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Deflating Swiss Prices over the Past Five Centuries

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Abstract. The authors present and compare new time series for calculating the real value of Swiss prices over the past five centuries. They analyze three different modes of price deflation using wages, consumer price indices (CPIs), and the gross domestic product (GDP), and assess the merits and limitations of each approach. The authors then examine how time series that cover long periods of time are made using Switzerland as a case study and introduce an original CPI for the years 1501–2006. The authors conclude by contrasting the different time series and proposing rough guidelines about their use.

Keywords: inflation, long price series, long wage series, methods of deflation, real prices, Switzerland

The past can only be accessed and understood with a mind-set formed by today's world. This is the reason that whenever we deal with monetary aspects of the past, we are naturally interested in knowing what the price tag would look like today—we cannot help but ask how much "it was really worth." One may wonder how costly living space was during the process of rapid urbanization hundreds of years ago by today's standards, or whether natural disasters in the past had as devastating a financial consequence as recent "unprecedented" storms, such as Hurricane Katrina. Time series capable of deflating prices have broader uses still. Apart from this aspect of understanding past events or structures against the background of the world in which one lives—or vice versa—deflation is central to all intertemporal comparisons of monetary aspects. No matter whether we aim at comparing the potency of an economy, productivity, income, or expenditure in consumer or state budgets across time, we depend on reliable instruments to determine "real" prices that correct for inflation over time.

There are several standards that can be used to account for inflation, that is, to determine "real" prices. This analysis will be limited to the three most widely used methods of price deflation: wages, consumer price indices (CPIs), and the gross domestic product (GDP). We discuss and compare these approaches and present a time series for each method, allowing us to calculate the real value of Swiss prices over very long time spans.

When comparing prices across time, the choice of the appropriate time series will often depend on the questions one wants to answer. As long as one can choose between multiple deflators, that option should be exercised. When deflators are available, this instrument should be used for intertemporal comparison.

We intend to provide such an instrument for Switzerland, and it comes in three parts. First, we analyze the three different modes of price deflation and assess the merits and limitations of each approach. Next, we examine how the long time series we created, which cover Switzerland in the years 1501–2006 (CPI), 1800–2006 (wages), and 1851–2006 (GDP), respectively (see appendix). We conclude by contrasting the different time series and proposing rough guidelines for their use.

Methods of Price Deflation

All methods of price deflation define a different standard against which they measure the price in question. Which deflator is most appropriate in a specific case depends on both the question and each deflator's quality. One should be careful when making this choice; it will significantly influence the results. Understanding the nature of deflation's various concepts, along with their general and country-specific strengths and limitations, is indispensable for their meaningful use.

Consumer Price Indices

The consumer basket is probably the most widely used approach to deflate prices today. John J. McCusker (2001,

14) wrote that this standard, based on the value of commodities, "has clearly won out as the accepted measure of changes in value over time." Instead of measuring values against a single commodity such as gold, a whole assortment of commodities and services is used as a standard; the items in the consumer basket are chosen to represent the items consumers actually buy. The price level is measured with a representative selection of market goods. Adam Smith (2002, 18) described the first implementation of this method, using corn as the sole item in the basket. Of course, the method has progressed from using only corn to a more advanced technique. The use of a consumer basket will be referred to as the CPI.

Two different measurements are based on the consumer basket, so caution is necessary, as both measure different things and produce different indices. The first one, the CPI, measures the changing prices of a fixed assortment of goods—its standard is a fixed basket of commodities and services. The second, the cost of living index (COLI), parts with the notion that the consumer basket should stay fixed and instead measures a fixed level of welfare. In effect, this method consists of calculating how much it costs to supply a household at some arbitrary but fixed level of economic welfare while assuming that this amount of money reflects a constant value over the centuries.

In practice, it is impossible to keep a consumer basket's commodities fixed over long periods of time because of the changing availability of commodities and services, changing relative cost, changing consumer preferences, and changing consumption patterns. All these factors are interdependent; a simple cause-and-effect model cannot account for them. Nor are only economic forces at work; as technology develops and society changes, so do its value system and the importance it places on certain commodities. The value of a horse and horse-drawn carriage, for example, changed drastically once mass-produced cars became available.

Most CPIs are based on the Laspeyres Formula or a close substitute, which aggregates the prices of the goods in the basket. Goods in the basket are weighted according to their relative importance in households. The previously mentioned factors manifest themselves mathematically in a change of the weights attributed to goods in the basket.

To represent the price level correctly, the index must represent what consumers buy. The weights must therefore be updated frequently. This poses two problems. The first one is practical; even today, complete household expenditure surveys in Switzerland—as in other countries—are carried out only every few years and cannot easily be done more often (Swiss Federal Bureau of Statistics [BFS] 1999, 91). This problem was less urgent in past centuries when household expenditure patterns changed more slowly, but this advantage is offset by the lack of detailed expenditure data.

The second problem is that most index formulas, and especially the Laspeyres Formula, do not allow for changing weights. This means that one cannot introduce new goods, or remove goods that are no longer used, without breaking the series of index numbers. Some solutions exist, most notably chained indices. When using a chained index, instead of directly comparing an aggregated basket price of 1850 with that of 2006, several intermediate comparisons are made, for example, from 1850 to 1851, 1851 to 1852, and so on. These are then connected to each other by way of multiplication. This method has the great advantage in that the weights must be kept fixed for only a single year, in which they hardly introduce an error. However, detailed household expenditure data are needed for every single comparison—every year between 1850 and 2006. The chances that economic historians can provide these data are slim. Even the BFS employed chained index calculation for the Swiss CPI only in fast-changing product categories (e.g., clothing) and kept the rest of the weights fixed between index revisions, and only for the twentieth century.

Weights are adjusted by index revisions (the Swiss CPI went through several revisions from its inception in 1922 to the end of the twentieth century), but at a high price: The series "breaks" at revision points and is no longer homogeneous. This is not true when chained indices are used, because if weights are changed every year, only a small percentage of the consumer basket is affected and the new basket mostly overlaps with the old one.

Chained indices could—if enough expenditure data existed, which is rare—also solve the "new goods problem," the question of how one can introduce an item into the basket that previously did not exist. Alfred Marshall knew this was a problem in 1887, and it remains an issue to this day: "This brings us to consider the great problem of how to modify our unit so as to allow for the invention of new commodities." His solution: "The difficulty is insuperable, if we compare two distant periods without access to the detailed statistics of intermediate times, but it can be got over fairly well by systematic statistics" (Diewert 1993, 60). Surprisingly, John Maynard Keynes rejected the chain method and suggested simply ignoring any new and disappearing goods, resorting to the "highest common factor method" of fixed base index calculation limited to goods available in base and report period (ibid., 61). This method seems hardly appropriate for certain comparisons; depending on how far back we go in time, we would have to throw out such goods as cars, cotton clothing, potatoes, and rice. This would hardly yield meaningful results, but without "detailed statistics of intermediate times," it may be the only avenue open to economic historians who attempt to build a very long CPI series (ibid.).

Quality poses a related problem. When one product is substituted for another, can their prices be treated as a single price series? The horse-drawn carriage price series cannot continue

with car prices. These are two different commodities, and horse-drawn carriages still exist today. This is probably possible for closer matches—a manual typewriter and an electronic one, for example—but then the question of quality comes into play. If the substitute is of better quality than the original, the fraction of the price caused by the increase in quality should not affect the index. The problem does not only occur with substituted products. For example, a pan could be made from more durable materials or a car could be fitted with a quieter or more efficient engine. Clothing could be made from easier-to-clean materials, made more durable, made to keep their true colors for longer periods, and so on. Quality remains inherently difficult to measure, however. The BFS (1999, 91) summed it up when judging its treatment of quality changes: "None of these methods are perfect. The treatment of quality change remains a hot topic in price statistics, all the more so as quality 'measurements' are often highly subjective."[1]

Even though the various national statistical bureaus have recently developed methods to cope with quality change, it remains one of the great conceptual problems of CPI calculation. To our knowledge, nobody has attempted to estimate the errors that result from quality change in the past. In all likelihood, quality change poses a vastly more serious problem for price series spanning the Industrial Revolution. For example, clothing was hardly of the same quality before, during, and after the Industrial Revolution, but how one would arrive at a measure for this quality change remains a mystery.

Cost of Living Index

If the CPI approach suffers from so many problems, might a COLI be better suited for long-term price deflation? In 1883, Walter Sidgwick wrote, "We have to abandon the prima facie exact method of comparing prices, and to substitute the essentially looser procedure of comparing amounts of utility or satisfaction" (Diewert 1993, 60). A COLI is constructed basically in the same way as a CPI, but it measures fixed levels of economic welfare (or utility) instead of the price of a fixed basket of commodities, solving many of the CPI's theoretical problems. However, the utility function needed to determine the utility of a basket of goods and services is not only a function of the items in the basket but also a function of time and space, or a function of a society's value system. Worse, what exactly constitutes a fixed level of economic welfare is hard to define because different people will feel differently about it.

This renders a COLI extremely difficult to calculate. On the one hand, we need a fixed standard, the fixed level of economic welfare; on the other hand, it turns out that this standard can be acquired only by continuously revising its constituting elements, the items in the consumer basket, and such items for inclusion are hard to quantify objectively. It is not surprising that nobody has yet managed to create a framework that allows this standard to be determined. Research is ongoing.[2] It remains unclear how utility functions should be constructed. The consequences of this inability are the practical problems that every attempt at a COLI suffers. The most visible are the quality and the substitution bias. We do not yet know how to correctly identify substitute goods (again, this has to do with determining equal levels of utility) and how to measure quality (which affects utility). Both substitution and quality measurement cannot yet be formalized; instead, price surveyors must make value judgments to determine substitute goods and differences in quality.

For these reasons, from a theoretical standpoint, price indices, both the CPI and the COLI, are often less suited for value comparisons over very long time periods than the labor approach. From a more practical viewpoint, it should not be forgotten that the CPI measures inflation as the average household experiences it. The average household is a statistical construct—it does not really exist and can be arrived at by several methods. Suffice it to say that statistical bureaus try to make it as representative for real households as possible. This means that the CPI provides a good representation for inflation on goods bought by households, but it will be less representative for other commodities' price inflation. For the economic historian, just constructing a reliable CPI already poses serious problems, as data on prices and household expenditure patterns are increasingly difficult to obtain the further one looks back in time.

Gross Domestic Product

Another standard useful for price deflation is the GDP or a similar aggregate. We all encounter this macroeconomic variable when we hear about federal deficits expressed in a percentage of the GDP. The GDP is not the only available national aggregate; the gross national product (GNP) was often used for similar purposes in the past, but with the increasing interconnection of our economies caused by globalization, the GDP is now the better aggregate to represent a country's economic performance.

The idea here is to calculate the share of the GDP a certain price represents in one year and then calculate the price this same share would represent in another year. Strictly speaking, expressing a value as a share of the GDP does not produce real prices from nominal prices; the relative GDP method, as we call it, is not a true deflator. Changes in the GDP have two components: inflation and growth. If we compare the nominal GDP from two different years, we not only account for inflation but also for the growth of the economy in question (which again has several components, although some, such as population growth, can be easily removed).

The GDP approach suffers from a host of problems, which make its suitability for price deflation, particularly for earlier periods, questionable. Arguably, its most obvious flaw is that it cannot be estimated reliably for past centuries, making it more problematic for historians than commodity price and especially wage indices. The system of national accounts that is used today to calculate the GDP was introduced and refined only in the second half of the twentieth century; in Switzerland, the

GDP based on the national accounts became available only after 1980. As a consequence, historians trying to estimate the Swiss GDP for earlier periods are confronted not with an occasional hole in existing series of macroeconomic data but with an occasional data point in a macroeconomic void. The GDP must be calculated with a host of proxy methods and detours—for example, using import statistics for cacao to determine total chocolate production (Ritzmann-Blickenstorfer 1998). Without dismissing the large amount of effort put into the GDP calculations—the resulting figures are more than educated guesses, but not by much—they can, at best, serve as rough estimates for any period before the twentieth century.

The GDP also seems to seriously overstate our collective economic welfare—at least for the second half of the twentieth century. The GDP was not designed to measure collective economic welfare, but it is important for meaningful value comparisons of the concept of welfare. The prime factor responsible for this overstatement of economic welfare is the inclusion of items identified as benefits for society that should actually be counted on the cost side. Viable alternatives that correct this overstatement in the twentieth century, such as the Index of Sustainable Economic Welfare (ISEW), suffer from the potentially fatal problem that they are even harder to estimate in past centuries. The ISEW is a composite index that requires information not available for past centuries, such as pollution, and there is no scientific consensus yet on which methods to use to assign costs to some of its constituent elements.

Even if it turned out that the GDP was not overstated, it would still suffer from consistency problems as a measure of collective economic welfare. Factors such as sustainability, resource depletion, nonmarket production, and distribution of wealth, which influence the value of goods and services as society perceives them, cannot be seen as constant over long periods of time. The GDP fails to sufficiently account for these factors. It cannot consistently represent the development of prices as we currently experienced (e.g., Lawn 2003, Daly and Cobb 1989). Finally, for very long time series, the GDP (assuming enough sources were available to attempt an estimate) cannot be used consistently in many countries because changing borders and people's changing allegiances affect the definition of the GDP itself. Switzerland, however, is an exceptionally unproblematic case in this respect.

Nominal Wages

The third deflation method one can use is labor. We can measure the price of something against the amount of labor needed to obtain it. We must choose a trade that does not change over the years, so that labor represents a constant value against which we can measure prices. If in 1800 a tradesman earned 1.50 francs and another tradesman earned 6 francs in 1900 for the same labor, we can conclude that the price level rose by a factor of four and construct a wage index to serve as a deflator.

A range of economic theorists have argued in favor of the labor approach—Smith, Benjamin Franklin, and Karl Marx among them (McCusker 2001, 13–14).[3] According to Smith (2002, 18):

> Labour, therefore, it appears evidently, is the only universal, as well as the only accurate, measure of value, or the only standard by which we can compare the values of different commodities, at all times, and at all places. We cannot estimate, it is allowed, the real value of different commodities from century to century by the quantities of silver which were given for them. We cannot estimate it from year to year by the quantities of corn. By the quantities of labour, we can, with the greatest accuracy, estimate it, both from century to century, and from year to year.

Even though Smith's praise overstates the continuity, and thus the accuracy, of the wage series, the labor approach has some clear advantages. It sidesteps the issue of the changing value of commodities and services; the desirability of certain commodities and services is not an issue. What is measured is simply the amount of money a worker gets for his labor, and we do not need to know which commodities and services the worker will buy with his wage. The mysterious utility function, so difficult to find in practice, can be excluded here. The simplicity of the labor approach to deflation is one of its main assets.

Another advantage of the labor approach is the higher degree of continuity. One can find trades that have not changed as dramatically over the centuries as the composition of a consumer basket has. Using the wages earned in these trades will be less problematic when one deflates prices over very long time spans. Yet for doing this, one must choose the trade carefully. The trade should first remain more or less at the same relative importance for society—it should not become a fringe trade. Second, the nature of the work performed in this occupation should ideally not change. Third, one should choose a trade that is representative of the rest of the population's earnings. The third requirement is not relevant in all cases but helps to extend the range of cases to which the resulting wage index can be applied.

Construction work, especially masonry, is a trade that comes close to fulfilling these criteria and thus serves as a good deflator. The mason's trade has hardly changed over the centuries; machinery has only marginally influenced the building of a wall. Most of a mason's work is still done in comparable steps. Even the mason's tools have largely remained the same—the brick trowel is still used today. Masons also fulfill the first requirement; they still hold a comparable place in society. In Switzerland, about 290,000 people work in construction; it is still one of the largest sectors of the labor market. In a way, this is a consequence of the absence of change, especially of the lack of increase in productivity comparable to that in other trades.

For the economic historian, using wage data for deflating prices bears another advantage: a parsimonious data requirement. A reliable time series only requires information on one variable (maybe two, if work time is counted as another), whereas CPIs, and particularly GDPs, require

a vast number of variables to be adequately measured. As mentioned previously, little or no data are available before the late nineteenth century.

Homogeneous Time Series for Deflating Swiss Prices

Despite the multitude of potential applications, there are no time series for price deflation available for Switzerland before the mid-nineteenth century. Some applicable series are available for later periods, but they remain—particularly before the turn of the twentieth century—rather heterogeneous and limited in coverage, and there are no previous studies the provide, let alone contrast, methods and evidence on different ways of deflating Swiss prices over long periods. We examine how new time series for all approaches to deflation—wages, CPIs, and GDP—have been constructed or how existing series have been extended or linked for Switzerland. The result of this enterprise will greatly enhance the possibilities of intertemporal comparison for both historians and economists. Of these series, the wage series is completely new, and it covers more than two centuries, starting in 1800 and extending until 2006 (see appendix A-2). The CPI, spanning over five centuries, is based on an entirely new series for the years 1501–1890 but is linked to existing indices for 1890–2006 (see appendixes). The long GDP series was constructed by linking existing estimates, and it encompasses the years 1851 to 2006 (see appendix A-2).

Masons' Wage Index for Urban Switzerland

Masons' wages are particularly well suited as wage deflators. We constructed a new masons' wage index for Switzerland, and it is an aggregate of two separate wage series, one for Basel and one for Zurich. Nineteenth-century wages were collected primarily in the Schweizerisches Wirtschaftsarchiv and the Staatsarchiv in Basel. These quotations stem from the register of debts of the city building authority (Stadtbauamt), from the payroll of the Werkhof and of the city's construction department (Bau-Departement Basel-Stadt; Staatsarchiv Basel-Stadt; Bau C8; Bau D b 25; Bau D b 22). Wages were also taken from bills issued to clients of various construction firms and were specifically found in the archived material of Sarasin Söhne AG (Handschriften 322 C, F, G), the Bank in Basel (Handschriften 323 C), and Buri (Handschriften 13 A). For Zurich, early wage quotations were found in the Staatsarchiv Zurich (RR II 1835, 14). But for the early nineteenth century, for Basel and Zurich, archives were not very forthcoming, as is usually the case for this period. The wages were supplemented by information from literature, specifically from Emil Notz (1925), Victor Böhmert (1873), Elisabeth Dürst (1951), and Erich Gruner (1968).

For wages before 1848, the monetary values, which were listed in old currency, were converted to the new Swiss franc using an exchange rate of 1.43 new francs to 1 old franc. This exchange rate is based on the Grossratsbeschluss of November 16, 1850, as cited in Notz (1925, 54).[4] Payment in kind was another issue that had to be resolved for the nineteenth century, as there were a few cases in which the wages were partly paid in kind. We followed Notz's (Ibid., 212–24) method of calculating a monetary value, which we then added to the wage earned when it was clear that payment in kind had been received. Because payment in kind slowly lost ground over most of the nineteenth century, this was not an issue for the twentieth-century wages. To construct the final Swiss series, we first calculated a series for Zurich and another one for Basel. Whenever several wage quotations per year were available for one town, we simply calculated their arithmetical average, irrespective of source and season. Years without observation were filled by interpolation. The resulting series for Switzerland was then obtained by calculating simple averages from the Zurich and Basel series.[5] Our findings are included in the appendix.

It becomes clear that for the nineteenth century, this new wage series suffers from a series of potential problems: it combines wages from two different towns, it is—particularly in the early decades—based on scarce data, it neglects the problem of seasonality, and the data come from a number of different sources, but figure 1 is rather reassuring in this respect. Given that the numerous wage quotations differ only marginally among the various sources used and between the two towns, the resulting wage series should reflect both the level and the trends of Swiss construction wages rather reliably.

The new wage series can be further validated when one examines the level and movement of wages of skilled craftsmen in Switzerland's neighboring countries, using the same monetary unit for all countries. As figure 2 depicts, the comparative picture is dominated by similarities, whereas the disparities are economically meaningful. First, wages everywhere stayed mostly constant over the first half of the nineteenth century. In this period, Swiss wages were higher than wages in Italy, a bit higher still than in Germany, but lower than in France. Wages began to rise simultaneously in all countries, with modest increases from the 1850s and more substantial increases from the 1870s onward. Wage increases in Switzerland over the whole century were below those enjoyed by Germans but above those in France. Italian wages fell substantially behind, which seems completely reasonable given Italy's slower pace of economic development.

When we move to the twentieth century, the problems related to the data and to the consistency of the series are very different. From the late nineteenth century (Zurich) or the early twentieth century (Basel) onward, printed sources and material, which had already been statistically treated, were used. The database for this later period is much broader than the comparatively sparse information available for the nineteenth century. Also, some potential problems connected to the heterogeneous nature of the nineteenth century source materials are much reduced. However, other problems, related to changes in the mode of payment and amount of work time, arise for the twentieth-century series.

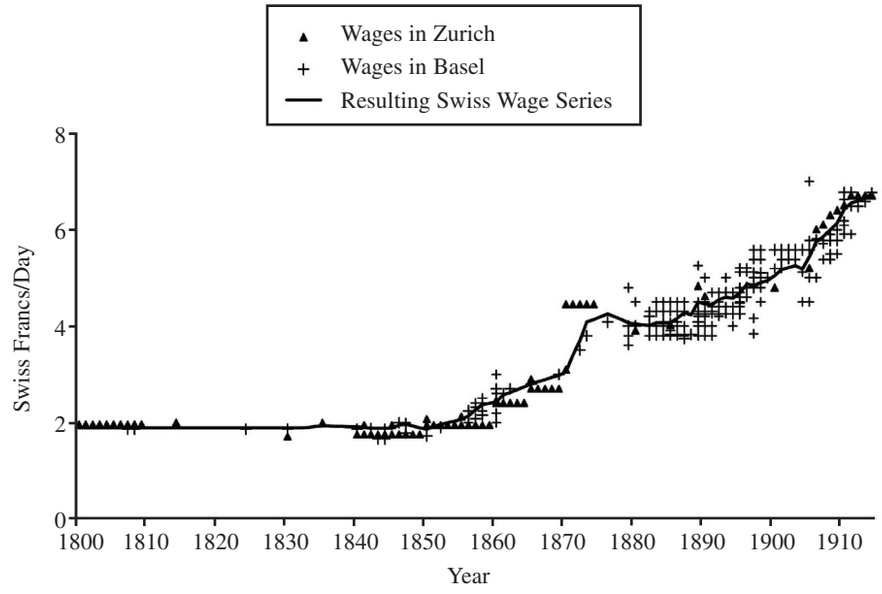

FIGURE 1. Wages of Swiss masons, 1800–1914.
Sources. See text.

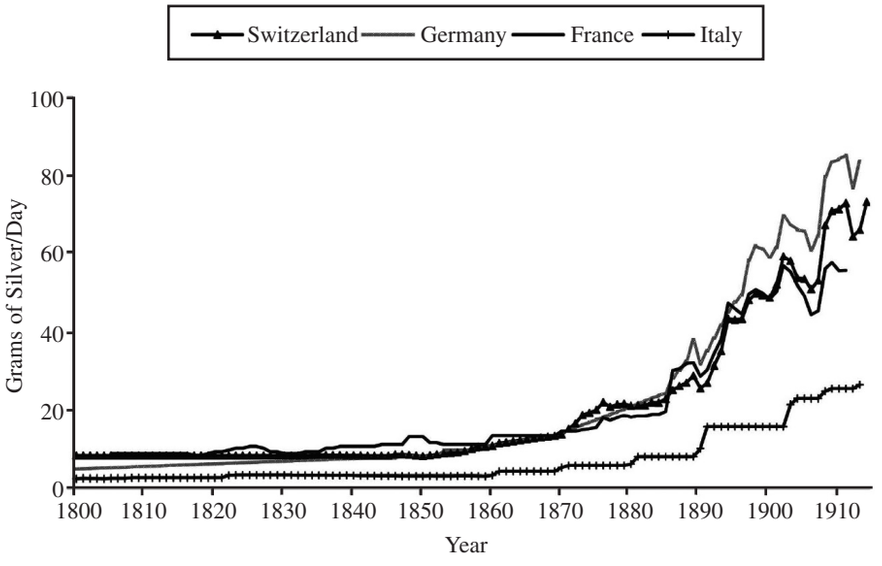

FIGURE 2. Nominal wages of skilled craftsmen in Europe, 1800–1914.
Note. Wages for France are from Paris, Italian wages are from Milan, and German wages are from Leipzig. These are wages for masons and carpenters. Swiss francs have been converted into grams of silver using Martin Körner (2007).
Sources. For Switzerland, see text. For other countries, see Robert Allen (2001).

The sources used for this later period include *Historische Statistik (*Ritzmann-Blickenstorfer 1996, 443, table 3, 452, table G.6a, table G.6b), Die Volkswirtschaft (Eidgenössisches Volkswirtschaftsdepartement 1949–86), Statistik der Stadt Zurich (1922–93), the *Lohn und Gehaltserhebungen* of the Bundesamt für Industrie (Archive of the Schweizerischer Gewerkschaftsbund 1986–93, PE 919), Gewerbe und Arbeit (ibid., 1986–93, PE 539), the "Tägigkeitsberichte" of the *Gewerkschaft Bau und Holz* (Schweizerischer Gewerkschaftsbund 1979–90, PE 539), and, finally, for the years from 1994–2006, the somewhat problematic publications of the BFS (1996, 1998b, 2000, 2002, 2006a, 2007a).[6] With these publications, the most serious problem

was that construction workers were no longer listed by trade but simply under the general classification "construction," which could include all kinds of construction workers and people working in construction, even architects and engineers. The situation was made worse because the time-honored distinction between craftsmen and unskilled laborers was given up in favor of a system with four classes that turned out to be incompatible with the old system. Although wage levels differ among the trades within the construction sector, trends, which are nonetheless essential to constructing an index, are very similar.

Another problem of twentieth-century wages is their differing natures. A wage could be a minimum wage, an average wage, a maximum wage (as decreed in the Gesamtarbeitsverträge [Eidgenössisches Volkswirtschaftsdepartment 1949–86] or Landesmantelverträge), or it could be an average wage as determined by surveys. Maximum wages were not used. However, no further adjustment was made to distinguish between an average wage as set in the Gesamtarbeitsverträge and an average wage as found in surveys. Judging from the actual data, only minor errors are introduced.

Over the twentieth century, various additional components of wages were introduced and were dealt with in one of three ways: they were: (1) removed from the wage, (2) left in the wage, or (3) ignored. Social security contributions, such as mandatory taxes for health insurance and AHV (old-age) pensions were ignored. Because these did not exist in the nineteenth century and were not at the worker's disposal, we removed them from the wages that contained them. In 2000, these taxes made up 13.5 percent of gross wages cited. In the nineteenth century, in the rare cases when a type of social security existed, this made up 1–2 percent of the wage. The "thirteenth monthly wage," which was introduced in two steps in 1973 and 1974, is an example of the second case. We treated it as a component of the monthly wage the worker actually received and left it in the wage. Finally, components such as bonuses for children or other family-related bonuses were ignored. The error introduced is most likely negligible, because the standard used in most surveys and statistics for the twentieth century is a male worker who does not receive such bonuses.

The concept of work time also changed during the twentieth century. This creates three problems. First, construction is a strongly seasonal trade, a fact that has to be taken into account when one builds a wage series. Thus, when available, summer and winter work times were recorded separately, and a weighted aggregate was built. Unfortunately, sometimes only summer work times were available in the statistics for the twentieth century. Second, although weekly work hours did not change much over the nineteenth century, they decreased substantially during the twentieth century. The standard we wanted to keep fixed in the labor approach is the actual work a worker performs, so daily wages were not calculated on the basis of a constant 63-hour work week from 1800 to 2006 (such a calculation would value additional leisure in the twentieth century at the worker's wage rate, which we believe to be incorrect). Rather, weekly work time data for the construction trades were used to calculate the actual daily wages—the standard used throughout the period—paid to workers in the twentieth century. Third, the twentieth century saw the advent of paid vacation time, which further reduced actual work time. Vacation leave grew from nothing to five weeks-per-year by the end of the twentieth century. The wage series was not corrected upward to account for additional vacation time.[7]

We made a considerable effort to ensure that the new wage deflator examining more than two centuries is as consistent and reliable as possible. However, the wider economic and social changes over such a long time are such that even when trying to describe earnings in a comparatively stable trade, one must make difficult assumptions and choices, some of which may to a degree be misleading. The story of reward for labor is simply too complex to be summarized in one time series.

Assembling a Swiss Consumer Price Index

We linked several existing and some new series together to produce a CPI series for the last five centuries, but their quality generally decreases the further back in time we move. We looked at all the subseries used to construct a CPI for the last five centuries and started with the one covering the most recent time periods, before going back in time.

From 1914 to 2006, the task was unproblematic, because we could use an official CPI provided by the BFS (1998a, 2007b). For earlier periods, however, the challenges are multiform; there are only a handful of retrospective and very limited indexes available to date.

Of these, the one covering the longest time span is presented in Heiner Ritzmann-Blickenstorfer's *Historische Statistik* (1996), covering the years 1811–1914. However, this index combines the results of three older studies that cover different time periods and that vary greatly in quality and adequacy. The period 1890–1914 was covered in a very detailed study by Thomas Gross and his coauthors (1982), which presents an index representative for the German-speaking urban centers and industrialized communities of Switzerland. It is based on a fixed model of consumer expenditure, which was created for 1910 and then used throughout the entire period of 1890–1914.[8] Ritzmann-Blickenstorfer (1996) then linked Gross's index with a less-reliable index covering the years from 1851 to 1890. To arrive at a deflator for the first half of the century, these CPIs were then linked with the only available index ranging back into the first half of the nineteenth century, which happened to be a wholesale price index (Projer 1987).

Because the only annual CPI available to date is rather unreliable before 1890, and there is actually no CPI before 1851, we created a new alternative index, which starts in 1800 and goes up to World War I (see appendix A-2). Even though a detailed account of the construction and the reliability of this new CPI can be found elsewhere, a few facts about this new series are worth discussing here (Studer forthcoming). This new index originally served another purpose—to enable an

international comparison of Swiss real wages—and our CPI bears the traces of this. Most important, the choice of what goods to include was not guided by detailed budget analysis of Swiss consumers, which would be very hard to carry out for the early nineteenth century in the face of missing information, but was solely determined by international comparability. The basket that met this criterion contains 12 goods: beans, bread, butter, candles, cheese, drapery, eggs, fuel, lamp oil, meat, soap, and wine. Prices are for Zurich, and for most goods, annual data on retail prices—in many cases, even overlapping series—were collected from sources such as the Staatsarchiv Zurich and old statistics journals. The single price series are rather robust, but its composition is too premodern, especially for the late nineteenth century. Another shortcoming is that we had to exclude rent. We used a Laspeyres Index to determine the budget shares, which kept the budget weights of the single goods constant for the whole period from 1800 to 1914.[9] Our indices are reproduced in the appendix.

Figure 3 depicts how this newly constructed CPI compares to the existing one from Ritzmann-Blickenstorfer's *Historische Statistik* (1996). The comparison also includes Siegenthaler's (1965) older estimates of consumer price inflation, whose database was broader than the one used for the index provided by *Historische Statistik*. The downside of Siegenthaler's index is, of course, that he did not provide annual data. The graph is reassuring. The new index shows a trend very similar to the one Siegenthaler constructed in the 1960s, and which is probably still the most reliable for the period from 1840 to 1890. Furthermore, the fact that Siegenthaler included rents in his calculations prove that omitting rent in the new calculations does not substantially change the trend. The graph also conveys that *Historische Statistik* is a poor match with the new index for the period before 1890, and especially before 1850, because the index relies on a wholesale index for that period. Even so, these discrepancies are not necessarily bad news, because the quality and adequacy of these existing early series are not very high. The present index, showing a far smaller fall in prices over the first four decades of the nineteenth century than the wholesale index used in *Historische Statistik*, conveys a more accurate trend of consumer prices despite its limitations in terms of geographical coverage and the range of goods included. The new CPI is almost identical to the existing CPI for the period 1890–1914. *Historische Statistik* relies on the study by Gross and his coauthors (1982), which is very detailed and reliable.

This CPI is the first to extend further back than 1851 annually for Switzerland. Analogous to the new wage index, we want to briefly examine the situation in neighboring countries to look for further validation. Again, prices in all countries are first converted into a single monetary unit. Figure 4 leaves no doubt—trends in consumer prices were stunningly similar for most of the century across all four countries.

The quality of the CPIs decreases hand-in-hand with the availability of data as we go further back in time, and this is particularly true for the index of the years before 1800. Annual prices are extremely hard to come by during the early modern period, so continuous prices for elaborate consumer baskets are too high a hurdle to leap. There is but one consumer item for which sufficient annual data are available—grain. Bread dominated the budget of the masses throughout the early modern period, however, so creating a consumer basket with grain as the only item seems a justifiable simplification. It is,

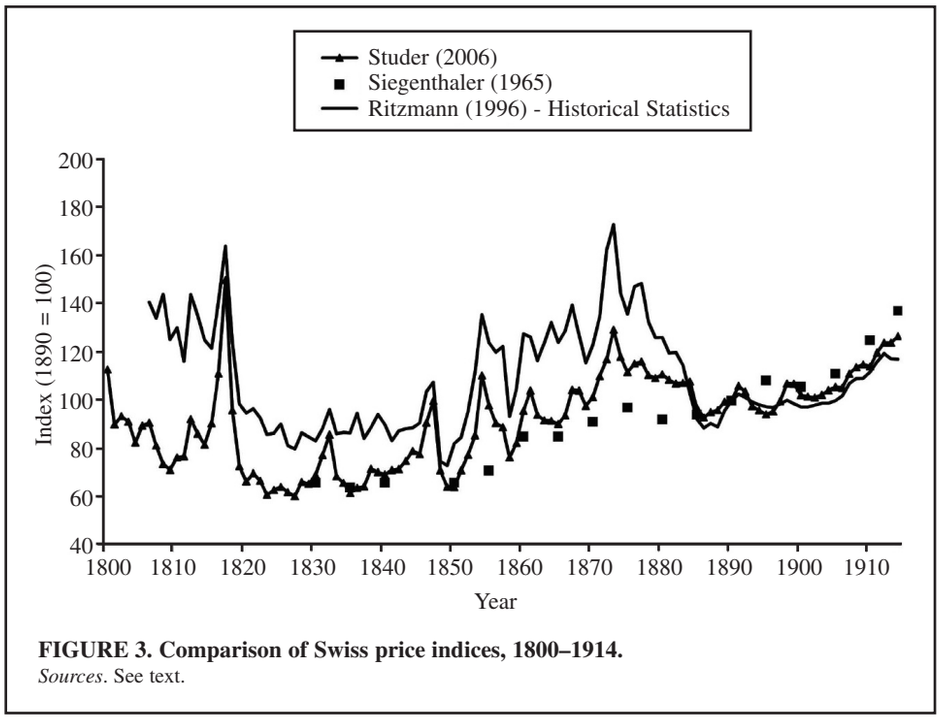

FIGURE 3. Comparison of Swiss price indices, 1800–1914.
Sources. See text.

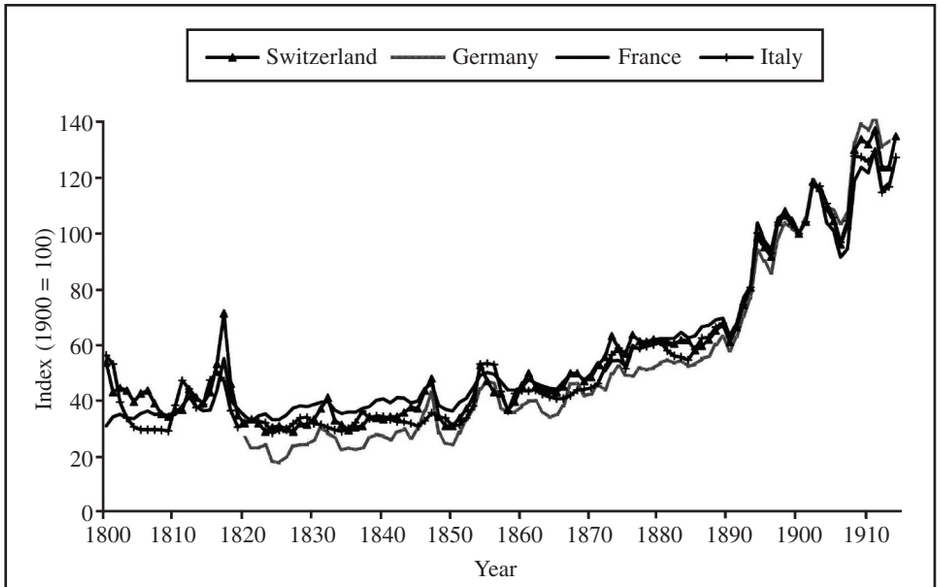

FIGURE 4. Consumer Price Indices in Europe, 1800–1914.
Note. Prices for France are from Paris and Strasbourg, Italian prices are from Florence, and German prices from Leipzig. Swiss prices have been converted into grams of silver using Martin Körner (2007).
Sources. For Switzerland, see text. For other countries, see Robert Allen (2001).

at any rate, the only possibility available at the moment. Thus, we created an index of average grain price in Switzerland from annual grain price series covering the years 1501–1800. The price series used are for the most important bread grains: rye, spelt, and wheat. Although the resulting time series, depicted in figure 5, is limited in the share of consumer expenditure it covers, its geographical coverage is superior to any CPI up to 1914, because long-grain prices series are available for many different parts of Switzerland. To prevent the overrepresentation of certain parts of the country, we first created four regional indices—northern Switzerland, central Switzerland, the region around Bern, and the French-speaking region. Next, we obtained the final national index by taking the simple average of the regional values.[10] The resulting index is fairly representative of Switzerland as a whole, and it is reliable because it draws on many independent series. Still, as the coverage of

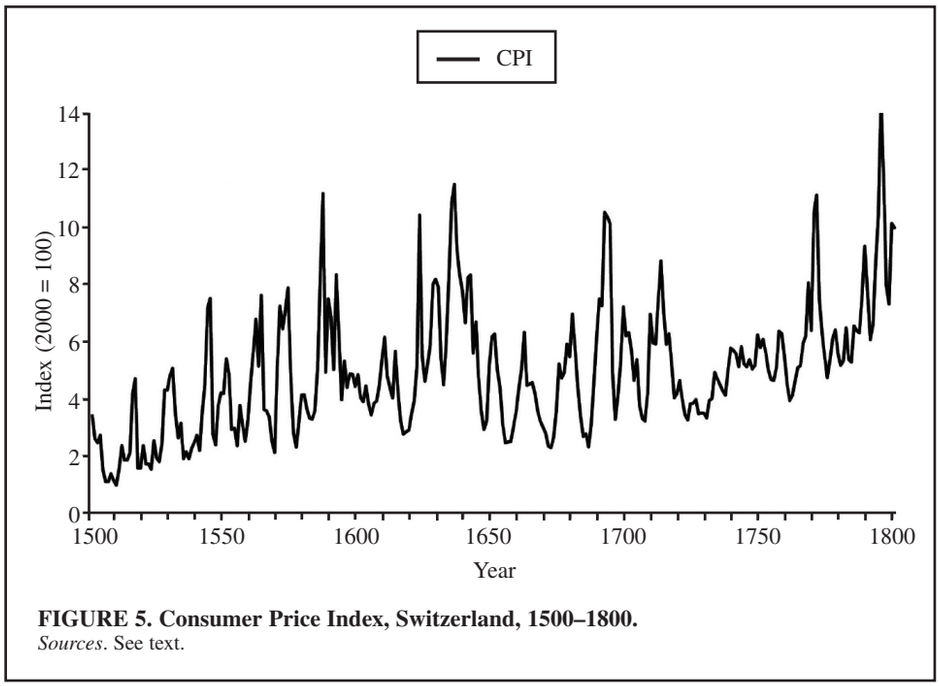

FIGURE 5. Consumer Price Index, Switzerland, 1500–1800.
Sources. See text.

this early price index is weaker than for the later periods and it should be applied with care.

The final CPI includes many new and existing subseries that cover more than five centuries. They consist of:

- 1501–1800: New CPI based on grain prices from various parts of Switzerland.
- 1800–1890: New CPI based on a fixed basket of 12 goods; prices are for Zurich.
- 1890–1914: Existing CPI developed by Gross and his coauthors (1982); fixed basket with prices for German-speaking Switzerland.
- 1914–2006: Official CPI provided by the BFS (1998a, 2007b); large database with regularly changing baskets and Swiss average prices.

Gross Domestic Product

The GDP series linked the latest estimates available. For the years 1851–1980, these were taken from Felix Andrist, Richard G. Anderson, and Marcela M. Williams (2000); the 1980–2006 series is the official GDP series produced by the BFS (1998a, 2006b, 2006c) and uses the Swiss national accounts.

Comparison and Discussion

Whereas the simple CPI depicted in figure 5 is the only deflator available for 1501–1800, there is a choice for the period after 1800. We examined how the CPI, GDP, and wage series compare with one another and how to choose a particular index when there is a choice.

Figures 6 and 7 illustrate how the three methods of price deflation produce significantly different results. In the nineteenth century, the CPI curve seems to move independently of the wage and GDP curves. In the twentieth century, the CPI, GDP, and wage curves have very similar trajectories. We will not attempt to explain exactly how and why these deflators differ, but two features encapsulate some central long-term economic developments. The first important characteristic figures 5–7 nicely depict is the well-known fact that in economic terms, the decisive break with the past came only in the twentieth century and after World War II in particular. Before, all indicators are either stagnant or rise only slowly, whereas afterwards, production, wages, and consumer prices, exhibit a totally different pattern—a steady and rather fast rise.

Another very broad and important conclusion arises when one compares the wage and CPI series. Figure 6 shows that the wage index is at a considerably lower level in the early 1800s than it is after 1860. Nominal wages rose considerably faster than consumer expenditures over the past 200 years, suggesting a rather dramatic rise in real wages.

The choice of index in deflating a nominal price will greatly affect the result. With this in mind, which index should we use for periods after 1800? The intuitive concept of the wage deflator and the relative continuity of what it measures make it a good choice in many situations. It is definitely the best deflator for prices connected to infrastructure—things that were constructed. It would be preferred to deflate building costs of avalanche protection structures or flood protection structures—an example with sadly current relevance. In such cases, the CPI is probably a poorer choice, because the CPI is especially representative of inflation on goods purchased by

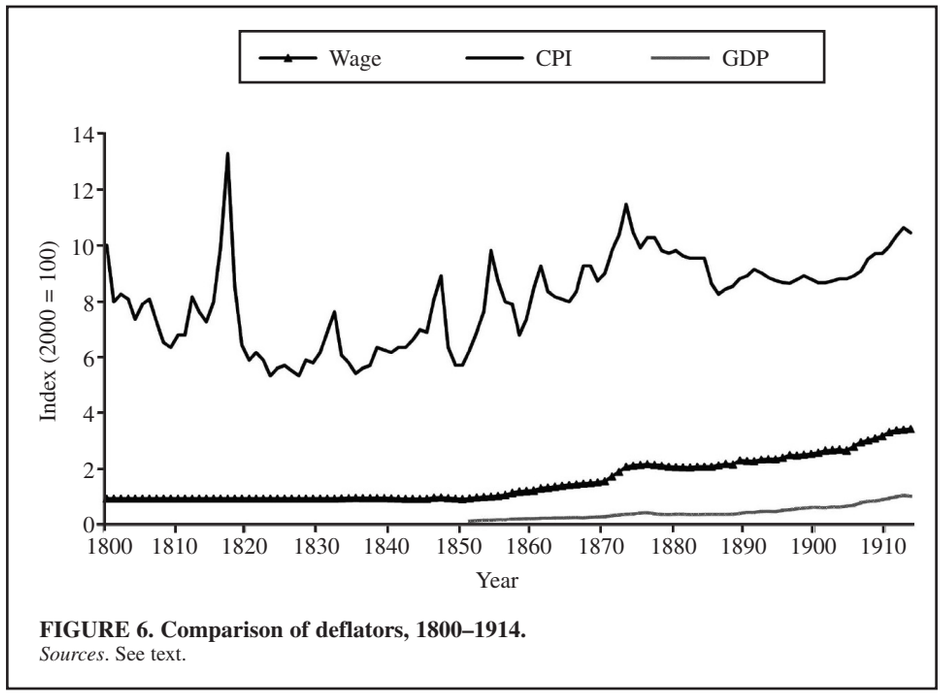

FIGURE 6. Comparison of deflators, 1800–1914.
Sources. See text.

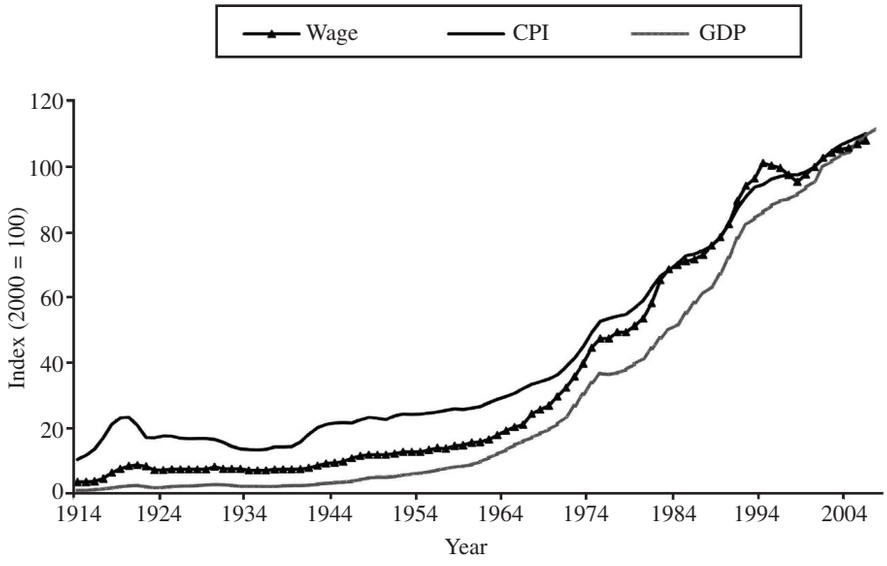

FIGURE 7. Comparison of deflators, 1914–2004.
Sources. See text.

households. This does not include avalanche barrier structures, dams, or houses. We can also use the wage index to compare other wages over time, and it shows how much a commodity is worth in terms of the amount of work or time it would take to earn its cost. Because work makes up a large part of life, one can relate very easily to such comparisons. The labor approach thus opens up a wide field of possibilities, such as the deflation of the federal debt, which does not have much to do with the building of houses or with other wages.

The GDP series is especially useful if one wants to estimate the impact of a transaction on a society (a corrected GDP without the probable overstatement of production in the last 40–50 years, such as the ISEW, would be even better suited). Because the GDP is a measure of an economy's entire final production, expressing the transaction as a share of the GDP is the best approach. Deflation of a nominal price with the wage index cannot offer this, nor can a commodity price deflator. The GDP is useful precisely when one is interested in how much something is worth when everything that is produced for final use in the economy is taken into account. One must recall, however, that especially the pre-twentieth-century values of the GDP series rest on a rather shaky quantitative basis.

The CPI is a good choice for estimates of purchasing power. If one is primarily interested in what people were able to buy with a certain amount of money, then it makes sense to use a commodity price deflator, and the CPI is representative of inflation on commodities typically bought by households. Finally, when one attempts intertemporal comparisons of prices that involve any pre–1800 period, the CPI is the only option at hand. And because it is not advisable to mix deflators, this is true whenever one deals with the period before 1800. Thus, when we compare land rents in the years 1660 and 1900, the wage and GDP deflators are useless.

When choosing a deflator, much depends on the questions one wants to answer. As long as there is a choice between multiple deflators, as is the case from 1800 onward, one should exercise it. And, more generally, when there are deflators at hand, one should use this instrument for intertemporal comparison, which has so many potential uses. We hope that readers take this to heart in the present case.

NOTES

To encourage the wider usage of the time series presented in this article, we set up a Web site to provide an easy-to-use online converter that allows for instantaneous and simple intertemporal conversion of real prices in Switzerland from 1501 to the present. We thank Mario Aeby, who did a great job in programming the tool. We will regularly update the site, which can be accessed at http://www.swistoval.ch starting in the autumn of 2008.

We would also like to thank Christian Pfister for encouragement and the National Centre for Competence in Research-Climate program of the Swiss National Fund for funding. We are grateful to an anonymous referee and the editor for helpful comments and suggestions.

1. This quote was translated by the authors. See also Ruth Meier and Utz-Peter Reich (2001, 67–70).

2. See Robert Pollack (1990) for an influential early article on the cost of living. See also Erwin Diewert (1990); for more recent overviews, see BFS (1999) and John J. McCusker (2001).

3. Franklin seems to have borrowed heavily from William Petty (1662).

4. The decision itself can be found in the Staatsarchiv Basel, Akten, Münz J 3.

5. For more detailed information about the sources and the construction of each wage series, see: Pascal Schuppli (2005) for Basel and Roman Studer (2003; forthcoming) for Zurich.

6. We also used information from the payroll of the construction firm of Wilhelm Löffel (Schweizerisches Wirtschaftsarchiv, Handschriften 483 C) for the 1920s. For these sources, see Pascal Schuppli (2005).

7. For in-depth discussion and further justifications about how we dealt with changing modes of payment, work hours, and new wage components, please consult Pascal Schuppli (2005). More detailed information about the sources and about how they were linked is also provided there.

8. These and all the other results from consumer price calculations are printed in Ritzmann-Blickenstorfer (1996, chap. H., tables 1–25, especially table 17, 437–42).

9. To construct the new CPI from 1800–1914, the following sources were used: Christian Pfister (1989), Heinrich Bertschinger (1873), Franz Haas-Zumbühl (1903), Ritzmann-Blickenstorfer (1996), Staatsarchiv Zurich (RR II: 120b1), Staatsarchiv Zurich (RR II: 141), Hansjürg Siegenthaler (1966), and Hans Brugger (1968). A full description covering the way in which this new CPI was constructed, the sources used, and the CPI's reliability can be found in Roman Studer (forthcoming), where it is also discussed against the background of previous Swiss CPIs and compared with CPIs of other countries for the same period.

10. For the construction of the pre–1800 price index, prices from the following locations and the following years (type of grain in parenthesis) were used: Basle, 1501–1797 (rye); Zurich, 1540–1800 (spelt); Lausanne, 1562–1720 (mix of wheat, rye, and spelt); Bernese Aargau, 1565–1770 (spelt); Lucerne, 1601–1800 (spelt); Schaffhausen, 1652–1800 (rye); Appenzell, 1656–1800 (rye); Berne, 1739–1800 (spelt). The sources are (in the same order): A. C. Hanauer (1876 and 1878, 82–86); C. K. Müller (1878, 50, 52); Anne Radeff (1978, 15–19); Willi Pfister (1940, 237–64); Haas-Zumbühl (1903, 370–72); Frank Göttmann (1991, 480–84); and Christian Pfister (1989).

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APPENDIX A-1
Deflator Time Series

TABLE A-1. Consumer Price Index, 1501–1800 (2000 = 100)

Year	CPI	Year	CPI	Year	CPI	Year	CPI	Year	CPI
1501	3.39	1533	2.62	1565	3.60	1597	4.84	1629	8.18
1502	2.58	1534	3.12	1566	3.56	1598	4.84	1630	7.89
1503	2.44	1535	1.87	1567	3.34	1599	4.42	1631	5.38
1504	2.71	1536	2.12	1568	2.49	1600	4.82	1632	4.46
1505	1.49	1537	1.87	1569	2.09	1601	4.02	1633	6.01
1506	1.08	1538	2.24	1570	5.13	1602	3.88	1634	8.31
1507	1.08	1539	2.45	1571	7.23	1603	4.42	1635	10.86
1508	1.36	1540	2.70	1572	6.43	1604	3.78	1636	11.49
1509	1.13	1541	2.17	1573	7.10	1605	3.40	1637	9.19
1510	0.95	1542	3.53	1574	7.87	1606	3.82	1638	8.34
1511	1.56	1543	4.53	1575	4.63	1607	3.90	1639	7.77
1512	2.34	1544	7.15	1576	2.78	1608	4.45	1640	6.65
1513	1.82	1545	7.48	1577	2.29	1609	5.37	1641	8.24
1514	1.82	1546	2.73	1578	3.19	1610	6.13	1642	8.33
1515	2.08	1547	2.37	1579	4.12	1611	4.77	1643	5.59
1516	4.16	1548	3.76	1580	4.13	1612	4.37	1644	6.68
1517	4.68	1549	4.19	1581	3.61	1613	4.01	1645	4.70
1518	1.56	1550	4.18	1582	3.29	1614	5.65	1646	3.56
1519	1.56	1551	5.39	1583	3.25	1615	4.23	1647	2.91
1520	2.34	1552	4.86	1584	3.57	1616	3.20	1648	3.19
1521	1.68	1553	2.91	1585	5.03	1617	2.74	1649	5.19
1522	1.68	1554	2.96	1586	8.22	1618	2.84	1650	6.15
1523	1.51	1555	2.33	1587	11.18	1619	2.90	1651	6.25
1524	2.52	1556	3.75	1588	4.90	1620	3.44	1652	5.00
1525	1.89	1557	3.08	1589	7.47	1621	3.92	1653	4.35
1526	1.77	1558	2.49	1590	6.86	1622	5.14	1654	3.12
1527	2.40	1559	3.23	1591	5.00	1623	10.41	1655	2.44
1528	4.29	1560	4.56	1592	8.33	1624	5.48	1656	2.46
1529	4.29	1561	5.62	1593	6.19	1625	4.58	1657	2.48
1530	4.79	1562	6.77	1594	3.95	1626	5.21	1658	2.98
1531	5.04	1563	5.13	1595	5.30	1627	5.90	1659	3.49
1532	3.40	1564	7.61	1596	4.39	1628	7.99	1660	4.28

(appendix continues)

APPENDIX A-1 CONTINUED
Deflator Time Series

TABLE A-1. (*continued*)

Year	CPI
1661	5.03
1662	6.31
1663	4.45
1664	4.49
1665	4.54
1666	4.17
1667	3.55
1668	3.19
1669	3.00
1670	2.78
1671	2.32
1672	2.26
1673	2.63
1674	3.54
1675	5.20
1676	4.69
1677	4.89
1678	5.89
1679	5.47
1680	6.96
1681	5.79
1682	4.44
1683	3.34
1684	2.67
1685	2.76
1686	2.29
1687	3.11
1688	4.61

Year	CPI
1689	6.61
1690	7.47
1691	7.24
1692	10.51
1693	10.35
1694	10.13
1695	4.87
1696	3.25
1697	4.15
1698	5.29
1699	7.20
1700	6.18
1701	6.29
1702	5.69
1703	4.61
1704	5.36
1705	3.74
1706	3.28
1707	3.19
1708	4.18
1709	6.95
1710	5.95
1711	5.91
1712	7.47
1713	8.81
1714	7.03
1715	5.90
1716	6.26

Year	CPI
1717	5.20
1718	4.02
1719	4.18
1720	4.61
1721	3.94
1722	3.41
1723	3.23
1724	3.81
1725	3.82
1726	3.95
1727	3.45
1728	3.48
1729	3.47
1730	3.29
1731	3.91
1732	3.99
1733	4.90
1734	4.68
1735	4.47
1736	4.27
1737	4.11
1738	4.97
1739	5.76
1740	5.69
1741	5.57
1742	5.11
1743	5.82
1744	5.21

Year	CPI
1745	5.10
1746	5.36
1747	5.02
1748	5.15
1749	6.22
1750	5.79
1751	6.05
1752	5.64
1753	5.00
1754	4.65
1755	4.61
1756	5.05
1757	6.35
1758	6.26
1759	5.49
1760	4.52
1761	3.92
1762	4.10
1763	4.59
1764	5.07
1765	5.14
1766	5.91
1767	6.17
1768	8.05
1769	6.37
1770	10.50
1771	11.13
1772	7.47

Year	CPI
1773	6.30
1774	5.47
1775	4.71
1776	5.35
1777	6.09
1778	6.39
1779	5.57
1780	5.16
1781	5.32
1782	6.47
1783	5.35
1784	5.27
1785	6.53
1786	6.36
1787	6.29
1788	7.60
1789	9.33
1790	7.64
1791	6.04
1792	6.56
1793	8.68
1794	10.41
1795	14.46
1796	11.73
1797	7.94
1798	7.30
1799	10.12
1800	9.98

APPENDIX A-2
Deflator Time Series

TABLE A-2. Swiss Deflators, 1800–2006 (2000 = 100)

Year	Wage	CPI	GDP
1800	0.98	9.98	
1801	0.98	7.99	
1802	0.98	8.26	
1803	0.98	8.08	
1804	0.98	7.35	
1805	0.98	7.90	
1806	0.98	8.08	
1807	0.98	7.26	
1808	0.98	6.53	
1809	0.98	6.35	
1810	0.98	6.81	
1811	0.98	6.81	
1812	0.98	8.17	
1813	0.98	7.62	
1814	0.98	7.26	
1815	0.98	7.99	
1816	0.98	9.89	
1817	0.98	13.25	
1818	0.98	8.53	
1819	0.98	6.44	
1820	0.98	5.90	
1821	0.98	6.17	
1822	0.98	5.90	
1823	0.98	5.35	
1824	0.98	5.63	
1825	0.98	5.72	
1826	0.98	5.54	
1827	0.98	5.35	
1828	0.98	5.90	
1829	0.98	5.81	
1830	0.98	6.17	
1831	0.98	6.90	
1832	0.89	7.62	
1833	0.99	6.08	
1834	1.00	5.81	
1835	1.00	5.45	
1836	1.00	5.63	
1837	1.00	5.72	
1838	1.00	6.35	
1839	1.00	6.26	
1840	0.99	6.17	
1841	0.99	6.35	
1842	0.98	6.35	
1843	0.98	6.62	
1844	0.98	6.99	
1845	0.98	6.90	
1846	1.02	8.08	
1847	1.02	8.89	
1848	1.00	6.35	
1849	0.98	5.72	
1850	0.97	5.72	
1851	0.99	6.26	0.16
1852	1.02	6.90	0.19
1853	1.04	7.62	0.20
1854	1.06	9.80	0.21
1855	1.08	8.71	0.23
1856	1.11	7.99	0.22
1857	1.18	7.90	0.24
1858	1.23	6.81	0.25
1859	1.24	7.35	0.26
1860	1.26	8.44	0.26
1861	1.34	9.26	0.28
1862	1.36	8.35	0.28
1863	1.39	8.17	0.28
1864	1.42	8.08	0.28
1865	1.46	7.99	0.29
1866	1.48	8.35	0.30
1867	1.50	9.26	0.28
1868	1.53	9.26	0.32
1869	1.55	8.71	0.32
1870	1.59	8.98	0.33
1871	1.76	9.80	0.37
1872	1.92	10.35	0.40
1873	2.12	11.43	0.43
1874	2.15	10.44	0.44
1875	2.18	9.89	0.47
1876	2.21	10.26	0.48
1877	2.18	10.26	0.44
1878	2.15	9.80	0.42
1879	2.11	9.71	0.41
1880	2.10	9.80	0.43
1881	2.09	9.62	0.43
1882	2.09	9.53	0.41
1883	2.11	9.53	0.41
1884	2.11	9.53	0.42
1885	2.11	8.62	0.42
1886	2.16	8.26	0.41
1887	2.22	8.44	0.42
1888	2.20	8.53	0.43
1889	2.34	8.80	0.45
1890	2.32	8.89	0.50
1891	2.31	9.13	0.48
1892	2.36	9.01	0.52
1893	2.39	8.84	0.53
1894	2.38	8.73	0.51
1895	2.44	8.66	0.57

(appendix continues)

APPENDIX A-2 CONTINUED
Deflator Time Series

TABLE A-2. (*continued*)

Year	Wage	CPI	GDP
1896	2.53	8.62	0.58
1897	2.52	8.76	0.62
1898	2.55	8.90	0.65
1899	2.57	8.78	0.67
1900	2.62	8.65	0.67
1901	2.69	8.65	0.66
1902	2.71	8.72	0.68
1903	2.73	8.80	0.68
1904	2.69	8.80	0.72
1905	2.83	8.89	0.74
1906	2.98	9.07	0.84
1907	3.04	9.51	0.89
1908	3.12	9.69	0.89
1909	3.19	9.70	0.94
1910	3.34	9.94	1.00
1911	3.40	10.32	1.06
1912	3.43	10.62	1.10
1913	3.45	10.43	1.07
1914	3.50	10.41	1.04
1915	3.55	11.77	1.23
1916	3.76	13.64	1.49
1917	4.51	16.98	1.78
1918	6.29	21.25	2.13
1919	7.50	12.33	2.41
1920	8.48	23.33	2.51
1921	8.74	20.86	2.12
1922	8.31	17.07	1.76
1923	7.15	17.06	1.95
1924	7.15	17.58	2.19
1925	7.41	17.52	2.30
1926	7.37	16.89	2.30
1927	7.37	16.69	2.44
1928	7.37	16.77	2.68
1929	7.37	16.79	2.77
1930	8.15	16.50	2.74
1931	7.50	15.64	2.53
1932	7.50	14.42	2.27
1933	7.50	13.68	2.28
1934	7.06	13.49	2.25
1935	7.06	13.35	2.20
1936	7.06	13.58	2.21
1937	7.32	14.24	2.42
1938	7.37	14.27	2.43
1939	7.37	14.37	2.48
1940	7.47	15.71	2.60
1941	7.86	18.11	2.86
1942	8.53	20.14	3.09
1943	9.17	21.16	3.33
1944	9.47	21.61	3.44
1945	9.81	21.76	3.71
1946	10.85	21.64	4.21
1947	11.54	22.61	4.73
1948	11.88	23.29	4.91
1949	11.88	23.09	4.84
1950	11.88	22.71	5.11
1951	12.27	23.80	5.60
1952	12.79	24.41	5.91
1953	12.79	24.27	6.21
1954	12.79	24.40	6.58
1955	13.35	24.65	7.09
1956	14.00	25.04	7.63
1957	13.76	25.53	8.11
1958	14.59	25.99	8.34
1959	14.76	25.83	8.86
1960	15.54	26.20	9.74
1961	15.71	26.68	10.96
1962	16.48	27.83	12.16
1963	17.85	28.79	13.37
1964	19.21	29.68	14.82
1965	20.38	30.69	15.87
1966	21.06	32.15	17.04
1967	24.48	33.45	18.34
1968	25.74	34.25	19.59
1969	26.92	35.11	21.22
1970	29.65	36.38	23.64
1971	32.38	38.76	26.85
1972	35.89	41.35	30.43
1973	39.80	44.96	33.91
1974	44.64	49.34	36.79
1975	47.48	52.68	36.54
1976	47.48	53.57	37.01
1977	49.51	54.27	38.01
1978	49.51	54.83	39.55
1979	51.33	56.82	41.34
1980	53.56	59.11	44.41
1981	58.34	62.95	47.71
1982	65.29	66.51	50.21
1983	68.66	68.46	51.81
1984	69.98	70.46	55.25
1985	71.19	72.89	58.49
1986	71.76	73.43	61.28
1987	73.16	74.49	63.42
1988	75.90	75.89	67.25
1989	78.46	78.29	72.33
1990	82.58	82.51	78.24
1991	89.59	87.35	82.28

(appendix continues)

APPENDIX A-2 CONTINUED
Deflator Time Series

TABLE A-2. (*continued*)

Year	Wage	CPI	GDP
1992	94.28	90.88	84.42
1993	96.52	93.87	86.26
1994	101.20	94.67	88.15
1995	100.40	96.37	89.59
1996	99.63	97.16	90.21

Year	Wage	CPI	GDP
1997	97.60	97.66	91.58
1998	95.50	97.68	93.70
1999	97.80	98.46	95.80
2000	100.00	100.00	100.00
2001	102.80	102.50	101.70

Year	Wage	CPI	GDP
2002	104.40	104.90	103.60
2003	105.40	106.70	104.60
2004	105.80	107.90	107.60
2005	107.00	109.10	109.60
2006	108.18	110.30	111.68

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References

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