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Does financial VAT affect the size of the financial sector?

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Abstract
The influence of VAT applied to financial services on the size of the financial sector is analyzed empirically. The authors use data from 36 European Union and OECD countries for the period from 1961 to 2012. Dynamic panel data techniques are used, concretely the GMM System. An unbalanced panel is handled. The results allow the authors to support the theoretical analysis that financial VAT has no significant effect on financial sector development. Results are robust to the specifications of the dependent and target variables and to the econometric method applied.

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1 Introduction

The topic of how VAT on financial services (hereafter, financial VAT) influences the size of the financial sector has not previously been studied empirically. Nonetheless, the development of the financial sector is an important issue. On the one hand, an expanding financial sector generates many positive externalities. As Levine (2005) states, financial systems produce information ex ante about likely investments and allocate capital; monitor investments and exercise corporate governance after providing finance; facilitate the diversification, trading, and management of risk; mobilize and pool savings; and ease the exchange of goods and services. As asserted by Schumpeter (1911, 1942), innovation (understood as the transfer of capital from businesses using old methods of production to businesses using new, innovative methods) takes place thanks to credit expansion. All this encourages the real economy positively.

On the other hand, the excessive size of a financial sector could also generate negative externalities, such as the presence of systemic risk, which could provoke serious financial and economic crises, as noted by the IMF (2010). The fall of a big bank can hamper firms' exposure to financial markets or direct funding, disrupting the traditional channels of interbank lending due to a lack of confidence. The recent experience of the financial crisis of 2007 shows how a small initial shock, such as the relatively minor sub-prime mortgage crisis in the USA, can lead to major economic repercussions due to the domino effect (Dreger and Kholodilin, 2013). Furthermore, the systemic financial crises had significant fiscal costs. The IMF (2010) points out that the negative external effects generated by financial market failures increase with the presence of a large and complex financial sector. This is due to the significant costs of the failure of a financial entity, because financial markets generally expect that governments will support the banking sector with funding in order to avoid adverse consequences (Hagen, 2013). This involves an additional moral hazard problem for the government.

During a financial crisis, practice shows that the bigger the institution, the more likely it is that the public authorities will trigger a bail-out. The methodology followed by international credit rating agencies supports this point. Under these circumstances, it is difficult to avoid the presence of moral hazard. The prohibition of bailing out, which is one of the principles of the European Banking Union, is intended to avoid these situations. The controversy regarding the performance of some Italian banks, where it would be appropriate to apply the "bail in" principle (lost compensation against stocks and hybrid financial instruments as a first step), reveals the difficulties of putting into practice some measures designed to eliminate the moral hazard phenomenon. Furthermore, the financial crisis which began in 2007 has shown the consequences of an excess of credit funding, the non-

monotonic relationship between financial size and economic development, and the importance of a stable financial sector (Dominguez Martinez and Lopez Del Paso, 2014).

Nevertheless, some analysts consider that a larger financial sector is not necessarily harmful, and could even bring economic stability. The use of securitization and the loss of the traditional financial intermediation chain are the real concern and the source of difficulties. We could also add the creation of complex derivatives, such as credit default swaps, with a design that conceals where the core of the credit risk lies. Complexity and the obfuscation of credit risk are thus the primary source of the problem, as distinct from the size of financial institutions (Kay, 2015). Rather surprisingly, some recent studies such as Dupire and Van den Spiegel (2016) show that the biggest banks are less profitable and also less risky than smaller banks. These authors also suggest that stock prices since the pre-crisis period have evolved more favorably for the biggest banks than for the smallest ones.

As Lockwood (2014) states, a recent literature has emerged that studies the undesirable activities of banks that generate external effects in the deposit and credit margins. The main result is that these external effects could be corrected by Pigouvian taxes that would be applied to the bank margins, as taxes on credits or deposits. Furthermore, these Pigouvian taxes could be complemented with taxes on financial services such as financial VAT, which could make it possible to recover VAT on inputs, contrary to the current system of exemption of financial services applied in the vast majority of countries.

It is worth noting that VAT on financial services, applied in different countries, is not a Pigouvian tax. This is because the objective of financial VAT is not to eliminate the negative externalities that the financial sector generates, but to tax the consumption of financial services, in contrast to financial transaction taxes. The *Financial Activities Tax* (FAT), developed by the IMF (2010) and discussed in Burman et al. (2016), consists of three alternative versions of the same tax, designed to address different kinds of financial distortions. FAT1 eliminates the exemption of financial services on VAT. All rents generated in the financial sector are taxed by FAT2, while FAT3 discourages risk taking by taxing the excess on rents from a fixed high rate of return. FAT2 and FAT3 could serve to understand better the rules for applying Pigouvian taxes to financial margins.

To sum up, the overall size of a country's financial sector and the size of individual institutions have gained increased attention, especially in the wake of the global financial crisis of 2007–08. In this context, there have been many proposals to establish different types of taxation on financial institutions, through both direct and indirect taxes. As these are intended to reduce the size of the financial sector and its institutions or other aims, it is very valuable to determine the actual effects

of the new taxes on financial sector size. This paper focuses on financial VAT and analyzes the influence of financial service taxes on the size of the financial sector, contributing an empirical test to a topic only dealt with theoretically to date. Financial service taxes mean taxing financial services via VAT (meaning the elimination of the exemption of financial services from VAT), or via other, non-VAT taxes on the value added of financial institutions.

After this introduction, Section 2 explains what financial depth means and how it can be measured, in order to give a theoretical explanation of the possible influence of financial VAT on financial sector size in Section 3. In Section 4 we review the literature on the topic, while Section 5 specifies the models to estimate. Section 6 estimates the econometric models arranged in Section 5 and discusses the empirical results. Section 7 provides the concluding remarks.

2 Definition of financial development and its measurement

Rajan and Zingales (2003, p. 9) considers that financial development "would capture the ease with which any entrepreneur or company with a sound project can obtain finance, and the confidence with which investors anticipate an adequate return. Presumably, also, a developed financial sector can gauge, subdivide, and spread difficult risks, letting them rest where they can best be borne. Finally, it should do all this at low cost."

This definition would include the process of financial intermediation but also direct financing through markets. It is also important to differentiate between traditional financing activities and financialization. Whilst the former involves the financial services provided to the real economy by financial institutions, the latter concept refers, as is well known, to transactions between financial institutions, i.e. inside the sector; which neither influence the real economy nor fulfill the financial needs of other economic agents.

Measurements of financial development can be formed by indicators of financial risk, financial sophistication or financial size. Financial risk can be captured by the risk of a credit default. Financial sophistication includes ratios such as equity market capitalization to GDP, or number of listed firms to population. Although they are proxies, these ratios broadly capture a country's level of financial sophistication.

Financial development can also be measured by the level of or changes in financial size, which is, basically, the weight of the financial sector in total GDP. Nevertheless, a problem emerges when trying to quantify the size of the financial

sector, because it is difficult to find available variables for posterior analysis that reflect faithfully the idea of the depth of the financial sector.

Khan et al. (2006) analyzes financial size by the study of different variables called "*fd*" (acronym of *financial depth*). The variable *fd1* measures the domestic credit (loans) provided to the private sector over total GDP. This variable plus the total capitalization of the stock exchange as a percentage of the GDP is measured by *fd2*. This variable also includes an indicator of financial sophistication: capitalization of the stock exchange. This indicator is affected by the market prices, resulting in a deviation from the resources actually channeled to the corporations. Finally, *fd3* represents the previous variable plus the capitalization of the public bonds market as a percentage of GDP. The last indicator is the most exhaustive of the three, but it is also the variable with the least data. In contrast, the first variable is the most available, but it represents a more limited approach. The first two variables focus on the domestic private sector, while the third variable relates to the public bonds market and thus it involves the public sector.

3 Influence of financial VAT on financial sector size

As far as we know, Aigner and Bierbrauer (2015) have contributed one of the first theoretical models of the impact of financial VAT on financial sector size. The authors base their findings on the analytical models of Ramsey (1927) and Mirrlees (1972), in which they include the financial sector. Aigner and Bierbrauer (2015) develop a model with the following features: there is a household sector that receives labor income, which is used to buy a final product. In addition, there is a productive sector that employs the labor force as an input and produces goods. The financial sector is introduced in the following way: workers have to be compensated for their work before their employers obtain income from the sale of the products. Thus, a business that wants to hire workers needs a financial intermediary that provides funding for payment of salaries. The intermediary is compensated by the promise of the repayment of the amount by the business after the sale of the goods. In this way, consumers receive the wage before the market of final goods opens. In t=0 households receive a wage, and until t=1, the wage is kept in a deposit account provided by the financial intermediaries, receiving the deposit plus the interest in t=1. The producers apply for a loan to the banks in t=0 for paying the wages, which is returned with interest in t=1. The consumption of the government is determined exogenously and the government also collects taxes.

There is a tax administration that introduces a tax on wages, τ_w, a value added tax rate on goods (hereafter, VAT rate), that we denote by τ, and also a value added tax rate on financial services (hereafter, financial rate), denoted by τ_b.

Aigner and Bierbrauer (2015) compare the working of the current VAT system with a hypothetical VAT system. The current VAT system in most countries exempts the financial sector from value added taxation, setting $\tau > 0$ and $\tau_b = 0$. Input VAT can only be fully creditable if the zero-rate method is applied. The hypothetical VAT system considered by the authors treats the financial sector and the rest of the economy equally, and is characterized by $\tau = \tau_b > 0$. Aigner and Bierbrauer (2015) study the impact of VAT exemption[1] by comparing the competitive equilibria that arise under these two systems.

Aigner and Bierbrauer (2015) describe the optimization problems of a household, a firm and a financial intermediary. All economic agents maximize in t=1. The households choose the labor supply and the deposits that maximize their utility facing the constraint that the consumed money has to be less or equal to the deposited money. The maximization problem of businesses is choosing the labor demand and the loan volume that maximizes profits (sells minus the loan volume including interest). Businesses face the constraint that the loan volume is higher than or equal to the wages paid. Banks maximize profits (non-defaulting loan volume minus deposit volume). The constraint satisfies that the bank labor force y_b is higher than or equal to the sum of the product of each financial service (deposit or loan) and the additional unit of labor input that an additional financial service requires. The tax administration seeks a Pareto-efficient tax system in which there is no other tax system that satisfies the revenue requirement of the tax administration and makes either the households, or the businesses or the bankers better off while making no one worse off.

Based on Equation (18) of Aigner and Bierbrauer (2015), the equilibrium of loan volume is equal to:

$$l^{eq} = \left(1-\tau_w\right)^2 \frac{i_d\left(1-\kappa_d\right)}{i_l\left(1+\kappa_l\right)}, \tag{1}$$

where κ_d are the additional units of labor input that an additional deposit requires, κ_l are the additional units of labor input that an additional loan requires, i_d is the net interest of the deposit, and i_l is the net interest of the loan.

As stated above, the financial sector is involved in financial transactions with households when acquiring deposits and with the goods producers (businesses) when granting loans. First we focus on the interaction between banks and

[1] The incidence of VAT is an unsettled question. Some authors, including the European Commission (2003) and Benedek et al. (2015), find that the pass-through of a lower VAT rate to lower prices for the consumers has never been fully realized.

households. In the hypothetical VAT system, the financial VAT rate is applied to the net interest of the deposit i_d that is realized by households when selling deposits to banks and the gross interest $i_d(1+\tau_b)$ is paid by the banks. Nonetheless, under a VAT system that includes financial transactions and collects VAT using an invoice-credit method, banks would be able to credit the VAT payment of $i_d\tau_b$. Hence the relevant interest for households and banks related to deposits is i_d, independently from τ_b.

With regard to businesses, Aigner and Bierbrauer (2015) consider two cases: one in which businesses can credit VAT payments (financial VAT), and one in which they cannot. For each case, there will be a different competitive equilibrium. In the first scenario, in which financial VAT can be credited, taxes on financial services affect the size of the financial system according to this equation:

$$l_v^{eq} = (1-\tau)(1-\tau_w)^2 \frac{i_d(1-\kappa_d)}{i_l(1+\kappa_l)} = (1-\tau)l^{eq}. \quad (2)$$

In this scenario, the relevant interest is the net interest on the loan i_l for businesses and banks.

In the second case, when financial VAT cannot be credited, the equilibrium of the volume of loans differs from the result of the previous case according to:

$$l_v^{eq} = \frac{1-\tau}{1+\tau_b} l^{eq}. \quad (3)$$

In the current VAT system, in which financial services are exempt and VAT payments cannot be credited, the ratio (3) would be equal to the ratio (2), due to the fact that the financial rate is equal to zero. If zero-rating with VAT input credits is in force, the ratio (2) also applies.

Thus, the only case in which financial VAT affects the size of the loan and therefore the size of the financial sector is in the hypothetical VAT system without VAT input crediting.

The main results of Aigner and Bierbrauer (2015) are summarized in Table 1.

Table 1: Cases of financial service taxation and their impact on loan volume

Cases: / *VAT system:*		**1**	**2**
		Cannot credit financial VAT	**Can credit financial VAT**
Current	$\tau > 0, \tau_b = 0$	I $\frac{1-\tau}{1+\tau_b} = 1-\tau$ Loan volume not altered by financial rate	II $1-\tau$ Loan volume not altered by financial rate
Hypothetical	$\tau = \tau_b > 0$	III $\frac{1-\tau}{1+\tau_b}$ An increase of the financial rate reduces the financial sector size	IV $1-\tau$ Loan volume not altered by financial rate

4 Determinants of financial sector size: literature review

As stated above, there is no empirical literature on the effects of VAT on financial size. In this section we focus on the variables that determine financial sector development. Firstly, as Klein and Olivei (2008) point out, it is important to note the lack of theoretical models that explain the determinants of financial sector depth. Nevertheless, there are some models that aim to explain the influence of some variables on financial size. It is worth mentioning the model of McKinnon (1973), which establishes a positive relationship between financial development and the level of output, which results from the complementarity between money and capital. We can also highlight the model of Huybens and Smith (1999), which models the strong negative long run correlation observed between inflation and financial development in countries with a low or moderate long-term inflation rate. English (1999), in contrast, models the increase of financial sector depth due to increased inflation. Finally, Do and Levchenko (2007) estimate a model in which goods differ in their need for external funding, which provokes changes in the equilibrium of financial development in trading countries.

Huang (2010b) and Ayadi et al. (2013) provide an exhaustive review of the empirical literature. They mention the following variables as the most explanatory: institutional and regulatory variables, variables of political stability, kind of property of the bank, macroeconomic factors such as economic stability or prosperity, variables of fiscal policy, openness to financial flows (financial openness), trade openness, geography, investment and remittances, and other variables such as culture or endowment factors.

La Porta et al. (1997) is one of the first papers to deal with the influence of institutional variables on financial sector size. This paper shows that the countries with the worst investment protection, measured by the nature of the law and the quality of the state of law, have smaller capital markets. Many authors also study the function of institutions in financial development: Levine et al. (2000), Beck et al. (2003), Rajan and Zingales (2003), Law and Demetriades (2005), Chinn and Ito (2006), Djankov et al. (2007), Law and Azman-Saini (2008), Huang (2010a), Luca and Spatafora (2012) and Allen et al. (2014). Other authors focus on the influence of political instability, corruption and other political determinants of financial development, such as Barth et al. (2004), Dinc (2005), Detragiache et al. (2005), Micco et al. (2007) and Roe and Siegel (2011).

Macroeconomic variables are also taken into account in the literature, for instance economic stability, measured by the inflation rate (Huybens and Smith, 1999; English, 1999; Boyd et al., 2001; Khan et al., 2006; and Bahadir and Valev, 2015), the degree of economic prosperity of a country, measured by the level of GDP per capita, or the population, (King and Levine, 1993; Levine, 1997; Jaffee and Levonian, 2001). Nonetheless, Cecchetti and Kharroubi (2012) show that financial development affects growth: it is good only up to a point, after which it becomes a drag on growth (see also Dominguez Martinez and Lopez Del Paso, 2014).

Other determinants of financial sector development are studied by the literature, such as the variables relating to the fiscal policy of the country, for instance public deficit, particularly in Caballero and Krishnamurthy (2004) and Christensen (2004). The literature of financial development has also considered financial openness as a determinant of financial sector size. That is, the openness of accounts to the exterior and financial flows to abroad can influence the financial development, as Klein and Olivei (2008) show. In addition to financial openness, it is also important to consider the influence of trade openness on financial development, measured as the sum of exports plus imports; see Levine (1997), Svaleryd and Vlachos (2002), Rajan and Zingales (2003), Law and Demetriades (2005), Gries et al. (2009), Kim et al. (2010), Kim et al. (2011) and Raza et al. (2014).

Some authors have remarked on the importance of geographical variables as determinants of financial development, but generally focusing on other kinds of variables than the geographical ones. Do and Levchenko (2007) developed a new instrumentation strategy based on geographical determinants exogenous to trade patterns. Many authors also focus on the variables of investment, both domestic and foreign, and the variable of remittances (Gupta et al., 2009; Demirgüç-Kunt et al., 2011; Huang, 2010a and Ayadi et al., 2013). Other authors find natural resources are also determinants of financial development, such as Shahbaz et al.

(2013) and Bhattacharyya and Hodler (2014). In addition to the variables mentioned above, there are many other variables considered in the literature as determinants of financial development. These include the degree of industrial competitiveness, the presence of a banking crisis, or the culture, as in Kroszner et al. (2007), Braun and Raddatz (2008) and Kim and Lin (2011). Some authors, such as Huang (2010b), aim to estimate a wide-ranging model that attempts to incorporate all the studied variables, at least the most significant. Sharpe (1995) and Altunbas et al. (2010) also show the need to use asset structure indicators (i.e., liquidity and capitalization) to assess banks' ability and willingness to supply new loans. Haldane and May (2011) sustain that the traditional rationale for such requirements is that higher requirements for banks' capital and liquid assets reduce idiosyncratic risks to the balance sheets of individual banks.

5 Specification

The purpose of this section is not the study of the determinants of financial sector development or size, but the formulation of an explanatory model in which we can see the impact of VAT taxation of financial services on the size of the financial sector. To do this, we estimated panel data with information from 1961 to 2012 for 36 countries, including all the countries of the European Union (27) and the OECD, with the exceptions of Switzerland, Cyprus, Romania and Malta.

We estimate a dynamic panel data model by the two-step GMM System method, following Boyd et al. (2001), Law and Azman-Saini (2008) and Huang (2010a). We estimate a dynamic model due to assuming that the financial development of the previous period affects that of the current period, a hypothesis that can be easily checked by the presence of good econometric properties in the model. Table 2 summarizes the econometric method and results of some papers in the literature.

In particular, we will estimate dynamic models using the GMM System developed by Arellano and Bover (1995) and Blundell and Bond (1998). The analytical formulation is as follows:

$$y_{i,t} = \gamma y_{i,t-1} + \beta_T T_{it} + \beta X_{it} + \varepsilon_{it}, \quad (4)$$

where $y_{i,t}$ is the variable that reflects the indicator of financial development of a country *i* at time *t*, $y_{i,t-1}$ is the first lag of the endogenous variable and γ is its coefficient. T_{it} is our vector of target variables (financial VAT and taxes separate from VAT), X_{it} is the vector of the remaining exogenous variables, β_T and β, are the coefficients, and ε_{it}, is the residual.

Table 2: Econometric models and data in the literature

Study	**Methodology**	**Main impacts on financial development**
Boyd et al. (2001)	OLS, Generalized-Method-of-Moments (GMM) in first differences	*inflation* (-)
Barth et al. (2004)	OLS, GMM instrumental variables regression	*stability* (+)
Detragiache et al. (2005)	OLS	*inflation* (-), *information* (+)
Khan et al. (2006)	Nonlinear least squares (NLLS)	*psize* (-)
Klein and Olivei (2008)	OLS	*openness* (+)
Law and Azman-Saini (2008)	System-GMM	*stability* (+)
Huang (2010a)	OLS, Least Square Dummy Variables (LSDV), bias-corrected LSDV estimator (LSDVC), and system GMM	*investment* (+)
Kim et al. (2010)	Pooled Mean Group (PMG)	*openness* (-)
Kim et al. (2011)	Simultaneous-equation model (SEM)	*openness* (-)
Ayadi et al. (2013)	Random-effects panel regression	*debt* (-), *fdi* (0,-)
Shahbaz et al. (2013)	Dynamic unrestricted error correction model (UECM)	*energy* (+)
Allen et al. (2014)	Ordinary Least Square (OLS)	*mobiles*, *industry* and *gdppc* (+), *density* (-,0)
Asongu (2014)	OLS	*population* (-), *fdi* (0,-)

We use different dependent variables as indicators of financial development. The size of the financial sector (*fsize*) is the logarithm of the percentage of domestic credit provided by the financial sector over the total GDP in first differences, in order to avoid unit root problems. The banking sector size (*bsize*) is the logarithm of the percentage of domestic credit provided by the banking system over the total GDP, and is also in first differences. Total financial depth (*fdepth*) reflects financial sector size, but also financial sophistication, because this variable is the sum of *fsize* and the logarithm of the stock capitalization to GDP. This last variable is not in first differences because our tests found it does not have unit root problems.

The following explanatory variables are related to the public sector. The first of our interest variables is the interaction of the financial tax rate (the marginal tax rate applied to financial services) and financial VAT (*tb*fVAT*), financial VAT being measured as a binary variable that takes the value 1 when financial VAT is in force in the country and 0 otherwise, applying the value 1 to data in Table 3, with

Table 3: Methods of taxing financial services employed in international practice

Method	Countries where applied	Method	Countries where applied
Zero-rating	*Quebec (up to 2013), New Zealand (since 2005; Merrill, 2011),*	Net operating income (full taxation)	*Mexico (since 1992; Schatan, 2003)*
Exemption with input credits (partial taxation)	*Australia (since 2000; De la Feria and Walpole, 2009), Singapore (since 1994; Jenkins and Khadka, 1998), Malaysia (since 2015; IMF, 2015)*	Subtraction method (differentiated taxation)	*Italy (since 1998; Keen et al., 2010), proposed in Japan to be established in 1950, but rejected (De la Feria and Krever, 2012), in Canada in 1987(Schenk, 2009), and in the Philippines (Xu and Krever, 2016) proposed on 2000, but abandoned before implementing*
Taxing fee-based services (partial taxation)	*Australia, Singapore, South Africa (since 1996; Merrill, 2011), Malaysia, the Philippines (since 1988), India (since 1994; Deloitte, 2013), China (since 1994; Owens, 2014), Korea (since 1982; MSF, 2012), Belgium (1971–1977; Ernst and Young, 2009), Slovenia (since March 2013, PKF, 2014), Andorra (since 2013), Ghana (since 2013; PWC, 2013), Mexico (since 1980; Schatan, 2003), Thailand (since 1992; BOI, 2016)*	Separate taxes (differentiated taxation)	*Quebec, Israel (since 1981; Gillis, 1987), France, Denmark, Italy, Andorra (from June 2002 to 2013, as a sales equalization tax), China (from 1994 (Owens, 2014) up to 1 May 2016 (KPMG, 2016)), India (since 1994 (Deloitte, 2013), proposed under GST in 2016, but postponed until 2017), the Philippines (since 1946; except for the year 2003 when it was taxed under VAT, ZGLO, 2006), Taiwan (since 1 April 1986; ROC, 2016), Thailand, Iceland and Korea*
Option to tax (full or partial taxation)	*Option to tax only fees* (partial taxation)*: Belgium (since 1978), Lithuania (since 1 May 2004), France (since 1979)* *Option to tax fees and margin* (full taxation)*: Austria (since 1997 with retroactive effect), Estonia*[i] *(since 2002), Germany (since 1968)* *Source: Ernst and Young (2009)*	Addition method (differentiated taxation)	*Quebec, Michigan (since 1953; De la Feria and Krever, 2012), France (since 1979; Pons, 2006), Israel (since 1976; Gillis, 1987), Denmark (since 1988; Møller and Hjerrild, 2013)*
Taxation of gross interest (full taxation)	*Argentina (since 1992; Zee, 2004). Proxy taxes: China (since 1994; Owens, 2014), on VAT since 1 May 2016; KPMG, 2016), the Philippines (since 1946;* ZGLO, 2006*), Taiwan (since April 1986, ROC, 2016), Thailand and Korea*	Financial Activities Tax (differentiated taxation)	*Iceland (since 2012; Keen et al., 2016)*

[i] None of the financial institutions of this country has opted to tax (Borselli, 2009).

the exception of separate taxes. Table 3 reflects the methods of taxing financial services employed in international practice (see Gendron, 2008, and López-Laborda and Peña, 2016 for an explanation), pointing out if the methods apply zero-rating (fully creditable input VAT, financial tax rate equals to zero), partial taxation (creditable input VAT, in some cases taxation of explicit fees), full taxation (creditable input VAT, taxation of explicit and implicit fees) and differentiated taxation (taxation of fees but not fully creditable input VAT). We expect this variable not to be significant, because it roughly corresponds to the cases reflected in cells II and IV of Table 1, in which businesses can claim VAT credit. As explained in section 3, in these cases, the competitive equilibrium of loan volume does not depend on the financial rate. The same result occurs in the case of

the exemption, which corresponds to the current VAT system reflected in Cell I of Table 1, with zero-rating of financial services on VAT and non-creditable input VAT for businesses.

The second variable of interest is *tb*separate*, the interaction of the financial tax rate and the presence of separated taxes, which is measured by taking the value 1 if the country applies a financial service tax other than financial VAT according to Table 3, or 0 otherwise. It corresponds with the case reflected in Cell III of Table 1, in which the financial tax rate is higher than zero and businesses cannot credit their VAT payments. According to the Aigner and Bierbrauer (2015) model, we expect a negative sign for this variable.

The size of the public sector is incorporated as an explanatory variable by the variable *psize*, measured by the ratio of the public expenditure to GDP, considering public expenditure as the government payments for operating activities for the provision of goods and services, including workers' remuneration (as wages and salaries), interests and subsidies, donations, social benefits and other expenditures. The last variable related to the public sector is *debt*, which measures the total public debt of the government as a percentage of GDP.

The commercial or geographical variables are: trade openness (*openness*), measured as the fraction between the sum of exports plus imports and the GDP; *closed*, a dummy variable that takes the value 1 if the country is landlocked, or 0 otherwise; *distance*, which measures the average of the three bilateral distances between each country of the sample and France, Japan and the USA; and *area*, which is the size of a country measured by its area.

The variables of the economic context included in the study are the following. The variable *gdppc* is the growth rate of GDP per capita. The non-monotonicity of the relationship between income and financial development is measured by the variable *gdppc2*, which is the square of the growth rate of GDP per capita. The presence of a financial crisis is included by the variable *crisis*, which takes the value 1 in the year of a systemic banking crisis and 0 otherwise. According to the World Bank and Laeven and Valencia (2013, p. 6): "A banking crisis is defined as systemic if two conditions are met: a. Significant signs of financial distress in the banking system (as indicated by significant bank runs, losses in the banking system, and/or bank liquidations), b. Significant banking policy intervention measures in response to significant losses in the banking system. The first year that both criteria are met is considered the year when the crisis starts becoming systemic. The end of a crisis is defined the year before both real GDP growth and real credit growth are positive for at least two consecutive years." The variables *crisis*, *gdppc* and *gdppc2* have been lagged one period in order to avoid simultaneity and reciprocity problems with the dependent variables. The last variable of the economic context is *inflation*, measured as the growth rate of the

price index. According to the World Bank (2016), "inflation as measured by the annual growth rate of the GDP implicit deflator shows the rate of price change in the economy as a whole. The GDP implicit deflator is the ratio of GDP in current local currency to GDP in constant local currency."

In addition, we incorporate some institutional variables, such as *language*, used as a proxy of institutional quality, representing the presence of at least one significant minority population whose native language is one of the five most widely spoken languages of Europe (English, French, German, Spanish and Russian). Another variable in this group is *stability*, which is the World Bank's "Political Stability and Absence of Violence/Terrorism" index, which "measures perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism. Estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately –2.5 to 2.5" (Kaufmann et al., 2010).

There are also variables of investment, such as *fdi*, a variable that measures the net flows obtained in the acquisition of at least 10% of the shares in a business that operates in a different economy than the investor, or *investment*, measured by gross investment over GDP, being the investment the purchases of fixed assets plus the net variation of stocks.

The next group of variables is related to the population and human capital. The gross rate of secondary education, which is the total of students in secondary school over the total people in the age range, is measured by the variable *secondary*. The variable *density* reflects the current population divided by the area of the country. The population is incorporated by the variable *population*, which is the growth rate of the current population estimated at mid-year.

Among the sectoral variables, *agriculture* is the participation of agriculture in the GDP, and *industry* represents the participation of industry in the GDP.

We also include some financial variables, such as *lerner*, a measure of the market power of the banking system. It compares the price of the final good with the margin costs (i.e. the *mark-up*). An increment of this variable indicates a depreciation of the competitive conduct of the financial intermediates. According to the World Bank (2016): "it is defined as the difference between output prices and marginal costs (relative to prices). Prices are calculated as total bank revenue over assets, whereas marginal costs are obtained from an estimated translog cost function with respect to output. Higher values of the Lerner index indicate less bank competition."

The depth of credit information is included by the variable *info*, which is an indicator that measures the rules affecting the accessibility, breadth, and quality of the information available in the registers. The index takes the values 0–8, and higher values represent an availability of more credit information.

Another group of variables is related to infrastructure: the variable *mobiles* measures the mobile phone lines for each 100 people and the variable *energy* refers to the use of primary energy before its transformation to other fuels of final use. The last group of variables reflects the asset structure: the variable *capital* measures the ratio of bank capital and reserves to total assets, and capital and reserves include funds contributed by owners, provisions, general and special reserves, retained earnings, and valuation adjustments. The variable *liquidity* is the ratio of bank liquid reserves to bank assets, measured as the ratio of domestic currency holdings and deposits with the monetary authorities to claims on other governments, non-financial public enterprises, the private sector, and other banking institutions.

All variables are obtained from the World Bank, with the exceptions of *language* and *closed*, obtained by the authors; the variable *stability*, obtained from the World Bank database; and the variable *distance*, obtained according to the definition of Chang et al. (2009), and from CEPII (Mayer and Zignago, 2011). The variables *tb*fVAT* and *tb*separated* were constructed by the authors, according to Table 3 and diverse sources. Table 4 summarizes the expected signs of the variables and their source.

6 Estimation and results

In order to avoid multicollinearity problems, we are going to evaluate the correlation matrix of the variables. Variables with a correlation higher to 0.5 have been eliminated. The results are shown in Table 5.

First we estimate non-robust models, in order to apply the Sargan test (of over-identification of the instruments), and the Arellano-Bond test (of no autocorrelation of the residuals). The null hypothesis of the Sargan test is the validity of the instruments used, and this is analyzed in the three non-robust models. The null hypothesis is accepted in all three models. The null hypothesis of the Arellano-Bond test is the serial autocorrelation of the residuals of order 1, and in the three models it is accepted that residuals are AR(1) and rejected that they are AR(2).

The lags usually added in the literature to explanatory models of financial sector size (one lag) are incorporated in the specification. Finally, robustness is applied. In the robust models, the residuals are obtained by a WC-robust estimator derived by Windmeijer (2005), which is a bias-corrected robust estimator for two-step VCEs (variance-covariance matrix estimators) from GMM estimators. This estimator avoids possible heteroscedasticity problems. Once robustness is applied, we obtain a first model that includes all the variables that are relevant in the literature, in addition to our interest variables: the interaction of the financial rate

with financial VAT (*tb*fVAT*) and with separate taxes (*tb*separate*). If that model does not have good econometric properties, we build successive models, obtained

Table 4: Expected signs

Variable group	Variable	Sign	Source
Fiscal	*tb*fVAT*	0	Aigner and Bierbrauer (2015)
	*tb*separate*	(-)	Aigner and Bierbrauer (2015)
	psize	(-)	Kahn et al. (2006) and Bahadir and Valev (2015)
	debt	(-)	Caballero and Krishnamurthy (2004), Christensen (2005) and Ayadi et al. (2013)
Commercial	*openness*	(+/-)	(+): Rajan and Zingales (2003), Law and Demetriades (2005), Kahn et al. (2006), Klein and Olivei (2008) and Roe and Siegel (2011), (-): Kim et al. (2010, 2011)
	closed	(+)	Roe and Siegel (2011)
	distance	(+/-)	Demirgüç-Kunt et al. (2011)
	area	(+)	Jaffee and Levonian (2001), Roe and Siegel (2011)
Context	*gdppc*	(+)	King and Levine (1993), Djankov et al. (2007), Allen et al. (2014)
	gdppc2	(-)	Cecchetti and Kharroubi (2012) and Dominguez Martinez and Lopez Del Paso (2014)
	crisis	(-)	Kroszner et al. (2007) and Braun and Raddatz (2008)
	inflation	(+/-)	(-): Boyd et al. (2001), Detragiache et al. (2005), Do and Levchenko (2007), Kim et al. (2010), Luca and Spatafora (2012), Asongu (2014) and Bahadir and Valev (2015), (+): Kahn et al. (2006)
Institutional	*language*	(+)	Huang (2010b)
	stability	(+)	Law and Azman-Saini (2008), Roe and Siegel (2011)
Investment	*fdi*	(0,-)	(0): Ayadi et al. (2013) and Raza et al. (2014), (-): Asongu (2014)
	investment	(+)	Huang (2010a) and Luca and Spatafora (2012)
Population	*secondary*	(+)	Kim et al. (2011), Demirgüç-Kunt et al. (2011)
	population	(-)	Asongu (2014)
	density	(-/0, +)	(-/0): Allen et al. (2014) , (+): Demirgüç-Kunt et al. (2011)
Sectorial	*agriculture*	(-)	Raza et al. (2014)
	industry	(+)	Rajan and Zingales (2003) and Allen et al. (2014)
Financial	*lerner*	(-)	Braun and Raddatz (2008)
	info	(+)	Detragiache et al. (2005), Djankov et al. (2007)
Infrastructure	*mobiles*	(+)	Allen et al. (2014)
	energy	(+)	Shahbaz et al. (2013)
Asset structure	*capital*	(+)	Sharpe (1995) and Altunbas et al. (2010), Haldane and May (2011)
	liquidity	(+)	Sharpe (1995) and Altunbas et al. (2010), Haldane and May (2011)

Table 5: Correlation matrix of independent variables

	capital	*liquidity*	*openness*	*lerner*	*psize*	*info*	*industry*	*density*	*mobiles*
capital	1.000								
liquidity	0.316	1.000							
openness	–0.083	0.340	1.000						
lerner	0.191	–0.077	–0.068	1.000					
psize	–0.220	–0.040	0.084	–0.061	1.000				
info	–0.052	–0.236	–0.308	0.118	–0.244	1.000			
industry	0.157	0.475	0.247	0.054	–0.364	0.174	1.000		
density	–0.382	–0.059	0.288	0.052	0.158	0.078	–0.070	1.000	
mobiles	0.034	–0.055	0.262	–0.179	0.144	0.008	–0.116	0.036	1.000
stability	–0.373	–0.090	0.226	–0.240	0.177	–0.198	0.027	–0.016	0.204
debt	–0.228	–0.250	–0.312	–0.026	0.253	0.298	–0.320	0.416	–0.106
fdi	–0.075	–0.025	0.120	0.077	0.054	–0.217	–0.196	0.041	0.146
gdp	0.061	0.250	0.169	0.065	–0.264	–0.223	0.270	–0.097	–0.113
gdp2	0.301	0.226	0.293	–0.014	–0.321	–0.232	0.071	–0.221	0.197
crisis	0.042	–0.127	–0.048	0.015	0.362	–0.018	–0.406	0.061	0.204
distance	0.011	0.022	–0.303	0.020	–0.257	0.152	0.249	–0.189	–0.221
*tb*fVAT*	–0.245	–0.193	0.265	–0.147	–0.029	0.125	–0.122	0.089	0.132
*tb*separated*	–0.102	–0.124	–0.107	0.082	0.115	–0.019	–0.125	0.032	0.077
	stability	*debt*	*fdi*	*gdp*	*gdp2*	*crisis*	*distance*	*tb*fVAT*	*tb*separated*
stability	1.000								
debt	–0.069	1.000							
fdi	0.140	–0.112	1.000						
gdp	0.065	–0.298	–0.090	1.000					
gdp2	–0.048	–0.302	0.066	0.062	1.000				
crisis	–0.059	0.249	0.112	–0.472	–0.053	1.000			
distance	–0.109	–0.180	–0.054	0.019	–0.114	–0.154	1.000		
*tb*fVAT*	0.051	0.008	–0.006	–0.024	0.105	0.049	–0.041	1.000	
*tb*separated*	0.097	–0.038	–0.049	–0.090	–0.086	0.043	–	–0.123	1.000

from the previous one, eliminating successively the non-significant variables, until we obtain a model with good econometric properties. We have applied Im–Pesaran–Shin and Phillips–Perron unit-root tests and we have not found any unit root problem on dependent variables.

All estimated models achieve the desirable econometric features and first lags are statistically significant, hence it is correct to think that the most suitable specification is the dynamic one. Table 6 reflects the results of the three models. According to the theory (Aigner and Bierbrauer, 2015), all the estimations obtain that financial VAT does not influence financial sector size. But all estimates also show that taxes on financial services separate from VAT do not influence financial sector size, in an apparent contradiction to what we would expect from the theory. However, it should be borne in mind that in the vast majority of countries applying separate taxes, businesses can partially credit input VAT, so this method approximates those ones reflected with the other variable of interest

The Model 1 in Table 6 is the definitive model for the variable *fsize*, obtaining that the following variables determine financial development as measured by the loans of the financial sector as a percentage of GDP: *openness*, *stability* and *gdppc2*. All the signs are as expected. Openness has a negative sign, as found in Kim et al. (2010, 2011). Political stability has a positive impact on financial development, as seen in Law and Azman-Saini (2008) and Roe and Siegel (2011). Finally, the variable *gdppc2* impacts negatively on financial sector size, as shown by Cecchetti and Kharroubi (2012) and Dominguez Martinez and Lopez Del Paso (2014).

Model 2 is the definitive estimation for the variable *bsize*, showing that the following variables determine financial development measured by the loans of the banking system as a percentage of GDP: *stability* and *gdppc2*. They are the same variables as in Model 1, with the exception of openness, and with the same sign.

Model 3 is the definitive model for the variable *fdepth*, finding that, once again, *gdppc2* determines financial development, as in the previous models and with the same sign, but also the coefficient of *industry* appears to be significant, with the same sign as expected, according to Rajan and Zingales (2003) and Allen et al. (2014).

In order to additionally check the consistency of the results, we have developed different robustness checks. We have considered other dependent variables, such as bank concentration or the number of bank branches, but none of them give estimations with good econometric properties. The only model that achieves the desirable econometric features from the robustness check models we have analyzed is the estimation with the variable risk. The variable *risk* is obtained from the World Bank, and reflects the logarithm of the Bank Z-score, defined as the probability of default of a country's banking system. According to the World Bank (2016), "Z-score compares the buffer of a country's banking system (capitalization and returns) with the volatility of those returns." With this alternative dependent variable, our interest variables remain non-significant.

We have also constructed in alternative ways the interest variables. For example, we have distinguished among different methods of financial VAT, obtaining no significant differences between them. We have distinguished between full taxation and partial taxation or zero-rating, and differentiate taxation, as specified on Table 3. The results are similar: no significance of the interest

Table 6: WC-robust GMM system models

GMM System	Model 1			Model 2			Model 3		
Dependent Variable:	*fsize*			*bsize*			*fdepth*		
Explanatory variables	Coeff.	Sign.	p-value	Coeff.	Sign.	p-value	Coeff.	Sign.	p-value
Dependent variable lag(t-1)	0.377	**	0.016	0.496	***	0.002	0.254	***	0.004
capital	0.008		0.541	0.003		0.823			
liquidity	–0.002		0.431	0.000		0.97	–0.021		0.215
openness	–0.002	**	0.047	0.000		0.963			
lerner	0.116		0.622	0.128		0.269	0.512		0.271
psize	0.006		0.304	–0.004		0.392			
info	–0.001		0.953	–0.008		0.596			
industry	–0.001		0.882	–0.005		0.226	0.091	***	0.000
density	–0.002		0.061	–0.001		0.216	0.005		0.297
mobiles	0.001		0.172	0.000		0.951			
stability	0.116	**	0.016	0.111	***	0.009			
debt	0.001		0.537	0.001		0.412	–0.003		0.734
fdi	0.000		0.384	0.000		0.584	0.000		0.512
gdp	0.003		0.190	0.002		0.351	–0.017		0.162
gdp2	–0.001	*	0.090	–0.001	***	0	–0.003	***	0.009
crisis	–0.039		0.207	–0.008		0.639	–0.277		0.289
distance	0.000		0.645	0.000		0.356			
*tb*fVAT*	–0.316		0.799	0.181		0.802	3.955		0.572
*tb*separate*	–1.921		0.689	–1.141		0.638	–0.056		0.995
Sargan (p-value)	0.426			0.721			0.363		
Arellano-Bond (p-value 1st,2nd order)	0.012	0.713		0.014	0.567		0.000	0.934	
No Observations	208			208			322		
No Instruments	32			32			40		

variables. Finally, we have re-estimated the three models of Table 6 by GMM in differences in order to look for the potential existence of asymmetries and eliminate them in order to avoid bias. We have found the same results, with the exception of the model explaining the variable *fsize*, in which we found a new result that is in line with the predictions of Aigner and Bierbrauer (2015): raising the financial tax rate in separate taxes negatively affects loan volume.

7 Concluding remarks

In this paper we have studied the existing theoretical literature on the possible influence of financial VAT on financial development (Aigner and Bierbrauer, 2015), which asserts that in general, unlike Pigouvian taxes, financial VAT does not influence the size of the financial sector. For example, for a case that is similar to the taxation of financial services in a tax separate from VAT, Aigner and Bierbrauer (2015) obtain that the size of the financial sector would decrease with respect to the exemption method.

In addition, we contribute empirical evidence about this lack of relationship, for the first time as far as we know, from a panel of 36 countries for the period 1961–2012, using the econometric technique of dynamic panel data models. In accordance with the theory, we find that the financial VAT rate does not impact financial development. The results are robust to the dependent variable, target variables and the econometric methods used.

Our research has focused on financial VAT. Further work could study the impact on the size of the financial sector of Pigouvian taxes, such as the Tobin tax, or financial transaction taxes.

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