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## Short Description HWWI-Labor-Market-Monitor (As of: 25.11.2024)

### **Preliminary Remarks**

This brief description describes the basic principles of the model on which the HWWI labor market monitor is based. A detailed description will be provided promptly in the form of a working paper.

The HWWI labor market monitor provides data on the likely future development of the German labor market. The focus is on forecasting the future shortage of workers. To do this, the model, which was developed from scratch, uses a production function approach to estimate labor requirements and estimates future labor supply based on demographic forecasts and detailed microdata from the German microcensus. In its current expansion stage, the model enables a forecast of the regional labor shortage at NUTS III level (districts) for three qualification levels (people without a vocational qualification, people with a vocational qualification and people with an academic qualification) up to the year 2045, 10 professional groups and 20 dif-

ferent industries. The model also enables an analysis of the consequences of various scenarios in which the framework conditions are specifically changed (e.g. due to economic policy measures or changes in the behavior of economic participants).

The forecasts are essentially based on a dynamic labor market model, which, based on economic theory, models the labor demand of companies and compares this with the available labor supply. Whenever the demand for labor from companies exceeds the available labor supply, a labor shortage occurs.

### **Labor Demand**

A production function approach is used to forecast labor demand. This approach is based on the idea that the gross domestic product of a region has a fixed relationship with the production factors used in production. The HWWI model assumes that the production function is a neoclassical production function of the Cobb-Douglas type. The parameters of Germany's production function are then estimated using econometric methods.

Typically, two different production factors are used in estimates of macroeconomic production functions: the volume of work and the level of the real capital stock. Since this data is only available at an annual frequency and therefore a very long period of time would be

required for an estimate from time series data, the production function is estimated from cross-sectional data at the district level.

The necessary employment data can be obtained from the regional statistics at district level by the Federal Statistical Office. Data is available for three different qualification levels: employees without a vocational qualification, employees with a vocational qualification and employees with a university degree. There is no finer breakdown at the district level, so the HWWI model differentiates between these three qualification levels.

Data on regional capital stocks for Germany can be obtained from the national accounts of the states, but only at the federal state level. As part of the HWWI model, the capital stock data is regionalized at the district level using a shift analysis.

To estimate, the HWWI model uses data from the last pre-Corona year of 2019. Specifically, the following data sources are used:

- Regionaler Output
  - Statistisches Bundesamt (Destatis Tabelle 82111KJ008)
- Regionaler Kapitalstock
  - Volkswirtschaftliche Gesamtrechnung der Länder (Statistikportal des Bundes),

## Regionalisierung mittels Shift-Analyse

- Deflator für Output und Kapitalstock
  - Statistisches Bundesamt (Destatis, Tabelle 81000BJ019)
- Regionale Beschäftigte
  - Statistisches Bundesamt (Destatis, Regionalstatistik, Tabelle 13312KJ001)
- Regionale Zusammensetzung der Beschäftigten nach Qualifikationsstufen
  - Statistisches Bundesamt (Destatis, Regionalstatistik, Tabelle 13111KJ032)

Im Anschluss wird die optimale Arbeits- und Kapitalnachfrage der Unternehmen aus dem Gewinnmaximierungskalkül des Unternehmenssektors bestimmt. Aus der Ableitung der Gewinnfunktion nach dem Kapitaleinsatz und den drei Typen von Arbeit ergeben sich insgesamt vier Optimierungsbedingungen, aus denen die optimalen Niveaus für Kapitaleinsatz und die drei Arbeitseinsätze berechnet werden.

In diesen Optimierungsbedingungen taucht unter anderem die Rate des technischen Fortschritts auf. Diese wird auf Basis von Vergangenheitsdaten als Residualgröße geschätzt und mit den Prognosen

des Sachverständigenrats abgeglichen. Als Ausgangswerte für den Realzins und die Reallöhne werden deren Gleichgewichtswerte verwendet, die sich aus den Daten berechnen lassen. Sind diese Größen bekannt, so verbleibt für jeden Kreis und jede Qualifikationsstufe ein Gleichungssystem von vier Gleichungen in vier Unbekannten, welches über lineare Optimierung gelöst werden kann.

Im Ergebnis lassen sich auf diese Weise für jeden Kreis, jedes Jahr und für die drei Qualifikationsstufen getrennt die regionale Arbeitsnachfragen der Unternehmen berechnen. Die Berechnungsergebnisse hängen dabei auch von der unterstellten Rate des technischen Fortschritts (siehe oben) und dem unterstellten Reallohnanstieg ab. Im Rahmen des HWWI-Modells werden drei Varianten für den technischen Fortschritt und zwei Varianten für die Reallohnentwicklung gerechnet, was in der Kombination zu insgesamt sechs unterschiedlichen Arbeitsnachfrageszenarien führt.

Alle sechs Arbeitsnachfrageszenarien werden schließlich konjunkturell bereinigt. Im Boom steigt die Arbeitsnachfrage naturgemäß über ihren langfristigen Wachstumstrend (den das Modell vorausagt) an und fällt in der Rezession unter denselben ab. Für diese Konjunkturbereinigung des Arbeitsangebots werden Daten aus den Konjunkturbefragungen der Handelskammern verwendet. Relevant ist hier insbesondere die Einschätzung der aktuellen Geschäftslage und

der erwarteten zukünftigen Geschäftslage.

### **Labor Supply**

The optimal labor and capital demand of companies is then determined from the profit maximization calculation of the corporate sector. The derivation of the profit function according to the capital input and the three types of labor results in a total of four optimization conditions, from which the optimal levels for capital input and the three labor inputs are calculated.

The rate of technical progress appears in these optimization conditions, among other things. This is estimated as a residual value on the basis of historical data and compared with the forecasts of the Council of Economic Experts. The equilibrium values that can be calculated from the data are used as initial values for the real interest rate and real wages. If these values are known, a system of four equations in four unknowns remains for each district and each qualification level, which can be solved using linear optimization.

As a result, the regional labor demand of companies can be calculated separately for each district, each year and for the three qualification levels. The calculation results also depend on the assumed rate of technological progress (see above) and the assumed real wage increase. The HWWI model calculates three variants for technological

progress and two variants for real wage development, which in combination leads to a total of six different labor demand scenarios.

All six labor demand scenarios are finally adjusted for economic trends. In a boom, labor demand naturally rises above its long-term growth trend (which the model predicts) and falls below it in a recession. Data from the economic surveys of the Chambers of Commerce are used for this economic adjustment of labor supply. The assessment of the current business situation and the expected future business situation is particularly relevant here.

### **Forecast of Labor Shortages**

In the third and final step, the available labor supply is compared with the respective labor demand for each year and each region. If the labor demand exceeds the local labor supply, there is a labor shortage (to be more precise, this already applies when the rate of unavoidable, frictional unemployment is reached). For each combination of labor supply (24 variants) and labor demand (6 variants), a scenario with different labor shortages arises. This results in a total of 144 different scenarios that are calculated in the HWWI model.

After the labor shortage for the three qualification levels has been calculated for all scenarios, it can also be broken down into sectors or occupations. In principle, this is possible for the entire forecast

horizon using shift analyses. The sector breakdown is based on the current fine-grained sector structure. The sector breakdown in the HWWI model follows the WZ 2008 employer level.

To break down the numbers by occupation, the HWWI model uses the latest figures from the Federal Employment Agency on the number of vacancies, which are published monthly at the state level. The data make it possible to break down the labor gaps at the employer level of the Classification of Occupations (KldB 2010) using shift analysis. The HWWI model currently shows the labor gaps at the employer level.