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HAS SWITZERLAND REALLY BEEN MARKED BY LOW PRODUCTIVITY GROWTH? HOURS WORKED AND LABOR PRODUCTIVITY IN SWITZERLAND IN A LONG-RUN PERSPECTIVE

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This paper shows that previous work has understated Switzerland's performance in terms of labor productivity growth. First, available data on hours worked are incoherent and overestimate growth in hours worked. The paper therefore establishes a consistent series of total hours worked and its components covering 1950–2010, showing that Swiss labor inputs actually were stable from 1964 to 2007. Second, long-term improvements in Switzerland's Terms of Trade indicate that quality improvements in Swiss exports might not be fully mirrored in growth of GDP and, hence, productivity growth.

JEL Codes: J22, N34, O47

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1. INTRODUCTION

Switzerland is, and has traditionally been, a country of high growth in the number of employed persons but mediocre productivity growth. This is how the Swiss State Secretariat for Economic Affairs (SECO) summarizes its analysis on Swiss labor productivity in its "growth reports" (SECO, 2002, 2008, 2012). Indeed, data from the OECD indicate that Switzerland's labor productivity is just average among OECD countries. For example, in 2011 GDP per hour worked was 10.9 percent lower than in the U.S. Similarly, OECD data suggest that Switzerland's growth in labor productivity since 1980 has been substantially lower than in all other OECD countries for which data exists.

As a consequence, Switzerland's low growth in labor productivity was identified as the main reason for its disappointing dynamics in GDP in the last 30 years. Switzerland's growth in terms of GDP per working age person was so low that Kehoe and Prescott (2002) and Kehoe and Ruhl (2003, 2005) even came to the conclusion that Switzerland went through a modern "Great Depression" between 1974 and 2000. Even though this might be an exaggeration of the extent of the problem, Swiss economists noticed Switzerland's poor measured economic performance, and hence tried to identify the sources for the apparent weakness in

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productivity growth (Brunetti and Zürcher, 2002; Dreher and Sturm, 2005). The academic and public debate about the issue reached its peak when Bodmer and Borner (2004) published a book on the "growth weakness" of Switzerland.

The main reason why the book was hotly debated in Switzerland was that the finding of a mediocre level and growth of productivity stands in contrast to public perception about the level and growth of well-being and welfare in the country (Abrahamsen *et al.*, 2005b; Kohli, 2005), and to some hard economic facts. For example, it contrasts with the high quality of Swiss exports (Credit Suisse Economic Research, 2011; Hallak and Schott, 2011), the very good reputation of Switzerland's educational system, the economy's high expenditure for R&D, and the fact that Switzerland is generally ranked among the most innovative and most competitive countries worldwide (Arvanitis and Hollenstein, 2012; IMD, 2012). Several economists have thus searched for simpler explanations for the "Swiss productivity puzzle"—notably by questioning the available data (Kohli, 2004; Abrahamsen *et al.*, 2005a, 2005b; Hartwig, 2006, 2008).

This paper belongs to this class of studies, too. In particular, it highlights that all previous papers on the issue were misled by inconsistencies and conceptual deficiencies in the data used in the denominator of labor productivity, that is, in total hours worked. The problems concern the hours worked data for the time before 1991 and pertain to the two widely used series on hours worked one can use for this period: the series from the University of Groningen/Conference board total economy database (henceforth GGDC series), covering the period from 1950 to the present, and the series of total hours worked from the OECD that starts in 1970. Because of the conceptual shortcomings of the two series, they overestimate growth in hours worked substantially.

Since the available series on hours worked are biased while the series is a basic ingredient for a serious discussion about Switzerland's growth in labor productivity, the first contribution of this paper is to establish a consistent long time series of total hours worked for Switzerland by exploiting available historical data on the different components of total hours worked.

As a second contribution, the paper uses the new hours worked series to study the evolution of labor productivity in Switzerland in the post-war period in a comparative perspective. The central aim of the analysis is to qualify the extent of Switzerland's productivity growth deficit compared to other European countries. I argue in line with and extending arguments from previous papers that given the high quality and complexity of Switzerland's exports and the substantial conceptual deficiencies of the historical export and import price index, Switzerland's Terms of Trade (ToT) might mirror to some extent quality gains in exports over imports erroneously accounted for as price phenomena when computing GDP. One way to deal with this problem is to concentrate on the evolution of real Gross Domestic Income (GDI) which deflates both imports and exports by the same price index.

The comparison of growth of GDP per hour worked according the OECD and growth of real GDI per hour worked using the newly estimated hours worked series indicates that Swiss "growth" or "productivity puzzle" after the first oil crisis might be resolvable to a substantial extent by accounting for two measurement issues: quality improvements in exports disregarded when calculating real GDP; and an overestimation of the increase in hours worked in previous studies.

The paper has two general messages on the measurement of aggregate labor productivity in a long-run perspective. First, it illustrates the pitfalls when comparing aggregate productivity growth across countries if the underlying data are questionable. "Growth weakness" and "Great Depression"—would these conclusions have been reached if the hours worked series had been available earlier? Second, the paper has important implications concerning the comparison of measured economic performance across countries, the measurement of aggregate productivity, and the measurement of the ToT. These implications are discussed in the conclusion.

2. A Consistent Series on Total Hours Worked

Table 1 illustrates the substantial differences that occur when using different hours worked series to evaluate Switzerland's growth of average labor productivity, defined as GDP per hour worked. These differences arise although the GDP series used is identical and although the series in Columns 1–3 and 5 in principle all employ the same data on the growth in the number of employees. Hence, the differences in the growth rates of labor productivity shown are (mainly) caused by different data on average annual hours worked of employees.

Where do the different data on working times of employees come from? Column 2 employs data on hours worked from the OECD database ranging back to 1970. These data have been used in the aforementioned influential book of Bodmer and Borner (2004). In the third column, hours worked data from GGDC are used. This is the only publicly available hours worked series for Switzerland prior to 1970 and thus is widely employed in empirical work (among others, in Abrahamsen *et al.*, 2005a; Rogerson, 2006). The labor input series in the third column stems from Christoffel (1995). His series was influential as it was used in the growth reports of SECO (cf. Brunetti and Zürcher, 2002; SECO, 2002, 2008) to motivate the introduction of different growth policies in Switzerland. Finally, in Column 5, we employ official hours worked data from the Federal Statistical Office (FSO) to compute labor productivity. The Work Volume Statistics is based on data from the Swiss Labor Force Survey and presently covers the period from

TABLE 1

Average Annual Growth in Labor Productivity (GDP per hour worked) in % According to Different Data Sources

Years	Estimated Series	OECD	GGDC	Christoffel (1995)	Work Volume Statistics
1950–1960	3.40	–	3.64	–	–
1960–1970	4.26	–	3.61	2.4	–
1970–1980	2.11	2.05	2.23	1.5	–
1980–1990	1.46	0.93	0.93	1.0	–
1990–2000	1.24	0.33	0.90	–	1.37
2000–2010	0.64	0.78	0.92	–	0.86

Source: GGDC total economy database, OECD statistics portal, Work Volume Statistics, and Christoffel (1995).

1991 to 2012. It can be viewed as the most reliable series on hours worked that exists for Switzerland, among others, because it adheres to international standards in computing total hours worked.[1]

The table illustrates that choosing among different series about hours worked per employee has a non-trivial influence on the conclusions about productivity growth in Switzerland. I will show below that the OECD and GGDC data suffer from conceptual shortcomings and (severe) inconsistencies, making them an inappropriate choice. In the Working Paper version of this paper Siegenthaler (2012), I demonstrate that the Christoffel (1995) series, too, suffers from conceptual problems and measurement error. The shortcomings bias all three series toward overestimating growth in hours worked and, as a consequence, toward underestimating growth in GDP per hour worked.

The limitations of the available series are the motivation why this paper estimates a new and consistent long time series on hours worked for Switzerland—the one displayed in Column 1 of Table 1. This task requires constructing series for each component of total hours worked, that is, full-time equivalent employment, normal and effective weekly working hours, the number of paid vacation and holidays granted to employees, and hours of absences from work from 1950 to 2010. Much of the discussion of how I constructed the series is deferred to the Online Appendix of this paper. Here, I just make a broad outline of the data sources employed and of how I proceeded.

The component of total hours worked that poses the least problems is *employment* as there exists an official long time series on the number of employees from the Employment Statistics.[2] However, while these statistics provide us with information on the number of employed persons, they are silent on their *activity levels*. I account for the trend in the reduction of full-time employment since the 1950s, mainly by relying on the Job Statistics of the FSO and, for earlier years, on data from several Business and Population Censuses.[3]

The main source to analyze the evolution of *normal working time* in Switzerland before 1991 is the Statistics of Normal Workweeks in Companies (henceforth NW statistics), available since 1942. Working with this data, however, poses two problems. First, the NW statistics has two structural breaks in 1973 and 1984. Second, the data cover solely blue-collar workers of the industrial sector until 1973 because the statistics sampled only workers covered by the factory act

[1]Other series of the volume of work in Switzerland covering the years prior to 1991 are, among others, constructed in Butare and Favarger (1992) and Kehoe and Ruhl (2003). Both of them are similar to the GGDC and/or the OECD series. Moreover, the Swiss National Bank has a (quarterly) series on total hours worked for Switzerland. However, the series is not publicly available and starts only in the mid-70s.

[2]One important problem of the Employment Statistics is that until 1991 it did not apply the international standard pertaining to the definition of an employed person. According to the ILO standard a person is considered as employed if she or he works at least 1 hour a week. The FSO, however, applied the (Swiss) standard of a minimum of 6 hours a week until 1991. In my view, the most consistent approach is to stick to the figures that conform to the old definition of the Employment Statistics, and use that definition over the whole period examined, mostly because all labor market data before 1991 were collected applying the old definition. Our series on total hours worked will hence be on a slightly lower level than the OECD, GGDC, or the official series of the Work Volume Statistics.

[3]The exact procedure of how the series on FTEs is built prior to 1991 is outlined in Section A of the Online Appendix.

(*Fabrikgesetz*). Working times of white-collar workers in the industrial sector and of most employees in the third sector remain disregarded by the series. Moreover, the statistics do not cover working times in agriculture even after 1973, as well as working times of self-employed persons.

My solution to these problems is that I employ the NW statistics only after 1973 (accounting for the structural break in 1984). Prior to this date, I rely mainly on representative and reliable figures from two Business Censuses (1955 and 1965). These benchmark figures are inter- and extrapolated using the dynamics from related series. Normal weekly working hours in the agricultural sector are derived from the Work Volume Statistics and from Population Censuses (cf. Section B of the Online Appendix for further comments on the applied approach). The three sector-specific series on normal weekly working hours are then averaged by weighting them according to each sector's share in total employment.

The estimated series of normal weekly working time in Switzerland is plotted in Figure 1. The figure illustrates that normal weekly working hours in Switzerland have constantly decreased over 50 years, from about 50 hours in 1950 to 42 hours in 2000. Since then, weekly working times have remained stable.

The second component of weekly working time to be considered is weekly hours of *overtime work*. Since 1991, the FSO has published a series on overtime work in the Work Volume Statistics. I extrapolate this series back to 1950 using an available historical series on overtime work. However, this requires making some relatively strong assumptions because the series has several conceptual limitations. Admittedly, our series on overtime work is hence not very reliable prior to 1991 (cf. Section C in the Online Appendix).

The third component of working time that has to be taken into account is *absences* from work. Mostly relying on administrative data, I construct separate series pertaining to absences due to accident, illness, military service, civil defense, civil service, labor conflicts, short-time work, and other absences, for example due

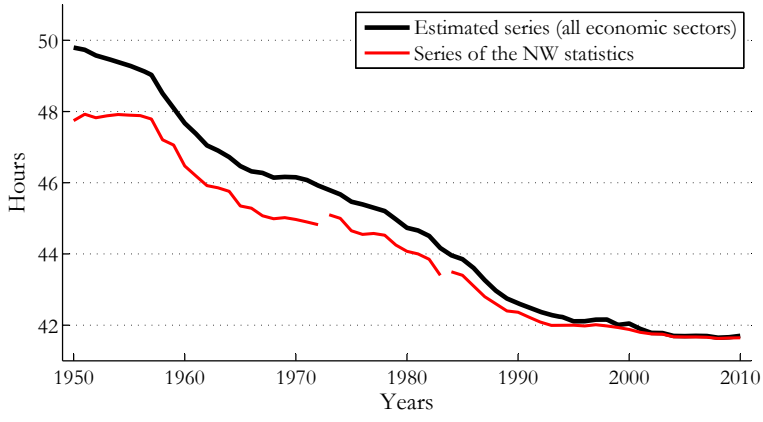

Figure 1. Normal Weekly Working Hours in Switzerland, 1950–2010

Source: NW statistics and own calculations.

to private reasons (cf. Section D in the Online Appendix). In contrast to the overtime series, our series on absences from work is accurate.[4]

Finally, we also have to take into account the amount of (paid) *vacation and holidays* granted to employees. Concerning weeks of vacation, the data put together stem from a variety of different sources.[5] In fact, considering the increase in weeks of vacations has an important effect on the long-term evolution of hours worked in Switzerland because an average full-time employee in Switzerland enjoyed only 1–2 weeks of paid vacation per year in the 1950s, while, in 2010, this figure had increased to nearly 5 weeks. These figures show that the amount of paid vacation has increased more in Switzerland than in most other industrialized countries in the last six decades (OECD, 1998).

Accounting for legal holidays is not of similar importance in terms of the long-term reduction in working time. However, the new series accounts for the fact that legal holidays may or may not fall on a working day. This fact contributes quite substantially to the year-to-year fluctuations in hours worked per employee.[6]

We now have all the ingredients to put together the series on total hours of work. All estimated components of the series are shown in the Data Appendix. The accuracy and validity of the new series obtained can be assessed by comparing the series with our reference series from the Work Volume Statistics available since 1991.

Figure 2 makes this comparison by showing annual hours worked per full-time employee according to the new series and hours worked per full-time job according to the Work Volume Statistics. The picture is encouraging: the correlation between the two series is 0.88, and they are basically on the same level. The similarity of the series is remarkable considering that the work volume series is based on data from a household survey, while the new series is constructed from a variety of different statistical sources.[7]

[4]The correlation between total annual absences per full-time employee according to our new series and annual absences per full-time employee from the Work Volume Statistics (the reference series) is 0.88, and the levels of the series are very similar.

[5]The first points of reference stem from the factory statistics (*Fabrikstatistik*) of 1944 and 1954, and from the two Business Censuses of 1955 and 1965. These four points of reference are inter- and extrapolated using the average of two distinct series, one on cantonal legislation about legal minimum entitlement of vacation to be granted to full-time employees, and one on regulations concerning vacations in collective labor agreements. From 1979 to 1996, data on vacations in Switzerland are derived from the UBS Prices and Earnings survey conducted in a three-year interval. The survey contains data on annual weeks of paid vacation for a relatively representative set of 15 professions in two Swiss cities (Zurich and Geneva). Finally, from 1996 onwards, I rely on representative data from the Swiss Labor Force Survey published by the FSO.

[6]It is, however, not straightforward to account for this in Switzerland because the cantons are responsible for determining which holiday is a non-working day, and cantons introduced different holidays at different points in time. Rather than treating each canton separately, I build, for a given year, a "representative" sample of statutory holidays for the whole country, and then calculate the amount of workdays per year by subtracting the holidays that fall on a working day from the amount of potential workdays. Section E of the Online Appendix shows the holidays that were considered in this exercise. A comparison of the resulting number of workdays with the number of workdays according to the Work Volume Statistics reveals that our pragmatic approach is appropriate.

[7]A detailed examination reveals that there are mainly two sources that lead to slight differences between the two series. First, our new series underestimates the cyclicality of absences from work. Second, the dynamics in the underlying series of normal hours worked per week are slightly different, particularly from 1991 to 1996.

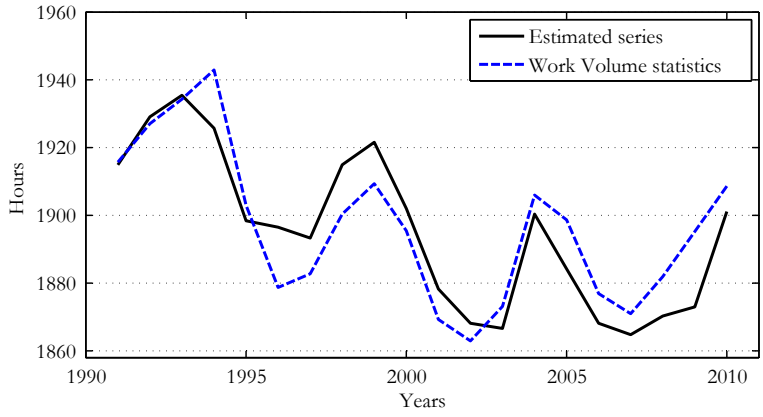

Figure 2. Annual Hours Worked per Full-Time Employed Person According to the Estimated Series and the Work Volume Statistics

Source: Own calculations and Work Volume Statistics.

3. The Evolution of Working Time

Figure 3 shows the long-run evolution of total hours worked in Switzerland according to the new series, and according to the series from the GGDC and the OECD. It is important to note that the GGDC and OECD series consider employees working 1–6 hours while our series does not, and should thus lie above the new series at any point in time (cf. Footnote 2).

The first point to be made about the figure is that the three series run more or less parallel from 1991 onward. This is because the GGDC and the OECD series use the figures from the Work Volume Statistics since 1991, and our new series and the Work Volume series essentially display the same dynamics, as shown in Figure 2. However, prior to 1991, the long-run evolution of the three series is very different. In particular, according to the new series, the volume of work has grown considerably less between 1950 and 1991 than according to the GGDC and OECD data.

The differences in the trend growth rates of the three series are linked to the most important deficiencies of the two series. Pertaining to the GGDC series, the first of these is that the series links three data sources that differ conceptually and should hence not be linked.[8] For instance, the series employed since 1991 takes into account absences from work and the increase in paid vacation granted to employees. The former two data sources do not.

The second deficiency is that the series relies on numbers about weekly hours worked in the 1950s and 1960s from the NW statistics which are too low. As discussed above, the NW statistics cover only blue-collar workers that were subject to the factory act. However, since the act aimed at protecting workers, employees

[8]It employs linearly interpolated level data on working time of Maddison (1991) for 1950, 1960, and 1970. These data are then extrapolated using growth of hours worked per employee according to the OECD. Finally, the series is linked to the figures from the Work Volume Statistics in 1991.

not covered by the factory act worked substantially more than those amenable to it. Hence, the GGDC series underestimates weekly working times in Switzerland in the 1950s and 1960s. This limitation is illustrated in Figure 1, in which our new figures on normal weekly working time, also taking into account working times of workers of the first sector, the third sector, and of white-collar workers in the second sector, are compared to the series from the NW statistics used by the GGDC.

The third and most important problem of the GGDC series is that it will per construction severely overestimate growth in hours worked until it is based on the Work Volume Statistics because it does not account for the increase in paid vacations granted to employees nor for the increase in part-time employment in Switzerland. The latter shortcoming is due to the fact that the series multiplies figures on weekly working hours for *full-time* employees with the number of employees instead of the number of full-time equivalent employees. Clearly, this approach is not valid, since the new series shows that the share of employees in Switzerland working part-time (i.e., less than 90 percent of normal working time) increased from less than 5 percent in 1950 to slightly more than 30 percent in 2010. Nowadays, Switzerland ranks among the countries with the highest share of part-time workers in the OECD. This third deficiency of the series explains most of the differential in the growth rate of the GGDC series and the newly estimated series displayed in Figure 3.

The OECD series on total hours worked also plotted in Figure 3 shares the two most important problems of the GGDC series. This is not surprising, since the OECD series is the source of the growth rates of the GGDC series between 1970 and 1990, explaining the parallel movements of the two series. In fact, the failure of the GGDC to account for the growth in paid vacations and the spread of part-time work is an inheritance from the OECD data. In the same way as the

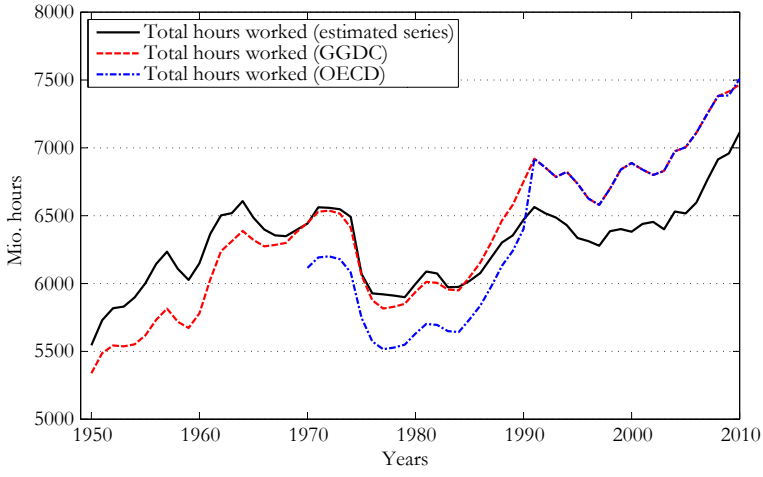

Figure 3. Different Series of Total Hours Worked per Year for Switzerland

Source: Own calculations, GGDC/Total economy database and OECD.

GGDC series, the OECD series also links its working time series to the new series from the Work Volume Statistics in 1991, giving rise to the same incompatibilities and inconsistencies. Figure 3 shows that the problem to link the series is even worse in the case of the OECD series, as it lies on a lower level prior to 1991. Linking the old OECD series to the new figures therefore requires a very sizable upward adjustment of total hours worked in 1991. This adjustment explains why, according to the OECD, Switzerland's labor productivity declined by –8.7 percent in 1991. It also explains why the GGDC, the OECD and the Work Volume series come to very different conclusions concerning average labor productivity growth in the 1990s in Table 1 despite the fact that the underlying numbers are identical from 1991 onwards.

What do we learn from the data put together about the long-term evolution of working time in Switzerland? Probably the most intriguing fact visualized in Figure 3 is that, according to the data put together in this paper, the input of labor in Switzerland's economy of 1964 is not reached until 2007, that is, the 3.05 million employees of 1964 worked as many hours as the 4.3 million employees in 2007. This implies that the contribution of hours worked to growth in GDP was zero over a period of more than 40 years.

Another interesting observation concerns the most recent period. Growth of hours worked between 2005 and 2010 has reached the level of the boom phases in the 1950s and 1960s, although GDP grew only by 2.2 percent annually, compared to 4.6 percent between 1950 and 1970. The growth in hours worked is driven by an unprecedented increase of 335,000 employees within five years. Unlike earlier periods, this job growth is not accompanied by reductions in weekly working time, large increases in part-time work, or growth in the duration of paid vacations. Not even the latest recession in the course of the financial crisis of 2008 interrupts the period of growth in total hours worked.

The new data also reveal sizable reductions in the annual working time of workers in Switzerland in the last 60 years. Hours worked per employed person have decreased by 33 percent since 1950, from 2402 hours to 1604 hours in 2010. Pertaining to full-time employees, the reduction was 22 percent, from 2445 hours in 1950 to 1901 hours in 2010.

Figure 4 puts these numbers into an international perspective. This is done despite the fact that international comparisons of the evolution of working times are problematic because substantial comparability and measurement problems occur with hours worked data from different countries (cf., for example, Hartwig, 2006)—as is not the least evidenced by this paper. Nevertheless, the figure illustrates that the evolution of hours worked per person in employment in Switzerland seems to have been similar to that in other European countries, especially Germany. However, the reduction in working time has been much larger than in the U.S. (cf. OECD, 1998; Rogerson, 2006).

4. Determinants and Breaks in Labor Productivity Growth

Using the historical GDP series of the FSO, the new series of hours worked allows for the first time examination of the long-term evolution of productivity in

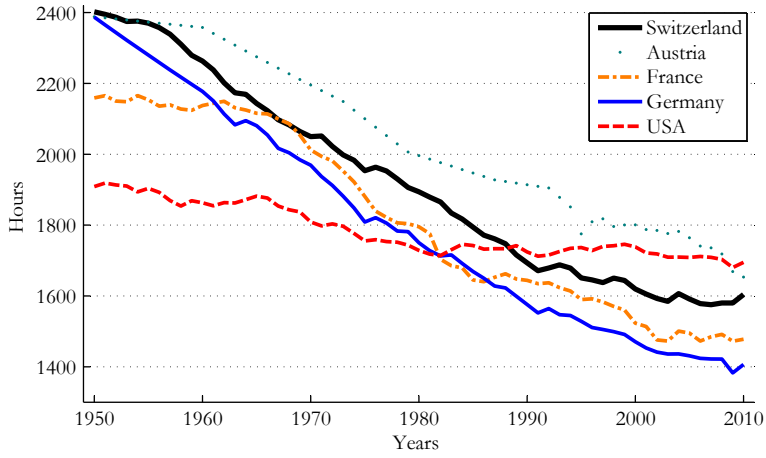

Figure 4. Annual Hours Worked per Employed Person in Different OECD Countries
Source: GGDC database and own calculations.

Switzerland with a consistent denominator.[9] In doing this, this paper focuses on the evolution of *average* labor productivity, that is, growth in GDP per hour worked. I do this because the effect of interest—an overestimation in growth in hours worked—affects *marginal* productivity as measured by total factor productivity (TFP) in the same way as it affects growth in GDP per hour worked. The effect is just scaled by labor's share in total factor costs which tends to be relatively constant over time.

To see this, note that according to standard growth accounting we can decompose growth in GDP (Y) into the contributions of capital (K), total hours worked (L), and TFP (A) in the following way:

$$\frac{d\ln Y}{dt} = (1 - s_L) \cdot \frac{d\ln K}{dt} + s_L \cdot \frac{d\ln L}{dt} + \frac{d\ln A}{dt}. \tag{1}$$

Since labor's share in total factor costs (s_L), according to calculations from the FSO, has averaged 72 percent from 1992 to 2010 in Switzerland, equation (1) shows that overestimating growth in the number of hours worked by 1 percentage point will lead to an underestimation of TFP growth (i.e., the Solow residual) by 0.72 percentage points.[10]

Therefore, Figure 5 plots annual growth rates as well as Hodrick–Prescott trend growth rates of GDP per hour worked in Switzerland. The graph shows that Switzerland's growth in average labor productivity can essentially be divided into a period of strong growth that ends in the early 1970s and a period of persistently

[9]Switzerland revised its annual national accounts in June 2012. In general, GDP and GDP growth increased because of the data revision. This paper employs the new data.

[10]Furthermore, the equation illustrates that if we overestimate growth of labor input by 1 point, we underestimate the contribution of capital intensity to growth by 0.28 percentage points. Early estimates of TFP growth for Switzerland covering 1949–1989 can be found in Kohli (1993).

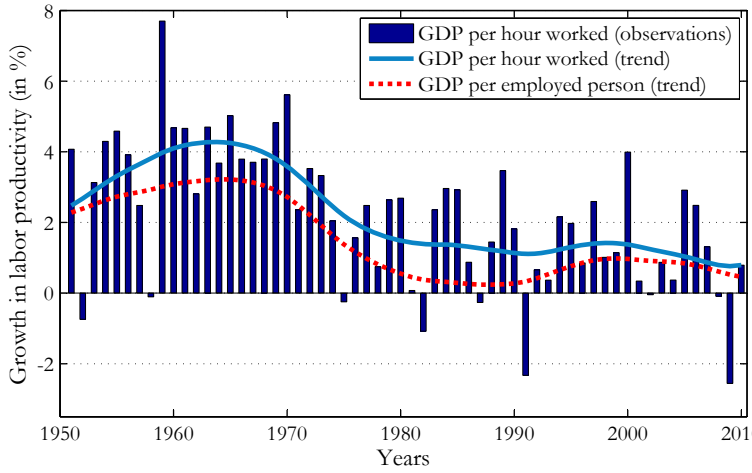

Figure 5. Annual Growth Rates of GDP per Hour Worked and per Employed Person (trends are HP trends using a weighting parameter of $\lambda = 100$)

and substantially lower productivity growth afterwards. The evolution of trend growth of labor productivity per head (i.e., growth in GDP per person employed), also plotted, is similar. The series displays a stronger decrease in the early 1970s and a slight resurgence in the early 1990s.

Using endogenous structural break tests, I examine the number of structural breaks in the means of the two productivity series and the timing of eventual breaks more thoroughly. Table A1 in the Appendix contains the results when applying, first, the Bai and Perron (1998, 2003) double maximum tests (*UDmax* and *WDmax*) for testing the null of no structural break in the two mean productivity growth rates against the alternative of an unknown number of breaks one at a time; and second, the Bai and Perron (1998, 2003) sup-F($l + 1|l$) test to evaluate the alternative of $l + 1$ structural breaks conditional on l breaks. Finally, the table contains the estimated break dates according to the method of Bai (1997a), and respective 90 percent confidence intervals (Bai, 1997b).[11]

The tests suggest that productivity growth has structurally declined in 1973, the year of the first oil crisis. The null of no structural break (as indicated by the *UDmax* and *WDmax* statistics) is clearly rejected in the case of GDP per head, while the null of having just one structural break is not rejected according to the sup-F(2|1) test. The same pattern arises for GDP per hour worked with similar statistical clarity.

The structural break tests thus show that Switzerland's evolution of labor productivity is very similar to the one in other European countries (Crafts and Toniolo, 1996; Eichengreen, 2007; Timmer *et al.*, 2010). The period before the first

[11]All p-values are bootstrapped according to the procedure proposed by Diebold and Chen (1996) using 1000 bootstrap replications. I set the maximum number of breaks allowed to 3 and the trimming parameter to $\varepsilon = 0.15$. The qualitative results, however, do not depend on these assumptions. The procedure follows the suggestions in Bai and Perron (2003).

oil crisis is characterized by high productivity growth in the process of the post-war "European catch-up" to the U.S. While Switzerland's average annual growth rate in GDP per hour worked of 3.7 percent from 1950 to 1973 is not as high as the annual growth of 4.9 percent reached by the EU-15 countries during that period, it lies above the U.S. growth rate of 2.6 percent (Timmer *et al.*, 2010). The high growth of labor productivity and the simultaneous increase in labor input shown in Figure 3—realized despite the fact that Switzerland had been spared from devastation during the Second World War—are important sources for Switzerland's ascent to one of the world's richest countries in the 1970s and 1980s (cf. Eichengreen, 2007).

As in most other European countries, the "Golden Age" of prosperity and high labor productivity growth ends with the first oil crisis. In 1975, Switzerland's GDP falls by 6.7 percent, and total hours worked decrease to the level of the early 1950s between 1973 and 1979 (cf. Figure 3). Since 1973, productivity has on average merely grown 1.2 percent per year. The reasons for the productivity slowdown in Switzerland are likely to be similar to those explaining the growth and productivity decline in other European countries in the mid-1970s (cf. Crafts and Toniolo, 1996).[12]

The evolution of GDP per hour worked as evidenced in Figure 5 qualifies earlier findings about Switzerland's productivity growth in several important ways. First, the picture about growth in labor productivity since 1973 is brighter than the one drawn in the growth reports of the SECO (2002, 2008) based on the data of Christoffel (1995), or from authors that use hours worked from the GGDC or the OECD (recall Table 1) which clearly overestimate growth in hours worked, particularly in the 1980s. An example is the influential study of Bodmer and Borner (2004).

Second, the new series shows that Switzerland has not been marked by historically low productivity growth in the 1990s as was the concern in Brunetti and Zürcher (2002) and Bodmer and Borner (2004). In fact, it seems that productivity growth in the 1990s just marks the continuation of a trend that started after the structural break in 1973.

Third, Switzerland's relative bad performance in terms of productivity per head in the 1980s and early 1990s—be it in terms of GDP per employed person or per person aged 15–64 as in Kehoe and Prescott (2002) that made them conclude that Switzerland was in Great Depression—can be explained by a large expansion of part-time work, an increase in paid vacation granted to employees, and a sizable reduction in weekly working times during that period. This can be seen from comparing the trend growth rates of GDP per head and GDP per hour worked in Figure 5.

[12]In the Swiss case, the most important explanations are likely to be, first, the combination of high inflation together with a sharp drop in global demand which hit Switzerland harshly due to its export-orientation; second, the end of the catch-up to the U.S., since Switzerland's productivity per hour worked came close the one from the U.S. in 1973; and third, the failure of wages to adjust to the new productivity growth rate in the years after 1973, mirrored in an increase in wage income share in GDP of about 4 percentage points from 1972 to 1976, resulting in persisting cost pressures for Swiss firms.

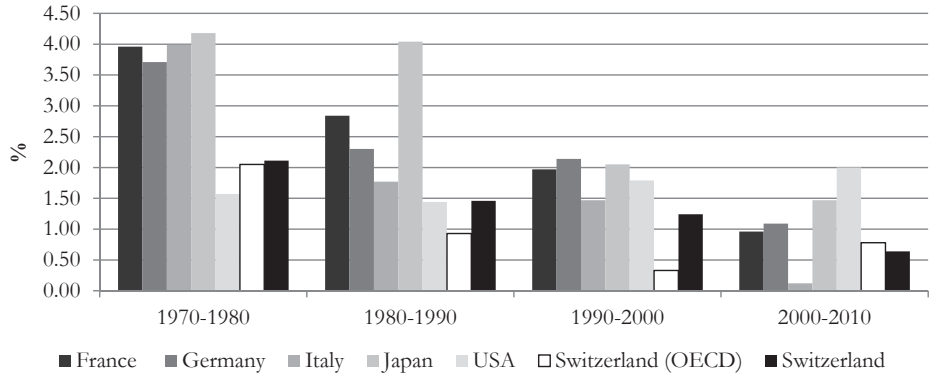

Figure 6. Average Annual Growth of Real GDP per Hour Worked in Different OECD Countries and in Switzerland, 1970–2010

Source: OECD. Switzerland: own series.

5. Terms of Trade, Quality Upgrading, and Productivity

The new hours worked series explains a substantial part of the relative deficit of Switzerland in terms of growth in GDP per hour worked compared to other European countries. Figure 6 illustrates this point by showing productivity growth in Germany, France, Italy, Japan, and the U.S., as well as productivity growth in Switzerland according to the OECD and our new data.

Still, the new hours worked data does not completely reverse the result that Switzerland's productivity growth has been comparatively weak after the structural break in 1973, especially in the 1980s and 1990s. Moreover, it also illustrates that productivity growth in the U.S. substantially exceeds that in Switzerland and in most other European countries since the mid-1990s—a resurgence in aggregate productivity growth that is generally attributed to productivity gains due to the spread and intensified use of information and communication technology (ICT) (cf., e.g., Jorgenson *et al*., 2008; Timmer *et al*., 2010).

Therefore, the relative shortfall of the Swiss labor productivity growth rate compared to other developed countries still warrants explanations. One explanation is simple: Switzerland had basically caught up to the U.S. in terms of GDP per hour worked in 1973. Since Switzerland had come closer to the technological frontier than most other European countries, the scope for productivity gains was relatively limited in the following years (Brunetti and Zürcher, 2002). Some authors have also argued that the high and at the time rising labor force participation rate provides another rationale for the relatively low productivity growth rate because it enables labor market participation of many relatively unskilled workers at the cost of lower labor productivity (e.g., Brunetti and Zürcher, 2002).[13]

However, these arguments can only partially explain the productivity shortfall in Switzerland as GDP per hour worked has fallen below the level in other

[13]Similarly, it has been argued that the low productivity growth is the result of Switzerland's past migration policy, as it led to a continuous and substantial inflow of unskilled labor to Switzerland (cf., e.g., Kehoe and Ruhl, 2003).

OECD countries during the 1980s and 1990s, and some countries (such as the U.S. since the mid-1990s) have reached higher GDP per hour worked with similar labor force participation rates (Brunetti and Zürcher, 2002). The growth reports of SECO (2002, 2008, 2012), Brunetti and Zürcher (2002), and Bodmer and Borner (2004) therefore emphasize structural deficits of the economy such as lack of competition in certain industries, a large sheltered sector, and lack of antitrust policy, in order to explain the gap in productivity growth.

However, the relative weakness of Switzerland in terms of GDP per hour worked might equivalently be searched in measurement issues pertaining to GDP (Abrahamsen *et al*., 2005b; Hartwig, 2008). The discussion circles around Switzerland's steady improvements in its Terms of Trade (ToT), that is, the ratio between the prices of exported and imported goods and services. In standard national accounting, changes in the relative price of exports to imports are treated as a pure price phenomenon. An increase in the price of exports would show up in the price deflator for exports, for example, and, if other real quantities did not change, real GDP would not change. Yet, the increase in the terms of trade reduces the amount of imports needed to produce one unit of output. Hence, it can be viewed as an increase in the country's income and purchasing power (Kohli, 2004; Feenstra *et al*., 2009) or interpreted as a change in technology (Kehoe and Ruhl, 2005, 2008).

The studies of Kohli (2004, 2005) have highlighted that changes in the ToT are of particular importance when analyzing the economic performance of Switzerland. The size of the ToT effect can be illustrated by comparing Switzerland's growth in real GDP with growth of real gross domestic income (GDI) according to the definition of GDI by the United Nations 1993 System of National Accounts (SNA).[14] The only difference between the two measures is that GDP treats the ToT as price phenomena, while real GDI deflates GDP, and hence the whole trade balance, by using the same price index, usually the final domestic expenditure price index.[15]

Figure 7 shows the long-run evolution of real GDP and real GDI in Switzerland. It shows that growth in real GDI and GDP growth begin to diverge in the beginning of the 1980s. The difference between growth in GDP and GDI is substantial: Switzerland's yearly growth in real GDI between 1980 and 2010 has been on average 0.33 percentage points higher than annual growth in real GDP only because of the differential development of export and import prices. In 2010, real GDI is thus 24 percent higher than real GDP. The figure illustrates the distinctive feature of Switzerland's ToT: they have constantly improved over time, such that they are very high today (Feenstra *et al*., 2009). Among the OECD countries, only Norway displays similar long-term improvements in its ToT.

[14]In the U.S., real GDI stands for real GDP computed from the demand side. This similarity has led some authors to avoid the term GDI. For example, Feenstra *et al*. (2009) employ the term "expenditure-side" GDP instead of GDI. The Bureau of Economic Affairs uses the term "command basis GDP."

[15]This choice is in accordance with the suggestions in Kohli (2006), Feenstra *et al*. (2009), and the series published by the OECD.

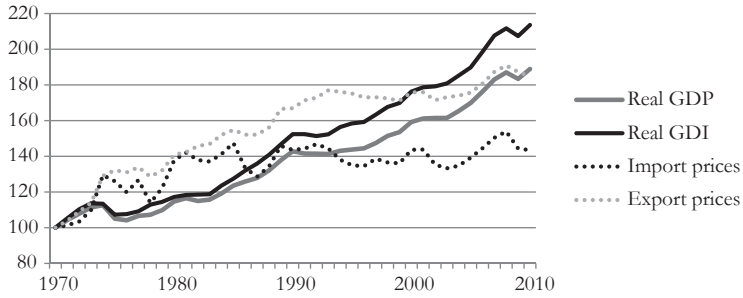

Figure 7. Long-Run Evolution of Real GDP, Real GDI, and Export and Import Prices in Switzerland (1970–2010)

Several recent papers appreciate that long-term changes in the ToT are not just a price phenomenaon. Instead, they are likely to proxy for changes in the relative quality of exported over imported goods and services erroneously accounted for as changes in export over import prices (Martínez-Zarzoso and Burguet, 2000; Hartwig, 2006; Schott, 2008; Feenstra *et al*., 2009; Timmer and Richter, 2009; Hallak and Schott, 2011). The reasoning is simple: if the prices of exports grow more than the prices of imports, then this might signal relative quality improvement of the same exported relative to imported products (Lipsey, 1994), or it might signal movements toward a particularly high-quality bundle of exported compared to imported products (Schott, 2004). For instance, Lipsey (1994) shows that quality improvements within specific groups of goods account for one fourth of the rise in these products' "impure" export prices.[16]

The problems of incorporating quality upgrading in export and import price indexes are for many countries of second-order importance for their ToT since they affect real imports and exports symmetrically, and thus do not differentially affect the ToT. This is, however, not the case for small open economies that have specialized in products and services with high quality, such as Switzerland.

The problem arises because in such countries, exported products and services are of higher complexity and quality relative to the imported counterparts, such that the problem of accounting for quality gains is unevenly distributed across the two sides of the trade balance. A common proxy for the quality of a country's exports relative to its imports is the average relative unit-value of imported compared to exported products (cf., e.g., Schott, 2004). By comparing absolute and

[16]Lipsey (1994, p. 4) writes: "A more general problem . . . with . . . export and import price indexes is that new products are underrepresented for some period after their introduction, and complex products are permanently underrepresented. A related problem is that price indexes for some manufactured goods suffer from upward bias due to the neglect of quality change. . . . The two issues are related because it is the complexity and rapid change in specifications that lead to the omission of many products from most countries' price indexes."

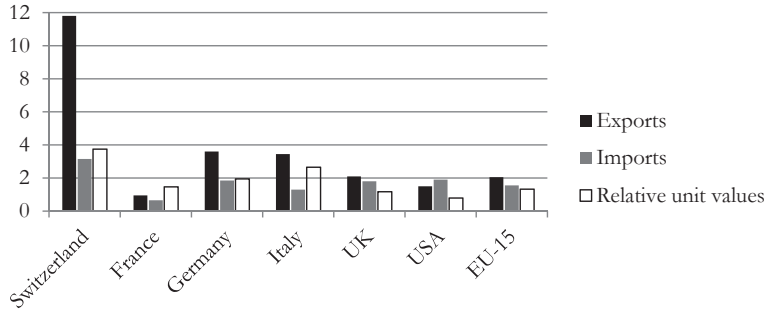

Figure 8. Unit Values of Exports and Imports and Relative Unit Values of Exports to Imports in Selected OECD Countries in 2009

Source: Credit Suisse Economic Research (2011).

relative unit values of imports and exports for different OECD countries, Figure 8 illustrates the unusually high quality of Switzerland's exports compared to its imports.[17]

The reason for the high relative unit values of Switzerland's exports is twofold (Credit Suisse Economic Research, 2011). On the one hand, Switzerland's exports have become—in contrast to the imports—mainly clustered in product categories with particularly high unit values. This is the result of a long-run specialization toward products where they face quality rather than price competition.[18] On the other hand, even within narrowly defined product categories, Switzerland's exporters produce products of higher unit values compared to most foreign competitors.

Another reason why the ToT are likely to reflect quality improvements is that historical export and import price indexes have been conceptually very limited in various ways (Lipsey, 1994). In the case of Switzerland, the export and import price index did not purport to apply to external trade. The export price, for instance, was until 2010 computed under the assumption that prices of exported goods rise in proportion to domestic producer prices. Probably more importantly, the Swiss export and import price indexes were not revised between 1964 and 1993, that is, they were computed by weighting products according to a product basket as of 1960 until 1993. As a consequence, within one revision, the weight of agricultural products in the import price index fell from 22.47 to 6.23 percent while the weight of chemical products rose from 1.45 to 16.1 percent. Furthermore, 43.72 percent of all products in the new import index of 1993 were not even contained in the old import price index—among others, machinery and vehicles.

[17]The figure is based on calculations of unit values on detailed product level made in Credit Suisse Economic Research (2011). The high quality of Switzerland's exports is also confirmed by Hallak and Schott (2011) who gauge the quality of exported products from relative differences in foreign demand for products of the same product category sold at the same price.

[18]Switzerland's main exporting industries are the chemical, pharmaceutical, electrical, and watch-making industries, manufacturing of machinery and equipment, and financial services.

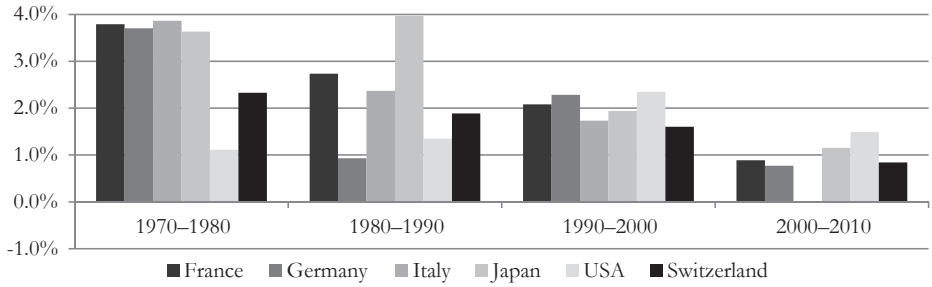

Figure 9. Average Annual Growth of Real GDI per Hour Worked in Different OECD Countries and in Switzerland, 1970–2010

Given the exceptional quality of exports compared to imports and the deficiencies of Switzerland's historical export and import price index, it seems reasonable to assume that the rise in the ToT shown in Figure 7 reflects—at least to some extent—quality improvements of exported relative to imported products and services that are deflated when computing GDP. If this were the case, growth in GDP would understate the "value added" of exporting firms in Switzerland, and real GDI per hour worked would be a better proxy of the productive gains in Switzerland than real GDP per hour worked. Therefore, Figure 9 shows average annual growth of real GDI per hour worked for different OECD countries and Switzerland since 1970.

The figure shows that Switzerland has had similar annual growth rates of real GDI per hour worked as its neighbors (Germany, France, and Italy) and Japan since 1990. Also the relative growth deficit compared to the U.S. becomes comparatively small. Even if one does not believe that Switzerland's ToT reflects to some extent quality gains of exports relative to imports, the figure implies that in terms of growth of generating real income per hour worked, Switzerland does not perform worse than most other industrialized countries in the last 40 years.

6. Conclusion

The paper has four important implications. First, the debate about Switzerland's performance pertaining to labor productivity growth was seriously flawed by the lack of a consistent and long time series on hours worked. For instance, the new hours worked series indicates that GDP per hour worked has in fact grown 1.35 percent per year between 1980 and 2000. This is 0.72 percentage points more than when using the inconsistent hours worked series from the OECD database. Thus, the new hours worked series helps in resolving the Swiss growth or productivity puzzle: Switzerland seems to have experienced lower output and productivity growth than most of its neighbors, and yet it has managed to stay ahead when it comes to income per capita.

Second, the paper has demonstrated a non-trivial impact of data deficiencies on the long-run view about the economic performance of a country. Therefore,

researchers analyzing historical productivity growth should always examine the plausibility of the underlying data series and look for structural breaks, especially in the data on hours worked and even when using data from the OECD. This is particularly true if the study calls for profound structural reforms as Bodmer and Borner (2004) did.[19]

Third, measured economic performance can depend substantially on whether we look at growth of GDP or GDI. For example, differences in the growth rates of real GDI and real GDP amounting to 0.5 percentage points can be observed for countries such as Germany, Italy, or Japan (cf. Figure 6 and Figure 9). A comparison of the two measures therefore seems appropriate in many circumstances, for example, when comparing the evolution of income, purchasing power, and probably productivity, as long-run changes in the ToT might in fact reflect shifts in the quality of exports relative to imports. The latter point is particularly likely if we look at small open economies which have become more and more specialized in exporting a limited set of high quality products and services, while imports are broadly distributed across different commodities and goods. The problem of accounting for quality upgrading is thus unevenly distributed across the trade balance of these countries, making it likely that export and import price deflators are not evenly biased by changes in the quality of products and services.

This indicates, fourth, that the driving factors of long-term shifts in the ToT should be better understood. Ultimately, what we are interested in is by how much long-term shifts in the ToT represent a pure price phenomenon just affecting income, and by how much they incorporate quality gains reflecting changes in the production technology. Disentangling pure price from quality effects in the ToT is part of the focus of a recent literature (e.g., Martínez-Zarzoso and Burguet, 2000; Hallak, 2006; Timmer and Richter, 2009; Hallak and Schott, 2011). Given the results from these papers, it is reasonable to assume that a sizable fraction of past changes in import and export prices mirror quality increases, because many export and import price indexes were and still are derived from the evolution of *unit values* (Lipsey, 1994; Martínez-Zarzoso and Burguet, 2000), that is, exactly those unit values that we have used for measuring quality differences and quality changes of imported and exported goods.[20]

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[19]In this specific example, it is also unfortunate that the OECD publishes figures on GDP per hour worked in Switzerland in 1990 and 1991 without indicating the structural break in the underlying data series on hours worked. Not publishing a figure for the particular year and leaving the choice of linking the old and the new data to the researcher seems preferable because it is more transparent.

[20]Silver (2010) contains a comprehensive discussion of the advantages and disadvantages of using unit values in order to construct price indices.

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Table A1: Endogenous structural break tests of annual productivity growth
Table A2: Components of hours worked in Switzerland (1950–2010)