P Á L Y A S Ú G Ó - F Ü Z E T E K
Munkaerő-piaci előrejelzések készítése, szerkezetváltási folyamatok előrejelzése

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Long-Term Industrial Labor Demand Forecast

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1. Introduction

The aim of this study is to forecast the structure of employment by industries of the Hungarian economy in long term (10 years).[1] The need for such analysis is self-evident as the proportion of employed persons in an economy is an important indicator of its efficiency: if only few people work, human resources will get lost for the country. In addition, many economic and social policies are strongly affected by the number of employed as a large part of taxes – both originating from labor activity and consumption – are contingent upon the labor market activity of the population. The state budget is also more easily in equilibrium if fewer subsidies are spent on unemployment benefits and support for the inactive. The government's stated goal is also to enlarge the traditionally low employment rate of Hungary and showing how employment will evolve can be useful information for such attempts.

Knowledge about the structure of employment across economic branches is useful for showing which industries are likely to grow their employment needs and which will shrink if the current conditions are maintained in the economy. Therefore, such analysis can provide a baseline for policy makers by giving them the knowledge of which industries should be induced to grow and which are likely to shrink anyway; diverting funds for their subsidies and organizational efforts to sustain them are probably not the best way of spending scarce public resources.

Given the time span of the forecast (10 years) we rely on a macroeconomic model developed in Vincze (2011) in Subproject No. 1 of this TÁMOP project. The macro model provides the total employment in the future and the output realizations as well. To be consistent with these results, we do not forecast directly the levels of sectoral employment. Instead, we estimate and predict how the industrial structure of employment, measured by employment shares, will evolve in time. Having estimated the structure of employment across economic activities, we transform them into numbers of workers with the help of the predictions of the total employment.

The industry-level data used in the forecasting start in 1992, right after the fall of the socialist system and end in 2010, when the world economy had already been in crisis for two years. In our baseline analysis we study the dependence of the industrial distribution of employment on the share of industrial production in total output and a time trend. Later we also add total employment and total output to the explanatory variables to take into account possible business cycle effects and also add industrial average wages to control for employment costs. We consider these estimations – especially those which

[1] The 10 aggregated industries for which the structure of employment is forecasted are listed at the beginning of Section 2 below.

include wages – as less accurate as wages are clearly simultaneously determined with employment at the industry level.[2]

Our forecasting strategy is the following. First we estimate a wide variety of specifications with the data truncated in 2003. With the help of the estimated coefficients and the realized output in the economy we fit curves and "forecast" the 2008 distribution of employment across the 10 industrial sectors of the economy. We chose 2008 rather than the last year available as this is the last year of the time series which is not affected (or is affected only to a small extent) by the global economic crisis. Then we run a formal test to check which estimation provide the most accurate forecasts and we use the chosen specification to perform the forecast. This methodology therefore assumes that the basic relation between output and employment at the industrial level changes only according to the time trend (or in a quadratic way in some equations).[3]

One major complication of the forecast is the decision how to treat the three industries which are predominantly composed of public sector workers (public administration, education and health). As the employment of these industries is affected not by market forces but by the policy decisions of the government, we do not treat them together with the other economic sectors. Instead, we discuss the difficulties of measuring output in the public sector dominated industries and show that the relation between labor and output in these sectors is rather weak. In the forecasting we use the employment predictions originating from the macro model.

The structure of the paper is as follows. In the next section we describe the data and provide basic descriptive statistics of the Hungarian economy at the level of the 10 industries we are going to forecast employment for. Then we describe the estimation methodology for corporate employment and provide the results, followed by the pseudo forecasts of the 2008 employment shares. Having chosen the empirical model that fits best our data, we perform the forecasts under alternative assumptions about the future output demand for the industries. In section 5 we add business cycle effects and wages to the estimation equations. This is followed by a discussion of how public sector employment in education and health care depends on the output of these sectors. In the next section we provided the employment shares for the corporate and public sectors together and transfer them into quantities. The last section concludes.

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[2] As we show int the results section, the results are robust to the introduction of new variables.

[3] We do not run vector autoregressive type models for two reasons. First, the time series are rather short which make such empirical models very sensitive and second, the time span of the forecast – 5 years – is too long to perform the forecast without putting any outside structure on the data (which we do as the industrial output and aggregate employment forecasts originate from a formal macroeconomic model).

2. Data construction and descriptive statistics

The industrial disaggregation for which the forecasts are made is the following (the NACE 1.1 categories are in parenthesis and we underline the industry name which is used in the text below for simplicity):

- Agriculture, horticulture, fishery (A, B)
- Mining, manufacturing, and energy (C, D, E)
- Construction (F)
- Trade, repair, accommodation, catering (G, H)
- Transportation, storage, post and telecom (I)
- Financial intermediation, real estate and other business services (J, K)
- Public administration, defense, compulsory social security (L)
- Education (M)
- Health services (N)
- Community, social, personal services, activities of households, extra territorial organizations (O, P, Q)

Aggregate employment, output and average wages were drawn from different yearbooks of the Hungarian Statistical Agency (HSA, 1992-2010).[4] The employment figures given in the Yearbooks are based on various waves of the Hungarian Labor Force Survey (LFS). According to the employment definition of the International Labour Organization (ILO) used in these surveys, everybody is considered employed who worked at least one hour for pay or in kind benefit at the reference week. Part-time workers therefore are treated equally with full time workers. Another aspect of the LFS-types survey data is that they are done through personal interviews and everybody who reports to have been worked in the reference week is counted as employed, even if the employment relationship is unofficial. Therefore, workers without official employment contracts are counted as employed as long as they report so and thus the variation of the grey economy across sectors industry does not bias the statistics, or it biases to a lower extent than information gathered from tax authorities or the firms, where workers without contracts are not included.

After the introduction of the new industrial classification in 2008, transports gained about 60 thousand employees, financial intermediation lost about 35 thousand and community services lost 24 thousand (in the case of the other sectors the differences are negligible). The HSA reported employment according to both the old and new classification in 2008, so we solved this problem by rescaling the employment figures

[4] We made huge efforts to obtain industry level data for earlier years in order to increase the length of the time series, but such data are not available because the definitions of sectors are not consistent before and after 1992.

for 2009 and 2010 with the proportional difference between the two figures reported for 2008. Output figures are reported according to the old classification throughout the time series so there is no need for rescaling. In order to reflect producer price changes and differences in price changes across industries, output was deflated with industry-level implicit price deflators to its levels of 2009, the last year with information available.

Wages in the HSA yearbooks are drawn from a firm survey which includes firms with at least 5 employees, and are computed only for those workers who work full time. Thus, the wage figures used in the analysis do not reflect the wages of workers in small firms, part-time employees and self-employed, nor the unofficial earnings of workers without a labor contract. The level of aggregation is the letter-level of the NACE classification. We constructed the wages for the 10 sectors by computing the average across the letter-level sectors, weighted by the number of workers in each sector, and deflated them with the consumer price index taking as the base year 2010.

The evolution of aggregate employment, output and wages as well as average labor productivity (defined as the ratio between output and employment) are shown in *Figure 1* for the period of 1992 to 2010 and it is normalized to the values in 1992, the first year we use in the analysis (the corresponding numbers are provided in *Table A1* in the Appendix). Employment decline continuously in the first 4 years of the analysis and started to recover only in 1998.[5] After this year is slowly recovered by about 7 percentage points and remained on that level until the global economic crisis unfolded. As a consequence of the crisis, employment fell by three percentage points in 2009 and remained at this level the following year as well.

Aggregate output had a very different pattern during the same period. After a fall starting in 1989 (not shown on the graph) it started to recover already in 1993 and it did not stop growing until 2008 – this year it was twice as high in real terms than in 1992. The crisis put an end to output growth. Output fell in 2009 by more than 10 percent in a single year but it already started to recover in 2010, the last year of the time series.

These numbers suggest that aggregate labor productivity (defined as the ratio between real output and employment) increased during the period studied. Indeed, the figure shows labor productivity steadily increased after 1992, its level being more than two times higher in 2008. The crisis, however, dropped output faster than employment which resulted in an almost 10 percent drop in productivity but also a partial recovery the following year.

Average wages stagnated for a long time and started to grow only after 1996. Although the time path varied, their growth was stopped only in the crisis, when they were already 50 percent higher than in 1992. In the first year of the crisis wages fell by about 5 percentage points and in the second year they continued to decrease by about the same proportion.

[5] This decline was a continuation of a the employment fall starting already in 1989.

How do the movements of these variables look at a more disaggregated level? Have all the economic sectors experience the same changes in employment or output, or the aggregate numbers mask some individual patterns? Employment changes of the 10 economic sectors are shown in *Figure 2* which documents significant diversity at the industrial level.[6] During the 19 years the largest decline in employment took place in agriculture, which lost more than 60 percent of its workers. Other sectors which experienced large declines in employment are manufacturing and community services where the decline was about one-quarter, and transportation with a decline of 18 percent. In the other sectors employment grew during the studied period. This growth was modest in the public sectors (4-8 percent relative to 1992), but some corporate sectors experienced large increases in their levels of employment. The overall growth rate in trade, constructions and financial intermediation is 17, 28 and 90 percent.

The global crisis had a diversified effect on sectors. Only the industries dominated by the public sector increased their employment while in the corporate sectors the number of workers fell with various paces. Large losses took place in constructions, manufacturing, trade, and other services, while employment in the other sectors did not fall much.

Industry-level real output (presented in *Figure 3*) have very different pattern relative to employment.[7] Relative to 1992, output grew in all sectors. The smallest growth is documented in agriculture which grew by only 4 percent by 2008, and the largest in manufacturing and financial intermediation (134 and 111 percent, respectively, during the same period). The divergent patterns of employment and output growth rates produced large increases in labor productivity not only at the country level but for the individual industries as well, as shown in *Figure 4*. Output per worker increased in all sectors but the growth rates are scattered. In constructions labor productivity increased by only 3 percent and in financial intermediation and trade by 12-18 percent. The other sectors experienced large labor productivity increases which are situated between 115-255 percent (the largest figure reflects labor productivity increase in manufacturing).

Sector-level average wages have mostly declined during the nineties (see *Figure 5*). In some sectors (agriculture, manufacturing, finance, transportation) they recovered fairly quickly but in other sectors they started to grow much later. This is especially true in education and health. By the end of the period studied wages in all sectors increased in real terms.[8] The smallest wage increases can be found in health and the largest in manufacturing. The crisis did stop the growth of wages but the declines are not very large and typical in the public sector. This can be attributed to the abolishment of the

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[6] The numbers corresponding to *Figures 2-5* are shown in Appendix *Tables A2-A5*.

[7] We show these figures only for the corporate sectors as in the public sectors the lack of reliable prices does not allow to compute output.

[8] In *Figure 5* (and *Table A5*) we deflate wages with CPI, but in *Table A6* we also present the number deflated by sectoral implicit deflators to show how wages changed in terms of the output revenues in the sector.

13th salary which was given before to all public sector employees. The largest decline was measured in the health sector where wages fell by a large proportion between 2009 and 2010.[9] Therefore, the long term trends in the data were abruptly stopped by the crisis. Employment and real output fell, but wages, did not decrease (at least not to a great extent), showing that the adjustment of firms was rather done on the extensive side by laying-off workers rather than decreasing their wages (Köllő, 2011).

The industrial composition of Hungarian employment for three distinct years is presented in *Table 1.* The first point in time shown is 1992, the earliest year with employment information on all economic sectors. By 2000 the data reflect vast restructuring. Agriculture, which had the third largest share in employment of 11 percent at the beginning of the nineties lost a huge amount of people and had a share of only 7 percent 8 years later. Its share further decreased and by 2010 as it lost an additional 2 percent. Manufacturing also lost from its importance in employment; from a share of 30 percent it went down to 27 by the middle of the period and its share further decreased to 23 percent by 2010. Community services employment also lost its share so some extent. The clear winners – at least by their employment share – are financial intermediation as this sector increased its share from a mere 5 to 11 percent. Trade and constructions also increased their share by 3 and 2 percent, respectively. Each public sector increased its employment by 1 percent.

These numbers reflect the major changes the Hungarian economy underwent during the last 19 years. As a result, employment fell and output grew in most industries resulting in large increases in labor productivity. Labor could not recover to its early transition levels ever since, but real wages did and they exceed their early transition levels in each industry. In the next section we discuss how we establish the relation between output, time and employment, the main ingredients for the forecasting.

[9] One reason behind this large fall may be compositional changes in employment in the health industry.

3. Estimation and forecasting methodology for corporate sectors

3.1. Baseline forecast

This section presents the forecasting methodology used for the 7 corporate sectors. We exclude the three industries dominated by the public sector (public administration, education and health) as the employment setting mechanism in these sectors is arguably different to that used in corporations: while decision makers in firms set the level of employment based partially or totally on the current possibilities and future prospects of the firms, the level of public sector employment is affected by political motivations and it is partially or totally the outcome of political decision making.

As we discussed in the introduction, we do not attempt to directly forecast the level of employment because the long time span for forecast sheds doubt on the usefulness of such an exercise. Rather, we rely on Vincze (2011), who develops a structural macroeconomic model to forecast medium and long-term employment for the whole economy and sector-specific output levels. In this baseline forecast we use the model which assumes that the export demand for the Hungarian output is growing by a yearly 7 percent.[10]

With standard econometric methods we set the relation between several variables and the industry-level employment share and with the help of the macroeconomic forecasts we predict the structure of employment in long term. The first and simplest estimation equation is the following:

$$EMPSH_t = \alpha_0 + \alpha_1 OUTSH_t + \alpha_2 TREND + \varepsilon, \qquad (1)$$

where *EMPSH* and *OUTSH* are the share of industrial employment and output in total employment and output in Hungary, *TREND* is a time trend, ε is a random noise and we run this equation for each industry separately.[11]

Next we augment Equation (1) with several variables. First we add a quadratic trend to allow more flexibility for employment adjustments:

[10] In the second part of this section we test how the outcome of the forecast changes under different assumptions regarding export demand.

[11] In the baseline model we do not use wages as a predictor of the employment share because wages are endogenous, especially in industry level aggregation: not only wages determine employment, but the level of employment has an effect on the equilibrium level of wages as well. Nevertheless, we perform robustness checks below where we include wages in the estimation equation.

$$EMPSH_t = \beta_0 + \beta_1 OUTSH_t + \beta_2 TREND + \beta_3 TREND^2 + \upsilon. \qquad (2)$$

We also include the lagged value of output share to allow for the possibility that firms set their employment level looking at past realizations of output:

$$EMPSH_t = \gamma_0 + \gamma_1 OUTSH_t + \gamma_2 OUTSH_{t-1} + \gamma_3 TREND + \varsigma. \qquad (3)$$

Finally, we include both a quadratic trend and the lagged output share:

$$EMPSH_t = \delta_0 + \delta_1 OUTSH_t + \delta_2 OUTSH_{t-1} + \delta_3 TREND + \delta_4 TREND^2 + \chi. \qquad (4)$$

With the help of the estimated coefficients we first perform pseudo-forecasts. Using the data through 2003 we "forecast" the employment distribution across economics sectors in 2008. We do this to perform tests which indicate which estimation method provides the best fit relative to the realized employment share and thus we can choose which estimation equation to use for the forecast.[12] The test used is the mean absolute percentage error (MAPE) test, which measures the proportional deviation of the fitted line from the realized values:

$$M = \frac{1}{n}\sum_{t=1}^{n}\left|\frac{R_t - F_t}{A_t}\right|$$

In the equation above R_t is the realized, F_t the forecasted value and n equals the number of years over which we performed the forecast. In our case n = 5 (the years between 2004 and 2008). It is worth mentioning that by using this pseudo-forecast to choose the estimating equation for the actual forecasting, we implicitly assume that the structure of the economy will be identical in the future with that of the past. This is obviously a strong assumption, but we cannot do much about it.

Having determined which equation to use, we can perform the forecast with the help of the industrial output values which come out from the structural model. As a final step, we transform the industrial employment shares into numbers of workers.

There is one difference in the equations used for the pseudo and the actual forecast. We add a crisis dummy (equal to 1 in 2009 and 2010) to equations (1) – (4) to allow for structural break in the years of the global crisis. We also rescale the forecasted employment shares to add up to 1 as nothing guarantees in our method that the industrial employment shares sum up to 1. This manipulation does not change the results as the sum of forecasted employment shares is usually very close to 1.

[12] We also ran specifications with output in levels instead of shares, but the test always favored the ones presented here.

3.2. Including business cycle and wage effects in the forecast

Not only industry dynamics, but also total growth of the economy may alter the demand for labor of corporations. In a booming economy firms may see their perspectives more optimistically, even if the share of their industry is shrinking, for example. Moreover, in a growing economy the level of sector-level output is more likely to grow even if its share is shrinking. Changes in total employment may also alter firms' decision about their own targeted output and input usage. Growing total employment may boost internal consumption and business related service orders. Increasing total employment, however, may also increase wages if the labor supply curve is not totally elastic which increase the labor costs of new hiring and thus have adverse effects on employment. To test for such effects, we include in the estimation equation the log of total output and redo the analysis.

Wages are the other key ingredient of a labor demand model. Wages are the main cost factor of labor so they obviously have an effect demand. Its importance notwithstanding, one should also be aware that wages are highly endogenous in a labor demand equation. Not only wages determine the quantity of labor demanded, but the quantity – through the equilibrium setting mechanism of an industry – also determine wages. If the data are not at the firm but at the industry level, this endogeneity problem is exacerbated. From the point of view of the forecast, if the nature of the endogeneity does not change over time, the results would not be biased. As we cannot know whether this is true or not, we did not include wages in the baseline forecasting, but we do a robustness check when we take its effects into account. Our estimation strategy is the following: we compute the following expression:

$$DWAGE = \frac{\overline{WAGE}_{IND} - \overline{WAGE}_{H}}{\overline{WAGE}_{H}}$$

which represents the proportional deviation of the industry level average wage from the economy-level average wage. As a next step, we augment the equation chosen from (1) – (4) with this variable and perform the estimation and the forecast. For this to be accomplished, we need a forecast of sectoral wages, which is not given in the macro model. We assume that the future growth rate of wages is the same as the realized average growth rate before the crisis. To compute this we use the years 2006, 2007, and 2008.

4. Forecasting results for corporate employment

4.1. Finding the equation with the best fit

Table 2.1-2.4 present the estimation results for the regressions when the time series are used only through 2003, and the aim is to choose the equation which the best fit. The tables are numbered in the same way as the estimation equations in the text. The effect of an increase in the industry's output share is almost always positive on employment share (the main outlier is the construction industry when this coefficient is always negative). In agriculture and industry the share of employment decreases by time as the estimated coefficient on the trend variable is negative in all four specifications. The resulting pseudo forecasts, as well as the actual realizations of the employment shares are presented in *Figures 6.1-6.4* for the four different specifications, and the visual inspection of the charts reveals that equations (1) and (3) (with only a linear trend specification, with and without lagged output share) do a much better job in predicting the sector's employment share in 2008 than the other two specifications, when a quadratic trend is also included.[13] The MAPE test results, presented in *Table 3,* formalize this result. For each sector equation (3) always outperforms equations (2) and (4) while equation (1) produces similar (but mostly somewhat larger) test results. The average the test scores across all industries (shown in the last row of the table) also indicate that the smallest proportional deviation is produced by equation (3). In the following we use this specification and estimate the correlation between the sectors' employment share, output share and its lagged value and a trend.

4.2. Forecast of the composition of the corporate employment: baseline estimation

Table 4 shows the results of equation (3) for the whole time series (1992-2010). The trend in employment share is negative in agriculture, manufacturing, transportation and community services and it is positive in construction, trade and financial services. An increase in the share of output has positive effects in 5 industries, the exceptions being trade and community services. The lagged share of output, is negative only in one trade and finance while it is large and positive in all other industries. Using these coefficients we perform the forecast, its outcome being presented in *Figure 7.* The figure

[13] The estimated coefficient of the quadratic trend is never significant except for financial intermediation.

shows which industries gain and which lose employment in the future. The four sectors which employment shares shrink by more than 1 percent are agriculture, manufacturing while transportation and community services decrease their employment share by around 1 percent. Construction, trade and financial services are likely to increase their employment share in the future.

The exact employment shares are presented in *Table 5* for the present (2010) and in long term (2020).[14] Our forecasts do not predict large changes in the economy, but some trends are clearly visible. Agriculture is constantly losing its importance despite that its share in overall employment was only 6 percent in 2010. If the trend of the past years continues, this already small share will decrease to a mere 1.8 percent in a decade. The other main loser, at least in terms of employment shares is manufacturing. Almost one-third of all Hungarian workers are employed in these branches of the economy, but according to the forecasts the share of industry declines to 25 percent in a 10 year time. Transportation will also lose 2 percentage points from the total share of employment. The employment of construction industry is likely to grow by 4 percentage points in long term while both trade and financial services will increase their share by more than 4 percentage points. Finally, community services will experience a small drop (of less than one percentage point) or its employment share according to this forecasting model.

What is the likely reason for these changes in the industrial structure? At least two mechanisms can be pointed out. First, changes in product demand of the industries will bring about changes in labor demand. Second, if labor productivity increases in some of these economic sectors – which we showed to have been happening in the past 20 years – fewer workers will be able to produce the same output which will cause shrinking employment shares of the sectors, ceteris paribus. To let the reader gauge the importance of the scale and productivity effects, we present in the lower panel of *Table 5* the predicted output shares for the 7 industrial sectors. Despite the shrinking of the share of agriculture in employment, the share of agricultural output falls by only 1 percentage point, showing that the main reason for the employment loss is a productivity increase in agriculture. Manufacturing has the most dramatic pattern in this respect as the drop in employment share of 5 percentage points is accompanied by an increase in output share of the same proportion.

To further illustrate how the structure of the economy will change if our predictions are correct, we create a figure which has on its axes the change in output share and change in employment share in long term. *Figure 8* shows the results. Only manufacturing increases its share in output while the other 6 sectors decrease it to some extent.[15] The large output share growth of manufacturing is accompanied by the largest

[14] Besides the predictions, the table contains information on the 95th percent confidence intervals as well.

[15] Of course this does not mean that all the industries shrink as the total output is likely to increase.

employment share decline while trade and finance increase the most their employment share despite the relatively large output share declines.

4.3. Optimistic and pessimistic scenarios

Our forecasting is based on a structural macro model which made several assumptions to predict the structure of output and total employment in Hungary. Among the most important ingredients of the model is the assumption about how will export evolve in the future. To test how alternative assumptions change the forecasts, the macro model was run with changed assumptions about international demand for Hungarian products. This was set at 3 percentage points higher (lower) than in the baseline to have forecasts for an optimistic (pessimistic) scenario (in the baseline model the export demand growth was set to 7 percent annually). The size of exports has a direct demand effect on industrial goods and also has secondary effects on other sectors' output through the increased input needs of industry and the higher level of incomes in the country. Using these output forecasts we prepared the new employment share predictions. *Figure 9* and *Table 6* show the results for the optimistic scenario. It is quite interesting to see that albeit the increased export demand does change the distribution of output across industries to some extent, employment shares do not change at all. For example, the share of manufacturing output is 2 percentage points larger under the optimistic scenario relative to our baseline, its employment share increases only by half percentage point. The change of other sectors' employment is even smaller than what is predicted in manufacturing.

The results for the pessimistic forecasting are shown in *Figure 10* and *Table 7*. Lower export growth decreases the employment share of manufacturing by about 1 percentage point while the employment shares of the other sectors do not change at all.

In conclusion, the alternative assumptions about the export demand show that this will affect industrial output and labor to some extent while the other sectors will be practically unaffected.

5. Robustness tests: business cycle effects and wages

To test the robustness of our results, we include variables in the estimation equation which may also have an effect on labor demand. As we described in the methodology section, first we include the log of total output to account for business cycle effects. Second, we add the proportional deviation of sector-specific wages from the national average.[16]

The medium term forecasts with business cycle effects and wages are presented in *Table 8*. The predicted employment shares are very similar to the baseline forecasts. Differences can be found in manufacturing where the inclusion of total output and employment increases the share of the industry by 2 percentage points, construction with a decline of 4 percentage points, transportation with an increase of 2 percentage points and financial intermediation with a decline of one percentage point. The inclusion of wages does not change any prediction by more than one percentage point except in construction where the predicted employment share is 2 percentage points lower than in the baseline scenario. Therefore, the forecasts are quite robust to the inclusion of new variables.

6. Public sector employment

Perhaps the most difficult part of forecasting employment is related to the public sector for a number of reasons. First, in lack of realistic prices, it is impossible to construct an output measure which is consistent with the output used in the case of the other sectors. Second, the employment levels in the public sector are likely to be decided upon through a political process with its own logic, and this will not be linked to output. To test for the hypothesis that public sector employment is not, or it is only weakly linked to output, we gathered data on several measures of physical "output" for education and health care (the data come from the Statistical Yearbooks of Hungary (National Statistical Office, 1992-2009). First, we added up each year the number of people who received any type of education.[17] Using this variable, we ran the following regression:

$$\ln EMPEDUC_t = \alpha_0 + \alpha_1 \ln STUDENT_{t-1} + \alpha_2 TREND + \varepsilon_t \quad (5)$$

[16] Based on the MAPE test we checked which equations give the best fit and the result is the same as in the baseline estimation in both cases. The estimated coefficients are presented in the Appendix *Tables 6* and *7*.

[17] This included the following categories: children in kindergartens, pupils in elementary education, pupils in secondary education (including vocational and theoretical types of education), students in tertiary education (including 3 and 5 year types of universities) and adults in different types of education.

where $EMPEDUC_t$ is the number of workers employed in education in each year (as shown in *Figure 2*), $STUDENT_t$ is the total number of people receiving education and *TREND* is a time trend. To allow for adjustment, we lag the number of students. The estimated coefficients, provided in *Table 9,* are small, insignificant at any conventional level, and the point estimate of the elasticity between the number of students and the employment in education is negative. Therefore this equation provides some evidence that the number of workers in education does not have a time trend and that there is not much correspondence between the number of students and the number of people employed in the educational sector.

We run similar regressions for the health sector.[18] In this case de variable of interest was the number of consultations by family doctors in a given year, the working hours yearly performed by specialists with outpatients and nursing days in hospitals. For the first and the third variable we find a positive effect of around 20 percent suggesting that a 10 percent increase in the number of consultations (or the days spent in hospitals) increase aggregate employment in health care by 2 percent. In the case when the variable of interest is the hours worked by specialists we estimate a negative coefficient of the magnitude of 0.14 (all effects are insignificant at any conventional level).

We also test whether loose and tight budget regimes have an effect on the number of public sector workers. We approximate the budget situation with GDP growth (in proportions and lagged one year) and the dependent variable is the number of workers (logged). This relationship is estimated to be negative and insignificant.[19]

To summarize, several difficulties arise in relation which forecasting public sector employment. First, it is hard to find a good measure of output in these sectors as there is no realistic price data to change quantities into the value of output. Some measure of quantity can be used for education and health, but not for public administration. Second, the regressions which establish the relation between output and the number of workers in the public sector provide a negative correlation for education and a weakly positive one for health. Third, even if these correlations were clear, there are no forecasts of the measures of output and therefore accurate forecasts cannot be made. The growth rate of GDP, which proxies the state budget's tightness, is also negatively related to the number of public sector employees. These problems make unlikely that a formal forecast of public sector employment can be performed. Instead, take the structural forecasts of Vincze (2011), who assumes that employment in the three public sectors does not change in proportional terms relative to total employment (the proportions are taken from 2010, the last year with employment information).

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[18] For the third public sector – public administration – no measure of output was available.

[19] We also tested whether public sector employment depends on the political cycle, but did not find any relationship between the number of years since the general elections and the level of public sector employment.

7. Employment predictions

Table 10 presents the forecasted employment levels for long term (for comparison, it also presents the realized employment levels in 2010). Besides the baseline forecast, it also shows the numbers for the optimistic and the pessimistic scenarios.[20]

According to the baseline forecasts, if the trends which have been present in the economy in the last 19 years are sustained in the future, the total number of employed in 2020 will increase by 153 000 workers. The optimistic scenario adds an additional 136 000 workers; if the pessimistic scenario will be realized, the number employed in 2020 will be only marginally larger than its level in 2010.

Regarding employment by sectors, agriculture will lose the most workers in the next 10 years. By 2020 the number of workers in this sector will be only 55 000. Manufacturing will also lose about 127 000 workers. On the contrary, financial intermediation will gain almost 140 000 workers and employment in trade will grow by 158 000. The construction industry will also increase its number of workers by 133 000 persons if our forecasts are correct. Community services will experience a small drop of 17 000 and the three public sectors together will have increased their employment levels by about 28 000.

As we showed in Section 4, the larger (lower) export demand does not change the structure of the employment across industries, but nevertheless its scale effect increases (decreases) total employment and thus more (fewer) people will work in some sectors. Under the optimistic scenario employment in manufacturing will reach 797 000, which is about 40 000 more than in our baseline scenario. On the contrary, the low export growth will results in only 718 000 workers employed in manufacturing. In constructions the number of employed will be larger by 13 000 under the optimistic scenario and lower by about the same amount under the pessimistic one. Trade will gain (lose) roughly 30 000 workers under the alternative assumptions about export growth and financial intermediation about 17 000. The remaining three corporate sectors – agriculture, trade and community services – will have changes in their employment of less than 10 000 workers.

8. Conclusions

The purpose of this study was to forecast the employment structure of the Hungarian economy in long term. We first selected the estimation from several specifications which has the best fit and then performed the forecast with the help of output predictions from

[20] The table also shows the corresponding employment numbers for the 95 percent confidence intervals.

a macroeconomic model. We find that the share of agriculture and manufacturing will decrease in the long term and construction, trade, and finance will increase its employment share in total Hungarian employment. It is worth noting that the employment structure is affected by two main forces: a scale effect which links the number of workers and the product demand and a productivity effect led by increases in sectoral labor productivity. While the scale effect is positive in nature – to produce more goods and services one needs to have more workers, ceteris paribus – the productivity effect is negative at constant output. If productivity increases, the same level of production can be reached with fewer workers.

At the end of the study it is work spelling out again the limits of this analysis, which affects most forecasting studies. First, as in any forecasting we have made assumptions about the future which might prove not to be correct. To minimize this problem, we calculated the forecasting under several scenarios: a baseline and an optimistic and pessimistic scenario which differ in the assumptions made about the international demand for Hungary's products. Second, we predict future employment share based on the relation between employment and a trend from the past data. If there is a structural break in the future either because of the economic environment changes or due to changes in regulation or other policy measures, our forecasted employment shares will not meet the realized ones. In the case of a crisis, for example, the economy may get back to its natural growth trajectory, and since our predictions are made for the long term, the economy may have time to get back on its natural expanding trajectory. Government intervention or some important innovation, however, may have effects on the levels and structure of labor which persist and our analysis cannot capture them. If labor productivity, for example, will have a different pattern in the future than in the past, our estimated relationship between output and employment will not be valid in the future and the forecasts will be biased. This potentially can induce some bias in the predictions but we cannot do much about it. Third, we have shown that public sector employment is only weakly dependent on output (at least in education and public health care while we cannot measure output in public administration at all). Therefore, it is close to impossible to make predictions about these sectors' future employment share since it depends on the political decisions of the government and not on the output demand for the services in these sectors. Finally, our time series are rather short. Despite that we made great efforts to expand the data beyond 1992, lack of industry level employment and output did not allow for it.

These difficulties notwithstanding, the robustness of the forecasts suggest that they are useful for to gauge what the structure of the employment and will be in the medium run as well as how many workers will be likely working in different industries. This knowledge may be important input for policy makers when making long-term plans that are based on the industrial structure of employment in Hungary.

References

Hungarian Statistical Agency (1992), Statistical Yearbook of Hungary, 1992. Budapest: Hungarian Statistical Agency.

Hungarian Statistical Agency (1993), Statistical Yearbook of Hungary, 1993. Budapest: Hungarian Statistical Agency.

Hungarian Statistical Agency (1994), Statistical Yearbook of Hungary, 1994. Budapest: Hungarian Statistical Agency.

Hungarian Statistical Agency (1995), Statistical Yearbook of Hungary, 1995. Budapest: Hungarian Statistical Agency.

Hungarian Statistical Agency (1996), Statistical Yearbook of Hungary, 1996. Budapest: Hungarian Statistical Agency.

Hungarian Statistical Agency (1997), Statistical Yearbook of Hungary, 1997. Budapest: Hungarian Statistical Agency.

Hungarian Statistical Agency (1998), Statistical Yearbook of Hungary, 1998. Budapest: Hungarian Statistical Agency.

Hungarian Statistical Agency (1999), Statistical Yearbook of Hungary, 1999. Budapest: Hungarian Statistical Agency.

Hungarian Statistical Agency (2000), Statistical Yearbook of Hungary, 2000. Budapest: Hungarian Statistical Agency.

Hungarian Statistical Agency (2001), Statistical Yearbook of Hungary, 2001. Budapest: Hungarian Statistical Agency.

Hungarian Statistical Agency (2002), Statistical Yearbook of Hungary, 2002. Budapest: Hungarian Statistical Agency.

Hungarian Statistical Agency (2003), Statistical Yearbook of Hungary, 2003. Budapest: Hungarian Statistical Agency.

Hungarian Statistical Agency (2004), Statistical Yearbook of Hungary, 2004. Budapest: Hungarian Statistical Agency.

Hungarian Statistical Agency (2005), Statistical Yearbook of Hungary, 2005. Budapest: Hungarian Statistical Agency.

Hungarian Statistical Agency (2006), Statistical Yearbook of Hungary, 2006. Budapest: Hungarian Statistical Agency.

Hungarian Statistical Agency (2007), Statistical Yearbook of Hungary, 2007. Budapest: Hungarian Statistical Agency.

Hungarian Statistical Agency (2008), Statistical Yearbook of Hungary, 2008. Budapest: Hungarian Statistical Agency.

Hungarian Statistical Agency (2009), Statistical Yearbook of Hungary, 2009. Budapest: Hungarian Statistical Agency.

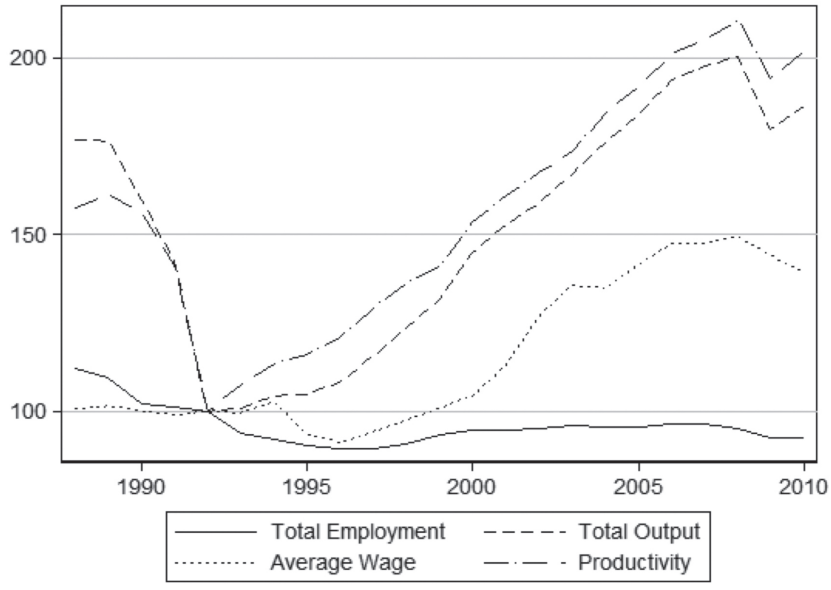
Hungarian Statistical Agency (2010), Statistical Yearbook of Hungary, 2010. Budapest: Hungarian Statistical Agency.

Köllő, János (2011), "Employment, Unemployment and Wages in the First Year of the Crisis." In: The Hungarian Labor Market – Review and Analysis 2011 (K. Fazekas, Gy. Molnár eds.). Budapest: Institute of Economics – HAS.

Vincze, János (2011), "Medium and Long-Term Output Forecasts for Hungary." Mimeo.

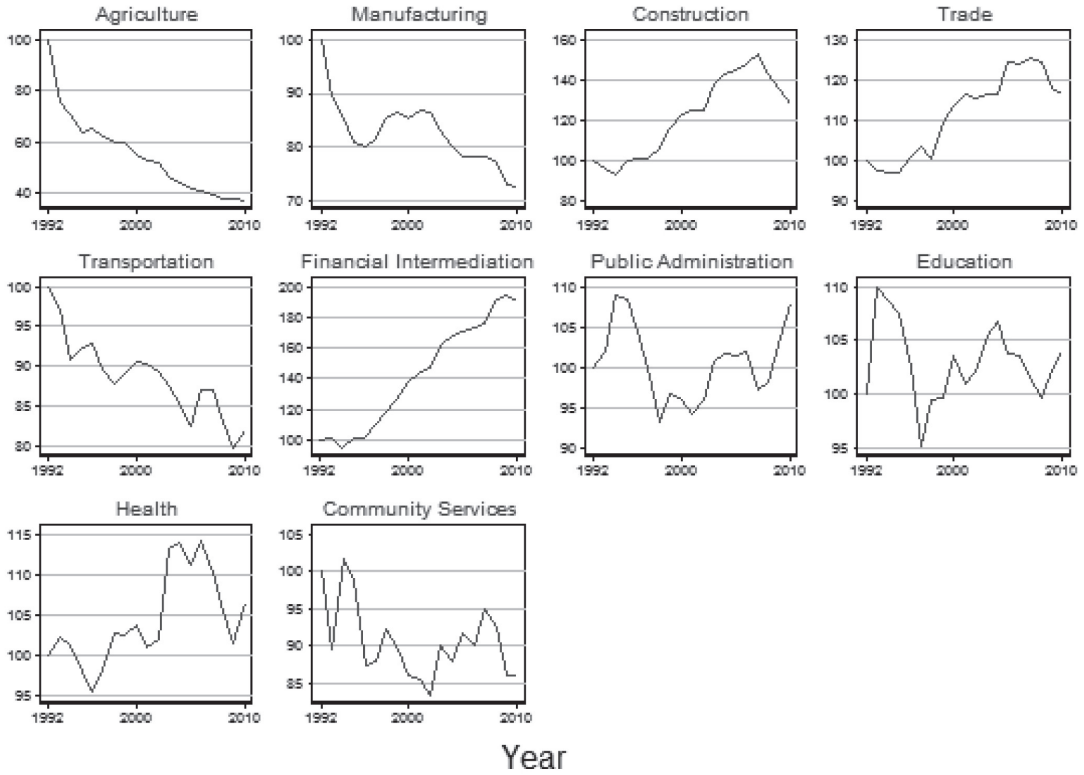
Tables and figures

Figure 1. Aggregate Employment, Output, Labor Productivity and Average Wages in Hungary



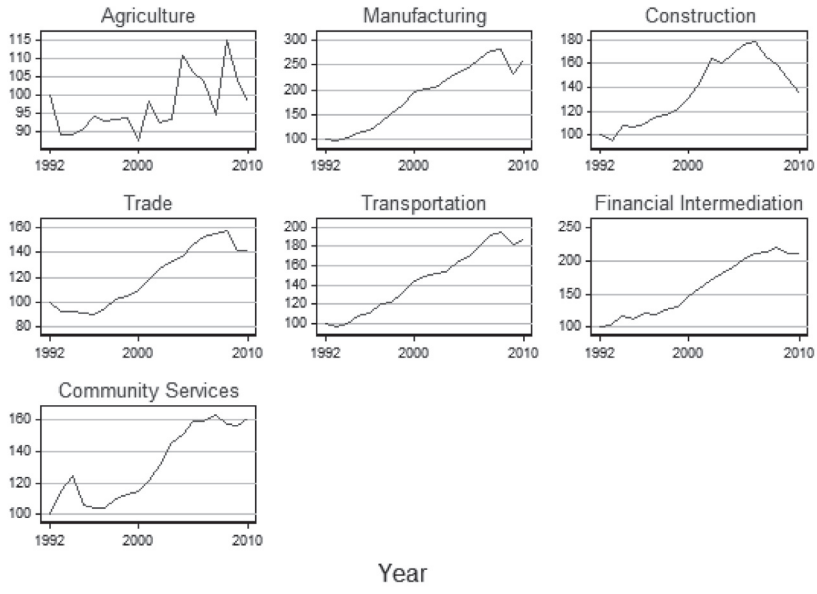
Note: 1992 = 100 percent. Output and wages deflated to their 2010 levels.

Figure 2. Evolution of Sectoral Aggregate Employment, 1992-2010



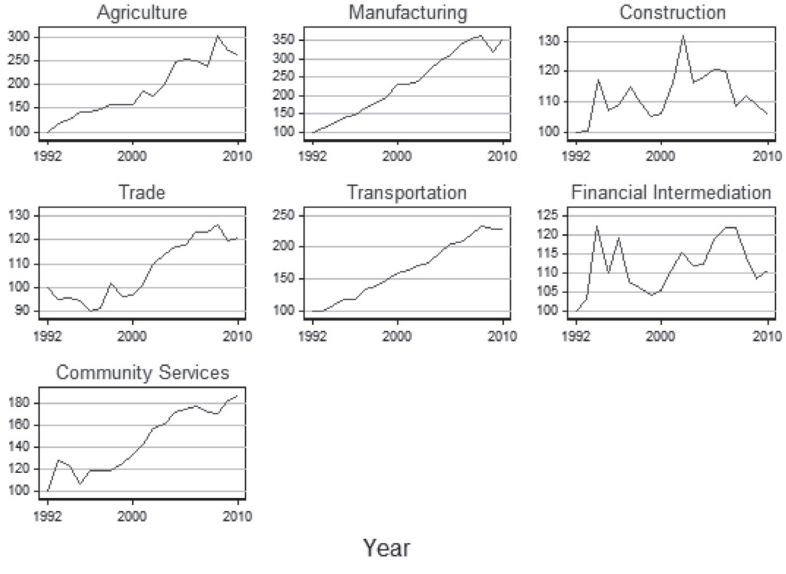
Note: 1992 = 100 percent.

Figure 3. Evolution of Sectoral Aggregate Output for the Corporate Sectors, 1992-2010



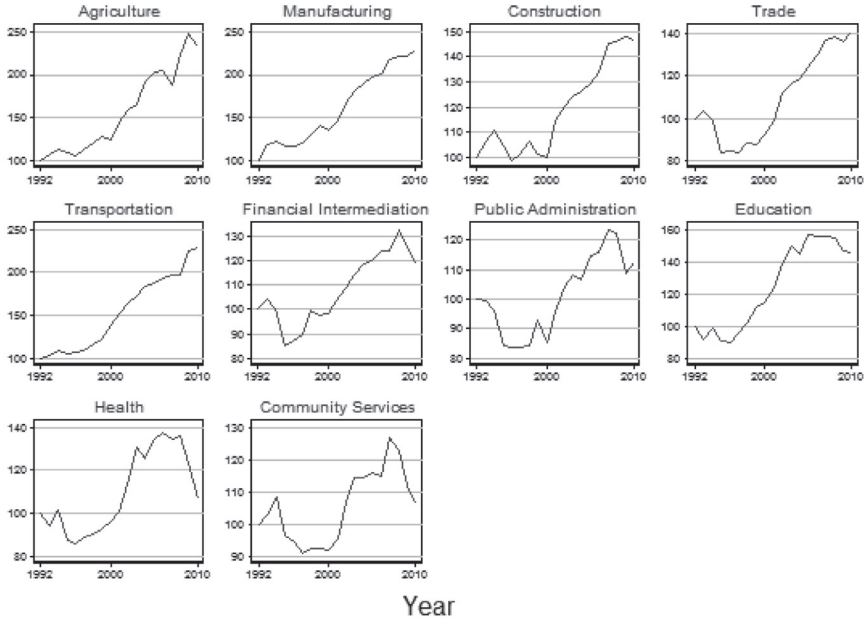
Note: 1992 = 100 percent. Output is deflated to its 2010 level.

Figure 4. Evolution of Sectoral Productivity in Corporate Sectors, 1992-2010



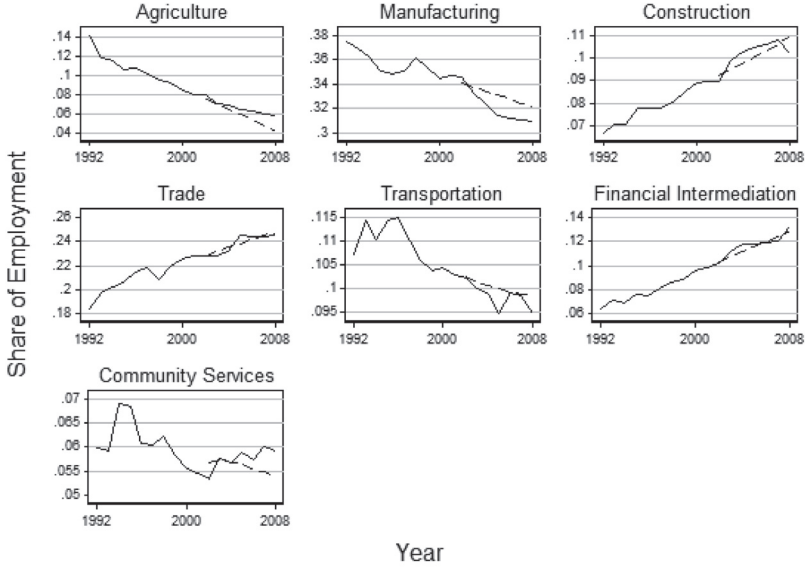
Note: 1992 = 100 percent.

Figure 5. Evolution of Sectoral Average Wage, 1992-2010



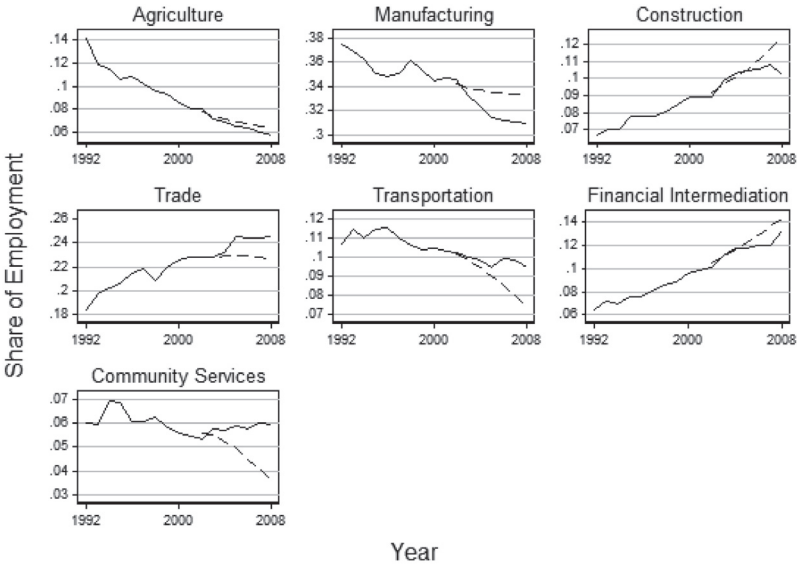
Note: 1992 = 100 percent. Wages are deflated to their 2010 level.

Figure 6.1. Results of the Pseudo Forecast, Equation 1



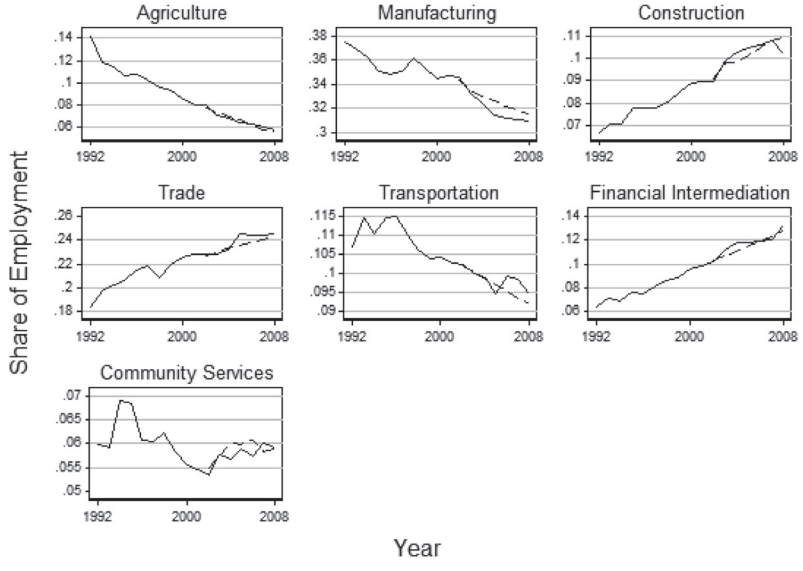
Note: Solid lines represent actual realizations, dashed lines represent forecasted values.

Figure 6.2. Results of Pseudo Forecast, Equation 2



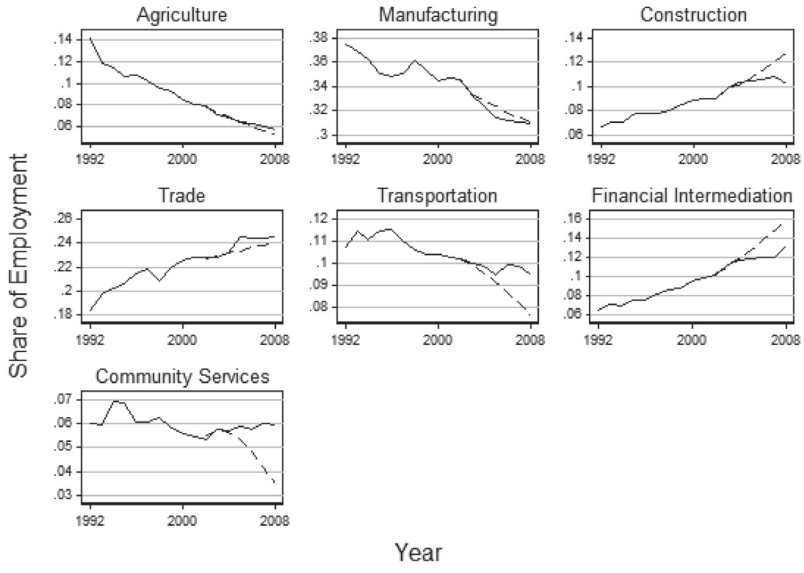
Note: Solid line represents actual realizations, dashed line forecasted values.

Figure 6.3. Results of Pseudo Forecast, Equation 3



Note: Solid line represents actual realizations, dashed line forecasted values.

Figure 6.4. Results of Pseudo Forecast, Equation 4



Note: Solid line represents actual realizations, dashed line forecasted values.

Figure 7. Forecast of Sectoral Employment Share

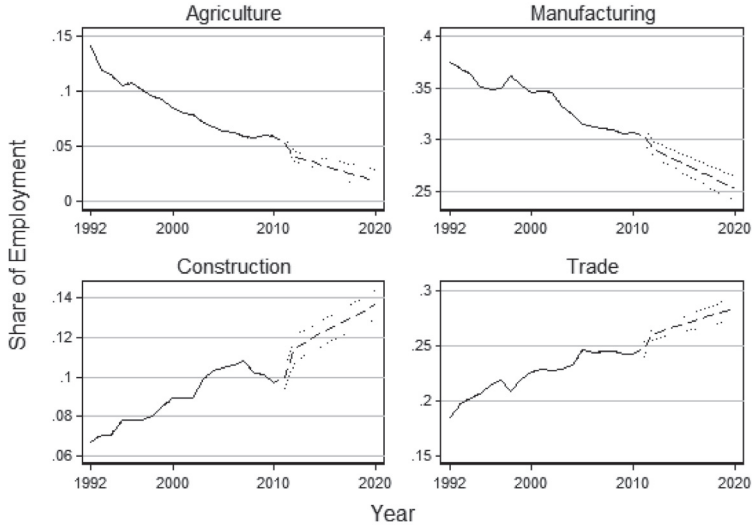
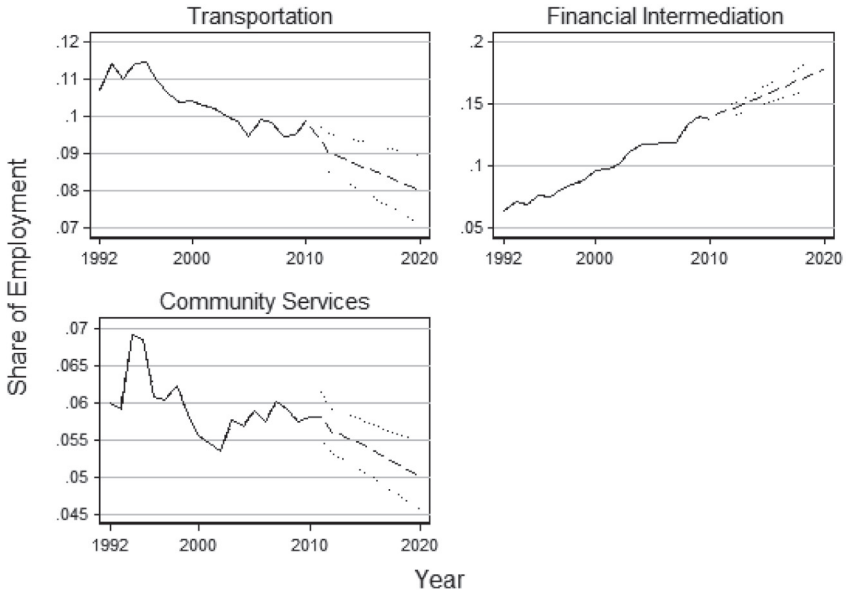


Figure 7. continued



Note: Solid line represents actual realizations, dashed line forecasted values, dotted line represents the 95th percent confidence interval.

Figure 8. Share of Output and Employment, Long Term

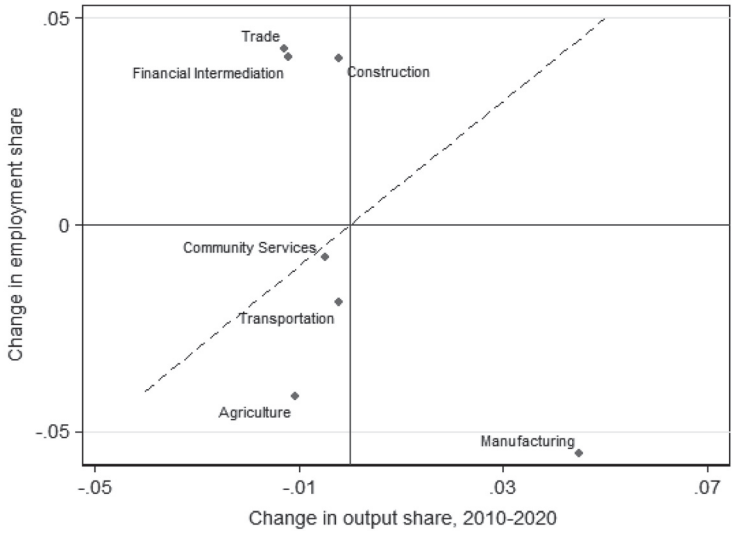


Figure 9. Forecasting Sectoral Employment Share, Optimistic Scenario

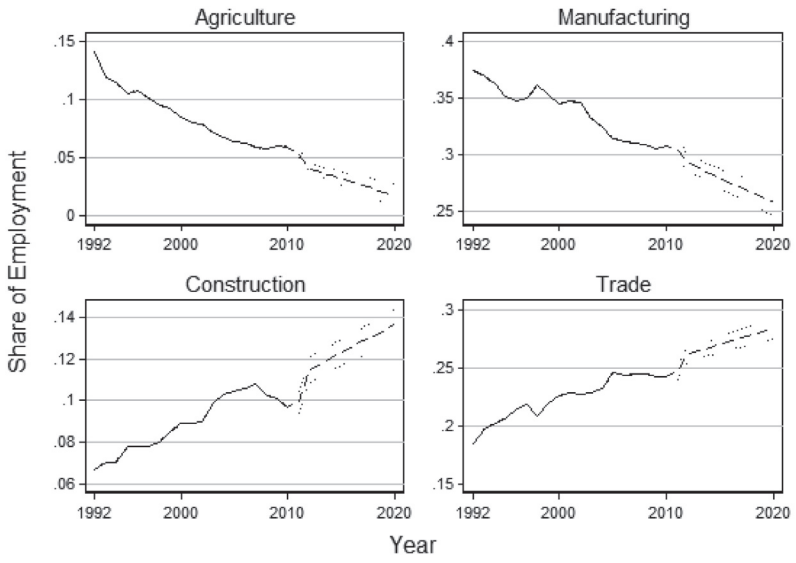
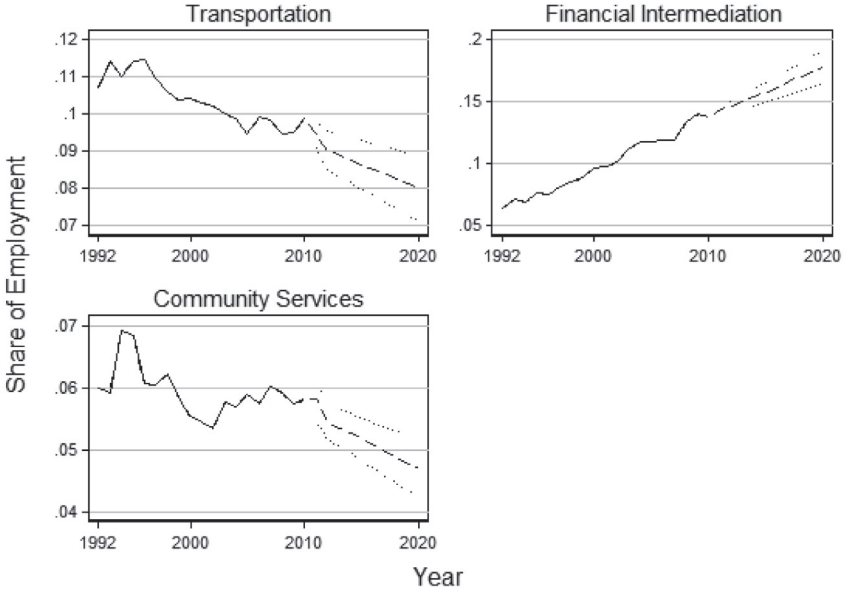


Figure 9. continued



Note: Solid line represents actual realizations, dashed line forecasted values, dotted lines represent the 95th percent confidence interval.

Figure 10. Forecasting Sectoral Employment Share, Pessimistic Scenario

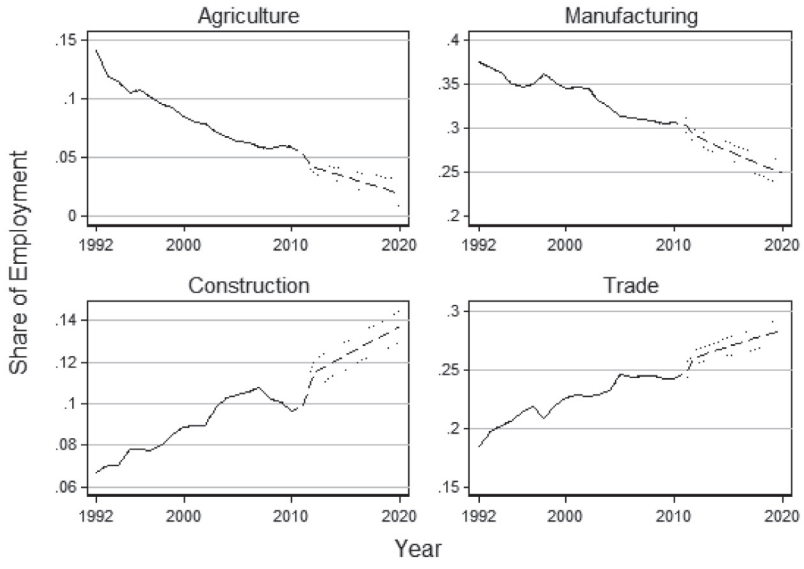
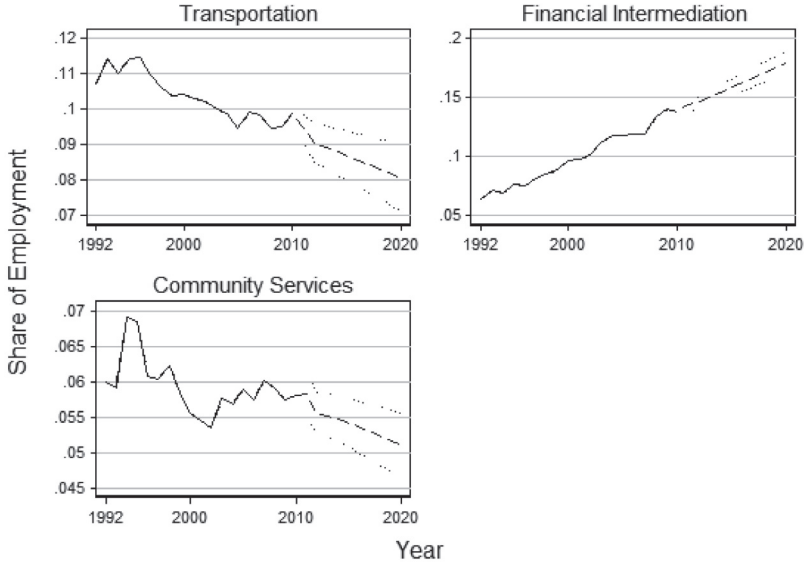


Figure 10. continued



Note: Solid line represents actual realizations, dashed line forecasted values, dotted lines represent the 95th percent confidence interval.

Table 1. Industrial Composition of Hungarian Employment

Year	Agricult.	Manufact.	Const.	Trade	Transport.	Financial Inter.	Public Admin.	Education	Health	Comm. services	Total
1992	0.11	0.30	0.05	0.15	0.08	0.05	0.07	0.08	0.06	0.05	1.00
2000	0.07	0.27	0.07	0.18	0.08	0.07	0.07	0.08	0.06	0.04	1.00
2010	0.05	0.23	0.07	0.18	0.08	0.11	0.08	0.09	0.07	0.04	1.00

Table 2.1. Results of Estimation for the Pseudo Forecast, Equation 1

	Agriculture	Manufacturing	Construction	Trade	Transportation	Financial Intermediation	Community services
Constant	0.169*	0.339***	0.064**	0.255***	0.101**	0.050**	0.055**
	(0.059)	(0.038)	(0.013)	(0.052)	(0.025)	(0.014)	(0.014)
Trend	-0.006*	-0.004**	0.003***	0.003*	-0.001	0.004***	-0.001
	(0.002)	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Share of output	-0.100	0.116	-0.147	-0.495	0.193	-0.050	0.331
	(0.448)	(0.101)	(0.204)	(0.322)	(0.259)	(0.103)	(0.305)
Adjusted R-squared	0.936	0.756	0.953	0.897	0.652	0.970	0.478

Note: N=12

Table 2.2. Results of Estimation for the Pseudo Forecast, Equation 2

	Agriculture	Manufacturing	Construction	Trade	Transportation	Financial Intermediation	Community services
Constant	0.190*	0.349***	0.100**	0.188*	0.118**	0.063***	0.025
	(0.056)	(0.041)	(0.021)	(0.062)	(0.025)	(0.011)	(0.020)
Trend	-0.011*	-0.007	-0.001	0.008*	0.003	0.001	0.004
	(0.004)	(0.004)	(0.002)	(0.003)	(0.002)	(0.001)	(0.002)
Trend squared	0.000	0.000	0.000	-0.000	-0.000	0.000*	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Share of output	-0.089	0.127	-0.469	-0.224	-0.190	-0.030	0.572
	(0.416)	(0.104)	(0.237)	(0.337)	(0.328)	(0.079)	(0.298)
Adjusted R-squared	0.951	0.773	0.969	0.923	0.743	0.984	0.639

Note: N=12

Table 2.3. Results of Estimation for the Pseudo Forecast, Equation 3

	Agriculture	Manufacturing	Construction	Trade	Transportation	Financial Intermediation	Community services
Constant	0.109*	0.293***	0.044*	0.240**	0.132***	0.051	0.034*
	(0.032)	(0.041)	(0.014)	(0.061)	(0.024)	(0.022)	(0.012)
Trend	-0.003*	-0.004**	0.003***	0.002*	-0.002**	0.004***	-0.000
	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Share of output	0.110	0.015	-0.348	-0.387	-0.021	0.007	-0.073
	(0.198)	(0.098)	(0.186)	(0.291)	(0.224)	(0.156)	(0.199)
L.Share of output	0.172	0.210	0.483*	0.018	-0.066	-0.070	0.898**
	(0.205)	(0.098)	(0.192)	(0.338)	(0.214)	(0.125)	(0.218)
Adjusted R-squared	0.985	0.793	0.969	0.898	0.852	0.964	0.869

Note: N=12

Table 2.4. Results of Estimation for the Pseudo Forecast, Equation 4

	Agriculture	Manufacturing	Construction	Trade	Transportation	Financial Intermediation	Community services
Constant	0.106*	0.292***	0.093*	0.217*	0.150**	0.105***	-0.034
	(0.034)	(0.047)	(0.030)	(0.082)	(0.028)	(0.014)	(0.033)
Trend	-0.002	-0.002	-0.001	0.004	0.001	-0.003*	0.008
	(0.002)	(0.006)	(0.002)	(0.004)	(0.003)	(0.001)	(0.004)
Trend squared	-0.000	-0.000	0.000	-0.000	-0.000	0.000**	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Share of output	0.135	-0.018	-0.603*	-0.317	-0.178	-0.293*	0.725
	(0.217)	(0.128)	(0.215)	(0.344)	(0.265)	(0.086)	(0.401)
Lagged share of output	0.135	0.228	0.281	0.038	-0.255	0.129	0.767**
	(0.231)	(0.112)	(0.201)	(0.361)	(0.275)	(0.065)	(0.186)
Adjusted R-squared	0.986	0.799	0.990	0.902	0.876	0.9942	0.9266

Note: N=12

Table 3. Test Results from Mean Average Percentage Error

	Equation			
Sector	1	2	3	4
Agriculture	0.193	0.056	0.059	0.084
Manufacturing	0.034	0.058	0.020	0.015
Construction	0.064	0.125	0.056	0.146
Trade	0.019	0.049	0.017	0.017
Transportation	0.021	0.144	0.033	0.129
Financial Intermediation	0.030	0.068	0.033	0.137
Community Services	0.049	0.244	0.027	0.228
Average	0.059	0.103	0.040	0.105

Table 4. Results of Estimation for the Forecast

	Agriculture	**Manufacturing**	**Construction**	**Trade**	**Transportation**	**Financial Intermediation**	**Community Services**
Constant	0.099***	0.274***	0.018	0.212***	0.111***	0.040	0.038***
	(0.014)	(0.030)	(0.019)	(0.040)	(0.019)	(0.022)	(0.006)
Trend	-0.003***	-0.005***	0.003***	0.003***	-0.001***	0.004***	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Crisis dummy	0.008**	0.013*	-0.013***	-0.010*	0.003	0.003	0.000
	(0.002)	(0.006)	(0.003)	(0.004)	(0.003)	(0.003)	(0.002)
Share of output	0.189	0.104	0.141	-0.190	0.064	0.096	-0.053
	(0.127)	(0.076)	(0.248)	(0.248)	(0.188)	(0.148)	(0.171)
Lagged Share of output	0.166	0.195*	0.417	-0.009	0.054	-0.092	0.791***
	(0.153)	(0.077)	(0.269)	(0.254)	(0.197)	(0.120)	(0.166)
Adjusted R-squared	0.993	0.956	0.954	0.946	0.89	0.983	0.794

Note: N=18

Table 5. Long Term Forecasted Employment Share

		Agriculture	Manufacturing	Construction	Trade	Transportation	Financial Intermediation	Community services
Forecast of employment share								
2010	Realized	0.060	0.307	0.097	0.241	0.099	0.138	0.058
2020	Forecast	0.018	0.252	0.137	0.284	0.080	0.179	0.050
	LB	0.007	0.240	0.130	0.274	0.071	0.167	0.046
	UB	0.029	0.264	0.144	0.293	0.089	0.191	0.055
Forecast of output share								
2010		0.043	0.480	0.047	0.126	0.075	0.185	0.043
2020		0.033	0.525	0.045	0.113	0.073	0.173	0.038

Note: LB , UB represents the values associated with the 95th percent confidence interval.

Table 6. Long Term Forecasted Employment Share, Optimistic Scenario

		Agriculture	Manufacturing	Construction	Trade	Transportation	Financial Intermediation	Community services
Forecast of employment share								
2010	Realized	0.060	0.307	0.097	0.241	0.099	0.138	0.058
2020	Forecast	0.017	0.257	0.136	0.284	0.080	0.178	0.047
	LB	0.007	0.245	0.129	0.275	0.071	0.165	0.042
	UB	0.028	0.268	0.144	0.293	0.089	0.192	0.052
Forecast of output share								
2010		0.043	0.480	0.047	0.126	0.075	0.185	0.043
2020		0.030	0.544	0.045	0.109	0.072	0.168	0.033

Note: LB , UB represents the values associated with the 95th percent confidence interval.

Table 7. Long Term Forecasted Employment Share, Pessimistic Scenario

		Agriculture	Manufacturing	Construction	Trade	Transportation	Financial Intermediation	Community services
Forecast of employment share								
2010	Realized	0.060	0.307	0.097	0.241	0.099	0.138	0.058
2020	Forecast	0.019	0.248	0.137	0.284	0.081	0.180	0.051
	LB	0.008	0.235	0.130	0.273	0.071	0.169	0.046
	UB	0.031	0.262	0.145	0.295	0.090	0.190	0.056
Forecast of output share								
2010		0.043	0.480	0.047	0.126	0.075	0.185	0.043
2020		0.035	0.509	0.045	0.119	0.074	0.179	0.039

Note: LB – Lower Bound of Confidence Interval. UB – Upper Bound of Confidence Interval

Table 8. Long Term Forecasted Employment Share with Business Cycle and Wage Effects

		Agriculture	Manufacturing	Construction	Trade	Transportation	Financial Intermediation	Community services
Forecast of employment share								
2010	Realized	0.060	0.307	0.097	0.241	0.099	0.138	0.058
Business Cycle								
2020	Forecast	0.027	0.274	0.101	0.275	0.100	0.169	0.054
	LB	0.016	0.236	0.082	0.238	0.080	0.141	0.039
	UB	0.039	0.312	0.120	0.311	0.120	0.197	0.070
Wages								
2020	Forecast	0.020	0.256	0.118	0.285	0.082	0.180	0.060
	LB	0.009	0.243	0.098	0.263	0.072	0.166	0.050
	UB	0.031	0.269	0.138	0.307	0.092	0.194	0.070
Forecast of output share								
2010		0.043	0.480	0.047	0.126	0.075	0.185	0.043
2020		0.033	0.525	0.045	0.113	0.073	0.173	0.038

Note: LB , UB represents the values associated with the 95th percent confidence interval.

Table 9. Relation between Public Sector Output, GDP growth and Employment

Education	**Education Sector Aggregate Employment**
Total Number of Students	-0.049
	(0.352)
Trend	-0.001
	(0.002)
Health	**Health Sector Aggregate Employment**
Number of Consultations	0.234
	(0.245)
Trend	0.006**
	(0.003)
Working Hours Yearly Performed by Specialist	-0.140
	(0.085)
Trend	0.012**
	(0.003)
Nursing Days in Hospitals	0.207
	(0.321)
Trend	0.012
	(0.006)
GDP	**Total Public Sectors Aggregate Employment**
Volume Index of GDP	-0.358
	(-0.391)
Trend	0.001
	(0.002)

Note: Total numbers of students, number of consultations, working hours and nursing days are logged as well as the dependent variables, and the independent variables are lagged one year.

Table 10. Long Term Forecasted Employment

	Agriculture	Manufact.	Const.	Trade	Transport.	Financial Inter.	Public Admin.	Education	Health	Community services	Total
Realized, 2010	171.8	883.1	277.6	694.3	284.2	397.4	317.2	323.9	251.6	166.9	3768.0
Baseline scenario											
Forecast, 2020	54.7	755.9	410.5	851.7	240.7	536.7	330.0	330.0	261.0	150.2	3921.5
LB	22.3	719.0	388.7	822.7	213.5	501.4	330.0	330.0	261.0	136.7	
UB	87.2	792.8	432.3	880.6	267.9	571.9	330.0	330.0	261.0	163.8	
Optimistic scenario											
Forecast, 2020	54.3	796.9	423.0	882.4	248.2	554.0	341.5	341.5	270.1	145.5	4057.2
LB	22.0	761.5	400.1	854.0	221.0	513.2	341.5	341.5	270.1	130.9	
UB	86.6	832.4	445.9	910.7	275.3	594.8	341.5	341.5	270.1	160.1	
Pessimistic scenario											
Forecast, 2020	55.8	717.6	397.1	820.7	233.3	519.3	318.0	318.0	251.5	147.5	3778.8
LB	23.1	678.6	376.1	789.2	205.9	489.2	318.0	318.0	251.5	134.4	
UB	88.5	756.6	418.1	852.1	260.6	549.5	318.0	318.0	251.5	160.5	

Note: Employment is measured in thousands.
LB, UB represents the values associated with the 95th percent confidence interval.

Appendix

Table A1. Evolution of Aggregate Employment, Output, Labor Productivity and Average Wages in Hungary

Year	Total employment	Total Output	Productivity	Average Wage
1992	100.0	100.0	100.0	100.0
1993	93.8	100.8	107.5	99.5
1994	92.0	104.4	113.5	102.7
1995	90.2	104.9	116.3	93.5
1996	89.4	108.2	121.0	91.1
1997	89.4	115.6	129.3	94.2
1998	90.6	123.7	136.5	97.5
1999	93.4	131.7	141.0	100.9
2000	94.6	145.1	153.5	104.4
2001	94.8	152.6	160.9	112.9
2002	94.9	159.0	167.5	126.9
2003	96.2	167.2	173.8	135.7
2004	95.6	176.1	184.1	134.8
2005	95.7	183.7	192.0	141.6
2006	96.4	193.7	201.0	147.5
2007	96.3	197.6	205.2	147.4
2008	95.1	200.5	210.7	149.4
2009	92.5	179.7	194.3	144.0
2010	92.4	186.4	201.8	139.2

Note: Total Output and Average Wage are deflated to their 2010 level.

Table A2. Evolution of Sectoral Aggregate Employment

Year	Agricult.	Manufact.	Const.	Trade	Transport.	Financial Inter.	Public Admin.	Education	Health	Community services
1992	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1993	75.9	89.4	95.5	97.3	97.1	100.6	102.0	109.9	102.2	89.6
1994	71.2	85.3	92.7	97.0	90.8	95.0	109.0	108.6	101.1	101.6
1995	64.1	80.8	100.2	96.7	92.3	101.8	108.3	107.6	97.9	98.6
1996	65.7	80.1	100.4	100.8	92.7	101.2	104.4	102.5	95.5	87.4
1997	62.6	81.4	101.1	103.6	89.5	109.9	100.0	95.2	98.2	87.7
1998	59.7	85.4	106.1	100.3	87.8	117.9	93.2	99.4	102.7	92.1
1999	59.9	86.3	116.3	109.2	89.1	126.0	96.7	99.6	102.3	89.5
2000	55.5	85.4	123.2	113.7	90.4	138.2	96.1	103.5	103.8	86.0
2001	52.9	86.8	125.2	116.3	90.2	142.6	94.1	100.9	101.0	85.4
2002	52.4	86.4	125.0	115.7	89.4	147.4	96.1	102.0	101.9	83.4
2003	46.8	82.9	138.1	116.2	87.5	162.1	100.6	105.5	113.1	90.1
2004	44.5	80.0	142.4	116.5	85.5	168.7	101.7	106.8	114.0	87.9
2005	42.2	78.2	145.3	124.2	82.4	170.4	101.4	103.7	111.2	91.6
2006	41.5	78.1	148.3	124.0	87.0	173.7	101.9	103.6	114.0	90.0
2007	39.8	78.3	152.4	125.4	87.1	175.5	97.1	101.4	110.2	94.8
2008	37.8	77.2	142.8	124.5	83.0	192.0	98.3	99.6	105.4	92.4
2009	38.2	73.1	135.3	117.8	79.7	194.6	103.7	102.3	101.4	86.0
2010	37.3	72.7	128.0	116.5	82.0	190.1	108.0	103.9	106.5	86.0

Table A3. Evolution of Sectoral Aggregate Output

Year	Agriculture	Manufacturing	Construction	Trade	Transportation	Financial Intermediation	Community services
1992	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1993	89.4	99.5	95.8	92.4	95.9	103.8	115.0
1994	89.2	104.7	108.6	92.8	99.1	116.2	124.4
1995	90.9	113.3	107.2	91.6	108.4	111.9	106.0
1996	94.0	118.0	109.4	90.8	110.2	120.6	104.5
1997	92.8	135.4	116.3	94.8	119.8	118.5	103.8
1998	93.2	152.0	116.4	102.4	121.6	125.2	109.5
1999	93.6	167.5	122.5	105.0	131.7	131.6	112.6
2000	87.7	196.1	130.6	110.1	143.7	145.9	114.9
2001	98.3	201.1	145.4	118.0	148.9	158.1	121.3
2002	92.7	204.9	164.9	126.7	152.6	169.8	131.3
2003	93.4	221.0	160.5	132.5	153.3	181.3	145.7
2004	110.8	234.3	168.5	136.1	163.9	189.5	150.5
2005	106.4	243.2	175.6	146.1	169.2	202.3	159.4
2006	103.6	263.7	178.1	152.7	180.8	211.6	158.9
2007	94.6	278.6	165.1	154.6	191.3	213.5	163.2
2008	114.9	280.8	159.5	157.0	194.0	219.2	157.2
2008	104.2	233.7	147.2	141.0	182.7	211.2	156.2
2010	98.3	258.3	135.0	140.9	187.1	210.8	160.6

Note: Output is deflated to its 2010 level.

Table A4. Evolution of Sectoral Productivity

Year	Agriculture	Manufacturing	Construction	Trade	Transportation	Financial Intermediation	Community services
1992	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1993	117.7	111.3	100.3	95.0	98.8	103.2	128.4
1994	125.3	122.7	117.2	95.6	109.1	122.3	122.5
1995	141.8	140.2	107.0	94.7	117.5	109.9	107.6
1996	143.0	147.3	108.9	90.0	118.9	119.2	119.6
1997	148.3	166.3	115.0	91.5	133.9	107.8	118.3
1998	156.0	177.9	109.7	102.0	138.4	106.2	118.9
1999	156.2	194.0	105.3	96.1	147.8	104.5	125.8
2000	158.0	229.6	106.0	96.9	158.9	105.5	133.7
2001	185.7	231.6	116.1	101.5	165.0	110.9	142.0
2002	177.0	237.2	131.9	109.5	170.7	115.2	157.5
2003	199.8	266.5	116.2	114.0	175.2	111.9	161.8
2004	248.8	292.8	118.4	116.8	191.8	112.3	171.3
2005	252.3	311.2	120.8	117.7	205.3	118.8	174.0
2006	249.9	337.8	120.0	123.2	207.9	121.8	176.6
2007	238.0	355.8	108.3	123.3	219.7	121.7	172.2
2008	303.7	363.8	111.7	126.0	233.8	114.2	170.2
2009	272.8	319.8	108.8	119.7	229.2	108.5	181.7
2010	263.3	355.2	105.4	120.9	228.1	110.9	186.8

Table A5.1. Evolution of Sectoral Average Wage (Deflated by CPI)

Year	Agricult.	Manufact.	Const.	Trade	Transport.	Financial Inter.	Public Admin.	Education	Health	Community services
1992	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1993	102.5	102.0	98.4	98.9	97.9	103.3	93.4	91.2	91.5	100.6
1994	110.4	104.1	98.7	94.6	102.7	100.7	93.8	100.0	100.1	103.3
1995	104.5	98.4	87.5	85.9	94.5	90.2	83.8	85.2	86.2	94.8
1996	99.3	96.9	83.5	85.9	95.0	91.8	79.2	77.1	80.6	92.1
1997	101.0	99.7	86.2	85.3	98.7	95.2	81.7	82.7	82.4	88.7
1998	102.1	101.6	87.0	86.2	103.8	104.2	82.8	87.5	83.8	90.9
1999	101.9	104.9	83.0	84.5	109.4	103.1	92.3	96.9	85.3	92.1
2000	102.7	109.8	85.5	89.1	111.6	105.3	93.7	98.3	89.8	94.0
2001	114.5	114.9	97.2	95.6	118.4	110.9	109.2	108.3	94.9	98.9
2002	127.0	122.9	99.8	106.9	128.3	116.7	132.2	135.5	118.0	114.1
2003	128.5	128.2	103.7	110.7	133.8	122.0	136.0	163.3	141.9	126.4
2004	130.8	132.1	103.5	109.5	138.5	124.4	129.8	150.5	133.4	126.1
2005	133.8	136.7	106.5	112.9	144.1	126.9	140.9	164.9	142.2	130.9
2006	140.2	143.0	113.2	120.4	150.1	134.5	145.9	167.2	144.2	132.9
2007	141.6	143.5	121.1	121.1	147.2	132.3	153.5	156.5	140.6	142.8
2008	146.1	144.1	122.2	124.1	148.1	139.3	152.7	155.4	140.8	139.2
2009	143.8	142.9	122.6	121.4	164.4	131.0	128.6	142.9	128.3	123.4
2010	143.9	143.6	117.5	121.4	159.3	120.8	127.1	136.9	108.0	114.8

Note: Average wages are deflated to their 2010 level with consumer price index.

Table A5.2. Evolution of Sectoral Average Wage (Deflated by Sector-Specific GDP Deflator)

Year	Agriculture	Manufact.	Construction	Trade	Transport.	Financial Inter.	Public Admin.	Education	Health	Community services
1992	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1993	102.5	102.0	98.4	98.9	97.9	103.3	93.4	91.2	91.5	100.6
1994	110.4	104.1	98.7	94.6	102.7	100.7	93.8	100.0	100.1	103.3
1995	104.5	98.4	87.5	85.9	94.5	90.2	83.8	85.2	86.2	94.8
1996	99.3	96.9	83.5	85.9	95.0	91.8	79.2	77.1	80.6	92.1
1997	101.0	99.7	86.2	85.3	98.7	95.2	81.7	82.7	82.4	88.7
1998	102.1	101.6	87.0	86.2	103.8	104.2	82.8	87.5	83.8	90.9
1999	101.9	104.9	83.0	84.5	109.4	103.1	92.3	96.9	85.3	92.1
2000	102.7	109.8	85.5	89.1	111.6	105.3	93.7	98.3	89.8	94.0
2001	114.5	114.9	97.2	95.6	118.4	110.9	109.2	108.3	94.9	98.9
2002	127.0	122.9	99.8	106.9	128.3	116.7	132.2	135.5	118.0	114.1
2003	128.5	128.2	103.7	110.7	133.8	122.0	136.0	163.3	141.9	126.4
2004	130.8	132.1	103.5	109.5	138.5	124.4	129.8	150.5	133.4	126.1
2005	133.8	136.7	106.5	112.9	144.1	126.9	140.9	164.9	142.2	130.9
2006	140.2	143.0	113.2	120.4	150.1	134.5	145.9	167.2	144.2	132.9
2007	141.6	143.5	121.1	121.1	147.2	132.3	153.5	156.5	140.6	142.8
2008	146.1	144.1	122.2	124.1	148.1	139.3	152.7	155.4	140.8	139.2
2009	143.8	142.9	122.6	121.4	164.4	131.0	128.6	142.9	128.3	123.4
2010	143.9	143.6	117.5	121.4	159.3	120.8	127.1	136.9	108.0	114.8

Note: Average wages are deflated to their 2010 level with implicit price deflator.

Table A6. Results of Estimation for the Forecast with Total Output and Employment

	Agriculture	Manufacturing	Construction	Trade	Transportation	Financial Intermediation	Community services
Constant	-0.755	0.566	-0.503	0.750	1.012*	0.134	0.242
	(0.619)	(0.913)	(0.285)	(0.735)	(0.344)	(0.644)	(0.335)
Trend	-0.001	0.001	-0.004	0.001	0.004	0.001	0.001
	(0.001)	(0.004)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)
Crisis dummy	0.011	0.003	0.006	-0.012	-0.014	0.009	-0.005
	(0.008)	(0.013)	(0.006)	(0.013)	(0.008)	(0.007)	(0.005)
Share of output	(0.619)	-0.071	-0.426	-0.575	-0.442	-0.190	0.244
	-0.001	(0.110)	(0.247)	(0.430)	(0.306)	(0.169)	(0.276)
Lagged Share of output	0.295	0.343*	0.593*	0.142	-0.087	0.041	0.646*
	(0.191)	(0.119)	(0.254)	(0.332)	(0.231)	(0.218)	(0.254)
Log of Total Output	-0.005	0.021	0.052	-0.038	-0.096	0.039	-0.040
	(0.039)	(0.074)	(0.039)	(0.072)	(0.059)	(0.047)	(0.032)
Lagged Log of Total Output	-0.020	-0.137*	0.077**	0.073	-0.017	0.030	0.015
	(0.015)	(0.056)	(0.023)	(0.049)	(0.025)	(0.033)	(0.019)
Log of Total Employment	0.180*	0.080	-0.036	-0.066	0.031	-0.181	0.061
	(0.074)	(0.191)	(0.090)	(0.146)	(0.081)	(0.129)	(0.081)
Lagged Log of Total Employment	-0.047	0.027	-0.054	-0.041	0.003	0.086	-0.056
	(0.039)	(0.080)	(0.038)	(0.075)	(0.034)	(0.039)	(0.039)
Adjusted R-squared	.997	.976	.983	.96	.94	.992	.863

Note: N=18

Table A7. Results of Estimation for the Forecast with Wages

	Agriculture	Manufacturing	Construction	Trade	Transportation	Financial Intermediation	Community services
Constant	0.096**	0.288***	0.031	0.187**	0.111***	0.061	0.035***
	(0.027)	(0.039)	(0.017)	(0.057)	(0.020)	(0.046)	(0.007)
Trend	-0.003**	-0.006***	0.002***	0.003***	-0.001*	0.004***	0.000
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Crisis dummy	0.008*	0.009	-0.008*	-0.008	0.004	0.006	-0.000
	(0.004)	(0.007)	(0.004)	(0.005)	(0.006)	(0.005)	(0.002)
Share of output	0.229	0.090	-0.158	-0.171	0.080	0.048	-0.001
	(0.140)	(0.098)	(0.260)	(0.286)	(0.269)	(0.182)	(0.206)
Lagged Share of output	0.150	0.229*	0.321	0.098	0.061	-0.127	0.572*
	(0.167)	(0.091)	(0.250)	(0.296)	(0.230)	(0.144)	(0.209)
Difference to Nat. Average Wage	0.014	-0.003	-0.041	0.006	0.009	-0.024	0.011
	(0.020)	(0.049)	(0.025)	(0.048)	(0.020)	(0.020)	(0.019)
Lagged Difference to Nat. Average Wage	-0.016	0.072	-0.031	-0.034	-0.004	0.005	0.025
	(0.022)	(0.054)	(0.028)	(0.044)	(0.029)	(0.021)	(0.019)
Adjusted R-squared	.994	.962	.97	.949	.892	.985	.842

Note: N=18

A kutatás az MTA Közgazdaság- és Regionális Tudományi Kutatóközpont Közgazdaságtudományi Intézet
TÁMOP-2.3.2-09/1-2009-0001 projekt (amely az Európai Unió és a Magyar Állam támogatásával,
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Munkaerő-piaci előrejelzések készítése, szerkezetváltási folyamatok előrejelzése című program keretében készült.

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