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Characteristics and Drivers of the Swiss "Job Miracle"

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Abstract: Switzerland's employment growth since the early 2000s was very high in both historical and international perspective, despite solid real wage increases and only moderate GDP growth. Yet, the reasons for the remarkable creation of jobs are largely unknown. We aim at filling this gap by studying the underlying characteristics and drivers of the Swiss "job miracle". We first outline the characteristics of the "job miracle" and show that the observed job growth correlates with a substantial increase in the labor intensity of economic activity. We then discuss five potential drivers of the unprecedented employment growth, which are consistent with the facts. Our empirical results suggest that immigration was the key factor in explaining the "job miracle" as it raised local demand and thereby triggered the creation of additional jobs.

Keywords: labor market, Swiss job miracle, job creation, employment forecasts, migration, local multipliers
JEL Classification: C52, E24, J21, J61

1 Introduction

The term 'Swiss "job miracle"' denotes the phenomenon that in the last decade total hours worked in Switzerland have grown substantially. Between 2003 and 2013, the number of employees increased by 15.2 percent, from 4.2 to 4.8 million persons. The job creation in this period not only represents a substantial change from the preceding decade, in which employment in Switzerland stagnated; it is also high from an international perspective. Figure 1 compares Switzerland's growth in total hours worked with that of other developed countries. It shows that Switzerland's increase in total hours worked was especially remarkable in the period between 2005 and 2011. Amongst the countries considered, in the period under consideration only Sweden displays similar long-term increases in

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Figure 1: Total hours worked for selected OECD countries (2002–2013).
Source: OECD, own calculations.

employment.[1] Germany, for which the recent surge in employment has been the subject of several studies,[2] had lower employment growth than Switzerland throughout this period.

The Swiss "job miracle" of the last decade is all the more remarkable considering that growth in GDP has not been impressively high in recent years,[3] that Swiss firms' competitiveness strongly decreased by a substantial and fast real appreciation of the Swiss franc of more than 15 percent of the real trade-weighted exchange rate between 2009 and 2013, and that the US had the opposite problem after the Great Recession: GDP growth without job growth.[4]

This paper is the first to describe the Swiss "job miracle" and to provide a qualitative assessment of its possible causes. Our first contribution is to establish the most important characteristics of the "job miracle". We show that new jobs were mainly created in the knowledge-intensive service sector and were almost entirely filled by workers with high observed formal qualifications. We also show

1 There are only four countries among the OECD countries with higher growth in total hours worked between 2002 and 2012: Australia, Israel, Luxembourg, and Mexico. Only Luxembourg and Australia have a level of development comparable to the one of Switzerland.

2 See e. g. Dustmann et al. (2014) and the literature cited therein.

3 As a result, the growth rate of labor productivity in Switzerland between 2000 and 2010 was, in a historical perspective, unprecedentedly low (Siegenthaler, 2014).

4 See e. g. Freeman (2013).

that observers of economic activity did not foresee the "job miracle". Modifying the analysis in an earlier paper (Graff, Mannino, and Siegenthaler 2012) by referring to a more adequate reference, we demonstrate that the two most important forecasting institutions in Switzerland, the KOF Swiss Economic Institute (KOF) and the State Secretariat for Economic Affairs (SECO), systematically and repeatedly underestimated the growth of the number of jobs. Moreover, using a decomposition of Swiss GDP growth into the contributions of capital deepening, growth of hours worked and labor productivity growth, we show that the "job miracle" is related to the fact that around 2000 GDP growth became remarkably more labor- and less capital-intensive. These changes are also detected in rolling window regressions as partial correlations between investment, labor productivity and employment growth.

Our second contribution is to present and assess five potential structural causes of the Swiss "job miracle" that are consistent with a shift towards a more labor-intensive GDP growth: (1) catch-up employment growth after an unusually long and turbulent phase of economic stagnation in the 1990s, (2) the evolution of the price of labor relative to the price of capital, (3) a labor supply and labor cost shock due to the introduction of a free movement of persons regime with the EU and EFTA countries aligning labor supply with the increasingly skill-intensive labor demand of firms, (4) increased settlements of foreign firms caused among others by substantially reduced corporate and income taxes, and (5) jobs created in the wake of migration into Switzerland through local multiplier effects on domestic demand. While we cannot exactly pin down the quantitative relevance of each of these factors in accounting for the Swiss "job miracle", our empirical analysis suggests that immigration was a key driver. Not only was immigration a pre-requirement for it – as the resident labor force would not have been sufficiently large to fill all new jobs created – but it also reinforced the "job miracle" by fueling local job growth through increasing local demand for goods and services.

Our analyses are relevant for at least three reasons. First, as we will show, low wage growth cannot account for the Swiss "job miracle". This warrants explanation, as wage moderation might be considered the natural candidate for explaining strong employment growth under relatively moderate GDP growth. Second, understanding the potential reasons for the "job miracle" helps to assess the reasons behind the systematic forecast errors in Switzerland. Third, understanding the Swiss "job miracle" is relevant to comprehend the recent immigration wave to Switzerland, which in turn is important because immigration has become an increasingly hot topic in Switzerland, with growing opposition among residents against free migration from EU/EFTA countries, while the majority of newly created jobs were filled by immigrants.

The remainder of the paper is structured as follows. In the following section, we highlight important characteristics of the "job miracle" and demonstrate the extent to which forecasters have underestimated the job growth. This section also takes a closer look at the structural changes in the nature of Swiss GDP growth that occurred around 2000. Section 3 provides a narrative account of the potential sources of the Swiss "job miracle". Section 4 concludes.

2 The unexpected Swiss "job miracle"

2.1 Characteristics of the "job miracle"

The Swiss "job miracle" refers to the growth of total hours worked. Figure 2 shows total hours worked and an index of real wages from 1950 to 2013.[5]

The hours worked series suggests that after a recovery from crisis of the 1980s, the 1990s mostly saw a decline; but in the late 1990s it started to rise. It gained momentum around 2004, and it has since then evolved on a steep growth path.[6] Remarkably, growth in hours worked in the latest period was as high as it had been in the early 1960s, despite the fact that GDP grew on average nearly three percentage points less.

Three characteristics of the "job miracle" are especially noteworthy. First, moderate wage growth cannot account for the "job miracle". First evidence supporting this view is presented in Figure 2. Using the Swiss wage index, it shows that real wages grew at similar rates between 2002 and 2013 as in the two decades before. There is no apparent slowdown in real wage growth around 2004, i. e. at the time when employment begins to surge.

Further evidence that wages cannot explain the "job miracle" is presented in Figure 3.[7] It shows the evolution of competition-weighted relative unit labor

5 The hours worked data are from Siegenthaler (2014), extrapolated to 2013 using the official time series on total hours worked from the Federal Statistical Office (FSO). The Swiss wage index is also published by the FSO.

6 The exact timing of the surge in employment slightly depends on the series looked at. For instance, the surge occurs in 2003 according to the official hours worked series from the FSO. By contrast, growth in full-time equivalent jobs (which is the reference series shown in Figure 6) leveled off only in 2005.

7 The evolution of Switzerland's labor share of income also suggests that average wages cannot account for the "job miracle". Switzerland's labor share has remained remarkably stable, which is in contrast to the decreases in labor shares observed in most other developed countries (see Siegenthaler and Stucki, 2015, and Graff and Siegenthaler, 2014).

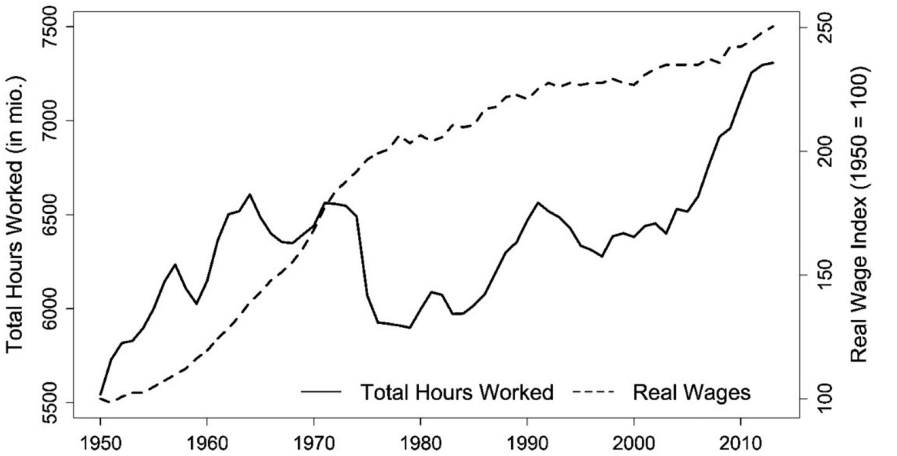

Figure 2: Total hours worked and real wages in Switzerland (1950–2013).
Source: Siegenthaler (2014) and Swiss Federal Statistical Office, own calculations.

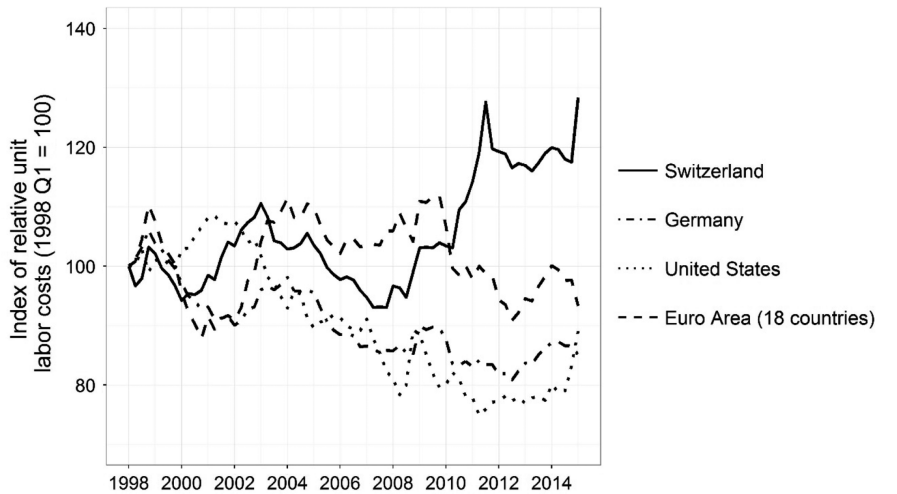

Figure 3: Competition-weighted relative unit labor costs for selected OECD countries (1998–2015).
Source: OECD.

costs for Switzerland, Germany, the United States and the euro area (comprising its present 18 countries) from 1998–2013. These series relate a country's unit labor costs to a weighted average of the unit labor costs of a country's main competitors on its domestic market and its export markets, using respective

trade shares as weights. They thus reflect the joint effects of changes in unit labor costs, labor productivities and nominal exchange rates on the price competitiveness of a country relative to its competitors. (An increase in the index mirrors a decline in competitiveness.)

The unit labor costs series for Switzerland shows no remarkable deviations from the series of the other countries until about 2008. Henceforth, however, the index for Switzerland first rose pronouncedly and then stayed at outstandingly high levels, whereas it remained more or less constant, or dropped, for the other countries. Conventional economic wisdom would now expect that the loss in price competitiveness on international goods and services markets had depressed Swiss employment. Along these lines, the improvement of labor market conditions in Germany over the last ten years, for example, is frequently attributed to wage restraint and the resulting export boom.[8] The same cannot be claimed for Switzerland, especially not since 2008, when Swiss employment growth has been particularly substantial in international perspective.

A second characteristic of the "job miracle" is that most new jobs were created in the service sector. Figure 4 gives an overview of the industries which account for the change in employment observed between 2002 and 2013. It shows the cumulative change in the number of employees in six different economic sectors.

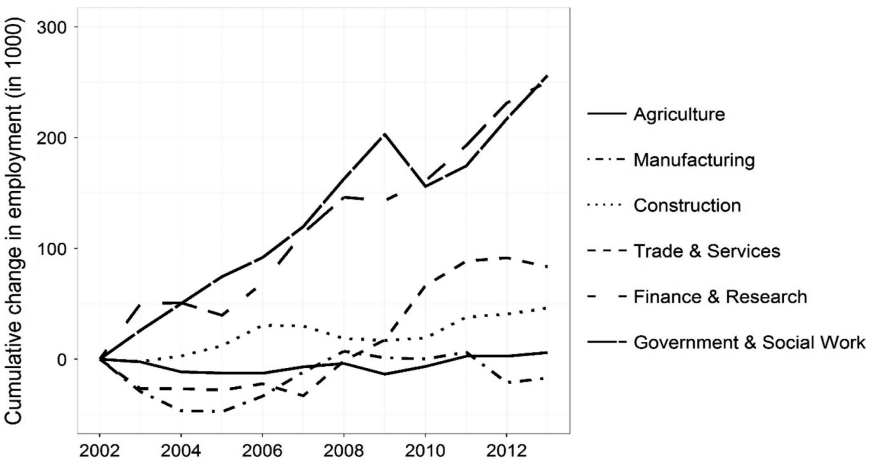

Figure 4: Cumulative change in employment by industry (2002–2013).
Source: Swiss Federal Statistical Office.

8 The paper of Dustmann et al. (2014) on the German labor market miracle shows a graph similar to our Figure 3.

As is evident from the figure, market-oriented, knowledge-intensive private sector service activities as well as public sector employment account for the largest part of the "job miracle". Other sectors contributing positively to the "job miracle" were the construction sector and, since 2007, also other service industries (especially wholesale trade and transportation). On the other hand, employment in manufacturing and agriculture stagnated.

These observations raise two questions. First, does the "job miracle" merely represent an inefficient and non-sustainable shift toward more state employment, as many concerned observers of the Swiss economy are claiming? In our view, this is not the case. To start with, according to Figure 4, growth in the (broadly defined) public sector only accounts for roughly one third of total employment growth. Second, a closer inspection of the detailed sources of the public sector employment growth suggest that it is mainly demand-driven, i. e. the increase in public sector employment can arguably be explained to a large extent by population growth, demographic ageing, the shift of Switzerland towards a knowledge economy, increased demand for health care, and a growing labor force participation of women.[9]

A second question raised by the above observations is whether the Swiss "job miracle" is a mere consequence of the ongoing structural shift toward the service sector, which is observed in many developed countries. Yet, as "tertiarization" is a continuous and gradual process that has been going on for many decades, it may have reinforced the Swiss "job miracle", but it cannot explain its timing: Tertiarization in Switzerland was particularly pronounced in the 1990s, in which total hours worked in Switzerland decreased. Moreover, tertiarization is observed in many developed countries that have stagnant employment.

The third important element of the Swiss "job miracle" is that the new jobs are nearly entirely filled by workers with high formal qualifications. Figure 5 illustrates this point by showing the number of employees in Switzerland according to their highest educational attainment. In particular, between 2002 and 2014 the number of tertiary employees in Switzerland increased by 736,000. In the same period, the number of non-tertiary educated employees declined. The shift towards high-skilled employment growth around 1998 is particularly

9 First, according to the Job Statistics around one fifth of the growth of the public sector between 2002 and 2013 is accounted for by employment growth in education. Second, approximately one third of the state sector growth occurs in residential care and social work activities. The largest part of the job growth in these areas arises in old age and care homes (especially for disadvantaged) as well as child- and daycare centers. Finally, another third of the public sector growth arises in health care, in which in the number of jobs in general and specialty hospitals, but also the number of medical specialists increased.

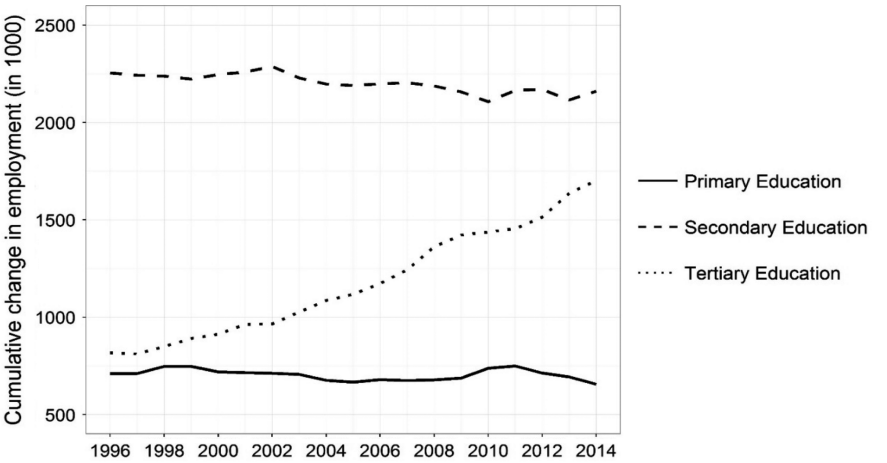

Figure 5: Employment in Switzerland by highest educational attainment (1996–2014). Source: Swiss Federal Statistical Office.

pronounced for the educational credentials of immigrants over time (SECO, BFM, BFS, and BSV 2014).

2.2 Forecasters' systematic underestimation of job growth

The strong job growth in Switzerland since 2002 took observers of economic activity by surprise. In fact, as Graff, Mannino, and Siegenthaler (2012) have shown, the two most prominent institutions that are forecasting employment growth in Switzerland – the KOF Swiss Economic Institute at ETH Zürich (KOF) and a group of experts under the guidance of the State Secretariat for Economic Affairs (SECO) – delivered systematically downward biased forecasts for an extended period.

Here, we replicate this analysis, referring to a more appropriate reference series.[10] The series that both KOF and SECO are forecasting is seasonally adjusted full-time equivalent jobs (FTE) according to the Swiss Job Statistics. Figure 6 shows several vintages of this series.

10 Graff, Mannino, and Siegenthaler (2012) evaluated the job forecasts with the ex-post data as reference series, which is not an entirely appropriate benchmark, as the forecasters aimed at the reference series at hand in real time. The forecasts thus could not know that due to the FSO sampling procedure both level and trend of their reference series would later be be revised upward. We are grateful to Benjamin Weber for directing our attention to this point.

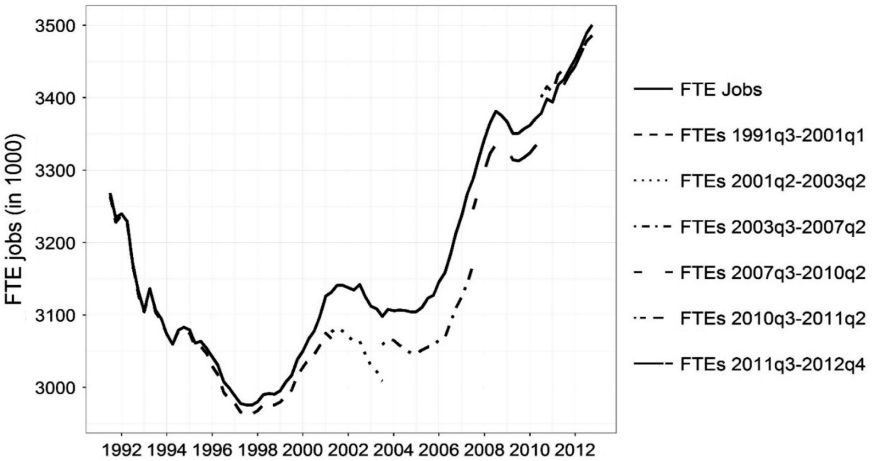

Figure 6: Reference series: full-time equivalent jobs in Switzerland (1991–2012).
Source: Swiss Federal Statistical Office.

The figure illustrates that in the period under consideration, the Swiss Federal Statistical Office (FSO) revised the FTE jobs series five times. The solid line, spanning the whole period from 1991 to 2012, is the latest plotted vintage of FTE jobs, and the one that was used as benchmark in Graff, Mannino, and Siegenthaler (2012). Clearly, this series lies above most of the previously published vintages, sometimes up to 3 percent; and the growth rates of the latest series exceed those of the earlier vintages, too.[11] Since the earlier vintages reflect the target that forecasters were aiming at in real time, we construct a synthetic reference series based on a spline of the six different vintages of the Job Statistics shown in Figure 6, and redo the forecast evaluation exercise of Graff, Mannino, and Siegenthaler (2012). As in the earlier study, the evaluation is made with reference to quarter-on-quarter growth rates rather than numbers

11 With the exception of the shift in 2010, the breaks and shifts in the series are not due to changes in definitions or concepts applied. Rather, the breaks result from the fact that the universe from which firms were sampled to participate in the Job Statistics regularly proved to be unrepresentative for the actual universe of firms in Switzerland. This prove came as soon as the FSO conducted a new business census in order to update its universe of firms. In order to fit the old series to the new (and generally higher) benchmark of the census, the FSO increased the trend growth rate of the old vintage while imposing the cyclical pattern of the old vintage on the new series.

of FTE jobs.[12] As we move from one to another reference series, we refer to the growth rates (but not the levels) of the *revised* series.[13]

Table 1 provides our evaluation of the KOF forecasts for the period 1998q1–2011q4 using the new reference series.[14] It shows the root mean squared error (RMSE), the mean error (ME), and the mean absolute error (MAE) as well as the R^2, i. e. the share of variation in the reference series explained by the forecasts.

Table 1: Accuracy statistics of the KOF full-time equivalent job forecasts.

Statistics	$t+0$	$t+1$	$t+2$	$t+3$	$t+4$
RMSE	0.33	0.42	0.50	0.53	0.48
ME	0.13	0.18	0.19	0.19	0.16
MAE	0.25	0.33	0.35	0.40	0.37
R^2	0.43	0.25	0.12	0.02	0.00

Notes: $t + h$ denotes a forecast horizon of h quarters. Accordingly, $t+0$ represents nowcasts and $t+h$ means h-quarter-ahead forecasts. The forecast accuracy statistics relates to quarterly growth rates. The total sample comprises 41 observations (for nowcasts). It is reduced by h for forecasts.

The table illustrates that KOF faced substantial difficulty even to *nowcast* FTE job growth, let alone to forecast it. The mean error of the 41 KOF nowcasts in this period is 0.13 percentage points. This implies a substantial bias of the nowcasts, since according to our reference series FTE jobs grew on average 0.18 percent from one quarter to the other; and as expected, the errors are getting larger for the one-to four-quarter-ahead forecasts. Generally, the table illustrates that the KOF employment forecasts were strikingly inaccurate, even for nowcasts and short forecast horizons, and practically useless as the forecast horizon approached one year.

12 The reason is that it proved difficult to identify when exactly the forecasters switched to the new benchmark numbers. This implies that despite our efforts to construct a synthetic reference series, we might evaluate forecasts using a wrong benchmark series at the transition points. As in Graff, Mannino, and Siegenthaler (2012), we thus evaluate the forecasts referring to quarter-on-quarter growth rates, since the growth rates of the series are less affected by the benchmark revisions than the level of the series.

13 For example, we evaluate the forecasts made in the third quarter of 2007 with the growth rates from the revised series published posterior to the fourth quarter of 2007.

14 KOF published forecasts regarding both FTE jobs twice a year (in the first and third quarter) until the third quarter of 2007. Since then, forecasts of FTE jobs are published on a quarterly basis.

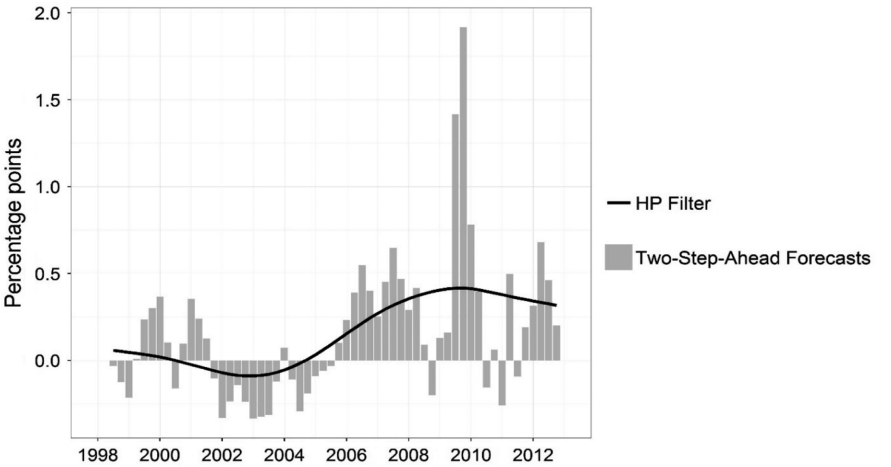

Figure 7: KOF two-step-ahead forecast errors and HP filtered series ($\lambda = 1{,}600$).
Source: KOF, own calculations.

The systematic bias in the KOF job growth forecasts is illustrated by Figure 7, which displays the KOF two-step-ahead forecast errors and, to ease the interpretation, a Hodrick-Prescott (HP) low-pass filtered series of these errors. The HP-trend shows that the positive bias in the KOF forecasts arises around 2005 and remains fairly stable over the rest of the sample period. Indeed, from mid-2005 onward, KOF overestimated job growth only four times, but underestimated it 25 times. (Similar pictures emerge for KOF forecasts with other forecast horizons.)

Notably, the KOF forecasters were not the only ones to be repeatedly surprised by the job growth in Switzerland. The same applies to the other important forecasting institution in Switzerland, SECO. Its job growth forecasts are published quarterly, relating to FTE jobs in the *current* year. They are available from the third quarter of 2001 onward and can thus be compared with the reference series from 2001q3 until 2012q4. Figure 8 shows the SECO forecast of annual growth in FTE jobs made in the first and the third quarter of the respective year. For the sake of comparability, the KOF forecasts and the reference series are expressed in terms of annual growth rates, too.

The figure demonstrates that from about 2005 onward the SECO forecasters also started to underestimate the growth in FTE jobs substantially. Overall, even with a synthetic reference series that reflects the real time knowledge of the forecasters, our re-analysis confirms the earlier findings of Graff, Mannino, and Siegenthaler (2012). Job growth forecasts in Switzerland had a substantial

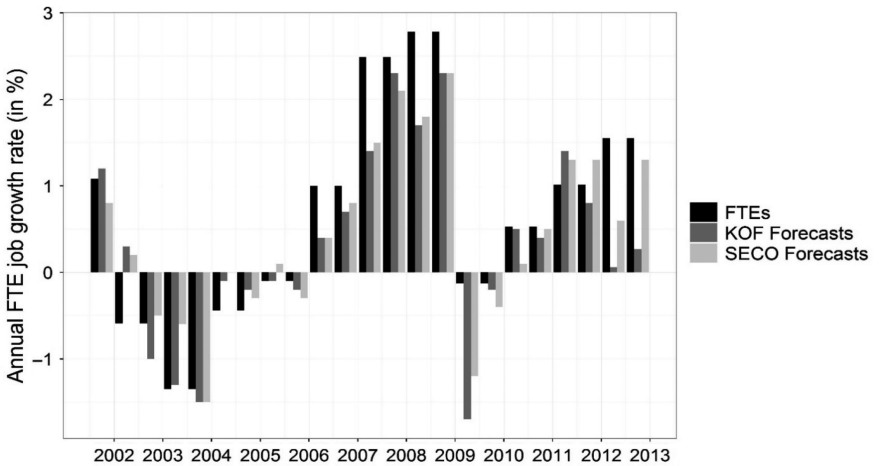

Figure 8: Synthetic reference series and KOF and SECO forecasts of Swiss FTEs job growth (2001–2012).
Source: KOF, own calculations.

negative bias for a considerable period of time. What we now call the Swiss "job miracle" had then escaped the attention of researches.

2.3 The shift towards labor-intensive GDP growth

The systematically negative job growth forecast bias in the forecasts suggests a structural break in the evolution of job growth, which escaped the forecasters' attention. Indeed, in the transition to the new millennium the nature of GDP growth in Switzerland changed. We demonstrate this referring to the standard neoclassical decomposition of the growth of real GDP (Y) into the contributions of real capital (K), labor (measured in total hours worked, L), and total factor productivity (A)

$$\Delta y_t = (1 - s_L)\Delta k_t + s_L \Delta l_t + \Delta a_t, \quad [1]$$

where lowercase letters denote variables expressed in logs, s_L stands for the labor share of total income (Y) and the annual periodicity is indicated by the subscript t. Figure 9 plots the results of this growth accounting decomposition for the periods up to and since 2002, based on calculations provided by the FSO.

The striking message from the decomposition shown in Figure 9 is that while capital accumulation accounted for about half of GDP growth in the

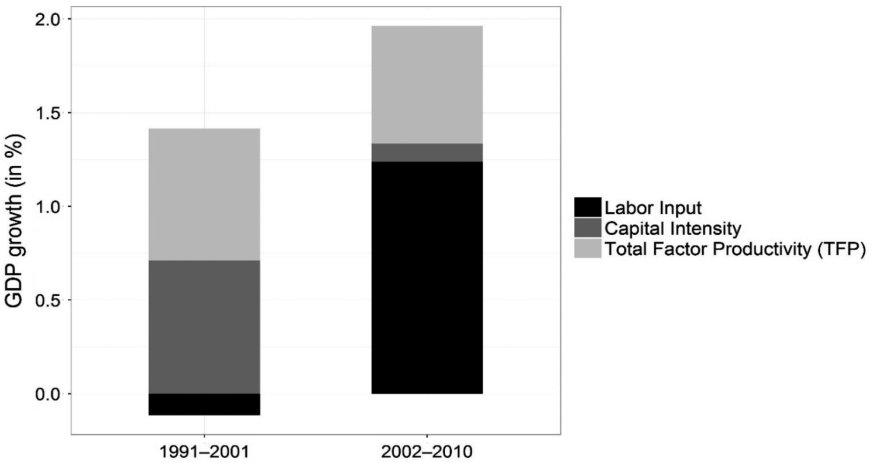

Figure 9: Decomposition of Swiss annual GDP growth (1991–2010).
Source: Swiss Federal Statistical Office.

1990s, its absolute and, in particular, its relative contribution to GDP growth in the second period was clearly smaller. Conversely, while growth in labor input contributed negatively to GDP growth in the 1990s, it was the main driver of GDP growth after 2002.[15] This growth decomposition thus indicates that in from about 1998 to 2002 economic activity in Switzerland became pronouncedly more labor-intensive.[16] In addition to this, comparative growth decompositions by the OECD (2013, 25) show that the labor intensity of Switzerland's GDP growth between 2007 and 2011 is also remarkable in an international perspective.[17]

Did the change in GDP growth also affect the series that are actually used to produce job growth forecasts? To examine this question, we run rolling window regressions of quarterly growth of FTE jobs of the following form:

$$\Delta l_t = \beta_0 + \beta_1 \Delta(y/l)_t + \beta_2 (I/Y)_t + e_t. \quad [2]$$

15 Qualitatively, this finding does not depend on 2002 as the exact year of the sample split. The results are similar for a split in 2000 or even 1998.

16 A more detailed growth decomposition by Rudolf and Zurlinden (2010) for the period 1991 to 2006 shows that the FSO decomposition in fact *underestimates* the contribution of labor, especially in the second period, as it attributes the growth in the quality of labor to TFP growth, which reinforces our argument.

17 Indeed, in the period from 2007 to 2011, Switzerland is the country with by far the largest positive contribution of labor input to GDP growth amongst all 18 OECD countries considered in the publication, while the contribution of capital is only average.

The purpose of the regressions is to examine whether there are changes in the contemporaneous partial correlations between FTE job growth (Δl), growth of average labor productivity ($\Delta(y/l)$, defined as GDP growth per FTE job) and the investment rate (I/Y, i. e. the ratio of machinery, equipment and buildings investment to GDP). If, as indicated by the growth decompositions, the relationships between the growth of employment, productivity and capital did change over time, we should expect the partial correlations between the variables not to be stable in rolling window regressions.

Figures 10 and 11 plot the point estimates of β_1 and β_2, respectively, referring to a rolling window of 30 quarters along with the 95-percent confidence intervals.[18] The horizontal axis shows the respective end date of the rolling window.

The first figure illustrates that, conditional on the investment rate, job growth and average labor productivity growth were negatively associated throughout the 1990s. The coefficient then increases in two relatively clear-cut steps, and becomes positive. The confidence intervals confirm that this is a statistically significant regime transfer: The trade-off between labor productivity

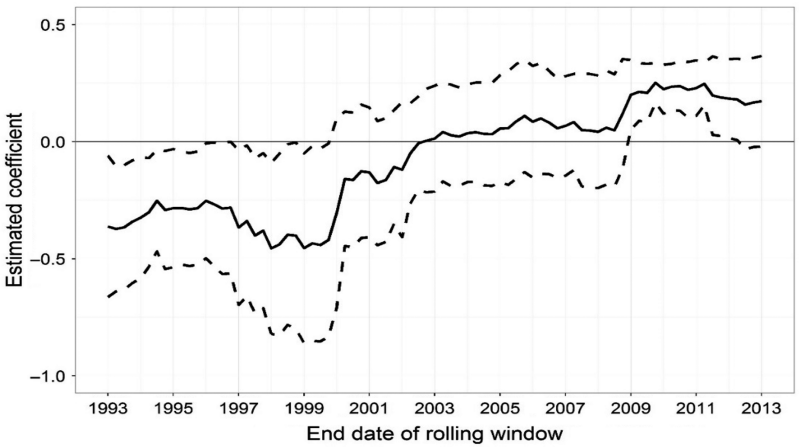

Figure 10: Partial correlation between job and labor productivity growth (1993–2013).

18 The choice of 30 quarters ensures that each window contains at least two phases of the business cycle in the period examined. The results, however, do not depend on this choice in qualitative terms.

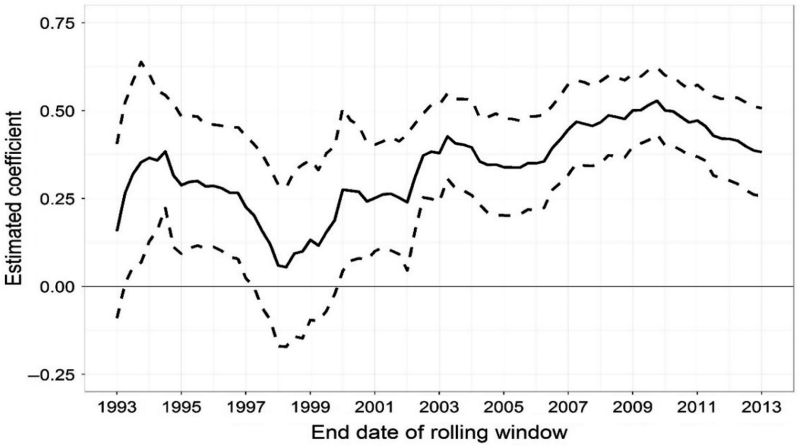

Figure 11: Partial correlation between job growth and the investment rate (1993–2013).

and job growth, which characterized the 1990s, disappeared around 2000.[19] As a result, productivity growth in Switzerland became less labor-saving.[20]

Figure 11 shows that, holding labor productivity growth constant, the investment rate and job growth have become more positively associated. Here, the change of the point estimate over time, although visible, does not amount to a statistically significant structural break. Having said this, the two figures taken together confirm that while the employment forecasts became biased, the Swiss economy underwent a structural change toward more labor intensity.

Considering the results presented in this section, any explanation of the Swiss "job miracle" should be consistent with the following four facts:

1. Solid average wage growth.
2. A trend towards a higher labor intensity and a lower capital-intensity of economic activity.
3. A disappearance of the trade-off between productivity and job growth.
4. A continuous shift in labor demand towards higher skills.

19 A similar pattern emerges if we correlate hours worked and TFP growth using the data underlying Figure 9. The correlation between TFP growth and growth in hours worked is −0.40 from 1991 to 2001. From 2002 to 2010, conversely, the correlation is 0.47.

20 An alternative to the rolling regressions presented above would have been a formal test for a structural break, where the timing is imposed exogenously or detected endogenously. However, the advantage of the rolling regression approach is that it does not impose a binary distinction (before and after a potential break), but allows to follow a potential structural transformation through time, which is more informative.

In the Appendix, we examine the extent to which these four factors account for the forecast errors of KOF's job growth forecasts. The analysis suggests that the identified factors are relevant, as we can explain the bias and more than two thirds of the job growth forecasts errors of KOF. We are thus confident to have identified some key factors and relationships that escaped the attention of the forecasters in real time.

3 Which factors explain the "job miracle"?

This section discusses potential driving forces behind the Swiss "job miracle". Although any factor leading to a dynamic economic development may have contributed to it,[21] we concentrate on factors that explain the "job miracle" *and* that are consistent with the four facts developed in the last section. Most importantly, we focus on factors that can potentially explain the structural change toward more labor- and less capital-intensive economic dynamics. Against this background, there are in our view five potential causes of the "job miracle".

3.1 Catch-up employment growth

A *first* potential driver of the "job miracle" is that employment in the early 2000s arguably still *was catching up* after of a long phase of economic stagnation in Switzerland between 1992 and 1996. In that period, employment had stagnated unprecedentedly long, and substantial restructuring had taken place: Unprofitable firms had gone bankrupt, employment in the industrial sector had decreased strongly, and firms had intensified the implementation of labor saving technologies.[22] One consequence of this restructuring process was that economic activity during the 1990s recession was characterized by capital deepening rather than by an expansion of employment (as evidenced by Figure 9). The second consequence was a substantially increased skill-intensity of labor demand *after* the recession.[23] As soon as the economy began to recover from the

21 Factors, which are therefore omitted from the analysis but may be important in explaining part of the "job miracle" are, among others: the bilateral trade agreements with the EU/EFTA states enacted in 2002, and the dynamic growth in certain important export regions in the relevant years (e. g. Germany or China).

22 See Lampart (2006), Frick and Lampart (2007) and Siegenthaler (2014).

23 See Puhani (2003 and 2005), Bolli and Zurlinden (2009) and Sheldon (2005).

recession around 1997, firms predominantly hired skilled workers, which they had been reluctant to engage during the long stagnation phase.[24] The growth in skilled employment after the long stagnation can explain why aggregate employment growth became more compatible with productivity growth in this period. Moreover, the catch-up of employment after the stagnation phase could still have contributed to the job growth in the early phase of the "job miracle", as the catch-up employment growth was interrupted by an economic stagnation between 2001 and 2003.

3.2 Moderate increases in the price of labor relative to capital

The *second* driver of the "job miracle", until approximately 2007, may have been the evolution of the price of labor relative to the main competing input factor, capital. Although wage restraint does not account for the "job miracle", wages may thus nevertheless have played a role in the first half of the "job miracle". If the price of labor grows weakly relative to the price of capital, firms have an incentive to invest into labor rather than capital. Figure 12 plots the average annual growth rates of the relative factor price[25] and total hours worked for four periods since 1990.

The figure shows a negative relationship between the growth in the relative factor price and total hours worked.[26] The figure also shows a substantial increase in the relative factor price for labor between 1990 and 1997, incentivizing firms to invest into labor-saving technologies and thus potentially depressing growth in hours worked (Lampart, 2006). The converse is observed in the 2000s: A distinctively slower increase of the relative factor price after 1997 reduced the impetus to invest in labor-saving capital and technology, and therefore may have contributed to the "job miracle" in the initial phase.

24 In 1997, university graduates were 1.7 times over-represented among the registered unemployed. In 2000, the fraction had decreased to 0.7; see Frick and Lampart (2007).

25 The relative factor price is computed as the Swiss wage index relative to the deflator of gross private investment in machinery and equipment, taken from the national accounts.

26 Such a negative relationship is predicted by models of directed technical change such as the one presented by Acemoglu (2003). In these models, relative supply and relative prices of factors influence firms' technology adaption and their direction of innovation. Following a similar argument, Pessoa and Van Reenen (2014) explained the recent slowdown in productivity growth in the UK by declining real wages, increased real wage flexibility and increasing costs of capital, incentivizing firms to invest into labor instead of capital.

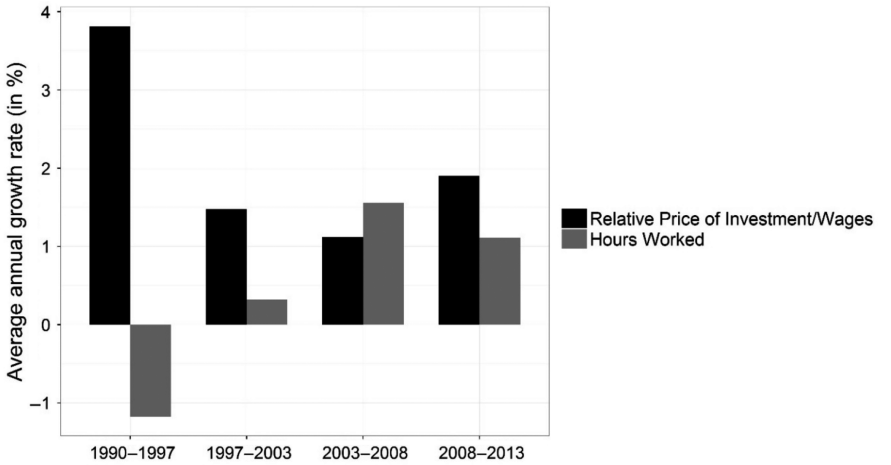

Figure 12: Average annual growth rates of the relative price for labor and hours worked (1990–2013).
Source: Swiss Federal Statistical Office, National Accounts.

3.3 Free movement of persons

The *third* potential driver of the Swiss "job miracle" was the introduction of free movement of persons (FMP) between Switzerland and the EU/EFTA starting in 2002. The reform granted EU workers full and free access to the Swiss labor market through gradually abolishing all previous administrative and quantitative restrictions on immigration. The reform in fact represented a substantial deregulation of the labor market.[27]

The move towards a less restrictive migration regime also arguably alleviated increasingly prevalent skill shortages in the Swiss labor market.[28] A look at the scale and skill composition of persons from EU/EFTA states immigrating into Switzerland after 2002 compared to the periods before supports this argument. Immigration of high-skilled workers surged after 2002 (SECO, BFM, BFS, and BSV, 2014), and while it is unclear whether FMP had a positive effect on the

27 See Rudolf and Zurlinden (2010) and Basten and Siegenthaler (2013).

28 Around 1997, when demand for skilled labor rapidly increased, it became apparent that the supply of skills of Swiss workers had not kept pace with demand (Sheldon, 2005). In the survey of the Job Statistics the share of firms reporting shortages of workers with at least an apprenticeship increased from 15.6 percent in 1995 to 36.1 percent in 2001. The share of firms reporting a shortage of workers with less education than a completed apprenticeship was always below 4 percent.

skill composition of immigrating workers, it did have a positive effect on the *quantity* of skilled workers immigrating to Switzerland.[29] Evidence along these lines is provided by Bolli, Schläpfer, and Siegenthaler (2015) who show that FMP exerted a substantial positive influence on gross and net immigration to Switzerland. Since many immigrants from EU countries were highly skilled and came to take up employment (more than half of all immigrants already have a job when immigrating to Switzerland), the conclusion is a positive effect of the change in the migration regime on employment of skilled workers in Switzerland. Other evidence in favor of the view that FMP lifted skill shortages for Swiss firms comes from studies examining the effects of the post 2002 immigration wave on the labor market situation of residents. These studies generally find that recent immigrants from the EU/EFTA countries had no adverse employment effects on residents. Rather, they support the view that immigrants were complementary to the resident workforce and filled vacancies that might otherwise have remained open.[30]

Along with limiting skill shortages, the introduction of FMP possibly decreased unit labor costs of firms, not only by limiting the increase of wages of skilled workers,[31] but also by reducing recruitment costs, thereby stimulating employment of skilled workers. Moreover, in line with studies examining the effect of immigration on productivity and on the composition of capital investment,[32] the increased availability of adequately skilled workers and the reduction in the costs of employing them may have influenced firms' capital investments and technology. In particular, the introduction of FMP may have reduced firms' incentive to adapt labor-saving technologies or to offshore jobs to foreign workplaces. Through these mechanisms, FMP is part of the explanation why the labor intensity of GDP growth increased after 2002.

3.4 Switzerland's attractiveness as a business location

The *fourth* driver of the Swiss "job miracle" is the fact that Switzerland became increasingly interesting for foreign investors in general and as location for a firm's headquarter or an affiliate in particular. As evidenced by Figure 13,

29 Can, Ramel, and Sheldon (2013) recently made a similar point.

30 See Can, Ramel, and Sheldon (2013), Basten and Siegenthaler (2013), Favre (2011), Favre, Lalive, and Zweimüller (2013) and Müller, Asensio, and Graf (2013).

31 See Favre (2011); Müller, Asensio, and Graf (2013) and Basten and Siegenthaler (2013).

32 See, e. g., Ottaviano, Peri, and Wright (2013); Peri (2012) and Lewis (2011).

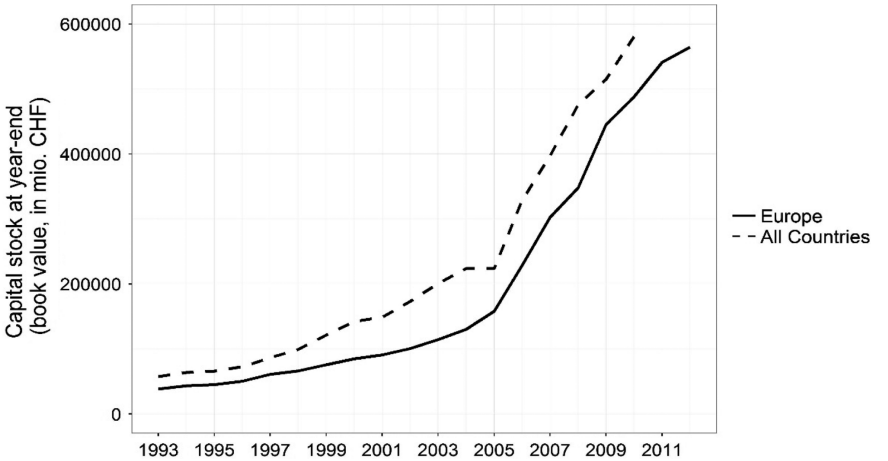

Figure 13: Capital stock of foreign firms in Switzerland (1993–2012).
Source: Swiss National Bank.

drawing on data from the foreign direct investment (FDI) statistics of the Swiss National Bank (SNB), the capital stock of foreign firms in Switzerland began to increase substantially around 2005. The main series to look at is the series for European-owned firms (straight black line) because it is only marginally affected by the extensions of the country coverage in the SNB data, which are present in the overall series (dotted red line). Both series, however, share the same general pattern: Inward FDI to Switzerland displays a marked increase around 2005 and subsequently grows at a higher rate.

The figure raises two questions: What drove the surge in inward FDI around 2005? And did it contribute to the Swiss "job miracle"? The first question is easier to answer than the second. Switzerland's inward FDI is disproportionally driven by the location of research and development (R&D) units, holdings, management, or principal headquarters in the country.[33] In line with the general Swiss "tax haven" strategy, an important reason for the increase in business locations in Switzerland is that national and especially cantonal policies in recent years actively promoted them, mainly by significantly lowering corporate taxes for multinational firms. The introduction of FMP also contributed to making Switzerland more attractive for FDI by increasing the availability of skilled workers.[34]

33 See Ernst & Young (2013).

34 A survey by Swissholdings (2009) among Swiss multinationals finds that "availability of skilled manpower" along with taxes are the most important factors for the location choice for their headquarters.

The employment effects of this inward FDI are harder to estimate because appropriate data to tackle this question are not available. According to data from the SNB, the number of employees in foreign owned firms increased by 143,000 persons from 2003 to 2012, representing a growth of 46 percent. This suggests a substantial contribution of inward FDI to employment growth in Switzerland. At the other end of the scale, a study by Ecoplan (2013) estimates that the relocation of firms to Switzerland in recent years created only about 1,800 domestic FTE jobs annually. While the former statistics overstates the actual employment effects of inward FDI and headquarter locations in Switzerland,[35] the figures cited in the Ecoplan (2013) study are likely to underestimate the effect, as the data insufficiently cover the actual growth of the relocated firms in the years *after* a new settlement.[36] Given the figures presented in this study, it is not improbable to assume that firms relocating to Switzerland from 2008 to 2012 directly created up to 7,200 new full-time equivalent jobs annually.[37] Data from the *Orell Füssli Wirtschaftsinformationen*, a private company analyzing movements in the Swiss commercial registry (*Handelsregister*), point into a similar direction. According to these data, 12,400 new firms with a foreign owner registered in Switzerland in 2013, creating an estimated number of 28,600 new jobs in their first year. These numbers imply that in 2013 40 percent of all new firms in Switzerland are registered by foreigners (increasing from 22 percent in 2000). Data for 2011 show a similar amount of jobs created by firms with a foreign owner: 37,600 new jobs in 11,400 new firms.

35 The job growth reflected by the SNB data may also reflect mergers and acquisitions of Swiss by foreign firms, where the effects on total employment are ambiguous.

36 The numbers in the study are taken from official data of the *Konferenz der Kantonalen Volkswirtschaftsdirektoren* (VDK) about settlements of foreign firms. However, the VDK data only count inflows of firms which came to Switzerland *with support of institutions from the national and cantonal location promotion*. Other firms that relied on the help of banks or consultants are not covered by the survey. Furthermore, the VDK data reflect only jobs created in the *first year* when a firm registers in Switzerland. Data from the cantons of Geneva and Vaud suggest that the number of FTE jobs in newly settled firms increases by factor 3.6 in the following four years (Swissholdings, 2009). On the other hand, the data do not contain *outflows* of previously located firms. Yet, there is limited evidence that such outflows were numerous at the time under consideration. Overall, the data are likely to substantially underestimate the net effect of new business from abroad on employment in Switzerland.

37 The figures are calculated under two assumption. The first is that the number of jobs created by firms not covered by the VDK data is equal to the number of jobs lost because firms left Switzerland in a given year. The second is that the experiences from the cantons of Geneva and Vaud about the job creation in establishments in the four years after settlement can be generalized.

There are two further reasons why it is likely that firm locations and inward FDI are quantitatively important factors in explaining the Swiss "job miracle". The first reason is presented in Figure 14.

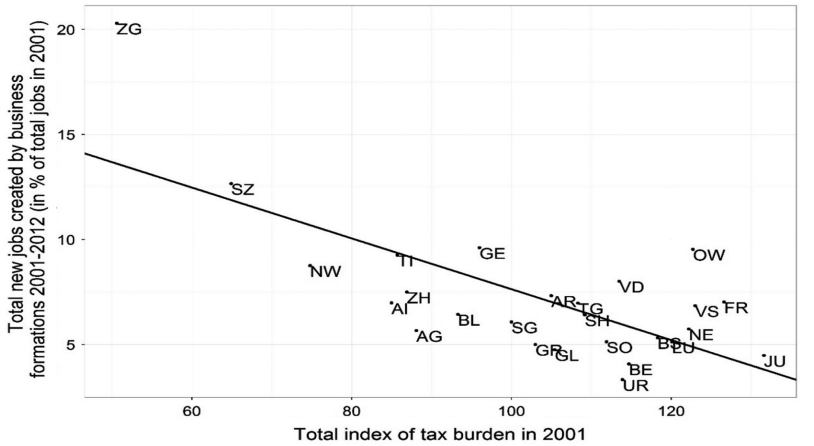

Figure 14: Relationship between the total tax burden in 2001 and jobs created by new business formations (2001–2012).
Source: Swiss Federal Statistical Office and Swiss Federal Tax Administration.

The figure plots an overall index of the tax burden in the main municipality of each Swiss canton in 2001 (as published by the Swiss Federal Tax Administration) against the number of jobs created by new (*ex nihilo*) businesses in the subsequent decade (i. e. 2001–2012), expressed relative to the canton's initial number of jobs. Two noteworthy findings emerge from the figure. First, new firms' job creation was sizable in certain cantons. In the canton of Zug, new firms created jobs equivalent to one fifth of total employment in 2001, despite the fact that the data only count jobs created in the first year of the firms' existence. Second, the tax burden is negatively related to job creation due to new businesses in Switzerland. The substantial reductions in the overall tax rates on labor income and wealth in several cantons since 2000[38] are therefore likely to have spurred cantonal job growth by attracting new firms.

38 Data from the Swiss Federal Tax Administration show that between 1999 and 2012 the tax burden on an accumulated wealth of 1,000,000 Swiss francs was on average lowered by 28 percent in the cantons' main municipalities. Similarly, the tax burden on a labor income of 100,000 Swiss francs was on average decreased by more than 13 percent. In some cantons, the reductions on either income amounted to more than 40 percent.

A further factor making inward FDI an important driver of the Swiss "job miracle" is the indirect effect of attracting new firms on *incumbent* firms. Greenstone, Hornbeck, and Moretti (2010) show that new firms can substantially add to employment in other local firms through spillover effects. Such multiplier effects from inward FDI or business relocations may be due to agglomeration economies, knowledge spillovers (Moretti, 2011), added consumption by immigrating workers and capitalists as well as due to additional effects such as increased local demand for intermediate inputs or infrastructure. Whilst such multiplier effects could be substantial, the literature on multiplier effects of business settlements in Switzerland is not conclusive about their size. For instance, a study by OSEC (2008) estimates that a typical headquarter in Switzerland directly creates 100 jobs in the medium term, and indirectly up to 350 to 400 additional full-time jobs in other firms.[39]

3.5 Multiplier effects of job creation in tradables on local employment

Spillovers on local employment can be particularly sizable when attracting foreign businesses, as argued above. But they also arise when an incumbent firm creates a new job and fills it with a worker from abroad, because the immigrant worker then adds to the demand for goods and services produced or provided locally in sectors such as construction, personal services, retail sales, education, or transportation. This multiplier effect of job growth on local employment is the *fifth* driver of the "job miracle".

Understanding the impact of local multipliers requires to distinguish between employment in sectors producing tradable and non-tradable goods and services. In the initial phase of the Swiss "job miracle", it was the tradable sector that created most new jobs, but this triggered additional employment in non-tradables. Figure 15 illustrates this fact. It shows the cumulative change in employment from 2005 onward, separately for tradable and non-tradable industries. Evidently, the growth of employment in tradable industries substantially exceeded the growth of employment in non-tradable industries in absolute terms in the years 2005 to 2008; but employment in non-tradable industries began to

39 Other studies estimate substantially smaller multipliers. The results in Delbiaggio and Egli (2012) based on four case studies suggest that, abstracting from agglomeration effects, for one job created in a new firm, between 0.01 and 0.88 additional jobs follow through indirect and induced effects in other firms. See also Haskel, Pereira, and Slaughter (2007).

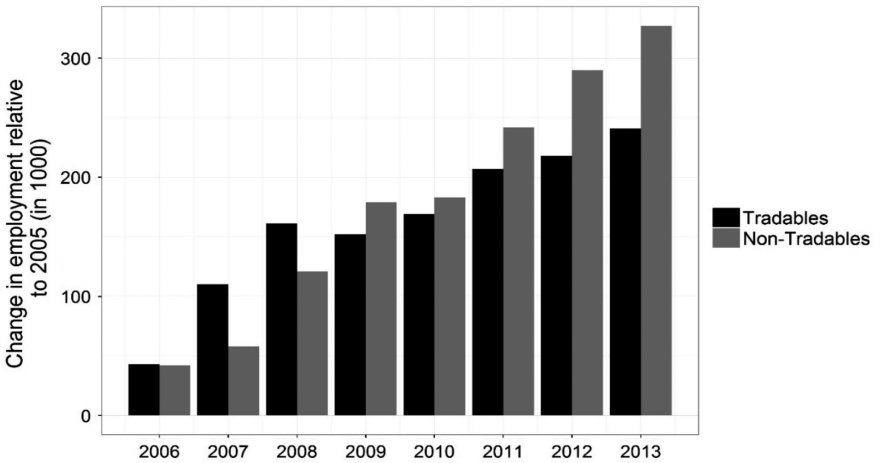

Figure 15: Cumulative change in employment relative to 2005 in the tradable and non-tradables sector (2006–2013).
Source: Swiss Federal Statistical Office, own calculations.

increase substantially in 2007, with a perceivable lag to employment growth in the tradables sector.[40]

In the following, we formally assess whether job growth in the tradables sector caused job growth in the non-tradables sector. To this end, we apply a theoretical and empirical framework developed by Moretti (2010). He analyzed "local multipliers" in US cities and found that every time a new job in a city's tradables sector was created, 1.6 additional jobs were created in this city's non-tradables sector. Following his framework, we study the size of the long-run *cantonal* multiplier in Switzerland by estimating a set of OLS and instrumental variable (IV) regressions relating cantonal employment growth in the non-tradables sectors to employment growth in the tradables sector. The data are taken from the Swiss Wage Structure Surveys 1996, 1998, 2004, and 2010. The regressions take the following form:

40 Evidence in favor of the idea that tradable employment growth led non-tradable employment growth throughout the "job miracle" is also provided by Ecoplan (2013), looking at gross immigration of employees by NOGA sections (NACE, rev. 2) over the period from 2002–2012. It is shown that the manufacturing, information and communication technologies sectors, and in particular professional, scientific and technical activities contributed to the increased immigration in the three years after the recession of 2003. On the other hand, immigration into the sectors construction, wholesale and retail trade, transportation, storage, accommodation and personal services did not surge before 2006.

$$\Delta N_{ct}^{NT} = \alpha + \beta \Delta N_{ct}^{T} + \tau_t + e_{ct}, \quad [3]$$

where ΔN_{ct}^{NT} denotes growth of employment in the non-tradables sector in canton c from period t–1 to t, and ΔN_{ct}^{T} represents the corresponding employment growth in the tradables sector.[41] We refer to two observations per canton, representing employment growth over the seven-year period 1997–2004 and the six-year period 2004–2010.[42] Note that τ_t accounts for period effects equally affecting employment growth in all cantons in the two time periods. Similarly, all time-invariant factors equally affecting cantonal employment growth in both periods are accounted for since the regression is in first differences. As ΔN_{ct}^{N} and ΔN_{ct}^{NT} may both be driven by common omitted third factors, such as changes in regional labor supply or cantonal policies, we instrument tradable job growth using a shift-share instrumental variable (IV). The strategy amounts to exploiting nationwide growth in employment in detailed tradable (two-digit) industries j,[43] and to translate these national *shifts* in industry employment growth into cantonal labor demand shocks by multiplying them with the beginning-of-period *share* of industry j in total tradable employment in the canton c. The idea is that different cantons are differently affected by nationwide industry-specific shocks to tradables, depending on the beginning-of-period industry composition of the tradables sector. The instrument for the growth in tradable employment in canton c is then calculated by summing up the predicted cantonal employment changes across the j industries.[44]

The local multipliers received from estimating the model of equation 3 by OLS and IV are shown in Table 2. Inference is robust to clustering on the cantonal level.

The first column illustrates that a 10 percent increase in tradable employment in a canton increases employment in the non-tradables sector by 5 percent.

41 Similar as Sachs and Shatz (1996), we proxy the tradables sector by all manufacturing industries plus electricity and water supply, as well as certain business services (banking, insurance, information and communication technologies, real estate, R&D, and business-related services). The sector "public administration" is dropped. The tradables sector hence consists of NACE rev. 1.1 industries 10–37, 65–67, 70 and 72–74. The remaining service sector industries comprise the non-tradables sector.

42 We pool the wage structure surveys in 1996 and 1998 in order to have a sufficient number of observations per canton to compute cantonal employment. This is relevant for the strength of the instrument.

43 We have redone the analysis building the instrument on the three-digit level of the industrial classification with very similar results.

44 More formally, for the period 1997–2004, the instrument is $\sum_j w_{jc} \Delta N_{jt}^{T}$, where w_{jc} represents the employment share of industry j in total tradable employment in canton c in 1997, and ΔN_{jt}^{T} is the Swiss-wide growth of employment in detailed tradable industry j.

Table 2: OLS and IV regression estimates of cantonal multipliers on employment in non-tradable industries (1997–2010).

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	FD	FD	FD IV	FD IV	FD IV	FD
					Imm.	Imm.
ΔN^T_{ct}	0.50***	0.42***	0.64***	1.04***	1.96***	
	(0.14)	(0.10)	(0.10)	(0.26)	(0.44)	
ΔI^T_{ct}						0.33***
						(0.09)
ΔR^T_{ct}						0.31
						(0.20)
Observations	52	52	52	52	52	52
R^2	0.23	0.31	0.24	−0.03	0.00	0.42
Period effects	Yes	Yes	Yes	Yes	Yes	Yes
Weights	No	Yes	Yes	No	Yes	Yes
Jobs per trad. job	0.68	0.60	0.90	1.42	0.25	
F stat. first stage			8.39	14.54	8.40	

Note: Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$; Dependent variable in columns 1–4: growth of employment in the tradables sector; dependent variable in columns 5 and 6: growth of employment of recent immigrants in the tradables sector.

Since the number of non-tradable jobs exceeds the number of tradable jobs in Switzerland by factor 1.4 given our sector definition, this estimate implies that an additional job in the tradables sector creates 0.68 additional jobs in the non-tradables sector, as follows from the second-last row of Table 2. This estimate implies a cantonal multiplier lower than the city-level multiplier in the US, but exceeding the regional multiplier in Sweden of around 0.5, as estimated by Moretti and Thulin (2013).

Columns 2–4 illustrate that the finding of a positive cantonal multiplier of tradable employment growth is robust. In the second column, the cantonal observations are weighted according to total (tradable and non-tradable) cantonal employment in t–1 (WLS regression). The estimated cantonal multiplier decreases to 0.6 in this specification, which does not affect the interpretation in qualitative terms.

In the third column, the cantonal multiplier is instrumented using the shift-share instrument. This leads to an increase in the estimated multiplier compared to the corresponding WLS estimate of the second column. The IV estimate of the local multiplier indicates that 0.9 additional non-tradable jobs are created per

new tradable job created in a canton.[45] In the fourth column, we slightly refine the shift-share instrument following a suggestion by Moretti and Thulin (2013).[46] This refined instrument is not strong enough if we weight observations according to cantonal employment. However, it works well if the weights are omitted, probably because down-weighting of small cantons strongly reduces the predictive power of the instrument. The estimated cantonal multiplier further increases in this specification to 1.4, thus reaching levels as high as the city-level multiplier in the US estimated by Moretti (2010).

In Table 3, we show our cantonal multiplier estimates with the *tradable* industries. To this end, we randomly select half of the tradable industries and estimate their local multiplier on the other half of the tradable industries.

Table 3: OLS and IV regression estimates of cantonal multipliers on employment in tradable industries (1997–2010).

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	FD	FD	FD IV	FD IV	FD IV	FD
					Imm.	Imm.
ΔN^T_{ct}	0.12	0.28*	0.46**	0.25	1.66**	
	(0.17)	(0.14)	(0.20)	(0.49)	(0.66)	
ΔI^T_{ct}						0.57*
						(0.32)
ΔR^T_{ct}						−0.31
						(0.69)
Observations	52	52	52	52	51	51
R^2	0.18	0.17	0.14	0.17	−0.02	0.18
Period effects	Yes	Yes	Yes	Yes	Yes	Yes
Weights	No	Yes	Yes	No	Yes	Yes
Jobs per trad. job	0.13	0.26	0.43	0.26	0.11	
F stat. first stage			7.04	5.50	6.84	

Note: Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$; Dependent variable in columns 1–4: growth of employment in the tradables sector; dependent variable in columns 5 and 6: growth of employment of recent immigrants in the tradables sector

45 However, note that the cluster-robust F-statistics of the first stage is 8.4, hence potentially indicating a problem of weak instruments.

46 In particular, in order to purge the influence of the cantonal employment change in an industry on the nationwide employment change in that industry from the instrument, we subtract the industry's cantonal employment change from the nationwide employment change in the industry.

Looking at columns 1–4 of Table 3, the results are generally in line with Moretti (2010) and Moretti and Thulin (2013), indicating that the local multiplier among tradables is relatively low compared to the effect on non-tradables, imprecisely estimated and low in absolute terms too. According to Moretti's model, the reason for this is that additional jobs in the tradables sector increase demand from other local firms in the tradable industry only if value chains are localized or agglomeration economies (i. e. local productivity spillovers) exist. Otherwise, the initial employment increase in tradables puts upward pressure on local wages for workers in the tradables sector, which tends to reduce local tradable employment.

How do the estimated cantonal multipliers relate to the national multiplier? The theoretical framework of Moretti (2010) gives important clues. On the one hand, the locally measured multiplier for tradable job growth on tradable employment is a lower bound for the national multiplier, because the demand effects of an additional job in a specific canton benefits firms in other cantons as well, owing to the national product market of tradables. On the other hand, the local estimate of the multiplier of tradables on non-tradables is likely to constitute an upper bound for the national multiplier, because labor is more mobile at the local than at the national level. In the extreme case of completely inelastic labor supply at the national level, any job created locally would result in a job loss elsewhere.

In Switzerland, however, labor supply at the national level is of course elastic. Firms always recruited workers abroad, and could so more easily due to free movement of persons. This implies that jobs created in the tradables sector could cause immigration by increasing local demand for non-tradables. This mechanism is studied in columns 5 and 6 of Tables 2 and 3. The outcome variable considered in these regressions is growth in cantonal employment of recent *immigrants* in the non-tradables sector (Table 2) or in the tradables sector (Table 3).[47] Both estimations instrument tradable employment growth applying the same IV as in the respective third column. They provide evidence in favor of the notion that tradable job growth fuels immigration.

Columns 5 indicate that 10 jobs created in a canton's tradable industry attract 2.5 immigrants into the canton's non-tradable and slightly more than one immigrant into the canton's tradables sector.

47 Since the data set does not contain a variable indicating where employees were born, the sample is split according to residency permits. Foreign nationals with a C (permanent residency) permit and cross-border commuters are not treated as immigrants. All other permit categories are treated as recent immigrants.

Finally, the last column presents WLS regressions of the same dependent variable, splitting employment growth in the tradables sector into the contributions of recent immigrants (ΔI_{ct}^{T}) and residents (ΔR_{ct}^{T}). The estimate in the sixth column of Table 2 implies that a 10 percent growth of employment of recent immigrants in the tradables sector increases employment of immigrants in the non-tradables sector by 3.3 percent. The estimated elasticity for residents has a similar magnitude, but is not statistically significant. Because an increase by 10 jobs represents a much larger *relative* increase in employment for recent immigrants than for residents, the estimated elasticity indeed implies that 10 additional jobs filled by immigrants in a canton's tradables sector create about 6.6 additional jobs for immigrants in the canton's non-tradables sector, as there are twice as many recent immigrant employees in non-tradable compared to tradable industries. In Table 3, the estimated elasticity for recent immigrants amounts to 0.57, but the simultaneous elasticity for incumbent workers is negative (with a huge standard error), so that the joint effect for the tradable sector is harder to quantify.

Without stressing the findings from our local multiplier regressions and their numerical precision too much, we feel confident to conclude that job creation based on immigration is likely to have triggered further immigration.

3.6 The relevance of immigration

Our approach to study the Swiss "job miracle" allows to highlight the various interactions of recent migration and economic change in Switzerland. At the same time, a quantification of the relative importance of each of the driving forces in accounting for the "job miracle" is not feasible on this basis. In qualitative terms, however, while it is most likely that each of the factors contributed to the "job miracle", we feel confident enough to conclude that catch-up employment growth (driver 1) and the evolution of relative factor prices (driver 2) will mainly have affected the early phase of the "job miracle", explaining a large share of the substantial increase in tradable employment in this period. However, our analysis suggests that as the "job miracle" gained momentum, immigration and changes in immigration policy played a central role in strengthening and reinforcing the growth of hours worked, not the least through the multiplier effects established in the preceding section.

The central role of immigration is also affirmed by the estimations in the Appendix, as we can explain a substantial part of the forecast errors in KOF's employment forecasts by considering variables related to FMP and labor force growth (which in turn is driven by net migration).

Apart from causing and reinforcing the "job miracle", immigration was also its *prerequisite*: Switzerland's resident labor force would not have been sufficiently large to enable employment of an additional 714'000 persons between 2000 and 2013. Indeed, the potential to increase the employment of the incumbent population were quite limited: with an employment rate of persons aged 15–64 amounting to 81.1% and an unemployment rate of 2.7% in 2000, the domestic labor market was practically already stretched to its limits. The "job miracle" would not have taken place without growth of the resident labor force through immigration. The consequence of this is shown in Figure 16. It plots an index of Switzerland's labor force from 1991 to 2013, separately for Swiss nationals, Swiss nationals excluding naturalized foreigners, and foreign nationals including naturalized foreigners. When accounting for naturalizations, virtually the entire increase in the Swiss labor force between 2000 and 2013 – a plus of 858,000 persons (+20.6%) – is accounted for by an increase of the foreign labor force. 75 percent of the growth of the foreign labor force since 1999 can, in turn, be attributed to *net immigration* of foreign nationals into the labor force.

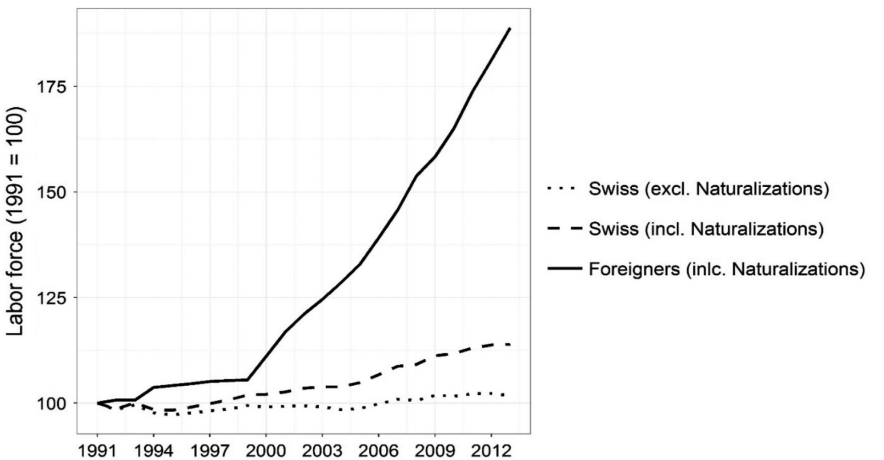

Figure 16: Indices of labor force size by nationality (1991–2013).
Source: Swiss Federal Statistical Office, own calculations.

4 Summary and conclusions

In the last decade total hours worked in Switzerland have grown substantially. This increase went along with a pronounced growth of the number of employees. This job creation not only represents a substantial change from the

preceding decade, in which employment in Switzerland stagnated; it was also high from an international perspective.

Understanding the drivers and results of the Swiss "job miracle" is of utmost relevance, both from a macroeconomic perspective, which opens a wide range of questions, as well as for applied discussions, given that the recent immigration wave into Switzerland is meeting an increasingly politicized and sometimes outright xenophobic discourse. While the majority of newly created jobs were filled with immigrants, the incumbent population may have profited as well, provided the migrants were equipped with skills that are complementary to those of the locals. Although we could not address all consequences of this Swiss "job miracle" in detail, we deliver insights into the underlying economic forces that ultimately determine the range of outcomes that are open to the political process.

In particular, we find that the Swiss "job miracle" has the following characteristics: (1) solid average wage growth, (2) a trend towards a higher labor intensity and a lower capital-intensity of economic activity, (3) an elimination of the previous trade-off between productivity growth and job growth, (4) a continuous shift in labor demand towards higher skills.

We then highlight five factors as the main drivers of the Swiss "job miracle": (1) catch-up employment growth as a result of the long and severe recession of the 1990s, (2) moderate increases in the price of labor relative to capital, (3) the free movement of persons (FMP) between Switzerland and the EU/EFTA starting in 2002, (4) Switzerland's attractiveness as a business location and the resulting attraction of new firms from abroad and (5) multiplier effects of job creation in tradables on local employment.

Although these drivers are discussed separately, they are of course interrelated and may have reinforced each other. For instance, the catch-up employment growth after the recession of the 1990s may have been accelerated and magnified by the introduction of free movement of persons, as the reform aligned labor supply and labor demand, reduced recruitment and unit labor costs for skilled workers, and increased the flexibility of Switzerland's labor market. These effects of FMP, however, did not manifest themselves rapidly in aggregate employment figures, partly because Switzerland's economy stagnated from 2001 to 2003, and partly because the introduction of the free movement regime occurred stepwise. Once immigration gained momentum, however, the local multiplier kicked in and exerted a reinforcing influence.

The story told here is a Swiss one; but its relevance is not restricted to Switzerland. It offers lessons to all economies facing substantial net migration inflows. Maybe the two most important ones from a general perspective are (1) that substantial employment growth is feasible *without* wage restraint and

(2) that when labor markets are tight migration may trigger additional migration due to local demand for non-tradable goods and services.

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Appendix

Do our findings explain the job growth forecast errors?

This appendix examines the extent to which our findings in Sections 2 and 3 help explain why forecasters systematically underestimated job growth in Switzerland. To this end, we run OLS regressions of KOF's FTE job growth *forecast errors* with a horizon of one and two quarters on a number of potential explanatory variables, where $e_{t+h,t}$ represents the forecast error for horizon $t+h$ and X_t a vector of explanatory variables:

$$e_{t+h,t} = \gamma_0 + \gamma_1 X_t + c_t \qquad [4]$$

The regression statistics for the one- and two-quarters-ahead forecasts are shown in Tables A.1 and A.2.

Given our discussion of the recent structural changes of the Swiss economy, we would expect that a major part of the bias in the forecasts will result from an underestimation of the labor intensity of GDP growth, and not from an underestimation of GDP growth itself. In the first column of Table A.1, we thus regress the forecast errors in the growth rate of FTE jobs on the forecast errors of the GDP growth rate. Not surprisingly, the estimated coefficients show that there is a positive correlation between the GDP and the employment forecast errors, i. e. KOF underestimated job growth whenever it underestimated GDP growth and vice versa. More importantly, however, accounting for the GDP forecast errors does not eliminate the downward bias in the forecast of FTE job growth, as can be seen from the statistically significantly positive regression constant. Job growth was thus consistently underestimated for any GDP growth rate.

Table A.1: Determinants of the one-quarter-ahead forecast errors (OLS regressions for $h = 1$).

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	OLS	OLS	OLS
ΔGDP, $t + 1$ forecast error	0.32**	0.30**	0.29**	0.27**	0.29**	0.26**
	(0.10)	(0.07)	(0.06)	(0.08)	(0.07)	(0.07)
Free movement of persons (stepwise)		0.38**	0.43**	0.42**	0.32*	0.52**
		(0.10)	(0.11)	(0.09)	(0.17)	(0.14)
ΔPot. labor force, $t+1$ forecast error			1.39			1.45**
			(0.83)			(0.58)
ΔProductivity, $t+1$ forecast				0.49**		0.52**
				(0.17)		(0.16)
Investment/GDP, $t+1$ forecast					−0.03	0.02
					(0.07)	(0.06)
Constant	0.18**	−0.07	−0.14	−0.09	−0.03	−0.19*
	(0.05)	(0.07)	(0.09)	(0.07)	(0.13)	(0.10)
Observations	40	40	40	40	40	40
R^2	0.29	0.46	0.51	0.59	0.46	0.65

Note: Robust standard errors in parentheses; ** $p < 0.05$, * $p < 0.10$; Dependent variable: one quarter ahead forecast error in quarter-on-quarter growth of FTE jobs.

Table A.2: Determinants of the two-quarters-ahead forecast errors (OLS regressions for $h = 2$).

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	OLS	OLS	OLS
ΔGDP, $t + 2$ forecast error	0.27**	0.26**	0.22**	0.21**	0.22**	0.18**
	(0.09)	(0.08)	(0.06)	(0.05)	(0.06)	(0.04)
Free movement of persons (stepwise)		0.39**	0.48**	0.30**	0.20	0.31**
		(0.14)	(0.15)	(0.12)	(0.20)	(0.14)
ΔPot. labor force, $t+2$ forecast error			2.12**			1.56**
			(0.97)			(0.46)
ΔProductivity, $t + 2$ forecast				0.90**		0.83**
				(0.17)		(0.15)
Investment/GDP, $t + 2$ forecast					−0.08	−0.03
					(0.11)	(0.07)
Constant	0.20**	−0.07	−0.20*	−0.00	0.06	−0.06
	(0.07)	(0.10)	(0.11)	(0.10)	(0.17)	(0.11)
Observations	39	39	39	39	39	39
R^2	0.17	0.29	0.40	0.63	0.31	0.68

Note: Robust standard errors in parentheses; ** $p < 0.05$, * $p < 0.10$; Dependent variable: two quarters ahead forecast error in quarter-on-quarter growth of FTE jobs.

Moreover, if the introduction of free movement of persons with the EU/EFTA was a major cause of structural change, the emergence of the forecast bias should coincide with the introduction of FMP. Column 2 confirms this hypothesis. In particular, we add a regressor that is constructed to mirror the three steps in the gradual introduction of FMP with the EU-15/EFTA countries.[48] This variable turns out to be statistically significant, and it completely eliminates the bias in the job growth forecast.

Column 3 examines the related hypothesis that the forecasters underestimated population growth and accordingly also employment growth. We examine this hypothesis by comparing the factual with the forecasted growth rates of *the potential labor force*. This is the KOF forecast of the part of the working age population (i. e. the Swiss population aged between 20 and 64 years) which is willing to participate in the labor market. Indeed, KOF repeatedly underestimated population and, along with this, potential labor force growth.[49] The resulting forecast errors are added as an explanatory variable. Column 3 shows that this regressor has the expected positive relationship to the forecast errors of job growth: The larger the underestimation of population growth, the larger the job growth forecast errors.

Now recall the evidence presented in Figure 10, which implies that productivity and employment growth have become positively associated in the course of the 2000s, whilst they were negatively associated before. The structural break would imply that while forecasters relied on a long-standing negative trade-off between productivity and job growth, this trade-off was actually not present anymore. If this were the case, one could use KOF's *actual* labor productivity growth *forecast* to explain the FTE job growth *forecast error*. Column 4 shows that there is indeed a strong positive association between the KOF forecasts of average labor productivity growth and the forecast errors relating to the growth of jobs. This implies that whenever predicted labor productivity growth was high, KOF's underestimation of job growth ended up to be particularly sizable.

48 The variable is coded as zero from the beginning of the time series. It takes the value of 1/3 in June 2002, when a limited free movement regime became effective. In mid-2004, the value increases to 2/3, since several limitations to free movement were eliminated. With all barriers to immigration fully lifted in June 2007, the value is set to 1.

49 Forecasts of the quarter-on-quarter growth rate of this measure lay approximately 15 percent below the *de facto* growth rate over the whole sample. Since the growth of the Swiss residents working age population can be quite accurately predicted by considering age cohort effects, a bias in the forecast errors of this variable must be mostly attributed to wrong assessments of the net migration of workers.

Accordingly, the forecasters failed to perceive the structural change in the association between productivity and job growth.[50]

Now recall also that Figure 11 suggests that the association between investment and job growth became more positive. Following the same reasoning as with the labor productivity forecasts, we can thus use actual KOF forecasts of the investment rate in order to explain the forecast error for job growth. Yet, according to column 5 the investment rate forecasts do not explain the job growth forecast errors beyond what already is accounted for by the GDP forecast errors.

Finally, Column 6 reports the regression with all explanatory variables added simultaneously. The important message from this regression is that we can explain most of the bias as well as roughly two thirds of the variation in the one step ahead forecast errors of job growth in the period under examination by introducing the variables presented.

Moreover, the results shown in Table A.2, which replicates the regressions reported in Table A.1 for a forecast horizon of two quarters are similar to this in Table A.1, or even more in favor of our explanations for the forecast errors. We thus have identified some key factors and relationships that escaped the attention of the forecasters in real time.

50 Since the regression intercept should represent the mean forecasting error, we normalize forecasted productivity growth to have a mean of zero over the whole sample period before running the regression shown in Column 5. The same applies to the investment rate.