Decrease of employers social contributions: A simulation exercise with a new Austrian INFORUM model

Christoph Hammer, Elisa Huber
Vienna University of Economics and Business

May 20, 2012

Abstract

This paper aims at demonstrating our approach to specify employment and wage equations on a sectoral level in the Austrian "AEIOU II" econometric input-output model, which is a member of the mutually linked world-wide family of INFORUM input-output models. Employment is a key element of the "price side" of any such model. Not only is employment the necessary multiplier to transform sectoral wage rates into corresponding wage bills but it might be as important in determining the wage rate itself via the role of unemployment in wage bargaining. A model of this dimension is never completed but we investigate improvement potentials for employment estimation in this work. In line with many other INFORUM models estimation of employment will be affected via estimation of sectoral labour productivities. Despite the need of the estimates being economically reasonable and statistically signicant, they also should prove useful in the forecasting environment. Since we want to demonstrate the capabilities of this model with a simulation which reduces overall costs of the factor labour, we will also show the wage specifications in this article.

1 Introduction

The latest Austrian INFORUM[1] model is an econometric input-output model which determines a wide variety of macroeconomic variables endogenously through estimated dynamic equations and the use of the Leontief quantitity- and price identities. With the exception of some aggregate variables such as the unemployment rate almost all variables are calculated for 60 activities[2]/products, which is more than the official 57-sector classification of Statistics Austria. The specifications for some of them will be explained in more detail in section (3).
Once all equations are estimated, the model can be used to perform forecasts of the Austrian economy. Its main purpose however is to create a reasonable "base case scenario" which then works as a benchmark for policy simulations. The complete model including all estimation equations is coded in R. An asset of this model which distinguishes itself from other macro models is the capability of observing shifts between sectors. So we can carry out a more detailed analysis of changes after we simulate a shock. One such simulation will be demonstrated in chapter (4), where we reduce employers social contributions to mark a reduction of overall labour costs for firms, which in turn lowers prices. We then study the induced changes relative to a base case scenario in chapter (5). Chapter (6) summarizes and concludes this article.

2 The Austrian INFORUM Model

Figure 1 shows an overview of the parts of the model and sketches the iteration cycle by which the model is solved. It consists of a "price-income side" where components of value added and auxiliary variables are specified for 60 activities:

- capital stock[3]
- employment by activity in full time equivalents
- aggregate wages and sector wages

[1]The interindustry forecasting models have their origin at the University of Maryland (hence the name INFORUM) and today there is a set of countries in which such models are being developed.

[2]We sometimes use the term "sector" if we mean either activity or product. The value added part of the model is classified in activities, the final demand part of the model is classified in products.

[3]The capital stock is used as one regressor in the employment equations. It was estimated following Statistics Austria calculation.

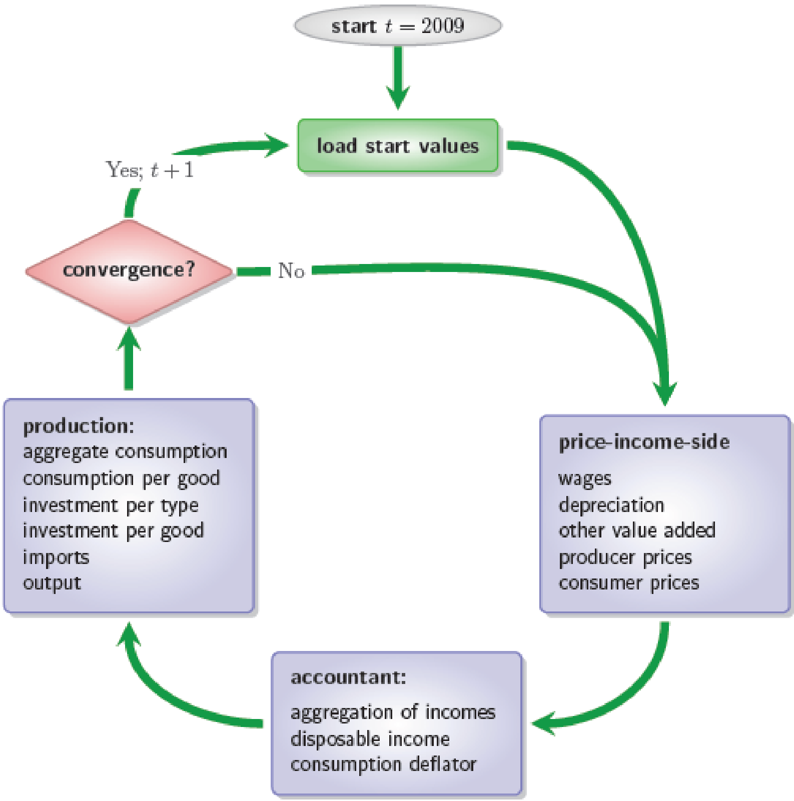

Figure 1: model overview, iteration cycle

Primary income distribution	Payment	Receipt
Operating surplus		6.507
+ Mixed income		22.392
+ Compensation of employees		120.004
+ Property income, received		21.110
- Property income, paid	2.953	
= Balance of primary income, net	167.060	
Secondary income distribution:		
Balance of primary income, net		167.060
+ Social benefits other than s.b. in kind		48.334
+ Other current tranfers, received		7.047
- Current taxes on income and wealth	25.581	
- Social contributions	43.011	
- Other current transfers, paid	6.676	
= Disposable income, net	147.173	

Table 1: Calculation of disposable income of private households 2005 in Million Euros

- aggregate unemployment rate
- depreciation rates
- operating surplus

The accountant determines the disposable income of households on an aggregate level by using the official calculation scheme of Statistics Austria. Table (1) shows the calculation for 2005, which is our base year[4]. Once determined, disposable income will then be used as regressor in the consumption estimations and therefore constitutes an important link between the price side and the production side of our model.

The third building block represents the "real-" or "production side" which includes the specification of:

- consumption of private households, government and non-profit organisations, whereas the latter two are exogenously fixed
- investment by type[5]

[4]The input-output table we use is the 2005 version. Price indices are normalized by 1 in 2005.

[5]Investment is first estimated for 15 categories and later split up in the usual 60 products classification.

- imports
- exports, which are estimated by the INFORUM “Bilateral Trade Model” (BTM[6]) and are therefore exogenous in our model

Finally output and price vectors are calculated via Leontief quantity and price model:

$$x = (I - A)^{-1} * fd \quad (1)$$
$$p = (I - A_D^{'})^{-1} * (v + t + A_m^{'} p^*) \quad (2)$$

x denotes the output vector for 60 goods/sectors, $(I - A)^{-1}$ is the Leontief inverse and fd denotes the vector of final demand. Prices in our model can be interpreted as mark-up over costs. The producer price vector is determined by the Leontief inverse (using only the domestic version of A[7]), v denotes the value added per unit output, t taxes per unit output and $p*$ import prices.
With the model set up, we then start forecasting and thus building a base case scenario by iterating the model until production output does not change any more, which is our convergence criterion for each year. In the next chapter we want to show the determination of employment and wages in more detail since we aim at simulating a reduction of employers social contributions and its impact on the most important variables.

3 Employment and Wages

In modeling the labour market we need to specify equations for determining labour (in full time equivalents) and wages per sector to ultimately get the desired total gross wage bill per sector.

3.1 Employment per sector

Employment is determined in a similar approach to other INFORUM models in first estimating labour productivity ρ and then retrieving employment per sector by transforming the estimation equations.
Equation (3) shows a typical regression for labour productivity, which is very

[6] It is sometimes called the INFORUM world model because it connects a variety of country models.

[7] A represents the matrix of input coeffients, A_D its domestic version and A_m denotes the matrix of import coefficients.

similar to the Spanish MIDE, the Chinese MUDAN or the Thai TIDY model. The US American LIFT model also used this specification for 30 years[8].

$$\rho_j = ln(\frac{X_j}{L_j})_t = \alpha_0 + \alpha_1 t + \alpha_2 ln(\frac{C_j}{L_j})_t + \alpha_3 X_{jUP} + \alpha_4 X_{jDOWN} + ln(\frac{X_j}{L_j})_{t-1} \quad (3)$$

Productivity ρ per sector j is defined as the log of output X_j per unit labour L_j (in full time equivalents), t is a simple linear time trend, C_j denotes the capital stock per sector, X_{jUP} and X_{jDOWN} are positive and negative deviations from last years output respectively. We expect a positive sign for α_2 since a higher capital endowment per unit labour should increase productivity. Earlier studies pointed out that productivity behaves pro cyclically therefore we expect α_3 to be positive and α_4 to be negative[9].
One interpretation for these variables could be labour hoarding. Firms don´t usually lay off workers immediately in a downturn and the opposite is true for upswings, at least when those deviations are expected to be short in time. Firms initially try to meet the rising demand by working overtime before hiring new labour.
In sectors with volatile output and/or employment we had to include a first lag of the dependent variable to improve the fit. If the estimation of equation (3) did not yield the expected signs and/or insignificant coefficients then we dropped those variables from the particular regression. Leaving insignificant but economically reasonable variables in the model often led to explosive behaviour of single sector variables. It is worth noting that the capital stock variable was insignificant in most sectors. This is a known problem, which was also encountered by the LIFT model for example. There are attempts[10] to overcome this weakness with a more detailed specification for estimating the capital stock. Unfortunately due to unavailable data we cannot use these approaches. In some sectors the underlying data is of very questionable quality leading to decreasing productivity even over the very long run. If we encountered decreasing productivity to an unrealistic extent we fixed the productivity growth by its historical mean growth rate (1976-2008).
After estimating labour productivity we transform equation (3) to obtain employment per sector

$$L_j = \frac{X_j}{exp(\widehat{\rho_j})} \quad (4)$$

[8]Meade (1999): "Thirty years have passed (...), and we are no closer to a labor productivity equation that incorporates capital, research and development or any other significant influence we believe should be working."

[9]We had to use absolute values in calculating these deviations.

[10]see [Wilson(2001)] for example

where $\widehat{\rho_j}$ denotes the estimated productivity per sector (ie. the right hand side of equation (3)).

3.2 Wages per sector

The second step of our procedure begins with the assessment of the aggregate wage rate $\frac{W_j}{L_j}$. We use as explanatory variables the deflator for private household consumption P_{CPI} and the unemployment rate u. Consistent with a Philips-curve interpretation we would expect a positive sign for the coefficient of the price level, and a negative sign for the unemployment coefficient.

$$ln(\frac{W_\Sigma}{L_\Sigma})_t = \gamma_0 + \gamma_1 P_{CPI,t} + \gamma_2 u_t \quad (5)$$

As equation (6) below indicates, we assume the growth of the sectoral wage rate simply to be a proportional function of the overall wage rate growth. The interpretation of the single coefficient in this equation is straightforward: If $\beta > 1$ then the wage rate of sector j grows relatively faster than the average, if $\beta < 1$ the opposite is the case.

$$\Delta ln(\frac{W_j}{L_j})_t = \beta_j \Delta ln(\frac{W_\Sigma}{L_\Sigma})_t \quad (6)$$

W_Σ denotes the overall wage sum (i.e. summed over all sectors) and L_Σ the overall employment figure.
Again to obtain wages per activity, equation (6) is transformed. Finally we multiply employment and wages per activity which yields the desired gross wage bill GW_j for each sector, ie total wages paid in one year in a sector.

$$GW_j = W_j * L_j \quad (7)$$

The reason for splitting up the definition of the wage rate per activity in this fashion is the centralized type of wage bargaining in Austria. Wage demands in the various sectors are usually formulated relative to those of a sector functioning as bargaining leader. Econometrically, equations (6) and (5) could be estimated in one step but with the loss of identifiability of coefficients γ_1 and γ_2. The latter was introduced for possible future analysis of alternative wage bargaining policies.

4 Base Case Scenario

In order to evaluate our simulation we first have to run our base case model to derive a benchmark. Here we want to sketch the most important variables which are later compared to the simulation results. Note that our forecast starts with 2009, as data for time series estimations is only available until 2008.

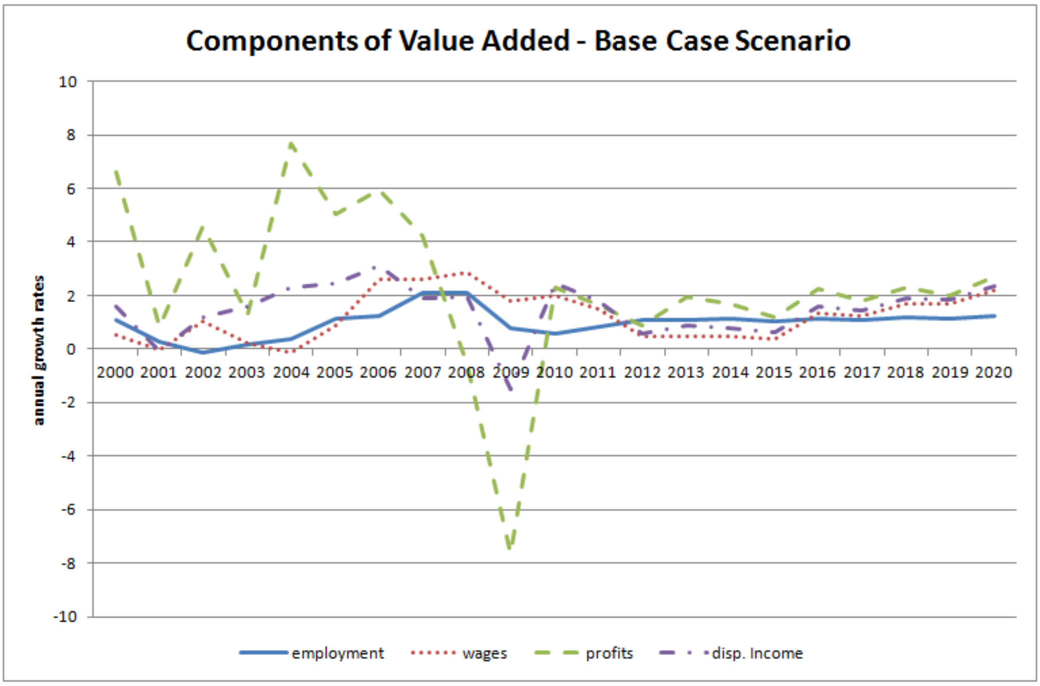

Figure 2: va components growth rates base case

As expected from the crisis years, we see a sharp decrease for all components of value added (see figure 2). However the forecast indicates a relatively fast recovery of growth rates to their pre-crisis level. Growth rates since 2009 are simulated values, so they might not reflect already available data perfectly.
Figure 3 shows growth rates of components of final demand. Again, we observe a sharp decrease in 2008 and 2009, which illustrates the impact of the crisis. Government consumption is assumed to grow at a fixed rate of 2%. Investment shows strong cyclical (and in the very long run explosive) behaviour. This indicates the necessity of modeling investment equations differently. Again we want to stress that we do not aim at forecasting every variable in perfect precision up to some date but to get an impression of overall reasonable trends.

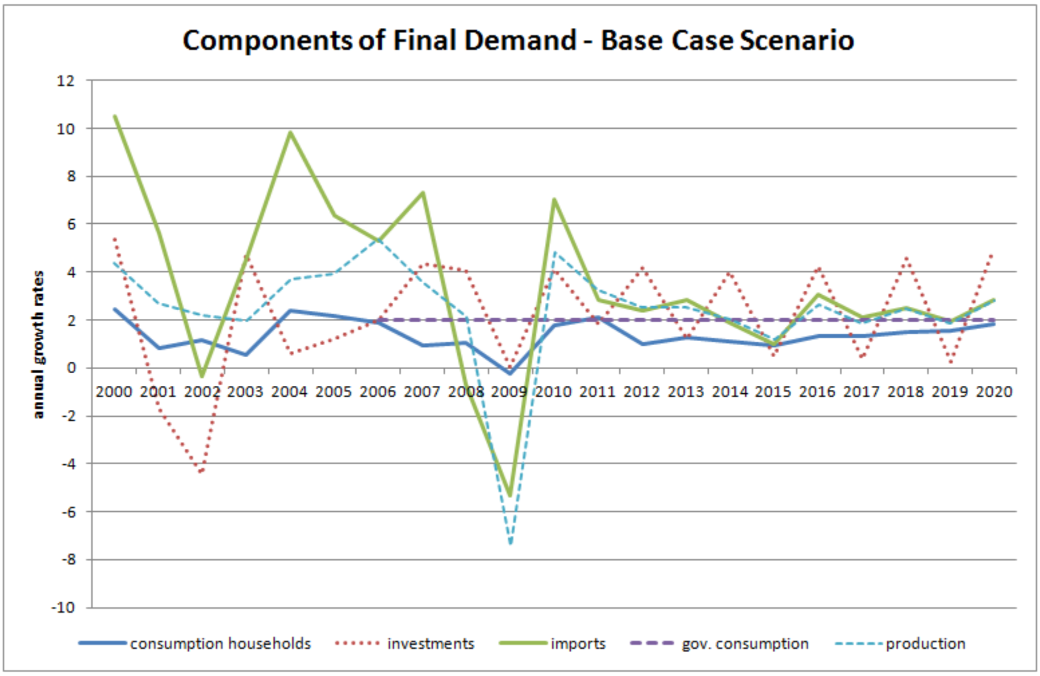

Figure 3: fd components growth rates base case

5 Decreasing social contributions of employers - a simulation

Our model is not only capable of performing forecasts of all the endogenous variables but can also be used to simulate a change in the system and its impact even on the sectoral level. We now turn to a simulation which uses the parts of the model described above. One interesting issue often discussed in politics is the overall cost of the factor labour. We now want to simulate a 2% decrease in the social contributions of employers, which should decrease the costs of labour for firms. First we change the model accordingly and then compare the base case scenario to our new forecast with the lowered social contributions. Employers social contributions are part of government income, so if we lower them, we either increase the debt or cut parts of government spending. Since we do not model government debt we have to lower government expenditure accordingly. This step has not yet been implemented but it should not change the overall directions of the effects. Again we want to point out that the shock will be implemented on the "price side" of the model.

5.1 Implementation

Data availability restricts possible approaches to implement the desired change. Social contributions of employers are part of the overall gross wages that firms have to pay and enter our model at two stages. They are part of wages per sector W_j, so they are included in all estimations. Secondly they enter the calculation of disposable income in the "accountant" (see above). So if we want to decrease the social contributions of employers we have to lower the gross wage bill per sector accordingly and modify the calculation of disposable income since disposable income which enters later in the consumption estimations must not change (at least not nominally as a "first round effect").
As mentioned, we decrease the part of the wages which should change the prices but not the nominal disposable income of households, since employers social contributions do not show up on employees bank accounts and hence do not influence consumption. By lowering the gross wages we achieve the desired lower prices (see Leontief price equation above). Regarding the calculation of disposable income, there are different possible approaches. Since the calculation of income uses gross wages[11], a decline of social contributions is "interpreted" by the accountant as lower wages and hence calculates a lower income of households. This creates the need of compensating this "loss" of income.
In a first attempt we compensated the alleged loss by a fixed sum, representing the loss in 2009 but this only solves the problem for this one year. An automatic compensation is not possible since this would require calculation of 2 different model set-ups at the same time. Additionally our "intervention" would be too restrictive, disposable income should remain a (at least semi-) endogenous variable.
So what we ended up with is the following approach. We begin by substracting 2% from the sectoral social contributions in 2005, the only data point we have regarding the distinction of paid wages and employers social contributions on the sector level. We next derive the implied decrease of gross wages which obviously differs from sector to sector. In a last step we substract the calculated decrease from equation (7), so we have to imply that the ratio at which we lower the sectoral wages keeps constant throughout the simulation period. We now have an alternative gross wage bill per sector which enters the price determination by lowering the value added per unit output v (see equation(2)) leading to lower prices. To avoid the need of intervening in the accountant, with all the problems described above, we use the "normal" gross wages as specified in chapter 3. Basically we now use two different wage

[11] We do not yet have time series data which separates paid wages and social contributions.

variables, the lowered one enters the price determination and the unedited version enters calculation of disposable income. We argue that the calculation scheme of the accountant substracts the employers social contributions anyway but -and this is the crucial part- on the basis of estimations. So we leave estimations of sector wages and the determination of nominal disposable income of households untouched and only use lower gross wages at the price determination. This ensures that we keep the important connections endogenous.

5.2 Simulation Results

After implementation of the change in the system we again run the model up to 2020 and examine the deviations from the base case scenario. All graphs show the yearly difference from base case to the simulation in absolute values and their share of the base value to get an impression of the size of the effect.

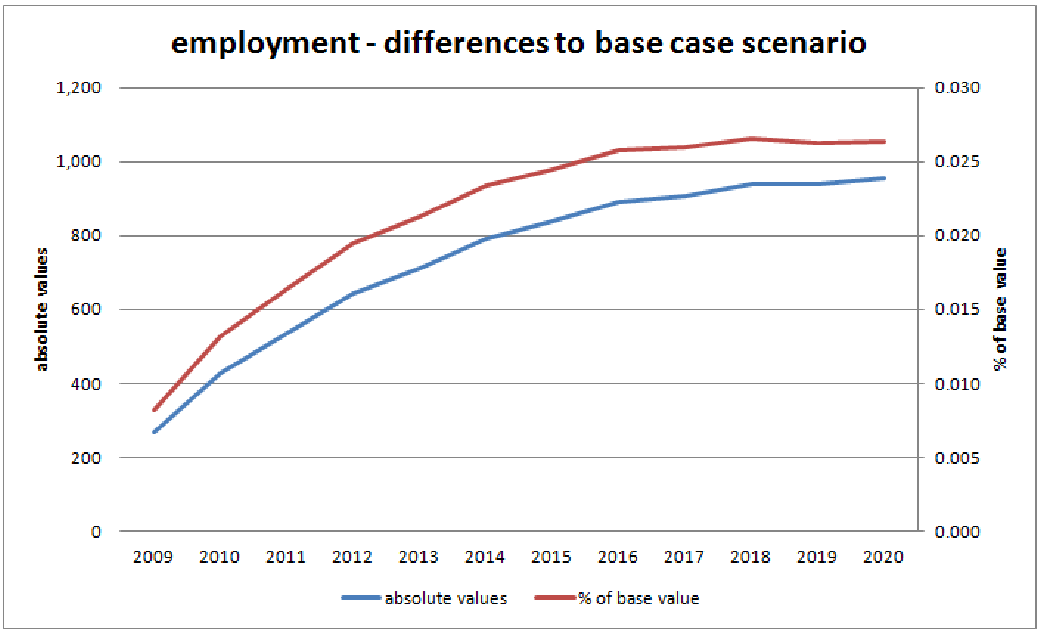

Figure 4: employment

We start with the new employment figure. As can be seen in figure 4 overall employment is increasing throughout the entire simulation period. In 2020, 1000 more jobs (in full time equivalents) are created due to our reduction of social contributions. The (small) increase mainly works through increased production. Most jobs are created in sectors CPA 45 (construction work), CPA 33 (medical-, precision- and optical instruments, watches and clocks), CPA 17 (textiles) and CPA 55(hotel and restaurant services).

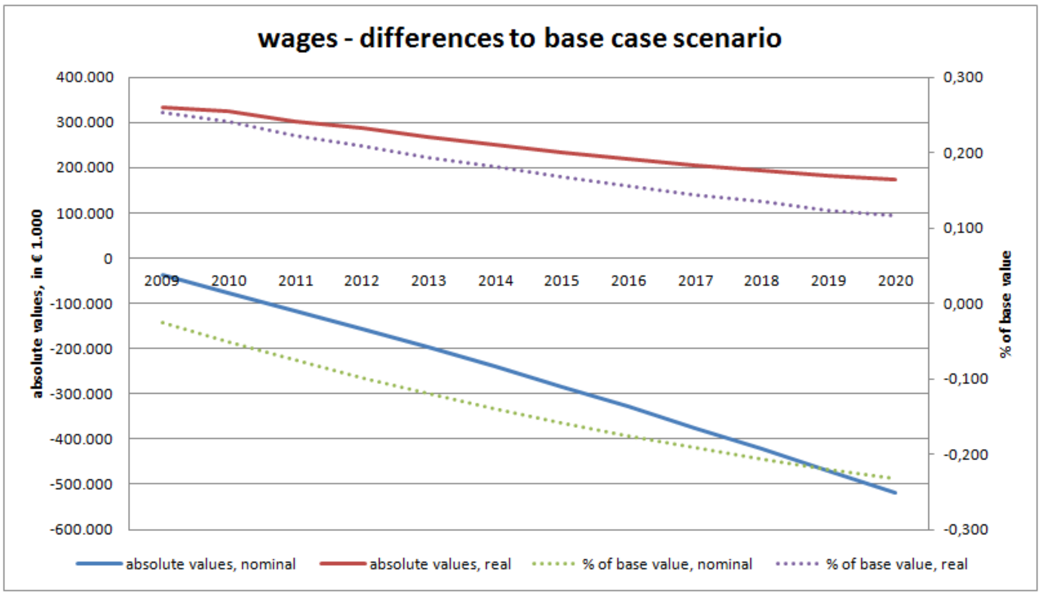

Figure 5: wages

Next we look at the differences in the gross wage bill (figure 5). One can see that nominal wages decrease since overall prices go down (which was intended). Nevertheless, since prices decline, real wages increase by about 0.17% or 180 million Euros in 2020. The biggest decline in nominal wages appear in CPA 74 (other business services), CPA 80 (education services), CPA 75 (public administration services) and CPA 85 (health and social work services).

As can be seen in the next graph 6, real disposable income increases due to lower prices, which will turn out to boost consumption expenditure.

Most additional consumption of private households are created in sectors CPA 34 (motor vehicles, trailers and semi-trailers), CPA 66 (insurance and pension funding services) and CPA 70AI (imputed rental services). Interestingly there are also few sectors with declining consumption, eg. CPA 55 (hotel and restauration services). Overall, aggregate consumption increases relative to the base case scenario as can be seen in figure 7.

Further due to declining domestic prices imports also shrink as can be seen from figure 8. Sectors with most declining imports are CPA 28 (fabricated metal products), CPA 29 (machinery and equipment) and CPA 15 (food products and beverages).

At this point we want to stress that the deviations from the base case sce-

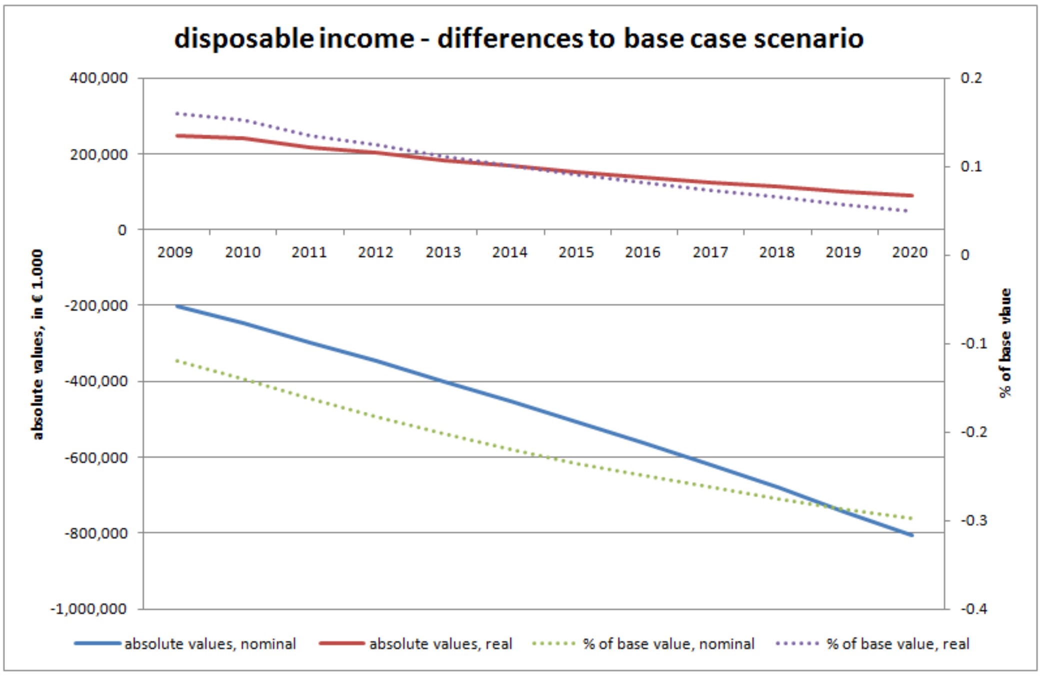

Figure 6: disposable income

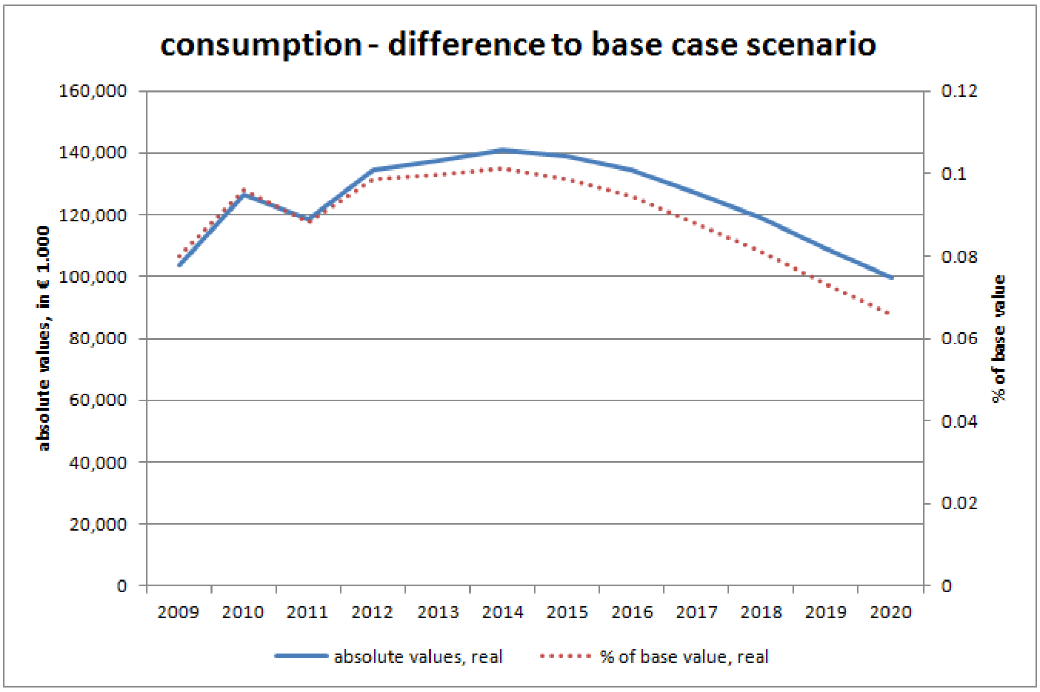

Figure 7: consumption expenditure private households

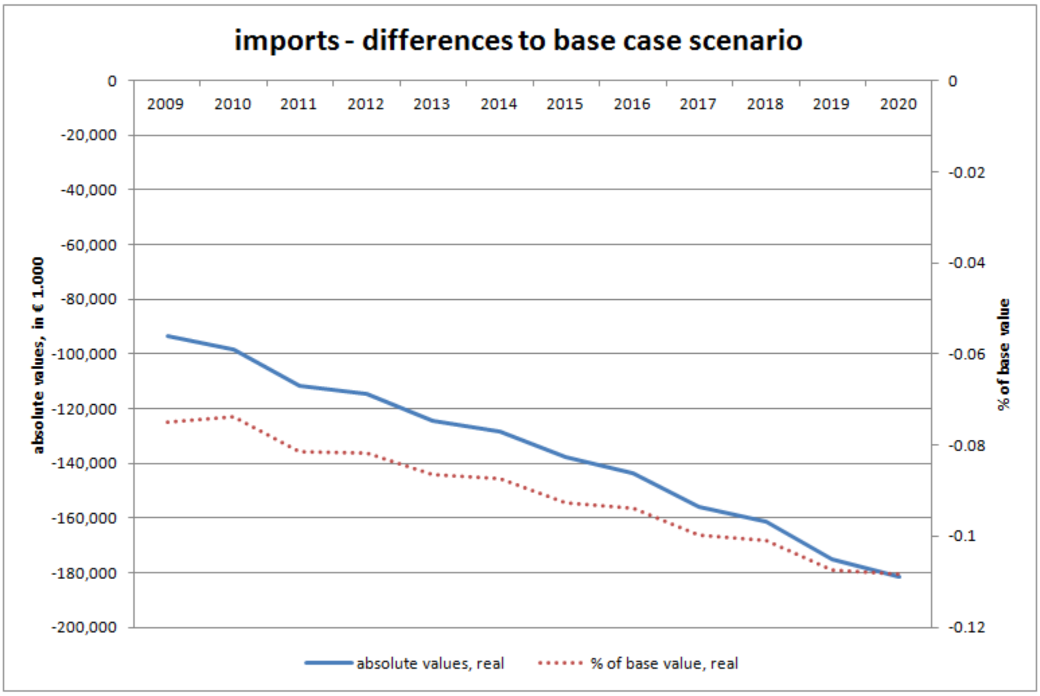

Figure 8: imports

nario are not very large in magnitude. We only lowered social contributions by 2% which translates into a decrease of the wage sum of about 0.5%. We chose the size of the simulation by looking at the implicit costs of this policy. Our simulated shock accounts for about 1.4 to 1.8% of yearly government expenditure, which grows exogenously by 2% each year in the base case. In our case the size of changes is almost proportional to the chosen size of decrease in social contributions.

Investments (see figure 9) are modeled as functions of earlier investments, a proxy for replacement investments and real output expressed in terms of inputs. Investment decreases since the decline of output prices is stronger than the decline of input prices. The observed regular pattern of investments points to some instability problem and will probably lead to re-designing this part of the model. Investment slows down mostly in CPA 71 (renting service of machinery and equipment) and CPA 60 (land transportation via pipeline services). Nevertheless in two sectors there is as positive difference in investments from the base case, CPA 70AM (real estate services, market) and CPA 70AI (imputed rental services).

At the moment operating profits are determined by a markup approach. The markups are based upon proportions of operating surplus in total nominal

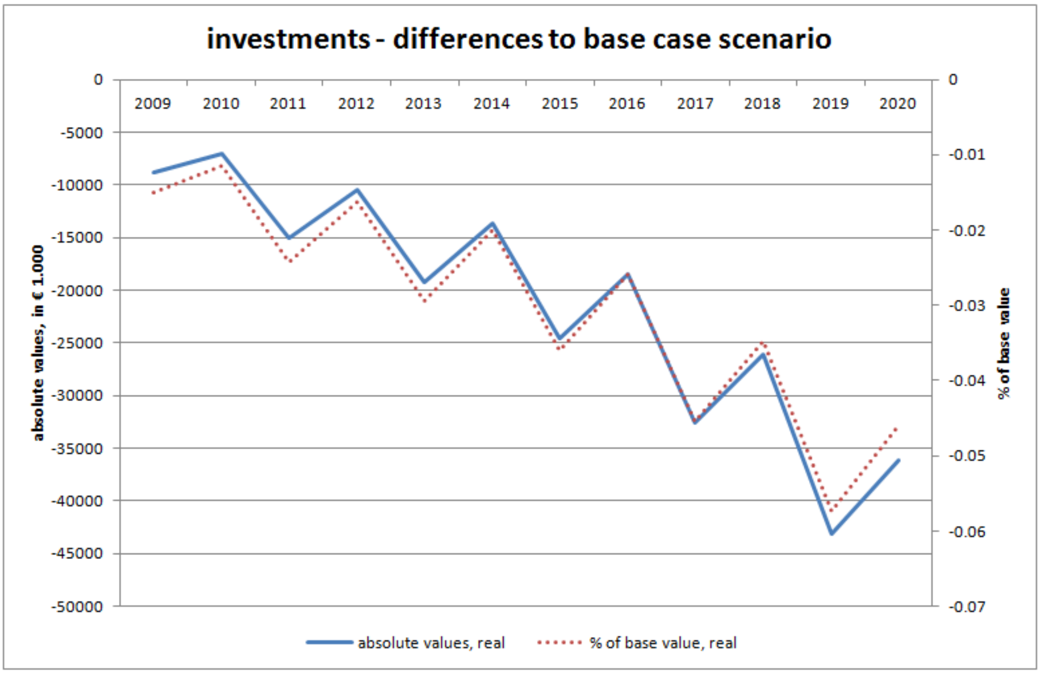

Figure 9: investment expenditure

output and averaged over the past decade. Since nominal output is slightly lower in the simulated scenario, profits decline moderately in comparison to the base case scenario (see figure 10), which is one reason for declining nominal disposable income of private households. Biggest relative losses are being created in CPA 11 (crude petroleum, natural gas, metal ores), CPA 74 (other business services), CPA 51 (wholesale and commodity trade services, exp. of motor vehicles) and CPA 70AI(imputed rental services).
Keep in mind that the figures only show differences between base case scenario and simulation. Investment and operating surplus grow in both scenarios, but not as fast in the alternative model. Consumption rises, investment declines, exports and government consumption are exogenously growing. In sum this leads to an increase in real production (see figure 11), which in turn explains the (small) increase in employment.
Production increases most in sectors CPA 28 (fabricated metal products), CPA 45 (construction work) and CPA 15 (food products and beverages).

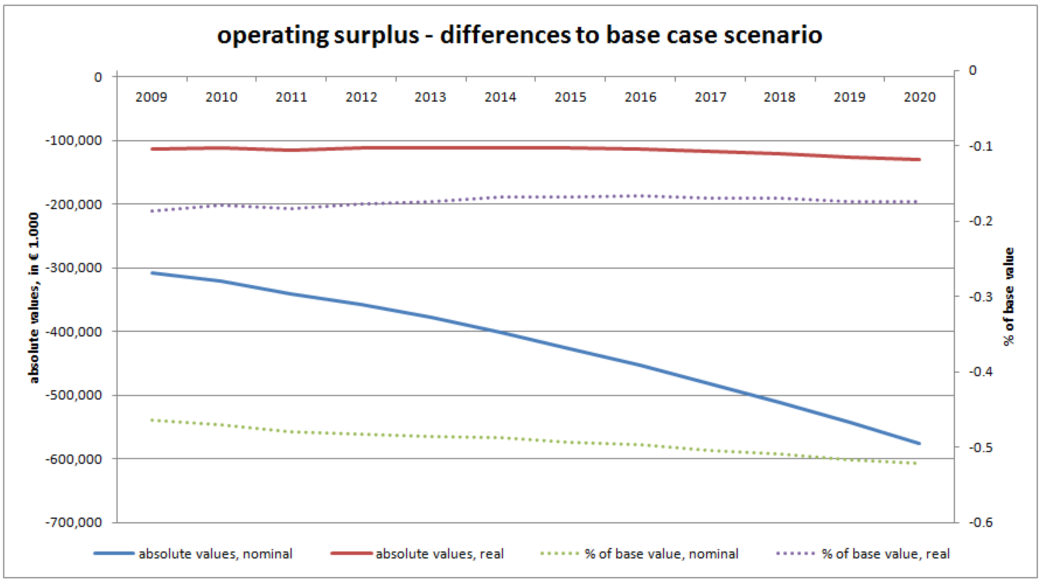

Figure 10: operating surplus

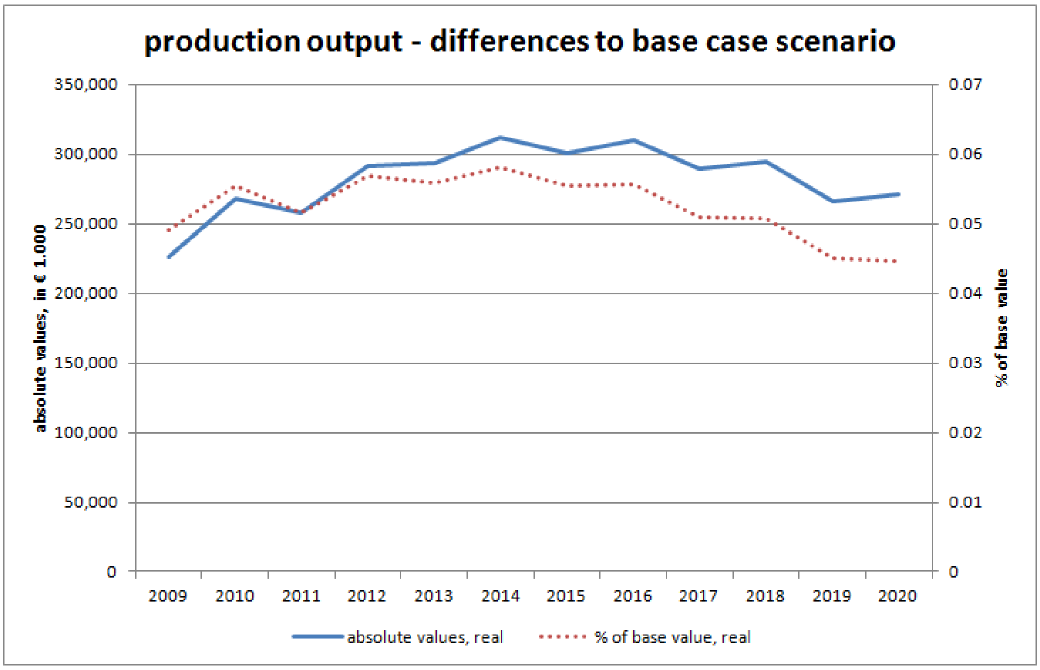

Figure 11: production

6 Summary and Conclusions

This paper analyzes the potential effects of a decrease in employers contributions to social insurance relative to a base case scenario with the latest Austrian INFORUM model. The first chapters describe the main construction and parts of the model. We then take a closer look at the determination of labour and wages since the simulation carried out in chapter 5 alternates those parts of the model. The base case scenario is our basic forecast from 2009 to 2020 which then acts as benchmark for the analysis. It captures the impact of the crisis in 2008/2009 and returns all variables to their pre-crisis levels after two years. We raised the question: "What happens if the government cuts social contributions of employers by x%?" Basically we want to lower the costs of labour for firms, without directly changing the nominal disposable income of households.

After decreasing employers social contributions by 2% we compare the base case scenario to the newly simulated forecast. As intended, prices go down leading to more consumption because real disposable income of households increases. The relative price changes of output prices to input prices lead to less investments and lower profits, although all effects are small in magnitude. Furthermore, one must keep in mind that we just looked at differences between the two scenarios. In the long run all variables grow within reasonable boundaries, our simulation just slows down some of them while accelerating others.

The next steps in improving the model will be the addition of some monetary variables such as credit volumes and interest rates. We will further keep adapting parts of the existing model, for example trying to model a labour market which is based more on demand and supply estimation equations. As always, data availability will strongly influence the upcoming improvements.

References

[Manprasert(2004)] Somprawin Manprasert. A THAI interindustry dynamic model with optimization. Ph.d. dissertation, University of Maryland, 2004.

[Meade(2000)] Douglas S. Meade. The IdLift model : A brief description. Inforum working paper, University of Maryland, 2000.

[Meade(2001)] Douglas S. Meade. The LIFT Model. Inforum working paper, University of Maryland, 2001.

[Shengcu and Songqi(2003)] Pan Shengcu and Yuan Songqi. An introduction to MUDAN model. Inforum working paper, University of Maryland, 2003.

[Werling(1992)] Jeffrey Francis Werling. MIDE: A macroeconomic multi-sectoral model of the spanish economy. Ph.d. dissertation, University of Maryland, 1992.

[Wilson(2001)] Daniel John Wilson. Capital-embodied technological change: Measurement and productivity effects. Ph.d. dissertation, University of Maryland, 2001.

[Yu(1999)] Qisheng Yu. Mudan: A China model for multisectoral development analysis. Ph.d. dissertation, University of Maryland, 1999.