Experiences from ten years of research on Danish Historical Monetary and Macroeconomic Statistics

by
Kim Abildgren
Head of Economic Research
Danmarks Nationalbank
Havnegade 5
DK-1093 Copenhagen K
Denmark
Phone:+45 33 63 63 63
E-mail: kpa@nationalbanken.dk

Paper presented at the 2015 archival workshop on "INFLATION, MONEY OUTPUT – Economic and financial data underpinning analysis and policy-making" organised by European Association for Banking and Financial History in cooperation with Czech National Bank and the Czech Banking Association, hosted by the Czech National Bank, Prague, 14 May.

Abstract

This paper outlines the main results from ten years of research on Danish historical monetary and macroeconomic statistics. The underlying research project has had two main objectives. The first objective has been an attempt to close some of the gaps in the existing historical monetary and macroeconomic statistics for Denmark. The second objective has been an attempt to enhance our insight into the monetary and macroeconomic history of Denmark through several new empirical analyses of a range of key issues. The main topics covered by the project have been: Business cycles, financial factors and financial stability; financial balance sheets and credit; price stability and inflation; interest rates and exchange rates; labour market; public finance; and capital flows.

Key words

Historical statistics; Monetary and financial economics; Danish economic history.

JEL classification

C8; E0; G0; N13, N14.

Acknowledgements

During the years a considerable debt of gratitude to others has been accumulated. The author would like to take the opportunity to thank those many individuals who took the time to read draft versions of the works presented in this paper. That includes colleagues from Danmarks Nationalbank, participants at workshops and conferences as well as members of review boards, editors and referees. The advice and criticism from this long range of people has been very helpful in improving and shaping the work.

Disclaimer

The paper is solely based on information, which is within the public domain. Views and conclusions expressed in the paper are those of the author and do not necessarily represent those of Danmarks Nationalbank. The author alone is responsible for any remaining errors and shortcomings.

Table of contents

1. Introduction

This paper outlines the main results from ten years of research on Danish historical monetary and macroeconomic statistics.

The research project behind the results presented in this paper has had two principal objectives. The first objective has been an attempt to close some of the gaps in the existing Danish historical monetary and macroeconomic statistics. The second objective has been an attempt to enhance our insight into the monetary and macroeconomic history of Denmark through several new empirical analyses of a range of key issues.

Naturally, historical statistics is of interest in relation to economic-historical analyses and many issues within this line of research can only be enlighted through quantitative empirical evidence. The study of for instance low probability events ("tail events") such as currency crises, banking crises, debt crises or severe stock-market collapses requires a large number of data points covering different crisis as well as non-crisis regimes. Furthermore, long time series spanning across periods with different economic-policy regimes, other institutional differences and variations in the rate of real or monetary shocks to the economy *etc*. might also serve as the basis for useful robustness checks in relation to more contemporary empirical analyses.

Historical statistical data within the social sciences are always subject to questions regarding their accuracy and reliability. Frequently a number of judgements and estimates have implicitly or explicitly been made in an attempt to overcome problems with missing observations, incomplete coverage and sampling biases, changes in compilation methods and statistical classifications *etc*. Sometimes historical statistical information have originally been collected for particular legal or political purposes, which have to be taken into account when the reliability of such data sets are assessed. Most historical statistics can therefore only be expected to give a rough picture of the topics at hand.

The general idea of the project relates most cosely to the works by Johansen (1985, 1991), which offer a collection of charts and economic-historical time series for Denmark. However, the collection of statistics presented in this paper has a much more comprehensive coverage of monetary and macroeconomic variables of relevance for the analysis of price stability and financial stability. Furthermore, the works by Johansen, *op.cit*., only contain data on an annual frequency whereas a substantial range of quarterly and monthly time series are included in the database presented in the paper.

In order to make the time series available to a larger research community and stimulate further studies on the monetary and macroeconomic history of Denmark, the database is available in electronic form as spreadsheets downloadable from the website of Danmarks

Nationalbank in relation to various working papers, which also contain descriptions of the sources and methods used for the compilation of the new database.

2. Main research findings

Business cycles, financial factors and financial stability

Abildgren, Kim. 2012a. Business Cycles and Shocks to Financial Stability - Empirical evidence from a new set of Danish quarterly national accounts 1948-2010, *Scandinavian Economic History Review*, Vol. 60(1), pp. 50-78.

Using filtering techniques, the article explores the stylised facts and empirical regularities in the cyclical movements of a broad range of macroeconomic time series for the Danish post-World War II period.

As basis for the analysis the article compiles a new set of quarterly national accounts for Denmark since 1948. Previously consistent time series of quarterly national accounts were only available in Denmark for the period since 1971. Furthermore, in order to facilitate and enhance the analytical application of this new data set, the article also compile a collection of seventeen other key quarterly macroeconomic indicators covering the Danish economy since 1948. The new long-span data sets cover almost nine complete business cycles, which gives more degrees of freedom and thus all else equal more reliable correlation estimates than those found in previous Danish studies based on substantially shorter time series.

In general, the findings of the article seem to be in line with what could be expected from mainstream macroeconomic theory and the empirical findings of similar studies in other countries as well as earlier studies for Denmark. The unemployment rate tends to lag the business cycle component in the real Gross Domestic Product (GDP), whereas interest rates, share prices and money tend to lead the cycle in output. The volatility in the business cycle component of real GDP was substantial lower in the period from the second half of the 1970s until the mid-2000s compared with the pre-1975 period. Similar results have been found for other countries, and the article suggests a number of reasons for this "Great Moderation".

Furthermore, the article includes an analysis of the monetary transmission mechanism in Denmark in the period 1948-2010 within the framework of structural vector autoregressive (VAR) models. The new long-span quarterly data sets applied makes it possible to estimate VAR models of a higher dimension than is usually found in the literature due to degrees-of-freedom problems. With a high-dimension VAR the risk of omitting important variables in the analysis is reduced. The analysis in the paper complements a number of earlier VAR studies on the monetary transmission mechanism in Denmark. However, the analysis in the article is the first Danish study to include asset prices, credit, money and the deposit banks' loan impairment charge ratio (write-downs ratio) among the endogenous variables.

The shape and direction of the impulse-responses to an increase in the short-term interest rate seem to be in line with what one could expect from mainstream macroeconomic theory: The long-term interest rate rises whereas real GDP, concumer prices, share prices, domestic credit and house prices decline. Furthermore, it seems that a shock to the short-term interest rate is followed by a significant increase in the deposit banks' loan impairment charge ratio reflecting that the declines in real GDP and asset prices and the increase in the interest rate level reduce the credit quality of the banks' customers.

Finally, the article includes a VAR analysis of the real effects of shocks to financial stability. The results from the analysis indicate a significant and long-lasting negative impact on real GDP following the extraordinarily large increases in the banking sector's loan impairment charge ratio. This is consistent with findings in recent economic-historical research for other countries, indicating that the economic recovery after a banking crisis tends to be slower than normal.

Abildgren, Kim. 2012b. Financial structures and the real effects of credit-supply shocks in Denmark 1922-2011, *European Review of Economic History*, Vol. 16(4), pp. 490–510.

This article examines the real effects of credit shocks. As basis for the analysis the article compiles a new set of quarterly data on a range of key short-term economic indicators for Denmark spanning the past 90 years or so.

The core of the analysis is a series of structural VAR models estimated on this data set. The new long-span time series make it possible to compare periods with different economic-policy regimes, other institutional differences, variations in the rate of real or monetary shocks to the economy *etc*. The analysis finds no evidence of real macroeconomic effects from supply-shocks to credit from deposit banks in the periods 1922-1938 and 1981-2011 even though these periods contained several cases of severe banking crises.

In the article these findings are partly attributed to the special role played by bond-financed mortgage banks in the Danish financial system. The mortgage banks' only grant loans against collateral and there is a large liquid market for mortgage bonds with a broad investor base. It seems therefore plausible that firms and households in the periods 1922-1938 and 1981-2011 were able to cover their borrowing requirement by shifting their financing pattern towards a higher degree of lending from mortgage banks at times when deposit banks had to reduce their credit exposures. Furthermore, there have also been comprehensive government interventions to safeguard financial stability during times of banking crises.

There seems, however, to be indications of real macroeconomic effects from credit-supply shocks in the period 1950-1980 where credit rationing and exchange controls served as important economic-policy instruments. This indicates that tight quantitative restrictions on credit intermediation can have real effects on the macro economy.

Overall the results from the analysis indicate that both the financial-system structure (including the possibilities for substitution between alternative sources of financing) as well as the extent of government intervention during banking crises play a key role to the significance of real macroeconomic effects of credit-supply shocks. These findings must be kept in mind when modelling the role of financial intermediaries in macroeconomic models.

Naturally, the findings above do not rule out that some firms or households might have found it more difficult to obtain funding during periods with banking crises and that this might have had real effects at the micro level in the form of e.g. lower investments or even the failure of some firms.

Furthermore, the findings do not imply that there are no negative real macroeconomic effects of banking crises. But the results suggest that the macroeconomic transmission mechanism of banking crises in Denmark have not primarily been through a significant contraction in the supply of credit from deposit banks, which have affected the rest of the economy via lower investment and consumption by credit-constrained firms and households. The negative effects of banking crises seem rather mainly to have been transmitted to the real macro economy via other channels. This could for instance be through changes in the saving behaviour of households and firms due to weakened confidence in the banking sector and greater uncertainty about the future economic outlook.

Financial balance sheets and credit

Abildgren, Kim. 2008a. A 'First Go' on Financial Accounts for Denmark 1875-2005, *Scandinavian Economic History Review*, Vol. 56(2), pp. 103-121.

To date projects related to historical national-accounts have – both in Denmark and internationally – only focused on the real side of the economy. This article presents a first attempt to construct a set of annual financial-account stock data for Denmark 1875-2005. Previously consistent time series of annual financial account stock data for Denmark has only been available for the period since end-1994. Furthermore, the article addresses some of the more methodological and conceptual aspects of using financial accounts as a framework for organisation of historical financial statistics.

The annual financial-account data constructed in the article are based on a comprehensive range of historical financial statistics. The data presented are broken down by 8 institutional sectors (central bank; deposit banks; mortgage banks; life-insurance companies and pension funds; investment associations; central government; other residents; and non-residents) and 6 main types of financial instruments (gold and SDR; currency; loans and deposits; bonds, shares and mutual funds shares; insurance technical reserves; and capital and reserves).

The overall conclusion in the article is that financial accounts constitute a useful framework for organising and analysing financial data even when data sources are somewhat fragmented

and sparse, which is often the case in relation to historical financial statistics. Financial accounts can be useful in an attempt to paint a more coherent picture of the historical development of the financial system and the financial structure. Utilising accounting identities a system of financial accounts allows e.g. for the compilation of the net financial asset position of the non-financial private sector, even when no separate balance-sheet statistics covers this sector. It would therefore be interesting if future projects on historical national accounts would make an attempt to cover long-span time series of both real-economy accounts as well as financial accounts stock- and flow-data.

Abildgren, Kim. 2009a. Credit Dynamics in Denmark since World War II, *Danish Journal of Economics (Nationaløkonomisk Tidsskrift)*, Vol. 147(1), pp. 89-119.

Based on new time series data for credit to Danish residents by sector and industry 1951-2008 constructed by the author this article explores the trends and cycles in credit during the past six decades or so.

The article finds a structural shift in the relationship between growth in real credit and economic activity around 1980. In the post-1980 period characterised by increased influence from market forces due to financial liberalisation and internationalisation the swings in real credit growth have been substantial relative to the economic activity compared to the pre-1980 period where credit rationing and exchange controls served as important economic-policy instruments. The house price development seems also to have played an important role for the credit dynamics.

According to the analysis there seems to have been a shift over time in the short-term cyclical behaviour of credit to firms. Real commercial credit was contemporaneous with private sector real GDP in the pre-1980 period but has lagged the business cycle with one year in the post-1980 period. This might reflect the more restricted access to credit in the pre-1980 period. Firms take their intertemporal decisions regarding real investments and financing simultaneously. Credit rationing and exchange controls in the pre-1980 period might therefore have provided an incentive for firms to raise loans at an early stage in the business cycle in order to be sure to have command over the funding necessary for their planned investments.

Another possible explanation suggested in the article is the increased significance of commercial and industrial foundations in the Danish economy. Industrial foundations might be seen as "patient owners" without an urgent need for return on equity. In step with the increased capital accumulation in those foundations it might have been possible for Danish firms to finance larger shares of their fixed investments in the initial stages of an upturn with own funds from retained earnings rather than loans from domestic and foreign credit institutes.

Price stability and inflation

Abildgren, Kim. 2010. Consumer Prices in Denmark 1502-2007, *Scandinavian Economic History Review*, Vol. 58(1), pp. 2-24.

This article presents a consumer price index for Denmark 1502-2007 compiled by the author and discusses some of the more conceptual issues relating to compilation of historical price indices and the measurement of inflation. For the post-1815 period the CPI index is based on existing figures whereas new data have been constructed for the pre-1815 period.

Due to limited data availability the CPI is based on "silver prices" for the period 1502-1640. Since the Danish currency depreciated vis-à-vis silver during this period, the pre-1640 CPI figures clearly underestimate the actual level of inflation.

The inflation rate in the period since 1640 has on average been just below 2.0 per cent per annum. There does not appear to have been a continuously rise in the price level, but rather some periods with price-level stability, some periods with low inflation, some periods where prices fell, and some periods with a strong and more sustained inflation.

However, disregarding periods with actual war inflation and the deflation during the first two decades or so after the end of the Napoleonic Wars, there seems only to have been one major exception from the overall picture of price stability in the post-1640 period: The first four decades following the end of the Second World War where inflation expectations lost their anchor.

Abildgren, Kim. 2007. Input-Output Based Measures of Underlying Domestic Inflation: Empirical Evidence from Denmark 1903-2002, *Economic Systems Research*, Vol. 19(4), pp. 409-423.

This article presents new annual input-output based time-series data for the underlying domestic inflation in Denmark 1903-2002 compiled by the author and analyses the inflationary development during the last century. The data set is constructed by stripping the development in the private consumption deflator of price increases caused by the direct and indirect content of imports, indirect taxes and gross rents. To the best of our knowledge such long time series of input-output based underlying domestic inflation have not previously been compiled for any other country. The article also discusses a range of conceptual issues in relation to the interpretation and use of input-output based domestic inflation measures.

The analysis seems to suggest that an input-output based underlying inflation measure might paints a fundamentally different picture of the inflationary development than the private consumption deflator in periods with large structural movements in the relative prices or periods with high inflation volatility. The most marked example is the period 1973-1986 characterised by large increases in indirect taxes and gross rents as well as a high and volatile

element of imported inflation due to large oil price movements and frequent devaluations of the Danish krone.

A low level of input-output based underlying inflation does not necessary imply a low future level of inflation. The input-output based measure of underlying domestic inflation reflects the development in wages and gross profit per produced unit in domestic goods and services delivered for private consumption. A temporary drop in the level of underlying inflation, e.g. around the second oil-price shock, may therefore partly reflect a temporary squeeze of profit margins that later gets restored.

An input-output based underlying inflation measure can provide insights into the inflation process that are not easily uncovered from other economic indicators. Despite the relatively comprehensive calculation procedure an input-output based measure of underlying inflation can therefore be a useful supplement to other types of information (e.g. the development in wages, output gap *etc*.) in relation to both an interpretation of the historical inflation development and as an input into a broad assessment of the current inflationary environment.

However, input-output based measures of underlying domestic inflation are on the other hand hardly suitable to be used as the targeted measure of inflation by inflation-targeting central banks. Not only because of the high volatility in such inflation measures but also due to the relatively complicated calculation procedure which makes such inflation measures less transparent and therefore more difficult to communicate to the general public than “headline” inflation figures.

Interest rates and exchange rates

Abildgren, Kim. 2005a. Interest-Rate Development in Denmark 1875-2003 – A Survey, *Danish Journal of Economics (Nationaløkonomisk Tidsskrift)*, Vol. 143(2), pp. 153-167.

This article compiles a new data set on annual interest rates in Denmark 1875-2003 and paints a broad picture of the development in nominal and real interest rates in Denmark since 1875, when the krone was introduced as the Danish currency unit.

The new data set consists of three different short-term interest-rate series (the official discount rate, the private banks’ average deposit rate, and the market rate of discount/money market rate) and two different long-term interest-rate series (the government bond yield and the yield on mortgage-credit bonds).

In the period 1875-1945 the average short-term and long-term nominal interest-rate level was around 4 to 5 per cent per annum. There was an upward trend in nominal interest rates during the 1960s and 1970s, and long-term Danish government bond yields reached a post-1875 all time high of just above 22 per cent in 1982. The government debt increased rapidly, and a fear that Denmark was on the verge of "state bankruptcy" began to rise. In the beginning of the 1980s the yield on long-term Danish government bonds exceeded the yield

on long-term Danish mortgage-credit bonds for the first time since the period around World War I. This highlights the extent of the crisis in the Danish economy. A switch towards a more stability oriented economic policy in Denmark – combined with the international decline of inflation rates during the 1980s and the beginning of the 1990s – caused a marked downward trend in both inflation and nominal interest rates in Denmark. In 2003 the Danish money market rate reached a post-1875 all time low.

Traditional measures of the *ex ante* real interest rate (nominal interest rate less contemporaneous rate of inflation) show average short-term and long-term real interest rates in Denmark around 3 per cent per annum for the period since 1875. Furthermore, such calculations indicate a rather high long-term real-interest-rate level during the late 1980s and the first half of the 1990s. However, the latter result might reflect a high degree of persistence in inflation expectations.

Abildgren, Kim. 2005b. Real Effective Exchange Rates and Purchasing-Power-parity Convergence: Empirical Evidence for Denmark, 1875-2002, *Scandinavian Economic History Review*, Vol. 53(3), pp. 58-70.

This article offers an analysis on the empirical evidence regarding long-run relative purchasing-power-parity (PPP) convergence based on a new annual data set on real effective exchange-rate indices for Denmark 1875-2002 compiled by the author. To the best of our knowledge such long time series of real effective exchange rates has not previously been constructed for other countries.

Two real effective krone-rate indices with respectively wholesale prices and consumer prices used as deflators are presented. All indices are constructed as geometrically weighted chain indices with current (i.e. annually updated) trade weights based on Denmark's foreign trade in goods with 15 of its largest trading partners. During each year in the period since 1875 these 15 countries accounted for at least 77 per cent of Denmark's total foreign trade in goods.

To avoid the risk of bias in the results due to outliers around the German hyperinflation in the early 1920s, the data sets are analysed for two separate sample periods (1875-1913 and 1924-2002). The results of the analysis based based on univariate unit-root testing of the real effective krone-rate index with wholesale prices as the deflator support a hypothesis of long-run relative PPP convergence. Half-lives of real exchange rate shocks are estimated to around 4 years in the post-1923 period and 2 years in the pre-1914 Classical Gold Standard period.

The fastest mean reversions towards relative PPP seems to have occurred in those periods where Denmark has pursued a fixed-exchange-rate policy vis-à-vis the majority of its trading partners and thus in those periods with the lowest volatility in the nominal effective krone rate. These results might reflect that a low level of nominal exchange-rate volatility facilitates cross-border goods-market arbitrage and thereby supports relative PPP convergence.

However, it might also reflect that in order to maintain a credible fixed-exchange-rate regime the domestic price and wage development has in general to be in line with that of the currency anchor. A stationary index for the real exchange rate could therefore also be the result of domestic economic policies (i.e. fiscal policy and other economic policies) and/or behaviour among labour market partners supporting the requirements for maintaining a fixed-exchange-rate regime.

Abildgren, Kim. 2014. Tail events in the FX markets since 1740, *Journal of Risk Finance*, Vol. 15(3), pp. 294-311.

This article takes a closer look at the frequency distribution of nominal price changes in the foreign exchange markets for a sample of 10 European exchange-rate pairs since 1740. This is the first study on nominal exchange-rate changes for a large number of exchange-rate pairs based on quarterly data for spanning almost three centuries.

As basis for the analysis the article compiles a new set with quarterly bilateral nominal exchange rates for ten European exchange-rate pairs spanning the period 1740-2012

The article finds 2-7 occurrences of quarterly changes in the exchange rates during the past 273 years, which are larger than eight standard deviations from the mean (a so-called 8-sigma event). This clearly illustrates the well-known fact that quarterly nominal exchange-price changes are far from following a normal distribution. An 8-sigma event can only be expected to occur once every 2.009E+14 years under the normal distribution.[1] To put this figure in perspective it can be noted that the period that has elapsed since the "Big Bang" of the Universe is approximately 13.82 billion (1.382E+10) years.

The fat-tailed nature of quarterly nominal exchange-rate changes seems to a large extent to be the result of structural breaks caused by extreme economic events such as changes of exchange-rate regimes, banking crises, wars, episodes of high inflation or hyperinflation *etc*. The analysis clearly illustrates the risk of seriously underestimating the probability and magnitude of tail events when frequency distributions of nominal exchange-rate changes are assumed fixed and assessed on the basis of fairly short historical data samples without taking into account the possibility of structural breaks.

The article suggests that financial institutions and regulators should have an eye for the long-term historical perspective when designing sensitivity tests or “worst case” scenarios in relation to risk assessments and stress tests.

[1] Scientific notation, i.e. 2.009E+14 means 2.009 times ten raised to the power of 14 (2.009×10^{145}).

Labour market

Abildgren, Kim. 2009b. Monetary Regimes and the Endogeneity of Labour Market Structures – Empirical Evidence from Denmark 1875-2007, *European Review of Economic History*, Vol. 13(2), pp. 199-218.

This article traces the possible links between the monetary regime and the institutional setting of the labour market in Denmark over the past 100 years or so based on a new data set on the Danish labour market 1875-2007 constructed by the author.

The results of the analysis seem to indicate that parts of the labour market structure are endogenous. The longest wage contract terms are found towards the end of the pre-World War I Classical Gold Standard period – characterised by price-level stability – and during the period since the mid-1990s that has seen a firm fixed exchange-rate policy and low and stable inflation. The shortest contract lengths are observed in the interwar period with high inflation volatility. Inflation indexation of wages was used most extensively in the Bretton Woods period and during the soft peg period of the 1970s when inflation was high and rising.

The degree of nominal wage rigidity in the economy is therefore not necessarily approximately constant, as it is otherwise assumed in many New Keynesian models. Explicit modelling of the links between the monetary regime and labour market structures might be particularly important if such models are to be used for analysis and comparison of alternative monetary regimes without being subject to the Lucas critique.

Public finance

Abildgren, Kim. 2006. Estimates of the Danish general government budget balance and the cyclical budget volatility 1875-2005, *Danish Journal of Economics (Nationaløkonomisk Tidsskrift)*, Vol. 144(3), pp. 287-303.

This article analyses the cyclical impact on the general government budget balance based on new time series data for the Danish general-government net lending since 1875 constructed by the author. Previously consistent time series data for the general government's net lending have only been available for Denmark since 1971.

The analysis indicates that the cyclical impact has increased over time in step with the increased level of the automatic stabilisers (i.e. the increased tax rate and unemployment benefit compensation rate). However, the cyclical impact on the general government budget balance seems most often to have been relatively modest compared to the impact from non-cyclical factors (i.e.. discretionary changes in fiscal policy and changes from extraordinary or structural factors).

Even though Denmark today has one of the largest public sectors in Europe, relatively speaking, the Danish general government’s deficit has only significantly exceeded 3 per cent of GDP during World War II and in the early 1980s. However, the calculations of the cyclical

budget volatility also seem to suggest that the cyclically adjusted budget balance has to be in surplus in periods with strong economic growth if the automatic stabilisers should be allowed to work freely during a cyclical downturn without violating a 3-per-cent budget criteria (the reference value in the Maastricht Treaty).

Capital flows

Abildgren, Kim. 2008b. Short-term impacts on exchange rates from portfolio flows to and from Denmark 1984-2004, *Danish Journal of Economics (Nationaløkonomisk Tidsskrift)*, Vol. 146(2), pp. 156-177.

This article offers an accounts of the Danish road to free cross-border portfolio flows and pure exchange-rate targeting since the breakdown of the Bretton Woods system and analyses the short-term relationship between capital flows related to portfolio investments and changes in the Danish nominal krone rate vis-à-vis the euro (D-mark prior to 1999) utilising a unique data set on monthly private cross-border portfolio gross and net flows to and from Denmark 1984-2004 constructed by the author.

The main finding is that portfolio investments are important to short-term exchange-rate determination and that the sign of the estimated effect is as expected: Net inflows of capital strengthen the exchange rate. This result is robust to a division of the data sample into sub-periods as well as to an inclusion of central-bank intervention in the foreign-exchange market and changes in the short-term interest-rate spread vis-à-vis the currency anchor as endogenous explanatory variables. Portfolio flows in Danish bonds appear to be driving the results prior to the introduction of the euro. Since then the main driver has been portfolio investments in foreign shares.

Over time there appears to have been a declining effect on the krone-rate from portfolio flows which might be seen as the result of increased credibility of the Danish exchange-rate peg.

3. Work in progress

Abildgren, Kim. 2013. Stress scenarios from the tails of historical distributions of macro-financial risk factors in Denmark, *Danmarks Nationalbank Working Papers*, No. 86, November.

Since the outbreak of the most recent international financial crisis, there has been a growing academic research interest in macro stress tests of the financial system. Macro stress tests are designed to assess the robustness of the financial system against adverse shocks to the macro economy, and they usually serve as the basis for discussions and actions on potential threats to financial stability and as a framework for communicating such risks. There is therefore also a huge focus on refining and expanding the range of approaches used for macro stress testing

among financial regulators and central banks. Better stress tests have the potential to improve the basis for assessment of financial stability and the need for macro-prudential regulations.

With hindsight, it has become clear that the macro stress tests used by the authorities in many countries prior to the most recent financial crisis did not pay sufficient attention to low-probability but high-consequence scenarios

Economic history is rich on extreme events which we illustrate in this paper by taking a closer look at the frequency and magnitude of extreme events in the economic history of Denmark on the basis of a new comprehesive data set with long-span time series on macro-financial risk factors compiled by the authors. We suggest using distributions of macro-financial risk factors based on long-span historical time series as a source of low-probability scenarios in macro stress tests.

Abildgren, Kim. 2015. Estimates of the National Wealth of Denmark 1845-2013, *Danmarks Nationalbank Working Papers*, No. 92, January.

In Denmark, there has been a long-standing tradition for estimating the stock of national wealth. However, the most recent estimate is from 1985 and the longest time series available covers only the period 1950-1978. In this paper, we review the earlier estimates and present new annual time series estimates on the stock of national wealth in Denmark 1845-2013 based on a broad range of contemporary and historical statistics as well as results from previous academic research.

The coverage of our national wealth is broadly in line with the most recent international national-accounts guidelines. As robustness checks, we compare this new data set with recent time-series estimates on the long-term development in the national wealth in other European countries and earlier estimates of the national wealth in Denmark.

We find that the wealth-to-income ratio in Denmark has followed a U-shaped pattern over the long run, which corresponds to developments in other European countries and indications from earlier estimates of the national wealth of Denmark. However, in two areas the historical development in Denmark differ from that of other European countries. First, there were no sharp declines in the Danish wealth-to-income ratio around the two world wars as was the case in France and Germany due to war-related destruction of the capital stock. Secondly, the wealth-to-income ratio in Denmark declined significantly from 1870 to 1913, whereas the ratios were basically stationary in France and UK during the same period. This reflects a faster growth in population and real gross domestic product per capita in Denmark during this period, which saw the first wave of industrialization in Denmark

4. Final remarks and scope for further research

A collection of historical statistics as the one presented in this paper can never be regarded as stationary. The arrival of new historical studies based on archive material might allow for

revisions and improvements of existing historical time series and the construction of data sets within new areas or for time periods not yet covered. Furthermore, the introduction of new definitions and compilation methods in contemporary statistics often call for the reconstruction of existing collections of historical statistics.

It is a common view that compilation and reconstruction of historical statistics is a time-consuming, old-fashioned and non-glorious exercise best left in the hand of research assistants. However, the compilation of high-quality long-span time series requires a thorough knowledge of the economic-historical development in order to deal with the large number of judgements and estimations that implicitly or explicitly have to be made in order to overcome problems with missing observations, incomplete coverage and sampling biases, changes in compilation methods and statistical classifications *etc*. It is the hope of the author that future generations of Danish economists and historians will find it stimulating to meet such challenges.

References

Abildgren, Kim. 2005a. Interest-Rate Development in Denmark 1875-2003 – A Survey, *Danish Journal of Economics (Nationaløkonomisk Tidsskrift)*, Vol. 143(2), pp. 153-167.

Abildgren, Kim. 2005b. Real Effective Exchange Rates and Purchasing-Power-parity Convergence: Empirical Evidence for Denmark, 1875-2002, *Scandinavian Economic History Review*, Vol. 53(3), pp. 58-70.

Abildgren, Kim. 2006. Estimates of the Danish general government budget balance and the cyclical budget volatility 1875-2005, *Danish Journal of Economics (Nationaløkonomisk Tidsskrift)*, Vol. 144(3), pp. 287-303.

Abildgren, Kim. 2007. Input-Output Based Measures of Underlying Domestic Inflation: Empirical Evidence from Denmark 1903-2002, *Economic Systems Research*, Vol. 19(4), pp. 409-423.

Abildgren, Kim. 2008a. A 'First Go' on Financial Accounts for Denmark 1875-2005, *Scandinavian Economic History Review*, Vol. 56(2), pp. 103-121.

Abildgren, Kim. 2008b. Short-term impacts on exchange rates from portfolio flows to and from Denmark 1984-2004, *Danish Journal of Economics (Nationaløkonomisk Tidsskrift)*, Vol. 146(2), pp. 156-177.

Abildgren, Kim. 2009a. Credit Dynamics in Denmark since World War II, *Danish Journal of Economics (Nationaløkonomisk Tidsskrift)*, Vol. 147(1), pp. 89-119.

Abildgren, Kim. 2009b. Monetary Regimes and the Endogeneity of Labour Market Structures – Empirical Evidence from Denmark 1875-2007, *European Review of Economic History*, Vol. 13(2), pp. 199-218.

Abildgren, Kim. 2010. Consumer Prices in Denmark 1502-2007, *Scandinavian Economic History Review*, Vol. 58(1), pp. 2-24.

Abildgren, Kim. 2012a. Business Cycles and Shocks to Financial Stability - Empirical evidence from a new set of Danish quarterly national accounts 1948-2010, *Scandinavian Economic History Review*, Vol. 60(1), pp. 50-78.

Abildgren, Kim. 2012b. Financial structures and the real effects of credit-supply shocks in Denmark 1922-2011, *European Review of Economic History*, Vol. 16(4), pp. 490–510.

Abildgren, Kim. 2013. Stress scenarios from the tails of historical distributions of macro-financial risk factors in Denmark, *Danmarks Nationalbank Working Papers*, No. 86, November.

Abildgren, Kim. 2014. Tail events in the FX markets since 1740, *Journal of Risk Finance*, Vol. 15(3), pp. 294-311.

Abildgren, Kim. 2015. Estimates of the National Wealth of Denmark 1845-2013, *Danmarks Nationalbank Working Papers*, No. 92, January.

Johansen, Hans Chr. 1985. *Danish historical statistics 1814-1980*, Copenhagen: Gyldendal.

Johansen, Hans Chr. 1991. *Danmark i tal*, Copenhagen: Politiken.