The Economic Impact of Immigration in Germany

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Abstract

We have combined a simple demographic model and the 58 sector econometric simulation and forecasting model INFORGE (Interindustry Forecasting Germany) which has been successfully used in different areas, e.g. modelling the effects of CO_2 taxes and the liberalisation of the IT market on the German economy. The demographic model gives a forecast of the female and male age structure till the year 2010.

INFORGE is part of the INFORUM International System that links 13 national Input-Output models on the sectoral level via export and import flows as well as the corresponding foreign trade prices. The model has a high degree of endogenization. Only some tax rates and the world market variables of the international INFORUM system are given exogenously. The high degree of endogenization has the advantage that in simulations the effects are depicted completely. The labour supply is modelled using the population module. The occupied population can be calculated by linking the age structure to the labour force participation rate of women and men for different age groups. So we have the possibility to simulate the effects of different migration scenarios on the German economy, assumed the structure of migration is constant over time.

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1 INTRODUCTION AND RESULTS

All population forecasts for Germany and other European countries emphasise an increasing declination over the next decades in the case of constant fertility rates and immigration. Therefore long-term economic models have to deal with the economic effects of a declining population. The change in the age structure and the total population must be modelled to describe their influence on economic variables such as labour supply. Dowd et al. (1998) analyse the effects of a changing age structure on consumption for the USA. Bardazzi (2000) has done a similar study for Italy.

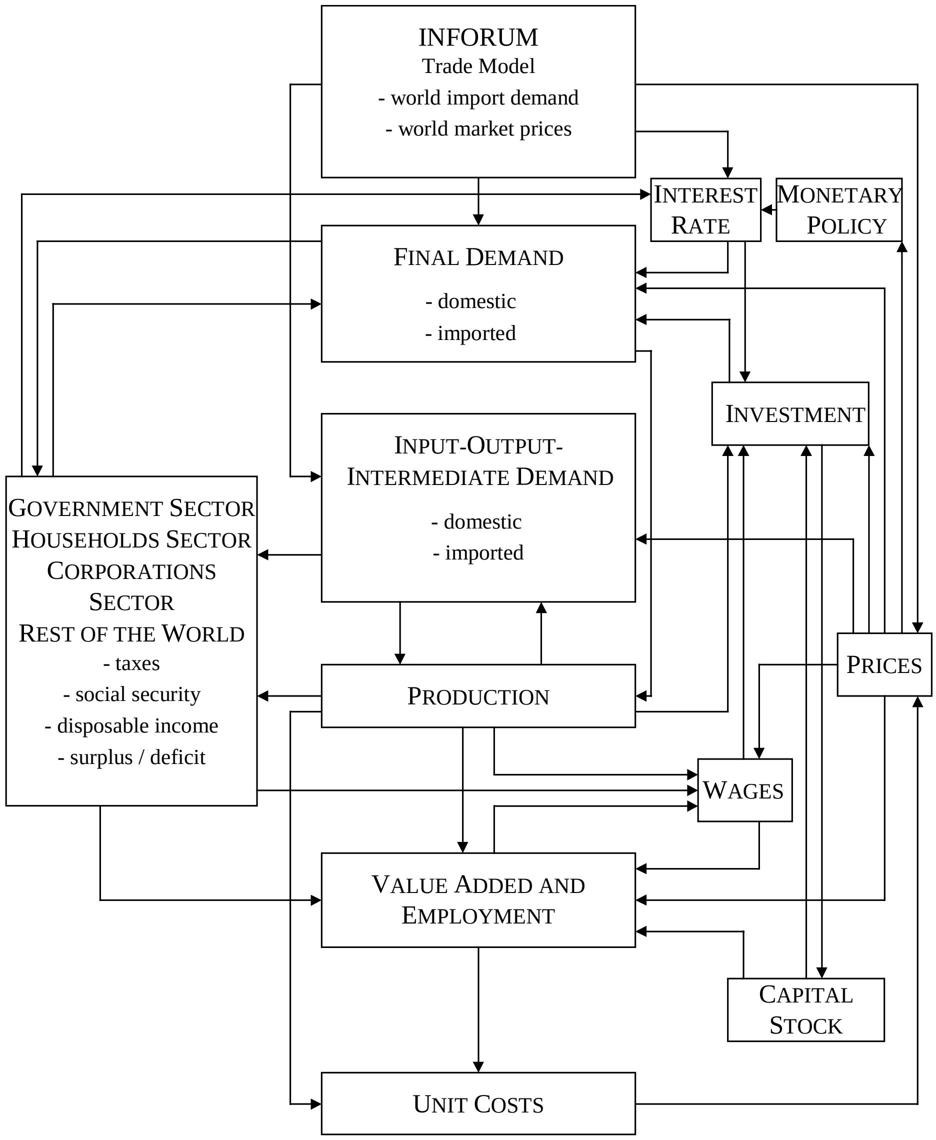
We use the econometric Input-Output (I-O) model INFORGE to show the effects of immigration on the German labour market and economy. The simulation period up to 2010 is chosen for two reasons. On the one hand, the time span is long enough to show clear differences between the immigration scenarios. On the other hand, it is short enough to use exogenous demographic variables such as fertility or death rates that will not strongly be influenced by economic variables. Section 2 gives a rough outline of the model. In the next section, a simple population module and its link to the economic model are described. It is used to explain the supply side of the labour market.

An important short-term component of population is immigration. To highlight its impact on the German economy, four different immigration scenarios are distinguished. The simulation results show higher immigration lowers wage rates and increases GDP. Whereas disposable income and private consumption rise, earnings and consumption per capita decline. In section 4 the simulation results for the different scenarios are shown and discussed.

2 THE MODEL INFORGE

INFORGE (Interindustry Forecasting Germany) is a 58 industry econometric simulation and forecasting model (Meyer, Ewerhart 1995). It is used for simulating sector effects of policy options within a macroeconomic framework. Recent applications include employment effects of the liberalization of the German telecommunication market (Distelkamp et al. 2000), the evaluation of environmental policy scenarios (Meyer, Ewerhart 1998, Meyer et al. 1999, Lutz 2000) and the economic impact of sports for the German economy (Meyer, Ahlert 1999).

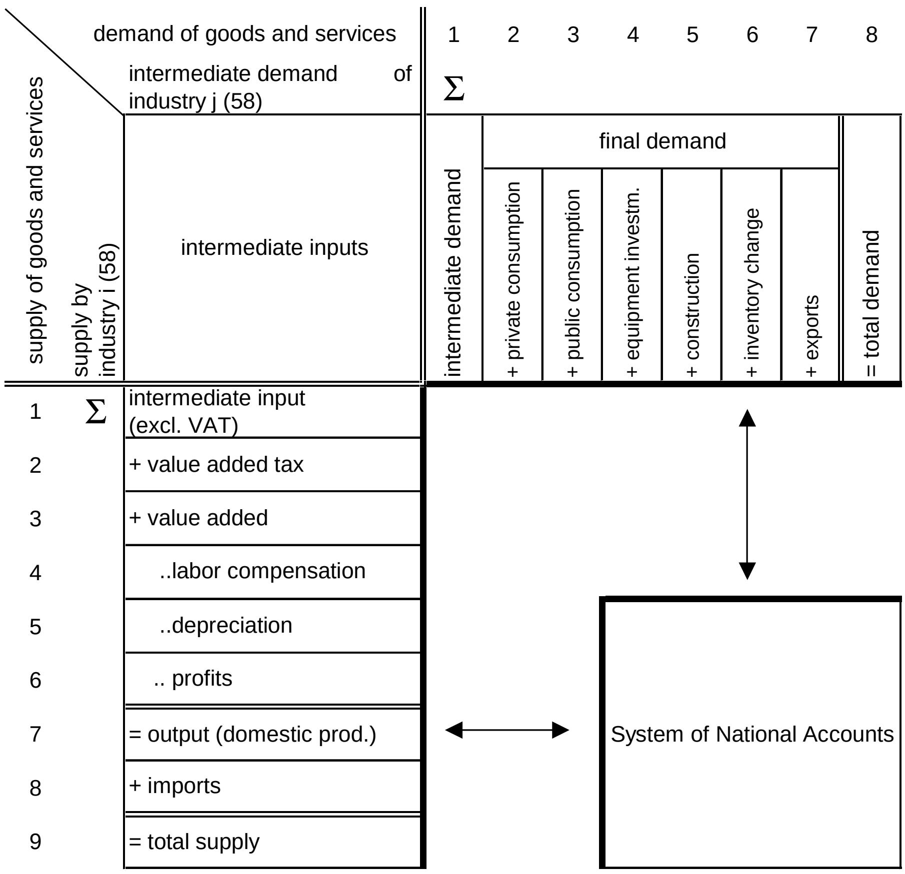
FIGURE 1
THE MODEL INFORGE



The performance of the model is founded on the INFORUM philosophy (Almon 1991). The dynamic econometric input-output model is built *bottom up* and *fully integrated*. *Bottom up* means modelling each industry in great detail and calculating macroeconomic aggregates by explicit aggregation within the model. The construction principle *fully integrated* contains the input-output structure, the complexity and simultaneity of income creation and distribution in the different National Accounts, its redistribution among the accounts, and its use for the different goods and services the industries produce in the context of global markets. Thus, the role of each industry in the interindustry relations, in the macroeconomic process and its integration into international trade is described properly (see Meyer et al. 1999 for a complete description of the model). INFORGE differs from other INFORUM country models in some country specific parts, but the description of the US model LIFT (McCarthy 1991) in connection with figure 1 gives a good idea of the model structure.

INFORGE is part of the INFORUM International System (Nyhus 1991) that links 13 national I-O models on the industry level via export and import flows. The system includes over 90% of world trade, as well as the corresponding foreign trade prices. The information gain of this system in comparison to isolated models allows for a reliable analysis of the contribution of exports for the performance of the German economy. Besides the goods markets the INFORUM International System also represents the international financial market, however less detailed. US interest rates as indicators for the international capital market have a strong influence on German interest rates and on German goods markets.

FIGURE 2
THE INPUT-OUTPUT DATABASE



The database for the economic part of the model consists of time series for Input-Output tables from 1978 to 1995 and the System of National Accounts (SNA) up to 1996. Figure 2 gives a short overview of the Input-Output database. The Input-Output tables from the German Federal Statistical Office contain primary and intermediate inputs for 58 industries and intermediate and final demand for 58 industries.

Final demand is modelled in great detail for 58 industries. Exports by industries are linked to the INFORUM International System. The export of each industry is explained by the world import demand of the particular product and the relation of the export price of that industry to the particular world market price. Imports of a product group are divided into intermediate imports and finished product imports. The latter are determined by real disposable income and the relation of the domestic price of the product to its import price.

The model distinguishes further equipment, construction and inventory investment for every industry. Investment in equipment and construction is mainly determined by real profits of the industry and real interest rates. Inventory investment is modelled by accelerator assumptions.

Behavioural equations for private consumption in constant prices are estimated for 26 expenditure categories. Disposable income of private households and the relation of the price index of the product group and a macro consumer price index are the main explaining variables together with the interest rate for consumer durables and some special influences like annual average temperature for heating expenses. Finally, the 26 categories are transformed via a bridge matrix into the consumption demand for the 58 product groups. The approach differs from the “perhaps adequate demand system” (Almon 1998) used in most INFORUM country models.

Input coefficients are variable and depend on relative prices and time trends. Material inputs are assumed to be complementary at the not observable level of the different products. But as in input-output tables only product groups are observed, their input coefficients are price dependent due to changes in the product mix of the sector (Georgescu-Roegen 1990).

Intermediate imports are observed for each of the 58 inputs in each of the 58 industries. A matrix of import ratios is defined, in which each element is variable and depending on the relation of the domestic price and the particular import price. Multiplying the import shares with total intermediate inputs in that cell yields intermediate imports.

Production is calculated as the sum of intermediate inputs and value added for each industry (see Figure 2). This equals the sum of intermediate demand and final demand minus imports for each industry.

Labour demand of every industry (measured in hours) is explained by its output, the deflated wage rate and a time trend. The wage rate of every sector is depending on the wage rate of the *automotive industry*, which is looked upon as a basic wage rate, and specific variables for every industry. The basic wage rate is explained by overall productivity and a macro price index. Wages are equal to the product of labour demand and the wage rate. The modelling of the wage bargaining process that differs from other INFORUM models points out the importance of strong trade unions in the leading metal industry sectors for the more corporate economic system in Germany.

From the other primary inputs, indirect taxes and subsidies are calculated as constant shares of gross production of the industry. Depreciation is estimated as a function of gross production. Profits finally follow as a residual. Unit costs are gained by dividing all cost components (intermediate inputs, wages, indirect taxes minus subsidies and depreciation) through gross production for each of the 58 industries.

Prices for 58 industries are determined by the mark-up hypothesis: Unit costs, competing import prices and the degree of capacity utilization explain the price of a product, another difference to other INFORUM models. The relation between price and unit costs is variable.

Additionally, the model describes the income distribution and redistribution. The detailed German System of National Accounts integrated into INFORGE includes the four sectors Government, Households, Corporations and Rest of the World.

The model INFORGE is highly endogenous. Only about 200 variables are exogenous, mostly fiscal policy instruments like indirect tax and subsidy rates for the 58 industries. From the variables representing the rest of the world only the exchange rates between the countries of the INFORUM International System are exogenous. All other variables, indicating the development on the global markets used for the determination of German trade, are calculated endogenously. Historical simulations, that are used to evaluate simulation models in the data base period, reveal very good results (Meyer et al. 1999, pp. 81-95).

INFORGE differs from Computable General Equilibrium models in different aspects. In the classification of West (1995) it is an I-O + Econometric model. In contrast to the neoclassical approach of optimisation, unemployment is permitted in these models. Markets are not necessarily cleared.

3 POPULATION AND LABOUR SUPPLY

3.1.1 Forecast of Population

The population module of INFORGE uses a simple technique to project population until the year 2010. To obtain population in year t+1, a base year population (1995) and some additional information about death rates, fertility rates and immigration are used. At the moment the population module is limited to West Germany. A population module for Unified Germany is under preparation.

The population of men by age i $bevm_i[t]$ and women $bevw_i[t]$ at the end of 1995 is the starting point of the calculation. In the following years, the population vectors are projected with almost constant death rates of men $szm_i[t]$ and women $szm_i[t]$:

$$bevw_{i+1}[t+1] = bevw_i[t] * (1 - szw_i[t])$$

$$bevm_{i+1}[t+1] = bevm_i[t] * (1 - szm_i[t])$$

In 1995, the average life span for a new-born female baby was 79,24 years. It increases to 79,53 years in 2010. Consequently, the population depends on the age structure in 1995 and the assumptions about the death rates.

The next step is to compute the number of births. Combining the vector of birth rates $gz_l[t]$ with the female population vector $bevw_i[t]$ gives the number of new born children for women of the age group i. Summing up over all age groups of fertile women (15 – 45 year old women), the total number of births can be calculated:

$$BIRTHS[t] = \sum_{i,l=15}^{45} bevw_i[t] * gz_l[t] \quad \forall i = l \in \{15,...,45\}$$

The development of total fertility rate is supposed to be almost constant over time. The total number of births is split up in male and female children by a constant gender proportion. It is assumed that out of 1000 births 487 children are female and 513 are male. The numbers of male and female births are multiplied by the gender specific infant mortality rate to get the number of surviving children (Bretz 1986, p. 255). These numbers are equal to the male and female population for the age group of persons younger than one year $bevm_1[t]$ and $bevw_1[t]$.

Additionally, immigration is modelled. As foreign developments and political decisions that will determine future immigration (Bretz 1986, pp. 239 and 250) are exogenous for a national economic model, we make different assumptions. In this first step, we assume the structure of immigration (by age, gender and qualification) to be constant over time. We only distinguish different scenarios for the total number of immigrants. The vectors of male and female immigrants are added to the corresponding population vectors.

3.1.2 Calculation of Occupied population

The occupied population EPP[t] consists of three groups. Firstly, the number of persons engaged ET[t]. Secondly, the number of unemployed people that are unemployed and registered at the labour exchange AL[t]. And thirdly, the number of unemployed people willing to work but not registered STR[t]. Adding up ET[t] and AL[t] yields the economically active population EP[t].

$$EPP[t] = EP[t] + STR[t]$$

$$EP[t] = ET[t] + AL[t]$$

Combining the labour force participation rate for men (eqm_k) and women (eqw_k) for people between 15 and 70 years old with both population vectors, the number of the occupied population can be calculated.

$$EPP[t]=\sum_{k,i=15}^{70} eqm_k[t]*bevm_i[t]+\sum_{k,i=15}^{70} eqw_k[t]*bevw_i[t]\ \forall i=k$$

The number of persons willing to work but not registered at the labour exchange STR[t] is estimated by the occupied population and the unemployment rate (ALQ[t]). The economically active population results as the difference between EPP[t] and STR[t]:

$$EP[t] = EPP[t] - STR\{EPP[t],ALQ[t]\}$$

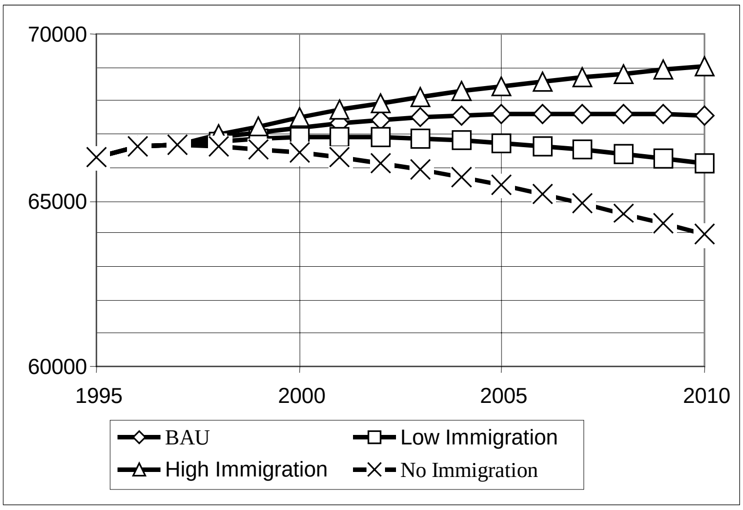
EP[t] is equal to the actual labour supply (Fuchs 1998, p. 114). The labour demand, the persons engaged ET[t], is calculated in the economic part of INFORGE.

4 SIMULATION RESULTS

To show the importance of immigration in the short run, four different scenarios are distinguished. One scenario assumes a total number of 250000 immigrants per year until 2010, keeping the West German population almost constant until 2010. It is called "business as usual" (BAU). In the other scenarios immigration per year is set to be 350000 ("high immigration"), 150000 ("low immigration") and zero ("no immigration"). All other assumptions about economic (tax rates, exchange rates etc.) and demographic (death rates, fertility rates etc.) variables are the same in all scenarios. Differences in model results can be traced back to different assumptions about immigration (Pindyck, Rubinfeld 1998).

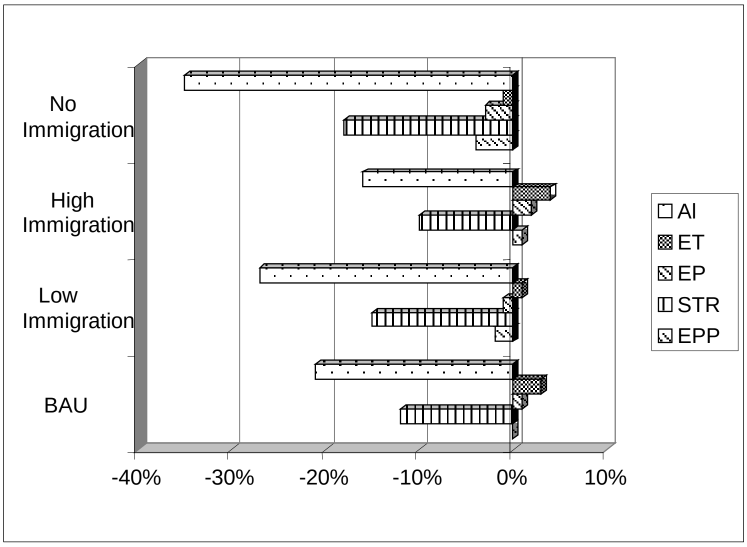
Figure 3 shows the difference in total population for West Germany. In the year 2010, population amounts to 69 millions in the scenario „high immigration". In the scenario „no immigration" population declines to 64 million persons.

FIGURE 3
DEVELOPMENT OF POPULATION IN 1000S FOR FOUR SCENARIOS



For each scenario, the developments of the number of employees ET[t], the number of unemployed people AL[t], the economically active population EP[t] and the number of persons willing to work but not registered at the labour exchange STR[t] are shown in Figure 4:

FIGURE 4
THE LABOUR MARKET –
PERCENTAGE CHANGE FROM 1995 TO 2010



In each scenario, the number of unemployed (AL[t]) and not registered persons (STR[t]) decline sharply. The reason is that the economically active population (EP[t]) declines faster than the number of persons engaged ET[t]. It is remarkable that the number of unemployed AL[t] declines independent of the immigration. Even in the scenario „high immigration“ the number of unemployed is reduced by 15% until 2010 compared to the year 1995. This is equal to a reduction of unemployment of 600000 persons in West Germany. Another result of the simulation is that a noticeable increase of persons engaged ET[t] only takes place if the immigration is 150000 persons and more.

In Table 1, the influence of different immigration scenarios on the labour market is depicted for the year 2010. Compared to the BAU, the number of unemployed people will be 8.58 % lower without immigration in 2010.

TABLE 1
- LABOUR MARKET –
PERCENTAGE DEVIATION FROM THE BAU SCENARIO IN 2010

	No Immigration	Low Immigration	High Immigration
Unemployed Persons	-8.58	-2.52	3.39
Engaged Persons	-3.20	-0.96	1.28
Basic Wage Rate	5.35	1.49	-1.91
Consumer Prices	1.46	0.44	-0.58
Productivity	2.28	0.63	-0.81
Unemployment Rate	-4.88	-1.37	1.81
Unit Costs	2.29	0.66	-0.86

Higher immigration leads to an increasing labour supply. With an increasing labour supply, the basic wage rate grows more slowly. Consequently the number of persons engaged ET[t] increases. Table 1 shows the deviation from the BAU scenario with an immigration of 250000 persons per year. If the immigration is lower than in the BAU scenario, the basic wage rate rises faster and vice versa. The reason is that higher immigration increases labour supply, which itself raises the unemployment rate. Higher unemployment reduces the raise in wages, which increases employment in the following year. The same argument is valid for the consumer prices. Lower wages induce lower unit costs and therefore consumer prices are reduced.

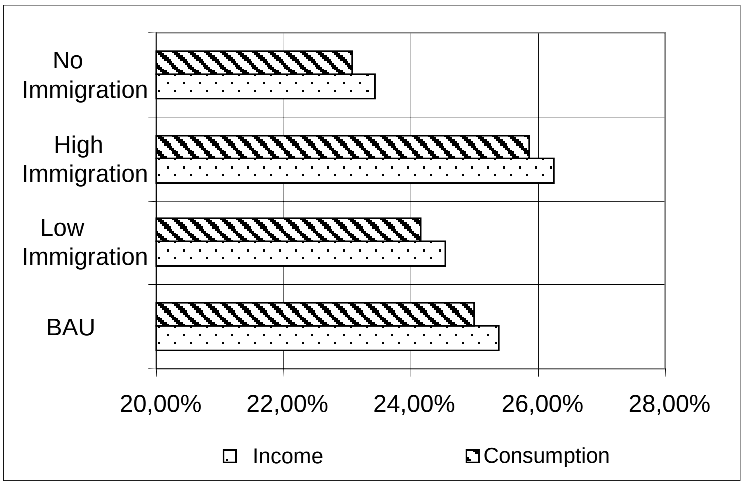
TABLE 2
– COMPONENTS OF GDP IN CONSTANT PRICES –
PERCENTAGE DEVIATION FROM THE BAU SCENARIO IN 2010

	No Immigration	Low Immigration	High Immigration
GDP	-1.70	-0.54	0.72
Private Consumption	-1.52	-0.50	0.67
Public Consumption	-2.07	-0.63	0.82
Equipment Investment	-3.80	-1.19	1.60
Construction	-1.44	-0.46	0.62
Exports	-0.30	-0.09	0.11

Table 2 shows the deviation from the BAU scenario GDP and its components. Higher immigration leads to higher GDP. If the immigration is lower than in the BAU scenario, GDP and all components are reduced. Investment in equipment and consumption are strongly reduced whereas exports are nearly not affected. They depend on world demand and the relation of German export prices to the corresponding world market prices.

Disposable income and the total consumption expenditure in constant prices increase with the number of immigrants (Figure 5). Income per capita and the consumption per capita decline with higher immigration.

FIGURE 5
DISPOSABLE INCOME AND CONSUMPTION EXPENDITURES IN CONSTANT PRICES – PERCENTAGE CHANGE FROM 1995 TO 2010



To summarize the simulation results: The higher the number of immigrants per year, the higher the growth of GDP and its component. With higher immigration labour supply increases and therefore wages and the unit costs decline. Although total consumption and disposable income increase with population, individual earnings and income decline because population grows faster than production.

The incorporation of population into INFORGE gives plausible results. The approach shows that the change in population is useful to understand future effects on economic variables.

5 FURTHER EXTENSIONS

A simple possibility to include demographic changes into economic models is shown. Further progress can be expected from integrating effects of demographic change on the social insurance system and the consumption structure. Currently, a population module for Unified Germany is prepared. The link between the social insurance system and the population model is planned. It is supposed to give information about the future costs of the social insurance pension system in Germany and its effects on the whole economy.

INFORGE is open to other sets of demographic assumptions or model results to be integrated. As it was already used to project the economic development up to the year 2030, it might even be linked to a more sophisticated demographic model. Other extensions can be the integration of different types of households distinguished by income or number.

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