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# Arbeitspapiere/ Working Papers

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Michael Graff, Christian Müller, Bernd Schips

## The Swiss Disease: Facts and Artefacts



# The Swiss Disease: Facts and Artefacts<sup>\*</sup>

Yngve Abrahamsen, Roland Aeppli, Erdal Atukeren,  
Michael Graff, Christian Müller, Bernd Schips

**Abstract:** In their introduction to the special issue of the Review of Economic Dynamics on "Great Depressions of the 20th Century" (Vol. 5, 2002), Timothy J. Kehoe and Edward C. Prescott argue that in the last few years "great depressions" have hit two rich countries: New Zealand and Switzerland. We briefly discuss Kehoe/Prescott's definition of a "great depression". Thereafter, we analyse the underlying data – time series of labour productivity for the countries under consideration – and perform sensitivity tests with respect to alternative operationalisations for Switzerland and the U.S. It is shown that with different (and arguably more appropriate) time series the impressive growth gap between the well performing U.S. and poor-performing Switzerland reduces considerably. Yet, this still does not explain the comparatively poor economic growth in Switzerland during the last decades, which is noted by many observers. Accordingly, we analyse economic performance within the comparative cross-country framework, which is now standard in the new empirical literature on the determinants of economic growth. Based on a balanced panel data set on a large sample of countries with multiple observations through time, the growth rate of labour productivity is regressed on its presumed determinants, which follow from an extended version of the neo-classical aggregate production function. This analysis departs from the standard approach by focussing on the country-specific fixed effects rather than the structural growth parameters. The results show that there is no significant deviation of Switzerland's performance from its predicted value after taking account of the explicit determinants of economic growth.

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## 1. Introduction

In a thought provoking introductory paper to a special issue of the "Review of Economic Dynamics" on "Great Depressions of the 20th Century", Kehoe/Prescott (2002: 2) argue that "great depressions" are not unique events from a remote past – the inter-war period. Quite to the contrary, according to Kehoe/Prescott, they occur frequently, and in the last few years, they have even hit two rich countries, which are commonly understood to be well-governed market economies: New Zealand and Switzerland.

This is, of course, a rather strong claim, and while it is not uncommon in Switzerland to complain about moderate economic performance and slow growth in the first half of the 1990s, neither the general public, nor policy makers, nor academic economists would readily agree with the idea that they just witnessed a "great depression" – at home, and not in far off Latin America or some other remote place.<sup>1</sup>

Hence, in this paper, we shall take Kehoe/ Prescott's claim serious. Specifically, we shall briefly discuss Kehoe/Prescott's definition of a "great depression". Thereafter, we analyse the underlying data – time series of labour productivity ( $Y/L$ ) for the countries under consideration – and perform sensitivity tests with respect to alternative operationalisations of the numerator ( $Y$ ) and the denominator ( $L$ ) for Switzerland and the U.S. It will be shown that with different (and arguably more appropriate) time series the impressive growth gap between the well performing U.S. and poor-performing Switzerland reduces considerably.

While this casts some doubt on Kehoe/Prescott's procedure to identify "great depressions", this still does not explain the comparatively poor economic growth in Switzerland during the last decades, which is noted by many observers.<sup>2</sup> Accordingly, in the following step of analysis, we try to identify some main factors which are responsible for economic performance in Switzerland (and elsewhere). We thus shall first give a short overview about the standard arguments put forward by economists and policy makers when talking about Swiss economic performance in the last few decades. Finally, in addition to reporting this country-specific "anecdotal evidence", we shall try to analyse economic performance within a comparative cross-country framework. To this end, we refer to the methodology which is now standard in the new empirical literature on the determinants of economic growth. Specifically, based on a balanced panel data set on a large sample of countries with multiple observations through time, the growth rate of per capita income (or rather: labour productivity) is regressed on its presumed determinants, which follow from an extended version of the neo-classical aggregate production function. This set-up allows for the inclusion of country-specific (time invariant) "fixed effects", and this procedure is

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<sup>1</sup> Probably the first objection that comes to mind is that during the period under consideration, Switzerland fared extremely well with respect to unemployment.

<sup>2</sup> See for example Brunetti/Zürcher (2001).

generally regarded as an elegant way to reduce the inevitable omitted variable bias. While we run the same type of regression, our analysis departs from the standard approach by focussing on the fixed effects rather than the structural growth parameters. In other words, whereas the standard approach includes fixed effects to yield better estimates for the core variables of the growth model, we use the standard growth model with its accepted core variables to get numerical estimates of the country effects, i.e. the deviation of a country's performance from its predicted value after taking account of the explicit determinants of economic growth.

This approach implies a concept of "depression" which maintains some of the spirit of Kehoe/Prescott's framework, yet relies on considerably more information than their inspection of  $Y/L$  time series. Like Kehoe/Prescott (2002), we refer to the U.S. as the country against which to evaluate all the other countries' performances. Now, if we let a selected country's fixed effect be the intercept, all the other fixed effects quantify these countries' comparative performance with respect to the reference country, and the corresponding t-statistics inform about the significance. Hence, in this framework, a straightforward definition of a "great depression" would be a significantly negative fixed effect with the U.S. – or another country; alternatively: the mean performance of a group of countries – as the reference. Consequently, a depression is not identified by means of an arbitrarily chosen level of a country's labour productivity growth rate, but as a statistically significant deviation from a country's predicted growth potential, where the empirical estimate U.S. total factor productivity growth rate (not captured by the explicit regressors) is fixed to be the norm.

## **2. Great Depressions: Conceptual Remarks**

To quantify economic performance, Kehoe/Prescott (2002) follow a widespread practice and refer to the growth rate of GDP in labour intensive form. Accordingly, the smaller the growth rate of per capita income (or labour productivity) of a country, the worse is its economic performance. Specifically, Kehoe/Prescott divide real GDP by the number of working age persons (persons aged 15–64 years). This procedure is – implicitly – motivated by the idea that it is the number of persons of employable age which determines the potential output of an economy.

Then, they discuss the notion of "trend output" and – though the paper presents some theoretical reasoning about the factors that govern growth – continue to propose a "de-trending" procedure which amounts to subtracting 2% from the annual growth rate of  $Y/L$ .<sup>3</sup> A

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<sup>3</sup> This is somewhat loosely motivated by the performance of the U.S. economy during the 20th century (p. 14). We might add that this is one of the "stylised facts" in the textbook version of traditional neo-classical growth theory (see e.g. Branson, 1979)

"great depression" is then defined as a situation when a country's "detrended"  $Y/L$  growth rate falls 20% below "trend", and thereof at least 15% within the first 10 years (p. 9).

Instead of starting a discussion about the adequacy of this detrending procedure, we point out to the fact that "detrending" is irrelevant for Kehoe/Prescott's criterion of a great depression. Since both their depression signal of  $-20\%$  and the "detrending" factor of  $-2\%$  are constant across time and space, we can drop the detrending step altogether and set a higher value for the depression signal to arrive at exactly the same results.<sup>4</sup> In any case, Kehoe and Prescott are to be credited for having highlighted the fact that Switzerland and New Zealand, though as far away from one another as possible, share the unpleasant characteristic to have experienced extended periods of relatively low  $Y/L$  growth. Hence, in what follows, we shall not pursue the semantic question of whether we just witnessed a "great depression" in Switzerland but rather what stands behind the remarkably poor Swiss performance which can be read out of the numbers from the National Accounts Statistics.

### 3. Labour Productivity: The Numerator

Without any doubt, the number of working age persons is essential for the determination of any economy's potential output. However, the comparison of the per capita income calculated in the manner described above urges that the countries considered meet the following requirements:

- there is no difference in the rate of change of employment,
- there is no difference in the rate of change of the participation rates,
- there is no difference in the rate of change of the relation between full-time and part-time employment,
- there is no difference in the rate of change of the average hours worked per year and per employee.

In reality, between 1980 and 2000 these requirements were not met for the USA and Switzerland: Employment rose in the USA by 33%, whereas the increase in Switzerland was only 24%. In addition, the participation rate in Switzerland was generally higher than in the USA. Also, the rate of increase of the participation rate in Switzerland in the years under consideration was stronger than in the USA. Already in 1980, the share of part-time employment as part of total employment was higher in Switzerland than in the USA. Since then, there was a substantial rise in Switzerland, whereas in the USA the share of part

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<sup>4</sup> Though the "detrending" does not affect the analysis at all, it certainly adds some dramatic flavour to the "great depression" story. Without this peculiar "detrending", Kehoe/Prescott's argument would just be that some countries have experienced lower  $Y/L$  growth rates than others, which is interesting enough, but not quite as alarming as the detection of a 20% drop of  $(Y/L)_t^* = (Y/L)_t e^{-t \cdot 2\%}$ .



time employment diminished slightly between 1980 and 2000. In the USA the number of hours worked per year and employee increased slightly from 1980 to 2000, while in Switzerland it fell by as much as 13%.

Thus, it can be seen that some important variables developed differently in the USA and Switzerland. The relevant relationships in this context can be stated as follows:

$$\begin{aligned}
 \text{VOLWKD} &= \text{EMPL} \cdot \varnothing\text{HWKD} \\
 &= (\text{EMPL} + \text{UNEMPL} - \text{UNEMPL}) \cdot \varnothing\text{HWKD} \\
 &= (\text{LF} - \text{UNEMPL}) \cdot \varnothing\text{HWKD} \\
 &= (1 - \text{URATE}) \cdot \text{LF} \cdot \varnothing\text{HWKD} .
 \end{aligned}
 \tag{1}$$

Switching to growth rates gives:

$$g(\text{VOLWKD}) = g(1 - \text{URATE}) + g(\text{LF}) + g(\varnothing\text{HWKD}) , \tag{2}$$

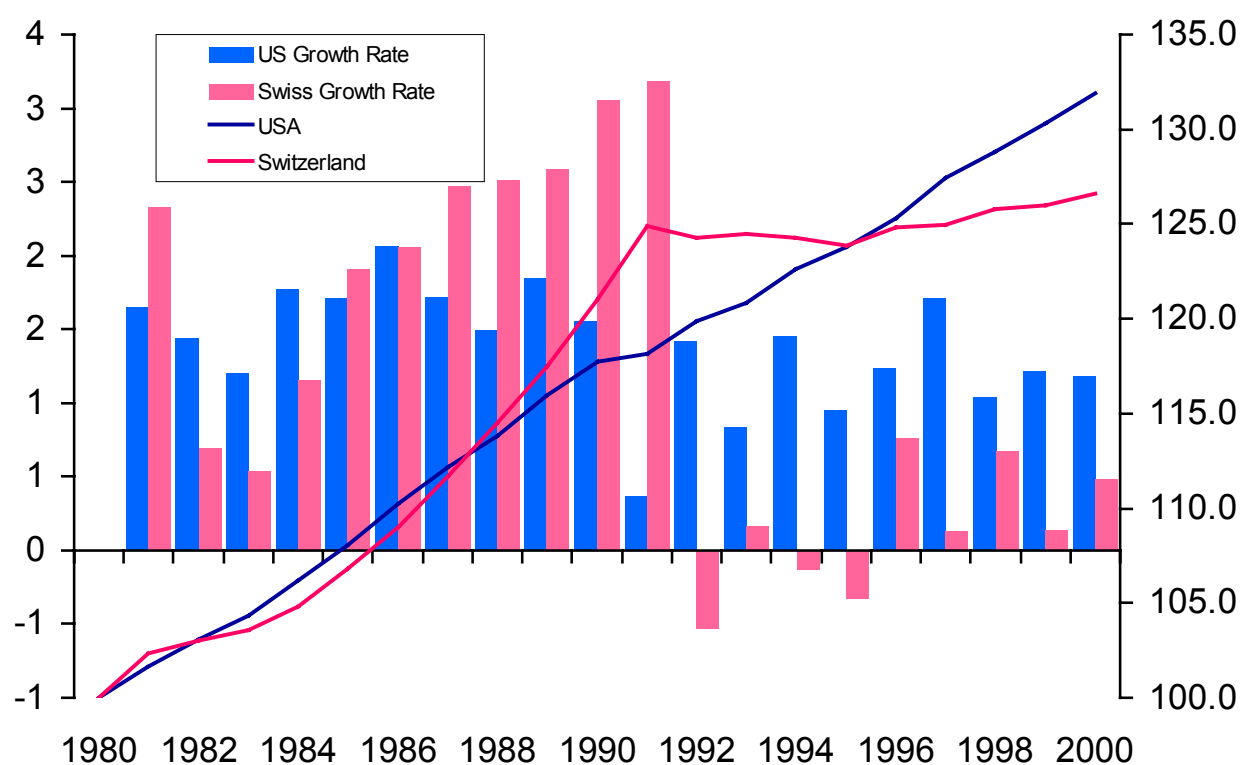
where  $g(X)$  denotes the growth rate of  $X$  and

VOLWKD: Total hours worked in the economy.  
 EMPL: Number of employed persons.  
 UNEMPL: Number of unemployed persons.  
 $\varnothing\text{HWKD}$ : Mean number hours worked per year and per person employed.  
 LF: Labour force ( $\text{LF} = \text{EMPL} + \text{UNEMPL}$ ).  
 URATE: UNEMPLOYMENT RATE ( $\text{UNEMPL}/\text{LF}$ ).

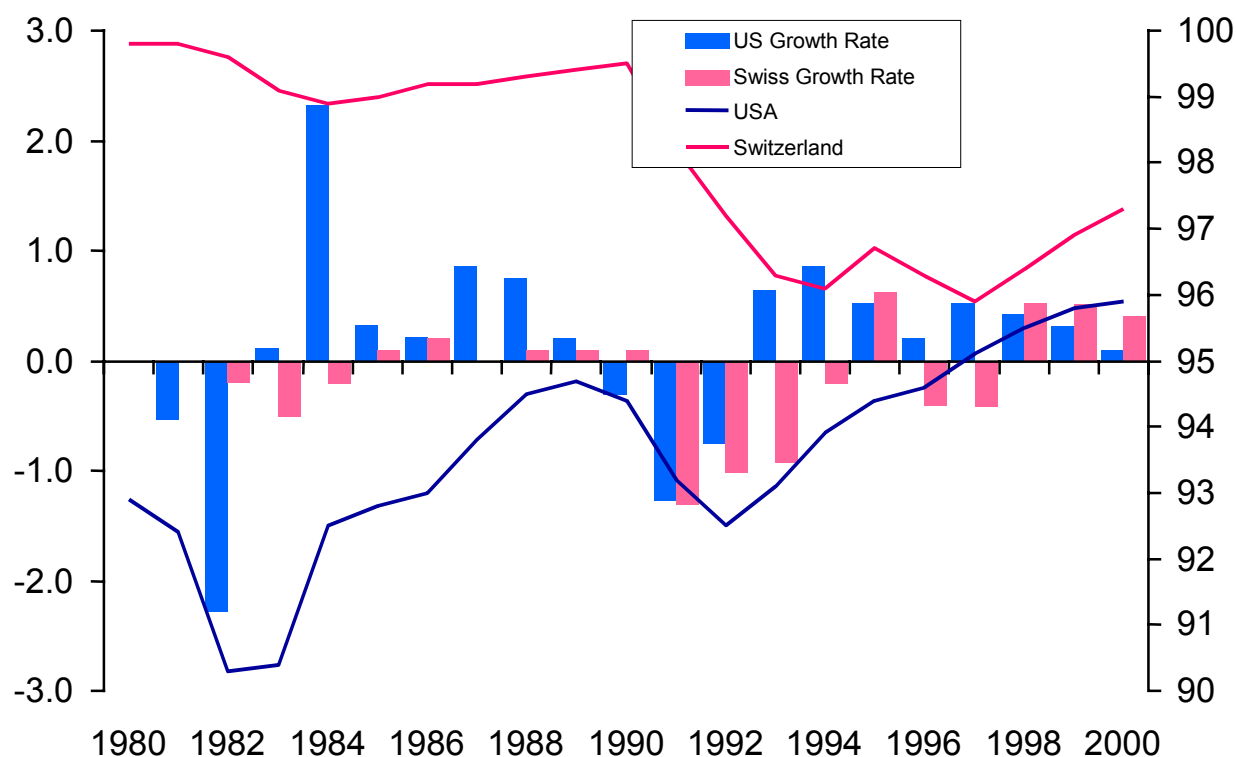
Thus, the growth rate of the total hours worked in the economy is the sum of the (inverse) percentage change of the unemployment rate, the growth rate of the number of persons employed, and the growth rate of the hours worked per year and per person employed. Of course, (2) is a simple accounting identity and no policy conclusions can be drawn out of it.

The following three graphs illustrate the development of the variables contained in equation (2) for the USA and Switzerland. They clearly show that the trends in the labour markets were quite different. In the USA the labour force increased more or less continuously between 1980 and 2000. In contrast to Switzerland, in the USA the number of hours worked per year increased with few exceptions over the whole period. The unemployment rate decreased in the majority of years. On the other hand, in Switzerland, the labour force grew strongly up to 1991, but remained roughly unchanged in the following years. The number of hours worked diminished more or less steadily. The unemployment rate increased almost over the entire period (especially in the years 1991 to 1994), but even in 2000 the standardised unemployment rate, as published by the OECD, was smaller in Switzerland than in the USA.

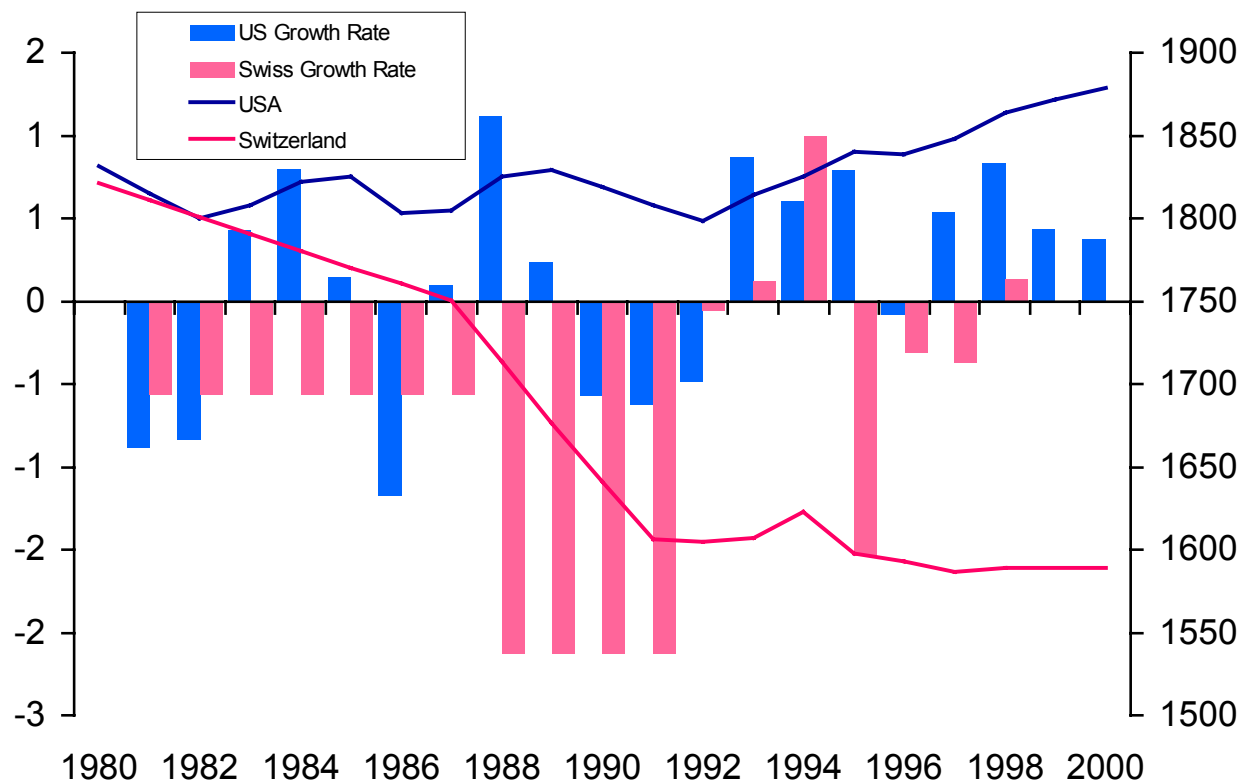
Graph 1: Labour force



Graph 2: Share of labour force employed



Graph 3: Mean number of hours worked per year and per person employed

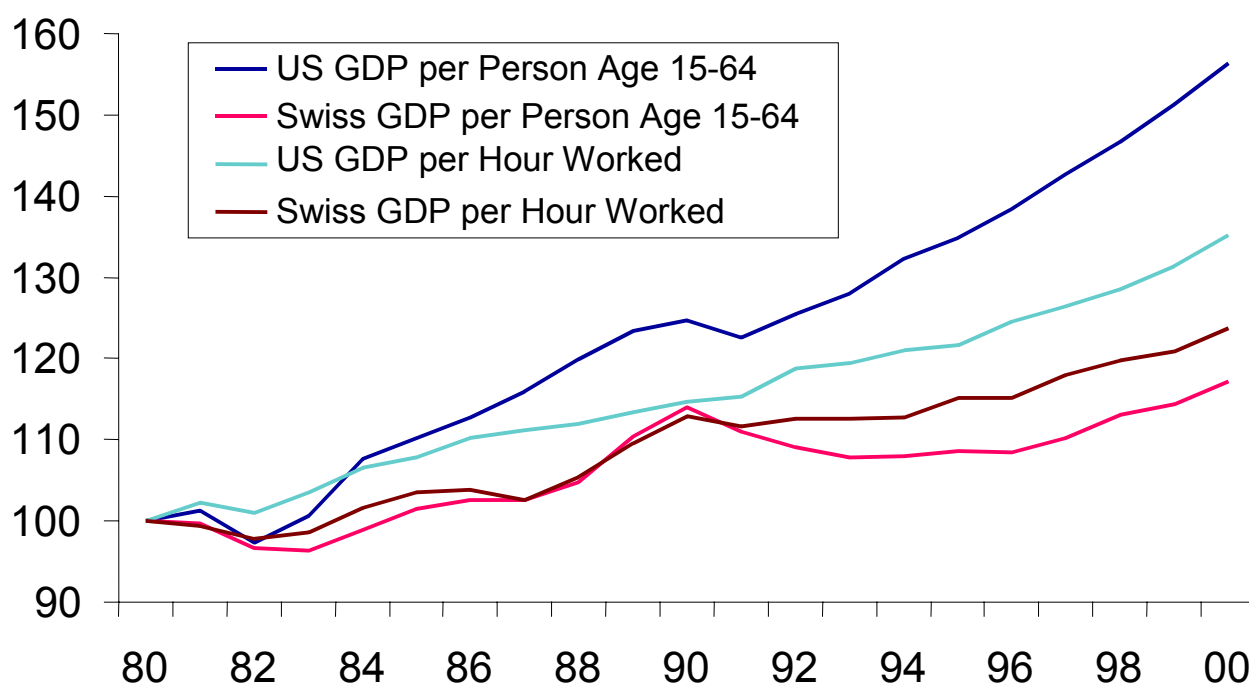


There is another interesting aspect of the different developments of the labour markets in the USA and Switzerland. In the years from 1991 to 2000 the participation rate of elderly people (65 years and older) in the USA rose from 11.5% to 12.8%, while in Switzerland it fell in the same time period from 14.5% to 9.5%. This is an additional fact which shows that dividing real GDP by the number of working age persons with an upper limit of 65 years, as done by Kehoe and Prescott, is not without risk. Moreover, the different time paths of the participation rate of the people older than 65 years points to the fact, that the different development of the change in employment is not only a consequence of a more or less favourable situation in the labour market. Obviously, it is also due to the differences in the social security systems in the two countries. In Switzerland, in contrast to the USA, an increasing share of persons older than 65 can afford to retire.

Hence, because of the different developments of participation rates, of the shares of part-time workers as well as of the number of hours normally worked on standard full-time employment jobs, the measure employed by Kehoe and Prescott, i.e. output per working age person as defined above, is a biased indicator. If, instead of output per working age person GDP per working hour per year and employee is used as the relevant measure, the results of the investigation change significantly.

Kehoe and Prescott argue that in the USA output per working age person rose by almost 60% between 1980 and 2000. In Switzerland, however, the respective increase was less than 10%. The difference of output per working age person between the two countries per year amounts to 1.2%. Graph 4 illustrates this. However, the differences in the respective growth rates diminish considerably, if, instead of output per working age person, GDP per hour worked is considered. Between 1980 and 2000, GDP per working hour rose by 35% in the USA, whereas in Switzerland the increase in the same period was 23%. Thus, a certain difference in the economic performance between the two countries remains, but it is by far smaller than what Kehoe and Prescott suggest. And, more importantly, with these figures, Kehoe/Prescott's conditions for a depression are not met in Switzerland. Graph 4 shows that the development of GDP per hour worked was roughly the same in the USA and in Switzerland between 1980 and 1990, and again after 1997.<sup>5</sup>

*Graph 4: GDP per Working Age Person (15–64) versus GDP per Hour Worked*



#### Sources:

Employment and hours worked: University of Groningen and The Conference Board, GGDC Total Economy Database, 2002, <http://www.eco.rug.nl/ggdc>.

Unemployment rate: World bank data base.

Hours worked: University of Groningen and The Conference Board, GGDC Total Economy Database, 2002, <http://www.eco.rug.nl/ggdc>.

GDP: Penn World Table Version 6.1 (Heston/Summers/Aten, 2002).

<sup>5</sup> The differences in the years 1991 to 1996 were mainly the consequences of a fairly restrictive Swiss fiscal and monetary stance during that time. (For a more detailed discussion of economic policy in Switzerland during the last few decades, see section 6.)

#### 4. Labour Productivity: The Denominator

The productivity measure we review in this paper is real GDP per labour input. Therefore, the outcome depends on both the accuracy of measured labour input and the output produced. In this section, we therefore take a closer look at the output figures and discuss alternative measurement concepts. The focus will be on dynamics rather than levels which implies that conversion from one unit of measurement to another is less of an issue.

##### *Comparing the Penn World Table with Swiss Data Sources*

The Penn World Table (henceforth: PWT) presents GDP data for a wide variety of countries including Switzerland. Its distinguishing advantage is the possibility to directly compare the output figures for all the countries involved. The country of reference is the United States of America, whose GDP price level provides the normalisation restriction for making the relative prices across the world comparable with one another. This procedure has the advantage that the choice of the normalisation does not affect the outcome of comparisons between countries at a given point in time but is relevant only for the inter-temporal perspective.

A second important feature of the PWT is the provision of a terms of trade (henceforth: ToT) measure intended to capture the differences in relative incomes due to differences in the relative prices of imported and exported goods. Generally speaking, the larger the terms of trade indicator the less the country under consideration has to supply domestic products in order to acquire foreign goods. Consequently, an increase in the ToT relative to another country can be interpreted as an increase in wealth.<sup>6</sup>

In the following we shall discuss alternative views on the performance of Swiss and U.S. GDP during the period 1980-2000 based on the information available from the PWT and from national data sources.

##### *Decomposing PWT GDP measures*

###### (1) Real GDP

The PWT show all income data in per capita terms. The growth rate of GDP is the sum of the growth rate of per capita GDP and the population growth rate. Accordingly, if population figures from national sources and the PWT are not equal, differences in reported output will occur. Table 1 and graph 5 make clear that although the national data sources and the data used in the PWT exhibit different growth paths, population growth seems to be more or less the same over the whole period. After accounting for population growth, the

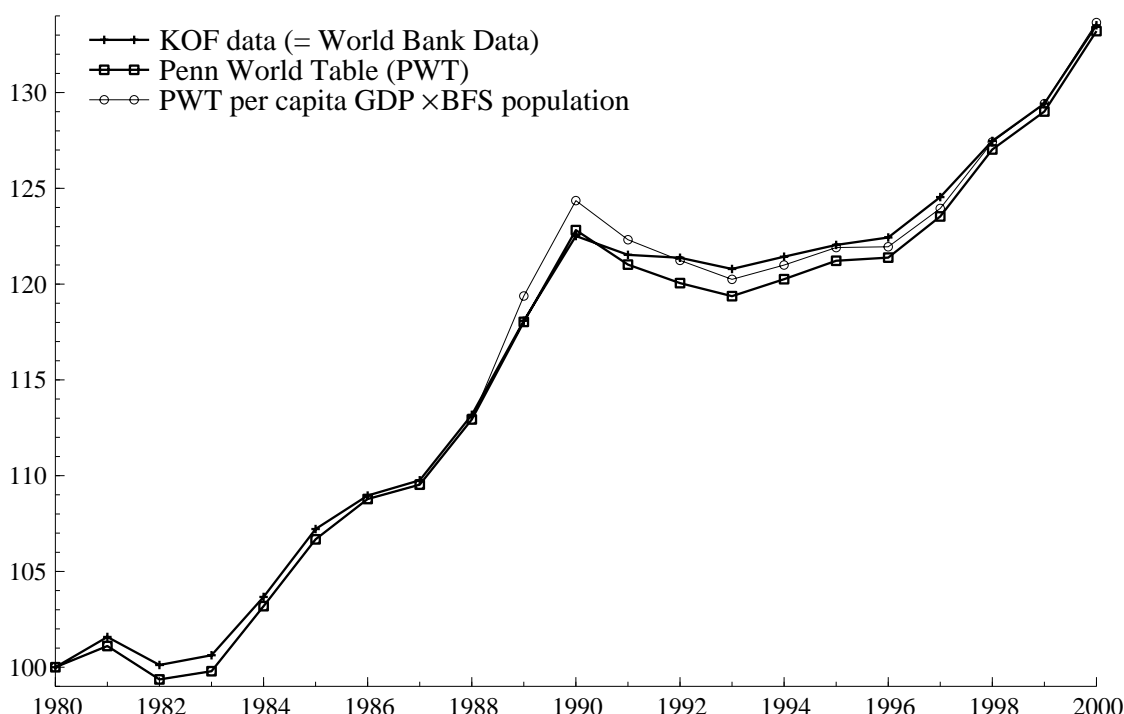
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<sup>6</sup> See Kohli (2002) for an elaboration of the argument, that this might be of particular importance in the case of Switzerland.

resulting PWT real GDP income ( $Y(\text{PWT})$ ) can then be compared to the national figures. As before, we normalise the data series to the 1980 observation in order to obtain unit free indices, denoted by  $Y(\text{CH}, 1980)$  and  $Y(\text{USA}, 1980)$ , respectively.

At this stage, the two series  $Y(\text{PWT}, 1980)$  and  $Y(\text{CH}, 1980)$  should be largely identical, allowing for statistical errors introduced by approximating prices between the benchmark years. It turns out that the difference is indeed marginal (see graph 5). This implies that so far, the calculation of productivity measures *ceteris paribus* leads to more or less the same results, irrespective of using either PWT or national real GDP data series.

Graph 5

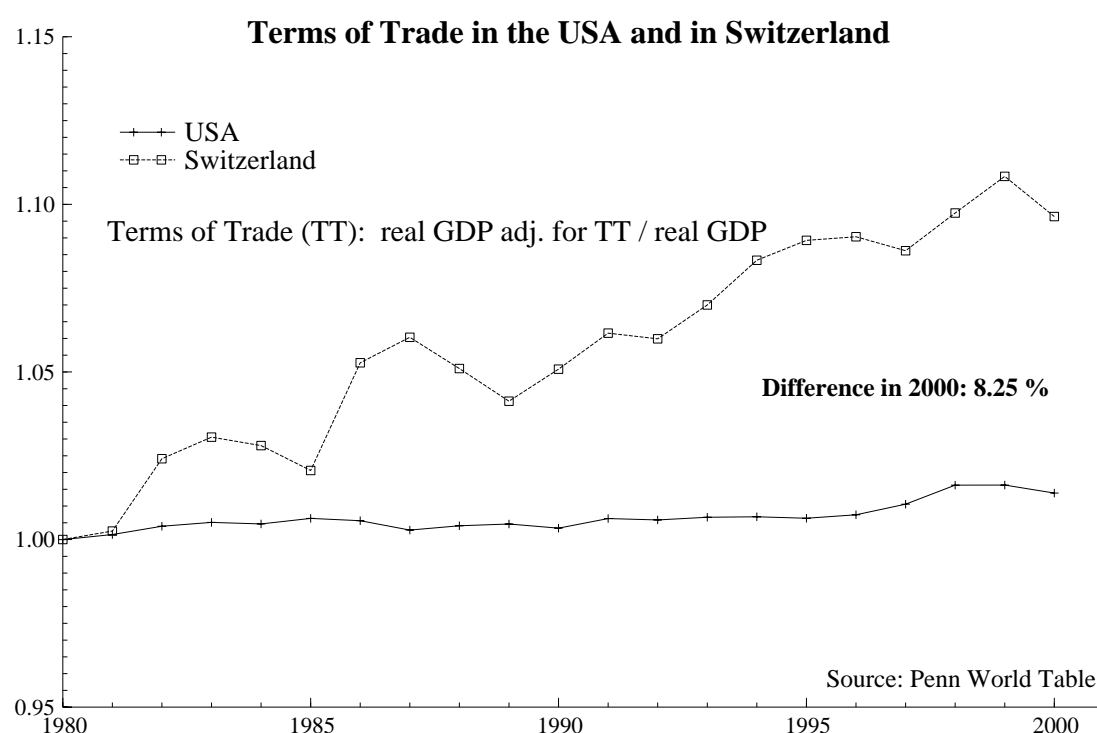


## (2) Real GDP adjusted by Terms of Trade

Even in a country where real value added does not increase over time, an increase in overall wealth can be observed if, due to trade with foreign countries, more import goods can be acquired by paying with the same amount of domestic products. Naturally, the potential for these terms of trade effect is bigger, the larger the share of exports and imports in GDP. It could even be argued that in the absence of market power, those changes will mainly be brought about by variations in relative differences between domestic and foreign traded products. Quality can only be poorly estimated and is therefore likely to be underestimated in the national accounts. Therefore, ToT can be regarded an approximation of neglected income growth which is due to unobservable improvements in quality.

The PWT implicitly include a measure for the change in the ToT. Graph 6 compares the findings for the U.S. and Switzerland. As a small yet very open economy, Switzerland experienced an increase in the ToT with an accumulated difference of 8.25 percent over 20 years. Therefore, allowing for an adjustment for ToT, the real GDP growth of Switzerland would have to be corrected upwards reflecting the mis-measured GDP quality growth.

**Graph 6**



**Table 1: Descriptive Statistics**

Accumulated (a) and mean (m) growth rates in %					
Measure	U.S.A.: 1980–2000			Switzerland: 1980–2000	
Real GDP					
PWT	a: 88.81	m: 3.18		a: 33.21	m: 1.43
KOF/BFS	–			a: 33.51	m: 1.45
Terms of Trade					
PWT	a: 1.34	m: 0.07		a: 9.64	m: 0.46
GDP deflator					
PWT	a: 87.48	m: 3.14		a: 100.93	m: 3.49
KOF/BFS	–			a: 68.65	m: 2.61

## 5. The influence of the GDP Concept

To measure the level of economic activity, the concept of gross domestic product is widely used. This concept, which sums up the gross value added of all economic sectors in the production process, dates back to the middle of the last century. In this concept, material intermediate input is subtracted from the output value, thereby avoiding double-counting of production. On the other hand, the depreciation on investment goods used in the production process is not deducted. The calculation of gross value added – and hence gross domestic product – is done within the so called production account within the system of national accounts.

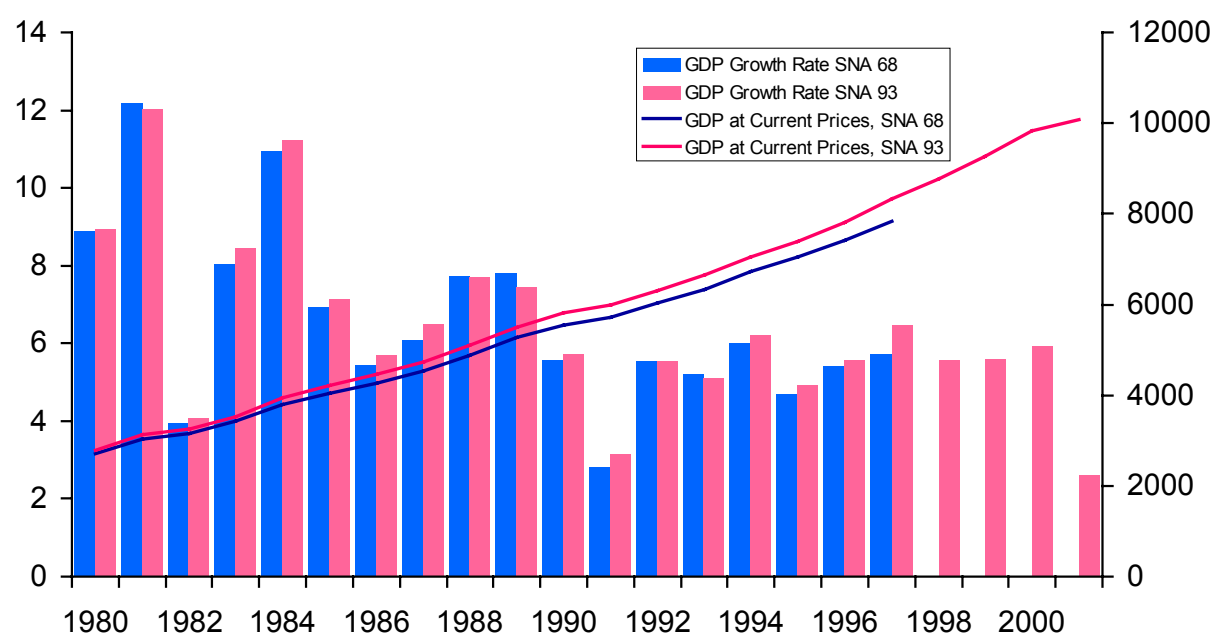
To allow for comparison between countries, there exist international standards for the national accounting, which are periodically revised. Today, the System of National Accounts of the International Monetary Fund from 1993 (SNA 93) is widely used. The European System of Accounts dated 1995 (ESA 95), is the corresponding European version. But there still exist a few countries, whose national accounts confirm to the previous standard, the SNA 68 (or ESA 78). One of them is Switzerland, which will adapt the ESA 95 at the end of 2003.

With the SNA 93, a new investment category was introduced, the investment in intangibles. In SNA 93, expenditures for software and other intangible investment goods were treated as intermediate input, and hence subtracted from the output value when calculating value added. Therefore, the SNA 93 GDP will always be higher than its SNA 68 counterpart. When comparing the levels of GDP, this fact has to be considered.

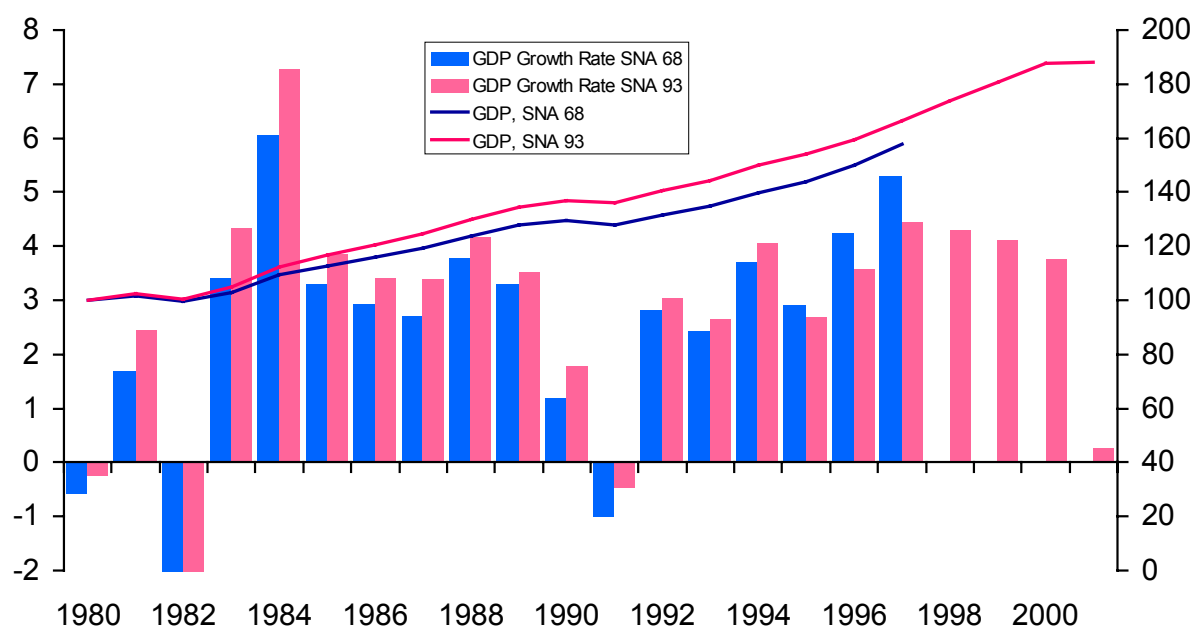
But the two different SNA concepts may also influence growth rates. If the relation of the investment in intangibles to GDP does not remain constant, the nominal growth rates will differ. Moreover, if the price movement of the intangible goods deviates from the general price change, the real growth rate will also be affected. And finally, the change to chain indices and the annual re-basing of the price and volume indices will produce deviating results, if the price change differs between growing and shrinking economic sectors. The results for the U.S. figures show that the computed average nominal growth rate between 1980 and 1987 rose by 0.16% due to the change to SNA 93. The change in the real growth rate was even higher. For the same time period the US economy grew at a 0.31% higher rate on average.



Graph 7: US Gross Domestic Product at current prices

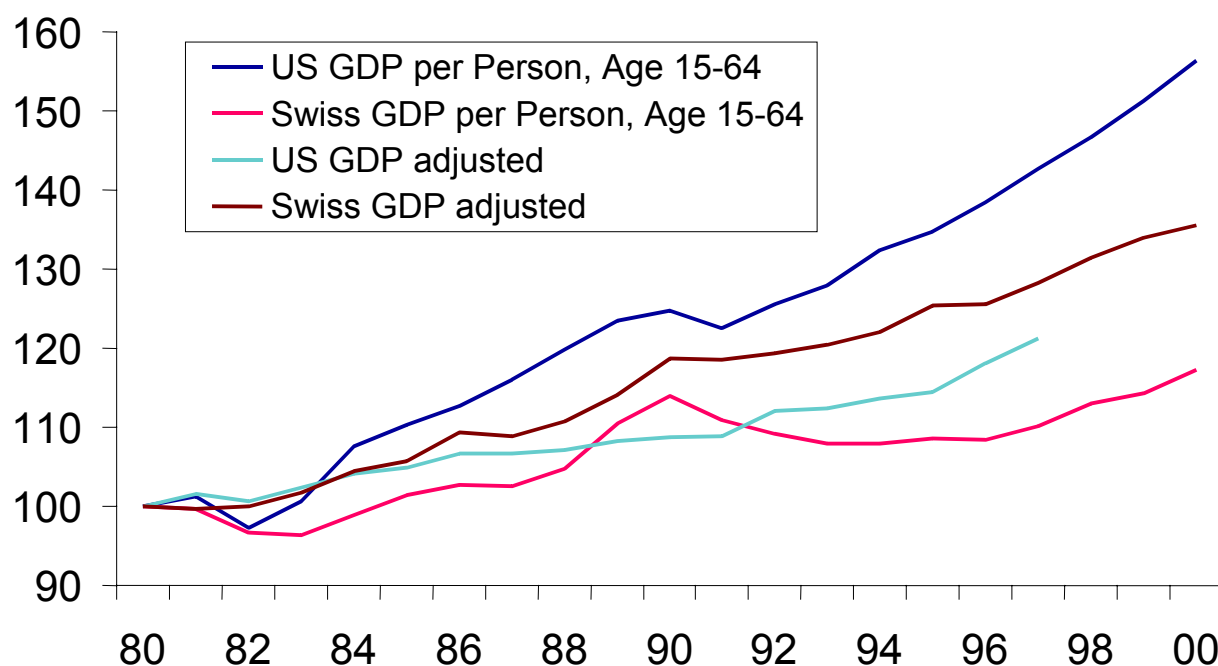


Graph 8: US Gross Domestic Product at constant prices, volume index



When combining the effect of the SNA revision on the US GDP, the effect of the terms of trade changes and the difference of labour input, in the period 1980 to 1997, the growth rate of *Y/L* in Switzerland was actually *higher* than in the USA. Apparently, average Swiss productivity increased at a higher pace in this time period.<sup>7</sup>

*Graph 9: Terms of trade and SNA adjusted US and Swiss GDP per working hour*



## 6. Swiss Economists' and Policy Makers' Explanations for Poor Growth

Switzerland, which until the beginning of 20th century was a rather poor and agriculture dominated country, experienced tremendous economic growth after World War II, during which it managed to remain politically neutral. From 1950 on, production rose permanently – with one exception in 1958 – until the first oil crises. The increase was fuelled by a large number of immigrants and seasonal workers, mainly from Italy. After the collapse of the Bretton Woods System, the Swiss Franc went through several appreciation periods. At the beginning of the first, the oil price increased sharply. But the resulting decreases in production and employment were not followed by a corresponding rise in unemployment. Lacking unemployment insurance, foreign workers returned to their home countries, or they had to leave because their residence and work permits were not prolonged. As a result, the resident population fell by nearly 150,000 – or 2.2% from 1974 to 1977. This

<sup>7</sup> Note however, that in order to judge whether Swiss growth was sufficient, we would have to investigate whether the relative reduction of labour input was accompanied by excess labour supply.

added a negative impulse on the economy. Having hardly revived from this shock, the second appreciation in late 1978 was even stronger. The real exchange rate rose by 16% from 1977 to 1978. After this experience, monetary policy focussed less on the inflation target, but rather on the exchange rate.

The eighties are considered as a golden period in Switzerland. However, economic growth was rather quantity than quality-driven. The rise in productivity was comparatively low, partly as a result of the immigration policy. Cheap foreign labour allowed for increases in low productivity sectors.

The tax cuts at the end of the eighties prolonged and strengthened the boom phase, with hard consequences for the treasury in the downturn period from 1992 onward. The high inflation rate, partly caused by a lax monetary policy to avoid negative effects of the drop on the Swiss stock exchange in 1987, was fought by a restrictive monetary policy from 1989 onward. The contribution to the unemployment insurance – obligatory since 1978 – was reduced to 0.4% in 1990. In the following recession and stagnation period – the longest in the Swiss history, which lasted from 1991 to 1996 – this contribution rate had to be increased to 3%. In addition, disposable income was further reduced by tax increases to avoid deficits in the local and regional governments' budgets. These factors as well as reduced public spending worked pro-cyclically and accelerated the downturn. On the other hand, immigration policy became stricter. The appreciation of the Swiss Franc from 1992 to 1995 forced the exposed Swiss companies to rationalise their production. As a result, the productivity growth proceeded at a higher level than in the eighties. Labour input was more or less continuously reduced from 1991 to 1998.

We may add that there is an ongoing debate about to which extent the reluctance of the Swiss electorate to let the country join the European Union in 1991 and the European Economic Area in 1992 was an additional factor in slowing down Swiss economic growth.<sup>8</sup>

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<sup>8</sup> See for example Hauser/Rottinger (2001).

## 7. Great Depressions in a Cross-Country Fixed Effects Growth Model

### *Derivation of reduced form for estimation*

Explicitly or implicitly, most of the empirical work in the new literature on economic growth is based on what Stiroh (2001: 41 f.) calls the "general approach" of endogenous growth models referring to a firm specific production function for firm  $f$ .

$$(3) \quad Y_{ft} = A_t(R) F(K_{f,t}, L_{f,t}, R_{f,t}),$$

where  $t$  denotes time and  $R$  stands for the aggregate stock of knowledge. In this formalisation, the growth of total factor productivity (TFP) comes about through the differential equation  $dA/dt = (dA/dR)(dR/dt)$  which, of course, in order to have substantial meaning needs further specification. The list of compulsory right-hand variables and other specification issues are, however, far from universally being agreed upon amongst applicants or observers. Yet, it seems fair to summarise that the standard procedure is to refer to an 'augmented' aggregate production function that relates GDP in country  $i$  at time  $t$  to the factors of production

$$(4) \quad Y_{i,t} = A_{i,t} K_{i,t}^{\alpha} L_{i,t}^{\beta} H_{i,t}^{\gamma},$$

where  $Y$  is GDP,  $A$  total factor productivity (TFP),  $K$  physical capital,  $L$  labour and  $H$  human capital.<sup>9</sup>

Assuming constant returns to scale in  $K$ ,  $L$  and  $H$  ( $\alpha + \beta + \gamma = 1$ ),<sup>10</sup> i.e. the production inputs traded on factor markets, dividing by  $L$ , and taking logarithms and time derivatives yields:

$$(5) \quad g(Y/L)_{i,t} = g(A)_{i,t} + \alpha g(K/L)_{i,t} + \gamma g(H/L)_{i,t},$$

where  $g(X)$  stands for the continuous growth rate of  $X$ . Now, the growth rate of the overall efficiency variable  $A$  itself can be expressed as a function  $g(A(\cdot))$  of a set of variables. Given the current state of (or rather lack of) theoretical knowledge, empirical modelling may start with the assumption of the linear relationship

$$(6) \quad g(A)_{i,t} = a_0 + a_1 T_{i,t-1} + a_2 [\ln(Y/L)_{z,t-1} - \ln(Y/L)_{i,t-1}] + \sum a_j X_j,$$

where  $T$  is the stock of knowledge relevant for improvements of TFP,  $\ln(Y/L)_z - \ln(Y/L)_i$  is the development gap to the most advanced 'frontier' country  $z$ , and the sum  $\sum a_j X_j$  is added to acknowledge other potentially important determinants of  $g(A)$ , which, of course,

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<sup>9</sup> For a detailed discussion of this approach, see Graff (2000).

<sup>10</sup> A pre-test for economies of scale in  $Y = A K^{\alpha} L^{\beta} H^{\gamma}$ , using the data to be employed in what follows, failed to reject the null hypothesis ( $\alpha + \beta + \gamma = 1$ ).

remain open to questions. Since  $\ln(Y/L)_z$  is constant across countries and hence influences only the intercept, it can be dropped without biasing the parameter estimates. The usual convergence/catching-up variable is therefore the (log of) per capita income in country  $i$ , and the expected sign of the coefficient is negative. The reduced form to be estimated is thus derived by substituting equation (6) into equation (5).

### *Data*

Before proceeding further, a few remarks concerning the sample and the data are in order (for details, see appendix).

Our endogenous variable is the growth rate of GDP per number of people in the labour force. Note that, notwithstanding the reservations made above (sections 3–5), this is conceptually the same variable as in the Kehoe/Prescott paper, which allows for a comparison of the results.

The sample consists of 90 countries. If not stated otherwise, the data are taken from the PWT, Version 6.1, which now consists of annual (albeit frequently incomplete) observations from 1950–2000. Due to missing data, our panel starts in 1960. For our analyses, we stack observations for every 5th year (1960, 1965, ..., 2000) so that we can refer to a balanced panel of  $90 \cdot 9 = 810$  points or  $90 \cdot 8 = 720$  five-year growth intervals, respectively.

Specifically, as a proxy for labour we refer to exactly the same labour force approximation as Kehoe/ Prescott, i.e. the number of people aged 15–64. Real GDP is from the PWT 6.1 (in "international \$", with 1996 as the common base year for deflating and adjusted for differences in purchasing power parities). Capital accumulation is frequently proxied by the investment rate. We choose to compute capital stock estimates and growth rates instead. The reason is that we assume the well-known problems of capital stock estimates (most of all the arbitrariness of assumptions regarding depreciation and obsolescence) to be more than outweighed by the provision of a variable that is much closer to the theoretical derivation of the long-run growth equation. Specifically, investment rates are likely to change more than capital stock growth rates along the business cycle and after macro-economic shocks. Moreover, having computed capital stock estimates allows us to compute individual time series for  $v = K/Y$  that will later be used to derive estimates for capacity utilisation. Human capital accumulation  $g(H/L)$  is frequently proxied by the rate of change of educational attainment using data on mean years of schooling. Technical knowledge  $T$  is generally acknowledged to be one of the major determinants of economic growth, yet, due to difficulties to find suitable estimates, it is very rarely explicitly modelled in empirical cross-country growth exercises. For the purpose of this paper, we chose to proxy it by the proportion of the labour force with completed higher education, which worked well in a series of related analyses (see Graff, 2002a).

Finally, since this study is concerned with long-run characteristics, it is desirable to eliminate business cycle and shock-related influences from our variables.<sup>11</sup> To this end, we correct our production input variables  $K$ ,  $L$  and  $H$  for capacity utilisation, drawing on a traditional method used to determine capital's capacity utilisation in policy-oriented business cycle research.<sup>12</sup>

### *Cross-country growth regression results*

We are now equipped with either straightforward data or at least with reasonably well defined proxies for all variables specified in the discussion of the relationships postulated in the general equations above.

Drawing on our panel data set of 90 countries and 8 growth periods of five years, we can estimate a fixed effects model with individual constants for all countries  $i$ .<sup>13</sup>

$$(7) \quad g(Y/L)_{i,t} = \beta_i + \beta_2 g(K/L)_{i,t} + \beta_3 g(H/L)_{i,t} + \beta_4 \ln(Y/L)_{i,t-1} + \beta_5 T_{i,t-1} + \varepsilon_{i,t},$$

where  $g(Y/L)_{i,t}$  is regressed on its presumed determinants. For our purposes, however, we pick one country – the USA – as the reference, i.e. we remove  $\beta_{USA}$  and add a common intercept  $\beta_0$ :

$$(8) \quad g(Y/L)_{i,t} = \beta_0 + \beta_i + \beta_2 g(K/L)_{i,t} + \beta_3 g(H/L)_{i,t} + \beta_4 \ln(Y/L)_{i,t-1} + \beta_5 T_{i,t-1} + \varepsilon_{i,t}.$$

The estimate of  $\beta_0$  in (8) then equals  $\beta_{USA}$  in regression (7), whereas the fixed effects for the remaining  $i \neq USA$  quantify the difference between  $\beta_0$  and average TFP growth in country  $i$  not yet accounted for by our explicit regressors.

To test for robustness, we shall re-run regression (8) with some modifications. First, we shall allow for a linear time trend, so that

$$(9) \quad g(Y/L)_{i,t} = \beta_0 + \beta_i + \beta_2 g(K/L)_{i,t} + \beta_3 g(H/L)_{i,t} + \beta_4 \ln(Y/L)_{i,t-1} + \beta_5 T_{i,t-1} + \beta_6 t + \varepsilon_{i,t}.$$

Secondly, we adjust our model for capacity utilisation  $q$ , referring to estimates of  $q_{i,t}$  obtained by dividing an estimate of the trend capital coefficient  $(K/Y)_{i,t}$  through its observed value  $(K/T)_{i,t}$  (for details, see appendix). Given this, we face two alternatives, either to relate adjusted output  $Y^* = Y/q$  to the unadjusted inputs (here:  $K$  and  $L$ ), or to relate unadjusted output  $Y$  to the adjusted inputs  $K^*$  and  $L^*$ . Accordingly, we get:

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<sup>11</sup> Note that due to the periodical subdivision of our data into periods of 5 years, the usual alternative to our elimination of cycles, namely the fitting of a long run growth rate through all observations during some decades ('world bank method'), is not feasible here.

<sup>12</sup> See Phillips (1963), Klein/Preston (1967) and Klein (1969).

<sup>13</sup> This particular method actually provides estimates for the fixed effects. It is usually referred to as "least square dummy variable" (LSDV) model.

$$(10) \quad g(Y^*/L)_{i,t} = \beta_0 + \beta_i + \beta_2 g(K/L)_{i,t} + \beta_3 g(H/L)_{i,t} + \beta_4 \ln(Y/L)_{i,t-1} + \beta_5 T_{i,t-1} + \varepsilon_{i,t}$$

$$(11) \quad g(Y/L^*)_{i,t} = \beta_0 + \beta_i + \beta_2 g(K^*/L^*)_{i,t} + \beta_3 g(H/L)_{i,t} + \beta_4 \ln(Y/L^*)_{i,t-1} + \beta_5 T_{i,t-1} + \varepsilon_{i,t}.$$

Moreover, we include an additional growth determinant, financial development (*FD*), which has lately attracted a lot of attention (for a survey see Levine 1997) and may be assumed to affect economic performance in Switzerland. Therefore ignoring it would bias the Swiss fixed effect possibly more than those of other countries, where the financial sector is of less importance. To this end we operationalise *FD* by a resource based concept which has proven useful in previous work (Graff 2002b), and this model is given by

$$(12) \quad g(Y/L^*)_{i,t} = \beta_0 + \beta_i + \beta_2 g(K^*/L^*)_{i,t} + \beta_3 g(H/L)_{i,t} + \beta_4 \ln(Y/L^*)_{i,t-1} \\ + \beta_5 T_{i,t-1} + \beta_6 FD_{i,t-1} + \varepsilon_{i,t}.$$

In a final (informal) test for robustness, we re-run the base regression (8) for the last two decades of the panel (1980–2000), which is to allow for structural shifts or breaks with respect to time, or due to changes in data quality, which again might be important for Switzerland, where reasonably reliable GDP data do not go back further than 1980:

$$(13) \quad g(Y/L)_{i,t} = \beta_i + \beta_2 g(K/L)_{i,t} + \beta_3 g(H/L)_{i,t} + \beta_4 \ln(Y/L)_{i,t-1} + \beta_5 T_{i,t-1} + \varepsilon_{i,t} \quad \text{with } t \geq 1980$$

The results are presented in Table 2.

As a first comment, it is obviously justified to say that judged by their overall fits,<sup>14</sup> our models fare quite well, and the coefficients of the explicit regressors generally show their expected signs, though the human capital accumulation variable  $g(H/L)$  and the technology variable  $T$  fail to be robustly<sup>15</sup> different from zero.

Since we are not primarily occupied with the core model, we suggest to accept this part of the regressions as fairly in line what is produced by similar regressions, and to proceed to the fixed effects of Switzerland and New Zealand.

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<sup>14</sup> The good overall fit is of course partly due to the inclusion of the country dummy variables for specific "fixed" effects and the adjustments for capacity utilisation in models (10) and (11).

<sup>15</sup> In the present cross-country growth literature, "robust" means that a parameter estimate is not sensitive to minor changes of the particular model specification.

Table 2: Cross-country growth regressions, pooled sample, dependent variable:  $g(Y/L)$

Model	(8)	(9)	(10)	(11)	(12)	(13)
$g(K/L)$	.32* (11.5)	.31* (11.1)	.86* (50.1)	.74* (37.4)	.32* (11.7)	.31* (6.63)
$g(H/L)$	.066* (1.86)	.064* (1.78)	.035 (1.61)	.041* (1.99)	.067* (1.90)	-.030 (-.44)
$\ln(Y/L)_{t-1}$	-.030** (-8.40)	-.029* (-6.95)	.001 (-.64)	-.009* (-4.06)	-.034* (-8.50)	-.054* (-6.29)
$T_{t-1}$	.001 (1.46)	.001 (1.64)	.001 (1.21)	.001* (1.67)	$\leq .000$ (.013)	.004* (3.55)
$t$		-.001 (-.77)				
$FD_{t-1}$					.008* (2.20)	
Capacity correction	none	none	$Y^*$	$K^*$ and $L^*$	none	none
Analysis starts	1960	1960	1960	1960	1960	1980
CHE-effect	.001 (.10)	.004 (.29)	.007 (.81)	.006 (.79)	-.012 (-.84)	.039 (1.76)
NZL-effect	-.007 (-.56)	-.005 (-.37)	.005 (.63)	.002 (.33)	-.016 (-1.17)	.007 (.36)
$R^2$	.48	.48	.85	.81	.48	.59

$N = 8 \cdot 90 = 720$ , all regressions include a general intercept, t-statistics in brackets, one-tailed significance tests for regression parameters, two-tailed significance test for fixed effects, \*  $p \leq 0.05$ .



According to the base model (8), we do indeed have signals for "depressions" (in 50 out of our 90 countries), *but neither in Switzerland nor in New Zealand*. As far as the fixed effects for Switzerland and New Zealand are concerned, the results are certainly robust with respect our various modifications (inclusion of  $t$ ,  $\beta_t$  and  $FD$ , two different adjustments for capacity utilisation, analysis of post 1980 period only). In other words, independently of the specific model, the estimates are not statistically significant from zero; if anything, the Switzerland-effect tends to become positive if we restrict our analysis only to the second part of the time period under consideration (model 13).

Now, note that in our set-up, an insignificant fixed effect implies that a country's average growth rate (precisely: the arithmetic mean of  $n = 8$  five-year growth periods, where  $g(Y/L) = [\ln(Y/L)_t - \ln(Y/L)_{t-1}] / 5$ ) is sufficiently explained by a linear combination of its realisations of the explicit regressors (the general growth determinants) and the point estimates of the model parameters. In other words, over the period under consideration (1960–2000), the comparatively low growth rates in Switzerland and New Zealand can be attributed to their accumulation of inputs and their starting position, and no "slow growth puzzle" remains.

Table 3 summarises this point by presenting the US, Swiss, New Zealand and total country average values for the regressands and the regressors. Accordingly, compared to the US, Switzerland had a lower rate of capital accumulation and a lower initial  $T$  (here: proxied by the percentage of adults with completed higher education), and New Zealand scores lower on  $g(K/L)$ ,  $T_{-1}$  and  $g(H/L)$ . Obviously, without further qualification, we would not want to call this fact a "depression"; it might be due to various reasons, among which we should certainly consider "preferences".

*Table 3: Descriptive statistics for core model,  $n = 8$*

	$g(Y/L)$	$= f [$	$g(K/L)$	$g(H/L)$	$T_{-1}$	$\ln(Y/L)_{-1}]$
USA	1.9%		2.2%	0.9%	13.4	10.7
CHE	1.0%		1.3%	0.9%	5.5	10.7
NZL	0.6%		0.7%	0.5%	7.0	10.5
all 90	1.6%		1.8%	2.3%	2.2	9.1

### *Economic performance through time: Evidence from the regression residuals*

In the final step of our analysis, we refer to the fact that in the cross-dimension fixed effects set-up, for every country, the residuals  $\varepsilon_{i,t}$  sum up to zero (since the mean deviation of a country's residuals from zero is exactly what is captured by the fixed effects). Accordingly, the residuals of a given country show us a profile of its economic performance through time.

Before proceeding, recall that the country-specific time profile from the residuals is conceptually very different from the fixed country effect: While the latter gives a combined measure of all country-specific peculiarities which are constant through time, the former identifies how a country's performance departs from its predicted value given its realisations of the explicit regressors as well as its fixed country effect. Hence, if the residuals contain anything apart from noise, we can interpret this systematic part as the period specific peculiarities. Moreover, if we add period specific fixed effects  $\beta_t$  to the base model, so that

$$(14) \quad g(Y/L)_{i,t} = \beta_i + \beta_t + \beta_2 g(K/L)_{i,t} + \beta_3 g(H/L)_{i,t} + \beta_4 \ln(Y/L)_{i,t-1} + \beta_5 T_{i,t-1} + \varepsilon_{i,t},$$

the  $\beta_t$  capture all period specific and world wide (or rather: sample wide) covariance not accounted for by the explicit regressors (i.e. the results of common shocks etc). Consequently, the residuals  $\varepsilon_{i,t}$  from regression (14) isolate from the time profile what is unique to country  $i$ . Hence, if the core model is reasonably well specified, we should see country-specific shocks or policy shifts show up in the profile of its residuals.

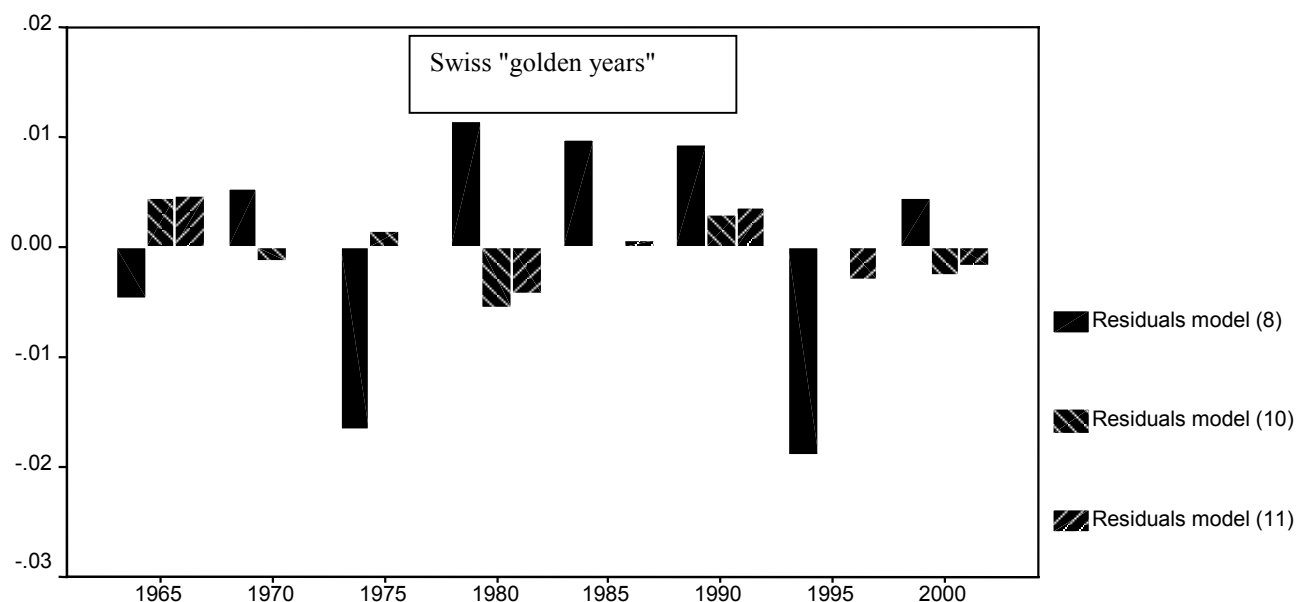
Specifically, the informed discourse on Swiss economic policy as summarised above would lead us to expect that part of the 1970s and the middle of the 1990s should show evidence of under-performance (with respect to Swiss mean performance). Keeping this in mind, let us now look at the corresponding time series plot for Switzerland.

Graph 10 shows that there are obviously two pronounced troughs which relate to the growth periods 1970–75 and 1990–95. In other words, having controlled for the explicit determinants of growth, all (implicit) time-invariant Swiss peculiarities and world-wide co-movements, these two troughs from the residual plots indeed co-incide with what are generally thought to be recent periods of economic under-performance.

This finding is certainly reassuring with respect to the appropriateness of our analytical framework. Let us now ask, what we should expect if we look at the residuals from the models which in one or the other way refer to data that account for capacity utilisation. Obviously, if capacity utilisation were the only reason for the systematic movements of the residuals through time, after correction for the former, the latter should be removed as well and the country residuals from (10) and (11) should be noise only. An inspection of graph

10 reveals that this is very much the case; at least, from what is now left of the residual variance, no obvious relation to recent developments in Switzerland can be drawn. Under-utilisation of resources and other growth retarding factors went hand in hand.

*Graph 10: Residuals for Switzerland, models (8), (10) and (11), including period dummies*



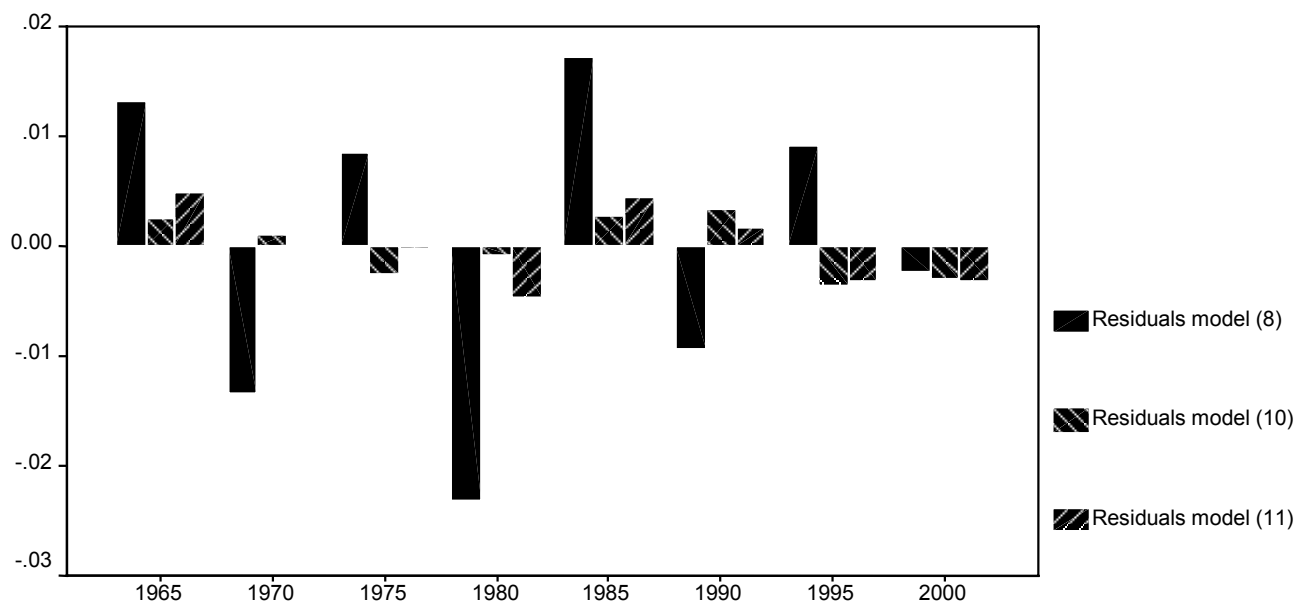
Graphs 11 and 12 show the corresponding time paths for the growth residuals of New Zealand and the USA, respectively. For New Zealand, the residuals from the base model (8) show evidence of a very pronounced and regular cyclical development with relative over-performance during the five-year growth periods ending in 1965, 1975, 1985 and 1995, while the end points 1970, 1980, 1990 and 2000 mark intervals, during which growth in New Zealand was above its 1960–2000 average. As in the case of Switzerland, after correction for capacity utilisation, there is considerably less residual variance, which implies that capacity utilisation is the major cause for the unexplained residual variance in model (8).<sup>16</sup>

For the United States, the residual plot shows a distinct path with a deep trough for the growth period ending 1970, followed by a long upswing until 1985 and a second, albeit less pronounced trough for the 1990–95 interval.<sup>17</sup> In contrast to the picture for Switzerland and New Zealand, though, the correction for capacity utilisation does not cancel out the systematic pattern to the same extent, which might indicate that other forces have been at work or that our admittedly crude capacity utilisation proxy is less valid for the USA.

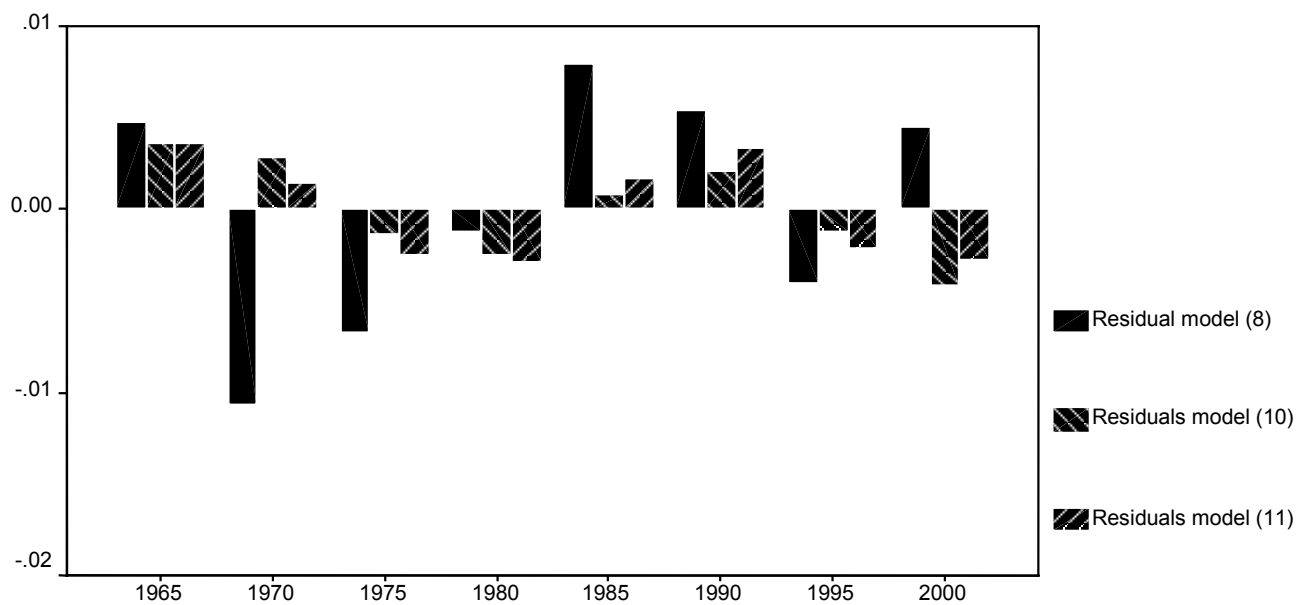
<sup>16</sup> We leave it to our fellow Economists from New Zealand to judge whether there are substantial reasons (e.g. abstinence from anti-cyclical economic policy) for the cyclical movements of the residuals in (8), or whether we should rather interpret them as noise.

<sup>17</sup> This does not look implausible to us, but, as above for New Zealand, we rather leave it to our colleagues from the USA to judge whether this pattern is conform with what they would have expected.

Graph 11: Residuals for New Zealand, including period dummies



Graph 12: Residuals for the USA, including period dummies



## 8. Summary and Conclusions

In this paper, we have addressed Kehoe/Prescott's claim that Swiss economic performance in the last decades merits the label "great depression" from different angles.

We proposed an alternative to Kehoe/Prescott's peculiar linear 2%-"detrending" procedure and choose a less dramatic starting point.

First, we investigated whether the poor growth performance of Switzerland, which clearly shows up in the macro data, is indeed a fact, and if so, whether we can find sound explanations for this.

A closer inspection of the data – time series of GDP per labour – revealed that a considerable part of the gap between the benchmark country's (USA) and Swiss growth performance may indeed be a statistical artefact due to systematic measurement biases.

We then emphasised the fact, that though it is probably inappropriate to speak of a "great depression" in Switzerland, many observers would agree that the recent growth performance has been comparatively poor, and we summarised some of the main arguments which are usually put forward in this context.

Moreover, we presented a different approach, namely to use the standard cross-country growth regression set-up to evaluate whether the empirical growth performance of Switzerland (and New Zealand) is keeping up to its potential when we control for factor inputs and other main determinants of economic growth. This analysis did not show any evidence of Switzerland, nor New Zealand, to grow significantly below potential. In other words, considering the accumulation rates of capital, labour and human capital as well the level of economic prosperity already reached, Switzerland and New Zealand are not significantly deviating from their predicted growth paths.

Of course, this does not mean that they could not have achieved higher growth, but this comes at the price of higher accumulation rates of capital, labour and, possibly, human capital, which implies less consumption and leisure, and after all, we should not forget that the ultimate objective of economic activity is providing utility – human well being – and not GDP growth.

Finally, in this context, we should note that we are aware of the fact that Switzerland, like other rich countries, faces numerous problems which call for improved institutions and continuous reflection about economic policy. Specifically, with respect to growth, there is certainly more need for disaggregated, sectoral analyses.

## 9. Appendix: Data and Sources

The sample consists of all countries for which the necessary data could be collected, with the exception of countries that are very small (population less than one million), of countries with centrally planned economies through most of the period 1970–90, countries in which oil exports accounted for more than 20% of GDP in 1985, and countries with war or civil war claiming a death toll exceeding 2.5% of the population during 1970–88. The exclusion of these countries is to acknowledge that it makes little sense to run regressions with countries which are fundamentally different from usual conditions (Harberger 1998).

If not mentioned otherwise, data are from the Penn World Table 6.1, October 2002). The complete 9 × 90 matrix of data underlying the regression analyses can be obtained from the authors upon request (graff@kof.gess.ethz.ch).

*Physical capital (K)* is estimated by the perpetual inventory method as specified for LDC's by Harberger (1978) and refined by Nehru and Dhareshwar (1993), using a common depreciation rate of 10%.

*Human capital (H/L)* is taken from the latest version of the Barro/Lee web-data base referring to mean years of schooling in the population aged 15–65.

*Technical knowledge (T)* is proxied by the share of persons with completed higher education in the labour force from the latest version of the Barro/Lee web-data base.

*Capacity utilisation (q)*: The underlying hypothesis is that the empirical short-run fluctuations of the capital output ratio  $v$  are mainly due to cyclical changes in capital utilisation. Accepting this, a long-run trend estimate of  $v$  can be used to identify the actual deviation of  $v$  from its 'equilibrium' level, which in turn allows to quantify capital utilisation. Labour utilisation would of course be adequately measured by the unemployment rate. However, it is hopeless to find reliable and comparable figures for unemployment for more than very few countries, so that for a large sample as ours, one has to resort to less direct methods. Here, taking into consideration potential firm specific qualifications of labour, the duration of work contracts and other institutional characteristics of labour markets, we assume that labour is laid off to a lesser degree than capital is put idle. To implement this argument, labour's capacity under-utilisation is computed as 50% of capital's deviation from its normal utilisation.

*Financial development (FD)* is computed as the first principal component of three resource based indicators for financial activity (share of the financial sector in GDP, share of employment in the financial sector, bank density) as described in Graff (2002) with M2/GDP as an additional indicator (source: World Development Indicators, World bank online access for journalists).

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