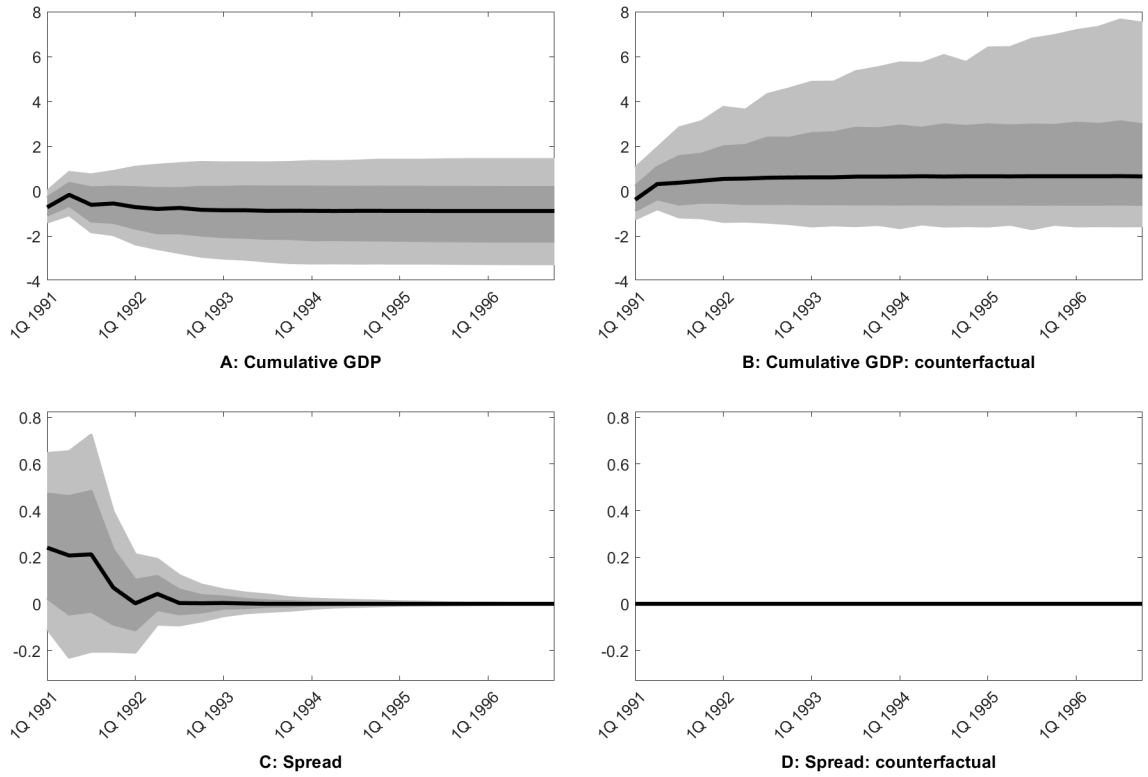

Figure 17: Impulse responses of cumulative GDP and the spread following the Soviet shock in 1Q 1991. Estimation until 4Q 1998.

Notes: Black line is the period-wise median. Shaded areas indicate the period-wise 90 percent (light gray) and 66 percent (dark gray) impulse responses.

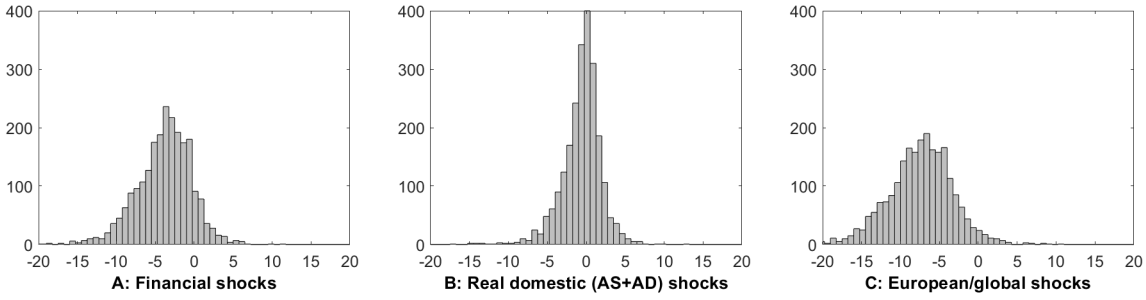

Figure 18: Distribution of cumulative GDP loss due to financial, real, and European/global shocks. Estimation until 4Q 1998.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to financial (panel A), real (B) and European/global shocks (C) occurring from 3Q 1989 to 2Q 1993.

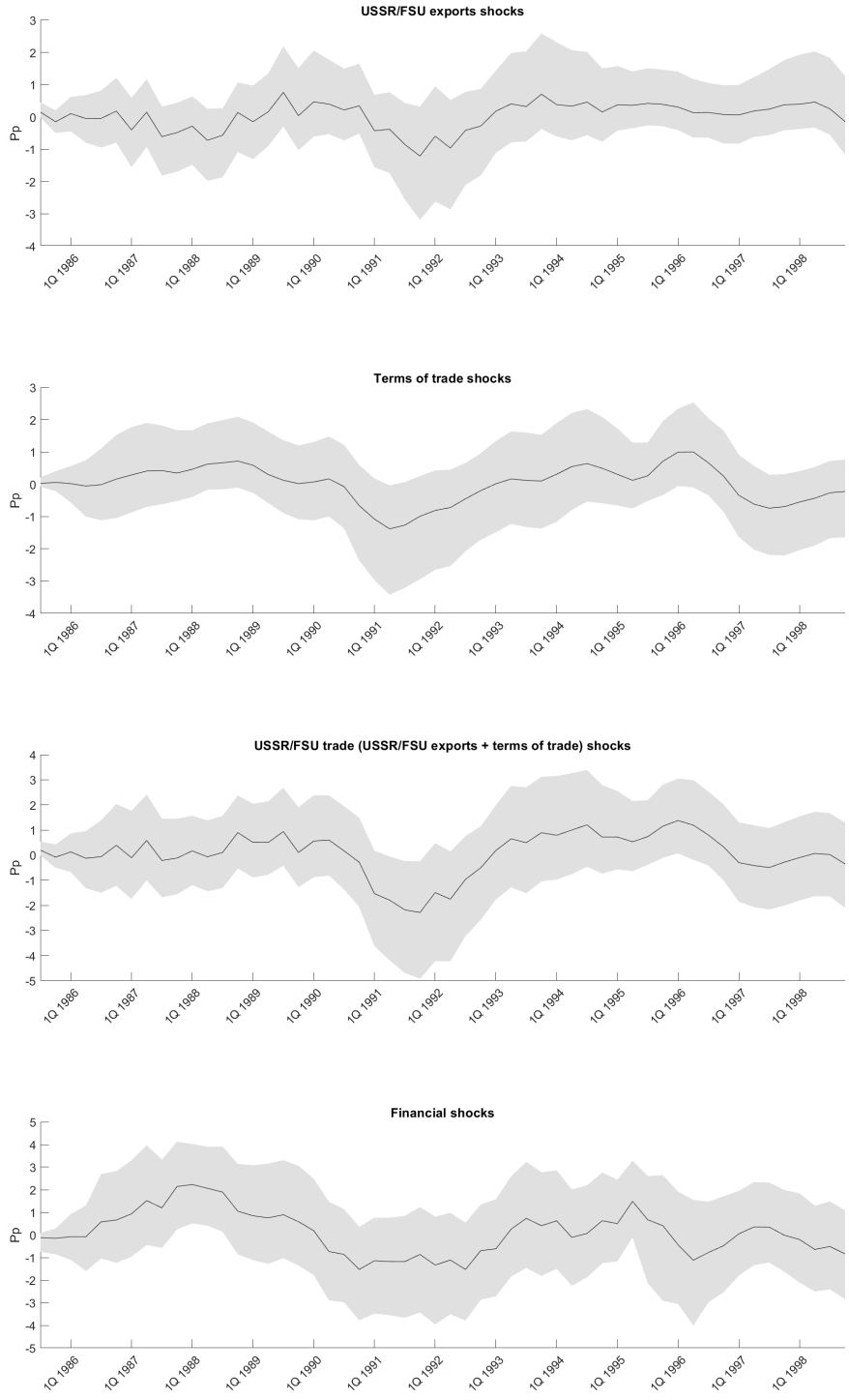

Figure 19: Historical decomposition of the Finnish business cycle. Estimation until 4Q 1998.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

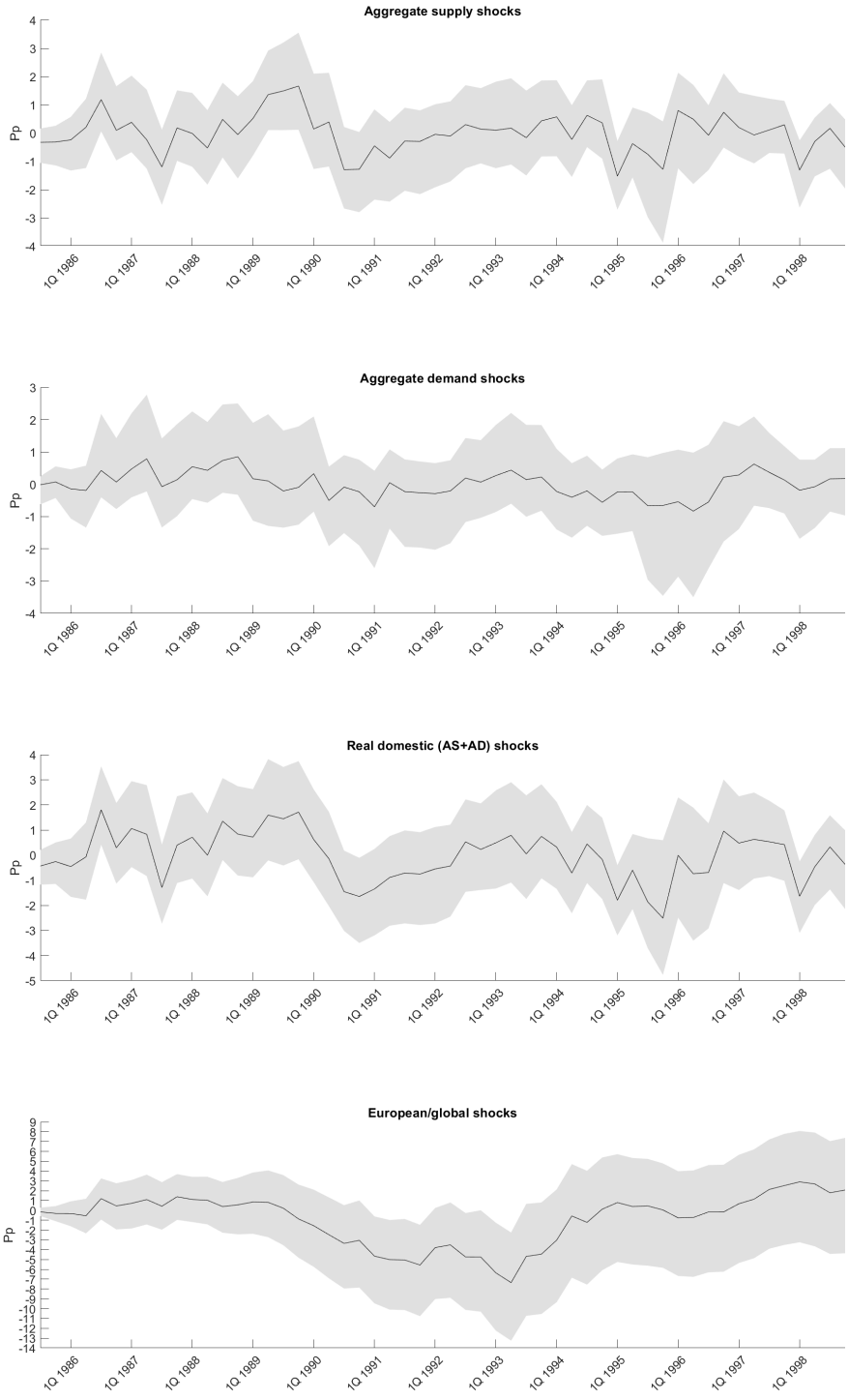

Figure 20: Historical decomposition of the Finnish business cycle (cont.). Estimation until 4Q 1998.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

D.3 Estimation starting in 2Q 1981

In this robustness check we extend the dataset into the early 1980s, by starting in 2Q 1981. Going further back is problematic due to unavailability of consistent time series, esp. those related to finance.

Given that the years 1981-1985 were still a time of strong financial regulation, our sign restrictions are less applicable to that period. Therefore, we do not include these years in the benchmark specification. Nevertheless, including these additional years does not affect the basic result.

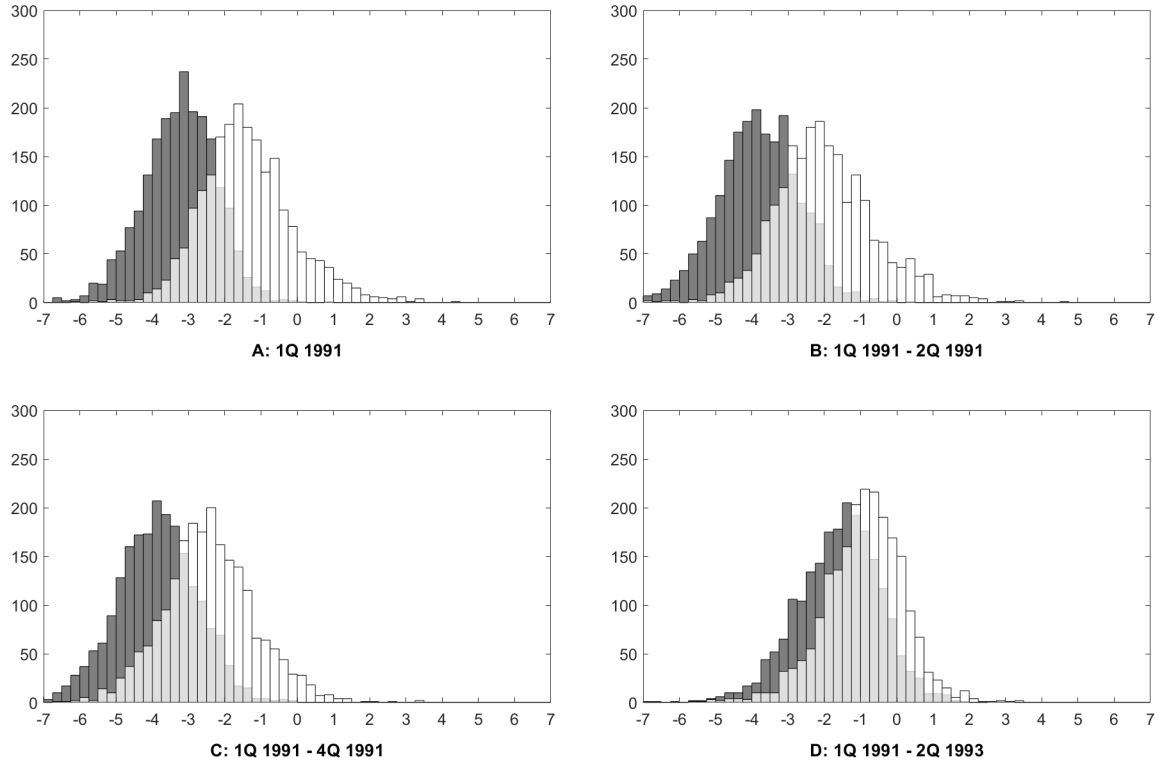

Figure 21: Distribution of the GDP loss due to the Soviet trade shock, with financial propagation (gray) and without (white). Estimation starting in 2Q 1981.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D).

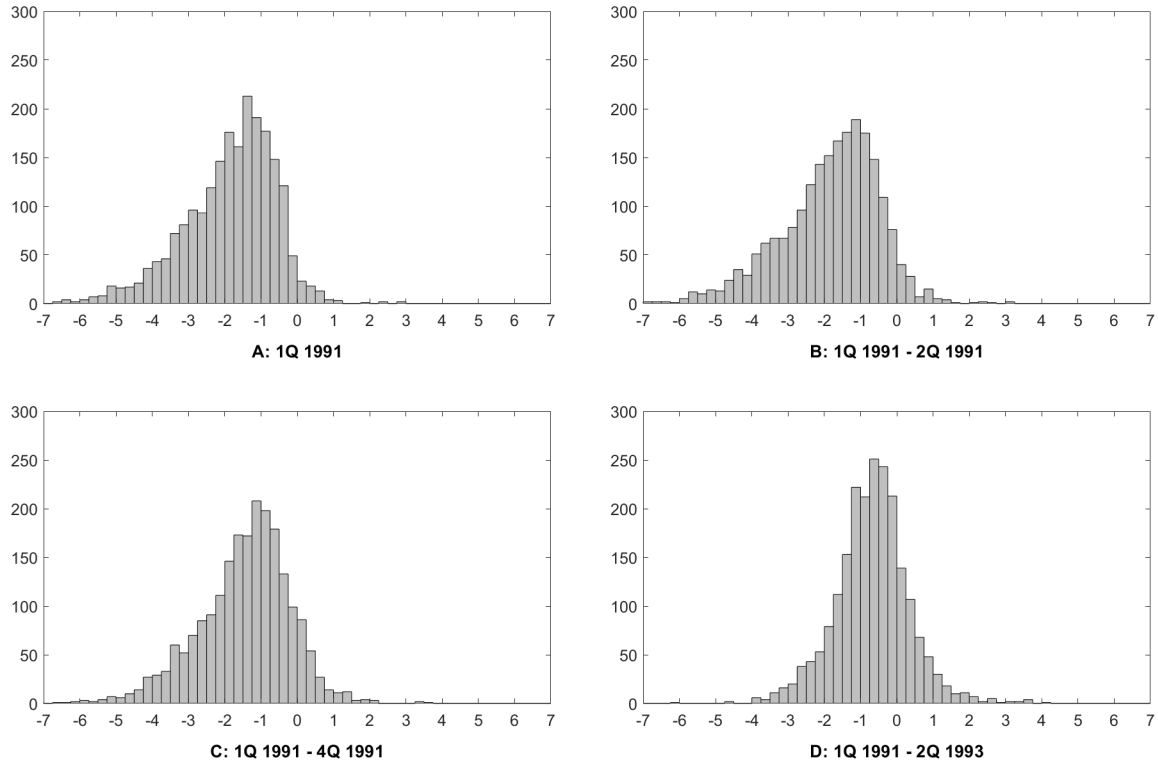

Figure 22: Distribution of cumulative GDP loss due to financial propagation of the Soviet trade shock. Estimation starting in 2Q 1981.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D). The effect of the propagation is the difference between the actual GDP loss and the GDP loss when the financial channel is shut down.

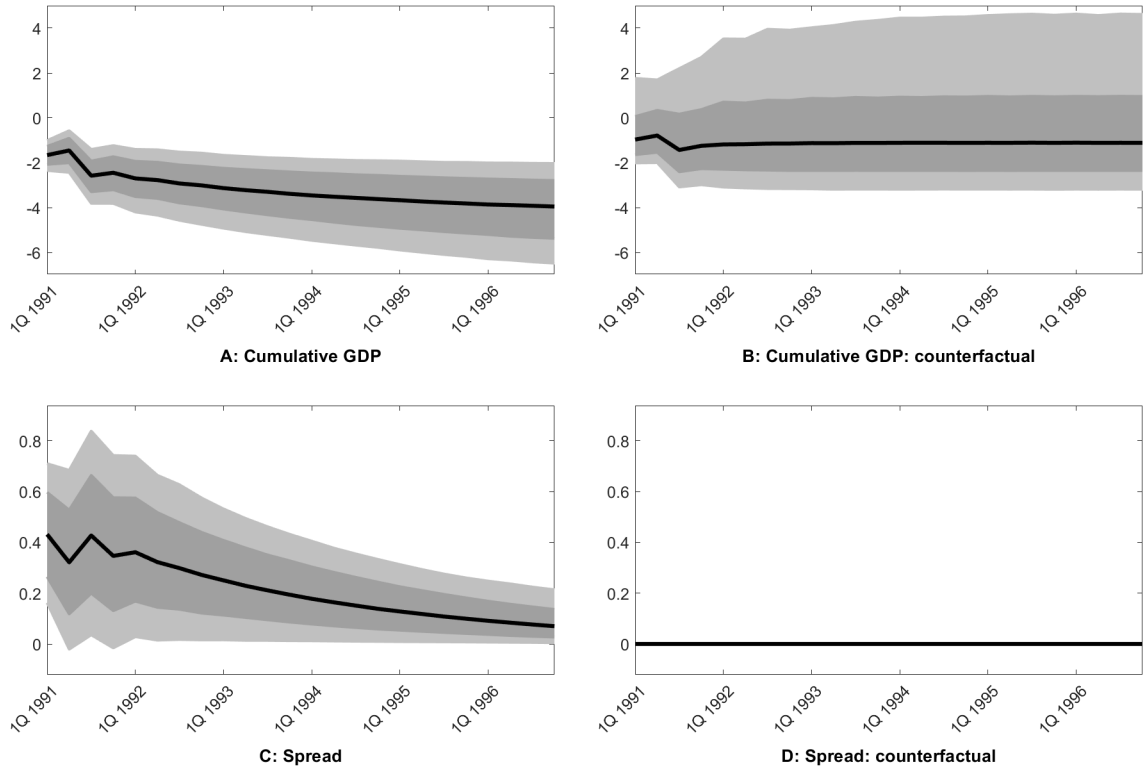

Figure 23: Impulse responses of cumulative GDP and the spread following the Soviet shock in 1Q 1991. Estimation starting in 2Q 1981.

Notes: Black line is the period-wise median. Shaded areas indicate the period-wise 90 percent (light gray) and 66 percent (dark gray) impulse responses.

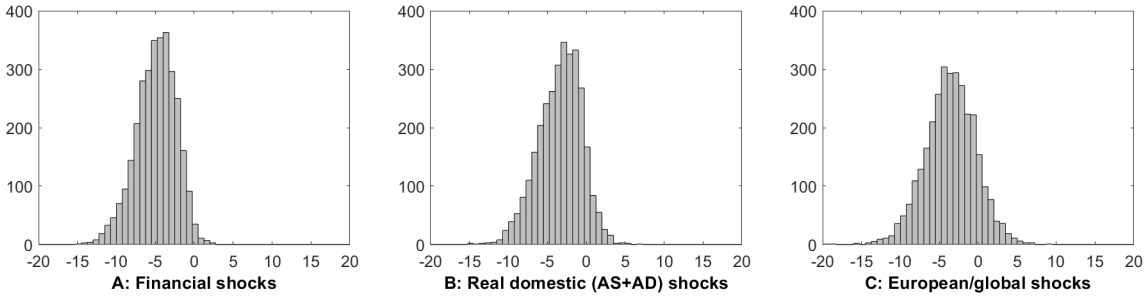

Figure 24: Distribution of cumulative GDP loss due to financial, real, and European/global shocks. Estimation starting in 2Q 1981.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to financial (panel A), real (B) and European/global shocks (C) occurring from 3Q 1989 to 2Q 1993.

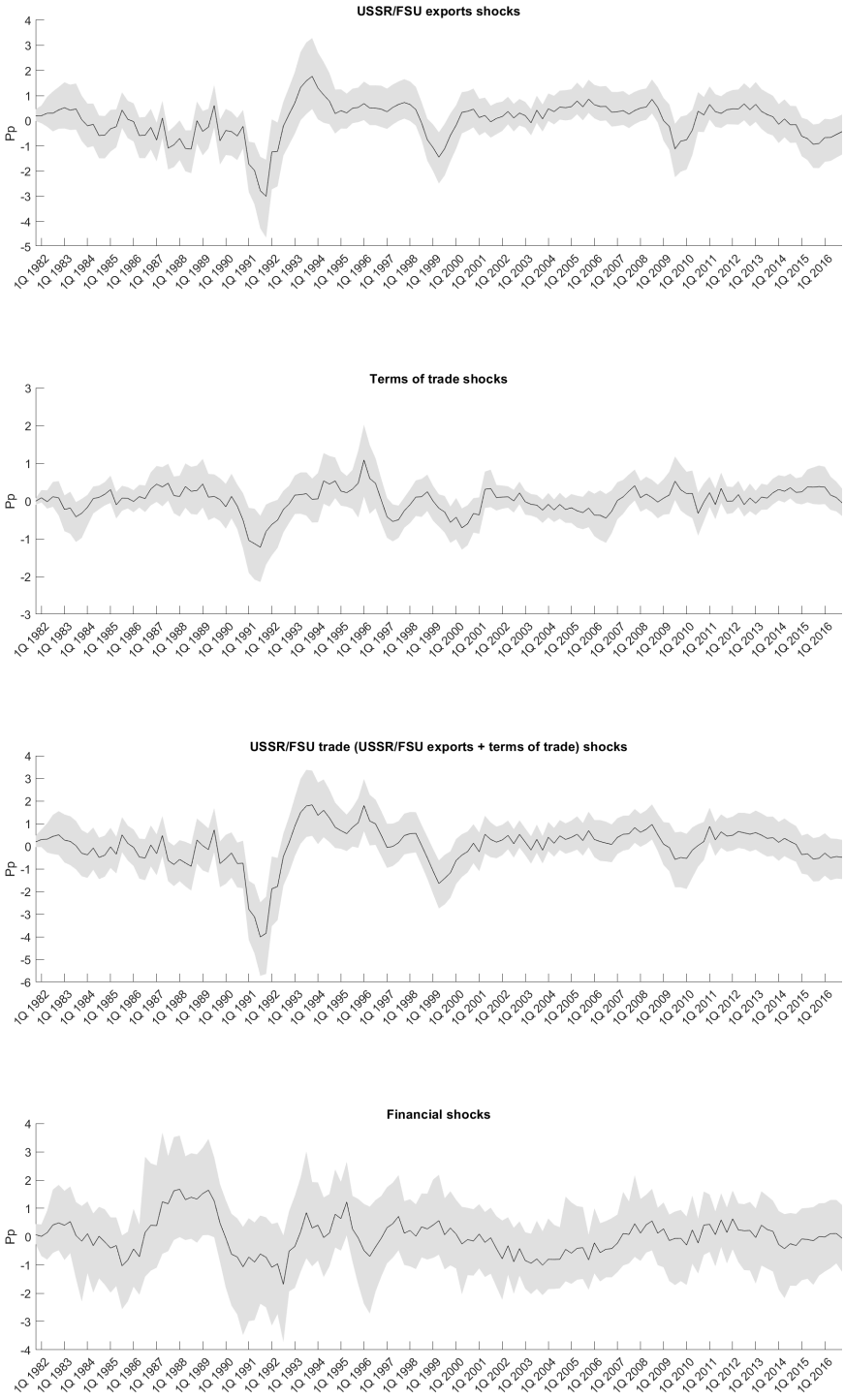

Figure 25: Historical decomposition of the Finnish business cycle. Estimation starting in 2Q 1981.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

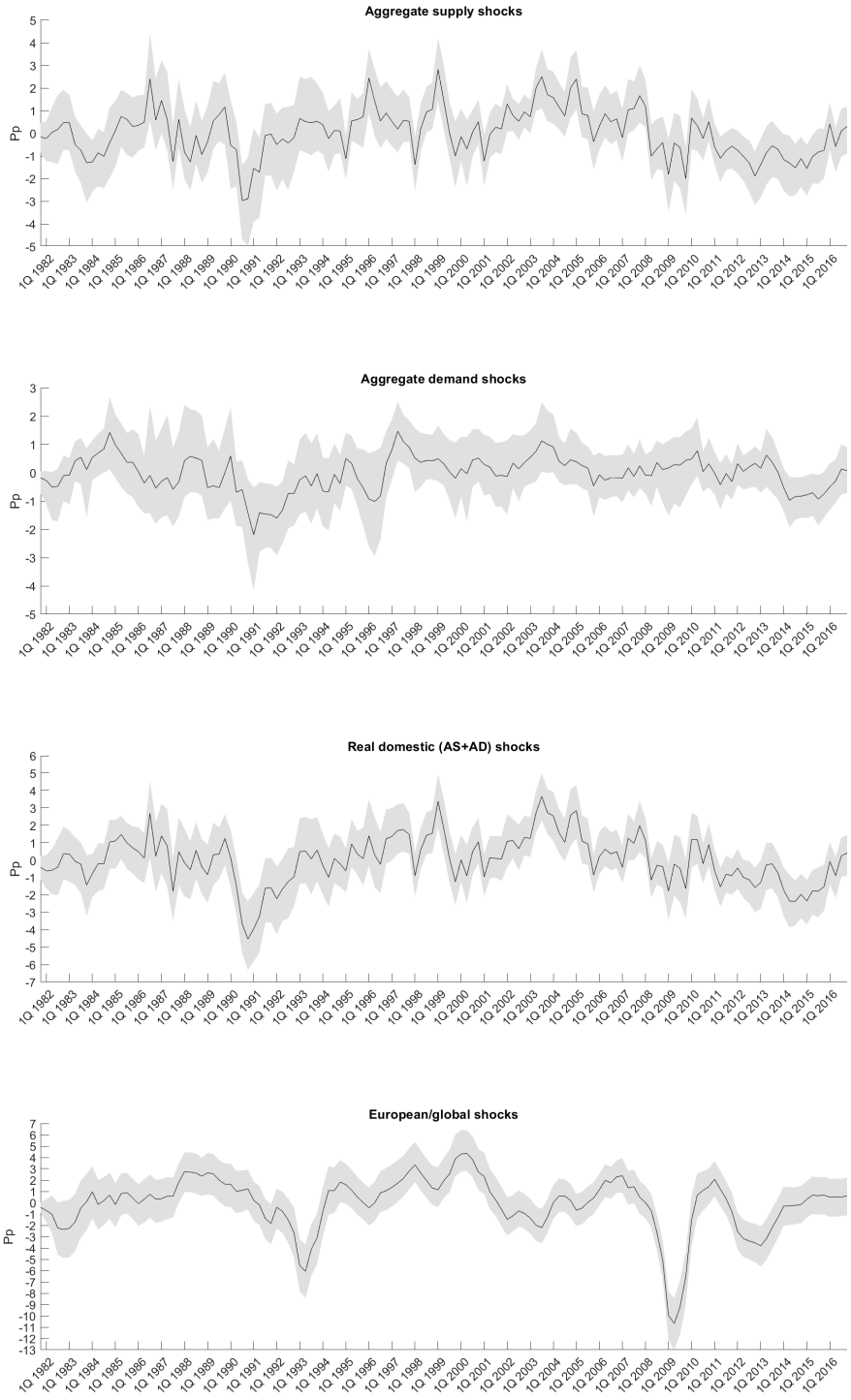

Figure 26: Historical decomposition of the Finnish business cycle (cont.). Estimation starting in 2Q 1981.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

D.4 Sign restrictions for 2 periods

Following the arguments by Canova and Paustian (2011), the sign of the response is required to hold only on impact in the benchmark specification. In this robustness check we explore restrictions for 2 periods. The restrictions are imposed on the cumulative impulse responses for variables in growth rates (GDP, prices) and on standard impulse responses for the variable in levels (spread).

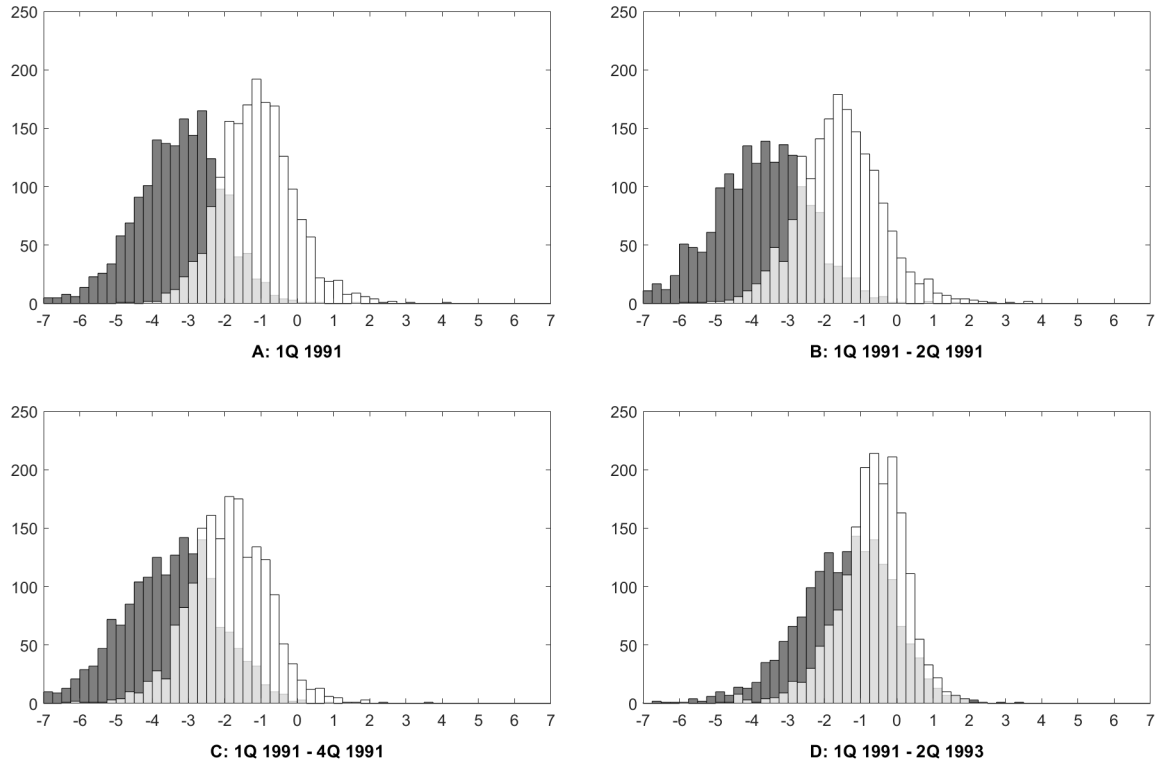

Figure 27: Distribution of the GDP loss due to the Soviet trade shock, with financial propagation (gray) and without (white). Sign restrictions for 2 periods.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D).

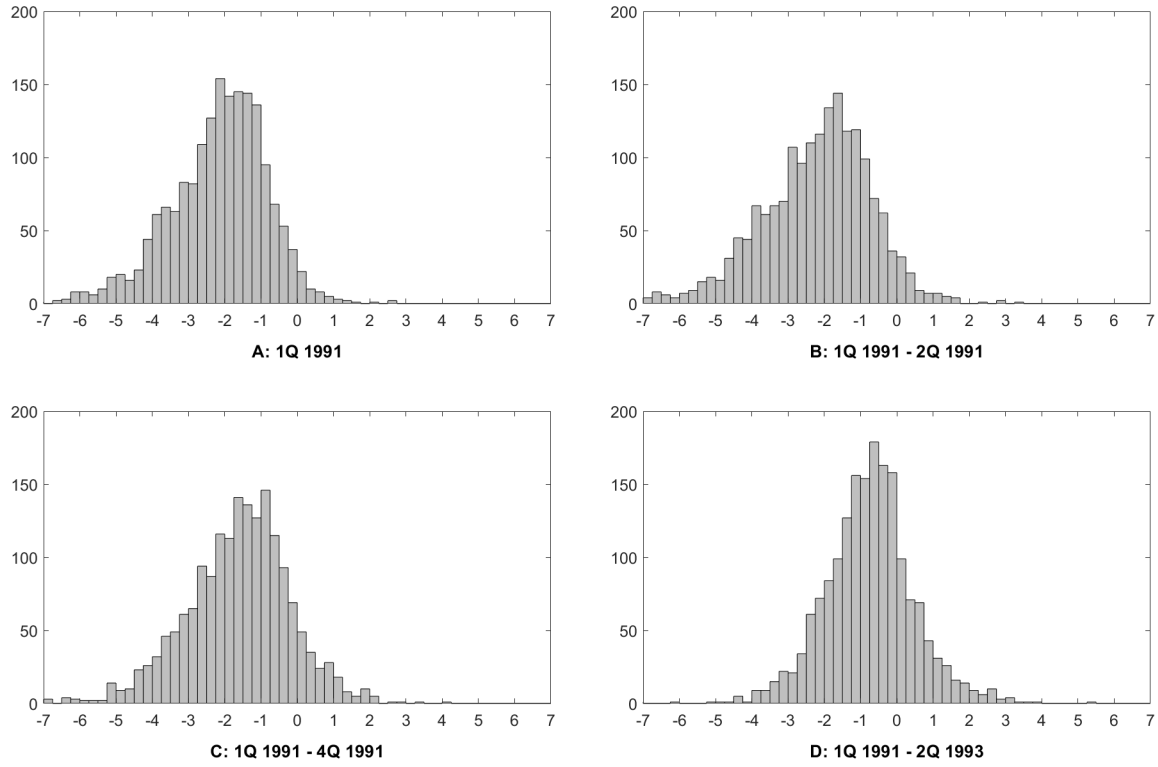

Figure 28: Distribution of cumulative GDP loss due to financial propagation of the Soviet trade shock. Sign restrictions for 2 periods.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D). The effect of the propagation is the difference between the actual GDP loss and the GDP loss when the financial channel is shut down.

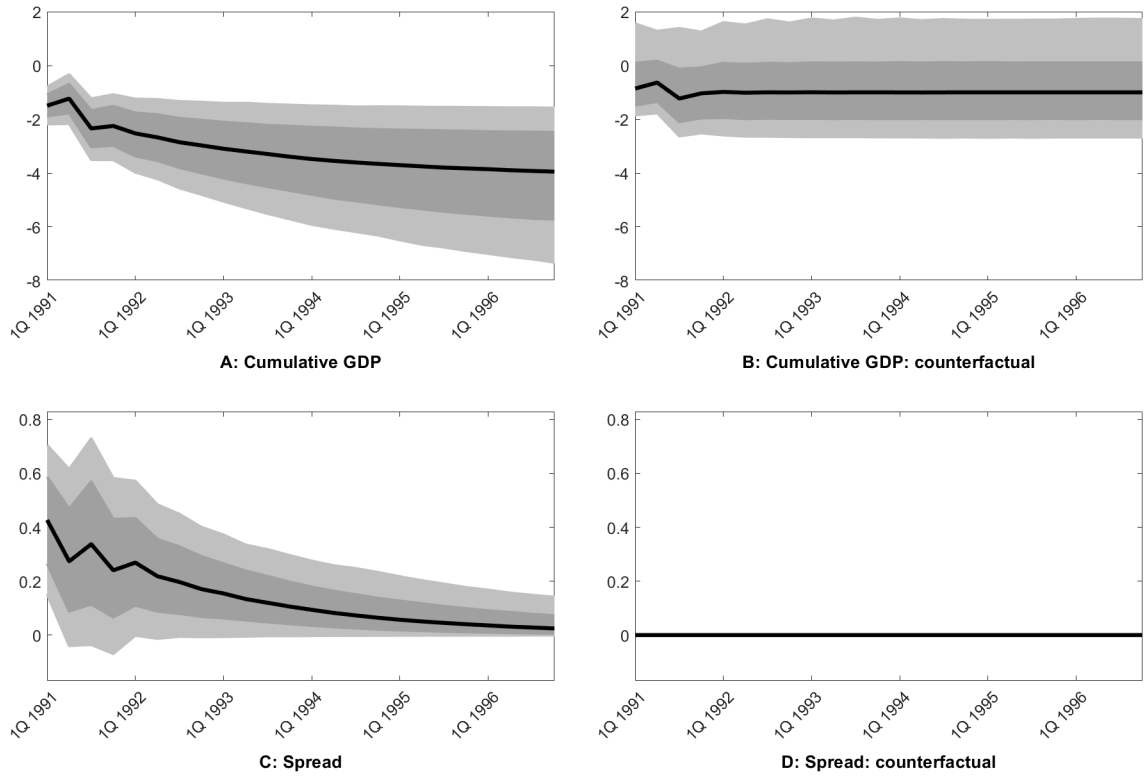

Figure 29: Impulse responses of cumulative GDP and the spread following the Soviet shock in 1Q 1991. Sign restrictions for 2 periods.

Notes: Black line is the period-wise median. Shaded areas indicate the period-wise 90 percent (light gray) and 66 percent (dark gray) impulse responses.

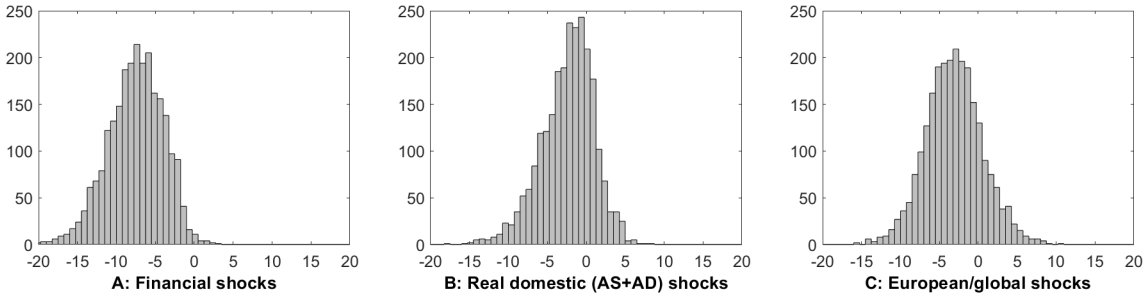

Figure 30: Distribution of cumulative GDP loss due to financial, real, and European/global shocks. Sign restrictions for 2 periods.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to financial (panel A), real (B) and European/global shocks (C) occurring from 3Q 1989 to 2Q 1993.

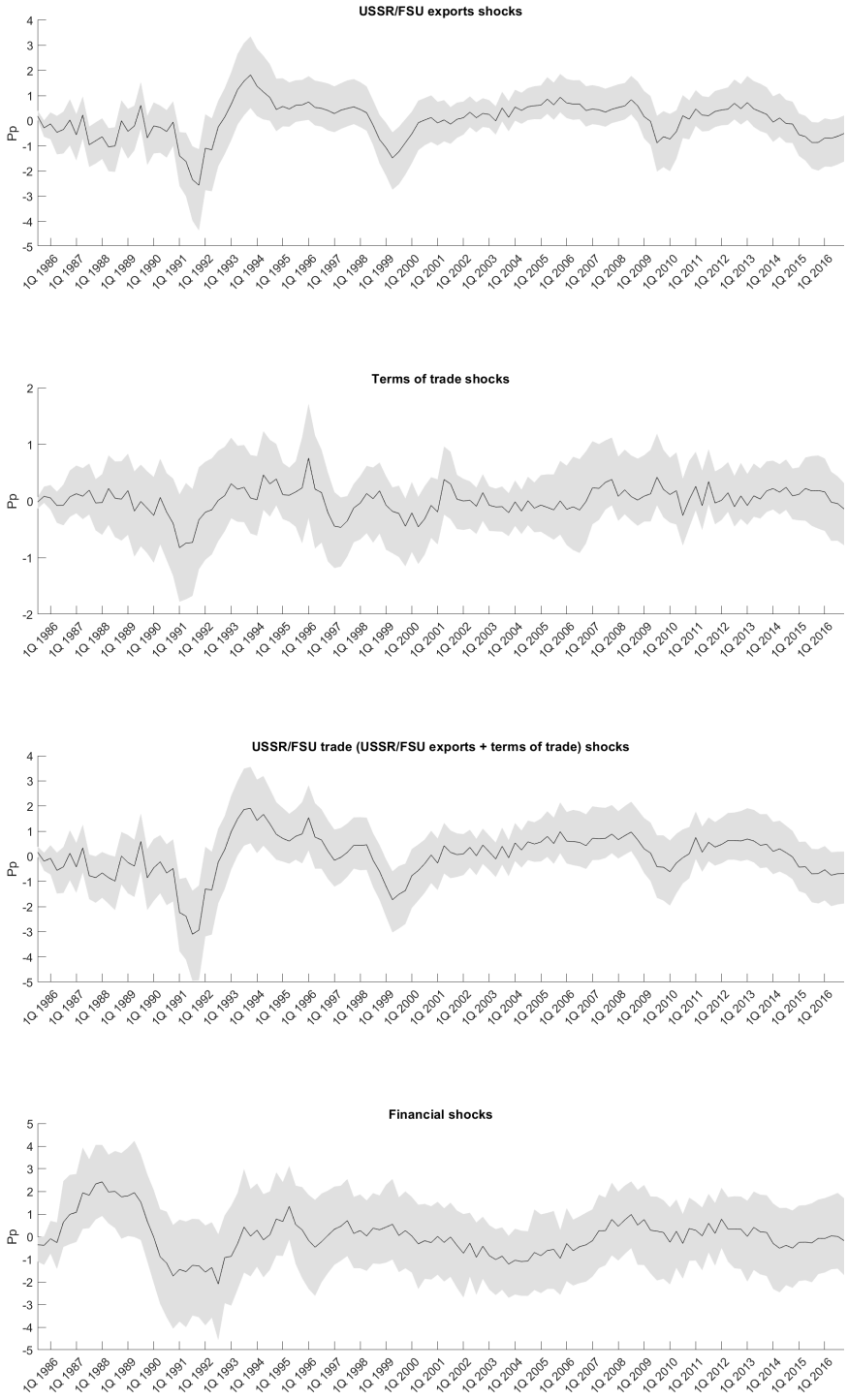

Figure 31: Historical decomposition of the Finnish business cycle. Sign restrictions for 2 periods.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

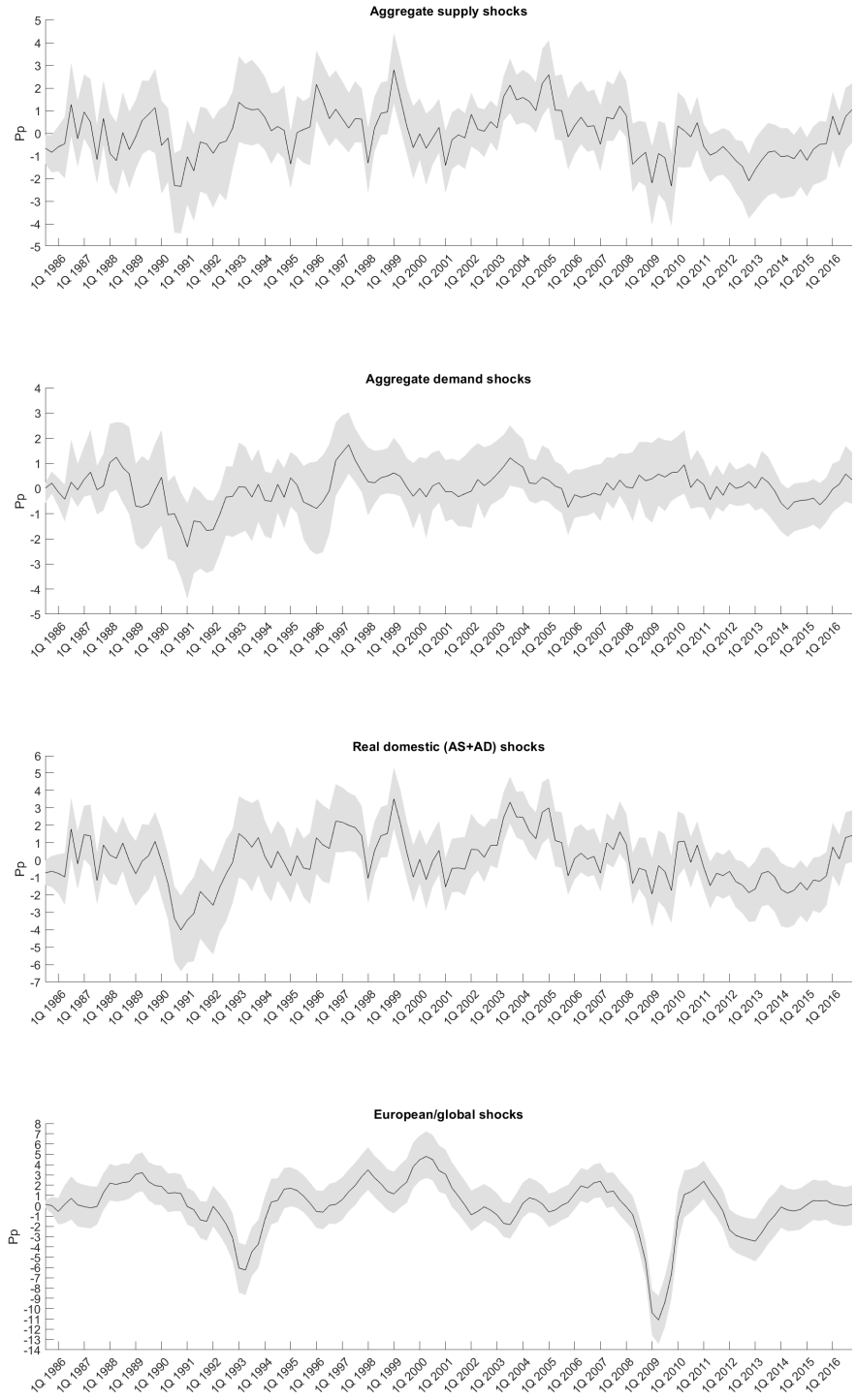

Figure 32: Historical decomposition of the Finnish business cycle (cont.). Sign restrictions for 2 periods.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

D.5 Sign restrictions for 4 periods

Following the arguments by Canova and Paustian (2011), the sign of the response is required to hold only on impact in the benchmark specification. In this robustness check we explore restrictions for 4 periods. The restrictions are imposed on the cumulative impulse responses for variables in growth rates (GDP, prices) and on standard impulse responses for the variable in levels (spread).

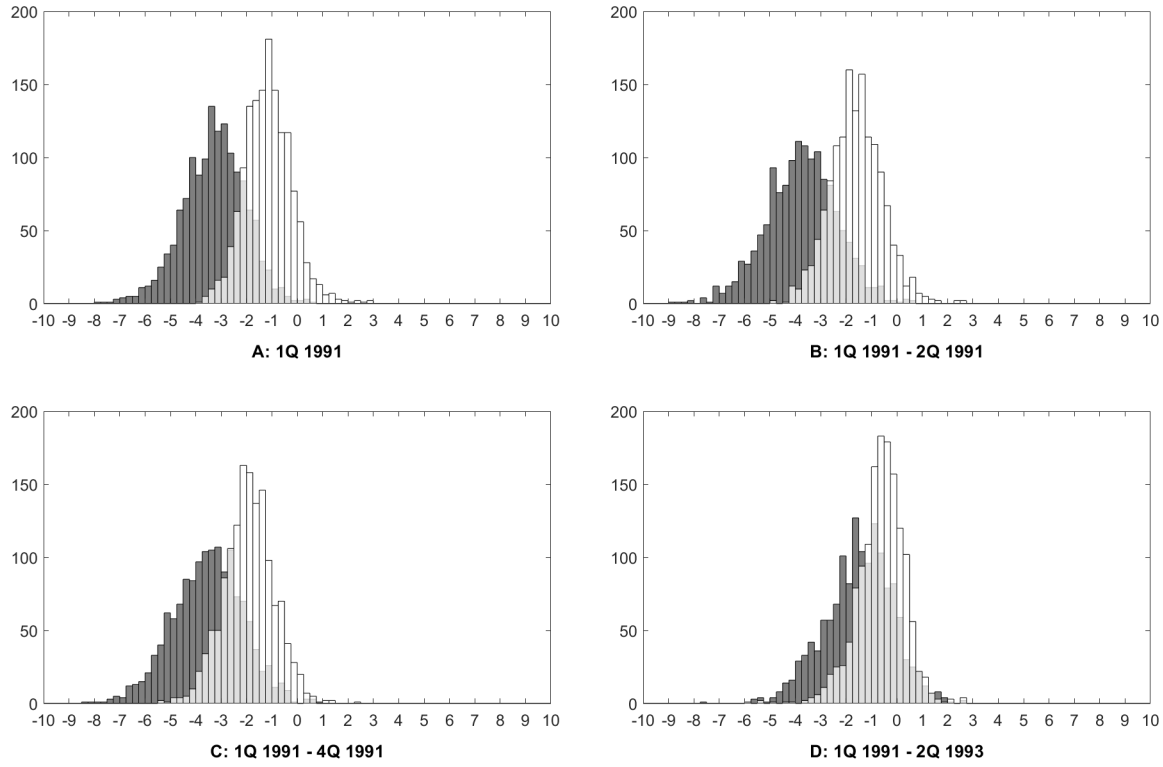

Figure 33: Distribution of the GDP loss due to the Soviet trade shock, with financial propagation (gray) and without (white). Sign restrictions for 4 periods.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D).

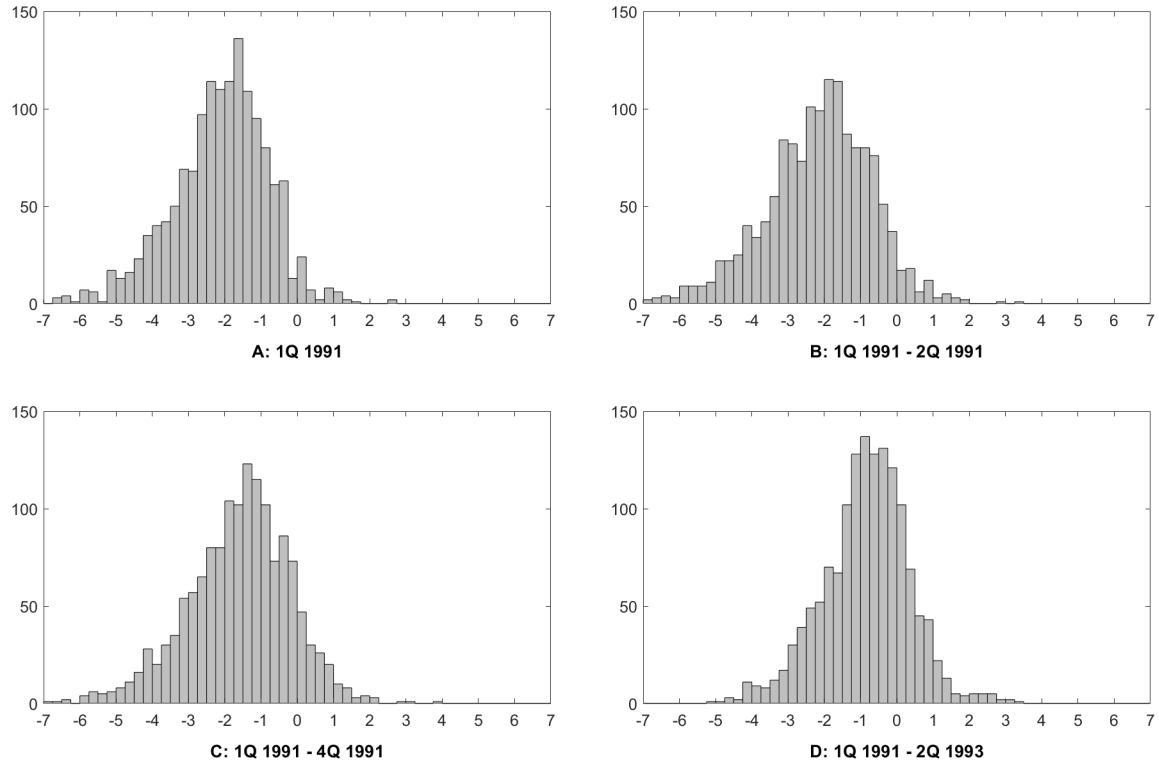

Figure 34: Distribution of cumulative GDP loss due to financial propagation of the Soviet trade shock. Sign restrictions for 4 periods.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D). The effect of the propagation is the difference between the actual GDP loss and the GDP loss when the financial channel is shut down.

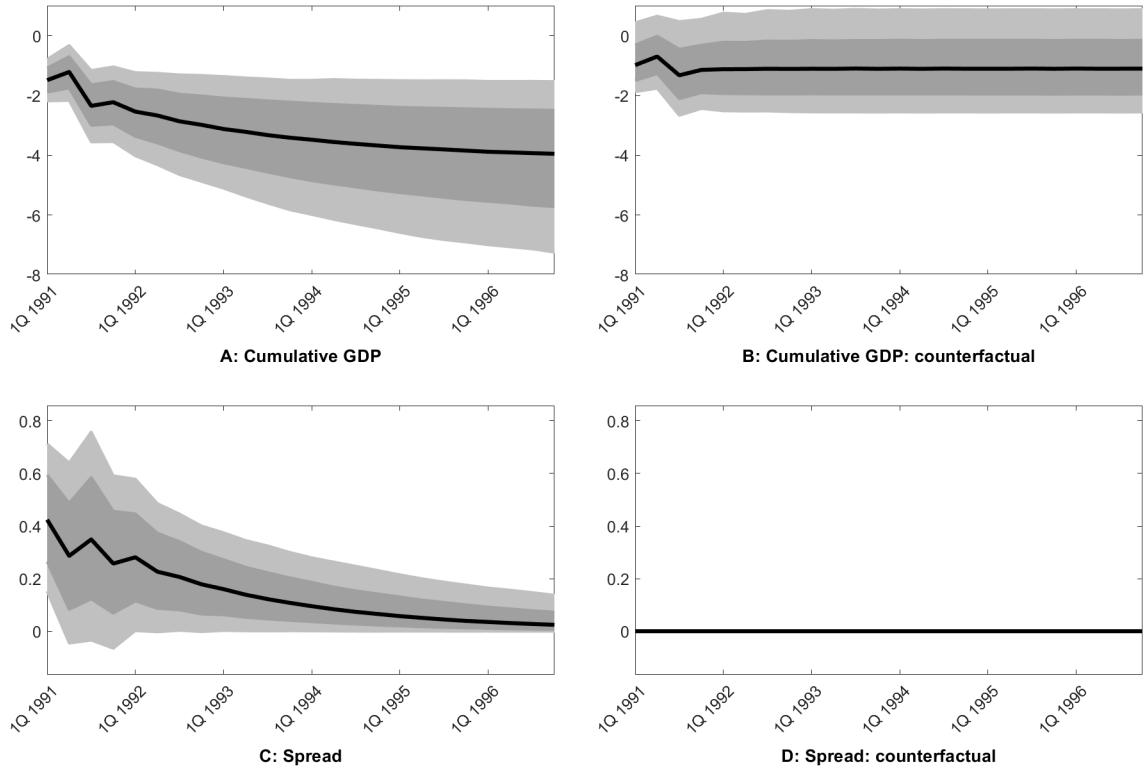

Figure 35: Impulse responses of cumulative GDP and the spread following the Soviet shock in 1Q 1991. Sign restrictions for 4 periods.

Notes: Black line is the period-wise median. Shaded areas indicate the period-wise 90 percent (light gray) and 66 percent (dark gray) impulse responses.

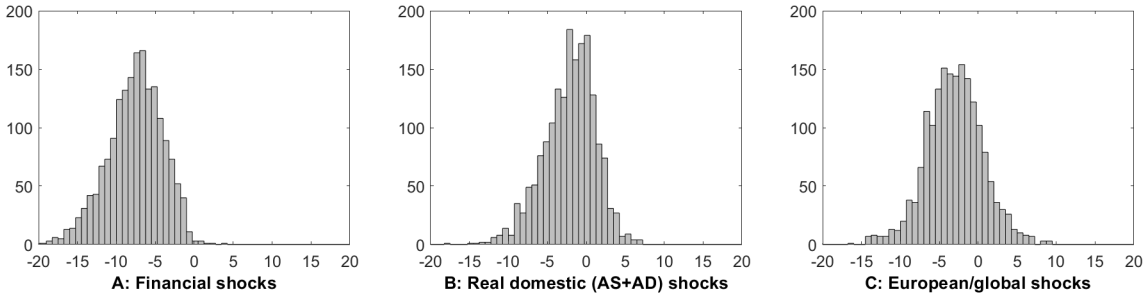

Figure 36: Distribution of cumulative GDP loss due to financial, real, and European/global shocks. Sign restrictions for 4 periods.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to financial (panel A), real (B) and European/global shocks (C) occurring from 3Q 1989 to 2Q 1993.

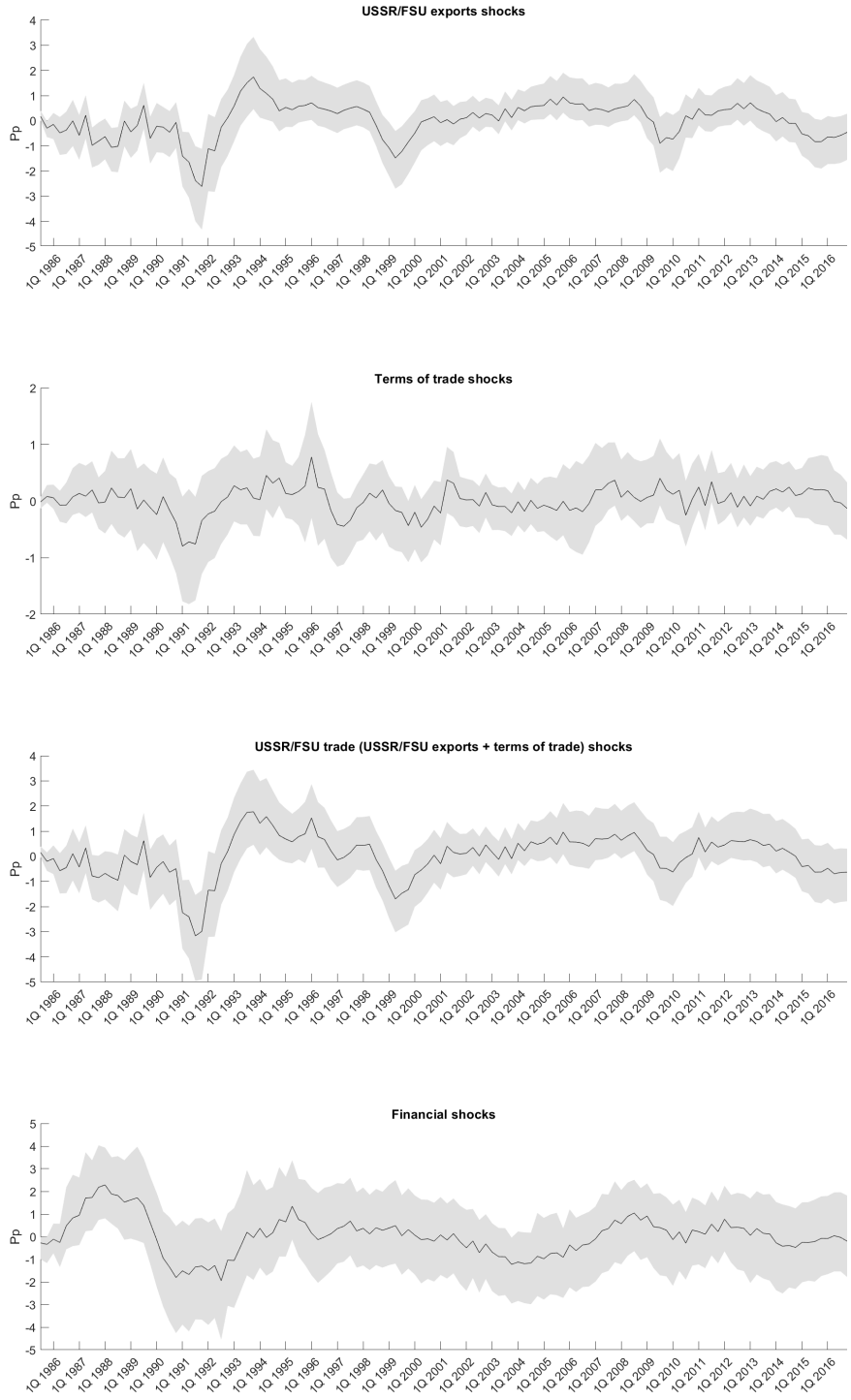

Figure 37: Historical decomposition of the Finnish business cycle. Sign restrictions for 4 periods.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

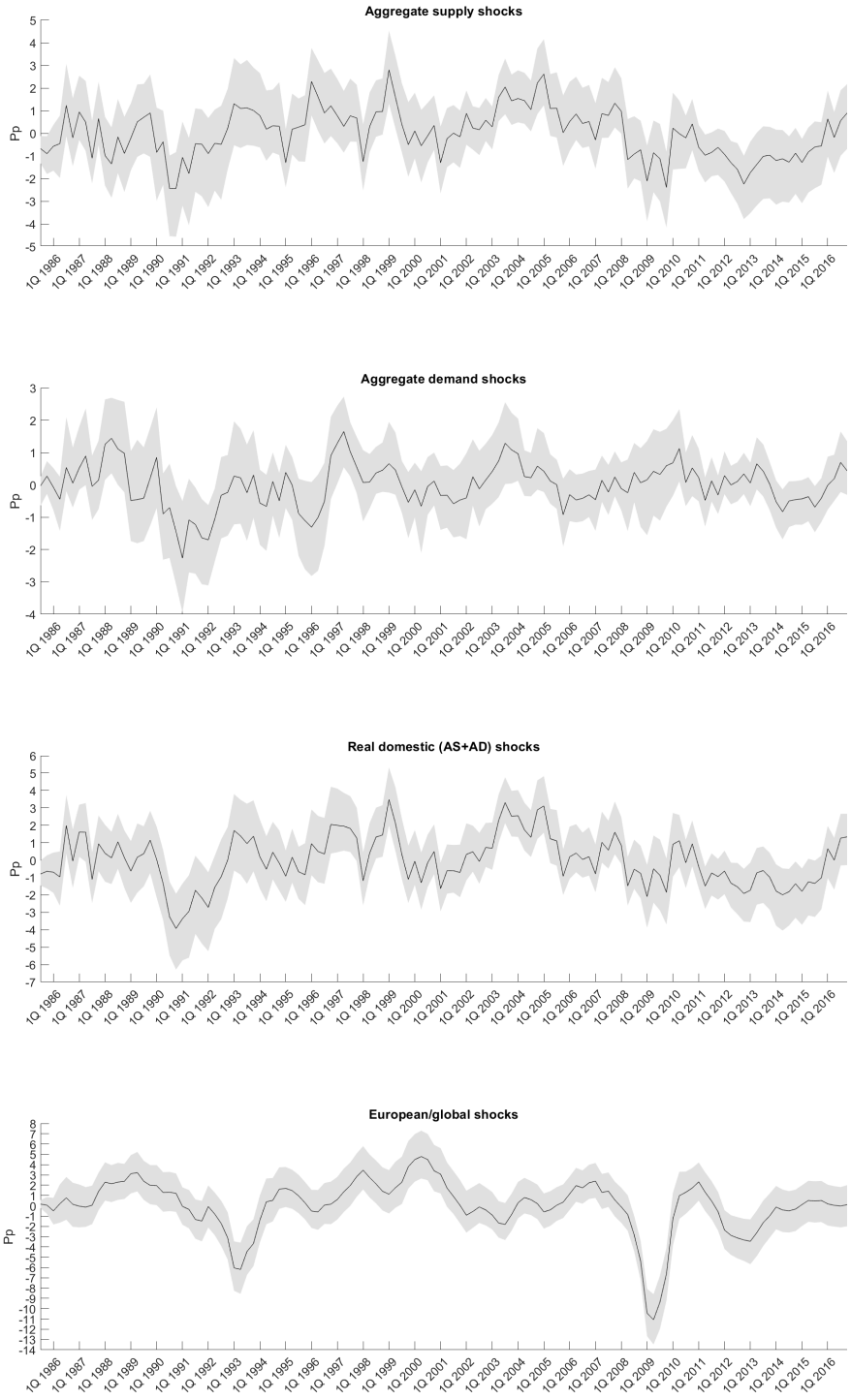

Figure 38: Historical decomposition of the Finnish business cycle (cont.). Sign restrictions for 4 periods.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

D.6 VAR with 1 lag

In the benchmark, the choice of VAR lags (2) was based on the indication of the likelihood ratio test and the analysis of residual autocorrelations. Here, we explore a more parsimonious VAR with one lag, given the indications of the Schwartz Information Criterion. This specification exhibits minor autocorrelations of the residuals and is therefore not taken to be the benchmark.

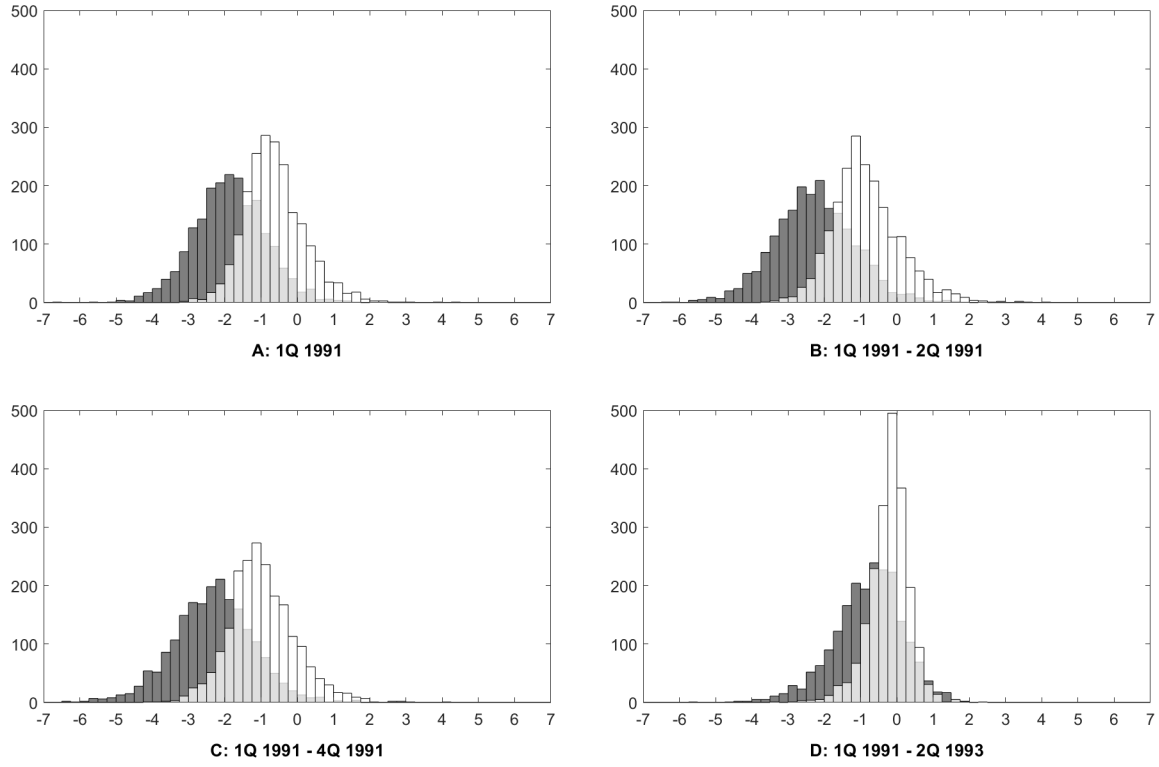

Figure 39: Distribution of the GDP loss due to the Soviet trade shock, with financial propagation (gray) and without (white). VAR with 1 lag.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D).

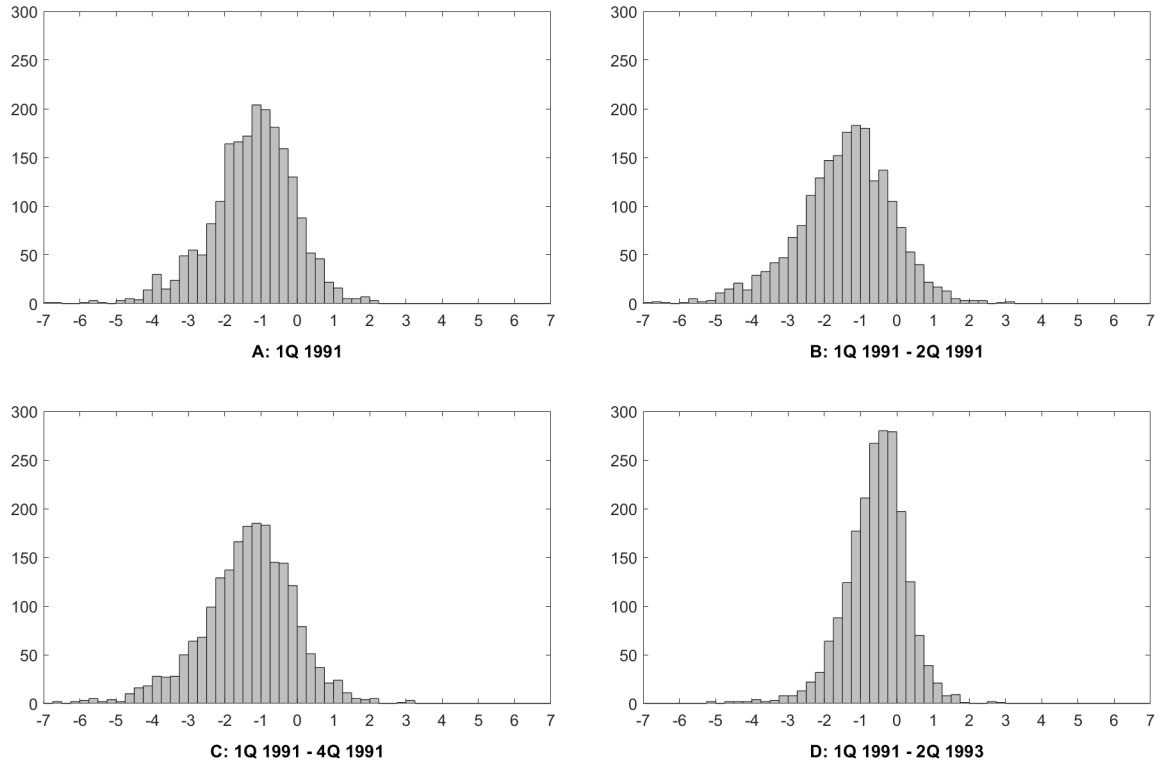

Figure 40: Distribution of cumulative GDP loss due to financial propagation of the Soviet trade shock. VAR with 1 lag.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D). The effect of the propagation is the difference between the actual GDP loss and the GDP loss when the financial channel is shut down.

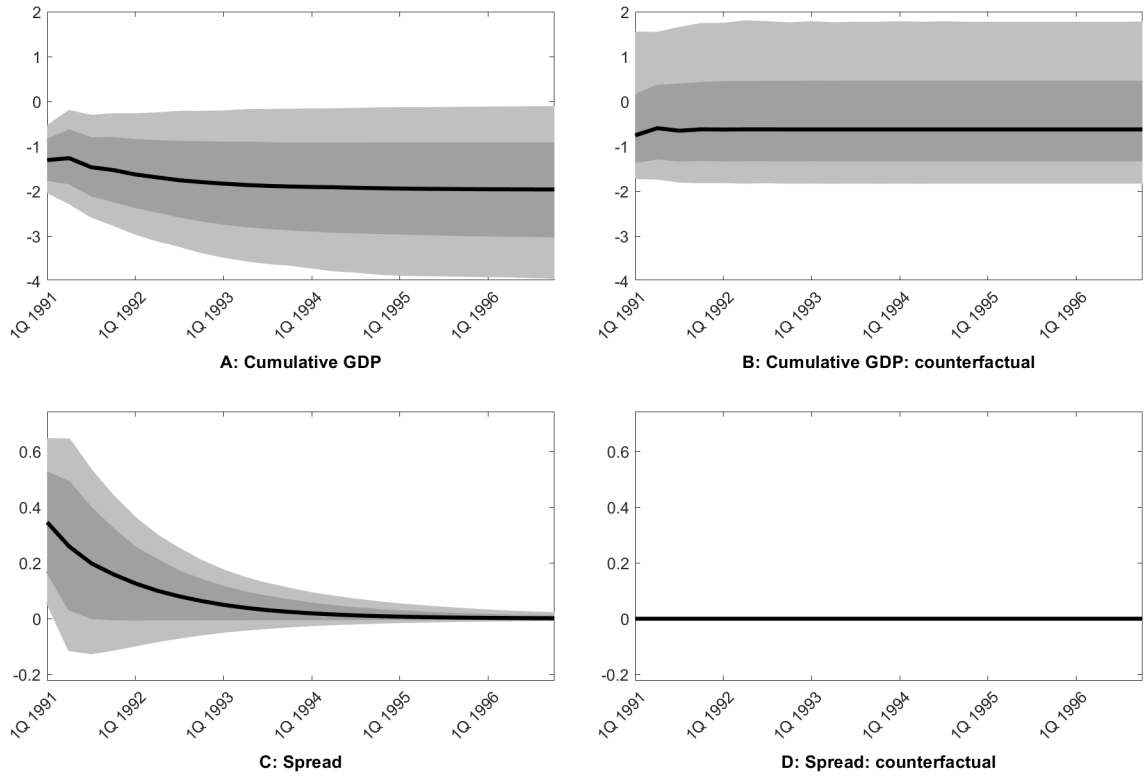

Figure 41: Impulse responses of cumulative GDP and the spread following the Soviet shock in 1Q 1991. VAR with 1 lag.

Notes: Black line is the period-wise median. Shaded areas indicate the period-wise 90 percent (light gray) and 66 percent (dark gray) impulse responses.

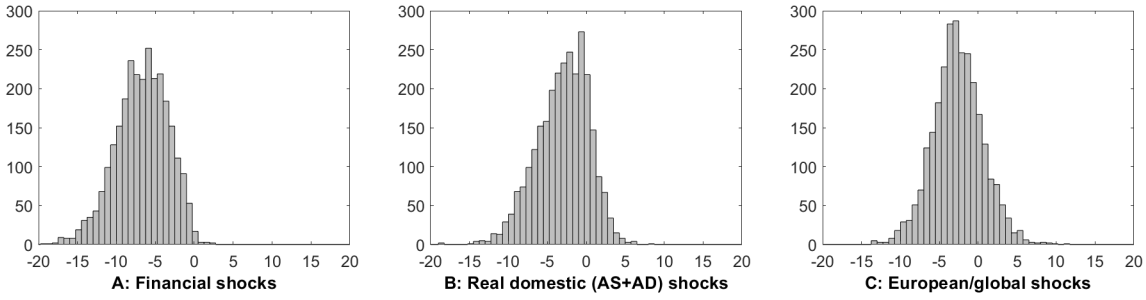

Figure 42: Distribution of cumulative GDP loss due to financial, real, and European/global shocks. VAR with 1 lag.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to financial (panel A), real (B) and European/global shocks (C) occurring from 3Q 1989 to 2Q 1993.

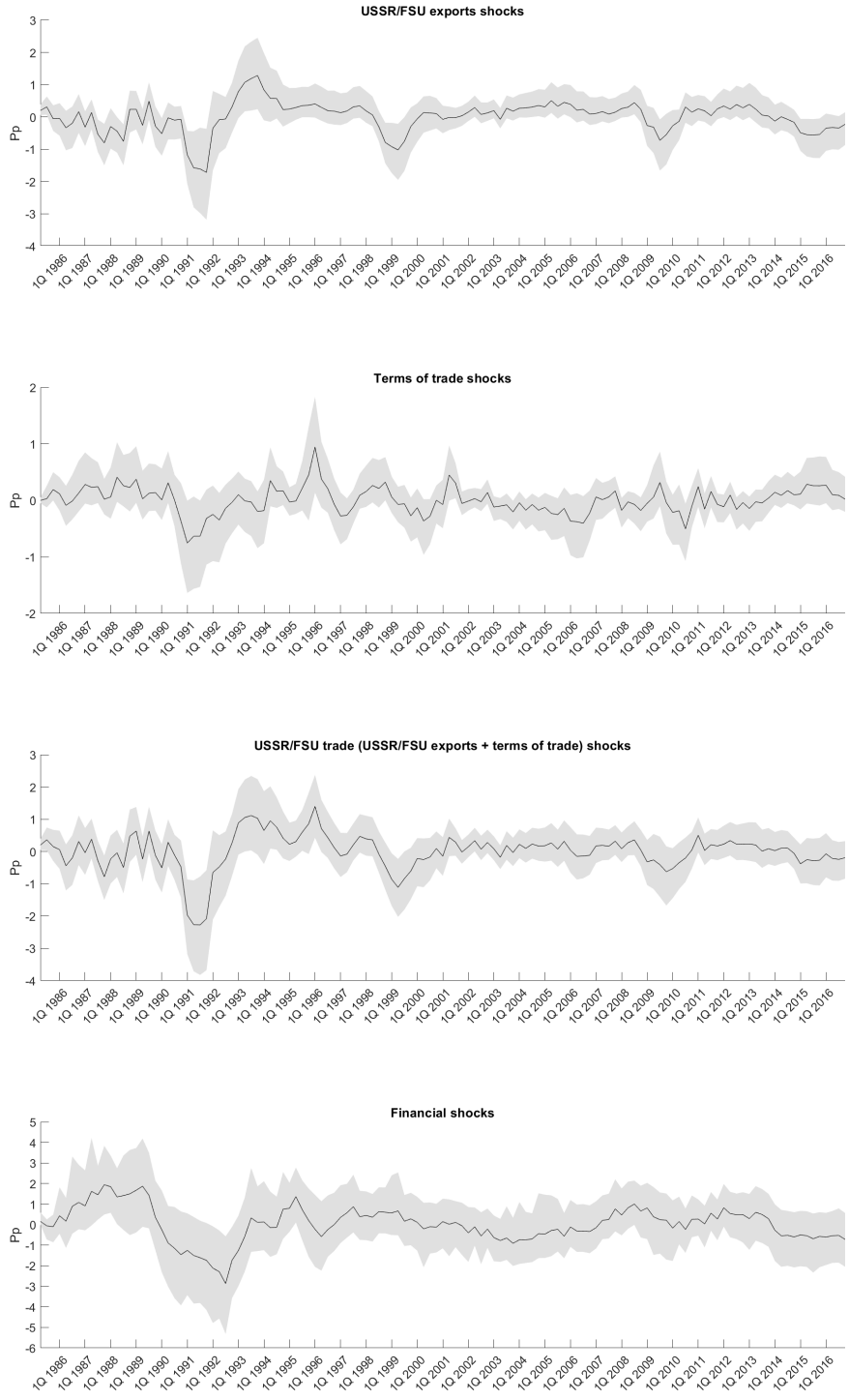

Figure 43: Historical decomposition of the Finnish business cycle. VAR with 1 lag.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

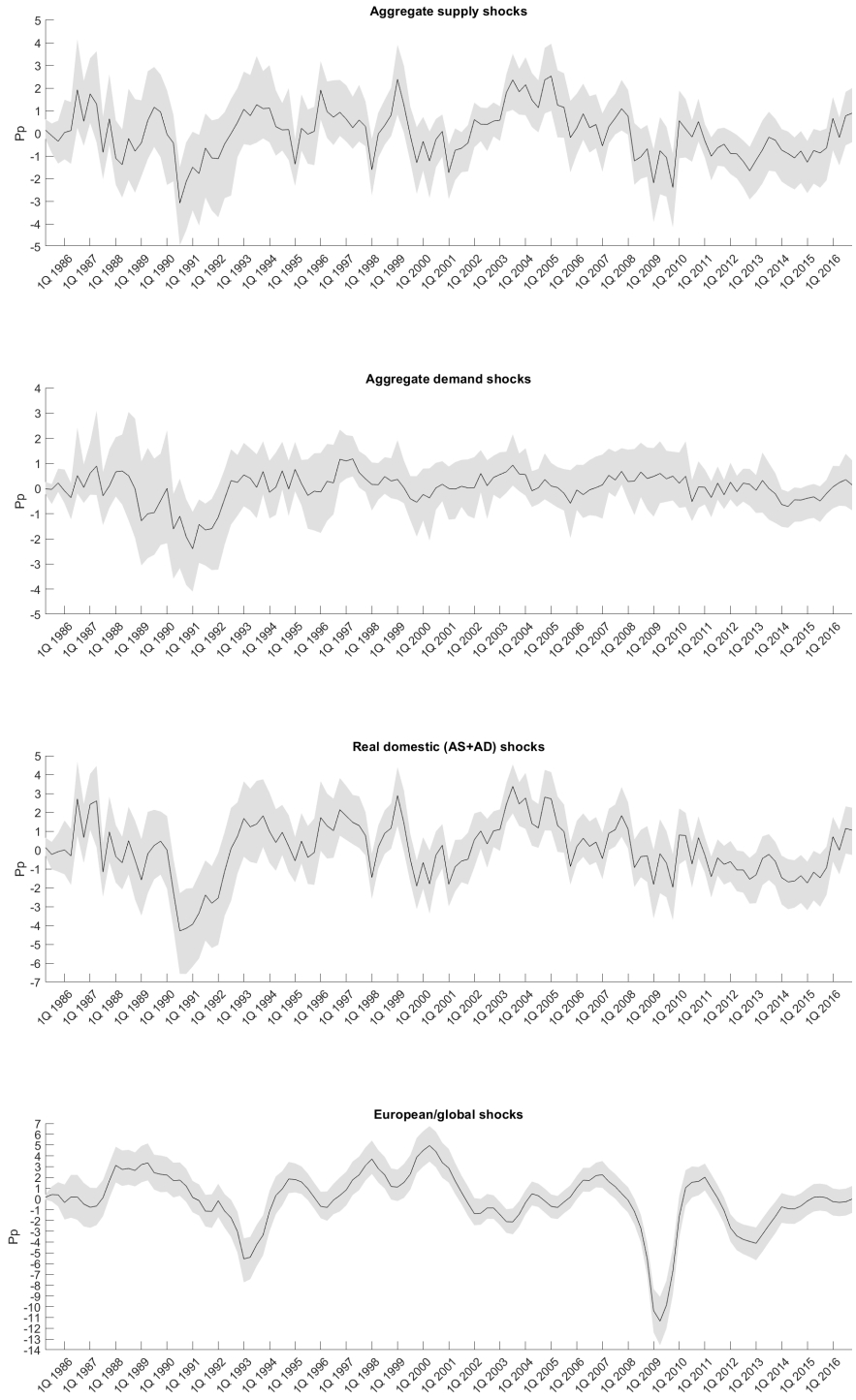

Figure 44: Historical decomposition of the Finnish business cycle (cont.). VAR with 1 lag.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

D.7 VAR with 4 lags

In the benchmark, the choice of VAR lags (2) was based on the indication of the likelihood ratio test and the analysis of residual autocorrelations. Here, we explore a VAR with four lags, given the indications of the Akaike Information Criterion.

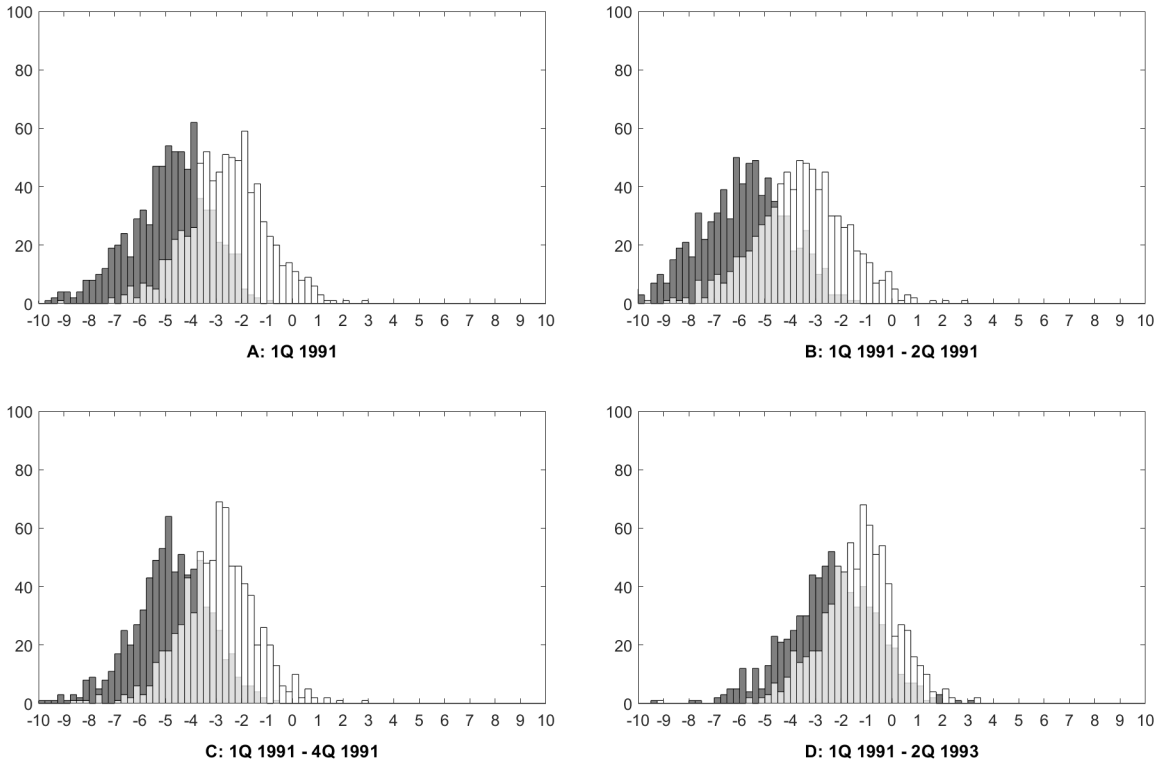

Figure 45: Distribution of the GDP loss due to the Soviet trade shock, with financial propagation (gray) and without (white). VAR with 4 lags.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D).

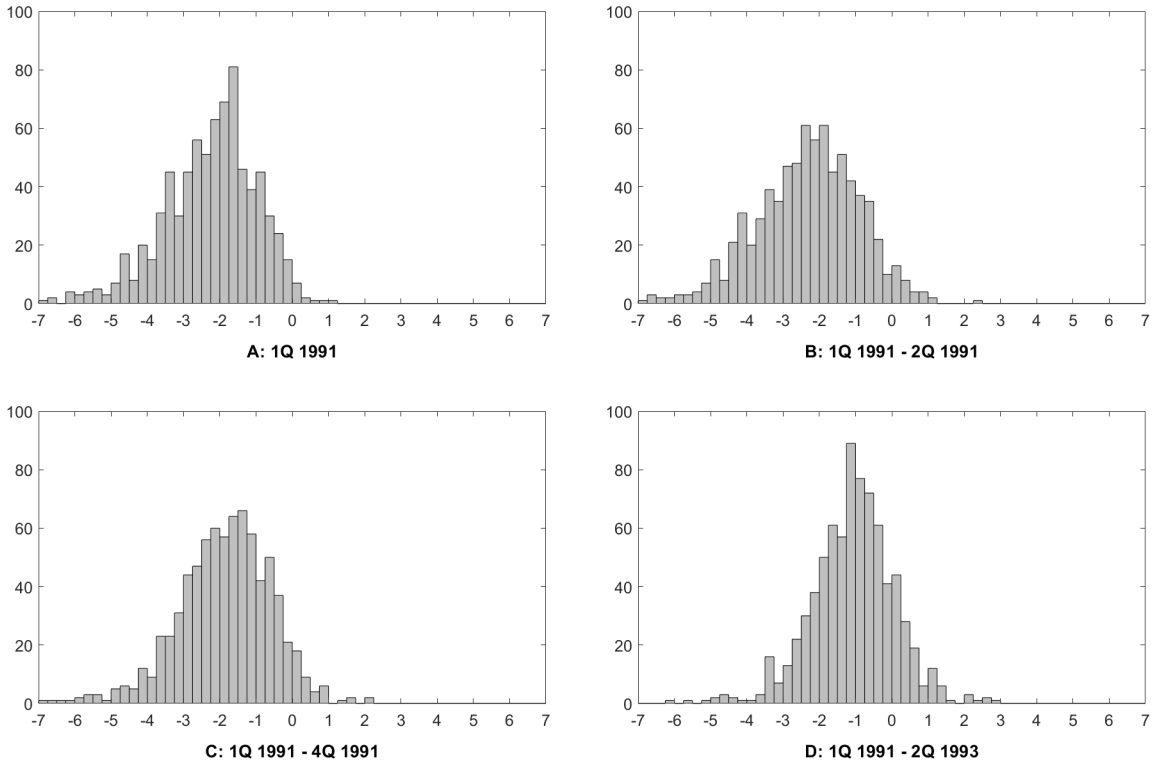

Figure 46: Distribution of cumulative GDP loss due to financial propagation of the Soviet trade shock. VAR with 4 lags.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D). The effect of the propagation is the difference between the actual GDP loss and the GDP loss when the financial channel is shut down.

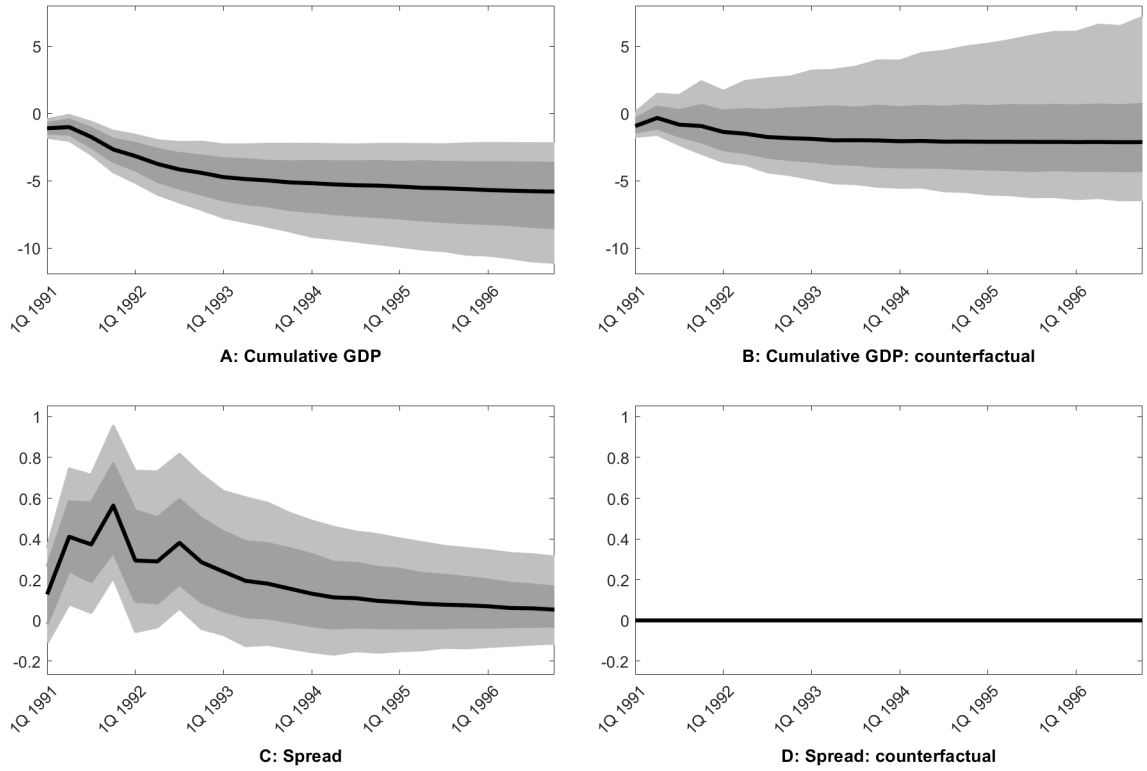

Figure 47: Impulse responses of cumulative GDP and the spread following the Soviet shock in 1Q 1991. VAR with 4 lags.

Notes: Black line is the period-wise median. Shaded areas indicate the period-wise 90 percent (light gray) and 66 percent (dark gray) impulse responses.

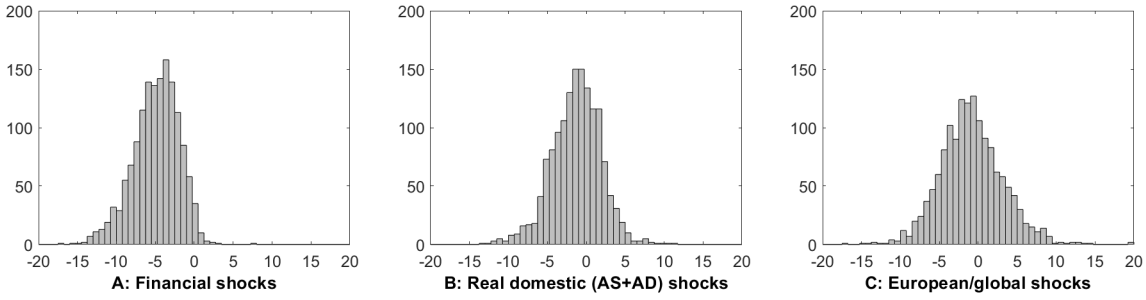

Figure 48: Distribution of cumulative GDP loss due to financial, real, and European/global shocks. VAR with 4 lags.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to financial (panel A), real (B) and European/global shocks (C) occurring from 3Q 1989 to 2Q 1993.

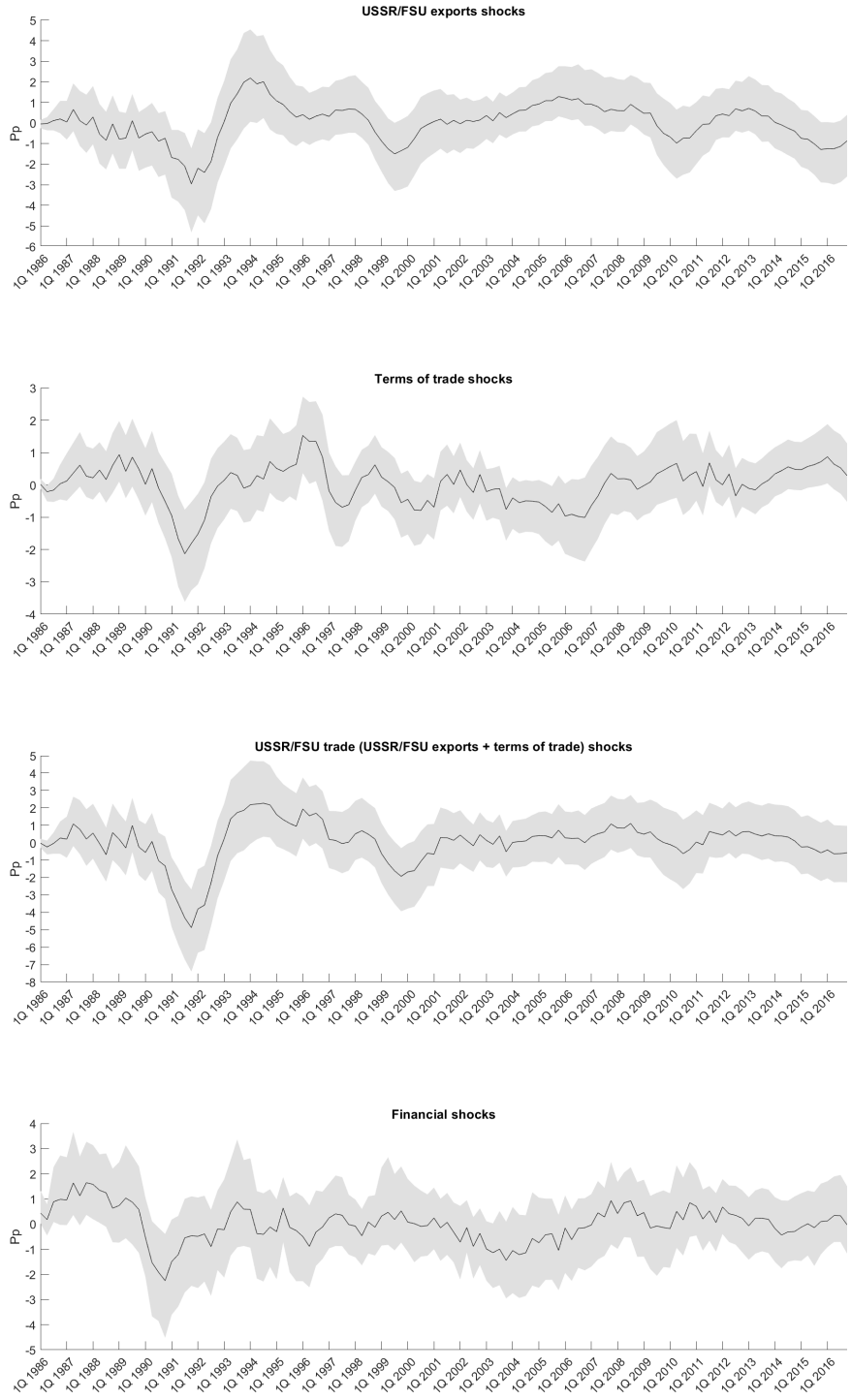

Figure 49: Historical decomposition of the Finnish business cycle. VAR with 4 lags.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

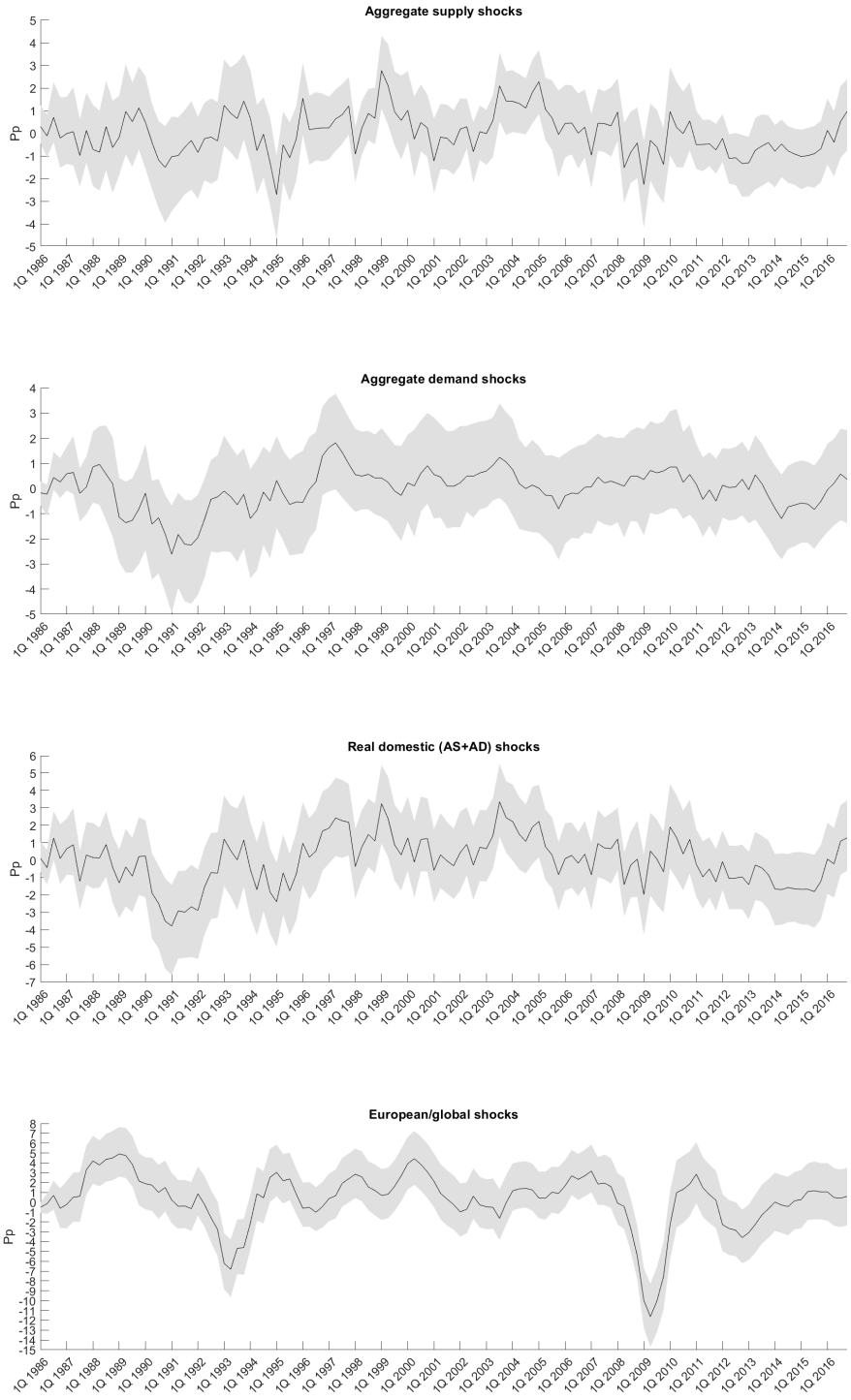

Figure 50: Historical decomposition of the Finnish business cycle (cont.). VAR with 4 lags.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

D.8 VAR with oil

In this robustness check we include global oil prices to the European/global block explicitly. We do so given that Finnish terms of trade (in particular prices of imports) are affected by this variable. Also, both the Soviet Union and its main successors (Russia, Kazakhstan) are major oil exporting countries, whose business cycle and external purchasing power depends largely on the global oil price. Therefore, oil prices may potentially be seen as an omitted variable.

By placing the oil prices in the European/global block we make the assumption that Soviet/FSU-specific shocks do not affect global oil prices. Although this may be seen as a somewhat problematic assumption, it is hard to think of clear cases in which the Soviet Union/FSU would deliberately manipulate the oil supply or be a source of a major supply shock. Neither the USSR, Russia or Kazakhstan have been members of the OPEC. Prime examples of major oil supply shocks studied in the literature are all related to events in the Persian Gulf (see, e.g. Hamilton (2003); Kilian (2008)). Minor disturbances coming from the USSR and Russia are mentioned in Cavallo and Wu (2012) (the Chernobyl disaster and production disruptions in August 1998), but they are detectible in the oil price series of daily or at most weekly frequency, but not quarterly. Caldara et al. (2019) mention production decline in May 1992 due to disintegration of the Soviet Union, which were, however, anticipated. This also doesn't seem to have pushed world oil prices significantly. In fact, following the operation Desert Storm, global oil prices witness a substantial decline.

Finally, putting the oil prices in the USSR/Soviet block would be more problematic because it would amount to assuming that global oil prices do not affect Europe or the rest of the world.

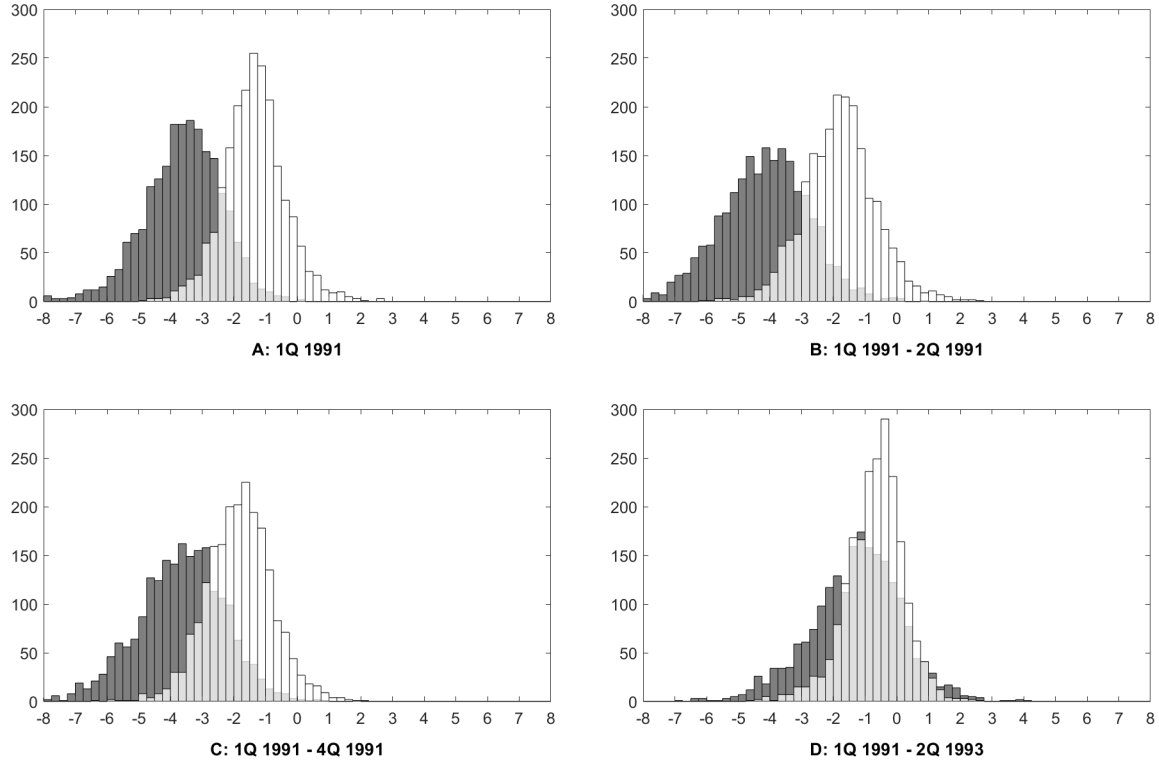

Figure 51: Distribution of the GDP loss due to the Soviet trade shock, with financial propagation (gray) and without (white). VAR with oil.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D).

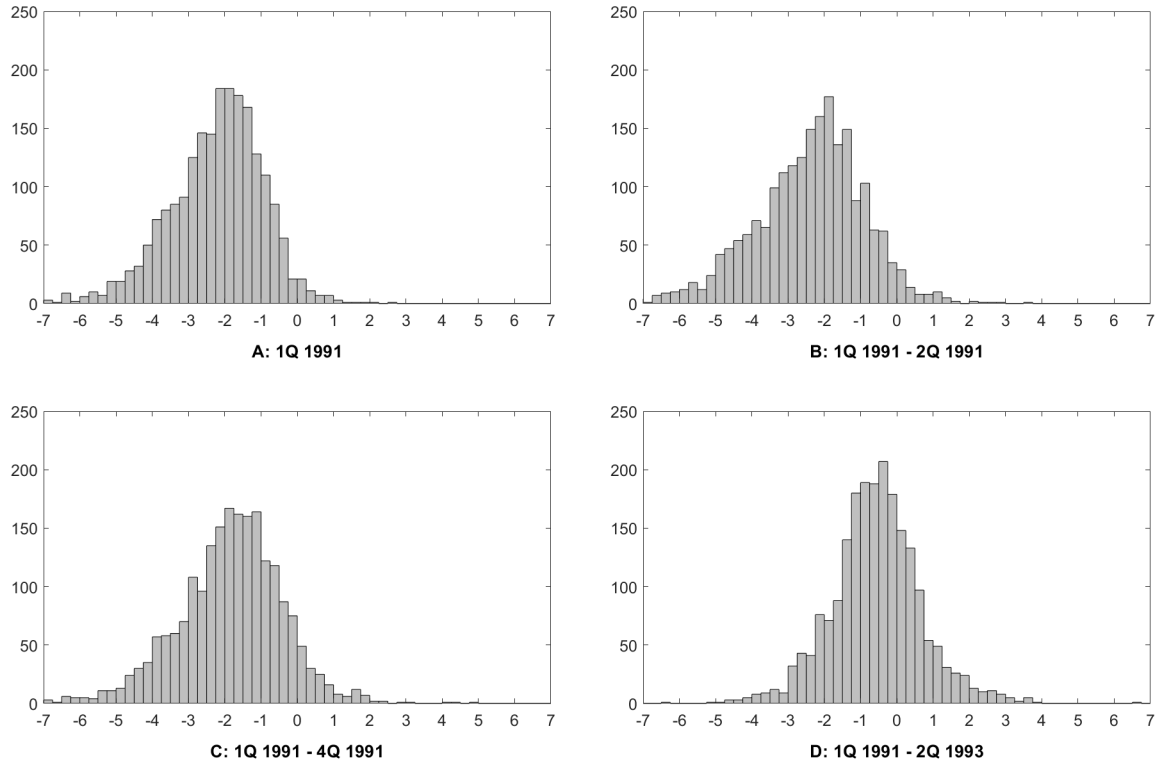

Figure 52: Distribution of cumulative GDP loss due to financial propagation of the Soviet trade shock. VAR with oil.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D). The effect of the propagation is the difference between the actual GDP loss and the GDP loss when the financial channel is shut down.

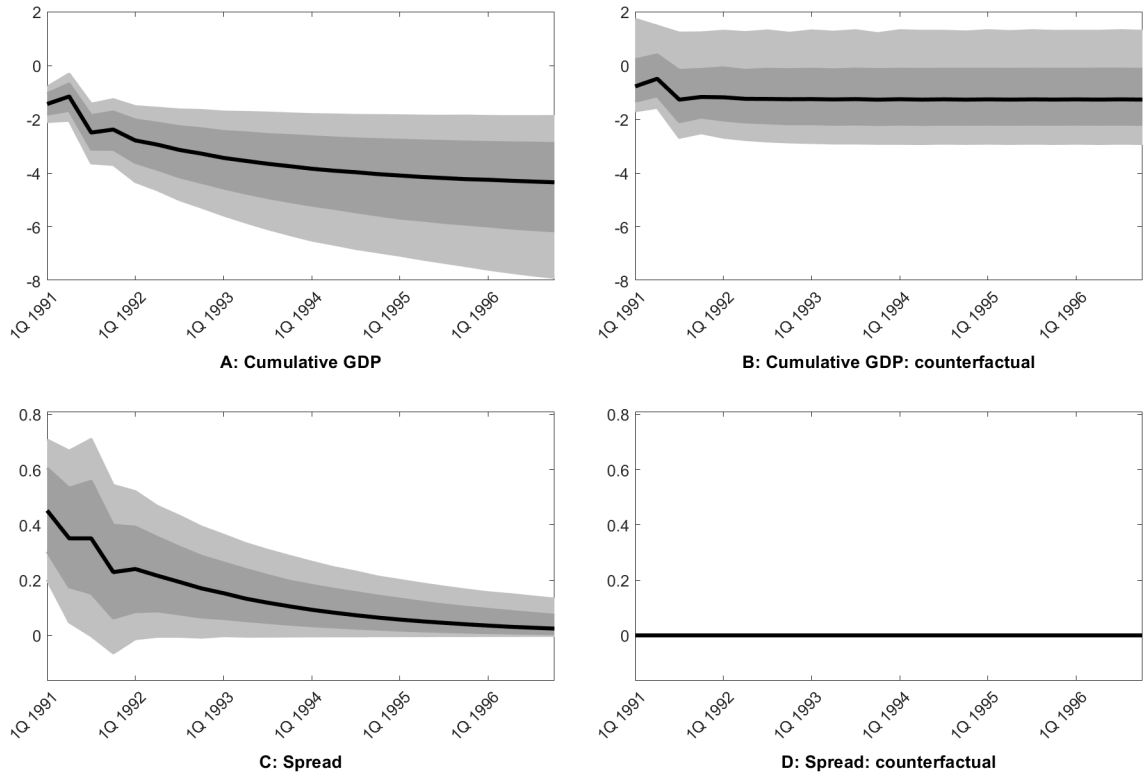

Figure 53: Impulse responses of cumulative GDP and the spread following the Soviet shock in 1Q 1991. VAR with oil.

Notes: Black line is the period-wise median. Shaded areas indicate the period-wise 90 percent (light gray) and 66 percent (dark gray) impulse responses.

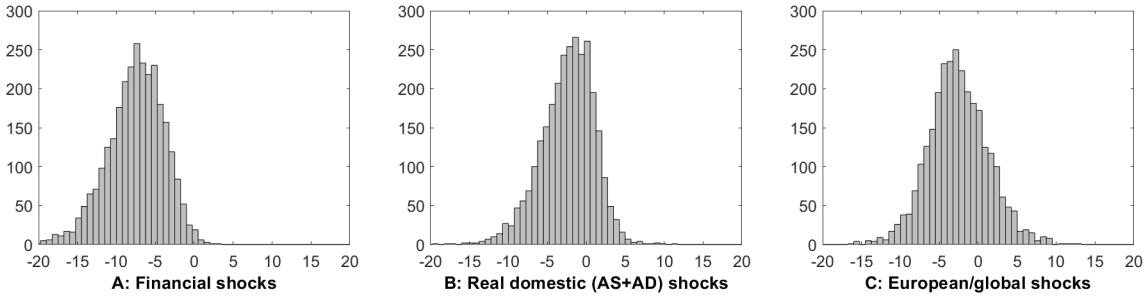

Figure 54: Distribution of cumulative GDP loss due to financial, real, and European/global shocks. VAR with oil.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to financial (panel A), real (B) and European/global shocks (C) occurring from 3Q 1989 to 2Q 1993.

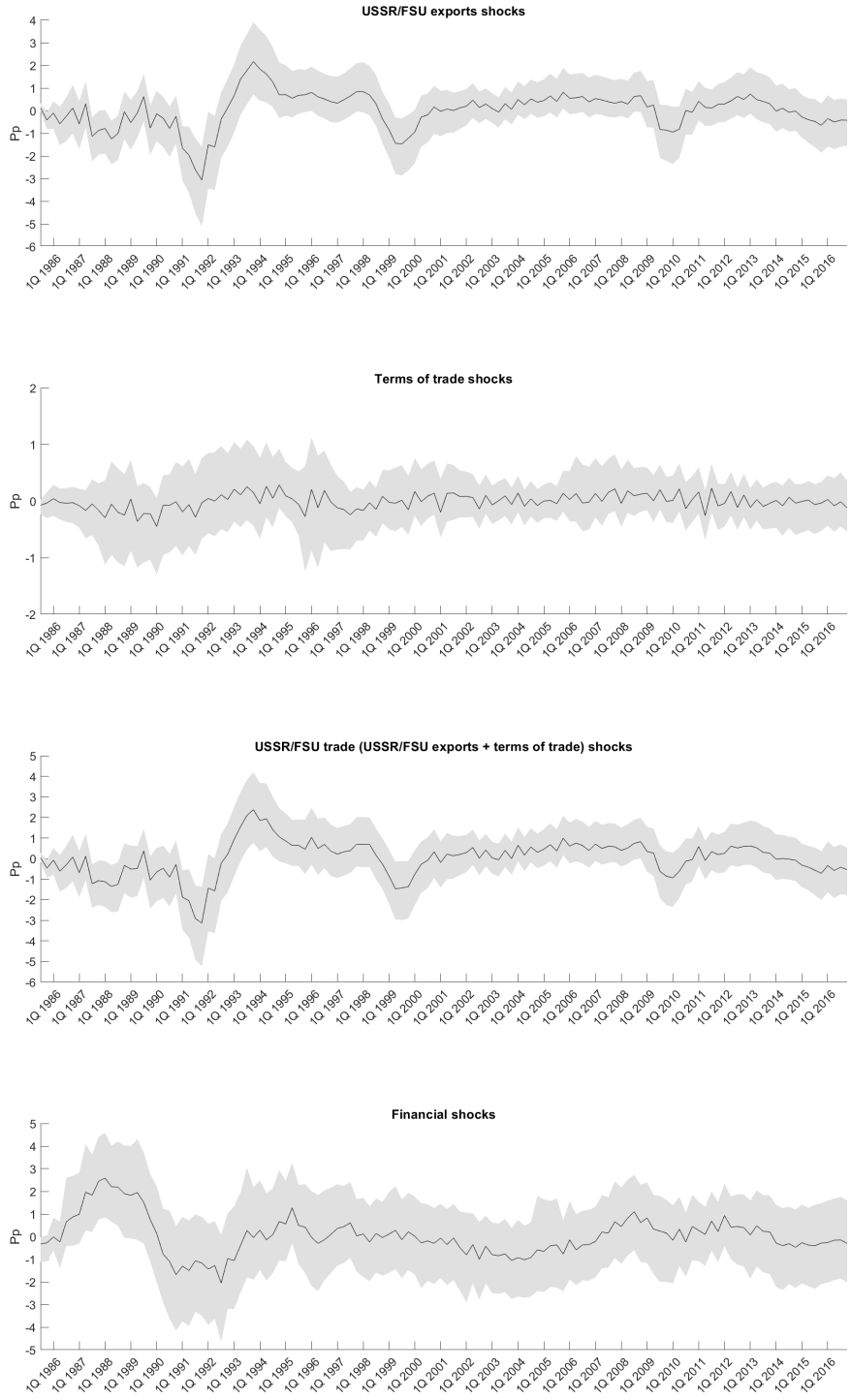

Figure 55: Historical decomposition of the Finnish business cycle. VAR with oil.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

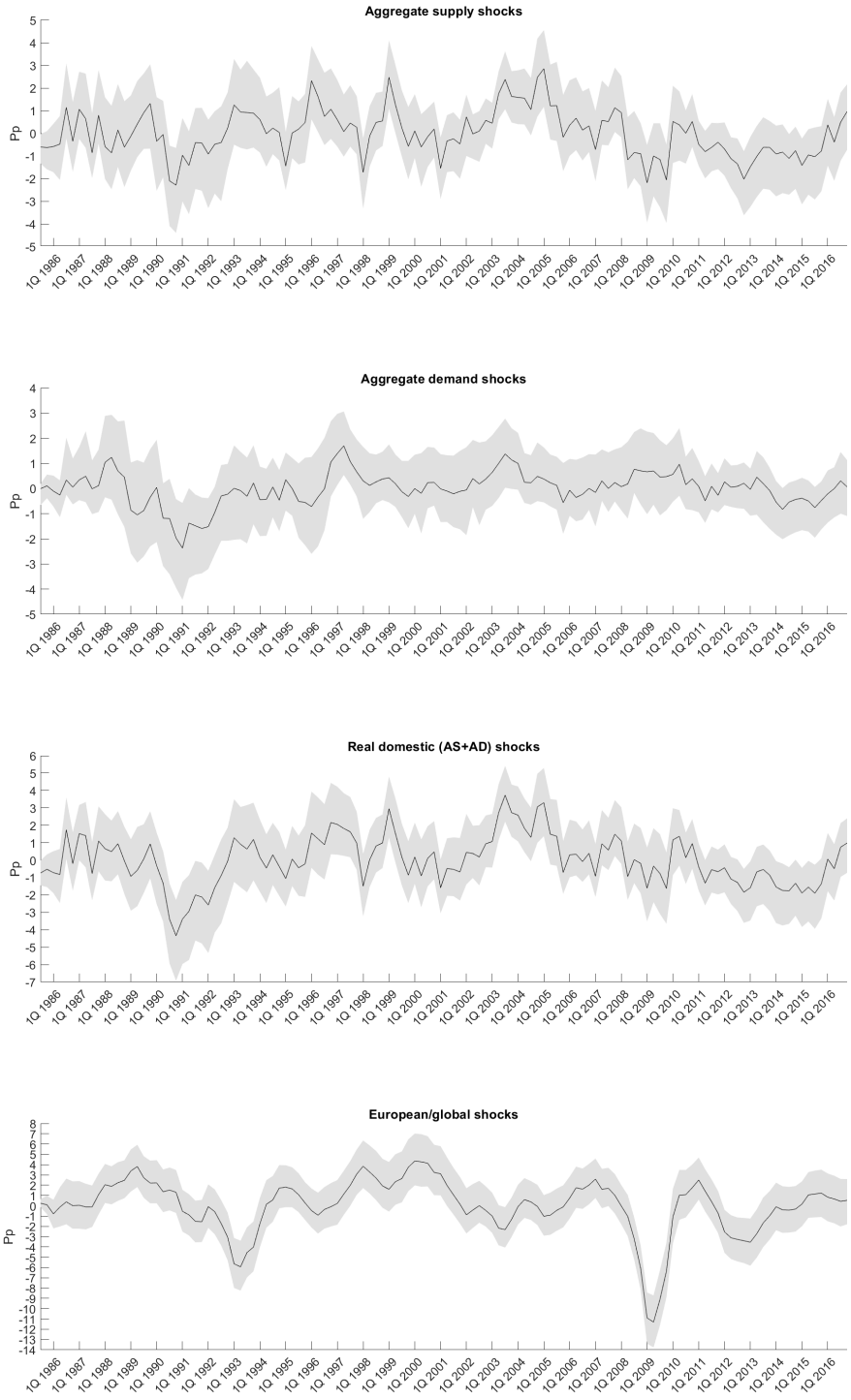

Figure 56: Historical decomposition of the Finnish business cycle (cont.). VAR with oil.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

D.9 VAR with financial stress

In this robustness check we explore the role of financial stress indicator as a potentially omitted variable. A financial stress indicator can potentially capture the impact and transmission of global financial shocks (unrelated to the global real shocks) to the Finnish economy. We use the CLIFS (Country-Level Index of Financial Stress) for Germany, France and the UK (details given in A) for two main reasons. First, it is one of very few indices that are available for our whole sample (and for the 1980s). Secondly, it reflects the potentially reflects the factors relevant for Finland better than, e.g. the widely used (and U.S. data-based) VIX and VXO indices. For example the Exchange Rate Mechanism Crisis of 1992 is well visible in CLIFS but not in VIX/VXO.

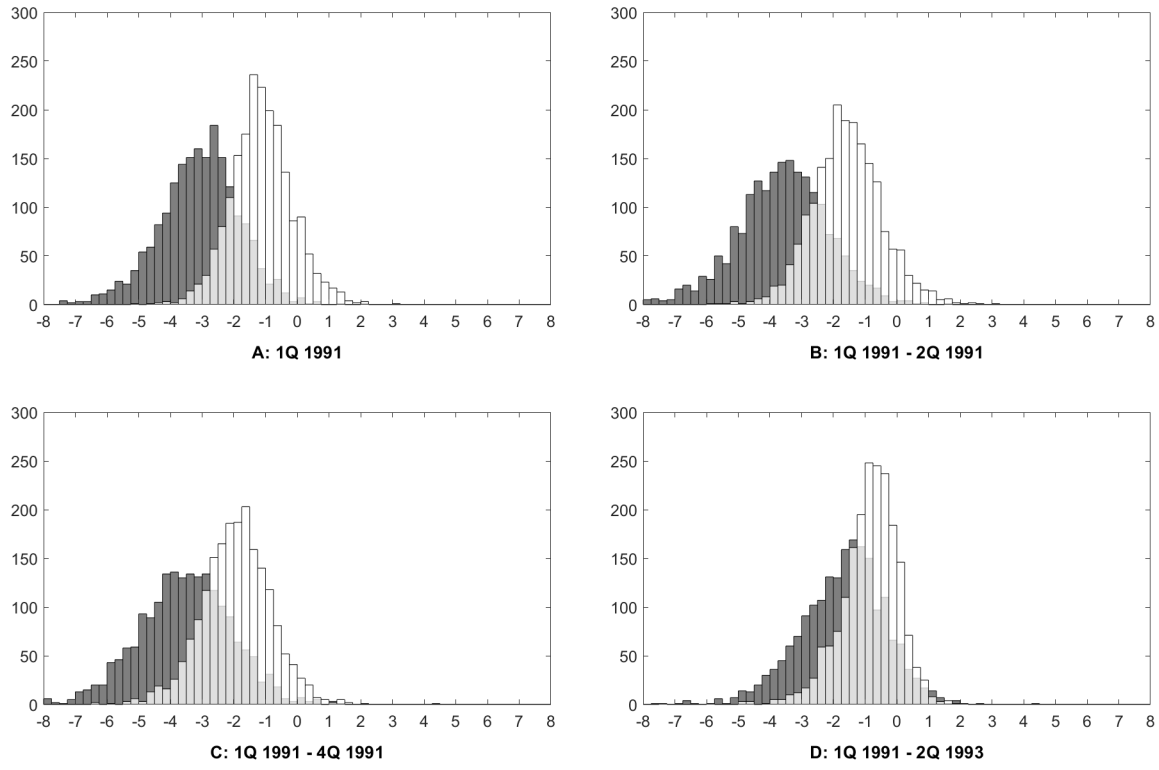

Figure 57: Distribution of the GDP loss due to the Soviet trade shock, with financial propagation (gray) and without (white). VAR with financial stress.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D).

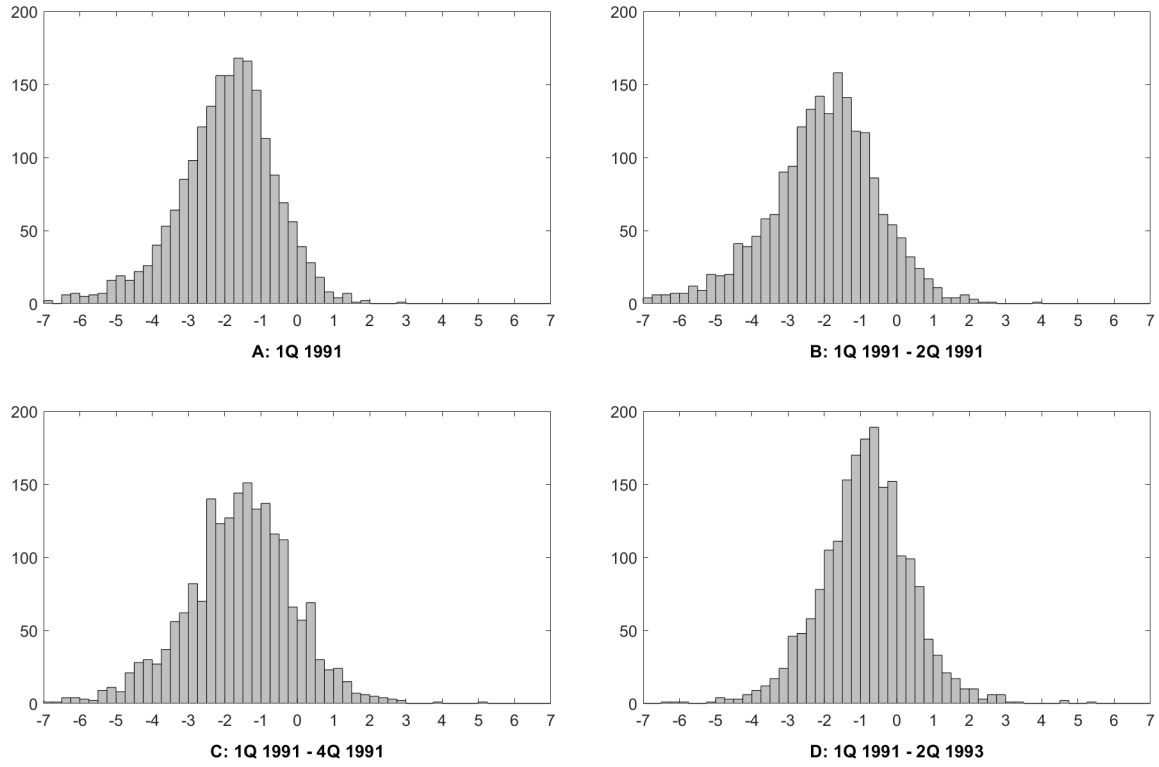

Figure 58: Distribution of cumulative GDP loss due to financial propagation of the Soviet trade shock. VAR with financial stress.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D). The effect of the propagation is the difference between the actual GDP loss and the GDP loss when the financial channel is shut down.

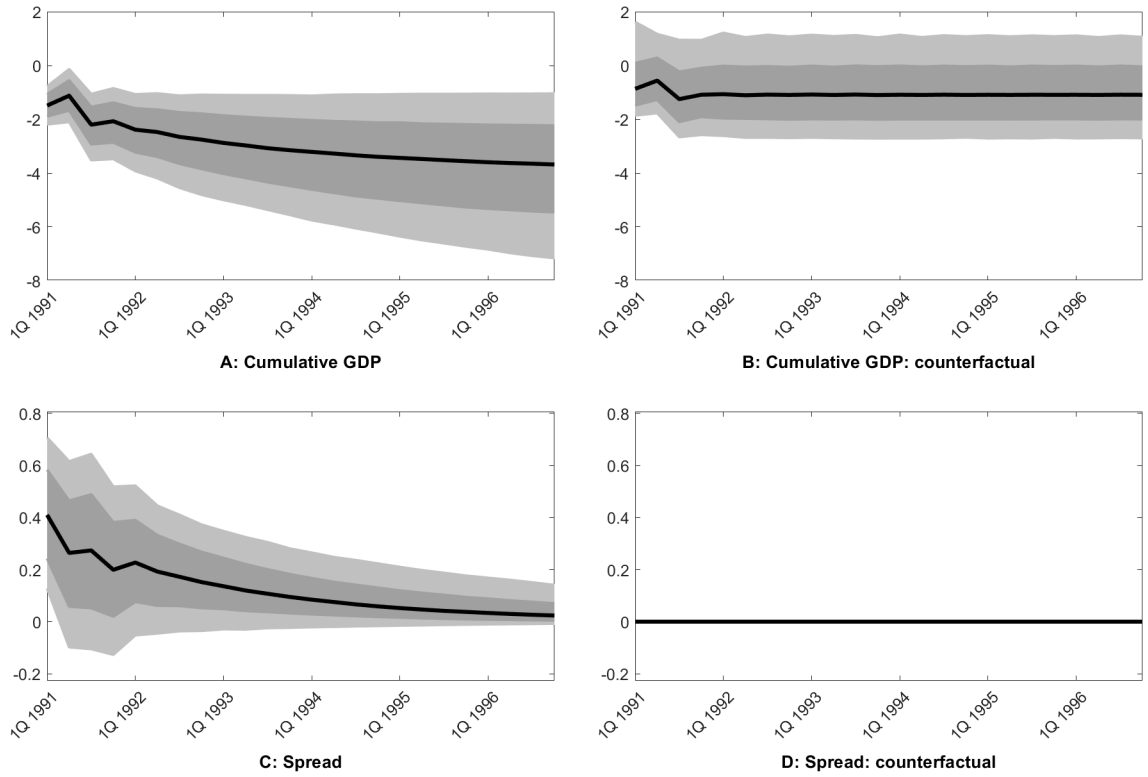

Figure 59: Impulse responses of cumulative GDP and the spread following the Soviet shock in 1Q 1991. VAR with financial stress.

Notes: Black line is the period-wise median. Shaded areas indicate the period-wise 90 percent (light gray) and 66 percent (dark gray) impulse responses.

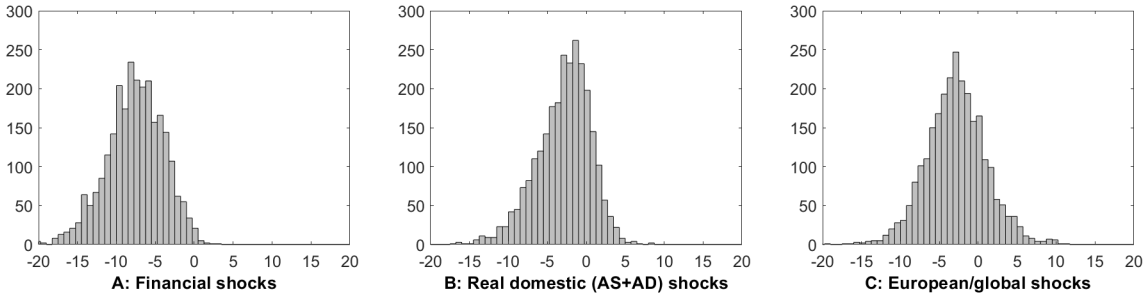

Figure 60: Distribution of cumulative GDP loss due to financial, real, and European/global shocks. VAR with financial stress.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to financial (panel A), real (B) and European/global shocks (C) occurring from 3Q 1989 to 2Q 1993.

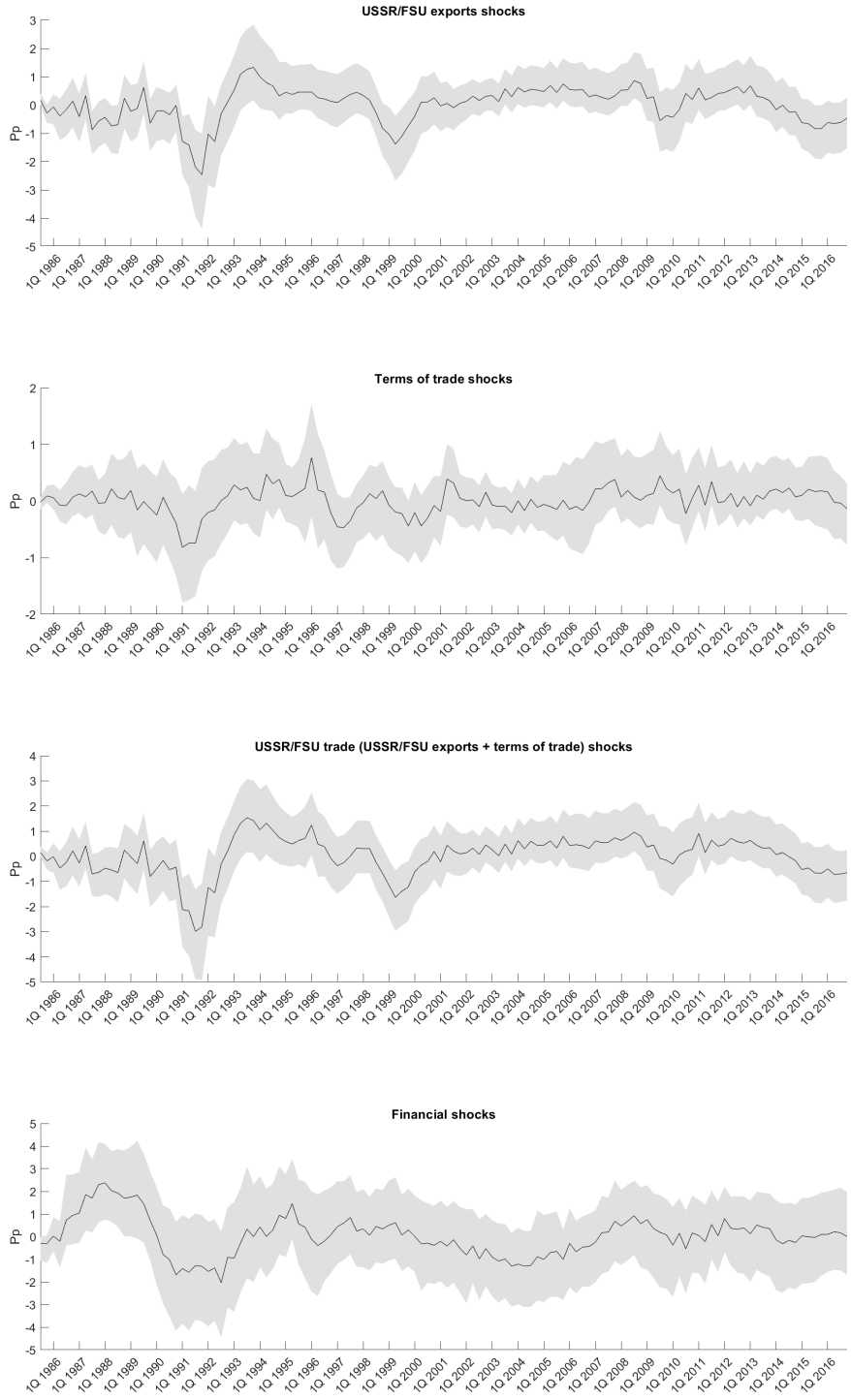

Figure 61: Historical decomposition of the Finnish business cycle. VAR with financial stress.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

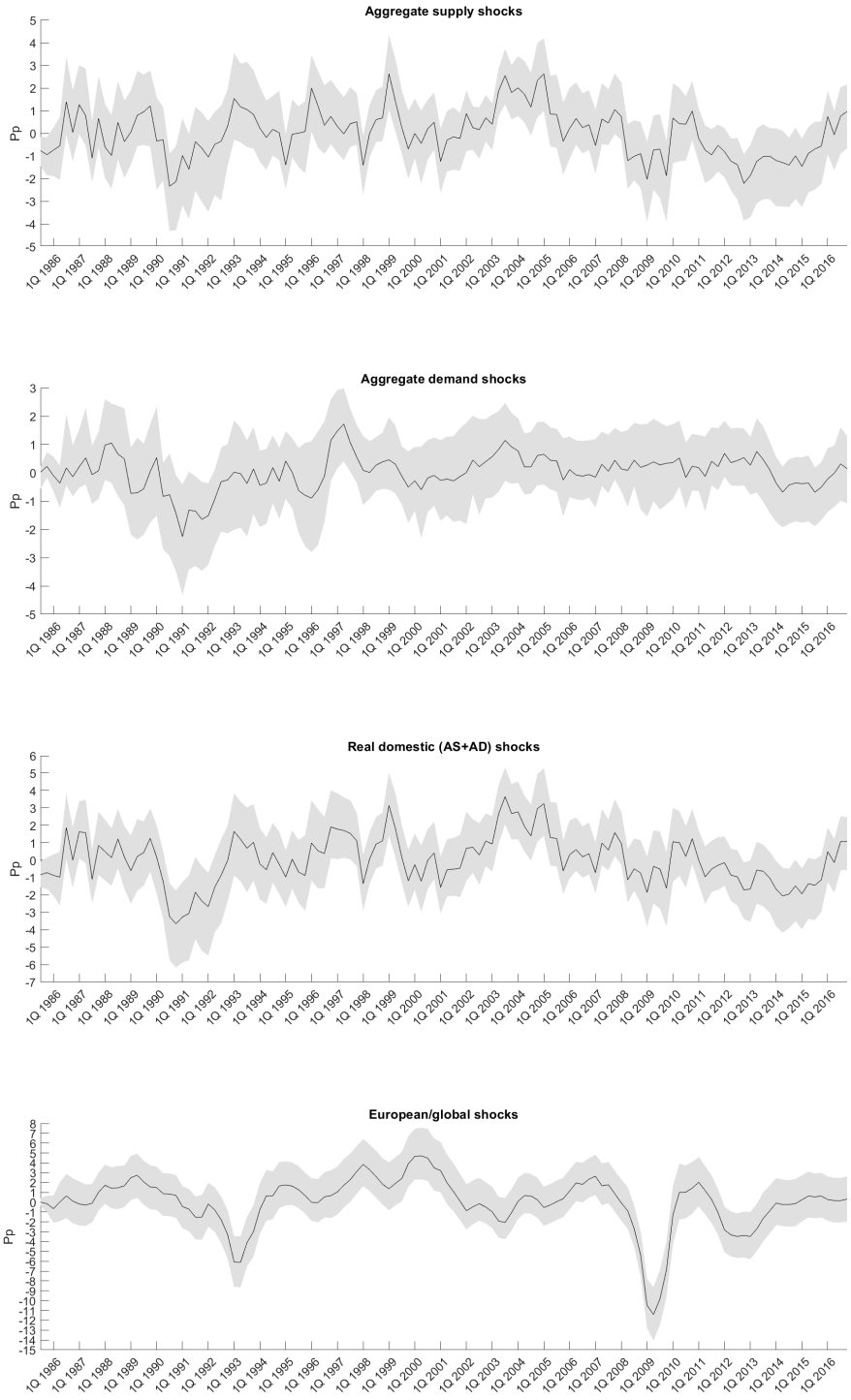

Figure 62: Historical decomposition of the Finnish business cycle (cont.). VAR with financial stress.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

D.10 European/global block with real interest rate

In this robustness check we replace the euro area nominal interest rate and the price deflator with a measure of the *ex ante* real interest rate

$$r_t = i_t - E_t\pi_{t+1}$$

where the interest rates indexed with t are those valid between t and $t+1$. We define the inflation expectations simply as the last-period actual inflation (i.e. inflation between $t-1$ and t):

$$E_t\pi_{t+1} = \pi_t$$

The motivation for this check is two-fold. First, the traditional open economy literature postulates that the two main channels through which the small open economy is affected are fluctuations in intra- and inter-temporal international prices. For the first, the proxy are the terms of trade. For the inter-temporal prices, the natural proxy is the real world interest rate. The second motivation for the robustness is to insure against the possibility that the European monetary policy rule might have evolved over time, hence possibly changing the interaction terms between the nominal policy rate and the inflation rate. Arguably, the real interest rate should be more immune to this issue.

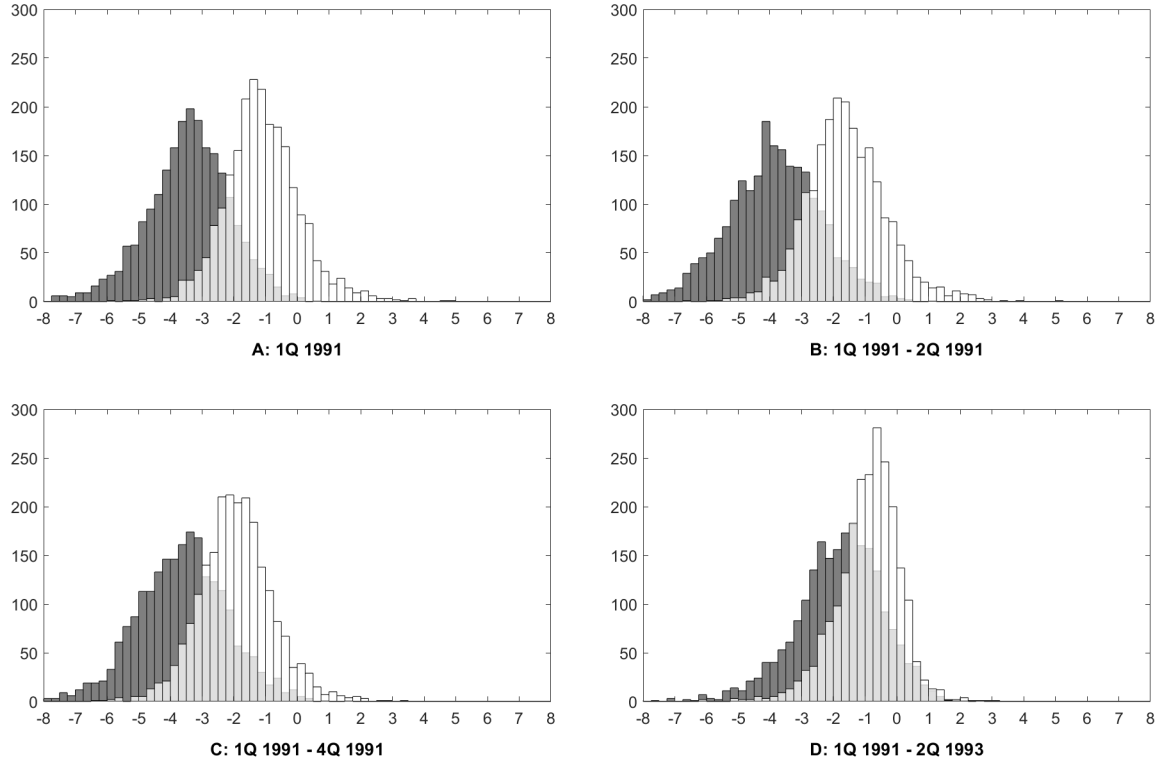

Figure 63: Distribution of the GDP loss due to the Soviet trade shock, with financial propagation (gray) and without (white). European/global block with real interest rate.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D).

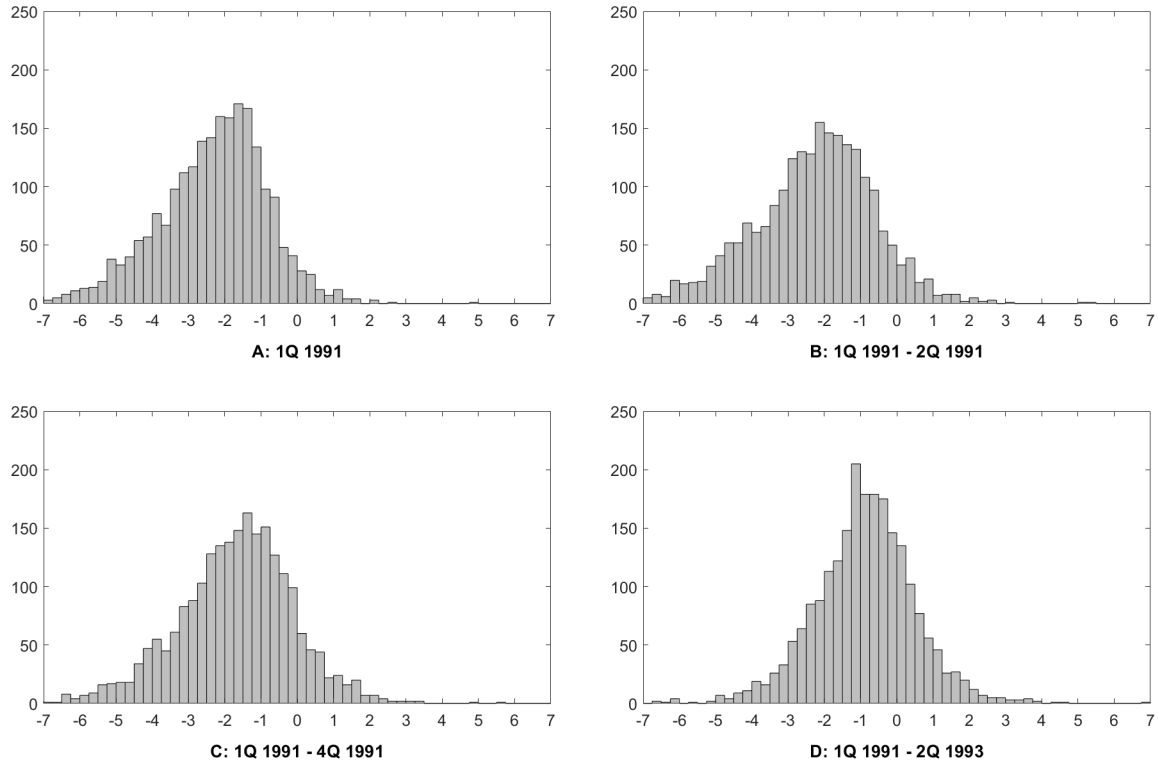

Figure 64: Distribution of cumulative GDP loss due to financial propagation of the Soviet trade shock. European/global block with real interest rate.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D). The effect of the propagation is the difference between the actual GDP loss and the GDP loss when the financial channel is shut down.

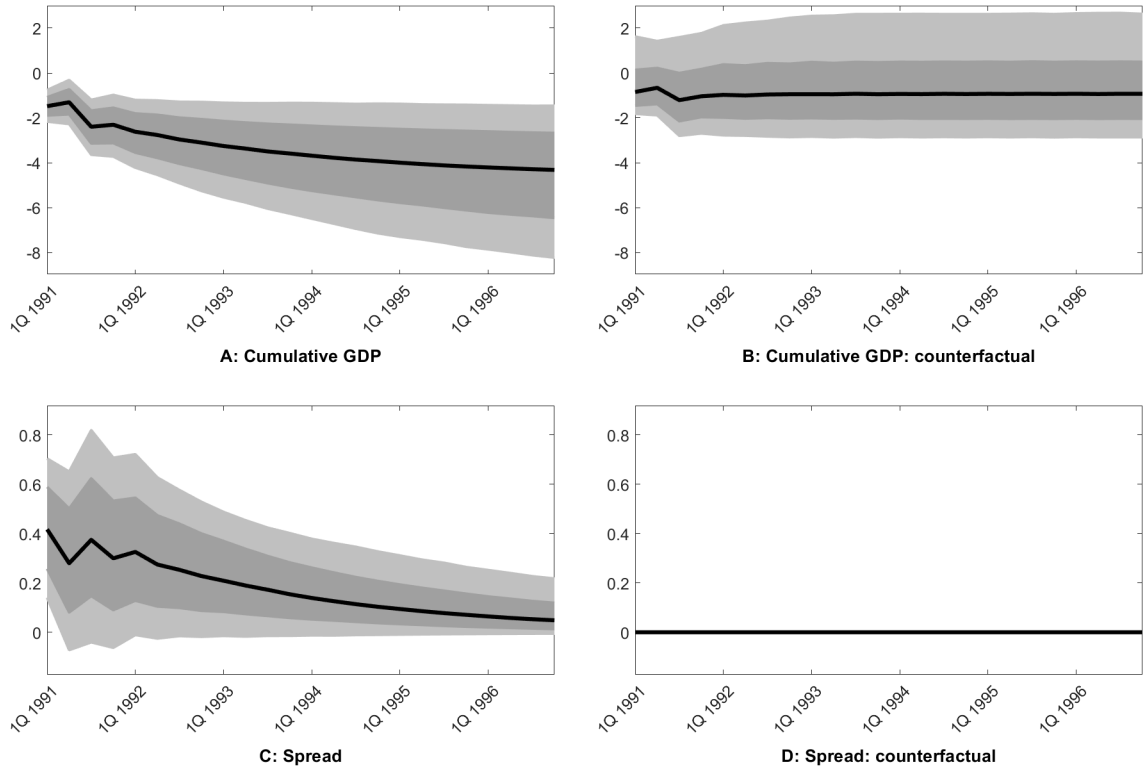

Figure 65: Impulse responses of cumulative GDP and the spread following the Soviet shock in 1Q 1991. European/global block with real interest rate.

Notes: Black line is the period-wise median. Shaded areas indicate the period-wise 90 percent (light gray) and 66 percent (dark gray) impulse responses.

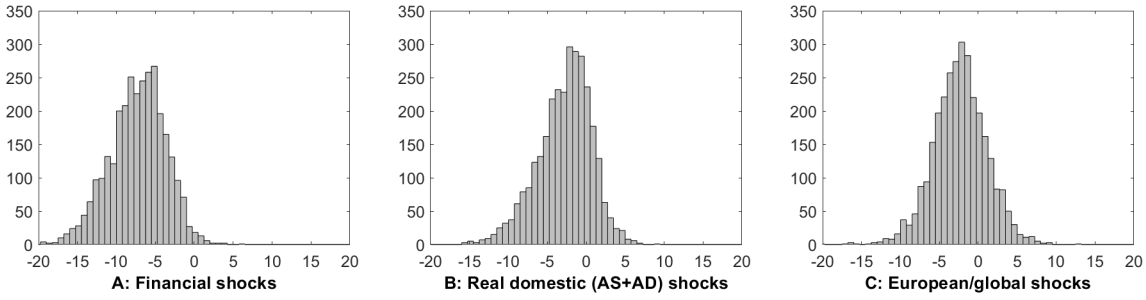

Figure 66: Distribution of cumulative GDP loss due to financial, real, and European/global shocks. European/global block with real interest rate.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to financial (panel A), real (B) and European/global shocks (C) occurring from 3Q 1989 to 2Q 1993.

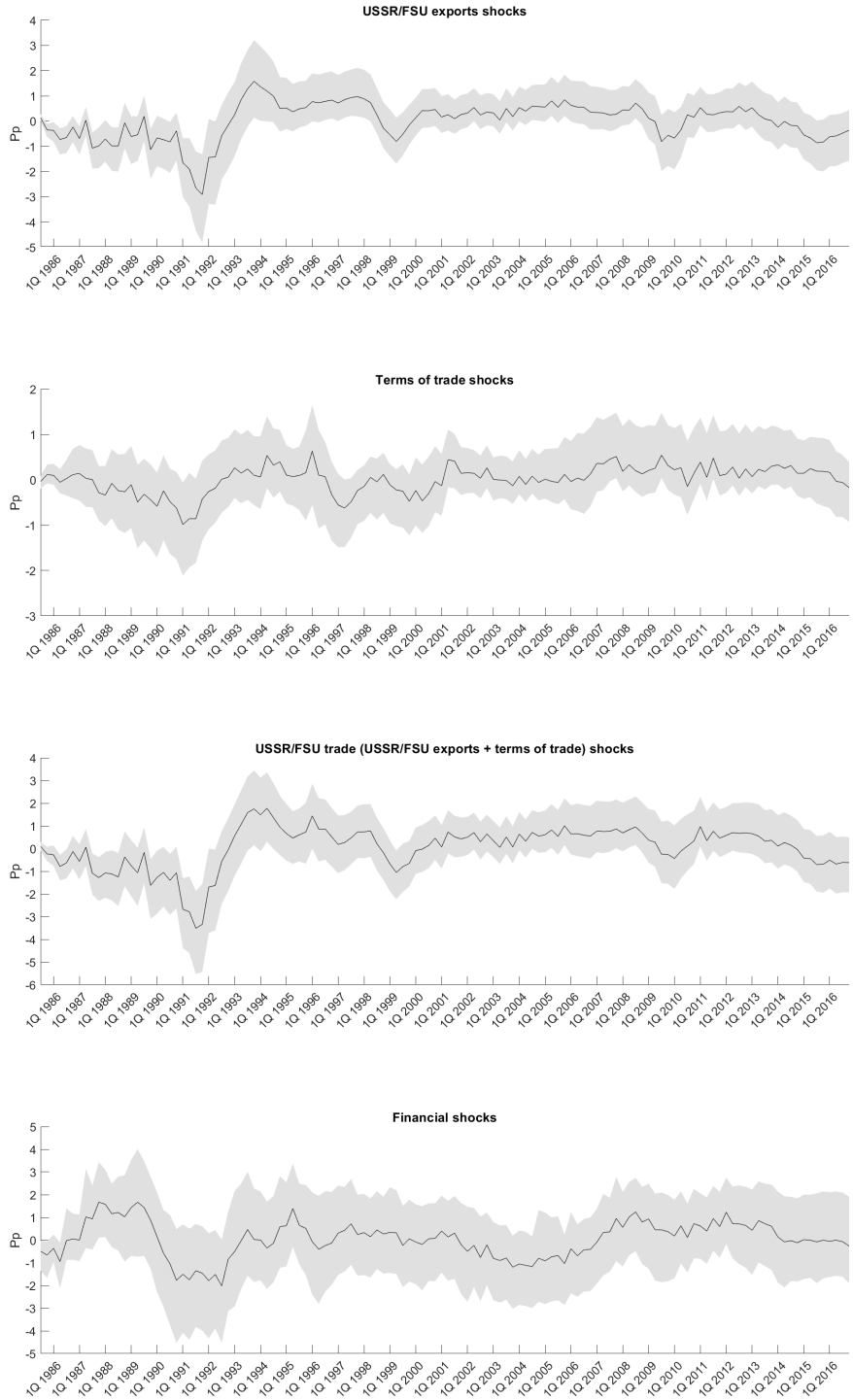

Figure 67: Historical decomposition of the Finnish business cycle. European/global block with real interest rate.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

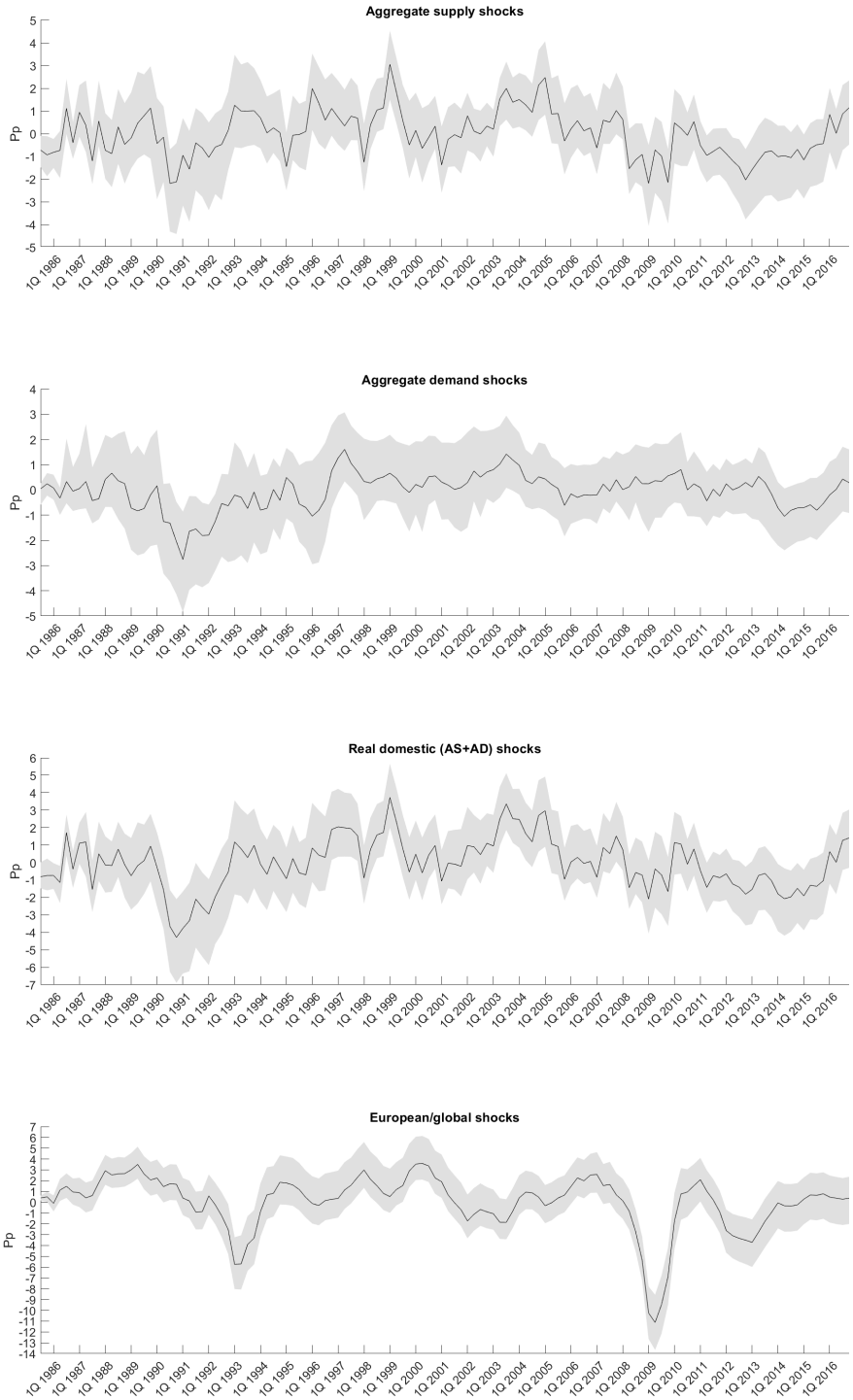

Figure 68: Historical decomposition of the Finnish business cycle (cont.). European/global block with real interest rate.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

D.11 Finnish exports to the USSR/FSU instrumented by Hungarian exports to the USSR/FSU and total USSR/FSU imports

In this robustness check we address the concern that Finnish exports to the USSR/FSU might be partly endogenous to Finland, despite the arguments provided in the main text. To this end, we construct the following instrument for Finnish exports to the USSR/FSU.

In the first step, we regress the (growth rate of the) actual Finnish exports of goods to the USSR/FSU on:

- (growth rate of) total USSR/FSU imports
- (growth rate of) Hungarian exports to the USSR/FSU
- Soviet trade dummy, which takes value 1 from the beginning of the sample until 4Q 1990, zero from 1Q 1991 onwards
- Soviet trade collapse dummy, which takes value 1 for 1Q 1991, zero otherwise
- a constant

In the second step, we use the predicted value of this regression in the VAR, instead of the Finnish exports itself. The choice of these regressors is discussed in Footnote 6 of the main text.

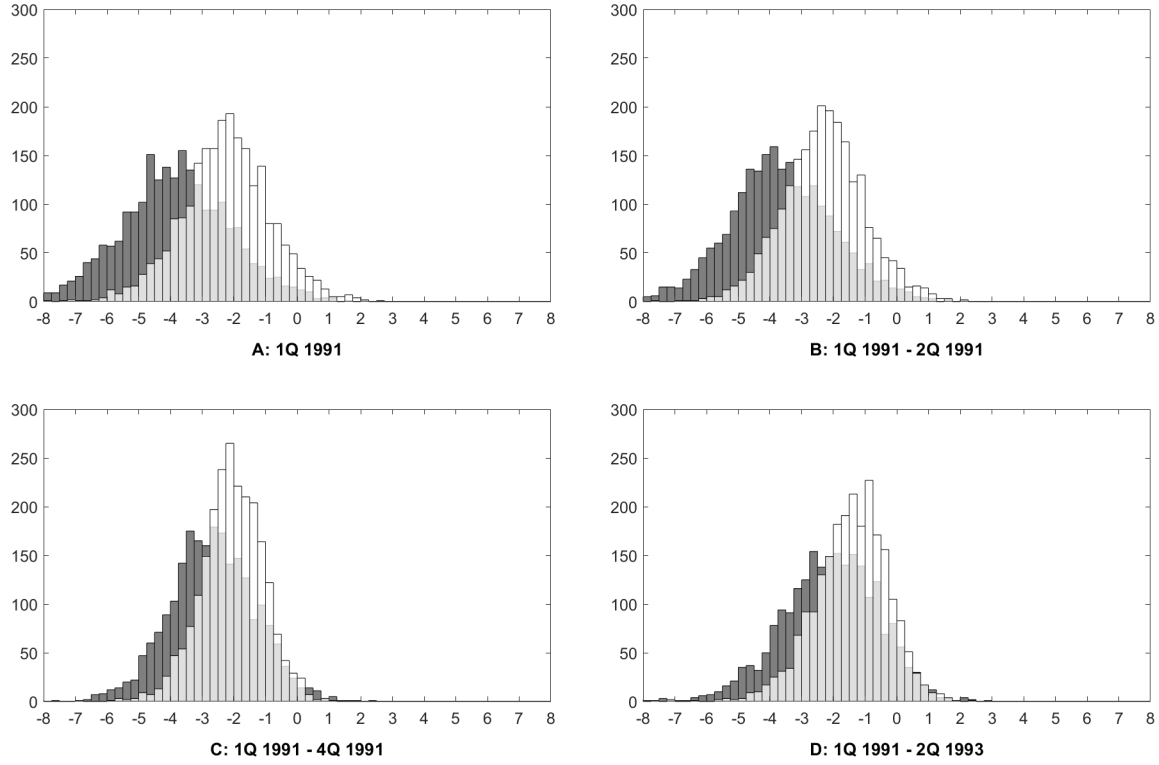

Figure 69: Distribution of the GDP loss due to the Soviet trade shock, with financial propagation (gray) and without (white). Finnish exports to the USSR/FSU instrumented.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D).

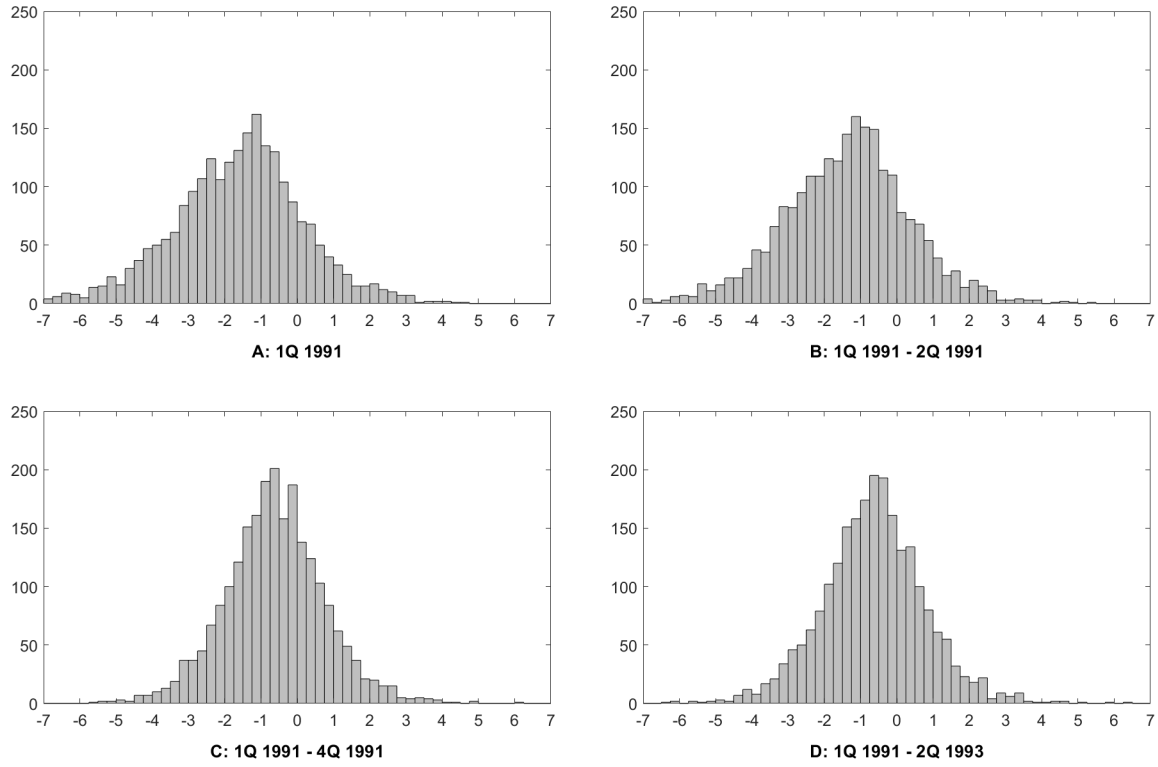

Figure 70: Distribution of cumulative GDP loss due to financial propagation of the Soviet trade shock. Finnish exports to the USSR/FSU instrumented.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D). The effect of the propagation is the difference between the actual GDP loss and the GDP loss when the financial channel is shut down.

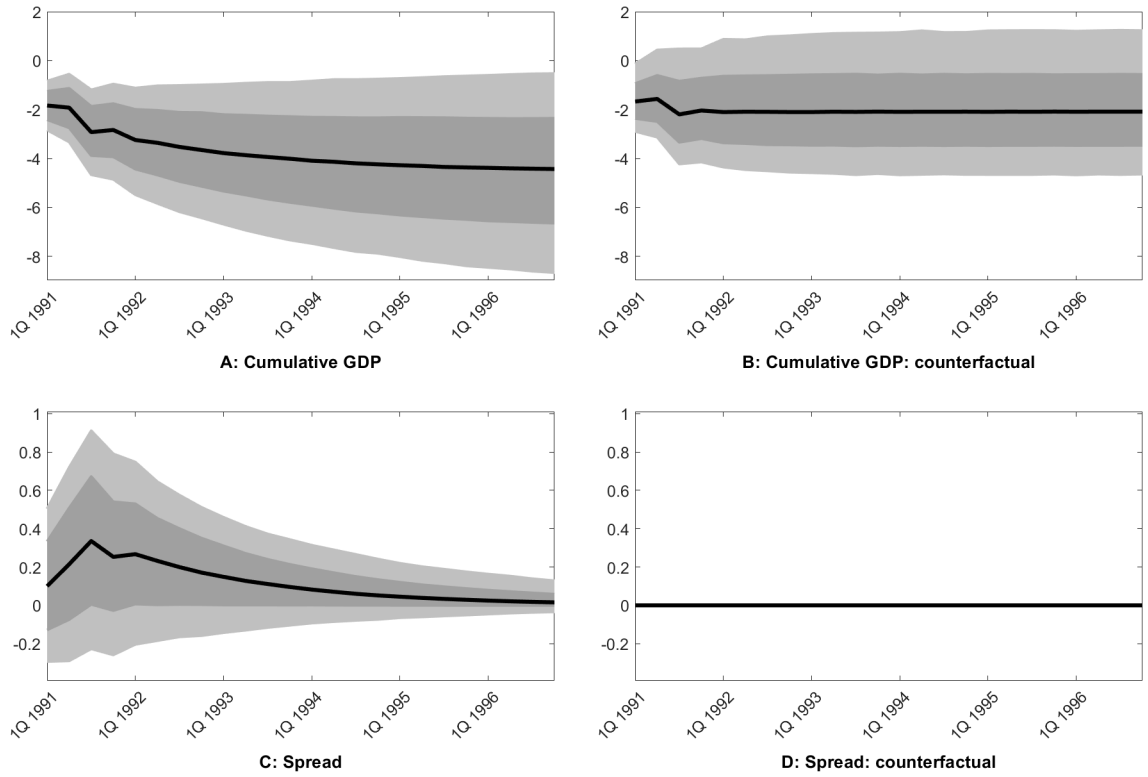

Figure 71: Impulse responses of cumulative GDP and the spread following the Soviet shock in 1Q 1991. Finnish exports to the USSR/FSU instrumented.

Notes: Black line is the period-wise median. Shaded areas indicate the period-wise 90 percent (light gray) and 66 percent (dark gray) impulse responses.

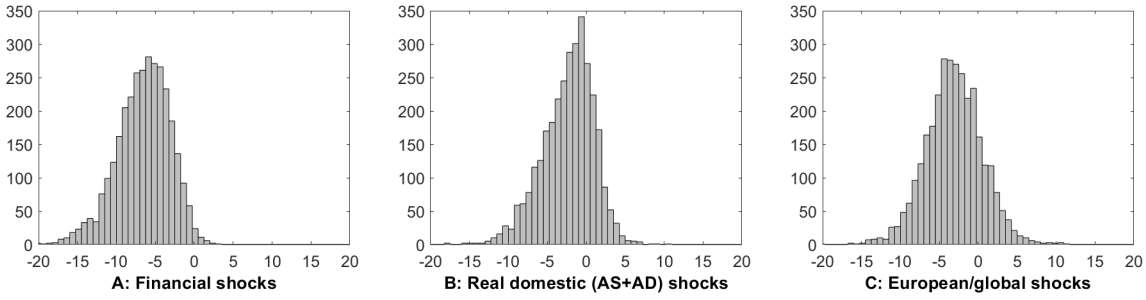

Figure 72: Distribution of cumulative GDP loss due to financial, real, and European/global shocks. Finnish exports to the USSR/FSU instrumented.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to financial (panel A), real (B) and European/global shocks (C) occurring from 3Q 1989 to 2Q 1993.

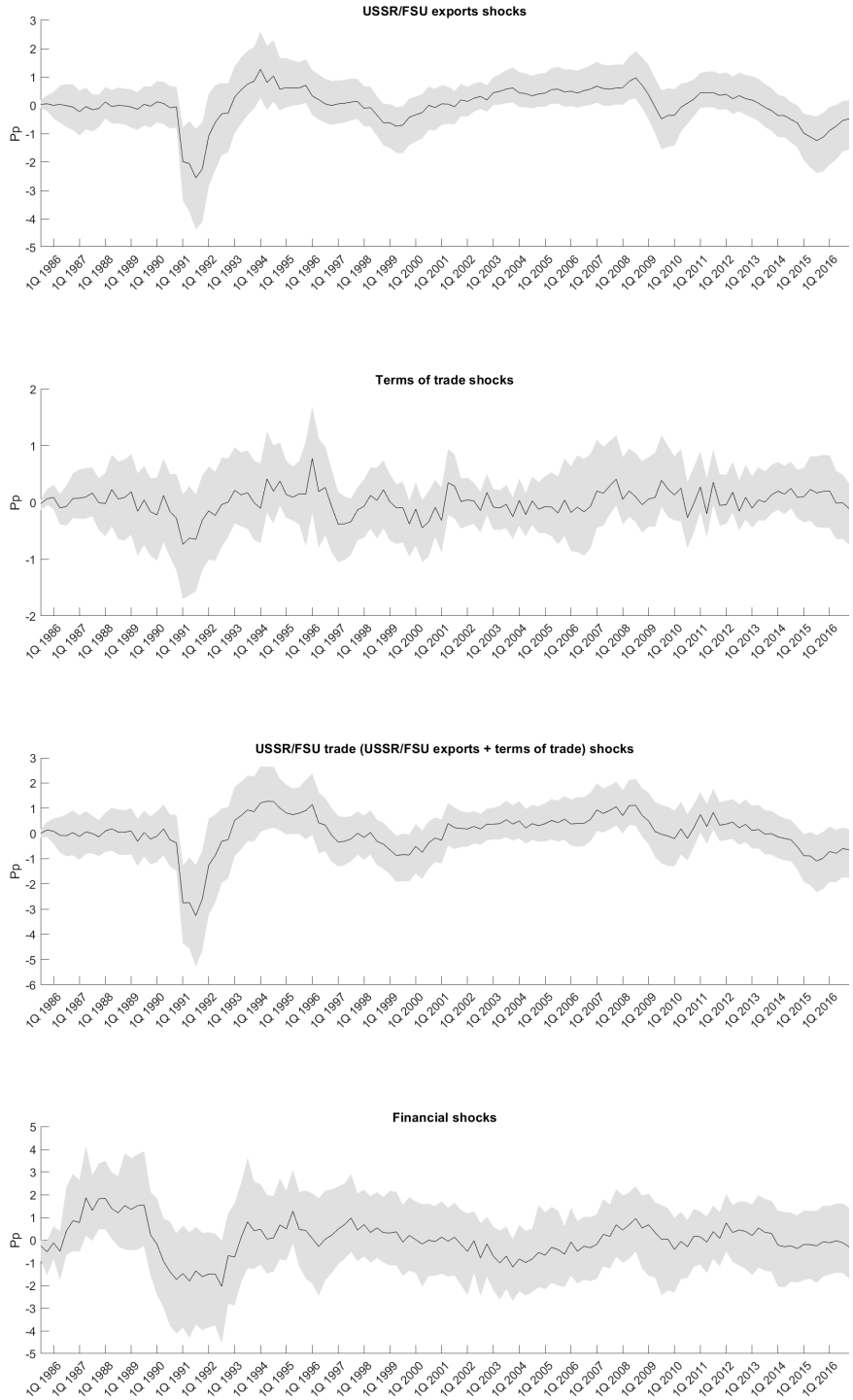

Figure 73: Historical decomposition of the Finnish business cycle. Finnish exports to the USSR/FSU instrumented.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

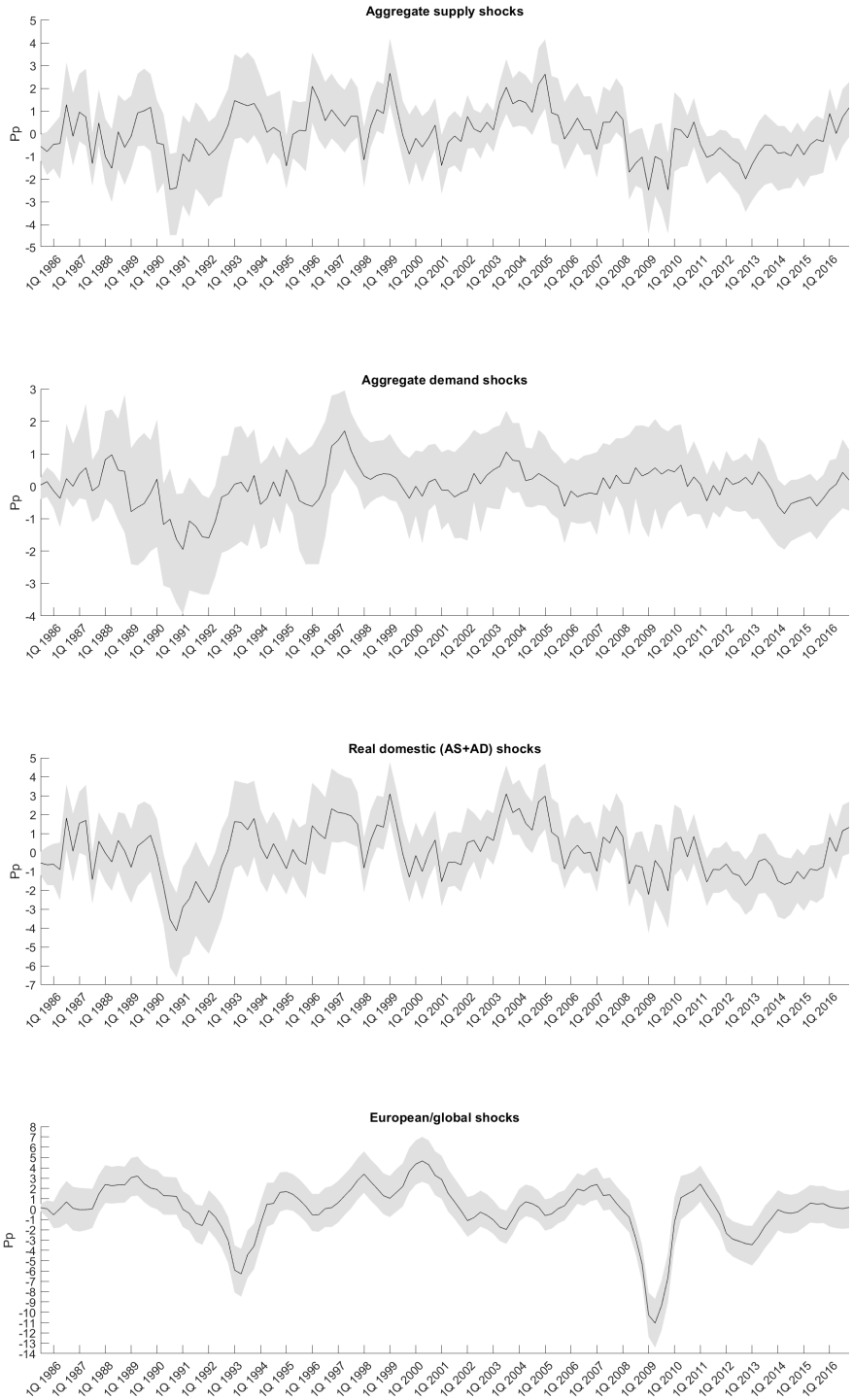

Figure 74: Historical decomposition of the Finnish business cycle (cont.). Finnish exports to the USSR/FSU instrumented.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

D.12 Finnish exports to the USSR/FSU replaced by Total USSR/FSU imports

In this robustness we use the series for Total USSR/FSU imports directly in the VAR. It serves as a proxy for Finnish exports to the USSR/FSU.

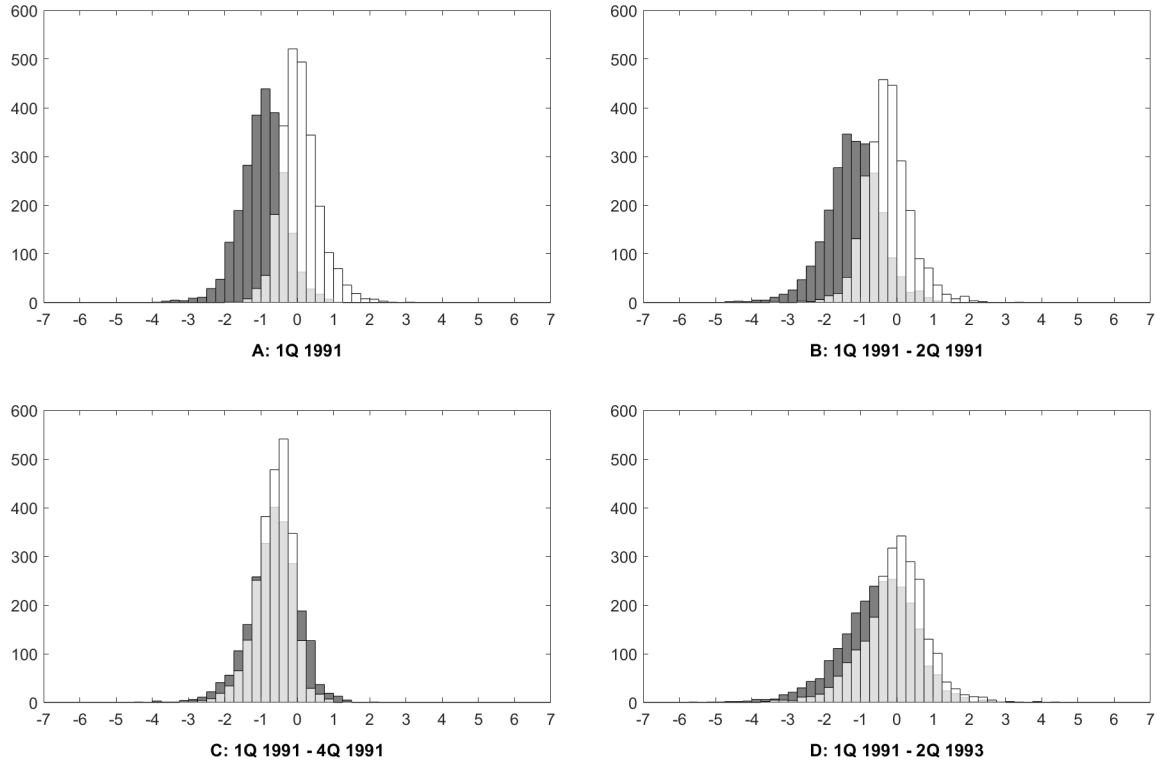

Figure 75: Distribution of the GDP loss due to the Soviet trade shock, with financial propagation (gray) and without (white). Total USSR/FSU imports.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D).

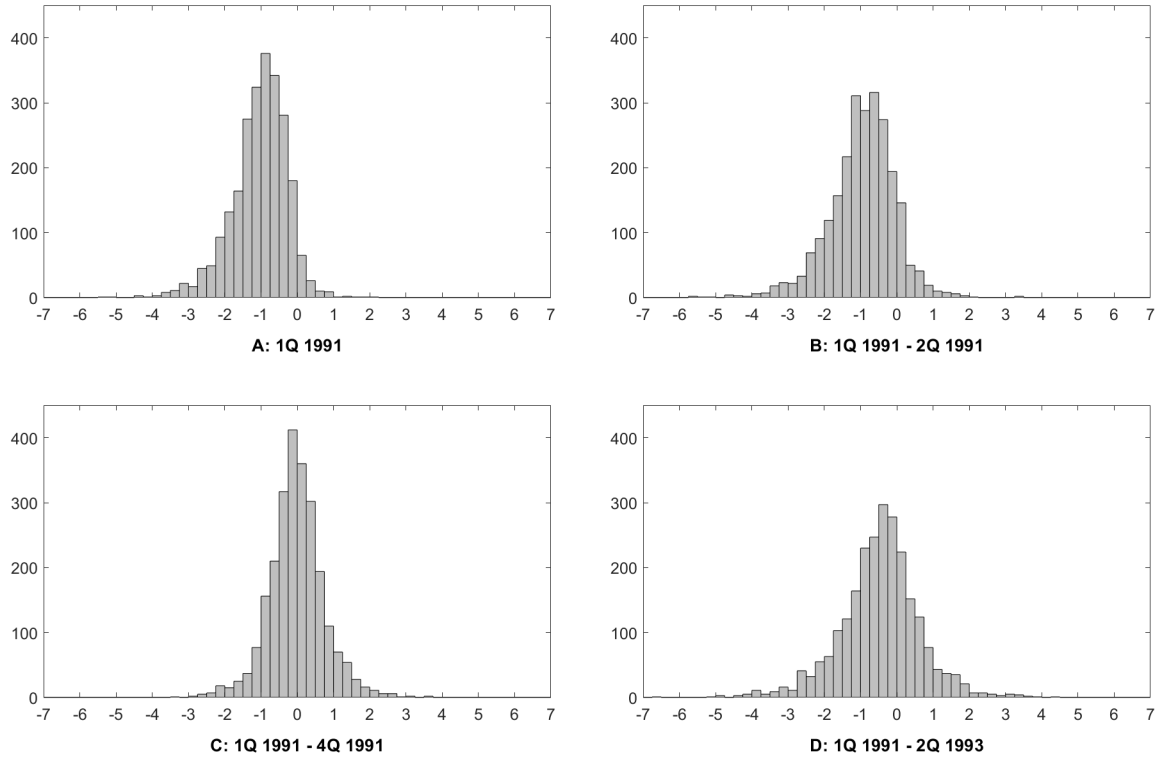

Figure 76: Distribution of cumulative GDP loss due to financial propagation of the Soviet trade shock. Total USSR/FSU imports.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D). The effect of the propagation is the difference between the actual GDP loss and the GDP loss when the financial channel is shut down.

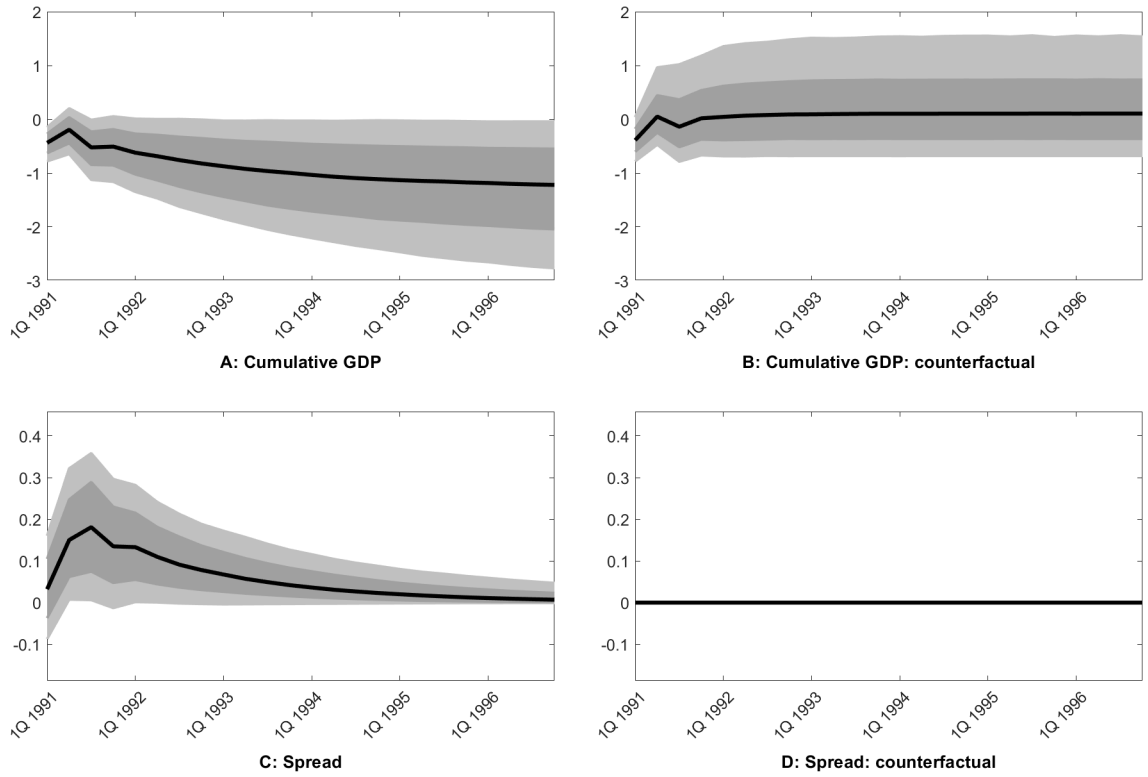

Figure 77: Impulse responses of cumulative GDP and the spread following the Soviet shock in 1Q 1991. Total USSR/FSU imports.

Notes: Black line is the period-wise median. Shaded areas indicate the period-wise 90 percent (light gray) and 66 percent (dark gray) impulse responses.

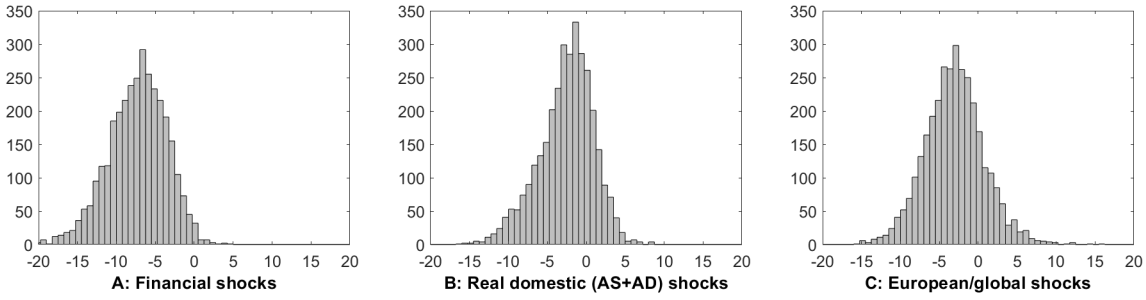

Figure 78: Distribution of cumulative GDP loss due to financial, real, and European/global shocks. Total USSR/FSU imports.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to financial (panel A), real (B) and European/global shocks (C) occurring from 3Q 1989 to 2Q 1993.

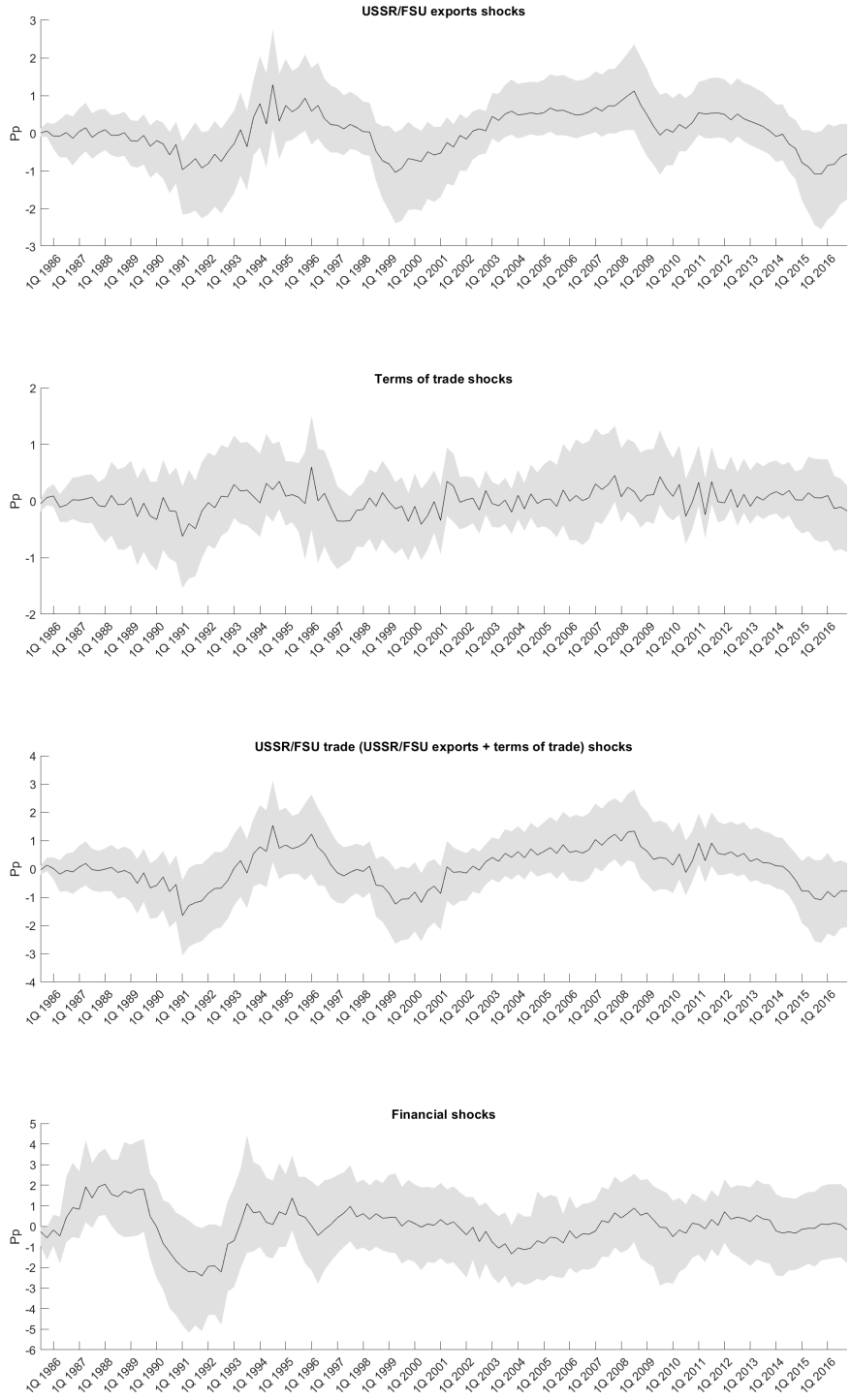

Figure 79: Historical decomposition of the Finnish business cycle. Total USSR/FSU imports.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

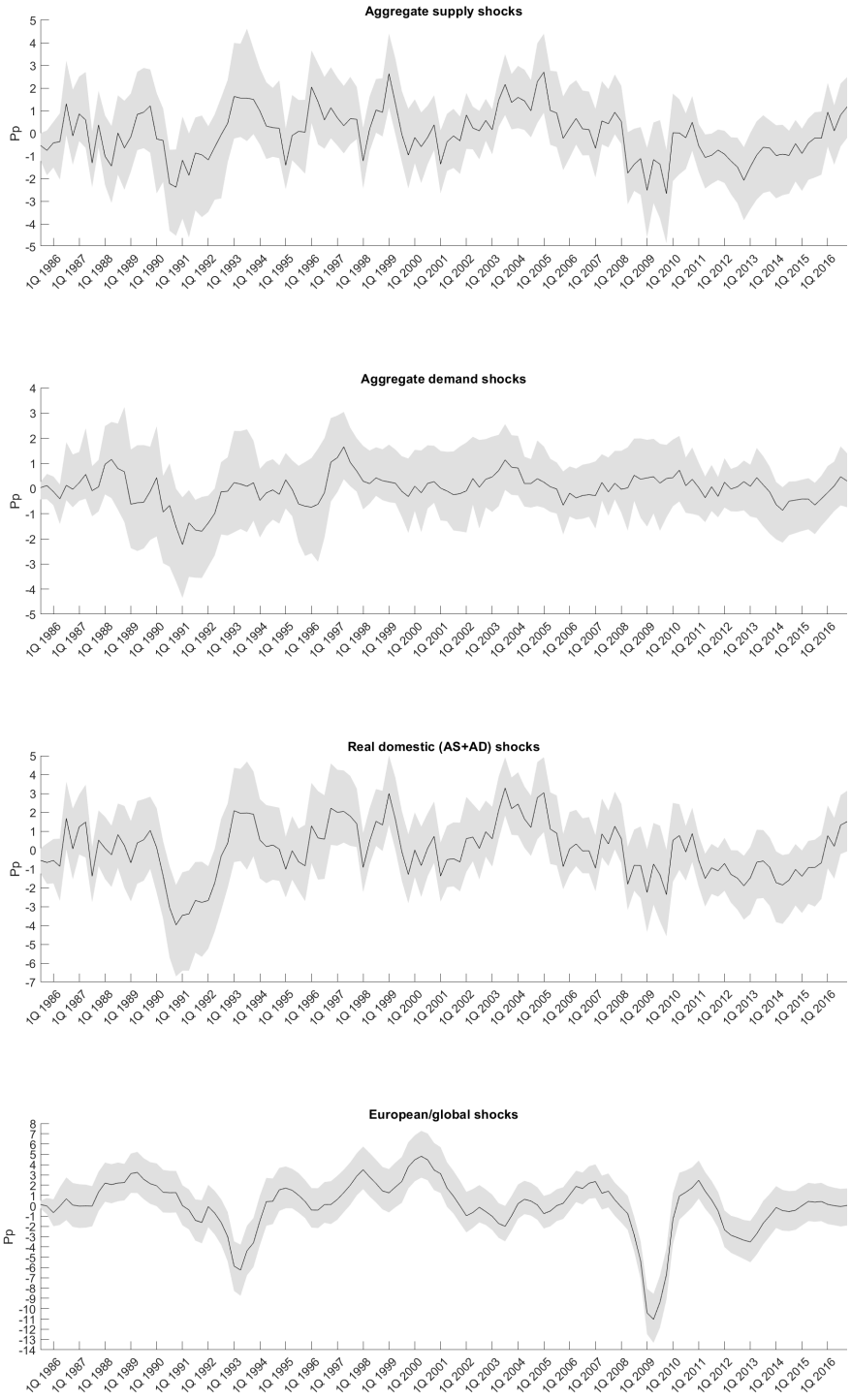

Figure 80: Historical decomposition of the Finnish business cycle (cont.). Total USSR/FSU imports.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

D.13 Larger domestic financial block

In this robustness check we explore the sensitivity of the results to the specification of the Finnish domestic financial sector. In particular, the financial shock and the financial propagation mechanisms postulated by theory and discussed in the main text rely partly on variables that are not included in the benchmark VAR. These variables are equity prices and bank lending.

To address the concern of omitted variables, we include two proxies for these variables: stock prices and new bank loans to the non-financial corporate sector. The stock market series is the capped OMXH index of the Helsinki Stock Exchange. 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 in the latter half of the estimation period. For the latter series, we focus on new loans (i.e. a flow) rather than the total outstanding stock of loans. 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 enough. In that sense, new loans is a much more up-to-date barometer of the loan market. It is also consistent with the fact that we use the lending rate for new loans when constructing the spread.

This modification requires a change in the specification of the sign restrictions, as summarized in Table D.13:

Table 3: Sign restrictions for positive domestic shocks.

Variable	Aggregate demand	Aggregate supply	Financial
GDP	+	+	+
Inflation	+	—	+
Interest rate spread	+	?	—
Stock prices	+	+	+
New bank loans	?	?	+

Stock prices should arguably rise after all expansionary shocks, reflecting higher profitability of firms. The response of new bank loans is less certain. For the demand shock, it depends on whether the shock ultimately comes from the private or public sector. On the one hand, higher demand should strengthen firm equity and household wealth and hence increase private lending, as is also the case in models with a financial accelerator, e.g. Bernanke et al. (1999). On the other hand, if the demand shock reflects higher government spending, it may crowd out private investment. This in turn would reduce new bank loans to the private sector.

The reaction of lending volumes is also uncertain following the aggregate supply shock. 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, boost profits and increase (inside or outside) equity or issue corporate bonds (Holmström and Tirole, 1997). All these can then finance the expansion of assets without raising bank lending.

In sum, we restrict new bank lending to go up only following the positive financial shock. We do so given that the financial shock may reflect shifts in the supply of credit and that it involves a drop of the corporate spread. We leave this variable unrestricted for the real shocks.

The design of the counterfactual simulations also changes relative to the benchmark specification. The larger model includes new bank lending which, like the spread, is a variable at the core of many theoretical financial propagation mechanisms. In order to shut down the financial propagation in the VAR, one has to therefore keep both of these variables (spread and new bank loans) at their steady state values. To do so, one needs to have two orthogonal shocks. Therefore, we define two financial shocks in two separate columns, rather than in one only. In other words, we put the financial shocks' sign restrictions twice. We can do so, because the total number of shocks we can identify is 5, whereas our number of sign-identified shocks becomes 4 (AD, AS, 2 financial shocks). Given that the sign restrictions on the two financial shocks are the same, they are not separately identified. Nevertheless, they can be thought of as capturing different types of financial shocks. For example, as discussed in the main text, one financial shock may originate in the non-financial corporate sector whereas the other may capture shifts in the loan supply, originating in the banking sector. To distinguish between these two types, one would need in principle an additional variable and a suitable identifying restriction. However, for our purpose, this is unnecessary. What suffices is that these two financial shocks appear in two orthogonal columns, which then allows us to generate two independent series of artificial financial shocks as to keep two variables constant in the counterfactual. This approach is therefore analogous to Ciccarelli et al. (2015) who close several sub-channels to study propagation of a monetary policy shock. Note also that we do not restrict stock prices to be constant in the counterfactuals because this is a meaningful variable even in real models without any financial frictions.

Finally, note that this specification our model is only partially identified in the sense that we define 4 structural shocks in a block of 5 variables and leave the fifth column unrestricted. Therefore, while collecting admissible models (and rotation matrices Q) that satisfy the sign restrictions for the identified shocks, one has to also keep track of the multiple shocks problem (Fry and Pagan, 2011). In particular, we require that the shock in the fifth unidentified column (generated by the last column of the rotation matrix Q) generates impulse responses with a sign pattern that is distinct from that of all the identified structural shocks' impulse responses. We discard all rotations that do not pass this additional orthogonality requirement.

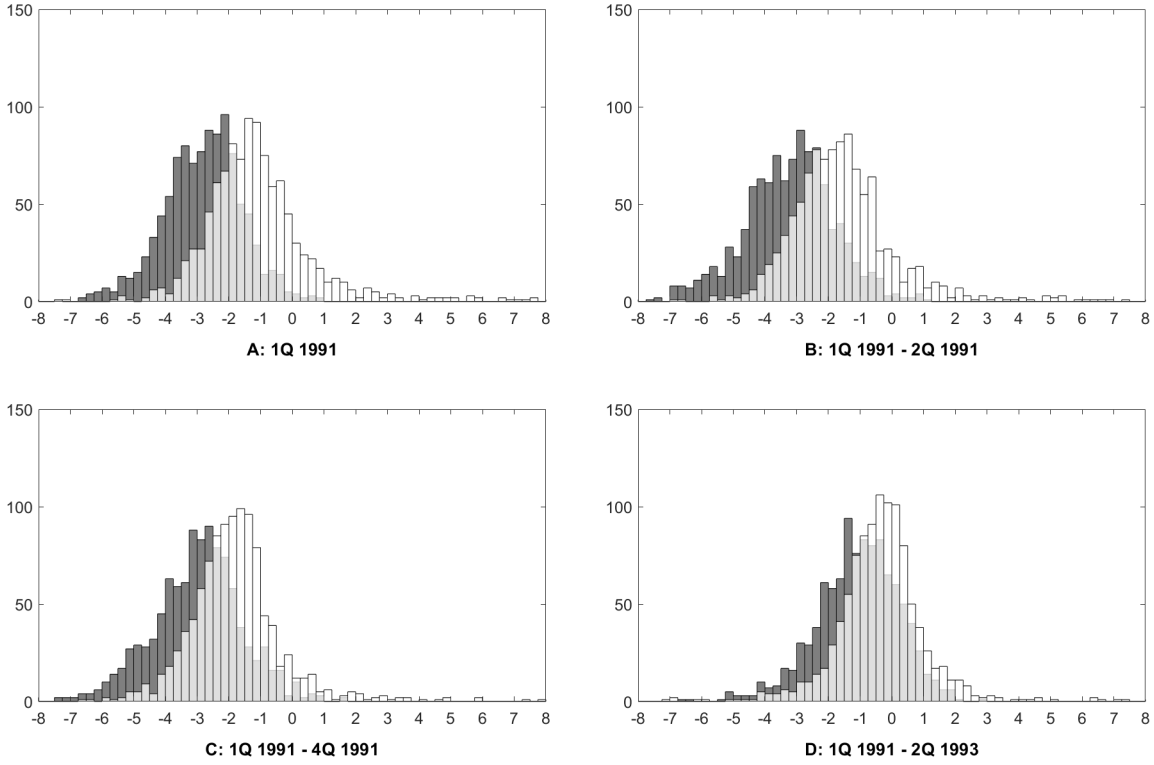

Figure 81: Distribution of the GDP loss due to the Soviet trade shock, with financial propagation (gray) and without (white). Larger financial block.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D).

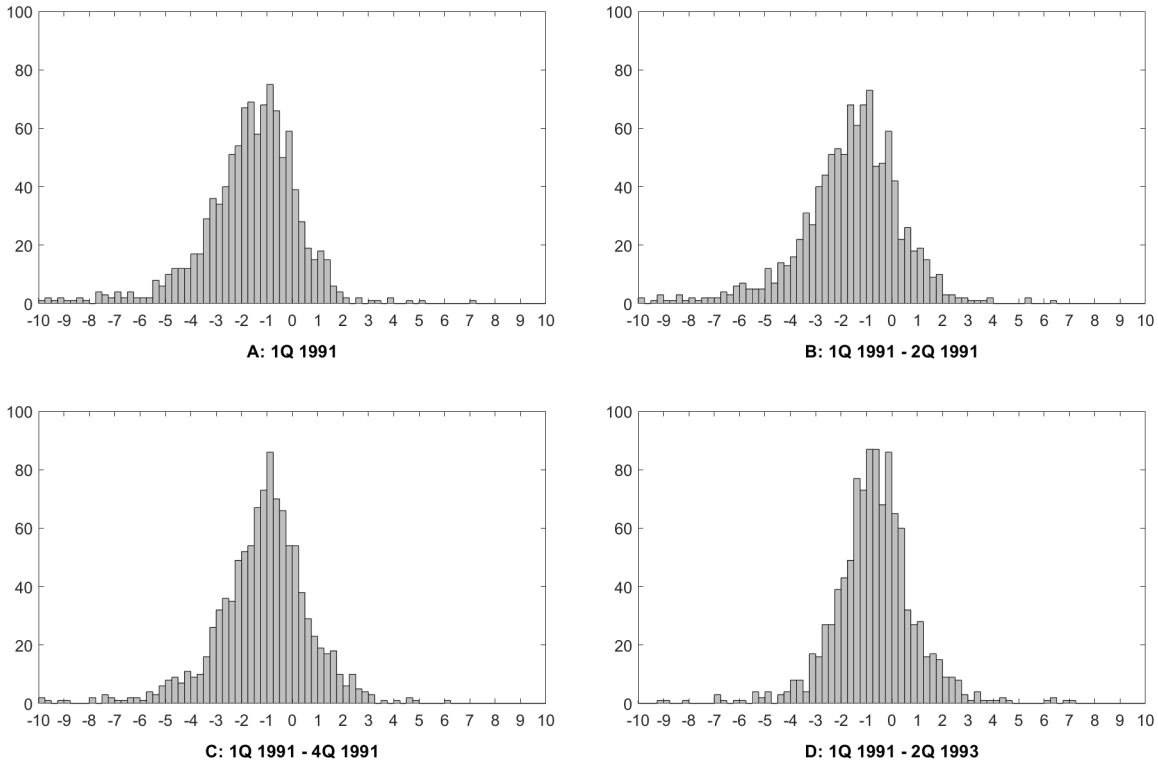

Figure 82: Distribution of cumulative GDP loss due to financial propagation of the Soviet trade shock. Larger financial block.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D). The effect of the propagation is the difference between the actual GDP loss and the GDP loss when the financial channel is shut down.

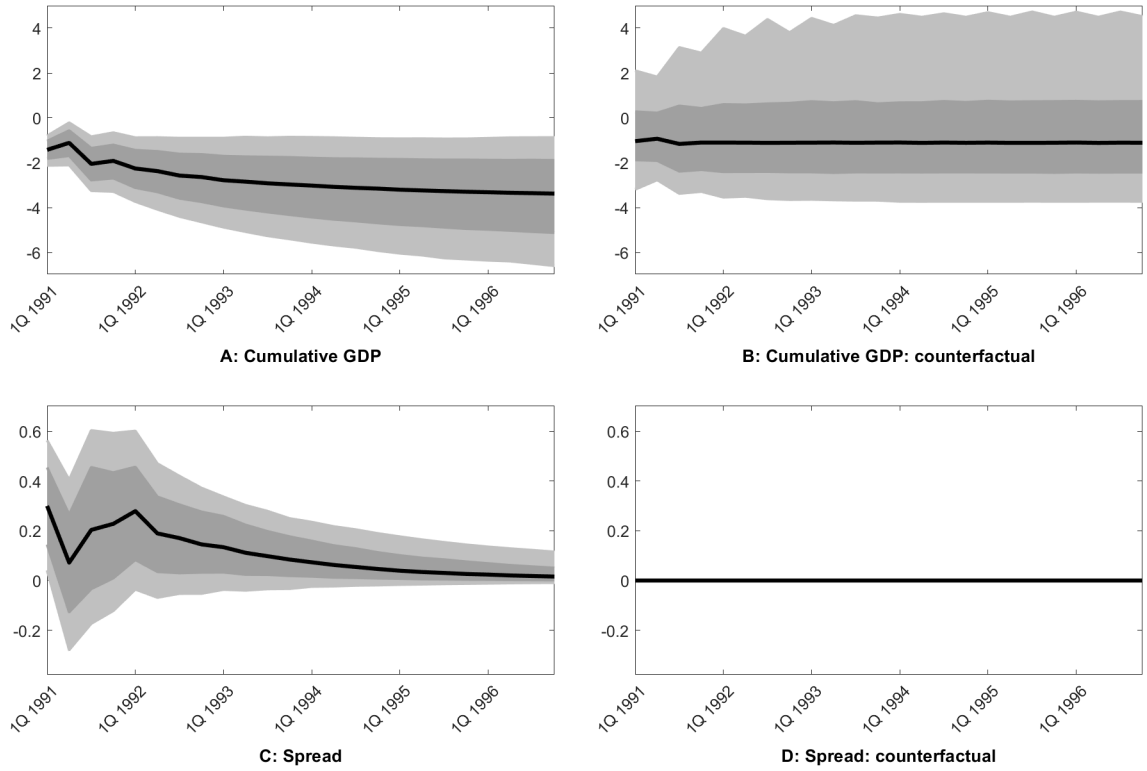

Figure 83: Impulse responses of cumulative GDP and the spread following the Soviet shock in 1Q 1991. Larger financial block.

Notes: Black line is the period-wise median. Shaded areas indicate the period-wise 90 percent (light gray) and 66 percent (dark gray) impulse responses.

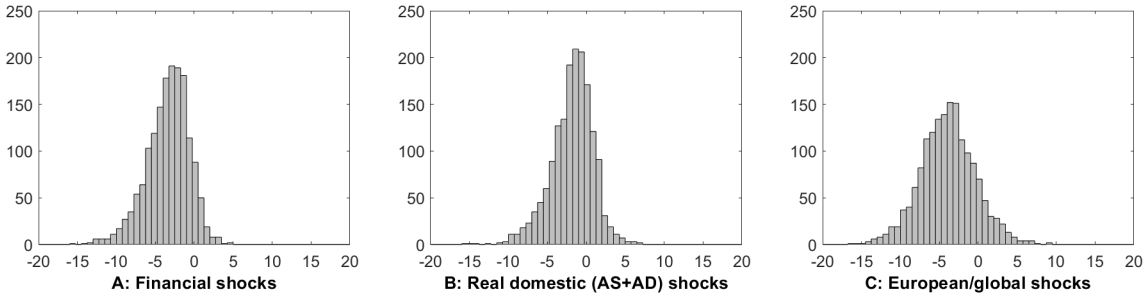

Figure 84: Distribution of cumulative GDP loss due to financial, real, and European/global shocks. Larger financial block.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to financial (panel A), real (B) and European/global shocks (C) occurring from 3Q 1989 to 2Q 1993.

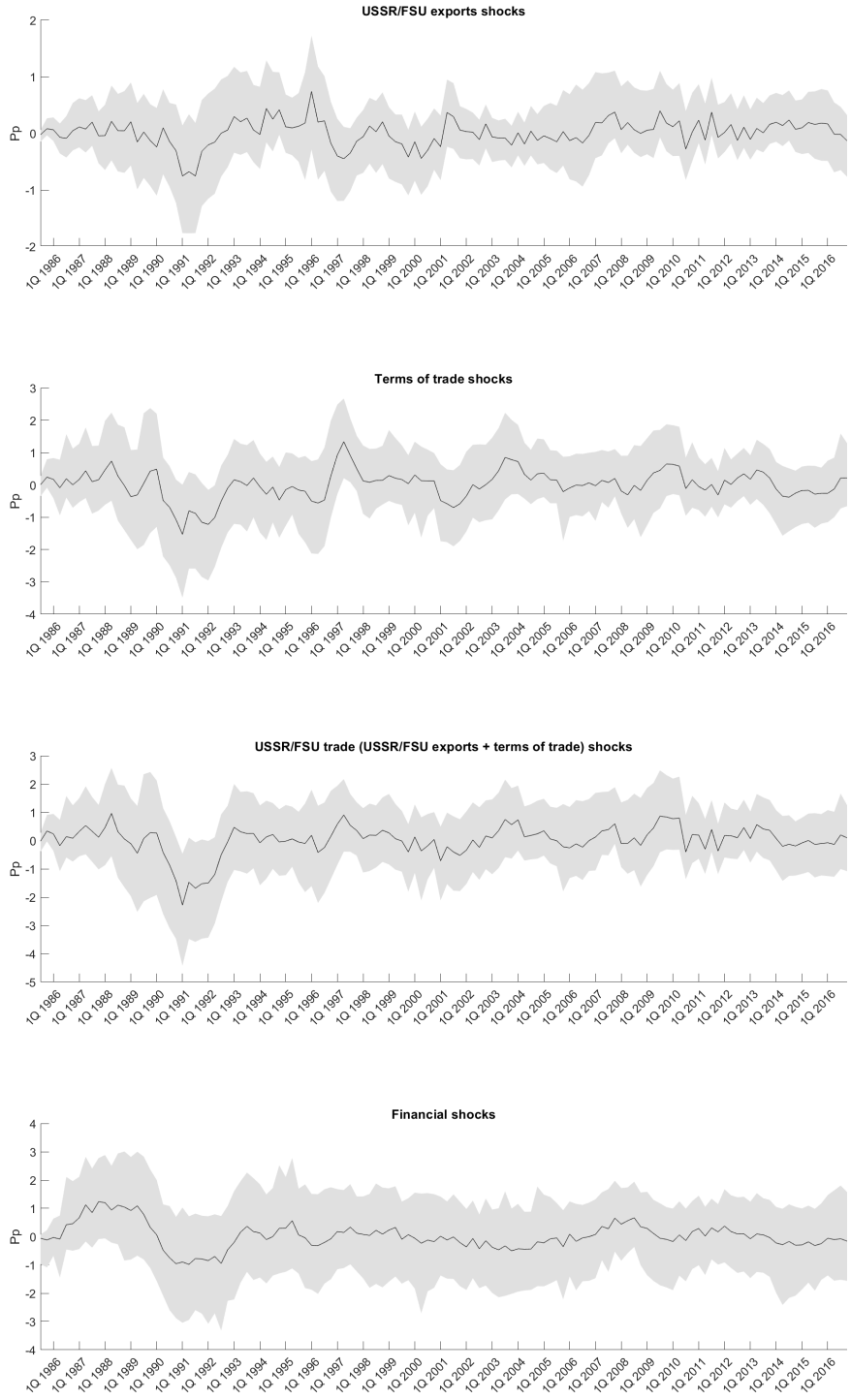

Figure 85: Historical decomposition of the Finnish business cycle. Larger financial block.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

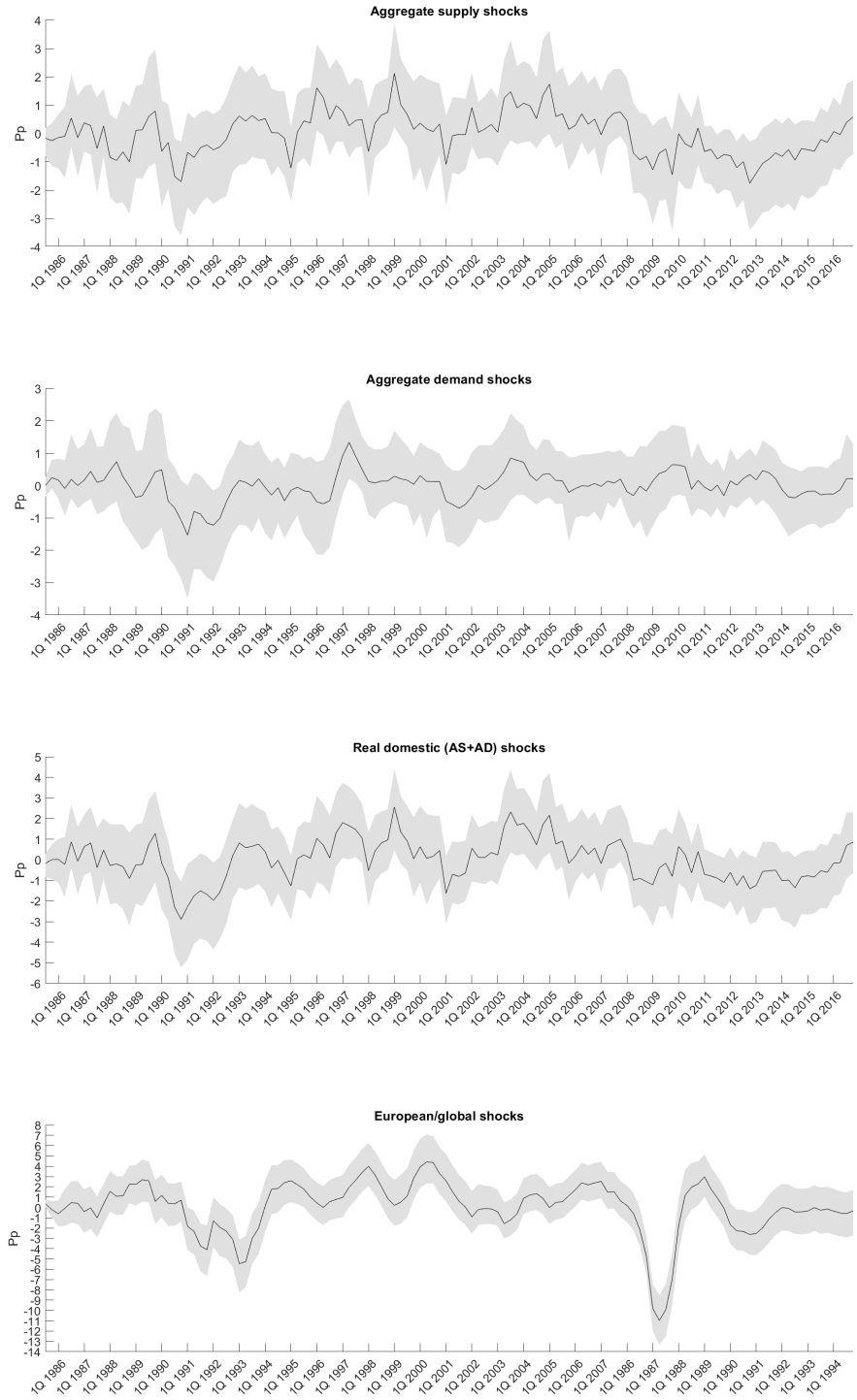

Figure 86: Historical decomposition of the Finnish business cycle (cont.). Larger financial block.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

D.14 GDP deflators replaced by CPI

In this robustness we explore the sensitivity of the results to replacing GDP deflators (in the euro area and in Finland) by their respective CPI indices.

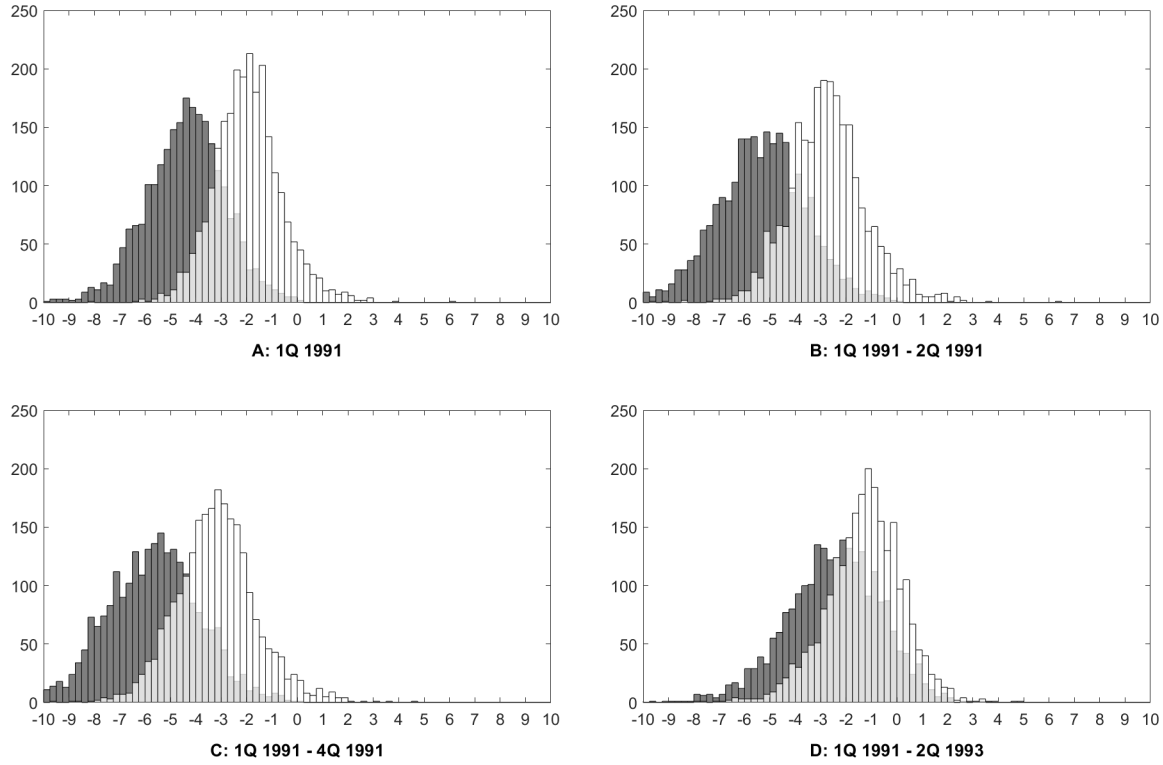

Figure 87: Distribution of the GDP loss due to the Soviet trade shock, with financial propagation (gray) and without (white). GDP deflators replaced by CPI.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D).

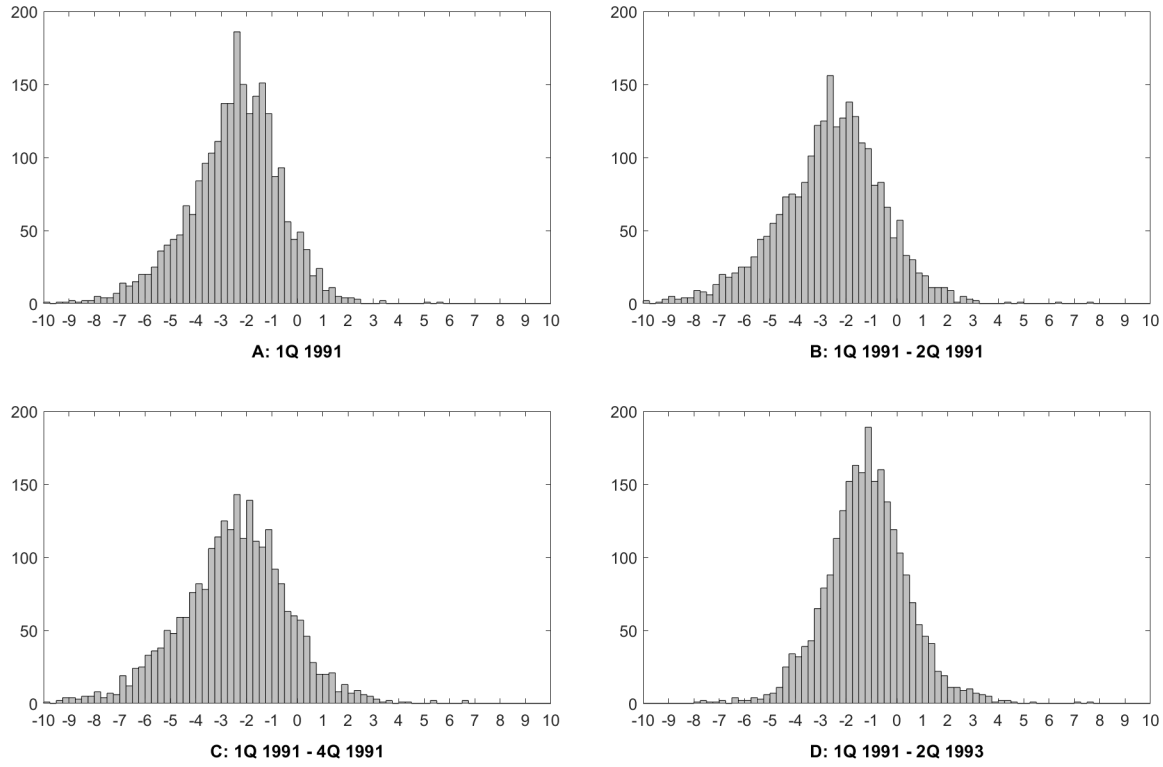

Figure 88: Distribution of cumulative GDP loss due to financial propagation of the Soviet trade shock. GDP deflators replaced by CPI.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to the Soviet shock occurring in 1Q 1991 (panel A), from 1Q 1991 to 2Q 1991 (B), from 1Q 1991 to 4Q 1991 (C) and from 1Q 1991 to 2Q 1993 (D). The effect of the propagation is the difference between the actual GDP loss and the GDP loss when the financial channel is shut down.

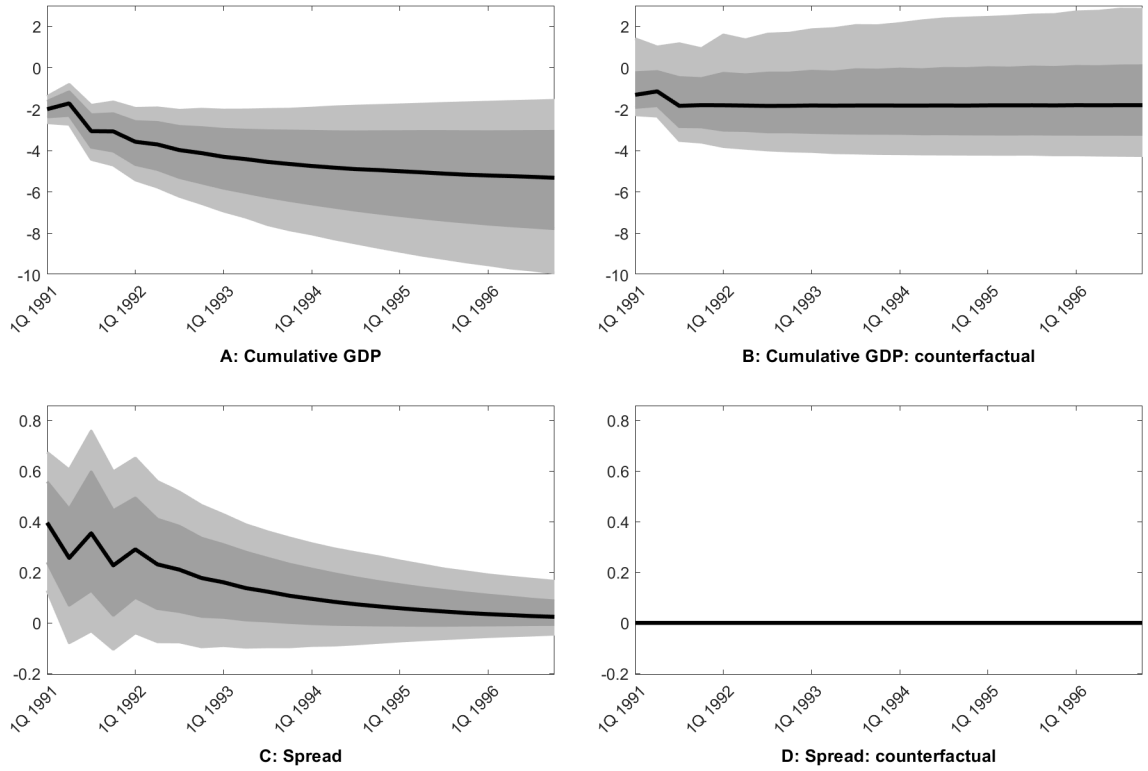

Figure 89: Impulse responses of cumulative GDP and the spread following the Soviet shock in 1Q 1991. GDP deflators replaced by CPI.

Notes: Black line is the period-wise median. Shaded areas indicate the period-wise 90 percent (light gray) and 66 percent (dark gray) impulse responses.

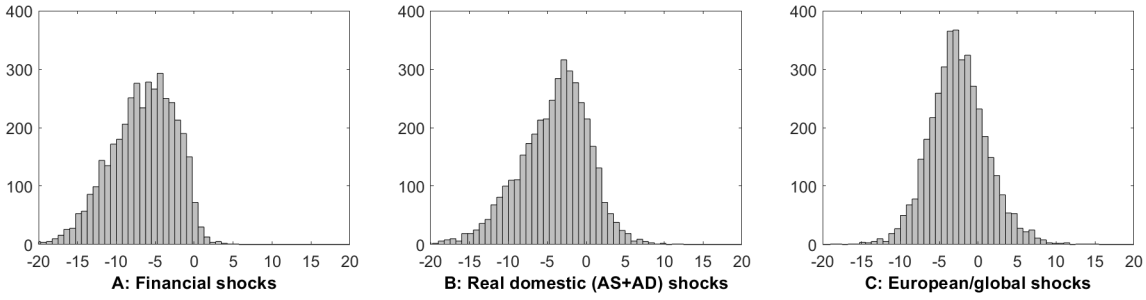

Figure 90: Distribution of cumulative GDP loss due to financial, real, and European/global shocks. GDP deflators replaced by CPI.

Notes: Histogram for the whole set of admissible models. X axis measures in percent the cumulative GDP loss in 2Q 1993, due to financial (panel A), real (B) and European/global shocks (C) occurring from 3Q 1989 to 2Q 1993.

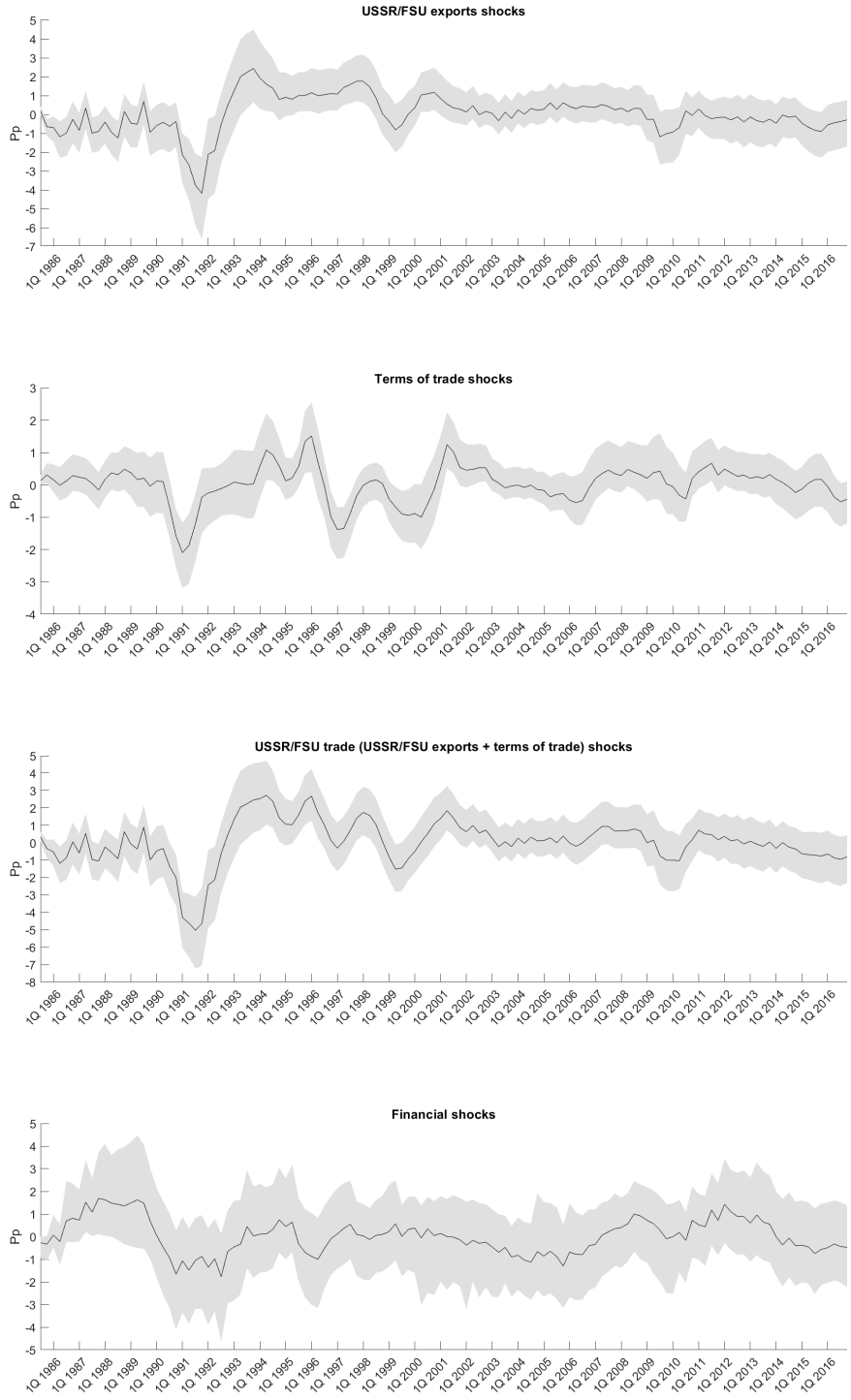

Figure 91: Historical decomposition of the Finnish business cycle. GDP deflators replaced by CPI.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

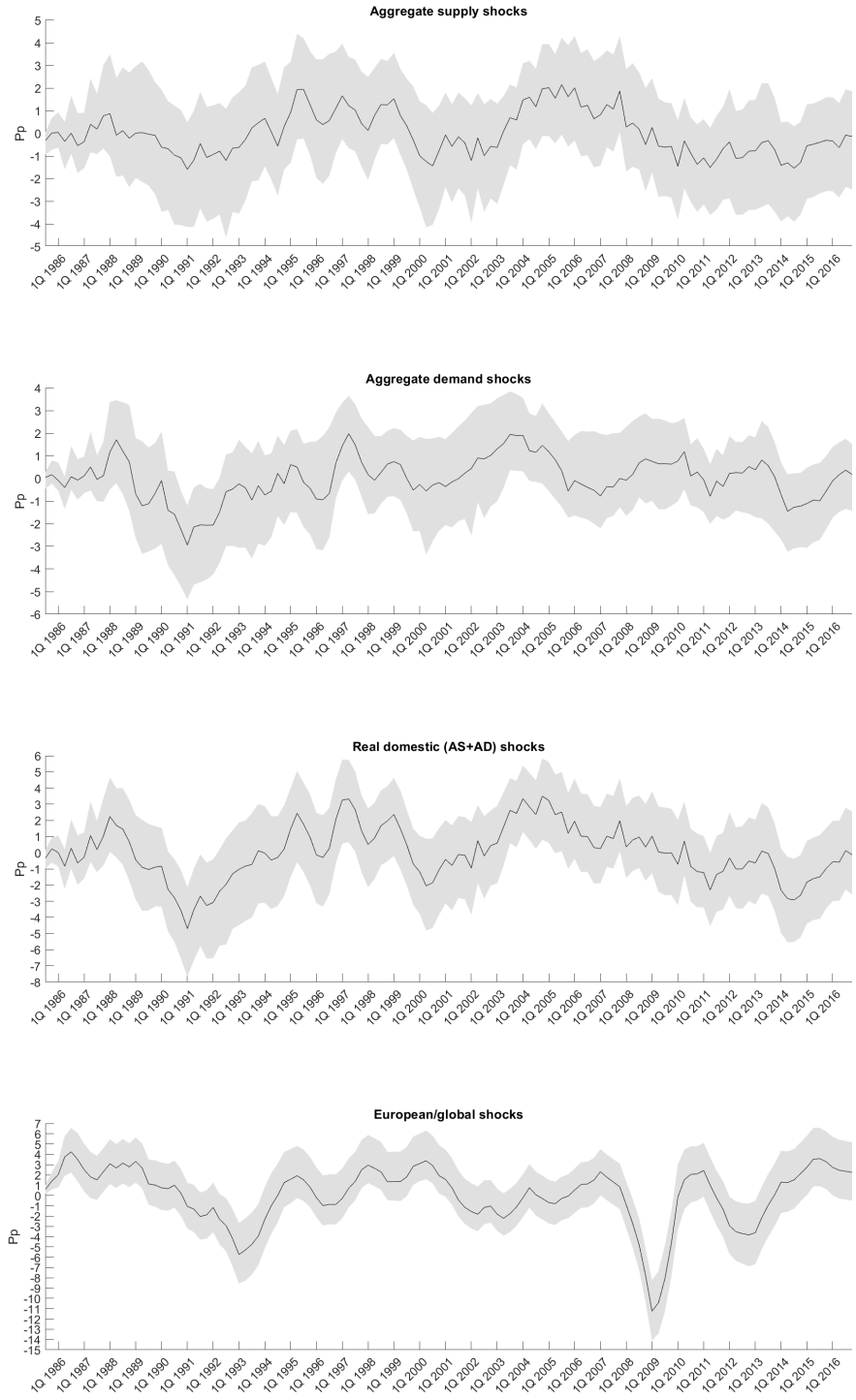

Figure 92: Historical decomposition of the Finnish business cycle (cont.). GDP deflators replaced by CPI.

Notes: Contributions are annualized using a 4 quarter moving sum. Black line denotes point-wise medians, gray areas denote 90 percent point-wise contributions.

Bank of Finland Research Discussion Papers 2019

ISSN 1456-6184, online

1/2019 Marco Gallegati – Federico Giri – Michele Fratianni
Money growth and inflation: International historical evidence on high inflation episodes for developed countries
ISBN 978-952-323-257-0, online

2/2019 Francesco D'Acunto – Daniel Hoang – Maritta Paloviita – Michael Weber
IQ, Expectations, and Choice
ISBN 978-952-323-258-7, online

3/2019 Orkun Saka
Domestic banks as lightning rods? Home bias and information during Eurozone crisis
ISBN 978-952-323-260-0, online

4/2019 Saara Tuuli
Model-based regulation and firms' access to finance
ISBN 978-952-323-261-7, online

5/2019 Thomas A. Lubik – Christian Matthes – Fabio Verona
Assessing U.S. aggregate fluctuations across time and frequencies
ISBN 978-952-323-263-1, online

6/2019 Karlo Kauko – Eero Tölö
On the long-run calibration of the Credit-to-GDP gap as a banking crisis predictor
ISBN 978-952-323-264-8, online

7/2019 Olli-Matti Laine
The effect of TLTRO-II on bank lending
ISBN 978-952-323-269-3, online

8/2019 Michaela Schmöller
Stagnant wages, sectoral misallocation and slowing productivity growth
ISBN 978-952-323-273-0, online

9/2019 Adam Gulan – Markus Haavio – Juha Kilponen
Can large trade shocks cause crises? The case of the Finnish-Soviet trade collapse
ISBN 978-952-323-274-7, online