Medium-Term Industrial Labor

Demand Forecast for Hungary

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Abstract

This study forecasts the Hungarian labor demand for 10 broad economic sectors for 2015. Using aggregate data for the period of 1992-2010 and a structural macroeconomic model, we find that the relative importance of agriculture and industry is likely to fall in total employment while the share of construction, trade and financial intermediation will increase.

Középtávú előrejelzés

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Összefoglaló

A tanulmány arra tesz kísérletet, hogy 2015-re előrejelezze a **magyarországi munkakeresletet tíz iparágra. Ehhez aggregált iparági adatokat használunk fel 1992 és 2010 között** valamint egy strukturális makromodellt, amely előrejelzi az ágazati kibocsátást. Előrejelzésünk szerint a mezőgazdaság és az ipar részaránya **csökken a** foglalkoztatásban, az építőipar, **kereskedelem és a pénzügyi szolgáltatások viszont növelik relatív méretüket.**

Tárgyszavak: munkakereslet, előrejelzés, Magyarország

JEL kódok: C530, J21, J23

1. INTRODUCTION

The aim of this study is to forecast the structure of employment by industries of the Hungarian economy in the medium term (5 years).[1] The need for such an 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. Also, the government's stated goal is to enlarge the traditionally low employment rate of Hungary and showing how employment will evolve can provide valuable 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 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 to subsidize the latter and exerting organizational efforts to sustain them are probably not the best way of spending scarce public resources.

Given the time span of the forecast (5 years) we rely on a macroeconomic model developed in Vincze (2011) in Subproject No. 1 of this TÁMOP project. The macro model provides total employment in the future and 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 predictions for 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 benchmark analysis we study the dependence of the industrial distribution of employment on the share of industrial production in total output and on 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 we also include industrial average wages to control for employment costs. We consider these estimations – especially those which

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[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 since wages are clearly simultaneously determined with employment at the industry level.[2]

Our basic 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 provides 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 about how to treat the three industries which are predominantly composed of public sector workers (public administration, education and health). As employment in 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 domain and show that the relation between labor and output in these sectors is rather weak. In the forecasting we use employment predictions originating from the macro model.

In addition to forecasting shares and levels of employment by broad economic sectors, we also consider two additional aspects of future labor demand in Hungary. The first is job reallocation, a measure of the turbulence or turnover of jobs within each sector: even if sectoral employment was constant, individual employers might still be growing or shrinking, and some firms will be entering or exiting. Our forecasts provide some indication of the future evolution of these processes. The second aspect concerns the role of foreign direct investment (FDI). If foreign owners behave differently in the labor market, there may be consequences for the sectoral allocation and levels of employment, and again we forecast this evolution based on alternative scenarios for future FDI in Hungary. Both of these analyses require firm-level data, as further described below.

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

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2 As we show in the results section, results are robust to the introduction of new variables.
3 We do not run vector autoregressive type of models for two reasons. First, the time series are rather short which makes 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).

corporate employment and provide the results, followed by the pseudo forecasts of 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 provide employment shares for the corporate and public sectors together and transform them into quantities. Section 8 presents the forecasts of job reallocation and the employment effects of foreign investment. Section 9 concludes.

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 parentheses 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] 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 for benefits in kind at the reference week. Part-time workers are therefore treated equally with full time workers. Another aspect of LFS-type survey data is that they are collected

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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.

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 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 average wages for the 10 sectors by computing the average across letter-level sectors, weighted by the number of workers in each sector, and deflated them by the consumer price index taking 2010 as the base year.

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, normalized to their values in 1992, the first year we use in the analysis (the corresponding numbers are provided in Table A1 in the Appendix). Employment declined continuously in the first 4 years and started to recover only in 1998.[5] After this year it 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

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

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 that 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.

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 do 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, construction and financial intermediation is 17, 28 and 90 percent.

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

Industry-level real output (presented in Figure 3) has a 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 construction, labor productivity increased by only 3 percent and in financial

6 Numbers corresponding to Figures 2-5 are shown in Appendix Tables A2-A5.
7 We show these figures only for the corporate sector as in the public sector the lack of reliable prices does not allow computing output.

intermediation and trade by 12-18 percent. Other sectors experienced large labor productivity increases of 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 services and the largest in manufacturing. The crisis did stop the growth of wages but the declines are not very large and rather typical in the public sector. This can be attributed to the abolishment of the 13th-month 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, 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 by 2010 as it lost 2 percentage points in addition. Manufacturing also lost from its importance in employment; from a share of 30 percent it went down to 27 percent by the middle of the period and its share further decreased to 23 percent by 2010. Community services employment also lost its share to some extent. The clear winner – at least by its employment share – is financial intermediation as this sector increased its share from a mere 5 percent to 11 percent. Trade and construction also increased their shares by 3 and 2 percentage points, respectively. Each public sector increased its employment by 1 percentage point.

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.

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8 In Figure 5 (and Table A5) we deflate wages by CPI, but in Table A6 we also present the number deflated by sectoral implicit deflators to show how wages changed in terms of output revenues in the sector.
9 One reason behind this large fall may be compositional changes in employment in the health services industry.

In the next section we discuss how we establish the relation between output, time and employment, the main ingredients for the forecasting.

3. ESTIMATION AND FORECASTING METHODOLOGY FOR THE 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 services) as the employment setting mechanism in these sectors is arguably different from 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 forecasting sheds doubt on the usefulness of such an exercise. Instead, 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 export demand for 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 the medium 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 shares of industrial employment and output in total employment and output in Hungary, respectively, *TREND* is a time trend, and ε is a random noise. 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 for more flexibility in employment adjustment:

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

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

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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 at the 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 estimating equation.

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

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 shares 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 industrial output values generated by the structural model. As a final step, we transform industrial employment shares into actual 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 a 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 anyway.

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

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

growing economy the level of output in an industry is more likely to grow even if its share in total output 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 in turn increases the labor costs of new hiring and thus has adverse effects on employment. To test for such effects, we include in the estimating equation the log of total output and we repeat 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 on 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 determines 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 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 their 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 industry level average wages from economy-level average wages. 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 estimation results for the regressions when the time series are used only through 2003 and the aim is to choose the equation with 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

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trend variable is negative in all four specifications. The resulting pseudo forecasts, as well as actual realizations of the employment shares are presented in Figures 6.1-6.4 for the four different specifications, and 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 sectoral employment shares 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 claim. For each sector, equation (3) always outperforms equations (2) and (4) while equation (1) produces similar (but mostly somewhat larger) test results. Average 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 and output share, lagged output share, and a trend.

4.2 FORECAST OF THE COMPOSITION OF 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 effect of lagged output share is negative only in 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 shows which industries will gain and which will lose employment in the future. The four sectors in which employment shares shrink by more than 1 percent are agriculture and 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 Panel A of Table 5 for the present (2010) and in the medium run (2015). 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. This already small share decreases to 3.3 percent in the medium term. 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 this industry declines to 27.6 percent by 2015. Employment in the construction industry is likely to grow by 2.5 percentage points in the next 5 years, while trade will increase its share from 24 to 27 percent. Financial services are also likely to increase their share by 2 percentage

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

points in the medium term. The other two sectors (transportation and community services) will experience only small changes in their employment shares according to this forecasting model.[14]

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 scale and productivity effects, we present in the lower panel of Table 5 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 displays the most dramatic pattern in this respect as the drop in employment share of 3 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 construct a figure – Figure 8 – which has on its axes the change in output share and the change in employment share in the medium term. Only manufacturing increases its share in output while the other 6 sectors decrease it to some extent.[15] The largest declines in output share are found in finance and trade, while the other industries keep roughly their present share. Employment shares, however, change very differently from output shares. The large output share growth of manufacturing is accompanied by the largest drop in employment share, while trade and finance increase the most their employment shares despite the relatively large losses in output shares.

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 various assumptions about international demand for Hungarian products. The growth of export demand was set at 3 percentage points higher (lower) than in the baseline to have forecasts for an optimistic (pessimistic) scenario (in the baseline model export demand growth was set to 7 percent annually). The volume of exports has a direct demand effect on

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14 Besides the predictions, the table contains information on 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.

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 increased export demand does not change the structure of employment at all. The largest change is measured for manufacturing, which has an output share increase of more than one percentage point, but its employment share changes only 0.3 percentage points. The other sectors' employment shares do not change at all.

The results for the pessimistic scenario are shown in Figure 10 and Table 7. Like high export demand, lower export growth has no effect on the employment distribution of corporate sectors.

In conclusion, alternative assumptions about export demand show that this will practically not affect the distribution of corporate labor in the medium term.

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, the share of transportation by 2 percentage points, while it decreases the share of construction by 3 percentage points and the share of financial intermediation by one percentage point. The inclusion of wages does not change any prediction by more than one percentage point. 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 variable used in the case of other sectors. Second, employment levels in the public sector are likely to be decided upon through a political process with its own logic, possibly unrelated to output. To test for the hypothesis

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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. Estimated coefficients are presented in Appendix Tables 6 and 7.

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 in each year the number of people who received any type of education.[17] Using this variable, we ran the following regression:

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

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 lagged 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 number of students and 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 ran similar regressions for the health sector.[18] In this case the variable of interest was the number of consultations by family doctors in a given year, the yearly number of working hours 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 days spent in hospitals) increase aggregate employment in health care by 2 percent. In the case when the variable of interest is hours worked by specialists, we estimate a negative coefficient 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 measure its effect on the number of workers (logged). This relationship is estimated to be negative and insignificant.[19]

To summarize, several difficulties arise concerning the forecasting of 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 translate quantities into value of output. Some measures of quantity can be used for education and health, but not for public administration. Second, the regressions that establish the relation between output and number of workers in the public

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[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.

[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.

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 for the measures of output and therefore accurate forecasts cannot be made for employment either. 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, we 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).

7.   EMPLOYMENT PREDICTIONS

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

According to baseline forecasts, total employment in 2015 will increase only marginally, by 25 000 workers. As we discussed before, the reason is the large increase in labor productivity which is likely to take place in future years as well as it happened in the past. The optimistic and pessimistic scenarios do not add/reduce employment to a large extent. If the volume of exports will increase faster than in the baseline scenario, the total number of employed will be 3 857 thousands while if export will be sluggish it will be 3 811 thousands.

Regarding employment by sectors, agriculture will lose the most workers in the next 5 years. By 2015, the number of workers in this sector will be only 95 000. Manufacturing will also lose about 83 000 workers. On the contrary, financial intermediation will gain almost 64 000 workers and employment in trade will grow by 92 000. The construction industry will also increase its number of workers by almost 80 000 persons if our forecasts are correct. Community services and the three public sectors will have a stable employment in the next several years.

As we showed in Section 4, larger (lower) export demand does not change the structure of 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 823 000, which is almost 20 000 more than in our baseline scenario. On the contrary, low export growth will result in only 788 000 workers employed in manufacturing. Trade will gain (lose) roughly 10 000 workers under the alternative assumptions about export growth. The remaining 5 corporate sectors will have changes in their employment of less than 5 000 workers.

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

8.   FORECASTING JOB REALLOCATION AND THE EMPLOYMENT EFFECTS OF FOREIGN OWNERSHIP

8.1 THE NATIONAL TAX AUTHORITY DATA

We use an additional dataset in this section, which comes from the National Tax Authority, and it provides balance sheet data for all legal entities engaged in double-entry bookkeeping. Comparison with the total number of companies by legal form from the Statistical Yearbooks of Hungary 1992-2008 reveals that essentially every formal sector employer is included in the data if the company is of limited liability (Ltd or joint stock), while the proportion of included partnerships gradually increases as the regulation changed and required them to engage in double-entry bookkeeping. The data are available annually from 2000 to 2009. The data thus provide information for a long period starting well before the dawn of transition and ending several years after the country's accession to the European Union. The firm-level data files include the balance sheet and income statement, the proportion of share capital held by different types of owners, and some basic variables, such as employment, location and industrial branch of the firm.

We cleaned both the firm level and individual datasets extensively. In particular, we cleaned firm ownership data, checking for miscoding and dubious changes. We also cleaned unbelievable data entries for employment. If the value of the variable increased (decreased) at least 8 times and then decreased (increased) back, we set the middle year's value to missing. In the case of employment, we first checked the time series manually and if it were possible, we imputed the value in the middle year. This procedure affected only a very small part of the dataset.

8.2 JOB REALLOCATION

This study has so far focused on forecasting employment levels and shares by sector to the year 2015. Another aspect of labor demand, to which we now turn, concerns job turnover. Even with a constant level of employment, many individual businesses will be expanding or contracting, and entering or shutting down. The resulting changes of employment for workers can have serious social consequences, again even if aggregate employment is constant. During periods of overall growth, some firms will be declining or exiting, and in periods of overall contraction, some firms will be expanding and others will be entering. This turbulence also categorizes individual sectors of the economy.

In order to measure the turnover, or reallocation, of jobs, we require data on individual businesses (firms or establishments) and methods for measuring the pace of reallocation. For data, we rely upon balance sheets provided by the National Tax Authority (NTA), described in the previous subsection.

One difficulty with the NTA data is that it appears that both the rules and the practice for including some legal forms (most importantly, partnerships) changed during the period. In particular, the data show a big influx of partnerships in 2004. Fortunately, we have been able to make use of information on the firm's founding date, with which we can elminate spurious entry. We have examined results both with and without partnerships to examine robustness with respect to this issue.

Our measurement methods draw upon work by Dunne, Roberts, and Samuelson (1989) and Davis and Haltiwanger (1992, 1999) which have set the standard definitions for all research in this area. Job reallocation (or turnover) in this literature is defined as the sum of job creation (JC) and job destruction (JD). Job creation is employment changes at expanding businesses (including entrants) and job destruction is the absolute value of employment changes at declining businesses (including those that exit). If employment is constant, then JC = JD, and job reallocation (JR) = 2JC = 2JD. JR is thus a measure of the degree of job-changing by workers associated with changes in levels of employment at employers. We define it separately for the 7 sectors used in this study.

For consistency, we use a similar forecasting method, in which we first forecast the shares of total JR by sector, and then compute the JR levels. As a first step, we obtain a forecast of total JR by extrapolating a linear regression of total JR on a time trend, the changes in the natural logarithms of employment and output, and a crisis dummy. Then we calculate the shares of each sector in total JR based on the NTA data for 2000-2009. Next, we forecast the sectoral JR shares by extrapolating from a regression of sectoral JR shares on a linear time trend, employment share, lagged employment share, a crisis dummy, and aggregate JR. Finally, we compute levels of JR for each sector based on these share forecasts.

Figure 11 shows the first step: historical and forecasted total JR for both samples (i.e., including and excluding partnerships). The shapes of historical plots are very similar, mostly differing because of the size of the sample, with some widening as time passes (reflecting an increased share of partnerships in the Hungarian economy). The forecasts imply fairly steady increases in the pace of job reallocation in both cases, with downward spikes associated with the end of the crisis period.

Figure 12 shows plots of the historical shares of sectoral JR in aggregate JR, again with and without partnerships. To a large extent, the trends mimic changes in employment shares by sector, and the rough pattern is similar in both samples. The forecast equation results are shown in Table 11. Even more than the employment level regression results, they suffer from the shortness of time series (only 9 observations in this case), reflected in some volatility in point estimates of coefficients and low levels of statistical significance.

Forecast results appear in Table 12 and Figure 13. The composition of aggregate JR is forecasted to change considerably, with a much smaller share coming from manufacturing, especially associated with the end of the crisis period. A smaller share is also expected in

agriculture, and much larger shares from construction, financial services, and other services. The trade share stays roughly constant.

Finally, Table 13 and Figure 14 show levels of JR by sector, computed on the basis of historical data and the forecasts.

8.3   THE EFFECT OF FOREIGN OWNERSHIP ON LABOR DEMAND

External markets are a major source of uncertainty in forecasting employment in Hungary. Our use of alternative paths for the evolution of real output are based on alternative scenarios for the development of export markets. In this section, we consider another source of external uncertainty: foreign direct investment (FDI) in Hungary. If foreign owners behave differently from domestic owners in the labor market, then changing patterns of FDI may affect the allocation of workers. Although this statement could hold in any economy, it holds a fortiori in countries like Hungary that have experienced large amounts of FDI in recent years.[21]

Our analysis considers two alternative scenarios for the evolution of FDI: first, we assume FDI remains constant at 2009 levels. Second, we assume that the share of FDI by sector follows a linear trend at the same pace as in the years 2000-2009. Doing this again requires micro-data at the firm level, to be able to measure ownership. Based on NTA data described in the previous section, Table 14 presents the historical values of these shares, and Figure 15 shows the two forecasts over the period 2010-2015. Clearly, the two scenarios lead to widely diverging levels of FDI across sectors.

To forecast employment by sectors conditional on these scenarios, we use the same specification adopted for estimating employment share equations by sector, with the addition of a variable representing the FDI share. The results, provided in Table 15, again suffer from the lack of time series observations, but the coefficients on FDI share are interesting. Positive coefficients imply that sectoral employment share is increasing in FDI share, while negative coefficients imply a decreasing relationship. According to these results, FDI tends to raise employment in all sectors except for trade and transportation, where foreign entry may displace domestic incumbents - for instance, as "big box" stores displace "mom&pops."

The results of the forecast conditional on a constant foreign share are shown in Table 16 and Figure 16, and the results assuming that foreign shares follow their previous trend are shown in Table 16 and Figure 17. In fact, different scenarios make little difference for the forecasted evolution of employment. Perhaps some more dramatic differences in future FDI patterns could have larger effects, but how to specify such scenarios is not clear.

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21 Studies of the impact of FDI on employment include Girma (2005), Gong, Goerg, and Maioli (2007) and Brown, Earle, and Telegdy (2010). By contrast with these firm-level studies, our sectoral approach in these forecasts takes into account possible spillover effects of FDI on domestic firms in the same industries.

9. CONCLUSIONS

The purpose of this study was to forecast the employment structure of the Hungarian economy in the medium term. We first selected the estimating equation from several specifications which has the best fit and then performed the forecast with the help of output predictions from a macroeconomic model. We find that the share of agriculture and manufacturing will decrease in the medium term and construction, trade, and finance will increase their employment shares 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 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 worth spelling out again the limits of this analysis, which affects most forecasting studies. First, as in any forecasting exercise, 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 international demand for Hungary's products. Second, we predict future employment shares 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. After a crisis, for example, the economy may get back to its natural growth 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 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 having made great efforts to expand the data beyond 1992, lack of industry level employment and output observations did not allow for it.

These difficulties notwithstanding, the robustness of the forecasts suggest that they are useful to gauge what the structure of employment 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 medium-term plans that are based on the industrial structure of employment in Hungary.

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