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Product Tax Modelling in INFORGE

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Product Tax Modelling in INFORGE

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ABSTRACT

In this paper, the application of INFORGE as an analyzing tool for fiscal policy shocks is introduced by using the example of taxes on products. In recent times, variations of tax rates on product taxes have become rather popular because it is a simple method to consolidate state budget. A detailed modelling of taxes on products is important for further two reasons: (i) they are an important component for the transition from demand at purchasers' prices to demand at basic prices. (ii) Taxes on products can be classified in general and specific consumption taxes. Both tax types affect categories of goods in a different way and have to be modelled accordingly. Thus, the main objective is to describe the setting of the database as well as the modelling approach of taxes on products in INFORGE. The paper ends with a simulation example on the variation of value added tax rates.

TABLE OF CONTENTS

ABSTRACT	III
TABLE OF CONTENTS.....	IV
1 INTRODUCTION	1
2 A REVIEW ON LITERATURE & GENERAL COMMENTS ON TAXES.....	2
2.1 EMPIRICAL MODELLING OF EXOGENOUS FISCAL POLICY SHOCKS	2
2.2 GENERAL COMMENTS ON TAXES	3
2.3 TAXES ON PRODUCTS.....	4
3 IMPLEMENTING TAXES ON PRODUCTS IN THE MODELLING FRAMEWORK	6
3.1 INFORGE AND THE LOCATION OF TAXES ON PRODUCTS.....	6
3.2 THE TECHNICAL IMPLEMENTATION OF TAXES ON PRODUCTS	8
3.2.1 <i>Database Setting</i>	9
3.2.2 <i>Modelling Taxes on Products</i>	10
3.2.2.1 Specific Consumption Taxes.....	11
3.2.2.2 General Consumption Taxes	11
4 SIMULATION ON VALUE ADDED TAXES.....	12
5 CONCLUSIONS.....	14
LITERATURE	16

1 INTRODUCTION

The impact of exogenous fiscal policy shocks on the German economy has been subject to economic literature for some time, whereas the application of simulation models has only recently attracted increasing attention (Bode et al. 2006). Considering the relative importance of fiscal policy analysis for politicians, this observation is more or less surprising. Particularly, as in the US or other European economies this branch of economic policy analysis is already well established (Kamps & Caldara 2006, Perotti 2002).

Fiscal policy is the attempt of the state to stabilize the national economy – especially to guarantee price stability and reach full employment – by altering state income and state expenditures.¹ The variation of state income is generally easier to realize than a variation of state expenditures as most of it are fixed expenditures for administration purposes. Tax policy is closely linked to state income policy and is one of the major instruments of fiscal policy. But tax variations always have been a critical political issue, first of all because they are rather unpopular. Additionally, tax policy can only affect the economy in an indirect way, which leaves its factual power to shape the economy rather small. Moreover, the economic effects might be visualized only with a high time lag.

But despite these limited facts of tax policy, it always has been part of the policy agenda. In 2000, the German Council of Economic Experts (SVR 2000) claimed that fiscal policy has at least three major tasks to fulfil: (i) cutting tax burden, (ii) consolidating state budget and (iii) reforming the finance constitution. Apart from the third issue, the first two tasks of fiscal policies are at first glance divergent goals. While pursuing lower tax burdens, a decline in state income with a probably negative effect on the state budget might be the result. In Germany, this typical trade-off between two favourable aims was witnessed in 2007 when the federal government announced the increase of the value added tax rate (VAT) from 16 to 19 percent. The effects of such an increase on the private demand and on the slowly recovering economy were widely argued. Considering the slow movement of private demand since 2001 and its comparable high impact on gross domestic product (GDP), the majority of economists and opposition leaders argued against such a steep increase. Still, beginning of 2007, the VAT was raised as it has been announced.

Since then, over a year has passed and the short-run effects are now visible. Indeed, private consumption in real terms has declined in 2007 by -0.4% in comparison with the previous year. Real GDP had slowed down remarkably from 3.1% to 2.5% during the same period. At the same time, the state budget recovered. Although other effects might have additionally caused the slow-down of the economy and although the economic growth was still comparable strong, it is evident that the VAT increase left its footprint on the overall economic performance in Germany.

But the effect of the VAT on the economy is not the only reason, why a well defined approach for product tax modelling becomes necessary. A detailed programming of taxes on products enables to quantify the effects of eco-taxes (Meyer 2001, 2004; Bach et al.

¹ Baßler et al. 2002, pp. 436

2001) or illuminates structural changes in private and public household consumption (Distelkamp et al. 2004).

This paper aims to specify the modelling background of taxes on products, which underlies the current version of the model **Interindustry Forecasting Germany** (INFORGE). The core of the working paper describes the modelling approach to taxes on consumptions. Thereby, focus lies on the setting of the historical database as well as on the modelling in INFORGE. The paper closes with a smaller but not less interesting chapter on simulation results. In the conclusion, attention will be drawn on possible soft spots of the current version. To start with, the subsequent chapter introduces to fiscal policy modelling in Germany and outlines the relative importance of consumption taxes in the national accounts.

2 A REVIEW ON LITERATURE & GENERAL COMMENTS ON TAXES

2.1 EMPIRICAL MODELLING OF EXOGENOUS FISCAL POLICY SHOCKS

Since the monetary integration of Europe and the establishment of the European Currency Union, fiscal policy remains the single economic policy instrument left in the hand of national governments. This shortcut in policy instruments strengthens the need to use the remaining one in a sensitive and intelligent way. Discretionary fiscal policy has consequences on income, distribution and structure of the economy which makes an empirical fiscal policy analysis an important pillar for the support of policy decisions. In Germany, this area of analysis has been living a shadow life for many years. Only recently, work is intensifying and more and more publications on this subject can be found. A first review of the existing literature on the effects of fiscal policy shocks on the German economy reveals that the qualitative effects correspond widely, whereas the quantitative effects alter considerable due to diverging modelling frameworks and different datasets.

Most of the empirical studies use autoregressive simulation (VAR-) models (Perotti 2002; Plötscher et al. 2004, Bode et al. 2006) which were first applied on fiscal policy analysis by Blanchard and Perotti in 2002. These models are characterized by their simultaneous analysis of causal relationships between two or more variables. The basic idea is that each variable is a result from its own historic development and from the historic development of other endogenous variables. Whereas these models offer a relative simple approach to the analysis of fiscal policies, its lack in theoretical background and its risk to disclose wrong correlations limits its usefulness.

To a smaller scale but with no less strong output, micro-simulation models (MSM) are also prominent tools for the investigation of fiscal policy. They are generally based on scientific use files of income and consumption samples which allow very detailed analysis of fiscal policy effects (Bach 2005). But they often lack linkages to production and do not incorporate rebound effects on the economy. Micro-simulation models are very good for partial analysis but are less appropriate for an extensive look on fiscal policy which needs total analysis.

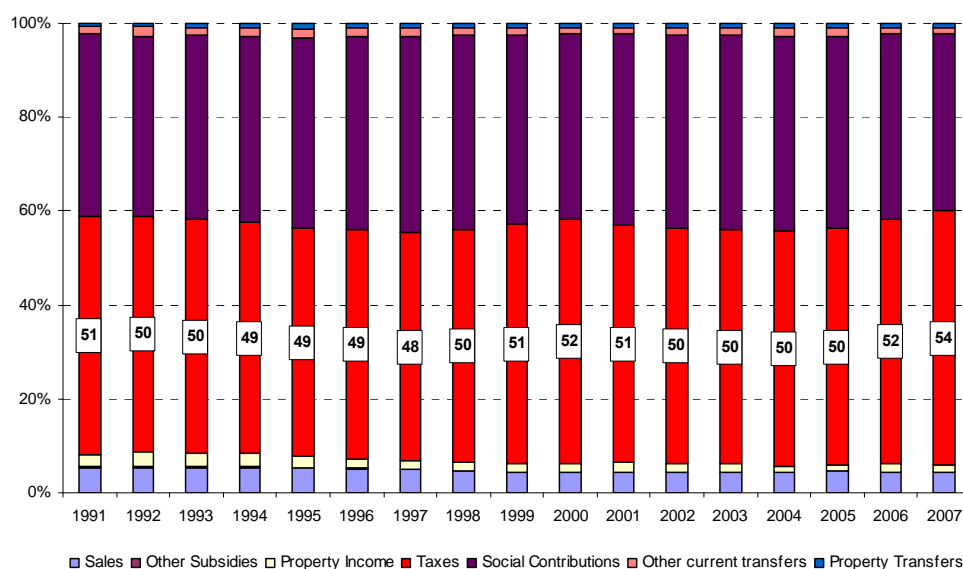
Other empirical studies on the impact of fiscal policies are based on the application of computable general equilibrium models (CGE). These macroeconomic models focus on the calculation of simultaneous equilibrium solution depending on given exogenous pre-adjustments. The Centre for European Economic Research (ZEW) is one prominent economic research institute in Germany which has developed a CGE model that can be applied to fiscal policy analysis. The PACE-L model from the ZEW is regularly used by the research institute of the federal labour agency (IAB) since 1999 (Peichl 2005).

In conclusion, the empirical work on fiscal policy analysis in Germany covers a wide range of simulation models. Econometric models that are embedded in the national systems of accounts and are applicable to fiscal policy analysis are less common and concentrate invariable on CGE-models.

2.2 GENERAL COMMENTS ON TAXES

According to §3 I of German tax order, a tax is defined with the following five characteristics: a tax is a forced levy paid in monetary units. They do not have assignable return services and are levied by public authorities. Further, taxes are levied on the ground of law and are not purpose-bound. Using the words of the Organisation of Economic Cooperation and Development (OECD) – taxes are “compulsory, unrequited payments to general government” (OECD 2006, p. 10). Taxes have to be distinguished from fees and contributions, whereby fees are individually and directly assignable to certain services, and contributions are hires for specific services that are not individually assignable, but for groups.

Figure 1: Components of Total State Income in % – 1991 to 2007



Source: Federal Statistical Office (2008)

Taxes are levied in general for three major reasons: there is a fiscal purpose, a steering purpose and a redistribution purpose. The fiscal purpose secures the liquidity of the public household and constitutes the main income resource of the public sector. Figure 1 shows the components of total state income from 1991 to 2007. The bright red rectangles shows

the tax ratio of total state income which fluctuates since 1991 around 50%. In 2007, the highest ratio of 54% was recorded.

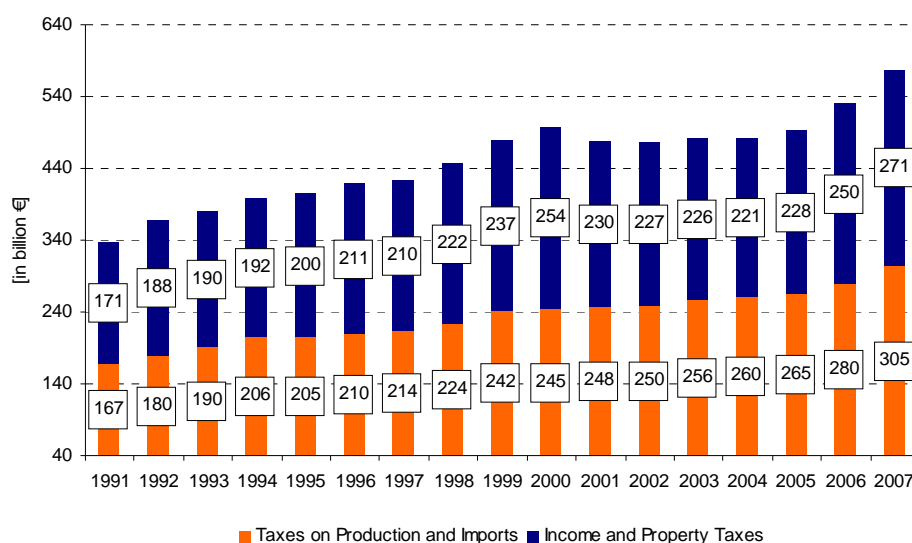
Taxes are often associated as a steering tool. This function aims to internalize external effects that are assumed to have negative implications for the society or the environment and it aims to influence the behaviour of individuals. Specific consumption taxes like tobacco tax, eco-tax, custom duties or mineral oil taxes are important examples. The steering function seems to collide with the fiscal purpose of taxes, because the more efficient the steering function works, the less tax revenues can be expected. But as Homburg (1997, pp. 6) observes, taxes with a steering purpose often veil mere fiscal interest to gain more revenues or to favour certain interest groups.

Taxes also play an important role as a redistribution tool. In this function, taxes are used to flatten income and wealth differences among citizens. Important examples for this tax function are capital transfer taxes or asset taxes. The progressively designed income tax is a further example.

2.3 TAXES ON PRODUCTS

Tax income composes of production and import taxes on the one hand and taxes on compensation of employees and property on the other. Reviewing the past, it becomes evident, that since beginning of this century, the two tax income groups drift apart: the income from production and import taxes is becoming more important than income and property tax revenues (compare Figure 2). In 2007, indirect taxes on production and imports – which are at the end taxes on consumption – contributed 53% to total tax income. The shift from labour and asset taxes was fostered in the early years of the new century, when income and property taxes were constantly reduced. While indirect taxation of consumption increased in average by 3.2% p.a. between 2000 and 2007, income and property taxes increased by only 0.9% p.a. in the same period.

Figure 2: Tax revenues of direct and indirect taxation in billion €– 1991 to 2007



Source: Federal Statistical Office (2008)

Within the National Accounts, consumption taxes – or taxes on products – are part of the primary income distribution account. It gives detailed information about the distribution of work compensation and property income to the different sectors of the economy – like private households, non-financial cooperation or the state in total. In the primary account, the distribution effects are solely motivated by production process and not by the state through transfer payments. In saldo, the primary account measures the primary or national income of each sector. It sums up by adding entrepreneurial income, compensation of employees, property income and received production and import taxes. For 2007, the primary income account is presented in Table 1. The yellow shaded row represents the focus of this working paper – taxes on products. In 2007, they summed up to 305 billion Euros, and were earned by the state sector.

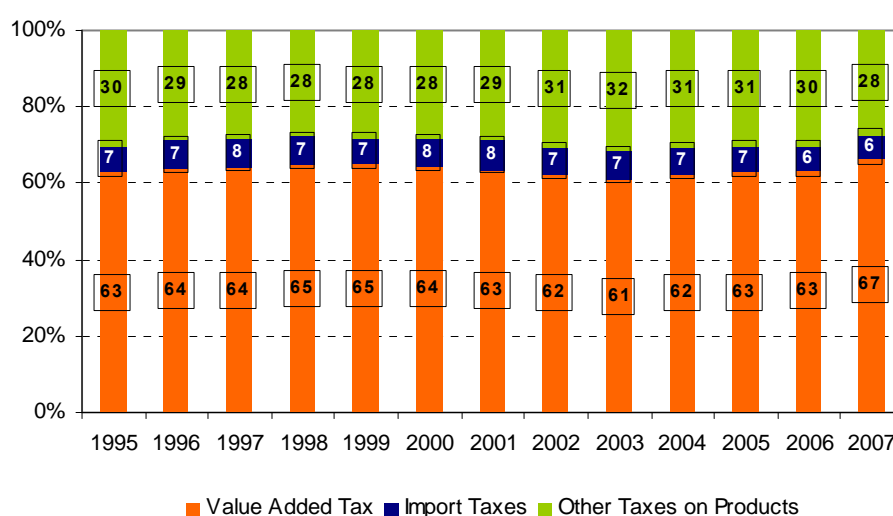
Table 1: Primary Income Distribution Account – 2007 in billion Euros

		Total Economy	Non-Financial Corporations	Financial	State	Private Households and non-profit Organisations	Rest of World	Quota
		S.1	S.11	S.12	S.13	S.14 / S.15	S.2	
II.1.2 Primary Income Distribution Account								
B.2/3n	Entrepreneurial Income	615,47	384,47	14,68	- 3,56	219,88	- 176,25	
D.1	Compensation of Employees	1 182,14	-	-	-	1 182,14	6,71	56,23
D.2	Received Taxes on Production and Imports	305,46	-	-	305,46	-	7,82	14,53
D.4	Property Income	970,00	102,48	425,71	17,38	424,43	194,97	46,14
D.3	Subsidies	26,95	-	-	26,95	-	5,66	1,28
D.4	Property Income	943,95	402,91	407,94	66,56	66,54	221,02	44,90
B.5n	National Income	2 102,17	84,04	32,45	225,77	1 759,91	- 193,43	100,00

Source: Federal Statistical Office (2008)

If production and import taxes are further divided, nearly 82% (in 2007) of the revenues are solely due to taxes on products. Those taxes on products can be split up in three major groups: value added taxes (VAT), taxes and duties on imports and other taxes on products such as excise duties. Figure 3 shows that value added tax revenue dominates with around 66.6% the total revenues of taxes on products. Other taxes on products have dropped in 2007 on their lowest level since 1995 with 27.5% of taxes on products.

Figure 3: Components of Taxes on Products in % – 1995 - 2007



Source: Federal Statistical Office (2008)

Those three tax types – VAT, import taxes and other taxes on products – can be categorized into general and specific consumption taxes. General consumption taxes are taxes levied on the turnover of all consumed products. Differently specific consumption taxes: they are product-bound and specifically constructed for the taxation of the consumed quantity of a certain good or service. Whereas under general consumption taxes, all products underlie the same tax rate and the same tax base, the tax rate and tax base of specific consumption taxes vary according to the taxed object. Value added taxes are normally classified as a general consumption tax. Although VAT exemptions exist and in most countries a reduced tax rate persists, one can say that all products are levied with a same tax rate. The tax base is in all cases the turnover of the taxed product. Excise duties or other specific consumption taxes belong to the specific consumption tax category. They are tax types which are constructed for a specific product or category of goods and are levied on their consumed quantity. Import taxes can be classified as either general or specific consumption taxes. Import taxes such as custom duties are specifically designed for a certain product. Their tax base can be either a quantity or turnover. The same is true for other import taxes such as specific excise duties on imported products. But also a value added tax or a general excise duty on imported products is collected. For the following discussion, import taxes are characterized as general consumption taxes. A closer and more precise definition of the components of taxes on products are outlined in the European System of Accounts (1995).

3 IMPLEMENTING TAXES ON PRODUCTS IN THE MODELLING FRAMEWORK

This chapter focuses on the implementation of taxes on products in the modelling framework of INFORGE. After a short re-visit of the INFORGE philosophy, the location of taxes on products in the modelling world is explained. Then, the setting of the historical database as well as the modelling of product taxes in INFORGE are explicitly outlined.

3.1 INFORGE AND THE LOCATION OF TAXES ON PRODUCTS

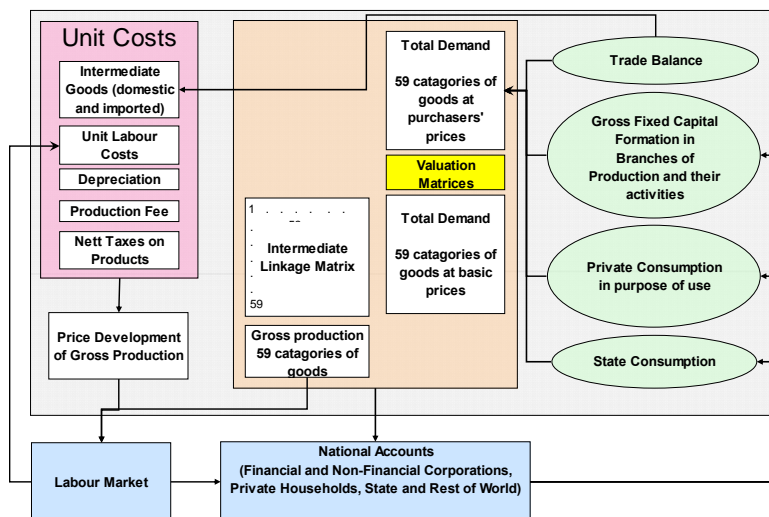
INFORGE is a sectoral highly disaggregated projection and simulation model that was first developed in 1991. Since then, INFORGE has been constantly improved and consists currently of a time series beginning in 1991. In its sectoral disaggregation, the current version is based on the NACE-structure¹ from 2003. The underlying philosophy of the model goes in line with the INFORUM-idea of modelling (Almon 1991), that rests on two basic fundamentals: bottom-up construction and total integration. Whereas the former indicates, that macro-economic variables are calculated through explicit aggregation, the latter describes a complex and simultaneous solution which takes into consideration the inter-industrial interdependence as well as the distribution of income, the redistribution

¹ Nomenclature Générale des Activités Économique (nomenclature of economic activities)

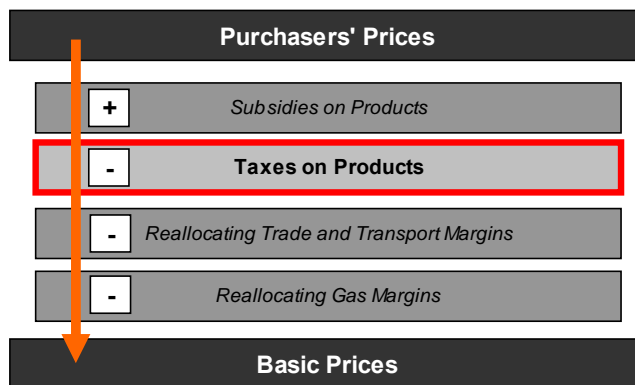
effects of the state and the usage of income for goods. Thus, the input-output tables are fully implemented in the national accounts (Distelkamp et al. 2003; Meyer et al. 2007).

The structure of INFORGE is represented in Figure 4. Basically, it resembles an econometric input-output model that can be classified as an evolutionary modelling approach (Meyer 2005). But although input-output-models are interpreted as models with a clear focus on the demand side of the economy, this interpretation does not hold for INFORGE. While production is determined by the demand side of the economy via the Leontief-equation, all determinants of demand depend on relative prices which are again a function of firm's unit costs and import prices. Thus, the price setting behaviour of firms depends on two fundamentals: on the one hand on the cost structure of a firm, on the other hand on the price pressure caused by competing import goods. When the firm has decided on its sales prices, the demand side reacts accordingly which again affects the production output (Meyer & Wolter 2007).

Figure 4: Sketch of INFORGE



A closer look at the specific price reactions of demand and supply reveals the usage of different price concepts. Whereas production is positively correlated to net final demand at basic prices, demand for goods or other factors such as labour or capital reacts on purchasers' prices. The difference is important, because taxes and subsidies for goods and services distort market prices and may lead to price-induced changes in consumption and/or production. In Figure 4 the transition from total demand at purchasers' prices to total demand at basic prices is condensed in so-called valuation matrices. They are shown in detail in Figure 5. The transition from purchasers' to basic prices has to consider subsidies, taxes on products and the reallocation of trade, gas and transport margins.

Figure 5: Valuation Matrices: Transition from purchasers' prices to basic prices

Subsidies on products are added, taxes on products are deducted from total demand at purchasers' prices. Additionally, trade, transport and gas margins have to be reallocated during the transition. The reallocation process is needed, because the valuation at purchasers' prices implies the allocation of trade, transport and gas margins to the product to which they pertain. A valuation at basic prices implicates that trade, transport and gas margins are recorded as services offered by the trade, transport and gas industry. Thus, during the transition from purchasers' to basic prices trade, transport and gas margins are deductibles. As a consequence of the reallocation of trade, transport and gas margins, the sum over all categories of goods is per definition zero.

Each transition matrix has exactly the same configuration: for 59 categories of goods in the rows, the transition value for each component of final and intermediate demand is given (compare Table 2). In the following, the subscript i represents categories of goods in the rows and the subscript j indicates the components of total demand in the columns. The transition matrix for taxes on products (U_{ST}) shows the total of tax revenue for each component of total demand and for each category of goods.

Table 2: Configuration of the valuation matrix taxes on products (U_{ST}) in 2004

		1	2	3	4	5	6	7	8	9	10
	product tax revenue (U_{ST}) 2004, in million Euro	Intermediate Demand	Private Con- sumption	Consumption of non-profit Organization	State Con- sumption	Fixed Capital Formation	Con- struction	Changes in Inventory	Export	Final Demand	Total Demand
1	Agriculture, Hunting and related activities	1481	1559	0	0	0	406	0	0	1965	3446
2	Forestry, logging and related service activities	2	45	0	0	0	0	0	0	45	47
3	Fishing	2	22	0	0	0	0	0	0	22	24
4	Mining of coal and lignite; extraction of peat	3	55	0	0	0	0	0	0	55	58
5	Extraction of crude petroleum and gas	2969	3460	0	12	0	0	0	0	3472	6441
6	Mining of uranium and thorium ores	0	0	0	0	0	0	0	0	0	0
7	Mining of ores	0	0	0	0	0	0	0	0	0	0
8	Mining and quarrying of stones and earthen	47	17	0	0	0	0	0	0	17	64
9	Manufacture of food products	579	8016	0	16	0	0	0	0	8032	8611
10	Beverages	932	6696	0	27	0	0	0	0	6723	7655
11	Manufacture of tobacco products	226	16526	0	0	0	0	0	0	16526	16752
12	...	...	...	...	...	...	...	...	...	...	...

3.2 THE TECHNICAL IMPLEMENTATION OF TAXES ON PRODUCTS

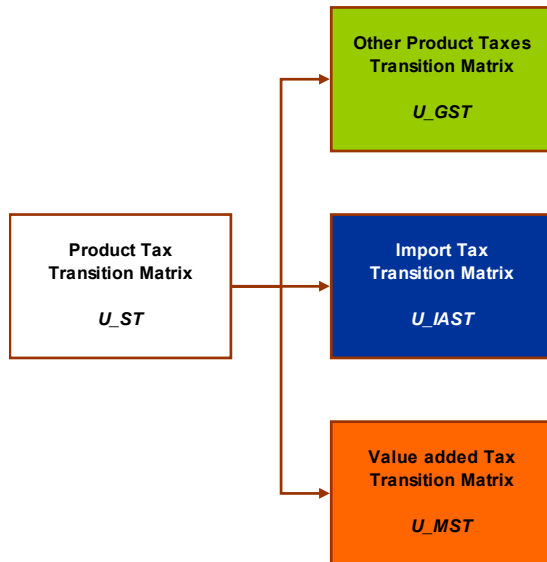
The preceding chapters have discussed taxes on products on a non-technical basis. The following sub-chapters concentrate on the technical implementation of taxes on products within the underlying modelling framework. First, the setting of the historical database is described, then the modelling of product taxes in INFORGE is outlined.

3.2.1 DATABASE SETTING

As an outcome of a project with the Federal Statistical Office of Germany, transition matrices for all variables of the transition process from valuation at purchasers' prices to valuation at basic prices were available (Distelkamp 2002). Thus, sectoral disaggregated information for subsidies on products, taxes on products as well as for the reallocation of trade, transport and gas margins were given.

When the impact of specific product taxes or value added taxes on consumption has to be quantified, a separation of taxes on products becomes necessary. Accordingly, the transition matrix of taxes on products has to be further unbundled in its individual components. Figure 6 illustrates the unbundling process. The aggregated transition matrix of product taxes (U_{ST}) has to be broken down in three specific product tax matrices: value added tax matrix (U_{MST}), import tax matrix (U_{IAST}) and other taxes on products matrix (U_{GST}).

Figure 6: Unbundling the Product Tax Transition Matrix (U_{ST})



Other taxes on products subsume all other tax types that become payable as a result of further usage of taxable goods. Excise duties are one of the most important consumption taxes and are levied on the consumption of specific goods. According to the Federal Ministry of Finance (BMF 2005) the following goods are levied with an excise duty: crude oil & natural gas, beverages, tobacco, mineral oil commodities, electricity, insurance premiums and real estate services. For all those seven categories of goods, information exists for tax rates (gst_s), tax base (gst_m) and tax revenue (gst_a). The tax matrix for excise duty revenues (U_{GST}) is conceived by multiplying the revenue of excise duties (gst_a) with the given proportion of each component of total demand with total demand. Then the matrix U_{GST} is scaled on its basic value of the System of National Accounts (SNA).

$$(1) U_{GST_{ij}} = U_{ST_{ij}} / U_{ST_{i10}} * gst_{ai}$$

The calculation of import tax revenues for i categories of goods and j components of total demand is challenging as no insight is given about the volume of import tax revenues for each element of the import tax matrix. Therefore, an overall import tax quota ($IASTQL_t$) has been calculated, which shows the portion of import tax revenues ($IMAGVN_t$)

on total revenues of taxes on products in Germany. Total revenues of product taxes are the sum of total value added tax revenue ($MWTGVN_t$), total import tax revenue ($IMAGVN_t$) and total revenue of other taxes on products ($SGGVN_t$). The subscript t indicates the times series. Over time, the import tax quota remains relatively stable, fluctuating around 0.08 %. Import tax revenues are obtained only from a number of products that were able to identify through publications of the national ministry of finance. Assuming a constant import tax quota for all components of total demand and for all categories of goods, the import tax matrix U_IAST can be received. Afterwards, the result is scaled on its basic value of the SNA.

$$(2) U_IAST_{ij} = (IMAGVN_t / (MWTGVN_t + IMAGVN_t + SGGVN_t)) * U_ST_{ij}$$

The value added tax matrix (U_MST) is determined by definition. By deducting U_GST and U_IAST from the historical given U_ST , the residual tax matrix shows the value added tax revenues for i categories of goods and j components of total demand. The matrix U_MST does not have to be scaled on its corresponding basic value of the SNA, because the value added tax matrix is a residual and has to correspond per definition.

$$(3) U_MST_{ij} = U_ST_{ij} - U_GST_{ij} - U_IAST_{ij}$$

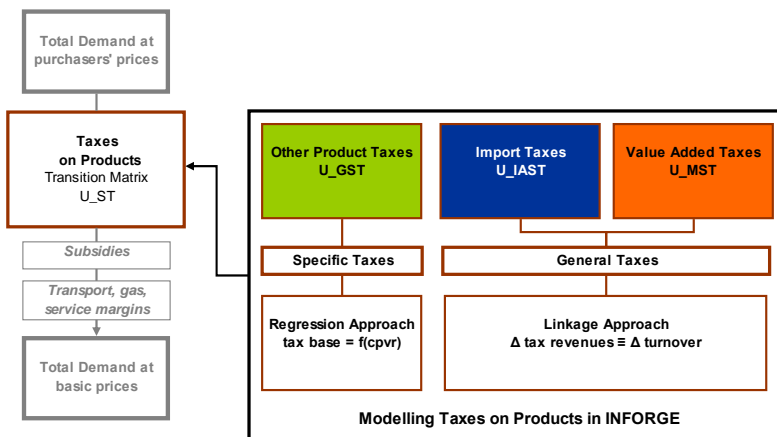
By definition, all three sub-matrices have to sum-up to the historical given matrix of taxes on products.

3.2.2 MODELLING TAXES ON PRODUCTS

The extrapolation of taxes on products underlies two different approaches: On the one hand, a direct regression approach was chosen. On the other hand, the predicted variable is linked to the development of regressand variable. The differentiation between those two approaches has its origin in the distinction between general and specific consumption taxes (refer to sub-chapter 2.3). For general consumption taxes such as VAT, the tax revenues depend on the turnover of consumed products. For specific consumption taxes such as excise duties, the tax revenues depend on the consumed quantity of a certain product. The difference becomes evident, when the effects of price changes on tax revenues are highlighted. An increase in turnover leads automatically to an increase in general tax revenues, independent whether the increase in turnover was induced by a rise in quantity or an increase in prices. Differently to quantity based taxation, where price changes have no impact on tax revenues.¹

According to the above outlined observation, other taxes on products such as excise duties, which are specific consumption taxes, are estimated by regression equations (see sub-chapter 3.2.2.1). Value added taxes are general consumption taxes and are projected with the linkage approach (see sub-chapter 3.2.2.2). Import taxes are also classified as general consumption taxes. Figure 7 summarizes the modelling approach for products on taxes in INFORGE.

¹ Under the condition, of course, that price changes are not induced by an increase in tax rates.

Figure 7: Modelling Taxes on Products in INFORGE

3.2.2.1 Specific Consumption Taxes

The tax revenue is a product of tax rate and tax base. For specific consumption taxes, the tax base is generally expressed in physical terms such as kilograms or liters. The tax base is then multiplied with a certain tax rate which gives the monetary equivalent of the specific tax revenue. In INFORGE the dependent variable for specific consumption taxes is the physical tax base (*gstm*). The regressand is a positive function of consumption expenditures in purposes of use in constant prices (*cpvr*). For products levied with a specific consumption tax, an increase in consumption expenditures raises the physical consumption of this product which leads to an increase in tax revenues under the condition of constant tax rates.

$$(4) \text{ } gstm = f(cpvr)$$

By multiplying the dependent variable with its corresponding tax rate (*gst*) by each category of goods, the hypothetical tax revenue (*gsta*) for other taxes on products is received. The prefix *hypothetical* is used at this stage, because the predicted hypothetical tax revenue cannot correspond in full with the actual tax revenue. This is so, because diverging tax rates for different goods within the same category of products persist. The projection of the matrix of other taxes on products is obtained by multiplying the matrix of other product taxes of the previous year (*U_GSTL*) with the growth rate of the hypothetical tax revenues (*gsta/Gsta*).

$$(5) U_GST_{ij} = U_GSTL_{ij} * gsta_i / Gsta_i$$

One consequence of this modelling approach is that the allocation of tax revenues to the components of total demand is assumed to be constant over time.

3.2.2.2 General Consumption Taxes

The linkage approach has been chosen for the prediction of import taxes and value added taxes. To forgo direct regression is the consequence of two simple assumptions: According to the design and intention of consumption taxes, a positive correlation between VAT or import taxes and consumption has to be assumed. An increase in consumption expenditures leads to a higher turnover of goods and services which has to lead automatically to an increase in VAT and import tax revenues. Further, it is assumed that

the allocation of tax revenues remains constant over time, category of good and component of total demand.

The tax matrices for general consumption taxes (U_MST and U_IAST) are extrapolated with the projected consumption of total demand at purchasers' prices¹ (VNL). Equation (6) and (7) show the programming code. The two matrices $MSTQL$ and U_IASTQL give the ratio of tax revenue to total demand by i categories of goods and for each j component of total demand.² According to the second assumption the tax ratios remain constant over time.

$$(6) U_MST_{ij} = MSTQL_{ij} * VNL_{ij}$$

$$(7) U_IAST_{ij} = U_IASTQL_{ij} * VNL_{ij}$$

The new total tax transition matrix on taxes on products (U_ST) is determined by adding-up the three single tax matrices.

4 SIMULATION ON VALUE ADDED TAXES

The abolition of the reduced value added tax rate is one topic which pops up regularly when the efficiency of the tax system is discussed (Böhringer et al. 2004). The optimal tax theory argues in favour of the coexistences of more than one tax rate under two conditions: First, products with a low price elasticity of demand shall be more heavily taxed than products with a high price elasticity of demand (Ramsey 1927).³ Second, products with a high complementary to leisure activities shall be taxed higher than products with a low complementary (Corlett & Hague 1953).⁴ Both conditions do not consider the distributional effects of a coexistence of two tax rates and were developed under certain assumptions.⁵ Nevertheless, the two arguments shall be used as justification for running the following simulation: It is assumed that the national government in Germany decides on the abolition of the reduced value added tax rate in 2009. From that time on, a uniform value added tax rate of 13% is set. The effects are summarized for relevant macro variables in Table 3.

¹ The projection of total demand by i categories of goods and j components of total demand are given at this state of the regression model. For an extensive discussion about the prediction of the total demand matrix refer to Distelkamp et al. 2003 or Meyer & Ewerhart 2001.

² These two tax ratio matrices can be interpreted as the tax rates for value added taxes and import taxes. Nevertheless, those tax rates do not resemble the actual tax rates in the economy, because in some categories of goods products with differently assigned tax rates can be summarized. This is especially the case in the category of food and beverages, where normal and reduced VAT rates co-exist.

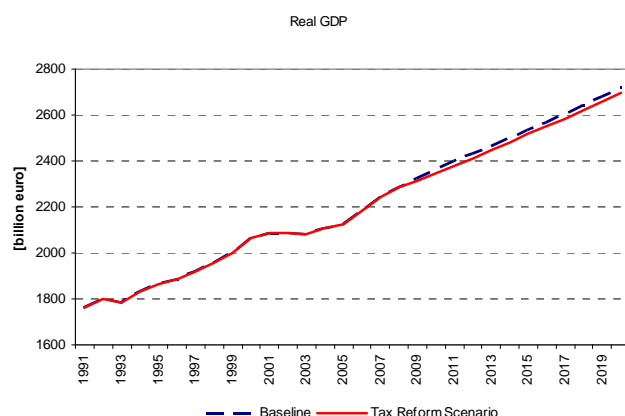
³ An example of a product with a high price elasticity of demand is tobacco.

⁴ An example for a product with a high complementary for leisure is a game boy.

⁵ See Ramsey 1927 and Corlett & Hague 1953 for a detailed description of their assumptions.

The results demonstrate, that an abolition of the reduced value added tax rate in 2009 combined with the introduction of a uniform value added tax rate on all products leads to a decline in GDP by -0.46% compared to the baseline. Until 2011, the effect increases to a percentage difference of -0.90% and remains at that level since.

Figure 8: Real GDP development – baseline and tax reform scenario



In the short-run a variation in value added tax rates has effects on the domestic price level. The introduction of a uniform VAT rate raises the price levels of all price indices, whereas the deviation to the baseline is the highest for consumption prices. This reaction is sensible as value added taxes effect private consumption the most. Further, it can be notified that the impact of the abolition of a reduced VAT rate is higher than the reduction of the normal VAT rate for some categories of goods. The background is that the reduced value added tax rate is levied on everyday products such as food or beverages. An increase of the reduced value added tax rate has therefore a higher impact on prices and total demand than the reduction of the normal value added tax rate. One consequence of an increase in the price level is an immediate decline in all components of total demand. Only fixed capital formation shows a deferred reaction due to a delayed adjustment of the capital stock. In combination with a simultaneous decrease in import demand, the negative effects on total output are lowered. Compared to the baseline, a uniform VAT rate increases the volume of product tax revenues by 23.5 billion Euros or by roughly 9%. Under the assumption, that most of the state income is used for consolidation purposes, net lending and net borrowing turn positive in 2010 – four years earlier than in the baseline.

With a time lag of approximately one year, the effect of uniform VAT rates reaches the labour market. Anticipated price increases react on wages and salaries which increase faster than in the baseline. Higher unit labour costs effects the price-setting behaviour of the firms and their demand for labour. Prices are further increased and the number of unemployed person rises. A higher unemployment rate puts pressure on the social security system which results in an increase in monetary benefits. The cumulating effects slow down after a further year of adjustment. In 2012, national output drops back to the growth path of the baseline.

Table 3: Simulation Results

Indicator	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Components of Gross Domestic Product																
constant prices, billion euros, absolute deviation																
Gross Domestic Product	0,00	0,00	0,00	0,00	-10,58	-18,11	-21,64	-21,51	-21,08	-20,44	-20,65	-20,86	-21,26	-22,01	-22,71	-22,72
Consumption of private households and non-profit organ.	0,00	0,00	0,00	0,00	-13,69	-15,83	-16,98	-17,15	-17,07	-16,95	-17,09	-17,25	-17,58	-17,95	-18,32	-18,57
Public Consumption	0,00	0,00	0,00	0,00	0,85	-0,16	-0,47	-0,51	-0,48	-0,45	-0,45	-0,45	-0,51	-0,51	-0,52	-0,53
Fixed Capital Formation	0,00	0,00	0,00	0,00	4,26	-1,77	-5,16	-3,90	-2,85	-1,70	-1,66	-1,73	-2,25	-2,43	-2,88	-3,02
Investment in construction	0,00	0,00	0,00	0,00	-1,35	-1,33	-1,25	-1,11	-1,06	-1,02	-1,06	-1,00	-1,04	-1,01	-1,03	-1,00
Investment in inventory	0,00	0,00	0,00	0,00	0,00	0,05	0,06	0,06	0,05	0,05	0,05	0,04	0,04	0,04	0,04	0,03
Export	0,00	0,00	0,00	0,00	-0,76	-2,06	-2,39	-2,48	-2,53	-2,54	-2,51	-2,54	-2,53	-2,67	-2,73	-2,64
Import	0,00	0,00	0,00	0,00	-1,14	-4,08	-5,64	-4,67	-3,94	-3,26	-3,14	-3,14	-3,65	-3,57	-3,77	-4,02
Price Indices																
deviation in percentage points																
Public Consumption	0,00	0,00	0,00	0,00	0,04	0,26	0,31	0,35	0,35	0,36	0,36	0,36	0,36	0,37	0,37	0,36
Private Consumption	0,00	0,00	0,00	0,00	1,60	1,73	1,79	1,82	1,84	1,85	1,87	1,89	1,91	1,94	1,96	1,98
Gross Domestic Product	0,00	0,00	0,00	0,00	1,16	1,37	1,46	1,50	1,51	1,52	1,52	1,53	1,53	1,54	1,55	1,54
State Budget																
in current prices, billion euro, absolute deviation																
Net lending, net borrowing	0,00	0,00	0,00	0,00	15,49	16,00	15,62	17,07	17,59	18,20	18,48	18,71	18,81	19,14	19,34	19,73
Monetary benefits	0,00	0,00	0,00	0,00	0,62	1,99	2,36	2,53	2,71	2,79	2,88	2,94	3,06	3,16	3,23	3,29
Product tax revenues	0,00	0,00	0,00	0,00	23,50	23,90	24,01	24,45	24,91	25,37	25,75	26,05	26,39	26,70	27,04	27,43
Income and asset tax revenues	0,00	0,00	0,00	0,00	-1,40	-1,63	-1,89	-1,74	-1,60	-1,48	-1,47	-1,47	-1,56	-1,57	-1,62	-1,65
Labour Market and Reallocation																
absolute deviation																
Gross wages and salaries per employee	0,00	0,00	0,00	0	35	205	199	193	202	211	221	226	230	236	237	238
Tax and contribution ratio	0,00	0,00	0,00	0,00	0,01	0,08	0,11	0,16	0,17	0,16	0,16	0,15	0,15	0,15	0,15	0,16
Employee in 1000	0,00	0,00	0,00	0	-120	-286	-319	-316	-314	-309	-308	-306	-314	-315	-317	-318
Unemployed in 1000	0,00	0,00	0,00	0	104	232	279	292	305	305	307	307	318	321	322	324

Indicator	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Components of Gross Domestic Product																
deviation in percentage to basic scenario																
Gross Domestic Product	0,00	0,00	0,00	0,00	-0,46	-0,77	-0,90	-0,88	-0,85	-0,82	-0,81	-0,81	-0,82	-0,83	-0,85	-0,84
Consumption of private households and non-profit organ.	0,00	0,00	0,00	0,00	-1,08	-1,24	-1,31	-1,31	-1,30	-1,28	-1,27	-1,28	-1,29	-1,30	-1,32	-1,32
Public Consumption	0,00	0,00	0,00	0,00	0,21	-0,04	-0,11	-0,12	-0,11	-0,10	-0,10	-0,10	-0,11	-0,11	-0,11	-0,12
Fixed Capital Formation	0,00	0,00	0,00	0,00	1,64	-0,67	-1,93	-1,43	-1,02	-0,60	-0,57	-0,58	-0,74	-0,78	-0,91	-0,94
Investment in construction	0,00	0,00	0,00	0,00	-0,63	-0,62	-0,58	-0,51	-0,48	-0,47	-0,48	-0,46	-0,47	-0,46	-0,46	-0,45
Investment in inventory	0,00	0,00	0,00	0,00	0,00	-1,05	-1,24	-1,30	-1,33	-1,33	-1,33	-1,32	-1,31	-1,31	-1,31	-1,30
Export	0,00	0,00	0,00	0,00	-0,06	-0,16	-0,18	-0,18	-0,17	-0,17	-0,16	-0,16	-0,15	-0,15	-0,15	-0,14
Import	0,00	0,00	0,00	0,00	-0,11	-0,38	-0,50	-0,40	-0,33	-0,26	-0,24	-0,24	-0,26	-0,25	-0,25	-0,26
Price Indices																
deviation in percentage to basic scenario																
Public Consumption	0,00	0,00	0,00	0,00	0,04	0,23	0,28	0,31	0,31	0,31	0,31	0,31	0,31	0,31	0,30	0,30
Private Consumption	0,00	0,00	0,00	0,00	1,42	1,52	1,56	1,57	1,57	1,57	1,58	1,58	1,58	1,59	1,59	1,60
Gross Domestic Product	0,00	0,00	0,00	0,00	1,06	1,25	1,32	1,35	1,35	1,35	1,34	1,33	1,32	1,32	1,32	1,30
State Budget																
deviation in percentage to basic scenario																
Net lending, net borrowing	0,00	0,00	0,00	0,00	-74,04	-114,70	-167,17	-334,48	-778,23	13846,58	602,93	355,75	236,83	162,59	118,62	98,82
Monetary benefits	0,00	0,00	0,00	0,00	0,14	0,44	0,52	0,55	0,58	0,59	0,60	0,61	0,62	0,64	0,64	0,64
Product tax revenues	0,00	0,00	0,00	0,00	9,25	9,23	9,10	9,10	9,11	9,11	9,07	9,03	8,98	8,93	8,88	8,84
Income and asset tax revenues	0,00	0,00	0,00	0,00	-0,51	-0,59	-0,67	-0,60	-0,54	-0,49	-0,48	-0,47	-0,49	-0,49	-0,49	-0,49
Labour Market and Reallocation																
deviation in percentage to basic scenario																
Gross wages and salaries per employee	0,00	0,00	0,00	0,00	0,12	0,71	0,68	0,64	0,66	0,68	0,70	0,70	0,70	0,71	0,70	0,69
Tax and contribution ratio	0,00	0,00	0,00	0,00	0,05	0,37	0,51	0,71	0,75	0,75	0,71	0,69	0,68	0,72	0,72	0,73
Employee in 1000	0,00	0,00	0,00	0,00	-0,33	-0,79	-0,88	-0,87	-0,86	-0,85	-0,84	-0,83	-0,85	-0,85	-0,85	-0,85
Unemployed in 1000	0,00	0,00	0,00	0,00	3,52	7,83	9,20	9,55	9,93	10,08	10,39	10,58	11,57	12,11	13,16	14,43

If not indicated differently, all variables are shown in real terms.

5 CONCLUSIONS

This paper has investigated the impact of exogenous fiscal policy shocks on the German economy by applying the simulation and projection model INFORGE. The core of the paper concentrated on the modelling approach of taxes on products. After a brief overview over other empirical work on the analysis of fiscal policy shocks, the relative importance of consumption taxes in the national accounts were outlined in chapter 1. Then, the setting of the historical database as well as the modelling of product taxes in INFORGE were described. In chapter 4, a simulation on value added tax rates were presented and discussed. It was shown, that a product tax variation in INFROGE has effects on national output, prices, state budget and reveals distributional effects.

The modelling approach chosen in INFORGE has unbundled tax products in three different types of taxation and separated tax revenues in categories of goods and in components of total demand. This deep disaggregation of product taxes enables a distinct analysis of product taxes and their affects on consumption and production. This includes an analysis of tax policies and its affects on income and distribution of all components of total demand.

Soft spots of product tax modelling in the current version of INFORGE can be found at the stage of the database setting. The unbundling of taxes on products are subject to certain assumptions and cannot reflect the reality in full. A further soft spot of the current version of INFORGE can be detected at the level of modelling specific consumption taxes. Specific consumption taxes are in reality more complex than imaged in INFORGE. For instance the tax rate for tobacco differs depending whether cigarettes or shag are taxed. Other categories of products show similar complex features when it comes to taxes on products. Overall, the described shortcomings of the current version of INFORGE can be mainly traced back to an insufficient endowment in data. With a more sophisticated historical dataset and less strong data restrictions, the modelling of taxes on products in INFORGE could be further improved.

LITERATURE

- Almon, C. (1991): The INFORUM Approach to Interindustry Modelling. *Economic Systems Research*, Vol. 3. pp. 1-7.
- BA (2007): Arbeitsmarkt 2006. Amtliche Nachrichten der Bundesagentur für Arbeit, Sondernummer 1, Jahrgang 55, Nürnberg.
- Bach, S. (2005): Mehrwertsteuerbelastung der privaten Haushalte – Dokumentation des Mehrwertsteuermoduls des Konsumsteuer-Mikrosimulationsmodells des DIW Berlin auf Grundlage der Einkommens- und Verbrauchsstichprobe. *Data Documentation* 20, Deutsches Institut für Wirtschaftsforschung, Berlin.
- Bach, S., Bork, C., Kohlhaas, M., Lutz, C., Meyer, B., Praetorius, B. & Welsch, H. (2001): Die ökologische Steuerreform in Deutschland: Eine modellgestützte Analyse ihrer Wirkungen auf Wirtschaft und Umwelt. Berlin, Heidelberg, New York.
- Baßler, U., Heinrich, J. & Utecht, B. (2002): Grundlagen und Probleme der Volkswirtschaft. 17. Auflage, Schäffer-Poeschel Verlag, Stuttgart.
- Blanchard, O. & Perotti, R. (2002): An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output. *Quarterly Journal of Economics*, pp. 1329-1368.
- Bleses, P. (2007): Input-Output-Rechnung. *Wirtschaft und Statistik*, 2007(1), S. 86-96.
- BMF (2005): Steuern von A bis Z. Bundesministerium der Finanzen, Ausgabe 2005.
- BMF (2007): 21. Subventionsbericht der Bundesregierung. Monatsbericht des BMF. September 2007, S. 33-37.
- Bode, O., Gerke, R. & Schellhorn, H. (2006): Die Wirkungen fiskalischer Schocks auf das Bruttoinlandsprodukt. Arbeitspapier 01/2006, Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung.
- Böhringer, C., Büttner, T., Kraus, M. & Boeters, S. (2004): Allokative und distributive Effekte einer Abschaffung des ermäßigten Umsatzsteuersatzes. Dienstleistungsauftrag BMF 06/03, Kurzfassung Oktober 2004, Zentrum für Europäische Wirtschaftsforschung, Mannheim.
- Corlett, W.J. & Hague, D.C (1953): Complementarity and the excess burden of taxation. *Review of Economic Studies*, 21, pp.21-30.
- Distelkamp, M. (2002): Computing a time series of Input-Output-Tables consistent with SNA 1993 / NACE Rev. 1. Paper presented at the 10th Inforum World Conference 2002, University of Maryland (USA).
- Distelkamp, M., Hohmann, F., Lutz, C., Meyer, B. & Wolter, M. I. (2003): Das IAB/INFORGE-Modell: Ein neuer ökonometrischer Ansatz gesamtwirtschaftlicher und länderspezifischer Szenarien. In: Beiträge zur Arbeitsmarkt- und Berufsforschung (BeitrAB), Band 275, Nürnberg.

- Distelkamp, M., Meyer, B. & Wolter, M. I. (2004): Demographie und Ökonomie: Einfluss der Bevölkerungsstruktur auf die Konsumnachfrage. GWS Discussion Paper, 2004/1, Osnabrück.
- ESA (1995): European System of Accounts (ESA). Brussels.
- Federal Statistical Office (2008): National Accounts: Accounts and Standard tables – Fachserie 1 / Reihe 1.4 – May Edition.
- Georgescu Roegen, N. (1990): Production Process and Economic Dynamics. In: Baranzini, M. / Scazzieri, R. (Eds.): The Economic theory of Structure and Change, Cambridge, pp. 198-226.
- Homburg, S. (1997): Allgemeine Steuerlehre. München.
- Kamps, C. & Caldara, D. (2006): What do we know about Fiscal Policy Shocks Effects? A Comparative Analysis. Working Paper. February 2006.
- Meyer, B. & Ewerhart, G. (2001): INFORGE: Ein disaggregiertes Simulations- und Prognosemodell für Deutschland. In: Lorenz, H.-W. & Meyer, B. (Hrsg.): Studien zur Evolutorischen Ökonomik IV: Evolutorische Makroökonomik, Nachhaltigkeit und Institutionenökonomik, Schriften des Vereins für Socialpolitik, Neue Folge, Bd. 195 IV, Berlin, S. 45-65.
- Meyer, B. & Wolter, M. I. (2007): Demographische Entwicklung und wirtschaftlicher Strukturwandel – Auswirkungen auf die Qualifikationsstruktur am Arbeitsmarkt. In: Statistik und Wissenschaft, Band 10, S. 70-96.
- Meyer, B. (2001): CO2- Taxes, Growth, Labour Market Effects and Structural Change: An Empirical Analysis. In: Welfens, P.J.J. et al. (Ed.): Internationalization of the Economy and Environmental Policy Options, Berlin, pp. 331-352.
- Meyer, B. (2004): Arbeitsmarkteffekte von Ökosteuern im Modell PANTA RHEI. In: Briem, S. & Fahl, U. (Hrsg.): Ansätze zur Modellierung von Beschäftigungseffekten in Energiesystemen, Berlin, S.179-192.
- Meyer, B. (2005): Strukturanalyse. In: Herrmann-Pillath, C. & Lehmann-Waffenschmidt, M. (Hrsg.): Handbuch Evolutorischer Ökonomie, Berlin.
- Meyer, B., Lutz, C., Schnur, P. & Zika, G. (2007): Economic Policy Simulations with Global Interdependencies: A Sensitivity Analysis for Germany. In: Economic Systems Research, 19(1), pp. 37-55.
- OECD (2006): Consumption Tax Trends – VAT/GST and excise rates, trends and administration issues. 2006 Edition. Organisation of Economic Co-Operation and Development, Paris.
- Peichl, A. (2005): Die Evaluation von Steuerreform durch Simulationsmodelle. Finanzwissenschaftliche Diskussionsbeiträge, 2005(1), Universität Köln.
- Perotti, R. (2002): Estimating the effects of fiscal policy in OECD countries. CEPR Discussion Paper Series, 4842.
- Plötscher, M.; Seidel, T. & Westermann, F. (2004): Fiskalpolitik in Deutschland: Eine empirische Analyse am Beispiel des Vorziehens der Steuerreform. CESifo, München.
- Ramsey, F. (1927): A Contribution to the Theory of Taxation. Economic Journal, March, pp. 47-61.

SVR (2000): Chancen auf einen höheren Wachstumspfad. Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung. Jahresgutachten 2000/1.

