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Value-added Taxation and Consumption

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Abstract

One of the main rationales for taxing consumption rather than income is that it is believed that consumption taxes discourage consumption, encourage savings, and thus generate higher economic growth. However, empirical evidence on the actual effectiveness of consumption taxes in stimulating savings is very limited. In this paper, we estimate the impact of a broad-based consumption tax, the value-added tax (VAT), on the aggregate consumption of fifteen European Union countries over the period 1961–2005. Our empirical results indicate, across a variety of estimation methods and specifications, that a one percentage point increase in the VAT rate leads to roughly a one percent reduction in the level of aggregate consumption in the short run and to a somewhat larger reduction in the long run.

Keywords: value-added taxation, consumption taxation, savings, economic growth, generalized methods of moments estimation
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1 Introduction

One of the main rationales for taxing consumption rather than income is that it is believed that consumption taxes discourage consumption, encourage savings, and thus generate higher economic growth. However, empirical evidence on the actual effectiveness of consumption taxes in stimulating savings is very limited. In this paper, we estimate the impact of a broad-based consumption tax, the value-added tax (VAT), on the aggregate consumption of fifteen European Union (EU) countries over the period 1961-2005. Our empirical results indicate, across a variety of estimation methods and specifications, that a one percentage point increase in the VAT rate leads to roughly a one percent reduction in the level of aggregate consumption in the short run and to a somewhat larger reduction in the long run.

As discussed in more detail later, there is a large empirical literature on the determinants of consumption and savings, which builds on an even larger theoretical literature on consumption and savings. However, it is striking that empirical work has, to our knowledge, yet to examine the impact of consumption taxes, especially the value-added tax, on consumption and savings. Indeed, the literature on the VAT is small relative to its rapid and seemingly inexorable spread as an essential revenue instrument for governments all over the world.[1] In more than 120 countries, the VAT is a major source of government revenue, affecting about four billion people. Thus, exploring its influence on major economic variables like consumer spending is of crucial interest to practitioners, academics, and policymakers.[2]

We investigate empirically the effect of a change in the effective VAT rate on the level of per capita aggregate household consumption in EU countries for years since 1960. Our first

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[1] Much of the VAT literature has been concerned with its design, implementation, administration, efficiency, and revenue performance. See Ebrill et al. (2001) for a detailed discussion of these issues.

[2] Note that there is also a large literature on the distributional effects of consumption taxes. For a recent and comprehensive review, see Warren (2008).

construct an empirical estimate of the effective VAT rate for each of the fifteen EU countries in our sample, and our measure indicates that the effective tax rate varies significantly over time for each of these countries. We then estimate an aggregate consumption function for these countries, exploiting the panel aspects of our data as an addition to much of the current literature that primarily uses time series approaches. We also apply the recently developed dynamic panel generalized method of moments (GMM) system estimator as our main (if not our only) econometric methodology; this method produces estimates that have superior finite sample properties and do not suffer from biases induced by endogeneity, simultaneity, omitted variables, or measurement error, all of which are typically present when estimating aggregate consumption functions using macro-level data.

We find under all estimation methods and empirical specifications that the VAT is negatively related to the level of per capita private consumption. More specifically, in our preferred GMM estimates, we find that a one percentage point increase in the VAT rate typically leads to a one percent reduction in the level of aggregate consumption in the short run and to a larger (by about 60 percent) reduction in the long run. This result is robust to a wide variety of alternative estimations.

Section two surveys the theoretical and empirical literature on consumption taxes and consumer behavior, including a brief review of the existing VAT literature. Section three presents the empirical framework, including an overview of the dataset, the empirical specification, and the estimation methodology. Our estimation results are discussed in section four, and section five concludes.

2 Some previous work on taxation and consumption

This section is divided into three parts, corresponding to theoretical studies on income versus consumption taxes, empirical studies on the determinants of consumption spending, and a brief survey of the VAT literature.

The *theoretical literature* on consumption and savings includes such classic studies as Duesenberry (1949), Friedman (1957), and Ando and Modigliani (1963), and has continued with work by Hall (1978), Skinner (1988), Dynan (1993), and Shea (1995), among many others.[3] Several studies have looked at the theoretical linkage between consumption taxes and consumer behavior, mostly focusing on the outcome of a tax reform that replaces the income tax with a consumption tax. For instance, Batina (1999) studies the effects of converting from an income tax to a consumption tax in the presence of bequests, using an overlapping generation model, and finds that taxing bequests at the consumption tax rate may lead to a reduction in capital accumulation. Similarly, Lewis and Seidman (1999) examine the effects of converting the income tax to a consumption tax, and conclude that conversion always increases the steady-state capital/labor ratio regardless of the elasticity of saving.

More recently, Blumkin et al. (2008) look into other behavioral responses (e.g., the labor-leisure decision) of moving from an income to a consumption tax. Their results reveal that the temporal separation between an individual's labor market and subsequent consumption decisions leads individuals to work longer when faced with a consumption tax than with an equivalent wage tax. Matsuzaki (2003) also studies other behavioral responses, focusing on the effects of a consumption tax on effective demand. Using a two-class model with uneven wealth distribution, he finds that an increase in the consumption tax rate decreases (increases) effective demand in

[3] There is also a large theoretical literature that examines the impact of taxes (e.g., income versus consumption taxes, progressive versus flat rate taxes) on endogenously determined economic growth. For example, see King and Rebelo (1990), Rebelo (1991), Barro and Sala-I-Martin (1992), Saint-Paul (1992), Jones, Manuelli, and Rossi (1993), Stokey and Rebelo (1995), Turnovsky (1996), and Milesi-Ferretti and Roubini (1998).

the case of heterogeneous households, when the ratio of poorer households is large (small) relative to the total population.

There is also a large *empirical literature on the determinants of consumption*, including the impact of different fiscal and monetary variables on consumption decisions. [4] Among the many empirical studies linking various fiscal variables (e.g., tax revenues, government transfers, government debt, government spending) to consumption behavior are Boskin (1978), Kormendi (1983), Aschauer (1985), Feldstein (1996), Darby and Malley (1996), and Lewis and Seidman (1998). However, the empirical literature that ties consumption taxes to consumer behavior is quite limited relative to those studies that examine other measures of taxes. Indeed, most studies that incorporate taxes when estimating the aggregate consumption function use either tax revenue as a percent of GDP or some measure of the marginal income tax rate. Importantly, to our knowledge there is no empirical study that examines the impact of the VAT rate on consumption.[5] [6]

However, there is some country-specific empirical work that is relevant here. For example, Freebairn (1991) investigates the effects of a consumption tax on the level and composition of Australian saving and investment, and finds that the short run effects on aggregate savings are small, though positive. Also, Andrikopoulos et al. (1993) assess the short run effects of the VAT on consumption in Greece, and they find that the VAT affected individual commodity prices, the consumer price index, and the allocation patterns of consumption

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[4] In a similar vein, several empirical papers have tested for the effects of fiscal policy in general, and taxes in particular, on country-level economic growth. See Levine and Renelt (1991), Miller and Russek (1997), Kneller et al. (1999), Myles (2000), and Padovano and Galli (2001), among others.

[5] Also, Poterba (1988), Hubbard et al. (1986), and Steindel (2001) examine how changes in income taxes affect consumer spending. However, these studies do not look at how expenditures are affected by changes in consumption taxes.

[6] Note that there is some work that uses numerical methods to assess the impact on consumption of different types of taxes (e.g., taxes on consumption, capital income, wages, corporate income, individual income). For example, see Summers (1981), Fullerton et al. (1983), Rege (2002), and Narayan (2003).

expenditures among groups of commodities. To our knowledge, there is no empirical work that addresses the issues that we examine here.

It is also useful to discuss briefly the *value-added tax literature*, including its main features. The VAT has been widely used in Europe for nearly four decades, and now has also been adopted in numerous other countries around the world. “Value-added” is the value that a firm adds during production to materials and services purchased from other firms. It equals the difference between a firm's gross receipts and the costs of all intermediate inputs used to produce the product (including the cost of capital goods but excluding wages). A tax on the value-added of all businesses therefore has as its base the total value of all final products, making a VAT equivalent (under some conditions) to a national retail sales tax.

Several studies have examined the various issues involved when implementing a VAT in developing and developed countries (Ebrill et al. 2001). For instance, Metcalf (1995) discusses the many issues related to the design of a VAT, including implementation, administration, compliance costs, its impact on savings and labor supply, its distributional effects, and various transitional concerns if implemented in the U.S. Regarding especially its impact on saving, Metcalf (1995) emphasizes that there is to date no clear cut answer on whether implementing the VAT would increase savings rate. Bird (2005) and Diamond and Zodrow (2007, 2008) also discuss VAT design issues, and similarly conclude that the effect of a VAT on consumption is an important but unresolved issue.

Importantly, the existing literature does not provide formal empirical evidence on the relationship between the VAT and consumer spending. Our paper is an attempt to fill this void by examining the empirical linkage between the VAT and consumption behavior, using actual data and dealing appropriately with standard econometric issues (e.g., the dynamic nature of the model, endogeneity, persistence, simultaneity bias, and omitted variable bias).

3 Empirical strategy

Our approach follows previous empirical studies that are based upon the estimation of an aggregate consumption function in which consumption depends upon current income, accumulated wealth, and additional variables that include (among other things) taxes. However, we extend these studies in several significant ways. We estimate our basic model with data that cover different time periods (e.g., five-year averaged data versus annual data), different explanatory variables, and different consumption measures. We also employ several different estimation methods, but we focus on estimators that attempt to control for endogeneity, omitted variable bias, simultaneity, and measurement error. Each of these extensions is discussed in turn, beginning with our data, then our basic empirical specification and its variants, and finally our alternative estimation methods.

3.1 Data

Our dataset includes fifteen EU countries over the period 1961-2005.[7] Annual data on real household consumption expenditures, real household consumption expenditures per capita, real GDP, real GDP per capita, inflation, total population, elderly population, and the consumer price index (CPI) (with 1995 the base year) are generated from various years of the World Development Indicators of the World Bank; all nominal values are converted to constant 1995

[7] These fifteen countries (with their entry into the EU in parentheses) are: Austria (1995), Belgium (founding member), Denmark (1973), Finland (1995), France (founding member), Germany (founding member), Greece (1981), Ireland (1973), Italy (founding member), the Netherlands (founding member), Portugal (1986), Spain (1986), Sweden (1995), and the United Kingdom (1973). Another ten countries joined the EU in 2004 (Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, and Slovenia), and two countries joined in 2007 (Bulgaria and Romania).

U.S. dollars using the CPI. Data on the unemployment rate and long-term interest rates are obtained from the OECD Economic Outlook. Due to difficulty in obtaining data on household wealth, financial system deposits are used to proxy for households' wealth, as drawn from the Financial Structure and Economic Development Database of the World Bank, recently updated through 2009.[8] Data on different tax revenues are drawn from the OECD Revenue Statistics, including: the VAT; taxes on goods and services; taxes on income, profits and capital gains; taxes on payroll and workforce; and total tax revenues. All nominal variables (e.g., consumption, income, wealth, and tax revenue data) are expressed in real terms.

We generate two datasets from these data. A first dataset consists of five-year averages for all variables. We use five-year averages for two reasons. First, we are interested in the long-run effects of the VAT on consumption, so we follow the common practice by generating averages to remove the cyclical effects of business fluctuations. Second, our preferred econometric technique (the GMM-System estimator, as discussed later) is better suited for samples with small number of time observations (i.e., when T is small and N is large). Even so, we also use a second dataset based on the annual data.

The dependent variable is per capita household final consumption expenditures for country i in year t, in natural logs, or $(Ln\ C_{i,t})$; its sample mean is about 9.2 in both datasets. We attempt to explain consumption with several "core" explanatory variables. Among our key explanatory variables are three tax variables:

- $EffectiveVATRate_{i,t}$ =
  [VAT revenues/(Total household final consumption expenditures)]X100
- $(TotalConsumptionTax\text{-}VAT)_{i,t}$ = [Taxes on goods and services – VAT revenues]
- $TotalIncomeTax_{i,t}$ = [Taxes on income, profits, and capital gains + Payroll taxes].

[8] See Beck et al. (2000) for the initial estimates of wealth. Beck et al. (2010)have recently updated these estimates.

The effective value-added tax rate (or $EffectiveVATRate_{i,t}$**)** is our main variable of interest. We also use the statutory VAT rate in some specifications for a robustness test, but we believe that the effective VAT tax rate is the more appropriate measure of VAT influence than either a revenue measure or a statutory rate, for two reasons. First, an effective tax rate is better able to control for variations in the VAT's statutory rates, exemptions, and the like across the EU countries and within each country than a statutory rate, thereby allowing better comparability across countries and time. Second, since we are interested in the intertemporal effect generated by the VAT as a tax on consumption, the effective rate is better capable of capturing that effect than a revenue measure, as the effective rate is easier to perceive as altering relative prices of consumption today versus consumption tomorrow. The effective VAT rate is expected to be negatively related to the level of per capita private consumption.

Another variables is total consumption tax revenues excluding VAT revenues (or $Ln\ (TotalConsumptionTax\text{-}VAT)_{i,t}$), calculated from OECD Revenue Statistics by subtracting VAT revenues from total taxes on goods and services and expressing the difference in natural logs. This variable is intended to control for the possible impact on consumption of all consumption taxes other than the VAT.[9]

A third tax variable is total income tax revenue (or $Ln\ TotalIncomeTax_{i,t}$), and is similarly intended to control for the potential influence of income taxes on current consumption. Income tax revenues included all taxes on income, profits, and capital gains plus payroll taxes, and are also expressed in logs.

In addition to these tax variables, other core regressors include (where *i* denotes the country and *t* denotes the year):

[9] Total trade taxes are the sum of tax revenues collected from import and export taxes.

- Lagged household final consumption expenditures *(Ln $C_{i,t-1}$)*. This variable is included to represent the influence of habits acquired in the past on current consumption behavior.
- Income *(Ln $Y_{i,t}$)*. Income for country *i* in year *t* is measured by the natural log of GDP per capita.
- Income growth *(Growth $Y_{i,t}$)*. We follow the adaptive expectations model, which means that consumers look forward in time using past expectations. In this case, we follow the conventional practice by using proxies for life-cycle income, employing (in addition to the current level of income) a measure for the growth of income. The level of income represents the anticipated/planned component of life-cycle income, whereas income growth represents any unanticipated/windfall element.
- Household wealth *(Ln $W_{i,t}$)*. Current consumption depends on human and non-human wealth. While human wealth (e.g., wage income) is measured by life-time income (as described above), non-human wealth (e.g., non-wage income) can be proxied by some measure of financial assets. We use the natural log of real per capita financial system deposits for country *i* in year *t* as a proxy for household wealth.
- Unemployment rate *($UnemploymentRate_{i,t}$)*. The unemployment rate for country *i* in year *t* is measured by the ratio of the number of unemployed to the total labor force, and is included to proxy either for the effects of liquidity constraints and/or uncertainty regarding future income.
- Inflation rate *($InflationRate_{i,t}$)*. The inflation rate is measured by the annual percent change in consumer prices. The inclusion of inflation proxies for macroeconomic uncertainty regarding economic performance, nominal incomes, future policies, and consumer confidence.
- Old dependency ratio *($OldAge_{i,t}$)*. The old dependency ratio, defined as the ratio of population over 65 years of age to the total population, captures life-cycle and demographic effects.
- Interest rate *($InterestRate_{i,t}$)*. The interest rate is typically included to capture three effects: the intertemporal substitution effect associated with changes in the relative price of current versus future consumption; the income effect that tends to raise consumption at all dates; and the human wealth effect that reduces consumption in all periods.

Tables 1 and 2 provide descriptive statistics of the five-year averaged and the annual datasets, respectively. There is substantial variation in both the averaged and the annual measures of effective VAT rate. Descriptive statistics of the averaged dataset show that the effective VAT rate ranges between zero and 17.36 percent, with a sample mean of 5.39 percent; in the annual dataset, the effective VAT rate varies between zero and 19.25 percent, with the same sample mean as in the annual dataset.[10] Figures 1 and 2 show the averaged and the annual effective VAT rate for the fifteen EU countries over the entire 1961-2005 time period. These figures indicate clearly the significant variations in the effective VAT rate, even when the rate is averaged across all countries. Indeed, when one examines the individual country data, the variation over time is of course even greater, especially with the annual data. With the annual data, the highest individual country effective VAT rate was implemented in Sweden in 1995 (19.25 percent), and the lowest rate was applied in Ireland. Denmark had the highest variance in the effective VAT rate, and Spain had the lowest. With individual country averaged data, the results are slightly different. Denmark had the highest effective VAT rate (17.36 percent), while Luxembourg had the lowest rate; the highest variance was for Sweden, and the lowest was in Spain.

3.2 Empirical specification

We employ a reduced form linear equation for consumption. We focus on a core set of regressors as determinants of consumption, selected based on theoretical connection and analytical relevance. We also examine the impacts of a number of less-standard consumption determinants.

As discussed earlier, our core regressors include a standard group of income-related variables: the natural log level of real income per capita and its rate of growth, and the log level of per capita real household (private) wealth. Other core variables include the real long-term interest rate, the old age dependency ratio, two tax control variables (the log level of per capita

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[10] The minimum value is zero because we include observations in years in which the VAT was not yet introduced in some countries. However, if we drop the zeros from the sample, then the number of observations drops from 138 to 105 in the averaged dataset; in this case the minimum effective VAT rate is 0.19 percent. If the zeros are dropped from the annual dataset, the number of observations falls from 665 to 493, and the minimum effective VAT rate is 0.43 percent.

total consumption tax revenue excluding the VAT revenue, and the log level of per capita total income tax revenue), and of course our main variable of interest, the effective VAT rate.

It should be noted that we also estimate several additional specifications. In some specifications we add two measures of macroeconomic uncertainty, the inflation rate and unemployment rate, as in Fischer (1993). In others we use the actual VAT statutory tax rate. Finally, we examine the impact of our core regressors on the natural logarithm of per capita consumption expenditures disaggregated into different components (e.g., services, food plus beverages plus tobacco). As we discuss in detail later, our main results are largely unaffected by these many variants.

3.3 Econometric issues and methodology[11]

We are interested in estimating the following simple AR (1) consumption model with unobserved country-specific effects:

$$C_{i,t} = \alpha C_{i,t-1} + \beta' X_{i,t} + \mu_{i,t}\ , \quad for\ i = 1,...,N \qquad and \qquad t = 2,...,T\ , \tag{1}$$

where

$C_{i,t}$ is the observable dependent variable (and $C_{i,t-1}$ is its lagged value)
$X_{i,t}$ is a *K* × *1* vector of observable independent variables
β is a *K* × *1* vector of parameters
$\mu_{i,t}$ is a random disturbance term satisfying the assumptions that

$$E(\mu_{i,t}) = 0,\ E(\mu_{i,t}^2) = \sigma_\mu^2,\quad and\quad E(\mu_{i,t}\ \mu_{j,s}) = 0 \quad if \quad i \neq j \quad and/or \quad t \neq s$$

N is the number of cross-sectional units, or countries
T is the number of time periods, or years.

Estimation of equation (1) poses several issues. Both of our datasets represent panels, and appropriate estimation methods must consider the dynamic panel nature of these data.[12] One or

[11] This section borrows heavily from Arellano and Bond (1991), Loayza et al. (2000), and Bond et al. (2001).
[12] The dynamic model is a regression in which the lagged value of the dependent variable is one of the explanatory variables. As pointed out by Bond (2002), even if we are not directly interested in the coefficient on lagged
(continued)

more of the right-hand side variables may well be endogenous. There are also the standard problems in time series estimation, as well as issues of omitted variables and measurement error. Accordingly, we present a range of estimation results.

Our first estimator is the basic pooled OLS (or "POLS") estimator using the White (1980) covariance estimator to produce consistent covariance matrix estimates when heteroskedasticity is an issue.[13]

However, the POLS estimator suffers from several significant problems. One of these is that it ignores the possibility that countries may experience unobserved time-varying shocks to consumption preferences that cause them both to change (e.g., reduce) consumption and to change (e.g., increase) VAT rates. Addressing this possibility requires that we identify a source of exogenous variation in VAT rates (or more broadly in the extent of a country's reliance on a VAT). We exploit the year of country entry to the EU as this exogenous source of variation, a source that is conceptually independent of consumption preferences.[14]

More precisely, we estimate a difference-in-difference variant in which we introduce a dummy variable for post-founding member entry into the EU ($Entry_{i,t}$), equal to 0 for all years t before EU entry by country i and 1 for all post-entry years. We also interact $Entry_{i,t}$ with $VATRate_{i,t}$, and it is the coefficient on this interaction term that is our difference-in-difference estimator of the impact of the effective tax rate. We denote this as the "DID" estimator.

However, both of these estimators still have potential problems. Both largely ignore the panel nature of the data; they assume that the errors are serially uncorrelated for a given

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dependent variable, allowing for dynamics in the underlying process may be crucial for recovering consistent estimates of other parameters.

[13] We test for panel-level heteroskedasticity using the likelihood ratio test. The significant *p-value* reveals that the null hypothesis of homoskedastic errors can be rejected.

[14] We are indebted to the Editor, Dhammika Dharmapala, and to an anonymous referee for this insight and suggestion.

country;[15] they do not account for country-specific effects; and they do not confront either the endogeneity problem of the regressors or the effect of including a lagged dependent variable as an explanatory variable. Therefore, these simple estimators are likely to biased and inefficient, and the estimated standard errors do not take into account the dependence of the error term within countries over time.

Accordingly, we also employ a two-way error component model, in which we include year dummies to account for time-specific effects and country dummies to account for country-specific effects (White 1980). We decompose the error term (μ_{it}) as follows:

$$\mu_{i,t} = \eta_i + \lambda_t + \varepsilon_{i,t} \ , \qquad (2)$$

where

η_i is an unobservable country-specific effect
λ_t is an unobservable time-specific effect
$\varepsilon_{i,t}$ is a stochastic error term that is identically and independently distributed *(IID)* with zero mean and constant variance $\varepsilon_{i,t} \sim IID(0, \sigma^2)$.

The resulting equation can be estimated using fixed effects or random effects estimators, where the crucial issue is whether the unobservable country-specific effect η_i is or is not independent of $X_{i,t}$. In the random effects model, η_i is independent; if the fixed effects model, it is correlated with $X_{i,t}$. If correlated, one estimates a conditional model in which the realized fixed effects are realizations of the random variable conditional upon the data; if uncorrelated, one gains efficiency by estimating the variance of the distribution. The Hausman (1978) specification test is the formal test for whether the random variable is correlated with the right-

[15] We have tested for panel-level autocorrelation using the Wooldridge (2002) test. The test-statistics are significant, and indicate the presence of autocorrelation.

hand side variables, and results from this test indicate that the fixed effects model is a better fit. We have in fact estimated this two-way fixed effects model ("Two-way FE") estimator.

However, the fixed effects estimator fails to account for other problems, including issues raised by endogeneity of the regressors, measurement error, and simultaneity bias, which render the within estimator biased and inconsistent. As a result, we must allow for the possible endogeneity of one or more of the explanatory variables,[16] we must address the potential problem of measurement error in the dependent and independent variables, we must tackle omitted variable bias, and we must consider the possibility of simultaneity bias.

To address all of these remaining issues, our preferred econometric technique is based on generalized method of moments (GMM) estimators applied to dynamic models using panel data. If a specific set of assumptions is met (as discussed later), then the dynamic GMM estimator allows us to control for all of these potential problems.

We control for joint endogeneity using "internal instruments", or instruments based on lagged values of the explanatory variables. To be precise, we assume that the explanatory variables are "weakly exogenous", which means that they can be affected by current and past realizations of the error term but are uncorrelated with future realizations of the error term. Conceptually, weak exogeneity does not mean that future levels of consumption cannot be correlated with current realizations of variables but rather that future innovations (or unforeseen changes) to consumption do not influence previous realizations of consumption determinants. Relaxing the strict exogeneity assumption of the explanatory variables allows for the possibility of simultaneity and reverse causality, which are very likely to be present in consumption

[16] In fact, the presence of lagged dependent variable among the regressors implies that it is by construction correlated with the country-specific component of the error term.

equation. We do not believe that this assumption is particularly restrictive; furthermore, we examine its validity through several specification tests, as explained below.

Recall that we are interested in estimating equation (1) with unobserved country-specific effects, where $\mu_{i,t} = \eta_i + \varepsilon_{i,t}$ is the usual "fixed effects" decomposition of the error term. Following Arellano and Bond (1991), Ahn and Schmidt (1995), and Blundell and Bond (1998), we assume that η_i *and* ε_{it} have the standard error components structure:

$$E(\eta_i)=0, E(\varepsilon_{i,t})=0, E(\varepsilon_{i,t}\eta_i)=0 \quad \textit{for} \quad i=1,...,N \quad \textit{and} \quad t=2,...,T \ . \qquad (3)$$

In addition, we assume that the transient errors are serially uncorrelated, or:

$$E(\varepsilon_{i,t}\varepsilon_{i,s})=0 \quad \textit{for} \quad i=1,...,N \quad \textit{and} \quad \forall t \neq s \ . \qquad (4)$$

Finally, we assume that the initial conditions C_{i1} are predetermined:

$$E(C_{i,1}\varepsilon_{i,t})=0 \quad \textit{for}\ i=1,...,N \quad \textit{and} \quad t=2,...,T \ . \qquad (5)$$

Because a lagged dependent variable is one of the explanatory variables in equation (1), it is expected to be correlated with the country-specific component of the error term (η_i). The suggested solution to resolve this problem is to first-difference equation (1) to eliminate the country-specific effect:

$$C_{i,t} - C_{i,t-1} = \alpha(C_{i,t-1} - C_{i,t-2}) + \beta'(X_{i,t} - X_{i,t-1}) + (\varepsilon_{i,t} - \varepsilon_{i,t-1}) \qquad (6)$$

We denote this as the "GMM-Difference" estimator.

The use of instruments is necessary to deal with several problems. A first problem is imposed by the existence of lagged difference of the dependent variable $(C_{i,t-1} - C_{i,t-2})$ among the regressors. A second problem is the possible endogeneity of the other explanatory variables in *X*.

Assumptions (3), (4), and (5) imply the following moment restrictions:

$$E[C_{i,t-s}(\varepsilon_{i,t}-\varepsilon_{i,t-1})]=0 \quad for \quad t=3,...,T \quad and \quad s\geq 2 \tag{7}$$

$$E[X_{i,t-s}(\varepsilon_{i,t}-\varepsilon_{i,t-1})]=0 \quad for \quad t=3,...,T \quad and \quad s\geq 2\,. \tag{8}$$

Moment conditions (7) and (8) are then used to calculate the dynamic panel GMM-Difference estimator, under the assumptions that the error term is serially uncorrelated and that the lagged levels of the explanatory variables *X* are weakly exogenous.[17]

However, Blundell and Bond (1998) point out that, when the time series are persistent (like consumption and GDP) and the number of observations is small, the GMM-Difference estimator has poor finite sample properties. Under these conditions, lagged levels of the series are only weakly correlated with subsequent first-differences, so that the available instruments for the first-differenced equations are weak. Also, the cross-country dimension of the data is lost by first-differencing. Finally, Griliches and Hausman (1986) argue that differencing may decrease the signal-to-noise ratio, thus worsening the bias resulting from measurement error.

Arellano and Bover (1995) and Blundell and Bond (1998) propose an alternative approach to deal with these problems. This alternative method estimates the regression in differences jointly with the regression in levels to produce a "GMM-System" estimator. The main advantage of the *system* estimator over the *difference* estimator is that the former exploits an assumption about the initial conditions to obtain moment restrictions that continue to be useful even for persistent series. Therefore, the *system* estimator has superior finite sample properties in terms of potential biases of the coefficient estimates, and it also reduces the asymptotic imprecision associated with the *difference* estimator. However, the inclusion of the regression in levels requires the use of appropriate instruments to control for country-specific

[17] As pointed out by Arellano and Bond (1991), the moment conditions of the GMM-Difference estimator imply the use of lagged levels of the explanatory variables dated (t – 2) and earlier as instruments for the equation in first-differences.

effects, typically lagged differences of the explanatory variables. These are considered valid instruments if the error term is serially uncorrelated, and if there is no correlation between the error term and the differences in these explanatory variables (even though there may still be correlation between the country-specific component of the error term and the levels of the explanatory variables). The additional moment conditions for the regression in levels are given by:

$$E[(C_{i,t-s} - C_{i,t-s-1})(\eta_i + \varepsilon_{i,t})] = 0 \qquad for \quad s = 1 \tag{9}$$

$$E[(X_{i,t-s} - X_{i,t-s-1})(\eta_i + \varepsilon_{i,t})] = 0 \qquad for \quad s = 1 \tag{10}$$

Using the four moment conditions produces the GMM-System estimator, in which the equation in differences uses lagged levels as instruments, while the equation in levels uses lagged differences as instruments. It is this GMM-System estimator that is our preferred approach.

The GMM-System estimator has one-step and two-step variants. Arellano and Bond (1991) and Blundell and Bond (1998) point out that the two-step estimates of the standard errors are asymptotically more efficient than the one-step variant, but that the two-step estimates also tend to be severely downward biased. To compensate for the downward bias, our GMM-System estimator employs a finite-sample correction to the two-step covariance matrix derived by Windmeijer (2005), which he demonstrates dramatically improves accuracy in Monte Carlo Simulations. We employ both one-step and two-step robust estimators as additional estimators, for completeness and as a robustness check.[18]

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[18] Note that we conduct several specification tests, also designed to examine the robustness of our results. Consistency of the GMM-System estimator depends on the assumptions that the error term $(\varepsilon_{i,t})$ is serially uncorrelated and that the instruments are valid ones. Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998) suggest two specification tests. The first test considers the assumption of serially uncorrelated errors, and is applied to the first-difference equation residuals in order to purge the unobserved and perfectly autocorrelated (η_i). This test examines whether the differenced error term is second-order serially correlated. Under the null hypothesis of no second-order correlation, the test statistic has a standard normal

(continued)

4 Estimation results

4.1 Core estimation results

This subsection focuses on our basic "core" results for the five-year averaged dataset and for our preferred estimation method (GMM-System, Two-step). It should be remembered that we have estimated many variants, with little substantive change in our results. These alternative specifications are discussed later, and include different estimation techniques, time periods (e.g., five-year averaged data versus annual data), explanatory variables, and consumption measures. It should also be noted that the specification tests generally support our dynamic GMM estimates. The Hansen test of overidentifying restrictions fails to reject the null hypothesis that the instruments are uncorrelated with the error term (*p-value* = 0.49 and 0.69 for the one-step and two-step GMM-System estimators, respectively). Similarly, the tests of serial correlation reject the hypothesis that the error term is second-order serially correlated, providing additional support to the use of appropriate lags of the explanatory variables as instruments for the estimation. Finally, the weak identification statistics for the lagged dependent variables in our One-step and Two-step GMM-System estimators exceed the Stock and Yogo (2005) critical value for 10 percent maximal bias of the instrument variables estimator, indicating that the instruments are not weak (e.g., the instruments are relevant).[19]

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distribution. If we do not fail to reject the null of no second-order correlation, it indicates that some lags of the dependent variable, which might be used as instruments, are in fact endogenous, and thus considered "bad" instruments. The second test is the Hansen test of over-identifying restrictions, which examines the overall validity of the instruments (i.e., the instruments are uncorrelated with the residuals). Under the null hypothesis of the validity of the instruments, the Hansen J-statistic has a χ^2 distribution with *(J-K)* degrees of freedom, where *J* is the number of instruments and *K* is the number of regressors. This test is robust to heteroskedasticity and autocorrelation. Failure to reject the null hypotheses of both tests provides support to our model.

[19] These test statistics are based on the first stage F-statistic, which equals 12.36 and 11.83 for the one-step and two-step GMM-System estimators of Table 3, columns (4) and (5), respectively. See Stock and Yogo (2005), who

(continued)

Table 3 reports the core results for private consumption using our five estimators for the five-year averaged data. Our preferred estimation method uses the GMM-System Two-step estimator. In this subsection we discuss the results obtained with this estimator (column (5) of Table 3). Later, we compare these results with those from the other estimation methods.

The results show a statistically significant relation between the exogenous component of the effective VAT rate and the level of private aggregate consumption. As expected, the direction of the relation is negative (with a coefficient of -0.0111) and statistically significant (at the 1 percent level), and implies that consumption declines in the short run by slightly more than one percent when the VAT rate is increased by one percentage point. Given the presence of lagged consumption in the GMM-System Two-step estimator, the long run impact is obtained by dividing the coefficient on *EffectiveVATRate* (-0.0111) by 1 minus the coefficient on lagged consumption (or (1-0.3694)=0.6306). The long run impact of an increase in the VAT rate is then roughly 60 percent larger than the short run impact.[20]

The economic impact of these results can be shown by an example. To illustrate, Italy's median value for the effective VAT rate over the period 1961-2005 is 3.62 percent. An exogenous increase in the VAT rate in Italy to the sample median of 5.09 percent would result in a 1.63 percent lower level of consumption over a five-year period, which translates roughly to a 0.33 percent lower consumption per year.[21] More generally, the point estimate of the coefficient indicates that, on average, a one percentage point increase in the VAT rate leads to a 1.11 percent

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provide critical values of the F-statistic based on alternative definitions of "weak" instruments. See also Stock et al. (2002), who focus on weak instruments in the GMM framework.

[20] We are indebted to an anonymous referee for emphasizing the difference between the short run and the long run impacts of the tax.

[21] This result follows from 5.09 – 3.62 = 1.47, and (1.47) × (1.11) = 1.63, where 1.11 is the point estimate on *EffectiveVATRate* in column (5) of Table 3.

decline in the level of private consumption in the short run and to a 1.76 percent reduction in the long run.

As for other variables, consider first the various measures of income and wealth. The log level of lagged consumption has a positive and significant coefficient (at the 10 percent level), whose size (0.37) indicates the presences of habit persistence in consumer behavior.[22] Both the log level of real per capita income and its growth rate have a positive and significant effect on private consumption (at the 5 percent and 10 percent levels of significance, respectively). The point estimate on the level of income implies an elasticity of consumption with respect to income of 0.45 and a marginal propensity to consume of roughly one-quarter. Both estimates are somewhat lower than other estimates, due perhaps to the inclusion of other determinants of consumption (e.g., wealth) and to the difficulties in distinguishing permanent from transitory changes in income in our data set (Shapiro and Slemrod, 2009).[23] The estimated growth coefficient indicates that an increase in the growth rate of income by one percentage point leads to a 0.82 percent increase in private consumption, a result consistent with consumption smoothing by forward-looking agents. The estimated wealth elasticity equals 0.05, which is comparable in magnitude to other estimates; however, the coefficient estimate is not statistically significant.[24]

The rate of interest has a negative and significant impact at the 5 percent significance level on private consumption. The magnitude of the estimated coefficient indicates that an increase of one percentage point in the rate of interest drives private consumption down by 0.84

[22] One way to interpret the coefficient of lagged consumption is in terms of the "speed of adjustment" in consumer behavior. For example, with the point estimate of lagged consumption equal to 0.37 in column (5) of Table 3, the adjustment rate is equal to 0.63, which means that 63 percent of the difference between desired and actual consumption is eliminated in five years.
[23] For recent surveys of consumption behavior, see Browning and Crossley (2001) and Jappelli and Pistaferri (2010).
[24] Again, see Browning and Crossley (2001) and Jappelli and Pistaferri (2010).

percent, comparable to if somewhat larger than some other estimates (Carroll, 2001; Attanasio and Low, 2004). The old dependency ratio is positive but statistically insignificant.

The influence of total consumption tax revenue excluding VAT revenue on private consumption is statistically insignificant, with a positive sign but a very small magnitude. Similarly, the impact of total income tax revenue on private consumption is numerically small and statistically insignificant.

4.2 Sensitivity analysis

In order to test for the robustness of the basic results, we conduct sensitivity analysis along several dimensions. First, we utilize alternative econometric techniques (e.g., POLS, DID, Two-way FE, and GMM-System One-step methods). Second, we work with two data sets based on the relevant time interval (e.g., the five-year averaged dataset and the annual dataset). Third, we both include and exclude several other explanatory variables; notably, we include the statutory VAT rate rather than the effective VAT rate. Finally, we include different measures of consumption.

Alternative estimators. Table 3 presents results obtained with alternative estimation techniques. The first estimator is shown in column (1), and represents the pooled OLS (POLS) estimates. As noted earlier, the POLS results are likely to be biased and inconsistent because this method ignores unobserved country-specific effects and joint endogeneity of the explanatory variables. The POLS results also do not address the possibility that countries may experience unobserved time-varying shocks to consumption preferences that cause them to change both consumption and VAT rates. Indeed, if time-varying tastes for saving lead to lower consumption and higher VAT rates, then one would expect that the POLS estimate for the effective VAT rate to be biased downward, a result that is confirmed by comparison of the POLS estimates for *EffectiveVATRate* in column (1) with the GMM-System Two-step estimates in column (5).

To address this possibility we use a DID estimator (column (2)). Also, to control for country-specific effects, we use the Two-way FE estimator in column (3). However, this estimator does not solve the joint endogeneity problem, and the presence of a lagged dependent variable renders the estimator biased and inconsistent. Finally, column (4) presents the results obtained with the GMM-System One-step estimator, which deals with country-specific effects, joint endogeneity, and the inclusion of a lagged dependent variable as one of the regressors but which is less efficient than the GMM-System Two-step estimator of column (5).

In most cases, the results obtained with our preferred GMM-System Two-step estimator are qualitatively similar to those obtained with the other three estimators. All estimators yield positive effects of the level of income, the growth rate of income, the level of wealth, and a negative effect of the interest rate, although the coefficients vary in size and statistical significance. Most interestingly, *EffectiveVATRate* (or its interaction with *Entry* in the DID estimates) continues to appear with a negative and statistically significant coefficient in all estimators, though with varying magnitudes and levels of significance.

Alternative time periods. Table 4 employs the annual dataset. These results indicate that the specification tests generally do not support our dynamic GMM estimates, as shown in columns (4) and (5). The *p-value* of the Hansen test is consistently equal to 1.00, indicating that our model is heavily over-identified so that our instruments are invalid.[25] Even so, we present these results for completeness, even if only briefly. Note in particular that *EffectiveVATRate*

[25] Recall that consistency of GMM estimates requires that T is small and that N is large. However, we have 45 annual observations for 15 countries, which means that $T > N$, and this invalidates the main assumption. Put differently, the large time dimension in the annual regressions means that there are many more moment conditions than parameters to estimate.

continues to appear with the expected negative sign, and the coefficient is significant across all alternative estimators. Note also that, compared to the five-year averaged data in Table 3, most explanatory variables have similar (and expected) signs, although they vary in magnitude and statistical significance.

Alternative explanatory variables. We add other potential determinants of private consumption, and we also drop some variables (e.g., the growth rate of income and the old dependency ratio) from the core specification, for both datasets. As shown in Table 5 only for our preferred GMM-System, Two-step estimator, our core results for the five-year averaged data or for the annual data are not sensitive to dropping income growth and the old dependency ratio (columns (1) and (4)): the coefficient on *EffectiveVATRate* is always negative, statistically significant, and of comparable magnitude to our core results. In addition, we include two macroeconomic uncertainty variables, the inflation rate and the unemployment rate. Adding these variables also does not affect our core results (columns (2) and (5), Table 5). With the five-year averaged data, the coefficients of both variables are small and seldom statistically significant, although they are significant across a wider range of estimators in the case of the annual data. Both sets of results confirm our predictions regarding the insignificant influence of the business cycle variables on the long-run level of aggregate consumption.

Finally, we use the actual VAT statutory tax rate, both for the five-year averaged data and for the annual data, rather than *EffectiveVATRate* as our measure of tax burden. These results are also reported in columns (3) and (6) of Table 5 for the core variables. With this measure, the impact of VAT taxes is still negative, but it is only statistically significant with the five-year averaged data.[26]

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[26] All results are available upon request.

Alternative measures of consumption. We disaggregate consumption into per capita consumption of services and also of food, beverages, and tobacco, where both measures are expressed in natural logs. Our core GMM-System Two-step estimation results for five-year averaged data or for annual data continue to demonstrate a negative and significant impact of the effective VAT rate on consumption, although the effects are slightly smaller than in our preferred estimation results, perhaps because these measures of consumption are more broadly classified as "necessities" than as "luxuries".[27]

5 Conclusions

Does the value-added tax affect consumption? Using a sample of fifteen EU countries over the period 1961-2005 and the recently developed dynamic panel GMM-system estimator, we find that the effective VAT tax rate is negatively correlated with the level of aggregate consumption. More precisely, a one percentage point increase in the VAT rate leads to about a one percent reduction in the level of per capita aggregate consumption. This result is consistent across various estimators, alternative time periods, and additional explanatory variables. To our knowledge, these estimation results are the first attempt to include explicitly and to estimate directly the effects of the VAT on consumption behavior.

Our results have the clear implication that policymakers should consider the potential impact of the VAT on households' consumption decision when designing a VAT. Our results are also consistent with the often-stated view of proponents of consumption taxes that taxing consumption rather than income generates more savings, and so leads to higher growth.

[27] For example, the coefficient on *EffectiveVATRate* in the GMM-System Two-step estimation with five-year averaged data is now -0.0076, significant at 5 percent. We are grateful to an anonymous referee for this suggestion. Again, all results are available upon request.

Of course, there are many considerations that influence any decision to tax consumption versus income. The effects on consumption choices are clearly important, but other dimensions also matter: how are other aspects of behavior (e.g., labor supply, portfolio choice, tax evasion) affected, what are the distributional effects of different forms of taxation, how does a country make the transition from one major tax base to another, what are the administrative dimensions of taxing different tax bases, how are different levels of government affected by income versus consumption taxes, how does consumption versus income taxation affect the international decisions of firms and individuals, to name just a few. Even so, our results demonstrate that greater use of the VAT has led, at least in EU countries to less consumption and more savings, a finding that has broader implications for the choice of a consumption tax versus an income tax.

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Table 1. ***Five-year Averaged Data, Descriptive Statistics***

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Index of countries	135	4.500	2.301	1	8
Household final consumption	133	10338.240	4145.464	2195.548	23121.630
GDP	133	18542.100	8553.299	3220.510	51290.130
GDP growth (%)	133	2.936	1.691	-1.079	8.543
Household wealth	133	14511.410	26631.730	706.762	249273.100
Consumer price index (1995 = 100)	135	53.3638	35.526	1.966	118.287
Inflation rate (consumer prices, %)	135	6.399	4.824	0.459	23.261
Interest rate (%)	116	9.214	3.594	4.663	25.825
Effective VAT rate (%)	133	5.391	4.862	0	17.365
Statutory VAT rate (%)	133	12.149	10.570	0	27
Unemployment rate (%)	133	5.496	3.872	0.029	15.572
Population, total	135	2.350E+07	2.460E+07	326200	8.210E+07
Old age dependency ratio (%)	135	13.172	9.268	0.057	55.430
Total tax revenue	135	4229.170	4201.052	75.500	18052.560
Taxes on goods and services revenue	135	1261.206	1193.909	33.400	5292.020
VAT revenues	135	687.204	734.788	0	3159.980
Total consumption tax revenues less VAT	135	572.380	485.332	33.400	2536.740
Taxes on income, profits, and capital gains	135	1547.824	1804.589	14.100	9643.260
Payroll tax revenues	135	51.411	122.340	0	709.540
Total income tax revenues	135	1599.234	1846.315	15.300	9734.640

Note: All nominal values are expressed in constant 1995 U.S. dollars.

Table 2. ***Annual Data, Descriptive Statistics***

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Index of countries	675	4.500	2.293	1	8
Household final consumption	665	10338.240	4154.774	2095.760	24508.080
GDP	665	18542.100	8579.418	2867.823	58464.230
GDP growth (%)	664	2.937	2.653	-7.914	11.566
Household wealth	653	13103.880	23954.950	535.578	434236.800
Consumer price index (1995 = 100)	675	53.363	35.659	1.863	126.644
Inflation rate (via consumer prices, %)	675	6.399	5.379	-0.708	28.783
Interest rate (%)	568	9.223	3.815	4.179	29.742
Effective VAT rate (%)	665	5.391	4.927	0	19.250
Statutory VAT rate (%)	665	12.149	10.976	0	27
Unemployment rate (%)	654	5.584	3.981	0.014	18.437
Population (total)	675	2.350E+07	2.450E+07	319000	8.220E+07
Old age dependency ratio (%)	675	13.172	9.308	0.057	56.685
Total tax revenues	615	4645.980	4273.548	75.500	18689.200
Taxes on goods and services revenues	615	1382.357	1212.075	33.400	5659.600
VAT revenues	675	687.204	742.580	0	3386.500
Total consumption tax revenues less VAT	615	618.797	496.256	33.400	2731.800
Taxes on income, profits, and capital gains	615	1701.493	1857.252	14.100	10492.800
Payroll tax revenues	615	56.32722	131.993	0	1074.600
Total income tax revenues	615	1757.821	1898.946	15.300	10567.500

Note: All nominal values are expressed in constant 1995 U.S. dollars.

Table 3. ***Alternative Estimators of Core Model with Five-year Averaged Data***

Explanatory Variable	(1) POLS	(2) DID	(3) Two-way FE	(4) GMM-System One-step	(5) GMM-System Two-step
EffectiveVATRate	-0.0041*	-0.0026*	-0.0063***	-0.0097***	-0.0111***
	(0.0021)	(0.0012)	(0.0021)	(0.0028)	(0.0027)
Entry	---	0.0011	---	---	---
		(0.0016)			
Entry × EffectiveVATRate	---	-0.0034**	---	---	---
		(0.0014)			
Ln C_{t-1}	0.5471***	0.4461***	0.3283***	0.3599**	0.3694*
	(0.0622)	(0.0829)	(0.0603)	(0.1268)	(0.1884)
Ln Y	0.3172***	0.4102***	0.5639***	0.4211***	0.4464**
	(0.0509)	(0.0718)	(0.0748)	(0.1228)	(0.1665)
Ln W	0.0129	0.0335	0.0421**	0.0578	0.0537
	(0.0119)	(0.0174)	(0.0187)	(0.0600)	(0.0692)
InterestRate	-0.0043**	-0.0051**	-0.0044**	-0.0075**	-0.0084**
	(0.0017)	(0.0019)	(0.0019)	(0.0030)	(0.0031)
Growth Y	0.0048	0.0068*	0.0089***	0.0073	0.0082*
	(0.0031)	(0.0053)	(0.0030)	(0.0046)	(0.0044)
OldAge	0.0008	0.0005	-0.0004	-0.0009	-0.0010
	(0.0007)	(0.0006)	(0.0012)	(0.0031)	(0.0056)
Ln (TotalConsumptionTax-VAT)	0.0070	0.0046	-0.0200	0.0004	0.0003
	(0.0132)	(0.0109)	(0.0199)	(0.0239)	(0.0342)
Ln TotalIncomeTax	0.0087	0.0167	0.0235	0.0427**	0.0388
	(0.0113)	(0.0104)	(0.0182)	(0.0193)	(0.0236)
Constant	0.9605***	0.4617***	0.3490	1.1220*	0.8628
	(0.2286)	(0.2314)	(0.5538)	(0.5667)	(0.5855)
Observations	109	109	109	109	109
Number of countries	---	---	15	15	15
Hansen test (*p-value*)[a]	---	---	---	0.49	0.49
Test for 2nd order serial correlation (*p-value*)[b]	---	---	---	0.69	0.72

Notes: The dependent variable is the natural log of Per Capita Household Final Consumption (Ln $C_{i,t}$). Robust standard errors are in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1%

[a] The null hypothesis is that the instruments used are uncorrelated with the residuals.

[b] The null hypothesis is that the errors in the first-difference regression exhibit no second-order correlation.

Table 4. ***Alternative Estimators of Core Model with Annual Data***

Explanatory Variable	(1) POLS	(2) DID	(3) Two-way FE	(4) GMM-System One-step	(5) GMM-System Two-step
EffectiveVATRate	-0.0007*	-0.0004*	-0.0013*	-0.0021**	-0.0015*
	(0.0004)	(0.0002)	(0.0008)	(0.0010)	(0.0008)
Entry	---	0.0009	---	---	---
		(0.0013)			
Entry × EffectiveVATRate	---	-0.0013**	---	---	---
		(0.0005)			
Ln C_{t-1}	0.8836***	0.5943***	0.7900***	0.5562***	0.4389***
	(0.0178)	(0.0678)	(0.0226)	(0.0807)	(0.1268)
Ln Y	0.0797***	0.0911***	0.1909***	0.2773***	0.3511***
	(0.0155)	(0.0213)	(0.0275)	(0.0580)	(0.1091)
Ln W	0.0088***	0.0044***	0.0075*	0.0265	0.0183
	(0.0026)	(0.0009)	(0.0045)	(0.0182)	(0.0222)
InterestRate	-0.0014***	-0.0012*	-0.0018***	-0.0010**	-0.0019**
	(0.0003)	(0.0006)	(0.0004)	(0.0004)	(0.0007)
Growth Y	0.0028***	0.0018***	0.0031***	0.0024***	0.0029***
	(0.0005)	(0.0004)	(0.0006)	(0.0007)	(0.0009)
OldAge	0.0003***	0.0002*	-0.0001	0.0008	-0.0009
	(0.0001)	(0.0001)	(0.0003)	(0.0005)	(0.0009)
Ln (TotalConsumptionTax-VAT)	0.0026	-0.0024*	-0.0091*	-0.0118	-0.0384*
	(0.0036)	(0.0011)	(0.0051)	(0.0118)	(0.0196)
Ln TotalIncomeTax	0.0005	0.0004	0.0081*	0.0362***	0.0668***
	(0.0027)	(0.0011)	(0.0046)	(0.0119)	(0.0180)
Constant	0.2193***	0.1046*	0.0274	0.9797**	1.3893***
	(0.0451)	(0.0509)	(0.1637)	(0.3443)	(0.3541)
Observations	520	520	520	520	520
Number of countries	15	15	15	15	15
Hansen test (*p*-value)[a]	---	---	---	1.00	1.00
Test for 2nd order serial correlation (*p*-value)[b]	---	---	---	0.29	0.12

Notes: The dependent variable is the natural log of Per Capita Household Final Consumption (Ln $C_{i,t}$). Robust standard errors are in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%
[a] The null hypothesis is that the instruments used are uncorrelated with the residuals.
[b] The null hypothesis is that the errors in the first-difference regression exhibit no second-order correlation.

Table 5. ***Sensitivity Results: Alternative Specifications, Five-year Averaged Data and Annual Data, GMM-System Two-step Estimation***

	Five-year Averaged Data			**Annual Data**		
Explanatory Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
EffectiveVATRate	-0.0102***	-0.0074***		-0.0057*	-0.0021***	
	(0.0024)	(0.0021)		(0.0029)	(0.0007)	
StatutoryVATRate			-0.0098**			-0.0011
			(0.0038)			(0.0008)
Ln C_{t-1}	0.4580***	0.3012*	0.4219*	0.5569**	0.6094***	0.5278**
	(0.1164)	(0.1443)	(0.2007)	(0.1932)	(0.0682)	(0.1926)
Ln Y	0.3070**	0.4258***	0.4913**	0.5115**	0.2590***	0.4266***
	(0.1251)	(0.1365)	(0.1782)	(0.2067)	(0.0599)	(0.1358)
Ln W	0.0821**	0.0399	0.0536	-0.0994	0.0051	0.0686
	(0.0280)	(0.0534)	(0.0672)	(0.0916)	(0.0163)	(0.0779)
InterestRate	-0.0066***	-0.0081***	-0.0132**	-0.0014	-0.0025***	-0.0103**
	(0.0018)	(0.0022)	(0.0047)	(0.0008)	(0.0006)	(0.0041)
Growth Y		0.0066	0.0115*		0.0037***	0.0018**
		(0.0044)	(0.0056)		(0.0006)	(0.0006)
OldAge		0.0010	-0.0055		0.0005*	-0.0012
		(0.0010)	(00174)		(0.0002)	(0.0024)
Ln (TotalConsumptionTax-VAT)	0.0048	-0.0160	0.0004	0.0277	-0.0057	-0.0532*
	(0.0187)	(0.0396)	(0026)	(0.0340)	(0.0114)	(0.0249)
Ln TotalIncomeTax	0.0334	0.0640	0.0662	0.0248**	0.0351**	0.0888***
	(0.0261)	(0.0394)	(0.0590)	(0.0107)	(0.0121)	(0.0209)
InflationRate		0.0027			0.0008	
		(0.0017)			(0.0006)	
UnemploymentRate		0.0026			-0.0003	
		(0.0034)			(0.0005)	
Constant	1.1460	1.6640	0.7992	-0.2921	0.8462***	1.1293**
	(0.8591)	(0.9461)	(0.5732)	(0.9459)	(0.2632)	(0.4309)
Observations	109	109	109	520	520	520
Number of countries	15	15	15	15	15	15
Hansen test (*p*-value)[a]	0.75	0.37	0.51	1.01	1.00	1.04
Test for 2nd order serial correlation (*p*-value)[b]	0.90	0.30	0.81	0.28	0.13	0.24

Notes: The dependent variable is the natural log of Per Capita Household Final Consumption (Ln $C_{i,t}$). Robust standard errors are in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1%

[a] The null hypothesis is that the instruments used are uncorrelated with the residuals.

[b] The null hypothesis is that the errors in the first-difference regression exhibit no second-order correlation.

Figure 1. ***Annual Effective VAT Rate: Average EU (1961-2005)***

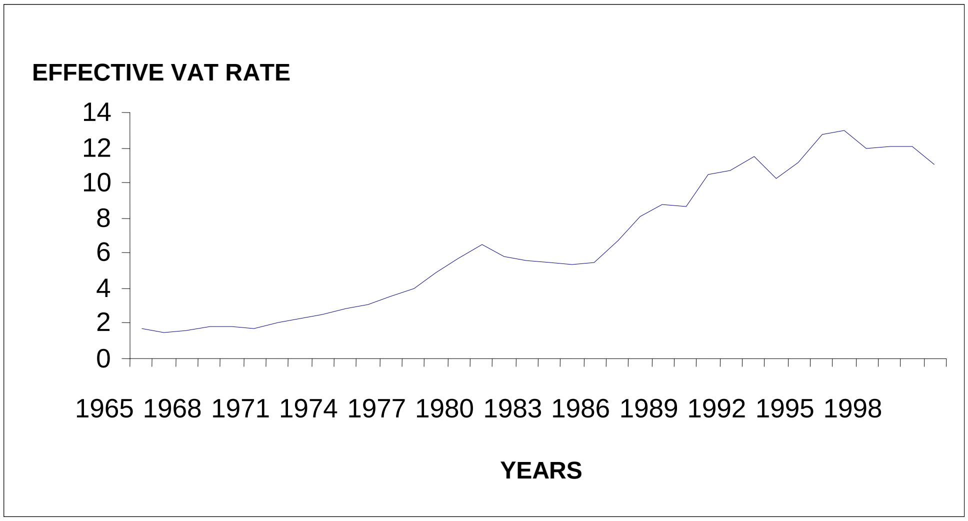

Figure 2. ***Five-Year Averaged Effective VAT Rate: Average EU (1961-2005)***