Revenue and Welfare Effects of Financial Sector VAT Exemption

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Abstract:

This paper provides an analysis of revenue and welfare effects associated with a VAT exemption of financial services, which is common among OECD countries. We follow a general equilibrium approach that considers effects of repealing the VAT exemption not only on consumer demand and intermediate-input demand for financial services but takes account also of the VAT distortion of labor supply. We derive formal expressions for revenue and welfare effects, which can be quantified with a minimum of information about behavioral effects. Using VAT statistics as well as national accounts we provide quantitative estimates of the effects of repealing the VAT exemption in Germany. Our baseline estimate indicates that tax revenues would increase by some €1.7 Billion or 1.3% of VAT revenues (excluding import turnover tax). Provided these revenue gains are used to finance a reduction in the VAT rate or in other distortive labor taxes our results indicate a modest welfare gain of about €1 Billion, or 0.04% of GDP.

Keywords: VAT; Financial Services; Exemption; General Equilibrium; Deadweight Loss; Input-Output Analysis

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1 Introduction

Recent times have seen various policy proposals to change the tax system in order to determine "*a fair and substantial contribution by the financial sector*." (IMF, 2010). Some of these proposals may be little more than a political reflex to the recent financial crisis that forced governments in many developed countries into providing large rescue packages for financial institutions. However, as a matter of fact, in many countries financial institutions are largely exempt from the value-added-tax (VAT). Given the relative size of the financial industry in some countries, repealing the VAT exemption of financial services might result in substantial revenue gains. For instance, according to the HMRC's overview of tax expenditures and structural reliefs, in the UK, the largest single VAT exemption is that of finance and insurance which amounts to no less than £9.1 Billion or, according to our own calculations, 11.4% of total VAT receipts (see also Mirrlees *et al.*, 2011).

Aside from revenue losses, the VAT exemption of financial services might also be associated with a distortion of relative prices. Auerbach and Gordon (2002) argue that, for reasons of allocative efficiency, VAT should be levied on resources devoted to financial services in the same manner as it is levied on resources used by other sectors. Several possible distortions of the exemption of financial services are noted in the literature (*e.g.*, Huizinga, 2002, Mirrlees *et al.*, 2011). Due to the exemption, private consumption of financial services enjoys a tax-advantage whereas productive uses face a tax-disadvantage. Moreover, under exemption, inputs used by the financial industry tend to be more costly than self production. This favors in-sourcing of production and tends to boost the size of the financial sector. From this perspective, repealing the exemption might not only generate additional revenues but might do so at relatively low cost since the exemption itself is associated with distortions.

The few existing studies that consider revenue effects of the VAT exemption of financial services come to rather different conclusions. Using data for Germany, Genser and Winker (1998) estimate

a tax revenue gain from repealing the exemption of about 8.3% of total VAT revenues. Huizinga (2002) finds a more modest revenue increase of 4.7% of total VAT revenues for the European Union in 1998. In a recent study, Lockwood (2011) considers revenue implications for 26 EU countries based on data for 2007 and finds small revenue losses in an amount of about 0.06% of total VAT revenues. Welfare effects of repealing the VAT exemption of financial services are hardly considered in the literature. Based on his revenue estimate, Huizinga (2002) provides some discussion noting that the welfare assessment tends to be favorable especially if the demand for financial services is unelastic and if the tax system as a whole is associated with substantial distortions. However, more comprehensive quantitative estimates of welfare effects are lacking and also the welfare effects of producer price distortions have not been explored.

This paper reconsiders the revenue effects and explores also the welfare effects associated with VAT exemption of financial services. We follow a general equilibrium approach which takes account of pre-existing distortions associated with VAT as well as of the input-output structure of the economy. This allows us to determine the effects of repealing the VAT exemption not only on consumer demand and intermediate-input demand but also on labor supply. Making use of general equilibrium relationships we derive formal expressions for revenue and welfare effects, which can be quantified with a minimum of information about behavioral effects of VAT taxation. In our baseline scenario we treat the final consumption of financial services like any other consumer good. While this enables us to link the theoretical model with the national accounts, the literature has argued that financial services do not generate utility and should be treated like an input (*e.g.*, Grubert and Mackie, 1999). We take this point into account by considering a more substitutive relationship between leisure and the consumer demand for financial services.

Using VAT statistics and national-accounts statistics we compute the effects of repealing the VAT exemption in Germany. Based on a realistic estimate of the extent to which the financial sector is able to deduct input taxes that are associated with exempted financial services, we find that repealing the exemption would result into a revenue gain of about €1.698 Billion or 1.3% of total

VAT revenues in the base year (exclusive of import turnover tax). Regarding welfare effects, our results indicate that a revenue neutral decrease in the VAT or in other labor taxes should result in a modest welfare gain, amounting to €1.028 Billion or 0.04% of GDP. At any rate, the effects of repealing the VAT exemption of financial services turn out to be much less promising than indicated by some of the previous research.

The next section outlines the tax system in a simple n-good, one-factor economy where final consumption is subject to VAT and where one individual good is exempted. The subsequent section 3, then, discusses the revenue effects of repealing the exemption from a conceptual point of view before section 4 discusses the welfare effects. Section 5 provides a brief discussion of data and institutions in Germany before sections 6 and 7 present our quantitative results for this case. Section 8 provides some sensitivity analysis, which explores how the results change if the share of unrecoverable input taxes is altered. Section 9 provides a brief summary and concludes.

2 A Tax System with a VAT Exemption

To study the consequences of the VAT exemption, we consider a simple stylized economy which displays sufficient structure in order to enable us to discuss revenue and welfare effects of an exemption of financial services. One requirement is that there are multiple consumption goods, in order to be able to address differences in their tax treatment. Moreover, the economy needs to have some input-output structure in order to allow us to address distortions due to taxation of inputs. Furthermore, we need to take account of the fact that a VAT system exerts a distortion of the labor-leisure choice even without exemptions. Given these requirements, we discuss VAT exemption in a model with one factor, labor, and n goods which are used for both production and consumption. There are two taxes in the model, a VAT and a labor tax, and, in addition, one good is exempt from VAT. Of course, this simple set-up may be extended to cover further taxes such as capital income taxes. But, qualitatively, the basic features of our simple model economy

would carry over to more comprehensive models.

The intermediate input linkage is captured by input coefficients a_{ij} which determine how many units from sector i are used in the production of one unit in sector j. The tax revenue is generated from taxing the value of output $p_i X_i$ less the recoverable taxes on inputs plus the tax on labor earnings, with τ_L denoting the labor income tax rate. Labor serves as numeraire in this analysis and the wage rate is set to unity. Adding the contribution of the sectors to VAT and the labor tax, we can define total tax revenues as

$$T \equiv \sum_{i=1}^{n} \tau_i p_i X_i - \sum_{i=1}^{n}\sum_{j=1}^{n} \tau_j p_j a_{ji} X_i I_i - \alpha \sum_{j=1}^{n} \tau_j p_j a_{jn} X_n \left(I_f - I_n\right) + \tau_L \sum_{i=1}^{n} L_i,$$

where $I_i = 1$ if sector i is taxed or zero-rated and $I_i = 0$ if the sector is exempt. L_i is the labor input in sector i. In the analysis below we will focus on the (partial) exemption of the financial sector. For this purpose we distinguish the financial sector in two parts, one of which, denoted as sector f, is already subject to taxation and receives a refund of input taxes – a tax credit, while the other part, sector n, may enjoy exemption without refund of input taxes. Our definition of tax revenues already takes account of possibilities of the exempted part of the financial sector n to deduct some share α of input taxes from VAT taxes collected by the taxed part of the financial sector, indexed with f. Thus, even if sector n is exempted such that $I_n = 0$, the tax revenue equation takes account of the possibility that some part of the input taxes associated with the exempted part of the financial sector might be deductible in practice. Defining consumer demand as $x_i \equiv X_i - \sum_j^n a_{ij} X_j$, and rearranging terms we obtain

$$\begin{aligned} T = \sum_{i=1}^{n} \tau_i p_i x_i \quad &+ \quad \sum_{j=1}^{n}\sum_{i=1}^{n} \tau_j p_j \left(1 - I_i\right) a_{ji} X_i + \tau_L L \\ &- \quad \alpha \sum_{j=1}^{n} \tau_j p_j a_{jn} X_n \left(I_f - I_n\right); \end{aligned}$$

where L is total employment. Accordingly, if no sector is exempt $I_i = 1 \; \forall i$, VAT is equivalent to a tax on final demand. If the sector n is exempted, $I_n = 0$ and $\tau_n = 0$. In this case, some revenue

comes from the taxes on intermediate inputs in this sector. As the last term shows, if some share α of the taxes on inputs can be deducted from the taxes collected by the financial sector, total tax revenues decline.

If all sectors are equally subject to VAT and only sector n may be exempted, inserting the budget constraint of the private household allows us to simplify the expression for total tax revenues

$$T = \frac{\tau_n - \tau}{1+\tau} p_n x_n + \frac{\tau_L + \tau}{1+\tau} L + (1-\alpha)\tau \sum_{j=1}^{n-1} p_j a_{jn} X_n \left(1 - I_n\right). \tag{1}$$

With uniform taxation, $\tau_n = \tau$ and $I_n = 1$, tax revenue originates only from the taxation of labor. In the presence of an exemption, $\tau_n = 0$ and $I_n = 0$, the first term is a tax revenue loss reflecting the implicit subsidization of the exempted sector. The third term captures revenues from the non-deductible input taxes. Note that the main part of the indirect tax is now captured by $\frac{\tau_L+\tau}{1+\tau}$ which is the effective tax on labor income including VAT.

3 Repealing the Exemption

Let us now consider the effects of repealing sector n's exemption. Of course, one argument for exempting the financial sector from VAT payments is that there are technical difficulties of levying VAT on the value added by financial institutions. More precisely, the technical problem is to define the tax base, because there is no explicit price for services like granting loans or taking deposits. In order to charge VAT, the tax authority usually builds on an invoice with a reported price. One way to solve this problem is to use the differences between the deposit and the loan interest rate compared to a benchmark interest rate to determine the value added in the financial sector. The concepts of cash-flow taxation and tax calculation accounts (TCA) are based on this approach (Mirrlees *et al.*, 2011). Also the national accounts follow this approach in order to compute the

value added of the financial sector.[1]

Supposing that administrative issues can be solved in a satisfactory way, and the exemption is abolished, the output of sector n will be taxed at rate τ. A second consequence is that VAT on inputs used in sector n will be refunded, formally $I_n = 1$. We obtain the revenue implication by evaluation of the tax-revenue equation (1) with and without exemption

$$dT = \frac{\tau}{1+\tau} p_n x_n + \frac{\tau_L + \tau}{1+\tau} dL - (1-\alpha)\tau \left(\sum_{j=1}^{n-1} p_j a_{jn} X_n \right), \tag{2}$$

where dT and dL denote the change in tax revenues and labor supply. This expression suggests that the revenue effects of repealing the exemption can be decomposed into three components. The first component is a direct revenue effect from the taxation of the final output of sector n. The second term captures the change in employment which might result from a change in labor supply. This change is evaluated with the effective marginal tax rate which includes the labor tax rate and the VAT tax rate. The last term summarizes the revenue loss due to unrecoverable or *hidden* taxes on inputs.

With a standard representative agent approach, effects on labor supply result from the substitution and income effects on the demand for leisure. Those effects will be triggered by the direct effect on the consumer price of financial services. In addition, producer prices might be affected, in particular if there are unrecoverable input taxes under exemption. As the Appendix shows, unrecoverable input taxes have implications in particular for the producer price of financial services but may also have further effects on the prices of other goods. However, focusing on price effects in the financial services sector, the labor supply effect can be approximated as

$$dL = -\left(\frac{\partial h_{n+1}}{\partial q_n} - x_n \frac{\partial m_{n+1}}{\partial y} \right) dq_n, \tag{3}$$

[1]The statistical offices in the EU use the interbank lending rate as a benchmark to calculate the price for loan and deposit services using the FISIM (Financial Intermediation Services, Indirectly Measured) approach.

where h_{n+1} and m_{n+1} are the compensated and uncompensated demands for leisure which serves as the $n+1$-th good in our analysis. The first term in brackets involves a cross-price effect between consumption of leisure and the consumer price of financial services. Following Goulder and Williams (2003) we may substitute the compensated elasticity of labor supply into this equation,

$$\frac{\partial h_{n+1}}{\partial q_n} = \epsilon_L L \frac{x_n}{y} \left[1 + \theta_n\right], \tag{4}$$

where y is household income, $\theta_n = \frac{\epsilon_{n\,n+1}}{\sum_{i=1}^{n} \sigma_i \epsilon_{i\,n+1}} - 1$ is an indicator of the degree to which good n is a substitute to leisure – relative to all other goods, and ϵ_L is the compensated labor supply elasticity.[2] The second term on the right-hand side of equation (3) contains the standard income effect on labor supply. Substituting the income elasticity of labor supply ϵ_y, we specify the total labor supply effect as

$$dL = -\left(\epsilon_L L \frac{x_n}{y} \left[1 + \theta_n\right] - \frac{x_n}{y} \epsilon_y L\right) dq_n. \tag{5}$$

4 Welfare Effects

Having discussed the revenue effects of repealing the exemption, at least from a conceptual point of view, let us consider possible welfare gains or losses. Welfare effects will arise, first of all, since the price of financial services is changed. In contrast to the case of taxation of a single commodity, where welfare effects of a reform can be determined using the Harberger triangle, in a multiple tax setting it is crucial to take account of pre-existing distortions (*e.g.*, Hines, 1999). This raises two issues. First, since VAT tends to distort the labor-leisure choice, a discussion of the welfare effects needs to take account of repercussions in the labor market. Second, if exemption is associated with non-refundable input taxes, further distortions may arise in the production sector.

[2] $\sigma_i \equiv \frac{q_i h_i}{y}$ denotes the share of expenses on good i in relation to total household income.

We consider a representative household with utility $u(x_1, x_2, ..., x_n, l)$, where x_i is consumption of good i, and l is leisure. The consumer's budget constraint is

$$\sum_{i=1}^{n} q_i x_i = y = (1 - \tau_L)(\mathcal{T} - l),$$

where $q_i = (1 + \tau_i) p_i$ is the consumer price for good i inclusive of taxes and $\mathcal{T}$ is the total time endowment of the household.

Denoting the Lagrangian multiplier with λ, the first order conditions for maximum utility are $\frac{\partial u}{\partial x_i} = q_i \lambda$ and $\frac{\partial u}{\partial l} = (1 - \tau_L) \lambda$. The welfare effect of repealing the exemption is found by the impact on utility expressed in terms of the numeraire. If all consumer goods are taxed at rate τ and only the taxation of the consumption of sector n differs, it is useful to reformulate the tax system so as to take account for VAT as a part of labor taxation and to discuss the specific treatment of sector n in terms of the deviation from the uniform tax rate. Taking a total differential of the utility function, making use of the first-order conditions as well as of the labor market equilibrium condition the marginal welfare effect can be specified as

$$\frac{1}{\lambda} du = \underbrace{p_n \widetilde{\tau}_n dx_n}_{\frac{1}{\lambda} du_A} + \underbrace{\widetilde{\tau}_L dL}_{\frac{1}{\lambda} du_B} + \underbrace{(1 - \alpha) \tau \sum_{j=1}^{n-1} p_j dX_{jn}}_{\frac{1}{\lambda} du_C}, \tag{6}$$

where $\widetilde{\tau}_n \equiv \frac{\tau_n - \tau}{1 + \tau}$, $\widetilde{\tau}_L \equiv \frac{\tau_L + \tau}{1 + \tau}$. Note that the main part of the indirect tax is now captured by $\widetilde{\tau}_L$ which is the effective tax on labor income including VAT. Accordingly, the discussion of welfare effects needs to consider three sources of utility effects of the reform:

$\frac{1}{\lambda} du_A$: demand changes for the previously exempted consumer good

$\frac{1}{\lambda} du_B$: labor supply effects

$\frac{1}{\lambda} du_C$: changes in the demand for intermediate inputs

In the following subsections we briefly discuss how these effects can be specified.

4.1 Demand for Consumer Goods

Let us start with effects on household demand for financial services that originate in the change of the consumer price. Inserting the Hicksian demand h_n for financial services into the first component of equation (6) we arrive at the utility effect associated with the demand change

$$\frac{1}{\lambda} du_A = p_n \widetilde{\tau}_n \frac{\partial h_n}{\partial q_n} dq_n. \tag{7}$$

With $q_n = (1 + \widetilde{\tau}_n)\, p_n$, the consumer price change can be formally expressed as

$$dq_n = d\widetilde{\tau}_n p_n + (1 + \widetilde{\tau}_n) dp_n. \tag{8}$$

There are two sources of the price change. The first source is the direct consumer price increase due to a higher tax rate. However the producer price might also change.

We insert equation (8) into (7) to obtain the welfare effect for the consumer price change. Then, we integrate equation (7) over the change in the tax rate as well as over the change in the producer price, which declines from p_n to p'_n

$$DWL_A \quad \equiv \quad - \int_{\widetilde{\tau}_n}^{\widetilde{\tau}'_n} \frac{1}{\lambda} \frac{du_A}{d\widetilde{\tau}_n} d\widetilde{\tau}_n + \int_{p'_n}^{p_n} \frac{1}{\lambda} \frac{du_A}{dp_n} dp_n,$$

where the prime denotes post-reform values. Noting that $\widetilde{\tau}'_n = 0$ and $\widetilde{\tau}_n = \frac{-\tau}{1+\tau}$, we can summarize the overall welfare effect associated with the consumer price change as

$$DWL_A = s_n y \frac{1}{2} \epsilon_{nn} \left[\left(\frac{\tau^2}{1+\tau} \right) - \widehat{p}_n \widetilde{\tau}_n \right], \tag{9}$$

where $s_n \equiv \frac{p_n h_n}{y}$ denotes the net-of-tax share of consumer spending on good n in relation to the total household income (net of labor taxes) y. $\widehat{p}_n$ denotes the relative change in the producer price $\left(\frac{p'_n - p_n}{p_n} \right)$. Since the own price elasticity is negative, a positive sign of the term in squared brackets

would depict a welfare gain. Since $\widetilde{\tau}_n < 0$ initially, a decline in the producer price tends to reduce this welfare gain. Intuitively, if the producer price decrease is small, we have a welfare gain from repealing the exemption as the initial subsidization is removed.

4.2 Labor Supply

Let us next turn to labor supply effects. Based on the assumption that only sector n experiences noticeable consumer price effects, inserting the Hicksian demand for leisure into the second component of equation (6), we obtain the utility effect associated with the change in labor supply

$$\frac{1}{\lambda} du_B = -\widetilde{\tau}_L \frac{\partial h_{n+1}}{\partial q_n} dq_n.$$

Integrating over the tax rate change and the producer price change

$$DWL_B \equiv -\int_{\widetilde{\tau}_n}^{\widetilde{\tau}'_n} \frac{1}{\lambda} \frac{du_B}{d\widetilde{\tau}_n} d\widetilde{\tau}_n + \int_{p'_n}^{p_n} \frac{1}{\lambda} \frac{du_B}{dp_n} dp_n.$$

Substituting equation (4), we can summarize the welfare effect associated with labor supply as

$$DWL_B = \widetilde{\tau}_L L s_n \epsilon_L \left[1 + \theta_n\right] \left(\frac{\tau}{1+\tau} + \widehat{p}_n \left(1 + \widetilde{\tau}_n\right) \right), \tag{10}$$

where s_n is defined as above. The increase in the price of financial services tends to result in an increased consumption of leisure, *i.e.* a reduced labor supply, which would contribute to a welfare loss. If the producer price declines, the second term in brackets would be negative and would work towards a reduction of the welfare loss.

4.3 Effects on Intermediate Input Demand

The above expression (6) for the marginal utility effect suggests that there is also a third effect on welfare which is associated with the demand for intermediate inputs. This term captures the consequences of a change in intermediate input demands by the exempted sector n, provided it effectively pays input taxes.

In order to determine the value of the change in the intermediate input demands $\sum_{j=1}^{n-1} p_j dX_{jn}$ we note that the first order condition for X_{jn} implies that the marginal product is equal to the input price. Assuming that all tax rates are the same $\tau_j = \tau, \forall j \neq n$,

$$p_n F_{nj}\left(X_{1n}, ...X_{jn}, ...X_{nn}, L_n\right) = \left(1 + (1-\alpha)\,\tau\right) p_j,\ \forall j \neq n.$$

Let us assume for simplicity that the output elasticity of F_n with regard to X_{jn} is equal to η_{jn}. From the optimal input of j in sector n $X_{jn} = \frac{p_n \eta_{jn} X_n}{(1+(1-\alpha)\tau)p_j}$ the value-based input coefficient

$$\widetilde{a}_{jn} = \frac{p_j X_{jn}}{p_n X_n} = \frac{\eta_{jn}}{1 + (1-\alpha)\,\tau},$$

is independent of prices. With this result, in order to determine the change in intermediate input demands, we just need to quantify the following expression

$$\sum_{j=1}^{n-1} p_j dX_{jn} = \left[\sum_{j=1}^{n-1} \widetilde{a}_{jn}\right] d\left(p_n X_n\right) - p_n X_n \sum_{j=1}^{n-1} \widetilde{a}_{jn} \widehat{p}_j.$$

This expression indicates that the change in intermediate input demand is a linear function of changes in the value of output of sector n and of the price changes in other sectors. Focusing on the producer price change in sector n, the utility effect associated with changes in the demand for intermediate inputs is

$$\frac{1}{\lambda} du_C = (1-\alpha)\,\tau \left[\sum_{j=1}^{n-1} \widetilde{a}_{jn}\right] d\left(p_n X_n\right).$$

Integrating over the output change in the financial industry, we obtain the deadweight loss associated with changes in the demand for intermediate inputs

$$DWL_C \equiv -(1-\alpha)\,\tau \left[\sum_{j=1}^{n-1} \widetilde{a}_{jn}\right] (p'_n X'_n - p_n X_n)\,. \tag{11}$$

The Appendix shows how the gross-output change in the financial industry $(p'_n X'_n - p_n X_n)$ can be approximated using the input-output matrix and the vector of cross-price demand elasticities $\epsilon_{n1}, \epsilon_{n2}, ...\epsilon_{nn}$.

4.4 Revenue Neutral Change of Labor Income Taxes

In the above derivation of welfare effects, revenue implications are already taken into account, based on the simplifying premise that revenue gains or losses are passed on to consumers by means of lump-sum transfers. However, if the revenue changes are used to finance a change in a distortive tax such as VAT or other labor income taxes in our model, further welfare effects result.

If the tax reform would result into a marginal revenue gain of dT, what would be the budget balancing reduction in $\widetilde{\tau}_L$? From the government budget constraint we have

$$d\widetilde{\tau}_L = -\frac{1}{L}\left[1 - \epsilon_L \frac{\widetilde{\tau}_L}{1-\widetilde{\tau}_L}\right]^{-1} dT. \tag{12}$$

Based on the assumption that, after repealing the exemption of financial services, $\widetilde{\tau}_i = 0 \ \wedge \ I_i = 1 \ \forall i$, from equation (6), the utility effect is equal to the change in labor supply evaluated at the effective tax rate on labor supply. Inserting the effect on the demand for leisure and integrating over $d\widetilde{\tau}_L$ gives us the deadweight loss associated with changes in labor taxes

$$DWL_D \equiv \frac{1}{2}\left(\frac{\widetilde{\tau}'^2_L}{1-\widetilde{\tau}'_L} - \frac{\widetilde{\tau}^2_L}{1-\widetilde{\tau}_L}\right) L\epsilon_L. \tag{13}$$

With $\widetilde{\tau}_L' < \widetilde{\tau}_L$, this term is negative, indicating that a reduction in the labor tax results in a welfare gain due to a higher labor supply.

5 Data and Quantification Approach

We quantify the revenue and price effects of the financial sector VAT exemption using data from Germany as one of the European Union countries, which all put a lot of emphasis on VAT and currently discuss new models of taxing financial services. The value added tax is one of the two most important tax revenue sources in Germany. With a volume of about € 190 Billion in 2011 – € 140 Billion excluding import turnover VAT – it makes up about a third of tax revenues. Similar to other countries, the financial sector is exempted. More specifically, §4 no. 8 German VAT Act (UStG) determines that provision and intermediation of loans and deposits are exempted from VAT. However, in Germany and other countries of the European Union financial institutions can opt for a taxation of business-to-business transactions (§9 I UStG).[3] Hence, in practice, only a fraction of the output of financial services is exempted. Applying the above framework, thus, requires decomposing the financial sector into a taxed and an untaxed part.

To take account of the input interdependencies between the different sectors we use the input-coefficient matrix from the national accounts, where the economy is split into 71 sectors. The base year for the analysis is 2007. We define as financial sector the financial intermediation services except insurance and pension funding services (*DL der Kreditinstitute*). In order to take account of partial exemption, we work with an extended classification of 72 sectors, where the financial sector is decomposed into two sectors, with one fully taxed and one exempted part. This decomposition relies on the amount of taxable services in the financial sector from the VAT statistics. According to this statistic, in 2007 € 37.638 Billion of financial services were subjected to VAT. Relating this amount of taxable services to the total output of the financial sector according to the national

[3]For a discussion, see De la Feria and Lockwood, 2010.

accounts[4] we obtain a fraction of 33.03% (=€37.638 Billion/€113.950 Billion) for the "taxed financial sector". Hence, the non-taxed part of the financial sector accounts for about 67% of the total output of the financial sector. In the following, this exempted part of the financial sector makes up the financial sector n. Implicitly, this procedure assumes that the share of inputs used by the exempted part is proportional to the output share.

While the above conceptualization is built on the assumption that non-financial activities are all subject to the same VAT rate, in practice, tax-rates on individual sectors differ. In particular, several sectors enjoy reduced rates. Table A-1 in the Appendix reports effective VAT rates for the 71 sectors. The average VAT rate for each sector is obtained from the VAT statistics by dividing the amount of paid VAT (for goods and services) with the amount of taxable supply of goods and services.[5] Excluding the financial services, the mean tax rate still amounts to 13.59%.[6]

Given that the exemption is only partial, the literature also wonders as to whether the financial sector may be able to deduct some part of the VAT on inputs, even if they are used to produce exempted services (Huizinga, 2002, Lockwood, 2011). In terms of the above model, this implies accounting for a share α of inputs for which the exempted part receives tax credits. Since official figures are not available, we provide our own empirical estimate based on the German VAT statistics (Statistisches Bundesamt 2009) and on the German national accounts (Statistisches Bundesamt, 2010) for the year 2007. From the VAT statistics we know that the VAT input taxes, that are currently recovered by the financial sector, amount to €5.085 Billion. This amount will cover both input taxes associated with the taxed and the exempted parts of the financial sector. Following the above notation $5.085 = \alpha \sum \tau_j \widetilde{a}_{jn} X_n p_n + \sum \tau_j \widetilde{a}_{jf} X_f p_f$. Rearranging terms, we obtain

[4]Our analysis uses data from the revised system of European National Accounts. Available since 2004/2005 it provides detailed information on the value added of the financial sector. In difference to some of the previous literature, we, therefore, do not need to provide own estimates about the value added of the financial sector.

[5]Intra-EU purchases and imports from third countries are excluded.

[6]The tax rate varies from 0% (public administration and defence) and 3.34% (health and social work services) up to 24.23% (services auxiliary to financial intermediation). Whereas tax rates below the normal rate of 19% might just reflect the presence of sales subject to reduced rates of 7%, the figure above 19% indicates that the figures suffer from some statistical discrepancies.

the share of recoverable input taxes:

$$\alpha = \frac{5.085 - \sum \tau_j \widetilde{a}_{jf} X_f p_f}{\sum \tau_j \widetilde{a}_{jn} X_n p_n}.$$

Based on the assumption that input coefficients are the same for both parts of the financial sector, and noting that $X_f p_f = 37.639$, $X_n p_n = 76.311$ and $\sum \tau_j \widetilde{a}_{jf} = \sum \tau_j \widetilde{a}_{jn} = 0.0618$, where we have used sector specific VAT rates (see above), we have

$$\alpha = \frac{5.085 - 2.325}{4.715} = \frac{2.760}{4.715} = 0.585.$$

Accordingly, 58.5% of the taxes on inputs used in the production of the exempted part are credited against taxes paid by the financial sector. This amounts to €2.760 Billion of recoverable input taxes associated with the exempted sector; only €1.955 Billion (=4.715-2.760) of input taxes are unrecovered.

To see how this estimate compares with the existing literature, note that our figure implies that unrecovered input taxes amount to some 28% $\simeq \frac{1.955}{2.325+4.715}$ of all input taxes paid by the financial sector as a whole, including exempted as well as taxed activities. Using data for a group of European financial institutions Huizinga (2002) reports a total share of unrecovered input taxes relative to all taxes on inputs of about 18.8%. From this perspective, when we base the calculations below on our estimate for α we are operating with a relatively modest estimate for the share of recoverable input taxes. Though Huizinga's estimate for unrecoverable input taxes is based on survey data which depict individual firms precisely, it is not obvious to which extent these figures are representative. De la Feria and Lockwood (2010) come to a different result. They provide survey evidence from a PWC study indicating that the fraction of unrecoverable input taxes is about 74% for Germany and the average rate is about 79% for the five biggest EU countries and the Netherlands. Lockwood (2011) distinguishes intra-EU sales of financial services from exports of services to the rest of the world and arrives at an average share of unrecoverable input taxes

between 90% to 100 % for intra EU-sales.[7]

Besides of using different data sources, our estimate of the share of unrecoverable input taxes may differ from the previous estimates due to the focus on the German case. While the European VAT Directive allows all member states to introduce legislation that allows financial services to opt for taxation, Germany is one of the member states where it is actually possible to opt for taxation of business to business transactions in the financial sector (de la Feria and Lockwood, 2010). This might provide the financial sector in Germany with more leeway to recover input taxes than is available in other countries. However, the VAT statistics do not allow us to distinguish between between VAT credits associated with regular VAT and VAT credits that come from optional VAT.

6 Quantitative Results for Revenue Effects

The above analysis has provided us with formal expressions for revenue and welfare effects of repealing the exemption in a general equilibrium setting which rest on a couple of simplifying assumptions. One such simplification is the assumption that producer price effects are more or less confined to the exempted sector. However, this assumption seems reasonable in the current empirical setting. In our baseline scenario, using the procedure outlined in the Appendix, the relative producer price change in the financial sector is estimated to be -2.9%, in the other sectors it is between 0 and -0.32 %. In absolute terms, the price effect in the financial sector is larger, on average, by a factor of twenty. Given the substantial information requirements needed to compute the demand effects of producer price changes in other sectors, we keep our focus on producer price changes in the financial sector.

Using equation (2) we first analyze the change in tax revenues due to repealing the VAT exemption

[7]This rate is not directly comparable to our rate, because it excludes large exempted sectors (education, medical care, public administration and financial intermediation services themselves) from the calculation of unrecoverable input taxes. Lockwood also notes that the activity classification does not cleanly divide the financial services sector into subsectors subject to VAT and exempt from VAT.

in the financial sector n. There are three components. The first component reflects the direct revenue effect from taxing consumers. It can be computed using the regular value added tax rate of 19% multiplied by the total consumer demand for financial services at pre-tax prices.

The second component is the labor supply response. Building on the assumption that only sector n's producer price changes, we use equation (5) in order to estimate the change in the supply of labor. Total labor supply is assumed to be equal to the total domestic employees' income which is reported in the primary input matrix with L=€1180.43 Billion. Dividing the final demand for non-taxed financial services by total final demand for all sectors, we obtain $s_n = 1.8\%$ (= €23.54 Billion/ €1306.34 Billion). Imposing a VAT of 19% results in a consumer price increase of 15.6% $(= -(1 + 0.19) * 0.029 + 0.19)$.[8] For the compensated labor supply elasticity and the income elasticity, we employ the average figures reported by Keane (2011) with $\epsilon_L = 0.31$ and $\epsilon_y = 0.25$. Now, we are able to calculate the change in labor supply evaluated at the current wage rate: dL= -€0.198 Billion. For the effective marginal labor tax rate we use $\frac{\tau_L+\tau}{1+\tau} = 0.53$, where the marginal income tax rate is $\tau_L = 43.8\%$ (OECD, 2008). This is calculated using OECD data for Germany capturing the marginal rate of the income tax plus employee contributions less transfers for a representative married one-earner couple with two children.

The third component is the revenue loss associated with current unrecoverable input taxes. In order to measure the unrecoverable input taxes as precisely as possible, we take account of sector specific VAT rates (see above). Hence, the sum of unrecoverable input taxes is computed as

$$UIT \equiv (1 - \alpha) \left(\sum_{j=1}^{n-1} \tau_j \widetilde{a}_{jn} p_n X_n \right). \tag{14}$$

Here we multiply every input quantity that is purchased by the financial sector by the per-unit VAT payments. Summing across sectors, we obtain the total amount of taxes that might not be deductible for the financial sector. To arrive at the unrecoverable input taxes this sum is pre-

[8]Note that the consumer price change can be specified as $\widehat{q}_n \equiv \frac{q'_n - q_n}{q_n} = (1 + \tau)\,\widehat{p}_n + \tau$.

multiplied with $1 - \alpha$, where the recovery rate is set to $\alpha = 0.585$, which we consider to be the best estimate for German case (see above).

The resulting figures for each of the three terms are as follows:

1. The first term on the right-hand side of equation (2) is the change in VAT revenue due to giving up the implicit subsidization of final demand for the financial sector. According to our calculations this revenue gain amounts to €3.760 Billion or about 2.9% of total VAT revenues in the base year (exclusive of import turnover tax).

2. The second term reports the change in tax revenues due to a change in labor supply. It amounts to a revenue loss of €0.105 Billion.

3. The last term represents the unrecovered or hidden input taxes. Based on the assumption that parts of the input taxes associated with the exempted part of the financial sector are deductible ($\alpha = 0.585$), the associated revenue loss amounts to some €1.957 Billion or about 1.5% of total VAT revenues in the base year (exclusive of import turnover tax).

The sum of these three effects amounts to a total tax revenue increase by €1.698 Billion or 1.3% of total VAT revenues in the base year (exclusive of import turnover tax).

7 Quantification of Welfare Effects

Following the above theoretical analysis, we first consider the deadweight loss due to demand changes for the previously exempted consumer good. Equation (9) includes the own price elasticity of financial services ϵ_{nn}. Lacking more recent empirical studies, we use a figure of -0.547, an estimate obtained by Chen (1999) for Germany in the group of consumption n.e.c. Taking account of a decrease in the producer price of financial services by 2.9%, the welfare effect of repealing the

VAT exemption associated with the consumer demand for financial services is estimated to be

$$DWL_A = -€\,0.166 \quad \text{Billion},$$

which is a small welfare gain. Intuitively, this is explained by the removal of the implicit subsidization of the consumption of financial services.

The deadweight loss caused by the reaction in labor supply is obtained from a quantification of equation (10). This expression depends on θ_n, a parameter that indicates whether financial services are a close substitute to leisure relative to other consumer goods. Assuming that financial services show the same degree of substitutability with leisure as other goods $\theta_n = 0$, and using the same parameter values as in the computation of the revenue effects

$$DWL_B = €\,0.472 \quad \text{Billion},$$

which is the welfare loss from a decline in labor supply.

The welfare effect associated with changes in intermediate input demand can be determined using equation (11). In order to quantify this expression we need to determine the demand for financial services by other sectors. This involves to determine the cross-price elasticities $\epsilon_{n,i}\ \forall i \neq n$ which would help us to compute consumer demand effects experienced by other sectors if financial services become more expensive. However, we have no information as to how large those cross-price effects are. Based on the assumption that cross-price elasticities are zero, the Appendix provides a derivation of the change in total output of sector n. Using the above figures for the own-price elasticity and the share of recovered input taxes and noting that the share of intermediate inputs from other sectors is $\sum_{j=1}^{n-1} \widetilde{a}_{jn} = 0.437$, the resulting welfare effect is

$$DWL_C = €\,0.084 \quad \text{Billion},$$

indicating a small welfare loss. The intuition for this welfare loss, is that a decline in the output of the exempted sector results in lower intermediate input taxes.

A further welfare effect, which should also be considered in order to give a comprehensive picture, is associated with the revenue implications of the reform. The basic premise of the welfare analysis is that the revenue changes are distributed back to households in a lump-sum fashion. However, if the distortive VAT or other labor taxes are used to feed back the revenue changes, an additional welfare effect would result. We evaluate this effect by computing the welfare change associated with a budget-balancing change in the tax rate on labor. In other words, we calculate the welfare effect by assuming that changes in revenues are used to finance a change in the effective labor tax rate. Of course, sign and size of the revenue change depend on the amount of unrecoverable input taxes. If a share $\alpha = 0.585$ of input taxes is already deducted from the VAT payments currently associated with the financial sector, we have seen above that revenues are increasing. Inserting the above estimate of the tax-revenue gain (€1.698 Billion) in equation (12), the revenue neutral change of the effective marginal tax rate on labor is $\widetilde{\tau}_L' - \widetilde{\tau}_L = -0.0022$ or 0.22 percentage points. To compute the associated welfare effect, we use equation (13) derived above and obtain

$$DWL_D = -€1.419 \quad \text{Billion.}$$

Taken together, these results indicate that repealing the VAT exemption turns out to be associated with a slight increase in the excess burden of taxation. The additional distortion of labor supply, through the increase in the consumer price level, outweights beneficial effects for the consumer through lower producer prices. The net welfare effect amounts to a welfare loss of $DWL_A + DWL_B + DWL_C = €0.391$ Billion. However, if we would use the revenue gain in order to lower the tax rate on labor, we need to sum all four welfare effects

$$DWL = DWL_A + DWL_B + DWL_C + DWL_D = -€1.028 \quad \text{Billion,}$$

which points to a welfare gain of about 0.04% of GDP.

8 Sensitivity Analysis

From German VAT statistics we have obtained a share α of deductible input taxes associated with the exempted part of the financial sector of 58.5% in the year 2007. By varying this share we obtain some insights into how important this parameter is for the actual results. Table 1 shows key figures obtained with our baseline estimate of α and with alternative parameter values.

Table 1: Results for Alternative Values of α

	$\alpha = 0$	$\alpha = 0.585$	$\alpha = 1$
$\widehat{p}_n$	-6.98%	-2.9%	0%
$\widehat{q}_n$	10.7%	15.6%	19%
UIT	4.715	1.957	0
ΔT	-1.027	1.698	3.631
DWL	1.297	-1.028	-2.651

$\widehat{p}_n, \widehat{q}_n$: change in producer and consumer prices for exempted financial services. UIT: unrecoverable input taxes, ΔT: revenue gain, DWL: deadweight loss, all in Billion €.

Without any deductibility ($\alpha = 0$), the distortion of the producer price would be strongest. Moreover, in this case, repealing the exemption would cause a loss in revenues from unrecoverable VAT on inputs in the amount of €4.715 Billion or about 3.7% of total VAT revenues in the base year (exclusive of import turnover tax). This figure of unrecoverable input taxes is similar to the number of €4.846 Billion of hidden input taxes for 2006 in Germany obtained by de la Feria and Lockwood (2010), who employ data which suggest that α is small. Since there would be a substantial amount of unrecoverable input taxes, it comes at no surprise that repealing the exemption would result also in a total revenue loss. Table 1 displays a total tax revenue loss of €1.027 Billion and a total welfare loss of €1.297 Billion for this case. With full deductibility ($\alpha = 1$) the producer price would not be affected. Repealing the VAT exemption would, however, exert stronger effects on the tax price to consumers, who face a price increase of 19% for financial services. In this scenario, the total revenue gain of repealing the exemption amounts to €3.631

Billion and the corresponding welfare gain is €2.651 Billion.

Since the parameter estimate employed in the baseline scenario refers to a broader basket of consumption goods, and not directly to financial services, we have also explored how results change if we vary the price-elasticity of the demand for financial services. From the above discussion of revenue and welfare effects, it is clear that the choice of the price elasticity matters only for the welfare effects. On the one hand, the welfare gain associated with removing the implicit subsidy for financial services increases with this elasticity. On the other hand, the welfare loss associated with the change of intermediate input demand increases with the price elasticity. Due to these countervailing effects, we found that the total welfare effect does not vary much with the price elasticity.

The baseline scenario assumes that the elasticity of substitution between leisure and financial services does not show major differences to the elasticity of substitution with regard to other goods. With this assumption θ_n has been set to zero. Of course, if financial services are a strong substitute for leisure relative to other goods, θ_n would be larger than zero. Lockwood (2012) argues that financial transactions associated with consumption activities require household time, and that the purpose of financial services is to save this time for the household (see also Grubert and Mackie, 1999). From this perspective it seems likely that financial services are a relatively strong substitute for leisure. As a sensitivity check, we have explored the case where the elasticity of substitution between leisure and financial services is twice as large as the elasticity of substitution between leisure and other goods, and, hence, $\theta_n = 1$. We found that labor supply shows a stronger decline with adverse implications for tax revenues. As a further consequence, the welfare gain, which can be generated by lowering the labor tax rate, is smaller than in the baseline calculation. We also found that the welfare loss associated with higher taxes on financial services is larger with higher substitutability. Consequently, the overall welfare effect is reduced: with $\theta_n = 1$ the welfare gain almost vanishes.

9 Summary and Conclusions

In this paper, we have considered a simple stylized economy which displays sufficient structure to enable us to discuss revenue and welfare effects of repealing the VAT exemption of financial services. More specifically, we have analyzed the VAT exemption in a setting with multiple consumption goods, with an input-output structure and with pre-existing distortions from VAT and a tax on labor supply. Our theoretical analysis shows that in this setting, revenue effects of repealing the exemption arise from the taxation of consumers, from the implicit taxation of financial services through the lack of input tax deductibility under exemption and from possible labor market responses. The analysis of the welfare consequences of repealing the VAT exemption of financial services indicates that four different effects need to be considered. First, repealing the VAT exemption removes the distortion of the consumer price of financial services. Secondly, households may respond to higher consumer prices with less supply of labor, which tends to reduce welfare gains. To the extent that the financial industry cannot deduct input taxes under exemption, further welfare losses may be obtained, as the lower output of the financial industry might lead to a decline in input taxes. Finally, if repealing the VAT exemption results in net revenue gains, the government might go for a revenue neutral decrease in other tax instruments. In particular, a reduction in the standard VAT rate comes to mind, which, in our analysis, would reduce the distortion of the labor-leisure choice.

In order to show how these concepts of revenue and welfare effects can be applied to discuss policy choices, we provide an empirical quantification for the case of Germany, one of the European Union countries, which all put a lot of emphasis on VAT and currently discuss new models of taxing financial services. For this case, we find that repealing the VAT exemption would result in a revenue gain of about €1.698 Billion or 1.3% of VAT revenues (exclusive of import turnover tax). This result critically hinges on the share of input taxes which can be recovered under the current exemption regime.

The welfare assessment of repealing the VAT exemption of financial services highlights advantages such as the removal of the implicit subsidization of financial services and improved incentives from a revenue neutral reduction of taxes on labor supply. Summing the various components of the welfare effects we find, however, that the total welfare gain of repealing the VAT exemption is rather limited. The gain would be about €1.028 Billion or 0.04% of GDP.

Our baseline estimates rest on our finding that a substantial fraction (58.5%) of input taxes paid by the exempted part of the financial industry are deductible. If no input taxes associated with the production of financial services could be refunded, our analysis would actually point at revenue losses of about €1.027 Billion or -0.8% of total VAT revenues in the base year. For this case, also the welfare analysis produces disappointing results, showing a total welfare loss €of 1.297 Billion or 0.05% of GDP. Our baseline scenario also builds on the assumption that leisure is not a particularly close substitute for financial services. If, however, the main purpose of consuming financial services is to save leisure time for the household, this assumption would not hold. In this case, our analysis indicates that the adverse consequences on labor supply would be larger, and the welfare and revenue gains would have to be further qualified.

Since there are various technical difficulties of implementing a VAT on financial services, these results are not very encouraging for attempts to repeal financial sector VAT exemption at least in Germany. However, it should be emphasized that a couple of issues have not been addressed in the analysis. One limitation of our analysis is the focus on VAT and labor taxation. From a practical point of view there are various other distortionary taxes which are not considered in the above analysis such as capital income or property taxes. Our focus on labor taxes results from the fact that while VAT does not tend to distort the capital allocation or savings decisions it is often regarded as distorting the consumers decision to work or to consume leisure. Hence, even if revenue gains are modest, a straightforward policy option is a revenue neutral reform that lowers the VAT in combination with repealing the VAT exemption of financial services. Our analysis is concerned with such a reform. Of course, if a reform involves the reduction of other taxes, results would be

different. A, perhaps, more important limitation of the paper is the lack of discussion regarding the international capital market. One might argue, for instance, that introducing a VAT on financial services could result into some tax-avoidance, where financial services might be purchased abroad. Cross-border transactions would also raise difficult questions for tax administration, if VAT on exports of financial services is reimbursed. Given that VAT exemptions and reductions in VAT rates are sometimes justified by distributional concerns, a comprehensive discussion would also have to consider distributional effects. However, to explore those issues is left for future research.

A Appendix

A-1 Producer Price Effects of Repealing the VAT Exemption

With perfect competition, the producer price equals unit cost and obeys

$$p_j = \sum_{i=1}^{n} a_{ij}(1 + (1-\alpha)(1-I_j)\tau_i)p_i + b_j,$$

where $I_j = 1$ if the sector j is subject to tax or zero-rated, and $I_j = 0$ if the sector is exempt. Therefore, the producer price of a sector depends on the input prices p_i and input coefficients a_{ij} as well as on the tax rates τ_i and the input tax refund. b_j is the per-unit labor input in sector j, as above, the wage rate is set to unity.

For sectors other than n, deductibility ensures that producer prices can be determined without taking account of tax effects. For these sectors we have

$$p_j = \sum_{i=1}^{n} a_{ij}p_i + b_j \; \forall j \neq n.$$

For sector n, before exemption is repealed

$$p_n = \sum_{i=1}^{n-1} a_{in}p_i(1 + (1-\alpha)\tau_i) + a_{nn}p_n + b_n. \tag{15}$$

This would suggest that taxes on inputs paid by sector n matter for the output price of this sector to the extent that the components are necessary as inputs. Yet, depending on the substitution

elasticity, input price effects might be compensated by changes of intermediate input demand. This requires us to allow for changes in the intermediate input coefficients. However, according to the Envelope theorem, the changes in the input quantities sum up to zero, *i.e.* the changes in the technical input coefficients for intermediate inputs and for labor can be disregarded for small price changes. Therefore, we can use the case with fixed input coefficients as a first approximation. After repealing exemption, the price in sector n is

$$p'_n = \sum_{i=1}^{n} a_{in} p'_i + b_n.$$

Using (15) we subtract the price under exemption

$$p'_n - p_n = \sum_{i=1}^{n} a_{in} \left(p'_i - p_i\right) - (1-\alpha) \sum_{i=1}^{n-1} a_{in} p_i \tau_i.$$

For sectors $j \neq n$ we have

$$p'_j - p_j = \sum_{i=1}^{n} a_{ij} \left(p'_i - p_i\right).$$

Translating into value based input coefficients

$$\begin{aligned}
\widehat{p}_1 &= \sum_{i=1}^{n} \widetilde{a}_{i1} \widehat{p}_i \\
&\vdots \\
\widehat{p}_{n-1} &= \sum_{i=1}^{n} \widetilde{a}_{in-1} \widehat{p}_i \\
\widehat{p}_n &= \sum_{i=1}^{n} \widetilde{a}_{in} \widehat{p}_i - (1-\alpha) \sum_{i=1}^{n-1} \widetilde{a}_{in} \tau_i,
\end{aligned}$$

with $\widetilde{a}_{ij} = \frac{a_{ij} p_i}{p_j}$.

With the transpose of the input-coefficient-matrix (excluding row n and column n)

$$\widetilde{\mathsf{A}}^T_{n-1 \times n-1} = \begin{bmatrix} \widetilde{a}_{11} & \widetilde{a}_{21} & \cdots & \widetilde{a}_{n-11} \\ \widetilde{a}_{12} & & & \\ \vdots & \ddots & & \vdots \\ \widetilde{a}_{1n-1} & \widetilde{a}_{2n-1} & \cdots & \widetilde{a}_{n-1n-1} \end{bmatrix}$$

we can solve for the vector of the relative price changes. Rewriting the system of equations of

relative price changes for n sectors in vector notation:

$$\left[\mathsf{I}_{n-1\times n-1} - \widetilde{\mathsf{A}}^T_{n-1\times n-1}\right]\begin{bmatrix}\widehat{p}_1\\ \vdots \\ \widehat{p}_{n-1}\end{bmatrix} - \begin{bmatrix}\widetilde{a}_{n1}\\ \vdots \\ \widetilde{a}_{nn-1}\end{bmatrix}\widehat{p}_n = 0$$

$$[-\widetilde{a}_{1n},\ldots,-\widetilde{a}_{n-1n},1-\widetilde{a}_{nn}]\begin{bmatrix}\widehat{p}_1\\ \vdots \\ \widehat{p}_n\end{bmatrix} = -(1-\alpha)\sum_{i=1}^{n-1}\widetilde{a}_{in}\tau_i$$

where $\mathsf{I}_{i\times j}$ is a i times j identity matrix.

$$\Leftrightarrow \underbrace{\begin{bmatrix} \mathsf{I}_{n-1\times n-1} - \widetilde{\mathsf{A}}^T_{n-1\times n-1} & & -\widetilde{a}_{n1}\\ & & \vdots \\ & & -\widetilde{a}_{nn-1}\\ -\widetilde{a}_{1n} & \cdots\ -\widetilde{a}_{n-1n} & 1-\widetilde{a}_{nn}\end{bmatrix}}_{\widetilde{\mathsf{A}}^T_{n\times n}}\begin{bmatrix}\widehat{p}_1\\ \vdots \\ \widehat{p}_n\end{bmatrix} = \begin{bmatrix}0\\ \vdots \\ 0\\ -(1-\alpha)\sum_{i=1}^{n-1}\widetilde{a}_{in}\tau_i\end{bmatrix}$$

Where the first set of equations above represent rows 1 to n-1 of the above system – the last equation represents row n. Solving for the vector of relative price changes:

$$\Leftrightarrow \begin{bmatrix}\widehat{p}_1\\ \vdots \\ \widehat{p}_n\end{bmatrix} = (I_{n\times n} - \widetilde{A}^T_{n\times n})^{-1}\begin{bmatrix}0\\ \vdots \\ 0\\ -(1-\alpha)\sum_{i=1}^{n-1}\widetilde{a}_{in}\tau_i\end{bmatrix}$$

Where the entry in the vector on the right-hand side captures hidden input taxes.

A-2 Determination of Total Output Change in the Financial Industry

Using value based input coefficients

$$\left[I - \widetilde{A}\right]\begin{bmatrix}d(p_1X_1)\\ \vdots \\ d(p_nX_n)\end{bmatrix} = \begin{bmatrix}d(p_1x_1)\\ \vdots \\ d(p_nx_n)\end{bmatrix}.$$

If we follow the above assumption that substantial price effects are only obtained with regard to sector n, we have

$$\begin{bmatrix} d(p_1X_1) \\ \vdots \\ d(p_nX_n) \end{bmatrix} = \left[I - \widetilde{A}\right]^{-1} \begin{bmatrix} p_1 \frac{\partial h_1}{\partial q_n} dq_n \\ \vdots \\ h_n dp_n + p_n \frac{\partial h_n}{\partial q_n} dq_n \end{bmatrix}.$$

Using Slutsky symmetry

$$\begin{bmatrix} d(p_1X_1) \\ \vdots \\ d(p_nX_n) \end{bmatrix} = \left[I - \widetilde{A}\right]^{-1} \begin{bmatrix} p_1 \frac{\partial h_n}{\partial q_1} dq_n \\ \vdots \\ h_n dp_n + p_n \frac{\partial h_n}{\partial q_n} dq_n \end{bmatrix}.$$

Rearranging terms we see that the output changes are linear functions of the price changes.

$$\begin{bmatrix} d(p_1X_1) \\ \vdots \\ d(p_nX_n) \end{bmatrix} = \left[I - \widetilde{A}\right]^{-1} \begin{bmatrix} \left(\frac{h_n}{1+\tau_1}\right) \epsilon_{n1} dq_n \\ \vdots \\ h_n dp_n + \left(\frac{h_n}{1+\tau_n}\right) \epsilon_{nn} dq_n \end{bmatrix}.$$

In the case where all taxes are equal $\tau_i = \tau, \forall i < n$, except for $\tau_n = 0$, initially, and where a tax $\tau_n = \tau$ is introduced, we obtain the changes in the value of gross outputs

$$\begin{bmatrix} d(p_1X_1) \\ \vdots \\ d(p_nX_n) \end{bmatrix} = p_n h_n \left[I - \widetilde{A}\right]^{-1} \begin{bmatrix} \left(\frac{\epsilon_{n1}}{1+\tau}\right) (\widehat{p}_n + \tau) \\ \vdots \\ \widehat{p}_n + \epsilon_{nn} (\widehat{p}_n + \tau) \end{bmatrix}.$$

The last element of this vector gives the output change in the exempted sector evaluated at pre-tax prices.

A-3 Table of Sector-Specific VAT Rates

Table A-1: Average specific VAT rates in Germany for 2007.

Sector number	Sector	Average VAT rate
01	Products of agriculture, hunting and related services	11%
02	Products of forestry, logging and related services	17%
05	Fish and other fishing products; services incidental of fishing	6%
10	Coal and lignite; peat	20%
11	Crude petroleum and natural gas; services incidental to oil and gas extraction excluding surveying	20%

12	Uranium and thorium ores	20%
13	Metal ores	15%
14	Other mining and quarrying products	15%
15.1 - 15.8	Food products	7%
15.9	Beverages	17%
16	Tobacco products	18%
17	Textiles	12%
18	Wearing apparel; furs	14%
19	Leather and leather products	13%
20	Wood and products of wood and cork (except furniture); articles of straw and plaiting materials	15%
21.1	Pulp, paper and paperboard	11%
21.2	Articles of paper and paperboard	14%
22.1	Books, newspapers and other printed matter and recorded media	14%
22.2 - 22.3	Printing services and services related to printing; reproduction services of recorded media	15%
23	Coke, refined petroleum products and nuclear fuels	21%
24.4	Pharmaceuticals	11%
24 (without 24.4)	Chemicals, chemical products and man-made fibres (without Pharmaceuticals)	12%
25.1	Rubber products	11%
25.2	Plastic products	12%
26.1	Glass and glass products	13%
26.2 - 26.8	Ceramics, nonmetallic mineral processing	16%
27.1. - 27.3	Basic iron and steel and ferro-alloys; Tubes; other first processed iron and steel	12%
27.4	Basic precious metals and other non-ferrous metals	11%
27.5	Foundry work services	13%
28	Fabricated metal products, except machinery and equipment	14%
29	Machinery and equipment n.e.c.	10%
30	Office machinery and computers	14%
31	Electrical machinery and apparatus n.e.c.	12%
32	Radio, television and communication equipment and apparatus	10%
33	Medical, precision and optical instruments, watches and clocks	12%
34	Motor vehicles, trailers and semi-trailers	9%
35	Other transport equipment	9%
36	Furniture; other manufactured goods n.e.c.	13%
37	Secondary raw materials	15%
40.1, 40.3	Production and distribution services of electricity; steam and hot water supply services	20%
40.2	Manufactured gas and distribution services of gaseous fuels through mains	21%
41	Collected and purified water, distribution services of water	13%
45.1 - 45.2	Site preparation work; works for complete construction or parts thereof; civil engineering work	19%
45.3 - 45.5	Building installation work; building completion work; renting services of construction or demolition equipment with operator	17%
50	Trade, maintenance and repair services of motor vehicles and motorcycles; retail sale of automotive fuel	17%
51	Wholesale trade and commission trade services, except of motor vehicles and motorcycles	14%
52	Retail trade services, except of motor vehicles and motorcycles; repair services of personal and household goods	15%
55	Hotel and restaurant services	17%

60.1	Railway transportation services	17%
60.2 - 60.3	Other land transportation services; transport via pipeline services	17%
61	Water transport services	4%
62	Air transport services	4%
63	Supporting and auxiliary transport services; travel agency services	13%
64	Post and telecommunication services	16%
65	Financial intermediation services, except insurance and pension funding services	19%
66	Insurance and pension funding services, except compulsory social security services	23%
67	Services auxiliary to financial intermediation	24%
70	Real estate services	14%
71	Renting services of machinery and equipment without operator and of personal and household goods	17%
72	Computer and related services	19%
73	Research and development services	15%
74	Other business services	15%
75.1 - 75.2	Public administration and defence services	0%
75.3	Compulsory social security services	0%
80	Education services	11%
85	Health and social work services	3%
90	Sewage and refuse disposal services, sanitation and similar services	18%
91	Membership organization services n.e.c.	9%
92	Recreational, cultural and sporting services	13%
93	Other services	17%
95	Private households with employed persons	0%

Source: Federal Statistical Office (VAT Statistics Germany 2007).

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