

A (not so brief) history of inflation in Austria

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We analyze the eventful history of inflation in Austria over the past two centuries against the background of institutional, economic and political developments. Ultra-high inflation or hyperinflation resulted from repeated monetary financing of war expenses, war-related destruction of productive capacity as well as fear of short-term political and social consequences of anti-inflationary measures. Like other countries, Austria experienced the highest inflation during peaceful times in the 20th century when efforts were made to cushion the negative output effects of oil price shocks. Inflation volatility was high in the 19th century up to the Gründerzeit boom and in the 20th century during the Great Inflation; it was low in the half-century up to World War I and during the Great Moderation. Our frequency domain analysis for the pre-World War I and post-World War II periods finds that, in line with the economic literature, the correlation between money growth and inflation is considerably higher for long and very long frequencies than for business cycle frequencies. The varying correlation between money and inflation reflects changing monetary regimes. We cannot establish a stable empirical Phillips curve relationship; in the post-World War II period, the relationship breaks down once supply shocks (oil prices) are included. Deflation was quite frequent in 19th-century Austria and was not necessarily associated with recessions. By contrast, Austria's 20th century Great Depression fits the textbook notion of deflation, high unemployment and economic slack. Formal central bank independence did not prevent the erosion of monetary value in "emergency situations" of wars. Hyperinflations and currency reforms repeatedly inflicted substantial and long-lasting damage on citizens' trust in state money and in the state more generally.

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Keywords: inflation, Austria

Maintaining price stability is the primary objective of monetary policy nowadays, and we have become used to very low rates of consumer price inflation in Austria over the past three decades. However, inflation has not always been low. The bicentennial of the Oesterreichische Nationalbank (OeNB) offers the opportunity to analyze the eventful – and at times dramatic – history of inflation in Austria over the past two centuries.

Looking back in history, we find that the central bank's role, mandate, and institutional status in relation to the government, the intermediate goals of monetary policy as well as the instruments available to, and used by, the central bank have evolved considerably over time. These changes reflect vary-

ing economic circumstances (such as the conduct of devastating and expensive wars) and the evolution of economic thought (e.g. the doctrine of metal standards that applied throughout most of the 19th century, the *Keynesian* concept of exploiting an – actual or perceived – tradeoff between unemployment and price stability during the 1960s and 1970s, and the emphasis on time inconsistency and central bank independence since the 1980s).

Any analysis of price and inflation developments should take this broader perspective into account rather than imposing present-day economic and institutional concepts *ex post*. In this article, we therefore combine a historic narrative that recalls relevant political, institutional and economic develop-

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ments when identifying various inflation regimes with empirical statistical and econometric analysis to shed light on Austria's inflation history from various angles.² We use the long time series that have now been made available by the OeNB to discuss specific features of the development of the inflation rate. In particular, we investigate inflation volatility, the long-run relationship between money growth and inflation, and the short-run correlation between the output gap and inflation in Austria; we then discuss whether these relationships have changed over time.

For our purposes, it is useful to distinguish five periods of inflation in Austria over the past two centuries: first, the pre-World War I period of an overall relatively stable price level (section 1); second, World War I (WW I) and the following period of hyperinflation (section 2); third, the post-WW I currency reform, the Creditanstalt crisis and the Great Depression (section 3); fourth, World War II (WW II) and the postwar inflation and currency reform (section 4); fifth, the further postwar period, which includes the response to the demise of the Bretton Woods system, the first and second oil price shocks as well as the hard currency policy and Austria's membership in Economic and Monetary Union (EMU) (section 5). Section 6 summarizes and concludes.

1 The first century until World War I

The foundation of the *privilegierte oesterreichische National-Bank* in 1816 reflected the attempt to establish monetary stability after 100 years of incon-

sistent policies resulting from the quest to achieve credibility for the central bank and paper money despite rulers seeking ways to have the central bank finance their expenses, most notably for wars. Various institutional changes had been attempted (Jobst and Kernbauer, 2016) to enhance the predecessor institutions' credibility by bolstering these institutions' perceived – rather than actual – independence. But despite this conflict of goals (monetary stability versus war financing) currency stability was not seriously endangered until the Napoleonic wars, as taxation and loans sufficed to finance most war expenditure. In the end, however, the Napoleonic wars proved to be too long; the pressure for the monetary financing of war expenses prevailed, and the resulting expansion of money in circulation eroded the purchasing power of money. Paper money, originally adopted by the public voluntarily for its ease of use, was eventually enforced by law, by being granted the status of legal tender. Repeated attempts at currency stabilization were half-hearted and had no lasting impact. The amount of paper money in circulation increased 120-fold between 1792 and 1816. In the two decades before the Nationalbank's foundation in 1816, the average price of seven food items in Vienna increased 50-fold. The sovereign default and currency reform of 1811, which had at its core the compulsory devaluation of paper florins to one-fifth of their value, was considered “a brutal and wrongful method of debt relief that shook financial and legal relationships to the core” (Brandt, 1978, as quoted and translated in Jobst and Kernbauer, 2016). At the

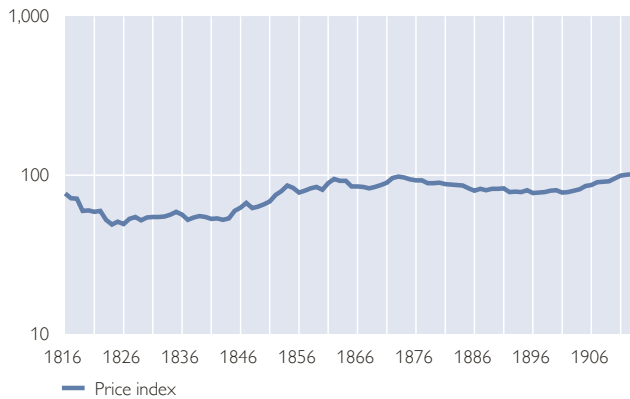
² For a detailed account of the broader economic historical and institutional developments, please refer to Jobst and Kernbauer (2016) as well as to Antonowicz et al. (2016). The latter publication also includes an overview chart of inflation in Austria spanning the period from 1800 to 2015 and numerous overview tables with relevant historical events.

Chart 1

The first century until World War I (1816 to 1913)

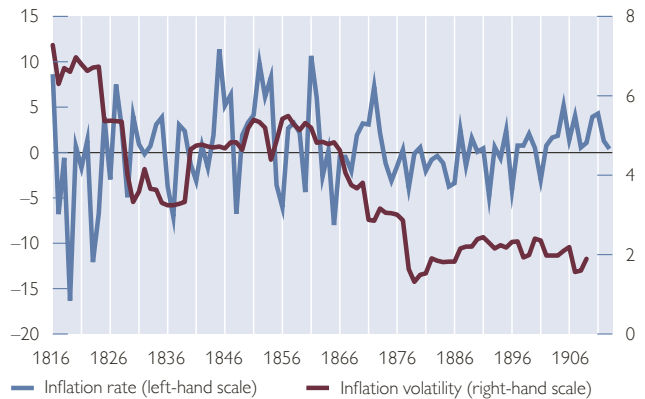
Price index

Index (1914=100, logarithmic scale)



Inflation

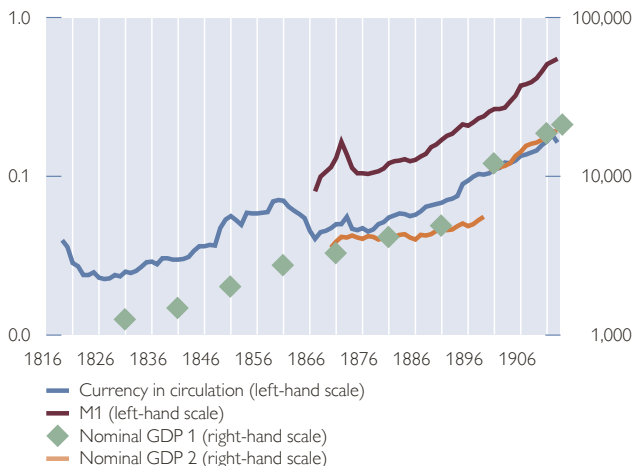
% Standard deviation in %



Nominal GDP and money supply

ATS billion (converted from original currency (logarithmic scale)

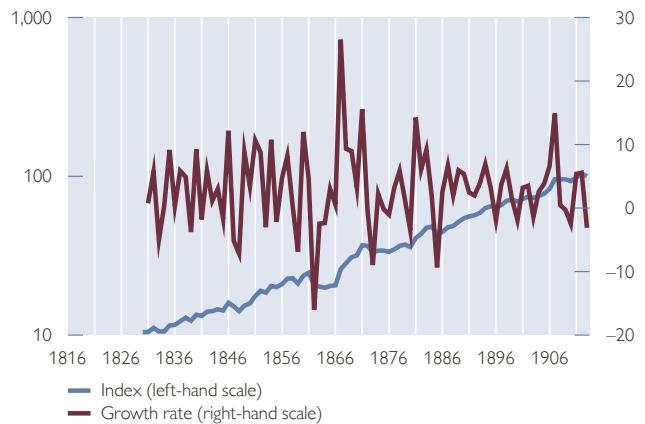
Million currency then in force (logarithmic scale)



Industrial production

Index (1913=100, logarithmic scale)

%



Source: OeNB, Komlos (1986), Mühlpeck et al. (1979), Kausel (1979), Bank of Greece et al. (eds.) (2014), authors' calculations. For further information on the data, see annex.

Note: Nominal GDP 1: Kausel (1979), Nominal GDP 2: Bank of Greece et al. (eds.) (2014). Before 1900 Gulden österreichischer Währung (Austrian florin), 1900 conversion to crown.

same time, the currency reform of 1811 did not bring the promised end to inflation.

It is against this background that the foundation of the Nationalbank in 1816 needs to be seen. The currency reform of 1816 was based on three pillars: first, the return to convertibility into metal currency; second, the credible consolidation of state finances; and, third, the foundation of a new institution in charge of monetary stability, whose incentive structure as an independent,

privately owned institution was shaped to pursue this objective.

However, subsequent changes in the central bank statutes successively increased the state's influence on the Nationalbank's policy, and a coalition of interests of the state, the Nationalbank's shareholders and management, who all sought to maximize seignorage from note issuance, implied that the share of banknotes in cash in circulation increased to much higher levels

than e.g. in France, England or Germany and that the Nationalbank's silver reserves remained lower than originally planned. A low silver coverage ratio of banknotes in circulation either triggered silver purchases (1830, 1840) or prompted the Nationalbank to use moral suasion to prevail upon the few large borrowers to curb the volume of discount (1836, 1840), reflecting the Nationalbank's focus on policy measures aimed at influencing the quantity rather than the price of money. The interest rate played quite a minor role as a policy instrument; rate cuts in 1829 and 1833 were targeted at smoothing the issuance of the government's capital market financing. At the time, financing the government was still an important activity of the central bank, as the predominance of claims against the government among the Nationalbank's balance sheet assets clearly showed.

While annual inflation fluctuated substantially (between -7.1% and $+7.5\%$), the level of consumer prices remained quite stable overall between 1825 and 1844, with inflation averaging 0.5% and the cumulated increase in the consumer price level coming to 5% . Inflation volatility³ also dropped over this period, starting from quite high levels after the Napoleonic wars. In the view of Jobst and Kernbauer (2016), this apparent monetary stability rested on secrecy with respect to the Nationalbank's fragile balance sheet and business model as well as on the state's assistance in ensuring silver convertibility during periods of tension. However, this very secrecy became a source

of uncertainty, distrust and panic in the run-up to the revolution of 1848. A run on banks and on the central bank in February 1848 prompted the Nationalbank to start publishing its balance sheet on a monthly basis. However, this made visible the large share of government debt in the Nationalbank's assets, further eroding rather than restoring trust and in turn precipitating an end to the convertibility of banknotes into silver. Attempts to restore convertibility failed several times until 1867, mainly as a result of repeated war-induced state recourse to central bank financing or of the issue by the state of parallel paper currency of the same value as the central bank's banknotes. This measure eroded the silver coverage ratio of banknotes in circulation. The three years up to 1866 witnessed a marked reduction in banknotes in circulation.⁴ There is no agreed view on whether this "deflationary" monetary policy was responsible for the contraction and subsequent stagnation of industrial production or whether the fall in the money supply was endogenous instead, reflecting low money demand in the face of foreign and domestic real shocks to aggregate demand.

Empirically, the correlation between growth in currency in circulation and inflation during this period was relatively high (see chart 2 and the annex for data and technical details). This is also true for various filter frequencies when one of the series is lagged. A possible interpretation might be that this period was without major innovations in payments systems (Kernbauer, 2016).

³ Inflation volatility is calculated as the standard deviation of the inflation rate over 11 years. We assign the result to the midpoint of the period. The length of the period chosen is both long enough for meaningful computations and short enough to capture the impact of contemporaneous structural, institutional and other historic developments.

⁴ Technically, this reduction of banknotes in circulation was implemented by the government reimbursing its debt with the central bank.

Largest correlation between inflation and currency in circulation or M1



Source: Authors' calculations.

Note: Figures attached to bars show lags(+)/leads(-) in years.

Jobst and Kernbauer (2016) characterized the period between 1866 and 1914 as the switch – with obstacles – from fiscal to monetary dominance. Two conditions were put into place to enable this switch: First, the new statutes of 1863 stated as the central bank's policy goal pegging the value of the currency to the price of silver; given the stable relation of the prices for silver and gold, this implied stable exchange rates vis-à-vis not only the many other silver and bimetallic currencies but also vis-à-vis the pound sterling – then the only major gold-based currency. Second, the central bank had the instruments to actually pursue its goal: It set the interest rate independently and it was in control of its balance sheet, thus ensuring that banknotes were indeed backed by silver, gold and private credit, rather than by claims against the government.

Fueled by abundant liquidity and historically low interest rates, the years between 1866 and 1873 witnessed the

so-called *Gründerzeit* boom. The excessively expansionary monetary policy was caused by a combination of several factors: first, the continued existence of a large stock of parallel state paper money which was not duly taken into account in the statutory banknote coverage ceiling; second, the central bank's revenue motive, which provided an incentive to continue its aggressive credit policy (since the generation of credit increased the profits of the central bank's shareholders); third, the concern that monetary restriction might hurt the financial sector and the view that monetary policy was neither able to nor supposed to prevent or curb speculative bubbles; fourth, capital inflows from foreign investors seeking to participate in the Austrian stock market boom, which further exacerbated surplus liquidity. The *Gründerzeit* boom was mirrored in a temporary surge in consumer price inflation caused by buoyant aggregate demand,

notably in the construction, metals and machinery sectors. The boom ended and the stock market crashed in May 1873. During the subsequent two decades until the early 1890s, inflation was negative in two-thirds of all years, measuring around -1% on average. There is no agreed view whether this deflationary period was also accompanied by a depression of the real economy (Jobst and Kernbauer, 2016).

The Compromise of 1867, which turned the Austrian Empire into a dual monarchy, implied for the central bank that it was transformed into the *Oesterreichisch-ungarische Bank*. While renewals of the central bank's statutes (now required every ten years) implied continuous complex political negotiations for the Nationalbank, which formally reduced its independence, its position as a single monetary entity between two political powers which often blocked each other in important decisions implied a substantial degree of de facto autonomy. As a result, the Nationalbank successfully managed to ensure monetary stability over the last two decades before WW I and pegged the Austrian currency to gold, with inflation emerging from negative territory in the second half of the 1890s and then remaining in moderate positive territory between 1% and 4% during most years until 1913.

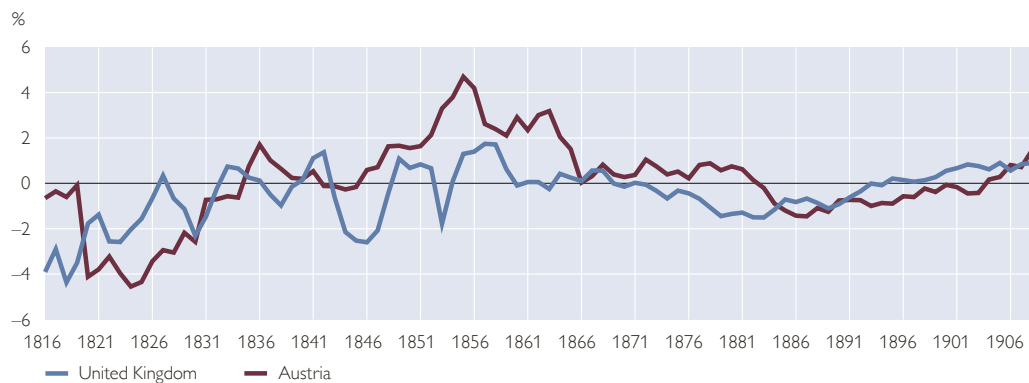
This is also reflected in the quite low inflation volatility over the 1867 to 1913 period. Apart from monetary policy and quite stable money growth, closer trade integration and technical progress that facilitated transport and communication might also have contributed to the downtrend in inflation volatility.

Compared to the pre-1967 period, during 1867 to 1913 the correlations between inflation and the growth in currency in circulation as well as M1

are relatively low. In fact, without lagging the variables and for both the short- and long-run frequencies, correlations between inflation and money growth were the lowest among all the subperiods for which we investigated these relationships (chart 2). Possible interpretations may include, first, that part of the *Gründerzeit* inflation found its way into asset price rather than consumer price inflation; and second, that the long period of post-*Gründerzeit* negative inflation may have affected the relationship between money growth and inflation.

To sum it up, the first 100 years up to WW I witnessed quite substantial fluctuations in the annual rate of inflation, reflecting numerous shocks affecting aggregate demand and supply, such as wars and revolutions, harvest-dependent fluctuations in food prices, but also crises of confidence in the central bank and the currency regime as well as repeated attempts by the government and central bank to re-establish trust and stability. The main episodes of inflation were associated with crop failures or monetary financing of wars around mid-century as well as the *Gründerzeit* bubble in the run-up to the 1873 crash. Periods of deflation occurred most notably in the decade following the end of the Napoleonic wars and – more mildly but for an extended period of time – after 1873.

At the same time, the period was also characterized by a remarkable degree of long-term stability in the *level* of consumer prices. This was likely due to the overall conception that monetary policy should in principle ensure convertibility into a precious metal (mostly silver in 19th-century Austria) at a given rate. Despite repeated recourse by the state to central bank financing, this principal notion was not challenged, and the state in several cases made efforts and took active measures to put

Inflation rate from 1816 to 1908: moving averages

Source: Bank of England, OeNB.

Note: 11-year moving averages.

the central bank into a position to re-establish silver convertibility. As a result, the value of money was quite firmly anchored in a long-run perspective.

Chart 3 suggests that international developments also played a role in determining inflation in 19th-century Austria. Assuming that inflation in the U.K. mirrored price developments of commodities and other goods in the world market, chart 3 suggests that global factors could explain a sizeable portion of Austrian inflation fluctuations during the 19th century. Nevertheless, the large positive inflation differential in the middle of the 19th century likely reflected domestic factors, notably the chronic deficit in government finances, which led to a lack of discipline in controlling the amount of banknotes and/or state paper currency circulated in parallel, thus compromising repeated attempts to re-establish silver convertibility (Jobst and Kernbauer, 2016, for details).

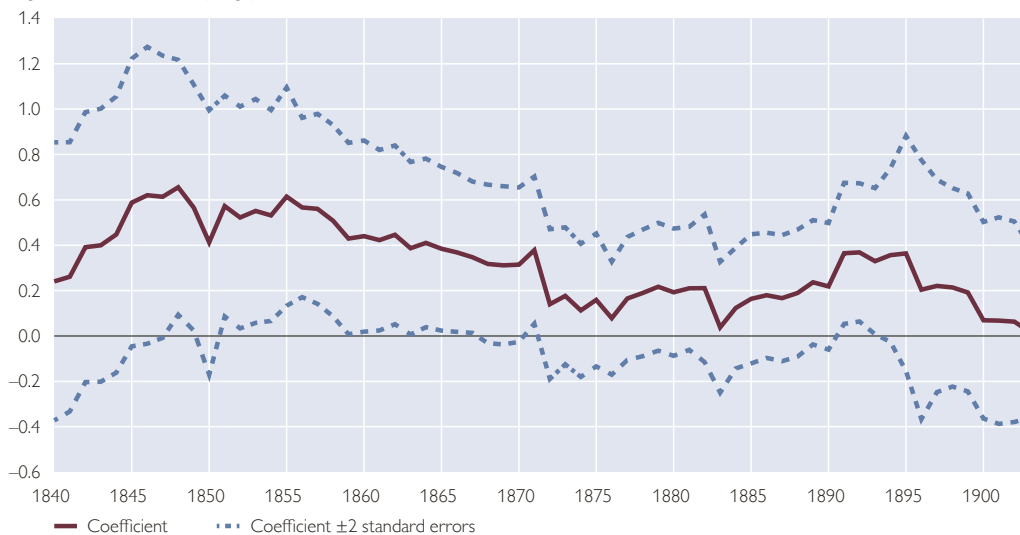
Given the ups and downs of economic growth and inflation in 19th-century Austria, the question arises as to whether there was a short-term correlation between economic activity and inflation, i.e., to put it in 20th-century economic terminology, whether there was a Phillips curve-type relationship. Chart 4 displays the coefficient for the output gap from rolling regressions of the inflation rate on the output gap and lagged inflation.⁵ The chart suggests that the correlation between the output gap and inflation was more pronounced until about the 1870s than in the final decades of the monarchy. The regression results (table A1 in the annex) for the two subperiods from 1830 to 1866 and from 1867 to 1913 also confirm this result: The estimated impact of the output gap on inflation was statistically significantly different from zero only in the years from 1830 to 1866 but not so from 1867 to 1913. Clearly, this simple analysis can provide only some preliminary clues and cannot be taken as the final word.

⁵ See the annex for more information on method and data used.

Chart 4

Phillips curve from 1840 to 1903

Regression coefficient on output gap



Source: Authors' calculations based on OeNB data. For further information on the data, see annex.

2 World War I and hyperinflation

WW I boosted inflation and eroded the value of the currency through several channels. First, the war led to a massive reduction of the labor force as well as the destruction of physical capital, reducing potential output: By 1918, real GDP had dropped to less than 60% of the prewar level.⁶ Second, war expenditures absorbed a substantial part of production: At 80% to 90% of prewar GDP, the total cumulative financial cost of WW I for Austria was considerable (though relatively moderate compared to other countries). Third, while WW I was mostly financed through war bonds actively marketed to the public, one-third of financing came through direct central bank credit to the government.

In August 1914, important parts of the Nationalbank's statutes were rescinded, abolishing inter alia the statutory minimum gold coverage of

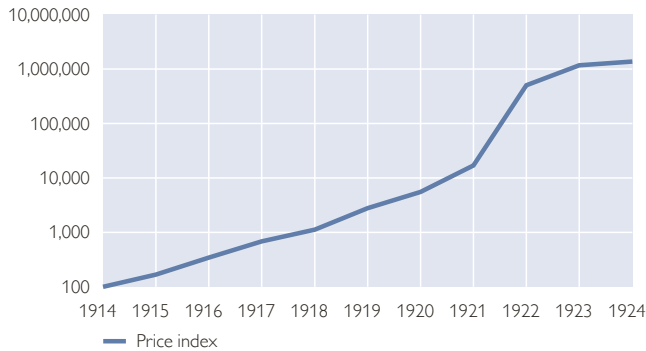
banknotes in circulation as well as the prohibition of central bank credit to the state. The amount of banknotes in circulation increased 12-fold from mid-1914 to the end of WW I. With some lag, the escalating volume of central bank credit to the state also resulted in hyperinflation. Between 1915 and 1918, annual inflation averaged 84%; in 1918, the level of consumer prices was 11 times higher than in 1914, which implies a striking co-movement of money in circulation and the price level. Annual consumer price inflation escalated further after the end of the war. In 1919, it reached 149% and in 1920 99%, to skyrocket to 205% in 1921 and to 2,877% in 1922. All in all, between 1914 and 1922, the level of consumer prices increased more than 5,000-fold, and by 1924, prices had surged to nearly 14,000 times their 1914 level.

⁶ Given that aggregate demand was boosted aggressively by extreme monetary expansion, most of this drop can be assumed to reflect a decline in productive capacity.

World War I and hyperinflation (1914 to 1924)

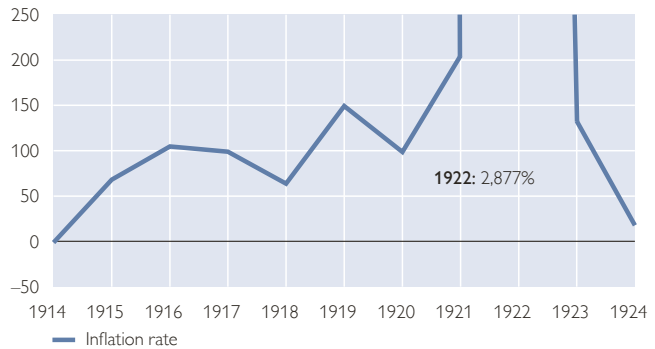
Price index

Index (1914=100, logarithmic scale)



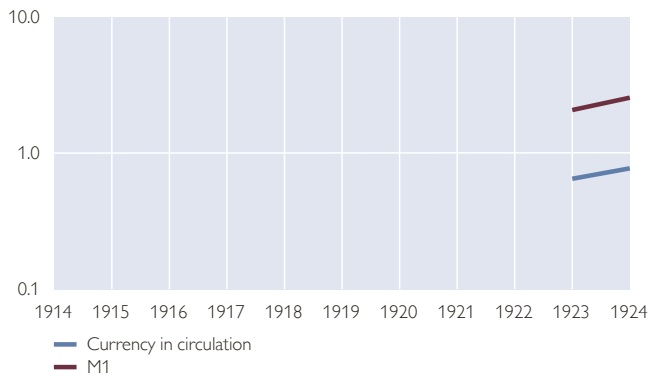
Inflation rate

%



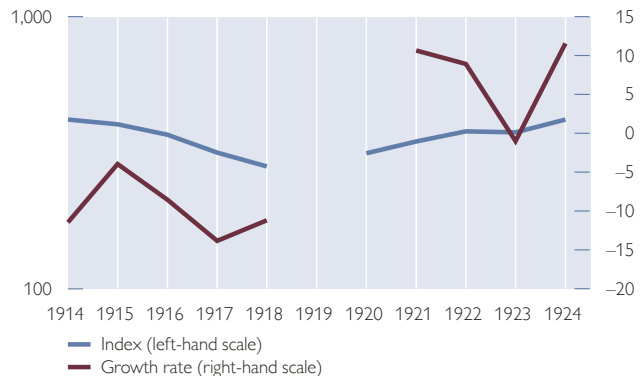
Money supply

ATS billion (converted from original currency; logarithmic scale)



Real GDP

Index (1830=100, logarithmic scale)



Source: OeNB. For further information on the data, see annex.

Like during WW I, the central bank perceived itself as being the government's printing press, causing the war-induced very high inflation to escalate into outright hyperinflation. The central bank's management was apparently aware of the likely medium-run outcome of this course of action but nevertheless chose to continue on its path toward hyperinflation out of the perceived immediate necessity to do so, for fear of upheaval, social chaos and anarchy (Kernbauer, 1995). In more general terms, short-term political necessities were taken as a justification for ultra-expansionary monetary policies that must have been – and were – known to ultimately ruin the monetary order and to lead to chaos and destruc-

tion, albeit a few years later. While alleviating the government's debt burden, hyperinflation at the same time implied the impoverishment of the holders of war bonds, and thus of the middle class.

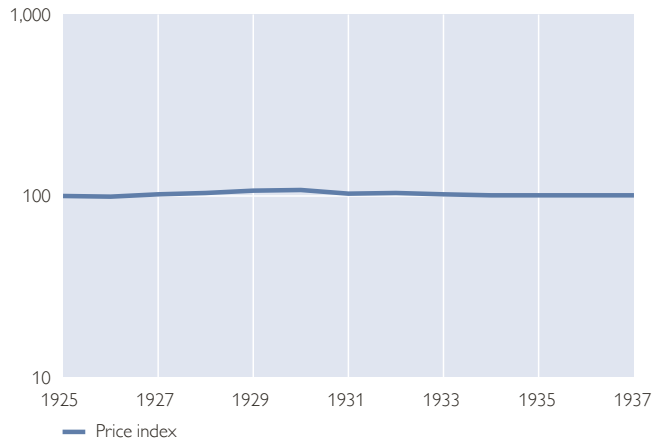
3 Currency reform, Creditanstalt crisis and the Great Depression

Hyperinflation was ended through a combination of measures, the first of which was an international rescue program of the League of Nations. This program included guarantees by several foreign states for the issuance of international bonds by Austria. This international help was tied to the implementation of strict monetary and fiscal reforms as well as close international

Currency reform, Creditanstalt crisis and the Great Depression (1925 to 1937)

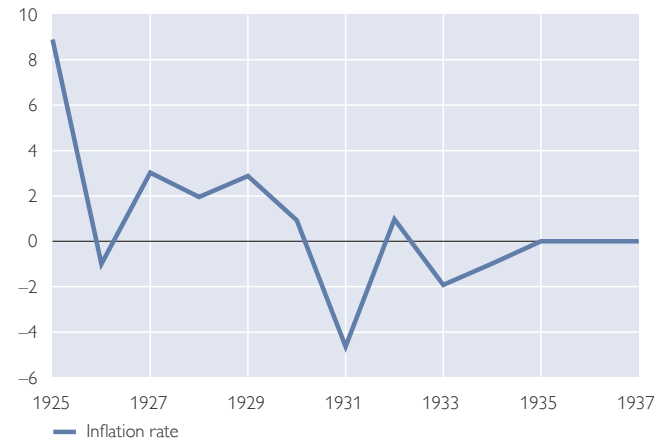
Price index

Index (1925=100, logarithmic scale)



Inflation rate

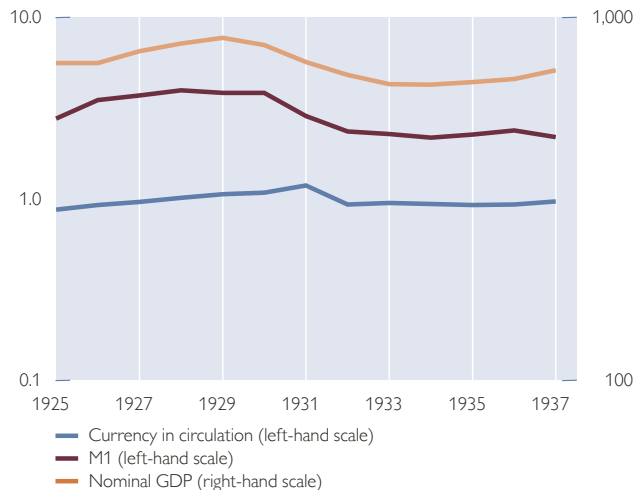
%



Nominal GDP and money supply

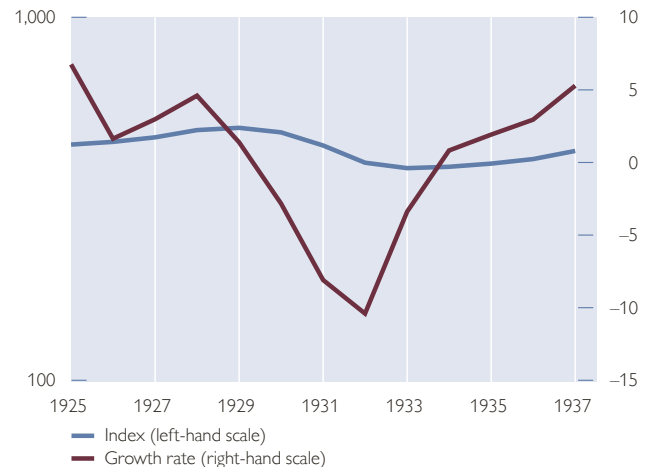
ATS billion (logarithmic scale)

EUR million (logarithmic scale)



Real GDP

Logarithmic scale (1830=100)



Source: OeNB. For further information on the data, see annex.

monitoring of Austrian economic policies. Second, the Oesterreichische Nationalbank (OeNB) was re-established as a stock corporation in which the central government's influence was fairly limited and monetary financing was strictly prohibited. Moreover, the central bank was given the mandate to prepare a return to the pre-WW I gold standard. Third, the exchange rate of the Austrian crown was stabilized against the U.S. dollar by ensuring the credibility of the overall reform pro-

gram as well as by boosting official reserves through a League of Nations loan. Finally, the Schilling Conversion Act, passed on December 20, 1924, provided for the conversion of crowns into a new currency, the schilling, at a rate of 10,000 paper crowns, or 0.694 gold crowns, to the schilling. Thus, the schilling's fine gold weight was fixed at 0.21172086 g, some 30% less than the weight of the gold crown.

Backed by the recovery of the world economy, real GDP grew on average by

3.5% per year and the budget was more or less balanced between 1925 and 1929. In this supportive environment inflation was relatively stable. The inflation rate dropped strongly in 1926 and then remained at a moderate level of 2.6% on average. However, despite this generally favorable situation unemployment remained high. The strong increase in unemployment in the early 1920s (amongst others because of a reduction in the number of public employees by 80,000) was not significantly reversed. As a consequence, Austria recorded an unemployment rate of 12.7% in 1929.

The Great Depression triggered the breakdown of the Austrian bank *Creditanstalt* in 1931, leading to costly rescue operations by the central bank and the government. The crisis prompted the central bank to defend the schilling exchange rate through interest rate hikes and foreign exchange controls. In line with many other countries, Austria ultimately abandoned the gold/foreign exchange parity and depreciated the schilling. Austrian real GDP shrank by 22% in total in the four years from 1930 to 1933 and recovered only half of this loss in the subsequent four years up to 1937. The unemployment rate in 1937 stood at 22%, indicating large and persistent economic slack. Monetary policy during this period followed a restrictive stance, which is exemplified by the decision in 1936 not to join a number of European countries' exchange rate devaluations. Inflation reflected the deep depression, plunging to -4.6% in 1931 and posting an average of -0.3% between 1932 and 1937. The entire period of very low inflation and rising unemployment between 1924 and 1937 suggests the existence of a Phillips curve-type relationship in interwar Austria.

4 World War II, postwar inflation and currency reform

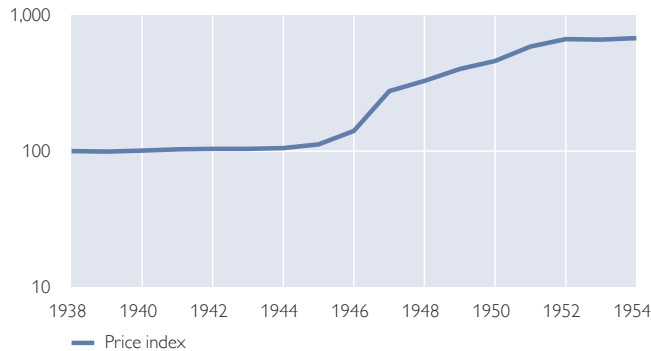
The *Anschluss* of Austria to Germany was swiftly followed by the liquidation of the OeNB, and the German reichsmark replaced the schilling as legal tender. Schillings were converted into reichsmark at a rate of 1.5 to 1. Although production expanded sharply after the *Anschluss* – Austria's GDP grew by 13% both in 1938 and 1939 – the price level, which had stagnated during the three previous years, shrank by 1% in both years. Prices fell because the schilling-reichsmark conversion rate implied an appreciation, railway ticket prices and postal fees were cut, the sales tax taken over from Germany was lower, and wage-price stops were enforced as well as the German system of price regulation (Jobst and Kernbauer, 2016).

The German Reichsbank financed the escalating war expenses of the Third Reich, during the last years of the war mostly by extending direct central bank credits. In Austria, the production of nonwar-related goods shrank, causing severe shortages of daily goods and food; however, the price freeze effective until the end of the WW II prevented inflation from breaking out openly: Between 1940 and 1944, inflation in Austria ranged between 0% and 2%, averaging 1.2%. By 1945, the volume of banknotes in circulation in Austria is estimated to have increased by a factor of 12 to 23 compared to 1937. As in Germany, GDP in 1945 is estimated to have halved compared to 1937. Thus, like WW I, WW II caused potential output to drop sharply and money supply to increase massively, which implied a dramatic explosion in the price level unless measures to eliminate the monetary overhang were taken (Jobst and Kernbauer, 2016).

World War II, post war inflation and currency reform from 1938 to 1954

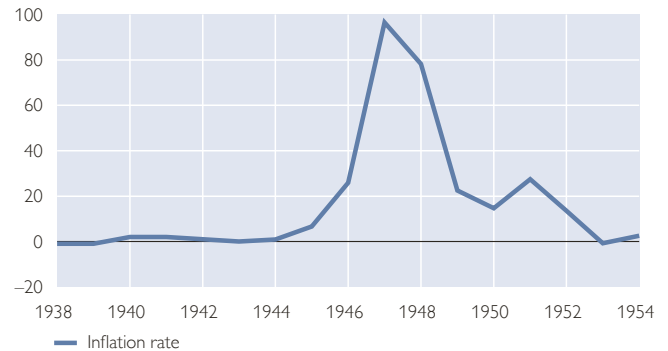
Price index

Index (1925=100, logarithmic scale)



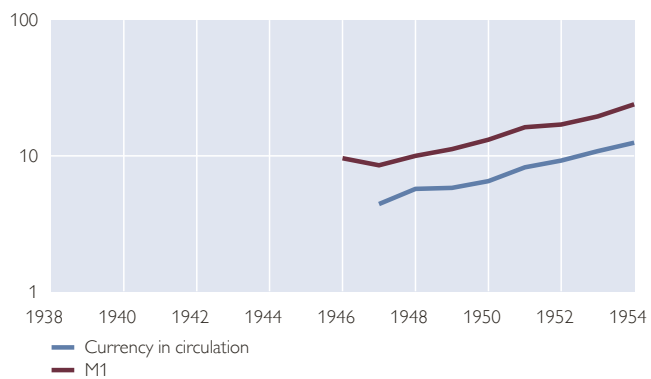
Inflation rate

%



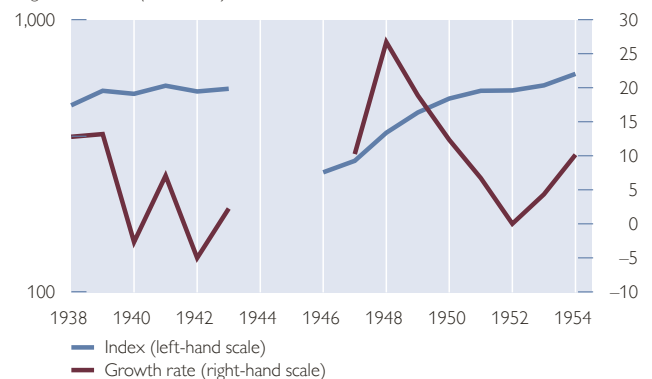
Money supply

ATS billion



Real GDP

Logarithmic scale (1830=100)



Source: OeNB. For further information on the data, see annex.

The currency reform involved several steps: The Resumption of Payments Act of July 3, 1945, blocked 60% of bank deposits; withdrawals of the remaining 40% were allowed subject to limits and for certain purposes only. The Schilling Act of November 30, 1945, reinstated the Austrian schilling as legal tender. In December 1945, reichsmark notes (and military schillings) in denominations of 10 reichsmark and above were exchanged into Austrian schillings at a rate of 1 to 1, up to 150 Austrian schillings per person. Amounts beyond this were transferred to limited access accounts. However, the subsequent release of blocked accounts as well as the financing by the central bank of sizeable occupation costs caused the

money supply to rise again. Ownership and use of foreign exchange remained restricted.

The lack of goods and food and the continued existence of a sizeable monetary overhang caused inflation to rise strongly and swiftly in the postwar years. Inflation peaked at 97% in 1947. The Currency Protection Act of 1947 finally tackled the inflation problem. Its purpose was to reduce banknote circulation and bank deposits, and to prepare the cleaning up of bank balance sheets. In December 1947, notes and coins in circulation were exchanged into new schilling notes at a ratio of 3:1, except for an amount of 150 schillings per person, for which a ratio of 1:1 was used. The accounts blocked by

the Resumption of Payments and Schilling Acts were completely rescinded, and restricted accounts were converted into claims against the federal government. In effect, the measures halved the volume of both notes in circulation and of deposits. Furthermore, all in all five price-wage agreements among the social partners (i.e. employers' and employees' associations) concluded between 1947 and 1951 aimed at containing inflationary pressures.⁷ Inflation reacted immediately and strongly, falling to 19% in 1948. The currency reform underpinned the Austrian schilling's exchange rate, dampened black market food prices and created a generally optimistic mood, in turn spurring a strong economic recovery. Real GDP jumped by 28% in 1948, and posted remarkable increases of 19% and 12%, respectively, also in the two subsequent years. By 1951, Austrian real GDP had doubled against 1946, clearly surpassing the prewar level. At the same time, inflation remained broadly under control, averaging 20% in the four years up to and including 1952.

To counteract the chronically high current account deficits, split exchange rates were used after WW II until 1953, and the Austrian schilling was devalued in 1949 and 1950 – however, without much effect. To curb the very strong credit growth that had been observed since 1947, credit controls were adopted starting from 1951 – unlike the devaluations, these were effective.⁸ Halting the credit expansion was the final step in breaking inflation: It fell to –0.7% in 1953. The decisive disinflation led to a temporary sharp fall in

GDP growth to 0.1% in 1952, which was, however, followed by a renewed vigorous recovery in subsequent years (4.4% in 1953 and double-digit growth rates in 1954 and 1955). The recovery in 1953 was helped by repeated cuts in central bank interest rates and by an effective depreciation of the Austrian schilling in the context of exchange rate unification, while the inflationary impact of exchange rate depreciation was contained by food price subsidies on wheat and imported animal feed; without these measures, inflation would, according to WIFO (1953), have reached 3.7%.

5 Postwar recovery, post-Bretton Woods era, hard currency policy and participation in the euro area

The final institutional step to ensure lasting currency stabilization was taken in 1955 with the passage of the Nationalbank Act, which contained a number of provisions to increase central bank independence and which changed the central bank's mandate toward maintaining both the domestic purchasing power and the international exchange value of the Austrian schilling. While independent, the central bank was required to consider the economic policy of the federal government in exercising its monetary and credit policies (for details, see 1955 Nationalbank Act, Article 2(2) and Article 4).

The success of currency stabilization was confirmed by the moderate inflation average of 2.3% in the years between 1954 and 1960, during which real GDP increased by 7% on average.

⁷ While the first three agreements were widely regarded as successful in containing inflationary pressures, the effects of the fourth agreement was questionable and the fifth agreement might even have contributed to higher inflation (Butschek, 2011).

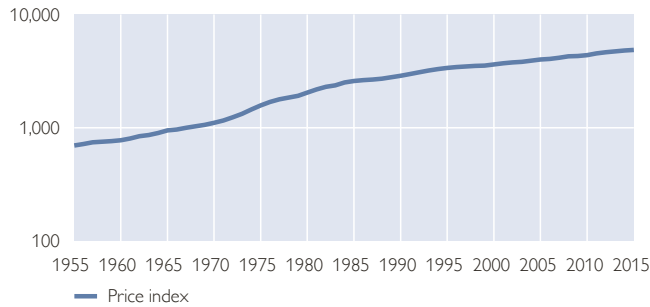
⁸ The Korean War in the early 1950s spurred U.S. military expenditure and inflation, which had global repercussions. Part of the inflation spike in Austria in 1951 may also have been related to these developments (Breuss, 1980).

Chart 8

Post-war recovery, post-Bretton Woods, hard currency policy and euro adoption (1955 to present)

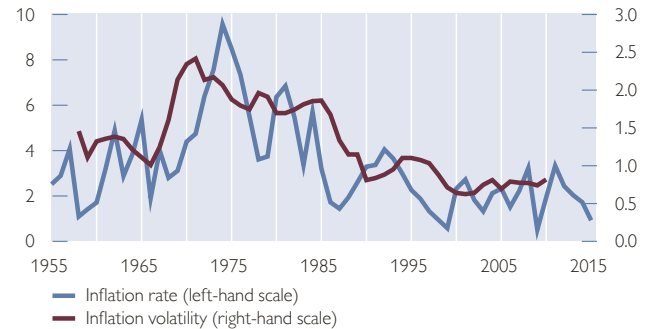
Price index

Index (1925=100, logarithmic scale)



Inflation

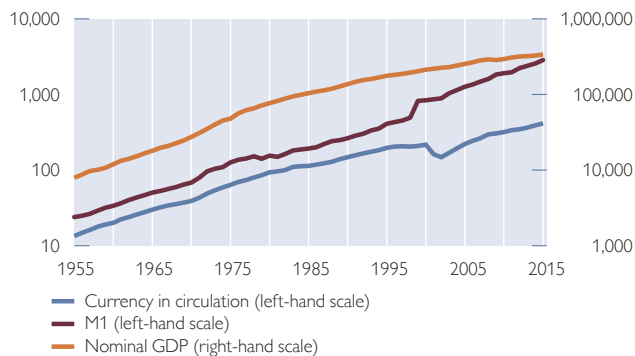
% Standard deviation in %



Nominal GDP and money supply

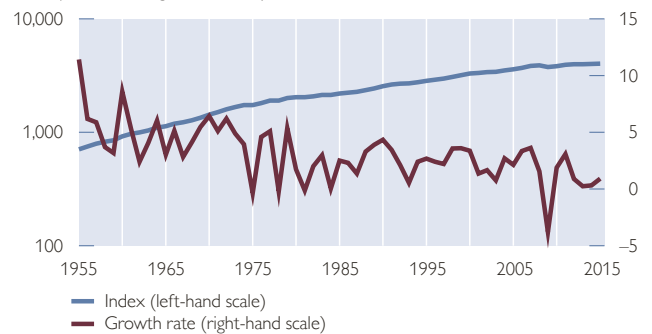
ATS billion

EUR million



Real GDP

Index (1830=100, logarithmic scale)



Source: OeNB. For further information on the data, see annex.

The 1960s were characterized by transition to full employment and relatively pronounced fluctuations of prices and wages. Between 1961 and 1971, inflation averaged 3.7%, and real GDP growth averaged 4.5%. Toward the end of the 1960s, inflation accelerated in the wake of global inflationary pressures emanating from U.S. expenditure for the Vietnam War and as a result of high wage increases in 1968 and 1970 (Breuss, 1980).

The combination of a remarkable economic catching-up process with relatively moderate inflation during the two decades until 1971 was facilitated by the close cooperation between the

government and the social partners, which aimed at establishing a fine balance between international cost competitiveness and real wage gains and at ensuring social well-being and peace. When inflation accelerated in 1957, the Parity Commission for Wages and Prices was established to control and dampen wage and price developments. Social partners committed themselves to reporting all planned price increases and wage demands to the commission for evaluation (Breuss, 2011). In the beginning of the 1960s (Raab-Olah-Abkommen) the responsibility for wage negotiations was transferred to a subcommittee on wages⁹ that approved the

⁹ A subcommittee on prices had already been established in the 1950s.

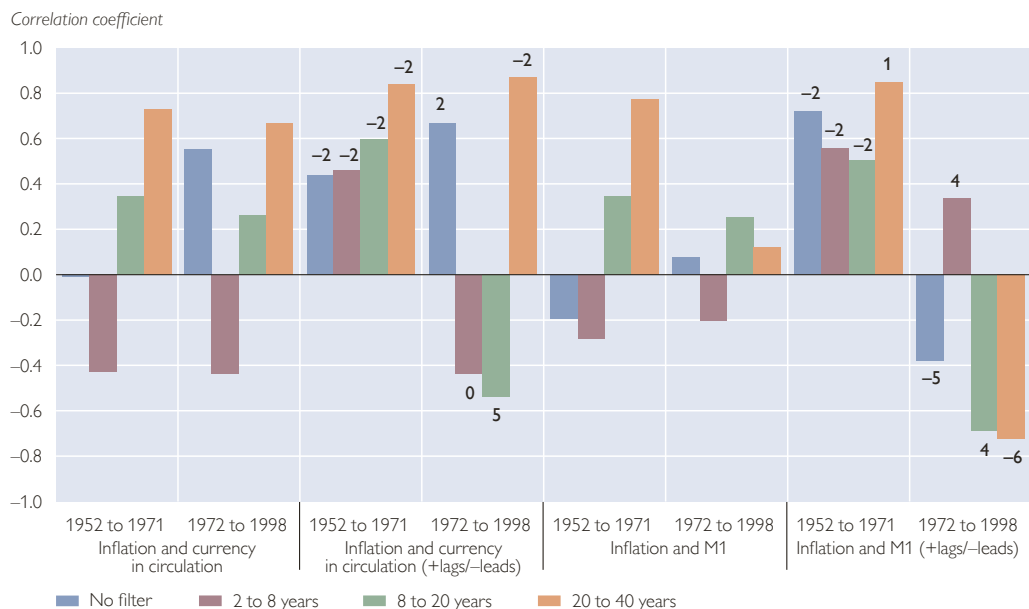
result of wage negotiations (system of collective wage bargaining in Austria).¹⁰ In addition, investment tax rebates and favorable investment financing helped develop the capital stock and bolstered potential growth. Export support schemes, which included favorable public guarantee schemes and financing, fostered Austria's integration in the global economy.

Since the adoption of a unified exchange rate in 1953, the Austrian schilling's parity vis-à-vis the U.S. dollar and thus also gold was maintained within a margin of $\pm 1\%$. This implied, however, a devaluation of some 15% against the Deutsche mark – the currency of Austria's main trading partner – and revaluations of 15% and 37%, respectively, against the pound sterling and the French franc. The suspension

of the U.S. dollar's international convertibility into gold in August 1971 marked the end of the postwar Bretton Woods system of fixed exchange rate parities. Unlike Germany, which let the Deutsche mark float from May 1971, Austria feared that free floating would expose the schilling exchange rate to international speculation. Instead, all political forces in Austria decided jointly to revalue the Austrian schilling by 5.5%. The revaluation was aimed at curbing inflationary pressures (inflation stood at 4.4% in 1970 and 4.7% in 1971). When many European Community countries adopted a policy of block floating in 1973 and the Deutsche mark was revalued by 3%, Austria opted for a 2.25% revaluation, while retaining its orientation toward the basket of currencies of its main trading

Chart 9

Largest correlation between inflation and currency in circulation or M1



Source: Authors' calculations.

Note: Figures attached to bars show lags(+)/leads(-) in years.

¹⁰ Even though the Parity Commission has only an informal basis, the Commission played an important role in Austrian economic policy. For an analysis of the functioning of the Parity Commission see Marin (1982).

partners, the so-called Indicator.¹¹ A further revaluation by 4.8% was decided in June 1973 (again slightly less than the Deutsche mark's revaluation of 5.5%). In July 1976, the peg was switched to the Deutsche mark, with some minor downward and upward adjustments until 1981.

Regarding the empirical relationship between money growth and inflation, the two post-war decades up to the end of the Bretton Woods system in Austria fitted very well the textbook notion of a weak relationship in the short run but a very strong positive relationship in the long run. During those two decades, most correlation coefficients for medium- and long-run frequencies were higher than those found for the whole sample (annex) and for the other three subperiods for which we conduct this analysis. What is more, we find that during this period, the correlation between growth of monetary aggregates and inflation was positive when monetary aggregates led inflation. Our empirical findings for this period are thus in line with the notion that inflation is a monetary phenomenon (chart 9).

The demise of the Bretton Woods system in 1971 and the first oil price shock in 1974 spurred inflation globally. Credit growth in Austria was buoyant, prompting the OeNB to take various restrictive monetary policy measures and to deliberalize international capital transactions. Inflation in Austria reached 6.4% in 1972 and peaked at 9.5% in 1974 before gradually receding to 3.6% by 1978. The second oil shock triggered a renewed rise in inflation to 6.3% in 1980 and 6.8% in 1981. A final spike in inflation occurred in 1984, with inflation surg-

ing to 5.7%. This spike was triggered among other things by an increase in value added tax (Pollan, 1984). Inflationary developments were also reflected in relatively high inflation volatility. At the same time, 1975, 1978 and 1981 were recession years in Austria, with real GDP growth turning slightly negative for the first time since WW II. Economic theory only in hindsight characterized the joint appearance of high inflation and low or negative economic growth as "stagflation." At the time, Austrian economic policymakers, like those in most other countries, initially attempted to cushion the negative growth impact of the oil price shocks by taking expansionary fiscal policy measures (note that the authorities' choice to pursue an exchange rate peg meant that monetary policy was not used actively and autonomously). The result was the described rise in inflation and a doubling of Austria's public debt ratio during the 1970s alongside sagging GDP growth and rising unemployment (albeit probably by less than without the fiscal measures, at least in the short run). Again, wage moderation was used actively to prevent a wage-price spiral from developing as a result of the one-off price hike in oil.

To fight rising inflation, exchange rate policy played an increasingly central role from the 1970s. The peg to the Indicator and from 1976 to the Deutsche mark implied that the Austrian schilling's nominal effective exchange rate gradually and consistently appreciated by a total of 80% between 1971 and 1995. Pegging proved effective in bringing inflation to below the levels of Austria's trading partners; as a result,

¹¹ For details, see Handler (2016) and Schmitz (2016) in this volume.

the real effective exchange rate of the Austrian schilling appreciated much less, but still substantially, climbing by around 30% over the same period and exerting continuing pressure on Austria's economy to improve productivity. During the period between 1983 and 1993 – i.e. the period after the inflationary impact of the second oil price shock had been absorbed but before Austria acceded to the European Union – inflation averaged 3.1% a year, i.e. on average 0.9 percentage points above the rate in the exchange rate-anchor country Germany. The successful stabilization of the inflation rate was reflected in a downward trend of inflation volatility. EU accession brought inflation in Austria down further to 1.9% on average during 1995 to 1999, as the opening up of the Austrian economy increased competitive pressures in many sectors, on the one hand, and as compliance with the Maastricht convergence criteria for participation in Stage

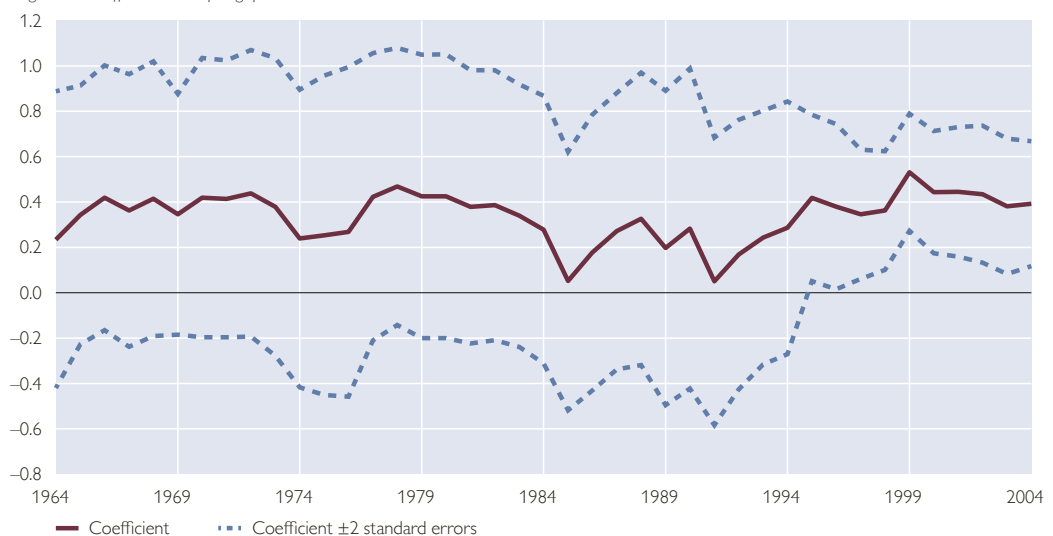
Three of EMU, which include low inflation and sound public finances, became an economic policy priority.

During the 17 years of Austria's euro area membership between 1999 and 2015, inflation in Austria averaged 1.9% and was thus in line with the ECB Governing Council's definition of price stability. Inflation during this period was also remarkably stable, exceeding 3% only in two years (2008 and 2011) as a result of renewed oil price shocks. Around the time of the euro cash changeover (which took place in 2002) the perception of higher inflation was relatively widespread. As the cash changeover in fact did not affect measured inflation, perceived inflation and measured inflation diverged widely during that period. (Fluch and Rumler (2005) and Fluch and Stix (2005)). Inflation was also rarely below 1%: in 1999 as a result of the Asian crisis and the low in oil prices, in 2009 in response to the Great Recession, with

Chart 10

Phillips curve from 1964 to 2004

Regression coefficient on output gap



Source: Author's calculations based on OeNB data. For further information, see annex.

real GDP shrinking by 3.8%, and in 2015 as a result of the oil price collapse.¹²

Rolling regressions for the Second Republic (after 1945) suggest a positive short-term correlation between the output gap and the inflation rate (chart 10). Regression results for the whole postwar period (table A1 in the annex) corroborate this result. However, for the period from 1972 to 1998, i.e. the time of the Austrian hard currency policy after the end of the Bretton Woods system, the coefficient on the output gap is not significantly different from zero. Furthermore, the role of the output gap drops if changes in crude oil prices are also included among the explanatory variables (table A1 in the annex). The crude oil price represents an external cost shock, i.e. imported inflation. Exogenous price shocks and changes in commodity prices were mentioned by e.g. Breuss (1980)¹³ as one of the reasons why the Phillips curve vanished. Breuss (1980) argues that after the first oil crisis in 1973/74, the impact of imported cost-push shocks on domestic inflation became more important.¹⁴

Looking at monetary aggregates, the strong empirical relationship observed for the two pre-Bretton Woods decades does not hold during the post-Bretton Woods era (chart 9). The correlation between inflation and growth

in currency in circulation or M1 is more often negative depending on the frequency and the lags included, and the high correlation between inflation and M1 growth found for the pre-Bretton Woods era is no longer found in the post-Bretton Woods/pre-EMU era. This may reflect the hard currency regime and the resulting endogeneity of money supply as well as the generally observed gradual breakdown of the stable relationship between money growth and inflation in the course of the quarter century up to 1998.

6 Summary and conclusions

In this paper, we distinguished five distinct periods of inflation history for Austria: the “long 19th century” with a fairly stable price level, partly relatively high short-term inflation volatility and the frequent occurrence of negative inflation rates, which were not necessarily associated with economic contractions; the two world wars, during which the central bank was forced to finance war expenses, resulting in ultra-high or even hyperinflation; the interwar period, which was marked by restrictive macroeconomic policies under the umbrella of the League of Nations and the gold standard as well as by the *Creditanstalt* and other banking crises, leading to the Great Depression; and finally the post-WW II episode, marked by Austria’s remark-

¹² In 2015, the inflation rate in the euro area as a whole was zero and even reached negative territory in some months. To avoid risks from longer periods of low or even negative inflation at a time when monetary policy rates have reached their effective lower bound, the ECB implemented various new measures (unconventional monetary policy). Analyses of recent inflation developments in Austria are published in the OeNB quarterly „Inflation aktuell“ (www.oenb.at/Publikationen/Volkswirtschaft/inflation-aktuell.html).

¹³ Breuss (1980) is one of several analyses from the 1970s and 1980s that discussed the stability of the Austrian Phillips curve. In contrast to our analysis, Breuss (1980) investigated the relationship between the unemployment rate and inflation (for the years from 1955 to 1978) and observed that this relationship is more stable in Austria than in most other countries.

¹⁴ Including other variables leads to a collapse of the Phillips curve relationship, suggesting that our results for the time of the monarchy (in particular from 1830 to 1866) could also be altered by including further variables and that the observed correlation between inflation and the output gap might not be robust to such changes. However, we had no suitable data for this time period.

able two- decade long economic catching-up period upon completion of the currency reform and monetary stabilization, Austria's response to the demise of the Bretton Woods system through an evolving exchange rate peg, and, ultimately, Austria's accession to the EU and the introduction of the euro. Despite these quite distinct periods, some stylized patterns of inflation developments in Austria over the past two centuries emerge from our analysis.

- The large expenses implied by wars were repeatedly used to justify monetary financing by the central bank. Central bank statutes conferring nominal independence from the state repeatedly turned out to grant insufficient protection. Wars also implied sizeable negative shocks to productive capacity. The combination of excessive money creation and reduced potential output repeatedly resulted in ultra-high or outright hyperinflation.
- Rulers or governments were aware of the ultimate consequences when they resorted to monetary financing. They accepted them deliberately, given their time preference for the short-term gains – mostly victory in war – they hoped for.
- The resulting unavoidable currency reforms were politically hard and included drastic measures with huge distributive consequences that many citizens perceived as unfair and that fundamentally undermined the social fabric. The financial losses that currency reforms inflicted on large parts of the population left people distrustful of state money and of state institutions more generally for decades.
- Whether war financing led to ultra-high or hyperinflation depended on the volume and the length of the episode as well as on the speed and vigor of subsequent measures to contain price pressures. In this vein, moderate short-term war financing in the 19th century (with the exception of the Napoleonic wars) did not endanger monetary stability. The post-WW I inflation may be squarely ascribed to the central bank's continued acceleration of the money printing press well after the end of the war for fear of political instability and social unrest caused by monetary reform. In the end, delaying necessary monetary reform increased the reform cost. The bulk of WW II inflation actually occurred only after the war, as price controls and goods management had tamped down inflation during wartime. But once inflation soared after WW II, a series of mutually complementary measures were taken fairly swiftly to contain it.
- The absorption of the postwar monetary overhangs after the Napoleonic wars as well as after WW I and WW II included three elements: first, conventional fiscal measures such as tax hikes or spending cuts; second, ultra-high or hyperinflation that in particular wiped out the real value of private sector claims against the government; third, currency "reforms" that eliminated by law existing private claims against the central bank (cash) or against banks (bank accounts). The exact institutional form and the relative importance of these measures varied over time (with the first measures being least important), but the effect of all measures was identical: They sharply reduced existing private real financial wealth. The second and third types of measures fundamentally violated one of the key functions of money, namely of being a store of value. Trust in state money therefore suffered for long periods every time.
- Disinflation as a rule also involved real costs in the form of recessions

and higher unemployment; in this sense, a Phillips curve-type relationship seems to have applied during such periods. At the same time, monetary stabilization was the precondition for the economic recovery thereafter.

- According to our empirical estimates, a Phillips curve relationship between some measure for the output gap and inflation in the short run is statistically significant only during some periods. It seems to have been weakest in Austria in the two post-Bretton Woods decades.
- Supply shocks dominated inflation developments in the post-Bretton Woods hard currency era. The highest nonwar-related inflation rates in Austria occurred in the 1970s as the combined result of oil price cost-push shocks and the attempt to cushion the negative permanent implications of the associated drop in potential output on economic growth and employment through expansionary fiscal policy. EU and EMU accession represented positive supply shocks. Also during Austria's euro area membership positive and negative oil price shocks were a major driving force behind variations in the inflation rate.
- Very low or even negative inflation was not systematically associated with low real GDP growth in the 19th century. By contrast, in the 1930s during the Great Depression, deflation was accompanied by high unemployment and economic slack.
- Financial bubbles also boosted consumer price inflation; the ensuing busts were accompanied by extended periods of deflation.
- Throughout the entire 200-year history of Austria's central bank, lawmakers and central bankers recog-

nized that stable money is beneficial and that the central bank should be put in a position to ensure it. However, in the short term, immediate financing desires (mostly but not exclusively for wars) often superseded the desire for monetary stability. Austria's monetary history shows that within a single state, statutory independence does not provide effective protection against monetary financing, excessive money creation and ultra-high or even hyperinflation, as the central bank statutes can simply be changed at any time. By contrast, the experience of the *Oesterreichisch-ungarische Bank* suggests that a "supranational" central bank within a monetary union of several states may, despite all the complications involved in such an arrangement, de facto strengthen central bank autonomy.

- The formal Maastricht rules for sound fiscal policies and the strong statutory independence of the Eurosystem go beyond any formal legal frameworks previously in existence in Austria in ensuring monetary stability. However, considering the policies actually practiced since the introduction of the hard currency policy, the de facto regime change for Austria resulting from EU and EMU accession appears more modest: For three decades, Austria had already gained experience in managing a fixed exchange rate and employing other instruments of economic policy to ensure international competitiveness and to avoid unsustainable macroeconomic imbalances.
- In Austria's monetary history, domestic consumer price stability in the sense of modern inflation targeting

rarely played a role as an operational target.¹⁵ Most of the time, some form of external anchor – the price of silver or gold during the 19th century and the interwar period, a peg to another currency (or briefly a currency basket) in the post-WW II period – was used to guide monetary policy.

- While inflation was quite volatile in the decade after the end of the Napoleonic wars and also in the two decades following the revolution of 1848, it was very low in the half century after the *Gründerzeit* boom. In the post-WW II period, inflation volatility rose markedly during the period of the Great Inflation between the late 1960s and early 1980s, in parallel with global developments after the demise of the Bretton Woods system and the first and second oil shocks. In line with international developments, Austria also witnessed much lower inflation volatility during the Great Moderation since the 1990s. This includes also

the period since Austria's membership in the euro area.

- Looking at the relationship between money growth and inflation, the frequency domain analysis conducted in this article for the pre-WW I and post-WW II periods finds that, in line with the economic literature, for long and very long frequencies, the correlation between money growth and inflation is considerably higher than for short business cycle frequencies. We also find that the correlation between money growth and inflation has changed over time, reflecting changing monetary regimes over the last two centuries in Austria and the world.
- Austria's 200 years of monetary history was also marked by the quest for maintaining or re-establishing the credibility of the central bank's ability and commitment to maintain price stability. The most recent measures by the Eurosystem to credibly prevent inflation from falling below the definition of price stability also fit in this more general pattern.

References

- Angeloni, I., L. Aucremanne and M. Ciccarelli. 2006.** Price setting and inflation persistence: Did EMU matter? ECB Working Paper Series 597.
- Antonowicz, W., E. Dutz, C. Köpf and B. Mussak. 2016.** Memories of a central bank. Oesterreichische Nationalbank. Since 1816. Brandstätter. Vienna.
- Bachinger, K., F. Butschek, H. Matis and D. Stiefel. 2001.** Abschied vom Schilling. Eine österreichische Wirtschaftsgeschichte. Graz.
- Bank of Greece, Bulgarian National Bank, National Bank of Romania and Oesterreichische Nationalbank (eds.). 2014.** South-Eastern European Monetary and Economic Statistics from the Nineteenth Century to World War II.
- Benati, L. 2005a.** Long-run Evidence on Money Growth and Inflation. Bank of England Quarterly Bulletin. Autumn. 349–355.
- Benati, L. 2005b.** The Inflation-Targeting Framework from an Historical Perspective. Quarterly Bulletin. Summer. Bank of England. 160–168.
- Benati, L. 2009.** Long Run Evidence on Money Growth and Inflation. Working Paper Series 1027. European Central Bank.

¹⁵ In fact, methods to measure consumer prices were not even evolved enough to use consumer prices as operational targets. Most of the currently available 19th-century (and earlier) indices were not constructed until the 20th century. For a detailed account of the history of price measurement, see Fluch (2016) in this volume

- Brandt, H. 1978.** Der österreichische Neoabsolutismus: Staatsfinanzen und Politik 1848–1860. Göttingen.
- Breuss, F. 1980.** Gibt es eine stabile Phillips-Kurve in Österreich? Monatsberichte 4/1980. WIFO – Austrian Institute of Economic Research.
- Bruggeman, A., G. Camba-Méndez, B. Fischer and J. Sousa. 2005.** Structural filters for monetary analysis: The inflationary movements of money in the euro area. Working Paper Series 470. European Central Bank.
- Butschek, F. 1996.** Statistische Reihen zur österreichischen Wirtschaftsgeschichte. Die österreichische Wirtschaft seit der Industriellen Revolution. Vienna.
- Butschek, F. 2011.** Österreichs Wirtschaftsgeschichte. Von der Antike bis zur Gegenwart. Wien.
- Fluch, M. 2016.** The measurement of inflation in Austria: a historical overview. In this volume.
- Fluch, M. and F. Rumler. 2005.** Price Developments in Austria after EU Accession and in Monetary Union. In: Monetary Policy & the Economy Q2/05. OeNB. 69–89.
- Fluch, M. and H. Stix. 2005.** Perceived Inflation in Austria – Extent, Explanations, Effects. In: Monetary Policy & the Economy Q3/05. OeNB. 22–47.
- Handler, H. 2016.** Two centuries of currency policy in Austria. In this volume.
- Jobst, C. and T. Scheiber. 2014.** Austria-Hungary: from 1863 to 1914. In: Bank of Greece, Bulgarian National Bank, National Bank of Romania and Oesterreichische Nationalbank (eds.). South-Eastern European Monetary and Economic Statistics from the Nineteenth Century to World War II.
- Jobst, C. and H. Kernbauer. 2016.** The Quest for Stable Money. Central Banking in Austria. 1816–2016. Campus. Frankfurt. New York.
- Jobst, C. and H. Stix. 2016.** Florin, crown, schilling and euro: An overview of 200 years of cash in Austria. In this volume.
- Kausel, A. 1979.** Österreichs Volkseinkommen 1830 bis 1913. In: Österreichisches Statistisches Zentralamt (ed.). Geschichte und Ergebnisse der zentralen amtlichen Statistik in Österreich 1829–1979. In: Beiträge zur österreichischen Statistik 550. Österreichisches Statistisches Zentralamt. Vienna. 689–720.
- Kernbauer, H. 1995.** Österreichische Währungs-, Bank- und Budgetpolitik in der Zwischenkriegszeit. In: Talos, E. (ed.). Handbuch des politischen Systems Österreichs. Erste Republik 1918–1933. Vienna.
- Kernbauer, H. 2016.** Cashless payments in Austria: the role of the central bank. In this volume.
- Komlos, J. 1986.** Die Habsburgermonarchie als Zollunion. Die Wirtschaftsentwicklung Österreich-Ungarns im 19. Jahrhundert. Vienna.
- Köhler-Töglhofer, W., D. Prammer and L. Reiss. 2016.** The financial relations between the Nationalbank and the government. In this volume.
- Marin, B. 1982.** Die Paritätische Kommission. Aufgeklärter Technokorporatismus in Österreich. Wien.
- Meller, B. and D. Nautz. 2012.** Inflation persistence in the Euro area before and after the European Monetary Union. In: Economic Modelling. 29(4). 1170–1176.
- Mühlpeck V., R. Sandgruber and H. Woitek. 1979.** Index der Verbraucherpreise 1800–1914. Eine Rückberechnung für Wien und den Gebietsstand des heutigen Österreichs. In: Geschichte und Ergebnisse der zentralen amtlichen Statistik in Österreich 1829–1979. Beiträge zur österreichischen Statistik 550. Österreichisches Statistisches Zentralamt. Vienna.
- Nationalbank Act. 1955.** Bundesgesetz vom 8. September 1955 zur Neuordnung der Rechtsverhältnisse der Oesterreichischen Nationalbank. Bundesgesetzblatt. Retrieved on July 12, 2016: www.ris.bka.gv.at/Dokumente/BgblPdf/1955_185_0/1955_185_0.pdf
- Pollan, W. 1984.** Hohe Inflationsrate in Österreich im Vergleich zur BRD im Jahr 1984. In: WIFO-Monatsbericht 11–12/1984. 694–703.

- Robalo-Marques, C. 2004.** Inflation persistence: Facts or artefacts? ECB Working Paper 371.
- Schmitz, S. W. 2016.** The OeNB's reaction to the end of the Bretton Woods system: tracing the roots of the Indicator. In this volume.
- Seidel, H. and H. Neiss. 1966.** Die Steigerung der Verbraucherpreise von 1953–1966. In: WIFO-Monatsberichte 39(8), 302–310.
- Shelley, G. and F. Wallace. 2005.** The relation between U.S. money growth and inflation: Evidence from a band-pass filter. In: Economics Bulletin 5, No. 8, 1–13.
- Van Walrè de Bordes, J. 1924.** The Austrian Crown. Its Depreciation and Stabilization. London.
- WIFO – Austrian Institute of Economic Research. 1953.** Zur Vereinheitlichung der Wechselkurse. In: WIFO-Monatsberichte 4/1953.
- Zipser, W. 1997.** Auf der Suche nach Stabilität: Das Zentralbankgeldangebot der österreichischen Nationalbank 1923 bis 1937. Frankfurt am Main.

Annex

Time period for statistical and econometric analyses

We exclude the 1914 to 1952 period from our statistical and econometric analyses because inflation developments were too unstable to allow for meaningful statistical inference. Inflation data in that period are affected by many factors: WW I, the interwar period with hyperinflation, WW II, the wartime economy, scarcity as result of the war, and the questionable reliability of official inflation data, e.g. because of price controls and illicit trade. According to Seidel and Neiss (1966), stabilization was completed in 1953 and a “normal” development began. For reasons of consistency and comparability over time, in this article we prefer models that can be estimated over the entire 200-year period. Clearly, the main constraint is data availability. We explicitly recognize that more sophisticated estimation approaches would in principle be desirable for a rigorous analysis but would depend on the availability of the necessary data.

The rationale for splitting the pre-WW I century into two subperiods (1830 to 1866 and 1867 to 1913) is the transition from fiscal to monetary dominance around the time of the Compromise of 1867 and (see section 1 and

Jobst and Kernbauer, 2016). The split of the post-WW II period into the periods before and after 1971 corresponds to the end of the Bretton Woods system and the hard currency policy adopted in Austria instead.

Phillips curve

We regress the inflation rate on the output gap and lagged inflation. We use output because data for the time before WW I are not available for other measures (e.g. unemployment). For the time before WW I, we use data on industrial production (Komlos, 1986) that are available from 1830 as a proxy for output. Another series for industrial production as well as GDP data are available from 1870 (on these series, see also Jobst and Scheiber, 2014). Even though there are differences between these output data, the main conclusions with regard to the Phillips curve are not affected. For the time after WW II, we use GDP data. We compute the output gap using a Hodrick-Prescott filter. The rolling regressions shown in the charts use 21 observations (years); the result is assigned to the midpoint of the estimation period. The number of observations included in the regression is large enough for reasonable analysis but also allows us to take into account variations over time.

Our approach is subject to several caveats, e.g. that the reliability of output gap estimations is in general questionable. In addition, in the 19th century, it is particularly difficult to disentangle one-off price level changes and an inflationary stimulus because, as a result of the typically large agricultural sector, good harvests would be interpreted as an apparent rise in potential output and bad harvests as an apparent fall.¹⁶ Furthermore, results are not always stable with respect to the estimation technique applied (e.g. ordinary least squares, OLS, versus least absolute deviation, as in Benati, 2005b). Finally, we apply only a very simple model that does not, e.g., take into account inflation expectations but that we are able to use for the entire 200-year period.

Table A1 supplements the rolling regressions displayed in the charts in the main text. In the table for the Second Republic, we begin only with 1957 (as compared to 1954 in the rolling regressions), as the oil price series (source: IMF) that we use to examine the stability of our results are only available from 1957 onward.

Frequency domain analysis

To complete our historical analysis of inflation, we analyze the long-run relationship between a measure of money growth and inflation. In the long run, a strong correlation between money growth and inflation is usually found, while in the short run, inflation is better explained by real and external shocks. While we describe the relationship between these variables for each subperiod, the statistical analysis is based on the long-run characteristics of our entire sample.

¹⁶ We thank the referee for this comment.

Table A1

Phillips curve: dependent variable inflation

Before WW I

	1830–1913	1830–1866	1867–1913
Output gap	0.297***	0.453**	0.160
Lagged inflation	0.199*	0.220	0.277**
Constant	0.007*	0.011	0.003

After WW II

	1957–2014		1972–1998	
Output gap	0.387**	0.240	0.250	–0.022
Lagged inflation	0.771***	0.742***	0.869***	0.797***
Crude		0.011**		0.011**
Constant	0.008**	–0.003	0.004	–0.005

Source: Authors' calculations based on OeNB data. Crude oil price: IMF.

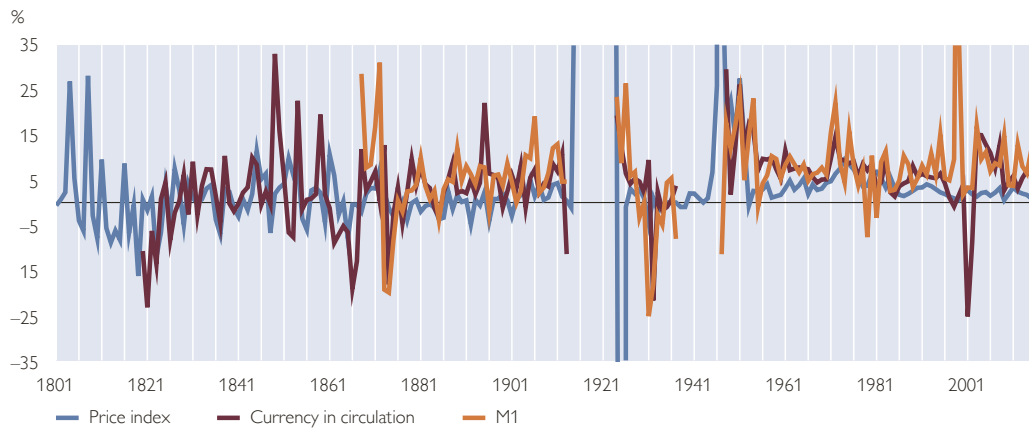
Note: ***, **, and * denote significance at the 0.01, 0.05 and 0.10 level, respectively. Output gap calculated using HP filter, before WW I based on industrial production, after WW II based on GDP.

We use two indicators as proxy variables for money: currency in circulation, which is available from 1819, and M1, which is available from 1867. The reason we concentrate on narrow money is purely practical; time series for M2 and M3 are available only from 1953 onward, so it would not be possible to carry out the analysis for the 19th century. Moreover, the reason for the correlation between money growth and inflation is based on the fact that money is used to carry out transactions. The kinds of deposits normally included in M3 (and M2) were not used for transactions in the 19th century; thus, it would not make much sense to carry out such a statistical analysis based on M2 or M3.

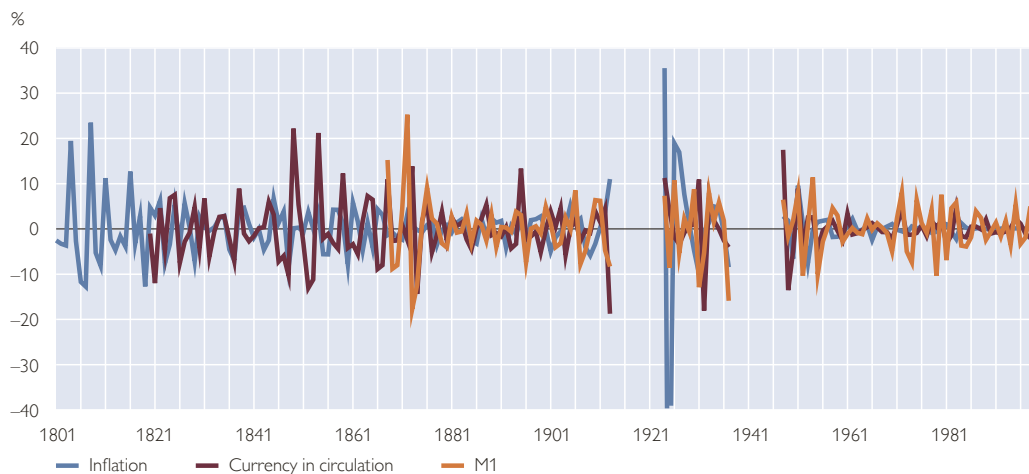
Two of the time series that we are using are discontinuous because no data for currency in circulation and M1 are available for the time of the two World Wars. Even though data for inflation in this period are available, using these data for the analysis we are interested in

Growth rates and filtered series of data used in the frequency domain analysis

Growth rates of price index, currency in circulation and M1



Filtered series at business cycle frequency (2 to 8 years)



Source: Authors' calculations.

would dominate the relationships and thus distort the results for “normal” periods. Furthermore, an extensive literature already analyzes the relationship between money growth and hyperinflation in those years;¹⁷ we summarize the insights of this literature in the historical narrative part of this article.

Chart A1 (upper panel) shows the annual growth rates of the price index, currency in circulation and M1. Note the large peaks in growth (positive and negative) of currency in circulation and M1 with the start of EMU in 1999.

These peaks are due to the statistical reclassification of these variables upon EMU implementation. Starting in 1999, the definition of M1 and currency in circulation in Austria changed to “Austrian contribution” to currency in circulation and to M1 of the euro area aggregates; thus, these have been more or less artificial variables since 1999. Hence, we chose to perform the analysis here with data until 1998 only.

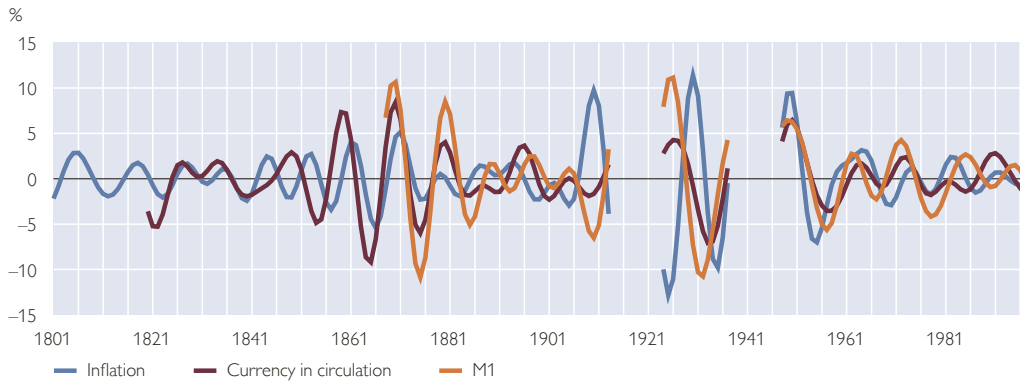
The frequency domain analysis was done with the commonly used Christiano-Fitzgerald filter with the full

¹⁷ See e.g. Jobst and Kernbauer (2016), Bachinger et al. (2001) and van Walré de Bordes (1924).

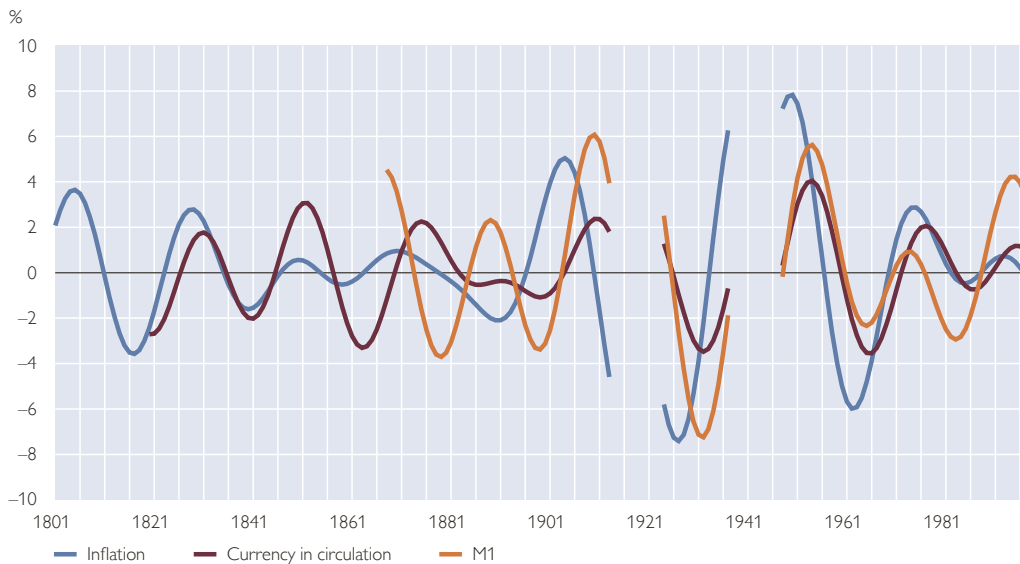
Chart A1 continued

Growth rates and filtered series of data used in the frequency domain analysis

Filtered series at long-run frequency (8 to 20 years)



Filtered series at very long-run frequency (20 to 40 years)



Source: Authors' calculations.

sample, which has the advantage of using all the data available.

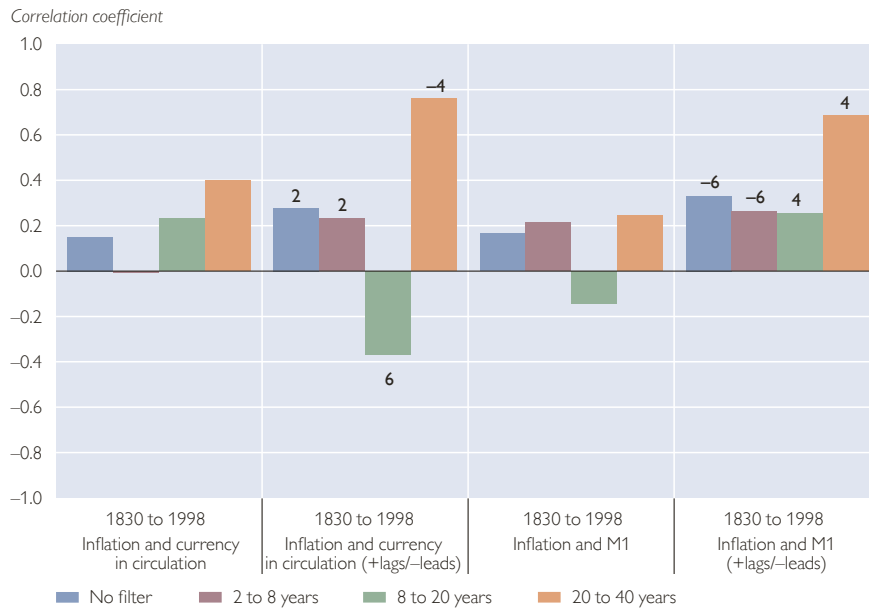
For the frequency filter, a fictitious continuous series was built that skips the years for which data are missing. Given that those are the hyperinflation years, we discard these years also for in-

flation. Filtered series for inflation using the entire sample show an extreme value for the hyperinflation years even for the frequency of 20 to 40 years.

Table A2 provides an overview of the definition of currency in circulation and M1 as well as the data sources.

Chart A2

Correlation between inflation and currency in circulation or M1



Source: Authors' calculations.

Note: Figures attached to bars show lags(+)/leads(-) in years.

Table A2

Currency in circulation in Austria by periods

Date	Definition	Source
1819–1847	Banknotes, Vienna standard florins (<i>Wiener Währung</i>) and treasury bills, without deposits at the OeNB	Jobst and Kernbauer (2016, chart 3.4)
1848–1862	Banknotes, Vienna standard florins (<i>Wiener Währung</i>) and treasury bills, without deposits at the OeNB	Jobst and Kernbauer (2016, chart 4.1)
1863(1867)–1913	M1 is defined as the sum of currency in hands of the public and demand deposits; the latter are net of interbank deposits. M3 is M1 plus time and savings deposits.	Bank of Greece, Bulgarian National Bank, National Bank of Romania and Oesterreichische Nationalbank (2014)
1923–1937	Estimates. Banking sectors are not comparable.	Zipser (1997)
1947–1998	M1 = banknotes and coins in circulation excluding gold and silver coins, excluding cash in vaults, excluding OeNB deposits and overnight deposits 1946–1950: Sum of banknotes, coins in circulation, overnight deposits (including checking deposit estimates from December 1951). Until 1950 including cash in vaults of banks.	Butschek (1996)
1999–2015	EUR million	OeNB statistics, Austria's contribution to M3 and its counterparts in the euro area