A comprehensive comparison of VAT reforms under different market conditions

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Abstract. The structure of markets and the behavior of agents condition resource allocation and the effects of any policy with economy-wide repercussions. We study and compare in a comprehensive manner, using the well-known *equal yield* assumption, the possible general equilibrium effects of two value-added tax policies. The first relates to the reform of the value-added tax (VAT) enacted by the Spanish government in 2012 whereas the other refers to an alternative single-VAT-rate reform. We evaluate and compare the effects of these two VAT reforms using three main modeling scenarios. In both cases, we use a computational general equilibrium (CGE) model that may present competitive as well as non-competitive behavior. This provides a more consistent appraisal of the comparison of the effects of these tax policies.

Keywords: computational general equilibrium, market behavior, tax policies, fiscal consolidation.

JEL codes: D41, D43, D58

1. Introduction

There is a general consensus that the appropriate tool for the exploration of the effects of economy-wide tax reforms is general equilibrium analysis. Whether one considers changes in income taxes or in indirect taxes, the underlying effects will be a collection of income and substitution effects initiated by the tax changes that will work their way throughout the economy. Rational agents will react to the stimulus enacted by the new tax policies which will induce, directly, changes in their demand and supply schedules. In turn, and along with the indirect interaction effects, the economy will end up in a new equilibrium allocation and price vector. Partial equilibrium would fail to capture the accumulated, interconnected effects of tax policies. The comprehensive evaluation of tax reforms clearly seems to require a general equilibrium model of some sort (Ballart et al, 2010).

However, the nature of the equilibrium correspondence between parameters and endogenous variables (prices and quantities), which determines the ensuing equilibria, depends on the assumptions that govern agents' behavior. Since the consumption side of the economy is composed by a myriad of small agents, competitive behavior is justified. Things may be different, however, in the production side of the economy. If firms are many and small then competitive behavior is a good approximation. Most CGE (Computational General Equilibrium) models use the assumption of competitive behavior. When we compare the actual number of firms in an economy (very large) with the level of sectoral aggregation that CGE (as well as input-output) researchers typically use (quite small), it is to some extent reasonable to model firms' behavior in a given sector as competitive. Each sector incorporates lots of firms and the running modeling assumption is that this will lead to sufficiently competitive behavior.

Some factors may upset this convenient competitive assumption. Even if each sector includes many firms, they may not be of the same size and some may exert partial market power. Or even if firms are many and similar in size, they could be subject to the presence of fixed costs, in whose case the CRS (constant returns to scale) assumption would need to be reexamined to account for increasing returns to scale (IRS). Or, in fact, with sufficient sectoral disaggregation, a sector may almost coincide with a large firm and then some sort of monopoly power could be exerted (unless somewhat restrained from foreign competition, think of Boeing and Airbus). The variety of market scenarios is, as a matter of fact, staggering for modeling purposes. The relaxation of the competitive assumption opens the door to numerous modeling possibilities.

Side-by-side to the huge number of standard competitive CGE contributions in the literature, non-competitive CGE models pale in comparison even when we consider the rich theoretical

field of industrial organization that studies market power, which is mostly focused to partial equilibrium analysis.

The first CGE model with IRS and non-competitive behavior is, to the best of our knowledge, Harris (1984), which was followed by Cox and Harris (1985, 1986). Both papers study the effects of the free trade agreement between the US and Canada. In general, non-competitive CGE models have dealt with trade issues since this is the potential enlargement of markets is the natural consequence of free trade agreements. CGE fiscal models, however, have stuck to using competitive behavior despite the fact that tax reform can also change the size of domestic markets. In the context of Spain, a few exceptions are the analyses undertaken by Gómez (1999) and Bajo and Gómez (2004). They explore the potential effects of alternative labor tax reforms in this economy under the presence of IRS. Following the same vein, in the present analysis we study and compare the effects of two tax reforms using two model versions calibrated to the same data set. We compare the results of a tax reform under competitive behavior with those that would arise from of a non-competitive model. This allows us to check for variability in tax simulation results due to market structure which enhances the comprehensiveness of the analysis.

Nevertheless, and in contrast to previous works, we undertake this comparison in the context of consumption indirect tax policies which constitutes, in fact, the first contribution of our approach. Specifically, we evaluate the macroeconomic and welfare effects of two value-added tax (VAT) reforms in Spain. The first empirical exercise explores the actual VAT reform enacted in by the Spanish government in 2012. While it kept the super-reduced VAT rates for basic goods, this reform increased the reduced and standard VAT rates from 8 and 18 percent to 10 and 21 percent, respectively. The goal pursued by the Spanish government was first to avert any further escalation of the run-away deficits to then redirect the economy to a path of fiscal sustainability. As is well-known, this type of tax policy reform was undertaken by different EU countries as well, sharing and suffering the same economic troubles. The second exercise is a counterfactual analysis based on the alternative proposal of Conde-Ruiz et al (2015). In their case, all VAT rates would be replaced by a common, homogeneous VAT rate of 21 percent levied on all goods and services. These authors stress that this alternative VAT reform not only would increase the collection capacity of the tax, but it would also be less distorting since–being homogeneous–would minimize the potential substitution effects[1]. In our approach, we have tackled the comparison of the actual and the single VAT rate reforms in a comprehensive way using the well-known "equal yield

[1] In their analysis, these authors proved empirically the first part of this statement: that a single VAT rate of 21 percent would increase the revenues 'collection capacity of this indirect tax. However, differently to our approach, their empirical analysis relied on a simulation technique using fiscal data from the VAT in Spain.

assumption", i.e. to make these two tax policies comparable, they should reach the same public deficit/surplus. This is, in our view, the second contribution of our work.

The debate is still open regarding which is the most appropriate structure of the VAT in order to favor fiscal consolidation while at the same time maximizing its efficiency. The fact that returns to scale and market behavior may condition the economy-wide effects of a tax reform adds spice to the ongoing debate. In this paper we study these issues using a CGE model under different modeling assumptions to shed some additional light on the debate. This wider perspective will hopefully provide a more consistent appraisal and a better understanding of the ensuing general equilibrium effects. We also explore the welfare effects of the tax reforms using the Konüs index, a relative welfare indicator, instead of the traditional absolute welfare indicators. This will allow us to verify that relative welfare effects seem to be quite similar regardless of the assumed market structure, i.e. CRS or IRS, a conclusion that would not be easily drawn if we just look at the usual welfare indices.

In Section 2 we describe the dataset and the nature of the CGE model. In Section 3 we discuss the simulation strategies and scenarios. Sections 4 and 5 present the core results of the paper under CRS and IRS. We appraise the sensitivity of these results in Section 6 while Section 7 briefly concludes.

2. The Data Set and the General Structure of the Static CGE Model.

The data set we use is a Social Accounting Matrix (SAM) of Spain for 2010. The SAM respects all macroeconomic identities for the base year and, at the same time, provides a detailed picture of the bilateral interactions taking place among agents. In this sense, it is a macro SAM with a micro structure. The SAM includes 34 productive sectors (see Table A in the Annex) and five institutional units (i.e. corporations, the public administration, households and two foreign sectors). We built the SAM using the official data from the Spanish National Income and Product Accounts published by the Spanish Institute of Statistics (INE). We have also used some supplementary information from other official statistical sources to improve the level of detail in transactions part of the SAM. Thanks to this, we have endowed the SAM with a richer set of microdata that includes sources of income, welfare payments, and taxes (income and transaction taxes) and other social costs affecting labor use (social contributions paid by employers and employees, whether they are actively working or unemployed).

We implement a computational general equilibrium model of the Walrasian type. The model is static and all agents pursue the fulfillment of their objective functions giving rise to a full set of price-parametric supply and demand functions. In an equilibrium, all markets clear with the possible exception of the labor market. For this market we substitute the 'classical'

assumption of perfect flexibility and instead we use a wage curve (Blanchflower and Oswald, 1994, 2005) that incorporates a negative relationship between unemployment rates and real wages. The advantage of using a wage curve is that it compatible with a scenario of non-voluntary unemployment. In the present context surrounding the labor market in Spain, this assumption is quite a realistic assumption. We represent private households with a single consumption agent whose preferences are modelled using a Cobb-Douglas utility function. In the supply side of the model, we posit a constant elasticity of substitution (CES) nested technology. Total output is an Armington (1969) composite of domestic and foreign outputs with CES substitution. The Armington elasticities reflect the degree of imperfect substitution between the two sources of output. We have used the econometric estimates provided by Welsch (2008) and Aspalter (2016). On the domestic side of production, we consider that labor and capital are homogenous and perfectly mobile across production units. These two factors combine as well using a CES production function to yield a composite primary factor that itself combines with material inputs using a Leontief fixed coefficients technology. We take the elasticity of substitution between labor and capital in the production function for the composite primary factor from the estimates of Raurich et al. (2012) for the Spanish economy.

3. Simulation and modeling strategies for a comprehensive approach.

3.1 *Definition of tax comparable policies*

When we want to compare the results of different policies, we need to make sure that the simulations are leveled to eliminate undue influences that may alter the sensibility of the comparison. In the case of tax policies that aim at reducing the public deficit level, as was the case of the enacted VAT reform in Spain, we need to define an 'anchor' point that guarantees that any alternative tax policy also satisfies it. As Musgrave (1959) pointed out long ago and Ballart et al (2010) correctly insisted, the efficiency and welfare effects of alternative tax policies will be comparable as long as they reach the same level of public deficit/surplus. Therefore, if we want to ensure an unbiased ordering of tax policies, we need to fix the 'dimension' of the public sector under the different tax reform scenarios.

Following the recommendation of these authors, the simulation strategy we undertake to enable a sensible and comprehensive comparison of tax policies is implemented in two steps. First, we use the CGE model to evaluate the actual 2012 VAT reform passed by the Spanish government (Scenario_1). This allows us to endogenously determine the new level of the public deficit/surplus according to the stated policy goal of reducing the deficit. In the second step, once the new level of the public deficit has been estimated, we fix it in the second run of the model to study the proposed alternative VAT reform of Conde-Ruiz et al (2015)

(Scenario_2). The key difference we introduce is that whereas Conde-Ruiz et al (2015) fix the common VAT rate exogenously (at 21 percent), we use the general equilibrium model to calculate the homogenous VAT rates as those that produce the same level of public deficit as the actual VAT reform did. This single VAT tax rate is therefore endogenous in our approach, which ensures that both scenarios share the same level of the public deficit and makes the policy comparison sensible and comprehensive.

3.2 *Definition of welfare indices*

While there are no major controversial issues regarding the way we usually calculate the macroeconomic effects of a policy under general equilibrium, there is a bit more debate when we try to decide which indicator we should use to evaluate welfare effects. In fact, this is a key issue for normative analysis. Even though the sign of the change in utility gives an unequivocal direction of welfare change, the ordinal nature of utility does not allow us to make cardinal measurements. The usual proxies for welfare are the money metric indicators of the equivalent variation (EV) and the compensating variation (CV), as proposed by Hicks (1939). These indicators share the same sign as the change in utility and provide income approximations to welfare change either in absolute terms or in relative (to some base income level) terms.

The use of cost of living indices, such as the Konüs (1939) index, is quite less common. This index is a relative welfare indicator as it indicates the ratio of minimal expenditures in two different equilibria that are needed to attain a certain level of utility. In the general case, the Konüs index depends on the selected level of utility, either the benchmark or the counterfactual, which makes interpretation a bit awkward. However, in the particularly frequent case of homothetic preferences (Layard and Walters, 1978), quite often used in empirical general equilibrium models, the index is unique and unambiguous. This is due to the fact that the expenditure function is homogeneous of degree one in utility. Additionally, under homotheticity, the Konüs index is equivalent to the ratio of the CV to the EV (Guerra et al, 2018). Since our CGE model exhibits homothetic preferences, we opt for using the Konüs index as a welfare indicator. This has at least two advantages. First, it avoids using decisions' criteria that rely upon absolute indicators (income in numéraire units) that are quite often difficult to interpret in general equilibrium terms. Second, we subsume the welfare effects reported in the EV and the CV in a single indicator that encompasses both of them.

3.3 *Definition of market structure*.

Since market conditions will influence the results that follow from the introduction of the two alternative tax policies, we emphasize the need to study their scale of sensitivity to market structure and firms' behavior. For this we will compare the results under CRS with perfectly competitive markets and under IRS with some degree of imperfect competition. We consider two competing scenarios where we relax the widely used CRS scenario and its implied condition that marginal cost will equal average cost.

Of the many modeling possibilities that incorporate IRS and imperfect competition, we will focus on those that reflect the short-term and keep unaltered the supply of primary factors and the number of firms. This helps in avoiding the risk of multiple equilibria (Kehoe, 1985, 1998) which would make comparative statics meaningless. The first modeling option is to eliminate free entry and exit and assume that pure profits are zero in any equilibrium. This would mean that firms select prices at average cost levels. This market structure is related to the concept of contestable markets in industrial organization theory (Baumol et al, 1983). Incumbent firms are assumed to be identical and set their price at average cost (hence, no pure profits), which makes unattractive the entrance of new firms whenever there is a rise in demand levels. Consequently, each firm's output varies proportionally according to the changes in total output of the industry. This market structure somewhat resembles the perfectly competitive one since no firm makes any profits. In considering this option, and not without criticism (Francois, 1998), modelers very often assume that primary factors cost have a fixed and a variable part. As an example, part of the needed labor force for production is ex-ante given and part is ex-post determined. The same would hold with other primary factors such as capital. On top of that, and from a calibration perspective, CGE models usually identify data on gross operating surplus with the value of capital services. This is acceptable as a proxy provided that all prices are calibrated to unity at the benchmark reference level. However, it makes the distinction of fixed and variable capital costs quite difficult if no additional, out of the SAM, industry information is available. The calibration requires exogenous information and two types of estimates are available. One is the Cost Disadvantage Rate (*CDR*) defined as the ratio of the difference between average (*AC*) and marginal costs (*MC*) to average costs (Roland-Holst et al, 1995). Another option is the use of estimates of the degree of market power through the Herfindahl index (Gómez, 1999, Bajo and Gómez, 2004).

The second modeling possibility relies in using mark up pricing. Starting from zero sectoral profits in the benchmark, they nonetheless may vary in the counterfactual. Households receive these potential profits as income. The price mark-up under Cournot-Nash competition

in each industry i is defined in relative terms as the ratio of the difference between price p_i and marginal cost MC_i to marginal cost:

$$m_i = \frac{p_i - MC_i}{p_i} = \frac{1}{E_i \cdot \varepsilon_i} \quad (1)$$

where E_i refers to the number of firms in industry i (which is held constant) and ε_i is the price elasticity of demand faced by firms in industry i. It is endogenously determined through:

$$\varepsilon_i = \sigma_i^A + s_i \cdot (1 - \sigma_i^A) \quad (2)$$

In expression (2), the parameter σ_i^A is the Armington elasticity of substitution between domestic and foreign output and s_i is the market share of the domestic output in industry i over total industry output (Francois, 1998).

The calibration of IRS with variable profits can proceed in different ways. When the data on the *CDR* is reliable and under the initial assumption of zero benchmark profits, we would have $p_i = AC_i$ and then we can use expression (1) to calibrate the number of incumbent firms in industry i. In contrast, if the only available data refers to the Herfindahl concentration index and we further assumed that firms are identical in size, the inverse of this index can be used to calibrate the number of incumbent firms in each sector and then we could use this information to estimate industries' fixed costs also using expression (1).

We consider these two IRS scenarios in our analysis. Additionally, we approximate sectoral fixed labor costs through the proportion of permanent workers in each industry. This information has been obtained from the annual survey on sectoral structure compiled by the INE. For the case of capital, we assume that they represent the same proportion of those calibrated for labor. Nevertheless, we have altered the structure of industries' costs, i.e. the size of the scale economies, to explore the potential effects of these calibration assumptions in our analysis (see Section 6 below).

4. Results under Constant Returns to Scale and perfect competition.

In Table 1 we present in real terms the main macroeconomic and welfare effects of the simulations of the two VAT reforms under CRS and perfectly competitive markets when the size of the public deficit is kept constant. The first result is that the counterfactual single VAT would be 15.77 percent. Notice that this figure is slightly above the minimum standard VAT rate within the EU, whose rate is 15 percent according to the Article 97 of VAT Directive (Directive 2010/88/EU). The macroeconomic results, shown down the two last columns of Table 1, clearly indicate that for the same public deficit reduction (-24.482 percent), the two VAT reforms would imply a decline in real aggregated income and thus in employment

levels. These negative effects are slightly more intense in the case of the alternative VAT reform proposed by Conde-Ruíz et al. (2015). From these aggregate results, we can observe that the actual VAT reform enacted by the Spanish government would be preferred to the alternative one. The differences in macro indicators, however, turn out to be small. The same type of considerations applies when we evaluate the tax revenue effects of the two tax reforms.

Table 1. Impacts of Actual and Alternative VAT Reforms for an Equivalent Reduction on Public Deficit: Macroeconomic Effects, Impacts on VAT Revenues and Welfare Indicators in real terms. AGE Model Spain 2010. Constant Returns to Scale and Perfectly Competitive Markets.			
	Benchmark Equilibrium Values	**Scenario_1: Spanish Government's VAT Reform 2012 Super-reduced: 4 % Reduced: 10 % Standard: 21 %**	**Scenario_2: Alternative VAT Reform Super-reduced: 0 % Reduced: 0 % Standard: 15.77 %**
Macroeconomic Impacts			
Unemployment Rate	**20.300 %**	**21.015%**	**21.048%**
GDP (millions of euros 2010)	**1,080,913.000**	**1,075,659.200**	**1,075,205.924**
% Change in GDP in real terms	**-**	**-0.4859%**	**-0.5279%**
Public Deficit/Surplus (millions of euros 2010)	**-39,288.000**	**-29,669.829**	**-29,669.829**
% Change in Public Deficit/Surplus in real terms		**-24.482%**	**-24.482%**
% Share of Public Deficit/Surplus over GDP	**-3.634%**	**-2.758%**	**-2.759%**
Impacts on VAT Revenues			
VAT Revenues (millions of euros 2010)	**58,812.730**	**72,293.195**	**72,634.638**
% Change in VAT revenues in real terms	**-**	**22.921%**	**23.501%**
% Share of VAT Revenues over GDP	**5.440%**	**6.720%**	**6.755%**
Absolute and Relative Welfare Indicators			
CV in real terms (millions of 2010 euros)	**-**	**-20,804.468**	**-19,750.431**
EV in real terms (millions of 2010 euros)	**-**	**-20,443.472**	**-19,449.273**
Konüs Index	**-**	**1.0176**	**1.0155**

Source: Own elaboration.

We now move to comment on the absolute and relative welfare impacts of these two VAT reforms with CRS and perfectly competitive markets. The negative signs of the CV and the

EV indicate that private welfare levels suffer some erosion in both scenarios. In contrast to the conclusions drawn by the analysis of the macroeconomic effects, it seems that the alternative VAT reform (Scenario_2) generates a lower decline in welfare. The reason may be found in the fact that while under Scenario_1 VAT rates raise in all sectors affected by the reform, while this is not the case under Scenario_2 (See Table_ B in the Annex). Observe, for instance, the values of the CV. Returning households' to their benchmark utility levels would have implied compensating them with an additional amount of 1,054.037 million of 2010 euros under Scenario_1. The difference between the two CV values seems quite large. However, the two Konüs indexes, which measure true cost of living variations, indicate that the dissimilarities between the two VAT reforms in terms of welfare impacts are rather small in this case. A reduction of the public deficit by 24.482 percent would increase, on average, the cost of living standards by 1.76 percent and 1.55 percent under Scenarios 1 and 2, respectively.

5. Results under IRS and imperfect competition

We now relax the widely-used assumption of CRS and perfectly competitive markets. We first explore a market structure with IRS, zero profits and no free-entry or exit of firms. Next we allow for profits to vary and pricing is governed by the presence of a mark-up over marginal costs, as stated in expression (1).

We summarize the key results of these two short term IRS scenarios in Tables 2_A and 2_B, respectively. For ease of comparison, we also add along the previous findings obtained under CRS. The first attention-grabbing result is that the presence of fixed costs would further reduced income levels in real terms. In very broad terms, the fall in real GDP would be about twice as much when we consider IRS vis a vis CRS for both VAT reforms (see last two columns of Table 2_A and Table 2_B). The main reason behind this result is that with IRS domestic firms price their products at AC, which are above MC. Furthermore, since production levels are reduced, there is an increase in AC. We can conclude that the introduction of hikes in VAT tax rates will exert further pressure on prices under IRS in comparison to what we observe in the more conventional CRS scenario. The same consideration applies when we compare the impact on welfare through the Konüs index. Observe that under IRS the raise in the costs of living almost doubles. In Scenario_1, for example, the increase in the costs of living under CRS is evaluated at 1.55 percent while under the two IRS scenarios it would go further up to 2.54 percent and 2.35 percent.

It should not be a surprise that when we add the possibility of mark-up pricing, there is a larger erosion effect on real income levels explained by the more intense upward pressure on final prices. The distribution of positive profits back to consumers, however, tempers down

a bit the effects on the cost of living (from 2.54 percent down to 2.03 percent in the actual VAT reform, and from 2.32 percent down to 2.03 percent in the alternative one). In fact, this would explain why under Scenario_2 with variable profits, the evaluated single VAT rate necessary to reach the same reduction in public deficit/surplus obtained under Scenario_1, would be slightly higher (15.801 percent versus 15.665 percent) when firms price at average costs, i.e. no mark-up and no profits scenario.

The simulation results we have presented until now seem to reflect correctly what economic intuition suggests. The bonus that a CGE model offers is that we can move past mere qualitative considerations and provide tangible quantitative evidence of the likely impacts. However, if the aim is to compare the two VAT reforms in a comprehensive manner, we can draw the same type of general conclusions under both market structures with CRS and IRS. The effects of tax hikes under a three-rate VAT structure (Scenario_1) and a single VAT rate (Scenario_2) do not appear to be much different. Consequently, when we take into account the empirical difficulties to obtain reliable estimates for the production structure—such as the level and distribution of fixed costs, the size of the mark-ups or the degree of market power— we may end up concluding that the relaxation of the CRS assumption does not add any additional comparative value to the major findings, except for the fact that numerical estimates will accordingly vary.

Table 2_A. Impacts of Actual and Alternative VAT Reforms for an Equivalent Reduction on Public Deficit: Major Macroeconomic and Welfare Indicators. AGE Model Spain 2010. CRS versus IRS /No Entry-Exit Scenario without Profits.

	CRS and Perfectly Competitive Markets		IRS No Entry-No Exit without Profits	
	Scenario_1: Spanish Government's VAT Reform 2012	Scenario_2: Alternative VAT Reform	Scenario_1: Spanish Government's VAT Reform 2012	Scenario_2: Alternative VAT Reform
Scenario 2: Standard Single VAT Rate	-	15.770%	-	15.801%
% Change in GDP in real terms	-0.4859%	-0.5279%	-0.905%	-1.003%
% Change in Public Deficit/Surplus in real terms	-24.482%	-24.482%	-22.569%	-22.569%
% Change in VAT revenues in real terms	22.921%	23.501%	22.233%	23.022%
Konüs Index	1.0176	1.0155	1.0254	1.0232

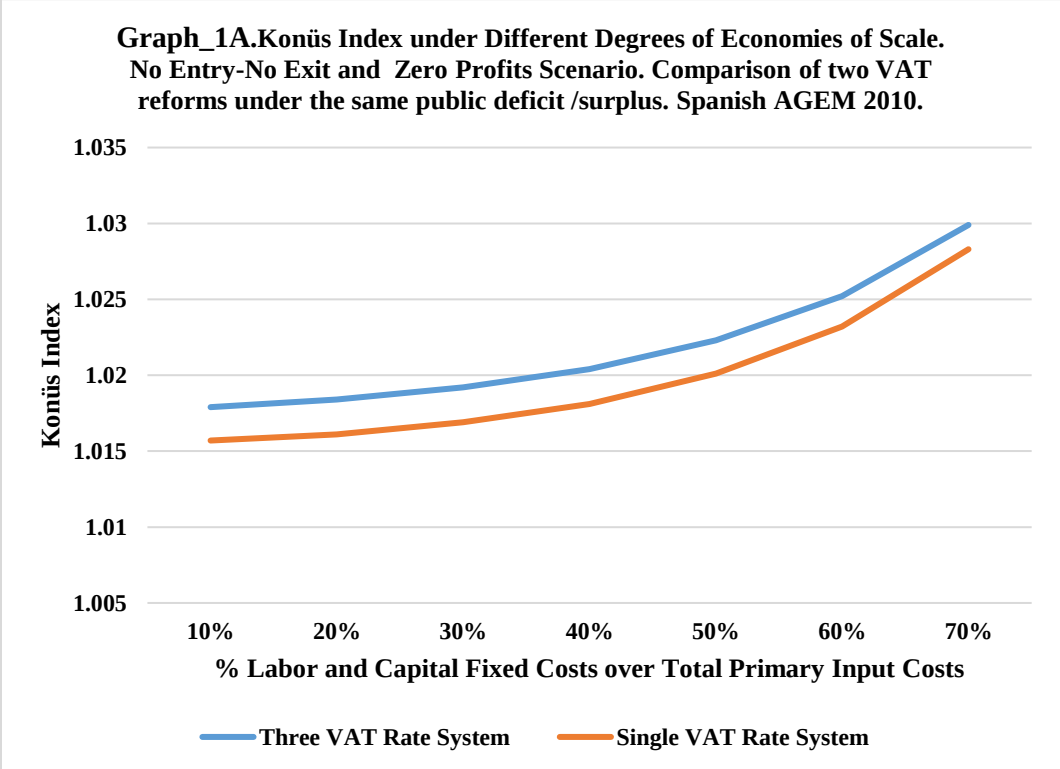
Table 2_B. Impacts of Actual and Alternative VAT Reforms for an Equivalent Reduction on Public Deficit: Major Macroeconomic and Welfare Indicators. AGE Model Spain 2010. CRS versus IRS /No Entry-Exit Scenario with Profits.

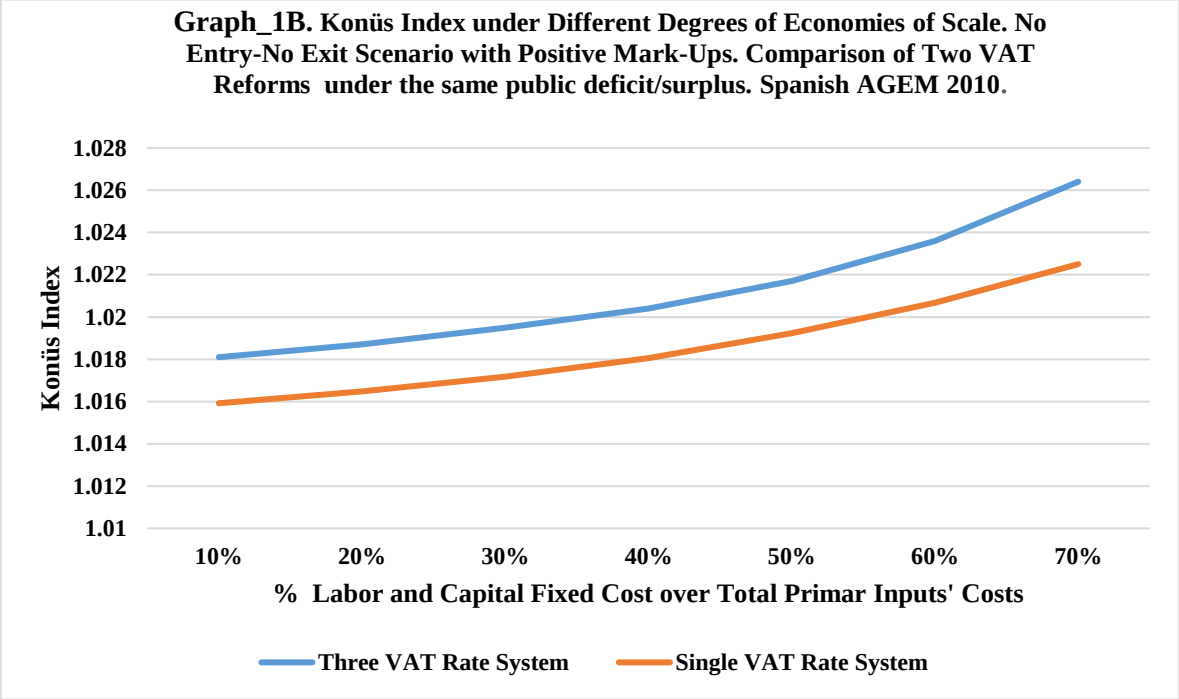
	CRS and Perfectly Competitive Markets		IRS No Entry-No Exit with Profits	
	Scenario_1: Spanish Government's VAT Reform 2012	Scenario_2: Alternative VAT Reform	Scenario_1: Spanish Government's VAT Reform 2012	Scenario_2: Alternative VAT Reform
Scenario 2: Standard Single VAT Rate	-	15.770 %		15.655%
% Change in GDP in real terms	-0.4859%	-0.5279%	-1.171%	-1.166%
% Change in Public Deficit/Surplus in real terms	-24.482%	-24.482%	-19.997%	-19.997%
% Change in VAT revenues in real terms	22.921%	23.501%	21.769%	21.695%
Konüs Index	1.0176	1.0155	1.0235	1.0203

Source: Own Elaboration

6. Sensitivity Analysis with respect to key parameters

Lastly, an interesting question still remains open: does the size of the economies of scale alter the aforementioned statements described in section 5?. We address this issue carrying out sensitivity analysis with respect to the degree of IRS in the production side of the economy. We proceed gradually changing the size of the fixed costs associated to the two primary factors, labor and capital, in the CGE model. We examine how the results change for both the three-rate VAT and the single-rate VAT under the two different IRS market behaviors, namely the zero-profits scenario and the positive-profits scenario. In Graphs 1A, 1B, 2A and 2B we show the equilibrium path for the Konüs index and real GDP changes, respectively. It is quite clear that the size of the fixed costs matter if we want to evaluate the potential welfare and macroeconomic effects and this turns out to be the case for the two VAT reforms. The conclusion, in fact, sounds quite familiar: the higher the size of the fixed costs, the larger the negative impact on both welfare and real income levels.



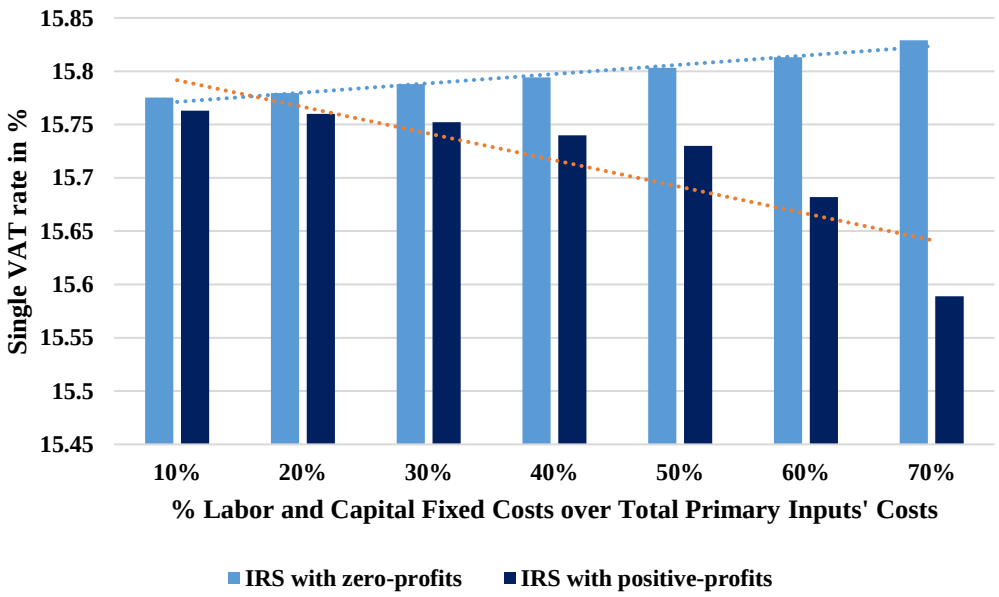


Notice, however, that the evolution of the wedge of the equilibrium levels of the Konüs index is different. In the zero profit simulation (Graph_1A) the wedge reduces in size as the proportion of fixed cost increases, whereas in the positive profits simulation (Graph_1B) the opposite happens and wedge becomes larger.

In the positive profits simulation the Konüs index is 0.218 points higher in the three VAT rate reform than in the single VAT rate reform for small economies of scale (10 percent of fixed costs) whereas the wedge goes up to 0.390 points, i.e. it almost doubles, when we consider large economies of scale (70 percent of fixed costs).

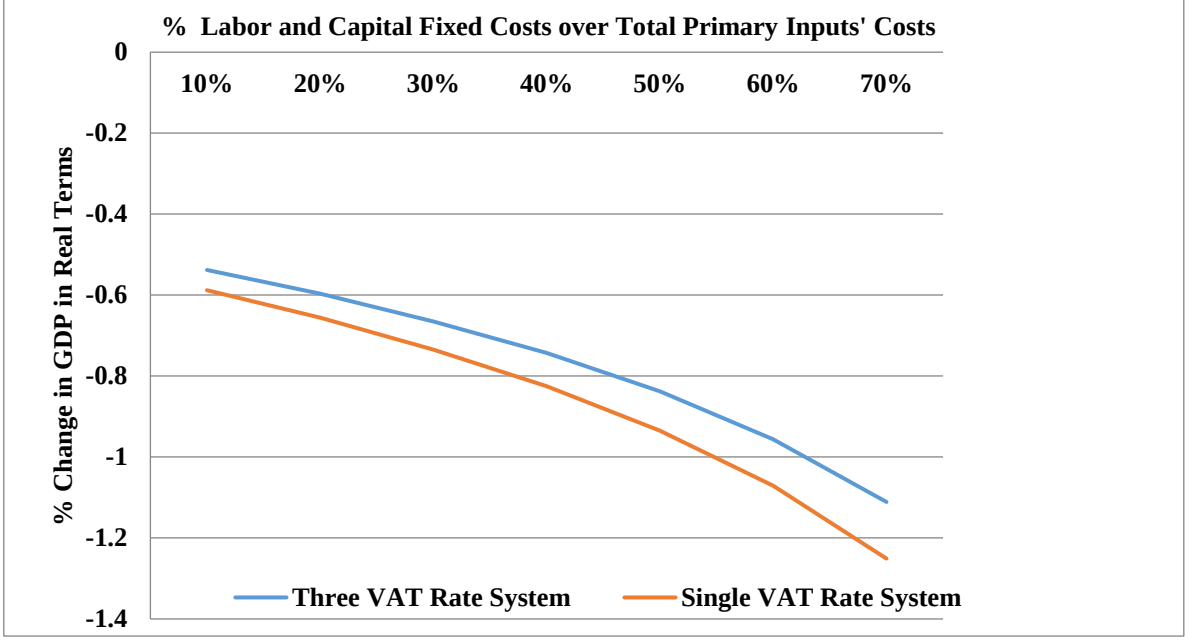
Our findings indicate that the increase in the cost of living, under the two VAT reforms, tends to converge in the no entry-no exit scenario with zero profits as the proportion of fixed costs increases whereas, in contrast, it tends to increase when we consider the possibility of positive profits.

Graph 3.Single VAT rate in % for a comprehensive comparison with the Three Rate VAT system and with different Degrees of Economies of Scale.

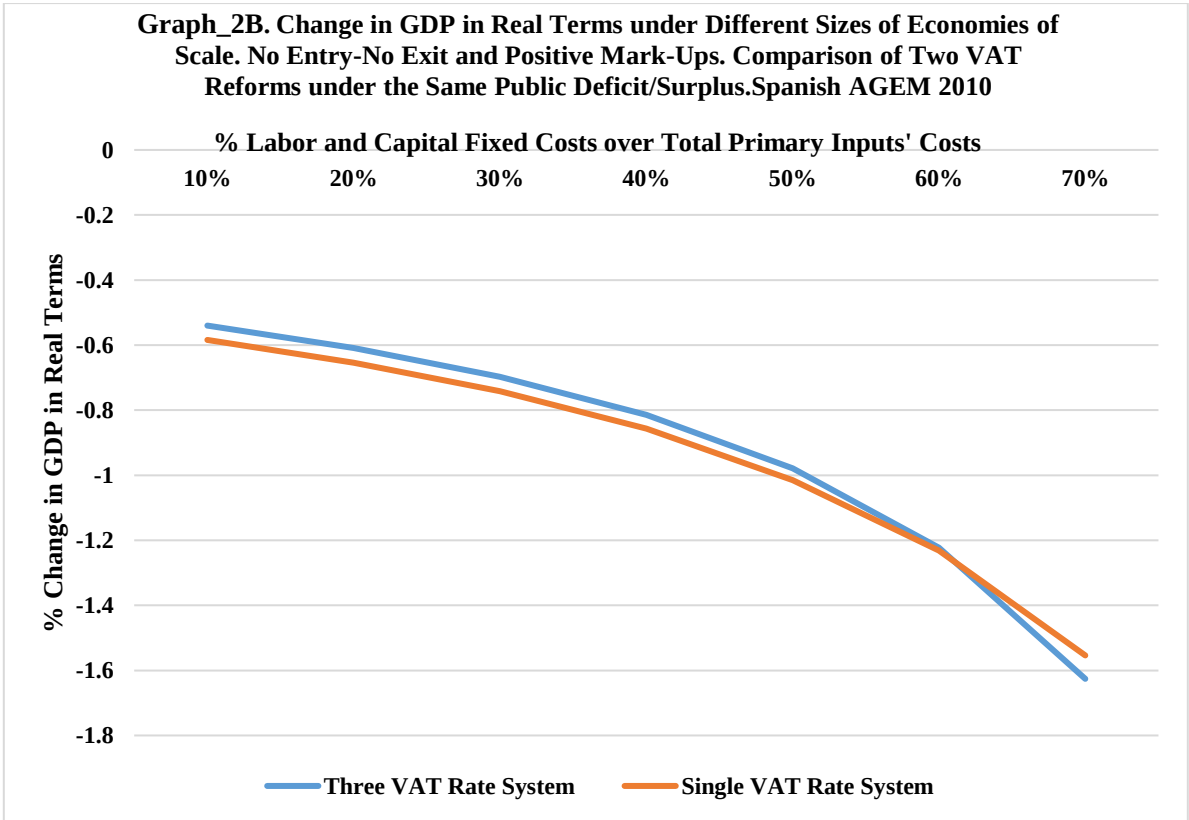


These results can be easily explained using Graph 3. The heights indicate the level of the endogenous equal yield single VAT tax rate for the two IRS cases and for increasing proportions of fixed costs. Under the IRS with zero-profits scenario, the single VAT rate would need to increases as the degree of economies of scale rises. The contrary occurs when a positive mark-up is introduced. Recall that, in this IRS scenario the mark-up, and thus pure profits, increases along with the level of sectoral economies of scales. Since a fraction of households are the shareholders of these firms, these larger profits have a positive impact on these households' income levels. Consequently, this positive income effect partially compensates the negative impact of the tax hikes exerted on the economy. Even more, this compensation mechanism along with the boost on price levels induced by the mark-ups make that the required single VAT rate to obtained the equivalent public deficit/surplus becomes lower, thanks to the increasing size of the value of the tax base, the larger the size of the sectoral economies of scale. It then follows that a lower single VAT rate deteriorates to a lesser extent welfare levels.

Graph_2A. % Change in GDP in Real Terms under Different Sizes of Economies of Scale. No Entry-No Exit and Zero Profits Scenario. Comparison of Two VAT Reforms under the Same Public Deficit/Surplus. Spanish AGEM 2010.



Graph_2B. Change in GDP in Real Terms under Different Sizes of Economies of Scale. No Entry-No Exit and Positive Mark-Ups. Comparison of Two VAT Reforms under the Same Public Deficit/Surplus.Spanish AGEM 2010



We draw different conclusions, however, when we examine the results on real GDP under IRS. The previously observed patterns for the Konüs index get reversed now. The difference in the computed decline in GDP in real terms between the two VAT reforms tends to diverge the larger the size of the economies of scale in the no profits scenario (Graph_2A). In contrast, under the positive profit scenario (Graph 2_B), the differences in the erosions on GDP levels become smaller the larger the sectoral fixed costs to the extent that, for large proportions of fixed cost (around 60 percent) the counterfactual single VAT rate reform turns out to be less perverse in terms of aggregate income levels than the actual three VAT rate reform. This result is in line with the findings already described in section 5 in the benchmark scenario where sectoral fixed costs were assumed to be quite high, i.e. approximately 60 percent in both cases, for the labor and capital costs. Similarly to the differences observed in the Konüs indexes, the reason for this result is that if firms exhibit 'strong' IRS due to the presence of high fixed costs, mark-ups will be larger and creating higher price levels as well as higher households' income levels. Therefore, a lower single VAT rate is needed to reach the equal yield scenario, which erodes real GDP levels to a lesses extent.

All things considered, we can conclude that the differences between the two VAT reforms are not very large, at least under the equal yield condition. The same conclusion follows when we alter the values of some of the exogenous key elasticities used in the CGE model. We provide evidence for this in Tables 4, 5_A and 5_B where we show the results of introducing a $\pm$ 50 percent variation the elasticity of the wage curve, the substitution elasticity between labor and capital, and the Armington elasticities under CRS and IRS. The results seem to be quite robust and even their variation conforms well to what economic intuition would suggest.

Table 4. Sensitivity Analysis of the Impacts of Actual and Alternative VAT Reforms for an Equivalent Reduction on Public Deficit with respect to relevant elasticity values: Wage Curve Elasticity, Capital-Labor Elasticity and Armington Elasticities. AGEM Spain 2010. CRS and perfectly competitive markets.				
	50 % Increase from Benchmark Values		**50 % Decrease from Benchmark Values**	
	Wage Curve Elasticity.		**Wage Curve Elasticity.**	
	Scenario_1	**Scenario_2 Standard VAT=15.778%**	**Scenario_1**	**Scenario_2 Standard VAT=15.755%**
Konüs	**1.0181**	**1.01606**	**1.0168**	**1.01456**
%Change in GDP	**-0.5754**	**-0.6231**	**-0.3422**	**-0.3767**
	Scenario_1	**Scenario_2 Standard VAT=15.778%**	**Scenario_1**	**Scenario_2 Standard VAT=15.755%**
Konüs	**1.01851**	**1.0164**	**1.0163**	**1.0139**
%Change in GDP	**-0.61066**	**-0.6609**	**-0.2876**	**-0.3184**
	Armington Elasticities		**Armington Elasticities**	
	Scenario_1	**Scenario_2 Standard VAT=15.764%**	**Scenario_1**	**Scenario_2 Standard VAT=15.77%**
Konüs	**1.0176**	**1.0154**	**1.0176**	**1.0155**
%Change in GDP	**-0.4884**	**-0.5281**	**-0.4834**	**-0.5278**

Source: Own Elaboration.

Table 5_A. Sensitivity Analysis of the Impacts of Actual and Alternative VAT Reforms for an Equivalent Reduction on Public Deficit with respect to relevant elasticity values: Wage Curve Elasticity, Capital-Labour Elasticity and Armington Elasticities. AGE Model Spain 2010.IRS No Entry No Exit without Profits. Benchmark Economies of Scale Levels.				
	50 % Increase from Benchmark Values		**50 % Decrease from Benchmark Values**	
	Wage Curve Elasticity.		**Wage Curve Elasticity.**	
	Scenario_1	**Scenario_2 Standard VAT=15.814%**	**Scenario_1**	**Scenario_2 Standard VAT=15.775%**
Konüs	**1.0277**	**1.0257**	**1.0212**	**1.0183**
%Change in GDP	**-1.005%**	**-1.113%**	**-0.717%**	**-0.797%**
	Capital-Labor Elasticity		**Capital-Labor Elasticity**	
	Scenario_1	**Scenario_2 Standard VAT=15.854%**	**Scenario_1**	**Scenario_2 Standard VAT=15.774%**
Konüs	**1.0320**	**1.0312**	**1.0191**	**1.0161**
%Change in GDP	**-1.402 %**	**-1.553%**	**-0.432%**	**-0.498 %**
	Armington Elasticities		**Armington Elasticities**	
	Scenario_1	**Scenario_2 Standard VAT=15.791%**	**Scenario_1**	**Scenario_2 Standard VAT=15.811%**
Konüs	**1.0257**	**1.0233**	**1.0251**	**1.0229**
%Change in GDP	**-0.896 %**	**-0.984 %**	**-0.914%**	**-1.021%**

Source: Own Elaboration.

Table 5_B. Sensitivity Analysis of the Impacts of Actual and Alternative VAT Reforms for an Equivalent Reduction on Public Deficit with respect to relevant elasticity values: Wage Curve Elasticity, Capital-Labor Elasticity and Armington Elasticities. AGE Model Spain 2010.IRS No Entry No Exit with Positive Mark-Ups.				
	50 % Increase from Benchmark Values		50 % Decrease from Benchmark Values	
	Wage Curve Elasticity.		Wage Curve Elasticity.	
	Scenario_1	Scenario_2 Standard VAT=15.651%	Scenario_1	Scenario_2 Standard VAT=15.666%
Konüs	1.0244	1.0212	1.0214	1,0184
%Change in GDP	-1.257%	-1.247%	-0.975%	-0.980%
	Capital-Labor Elasticity		Capital-Labor Elasticity	
	Scenario_1	Scenario_2 Standard VAT=15.634%	Scenario_1	Scenario_2 Standard VAT=15.676%
Konüs	1.0277	1.0242	1.0184	1.0155
%Change in GDP	-1.580%	-1.551%	-0.668%	-0.6842%
	Armington Elasticities		Armington Elasticities	
	Scenario_1	Scenario_2 Standard VAT=15.655%	Scenario_1	Scenario_2 Standard VAT=15.662%
Konüs	1.0235	1.0204	1.0234	1.0203
%Change in GDP	-1.183%	-1.176%	-1.164%	1.163%

Source: Own Elaboration.

7. Concluding Remarks

We have used a CGE model to explore the issues surrounding the value added tax reform implemented by the Spanish government in 2012. This tax reform kept the traditional three VAT rate structure but modified the rates upwards. We have compared the actual reform with a counterfactual one, and certainly simpler in structure, that would only have a single tax rate. We perform a comprehensive comparison of these two tax policies under the condition of equal yield in tax revenues. This condition ensures that our comparison is indeed sensible

since the size of the government budget would not change. This precludes second order effects attributed to government activity levels that would obscure the comparisons. With our results we provide evidence to shed some additional light on the ongoing debate regarding the structure of the VAT and how to minimize the efficiency costs that it inflicts on welfare levels.

Despite the fact that a well built value added tax system falls mainly on the demand side of the economy, its final impact is nonetheless global given its widespread reach to production and government revenue levels. This justifies the use of a general equilibrium approach as the correct modeling platform. Since the behavior of the supply-side of the economy can vary considerably depending on the degree of competitiveness of the industries, the need for a more encompassing approach arises. For this, and to improve the reliability of the results, we have studied these two VAT reforms under the standard CRS and competitive assumption as well as under two IRS cases that allow us to introduce two modeling options for imperfect competition.

Economic theory shows that any tax hike will give rise to erosions in welfare and income levels. The numerical results produced by the CGE model with CRS confirms these negative effects of the actual 2012 VAT reform. When we relax the CRS assumption the negative impacts on welfare and income levels amplify, as predicted by theory. Our CGE model with IRS yields specific numbers that allow us to estimate the additional likely effects induced by the tax reforms and that can be attributed to market structure.

But on top of that we also observe different patterns when we visualize possible equilibrium paths, depending on the level of economies of scale and the type of market behavior, i.e. zero profit condition versus positive profits with mark-up pricing. At the end, however, the range of the reforms plus the restriction imposed by the equal yield condition limit considerably the extent of the effects. This, in our view, is one of the main findings of the empirical exercise, even when we introduce modification on the value of some key elasticity parameters and we re-run the simulations. One possible reason is the implicit unitary price demand and income demand elasticities that follow from the Cobb-Douglas utilities specification that we use for households. The Cobb-Douglas assumption is quite standard in CGE modeling since it does not require any externally estimated substitution elasticities. However, since prior to any ensuing general equilibrium effects, any change in VAT rates will initially and strongly impact on the structure of households' demand, we feel more

research is needed to ascertain the role that the demand structure ends up playing on the estimated results. We will consider in the future different demand specifications to ascertain the consequences of changing this assumption.

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Annex

Table_B: VAT Reforms for an Equivalent Reduction on Public Deficit. Description of Simulation Strategy: Evaluated Changes in VAT Rates within the AGEM for Spain 2010. CRS and perfectly Competitive Markets.								
	Benchmark Values		Scenario_1			Scenario_2		
Sector Code	VAT Rates	Average VAT Rates	New VAT Rates	New Average VAT Rates	Evaluated Changes VAT Rates	New VAT Rates	New Average VAT Rates	Evaluated Changes VAT Rates
S_1	4,7.5,17	9.5	4, 10, 21	11.666	22.807	15.77	15.77	66.00
S_2	17	17	21	21	23.529	15.77	15.77	-7.235
S_3	4,7.5,17	9.5	4, 10, 21	11.666	22.807	15.77	15.77	66.00
S_4	17	17	21	21	23.529	15.77	15.77	-7.235
S_5	17	17	21	21	23.529	15.77	15.77	-7.235
S_6	17	17	21	21	23.529	15.77	15.77	-7.235
S_7	4,7.5,17	9.5	4,10,21	11.666	22.807	15.77	15.77	66.00
S_8	7.5,17	12.250	10,21	15.5	26.530	15.77	15.77	
S_9	17	17	21	21	23.529	15.77	15.77	-7.235
S_10	17	17	21	21	23.529	15.77	15.77	-7.235
S_11	17	17	21	21	23.529	15.77	15.77	-7.235
S_12	17	17	21	21	23.529	15.77	15.77	-7.235
S_13	17	17	21	21	23.529	15.77	15.77	-7.235
S_14	17	17	21	21	23.529	15.77	15.77	-7.235
S_15	17	17	21	21	23.529	15.77	15.77	-7.235
S_16	17	17	21	21	23.529	15.77	15.77	-7.235
S_17	17	17	21	21	23.529	15.77	15.77	-7.235
S_18	7.5,17	12.250	10,21	15.5	26.530	15.77	15.77	28.734
S_19	7.5	7.5	10	10	33.333	15.77	15.77	110.266
S_20	7.5	7.5	10	10	33.333	15.77	15.77	110.266
S_21	7.5,17	12.25	10,21	15.5	26.530	15.77	15.77	28.734
S_22	4,7.5,17	9.5	4,10,21	11.666	22.807	15.77	15.77	66.00
S_23	0,17	8.5	0,21	10.5	23.529	15.77	15.77	85.529
S_24	7.5	7.5	10	10	33.333	15.77	15.77	110.226
S_25	0,17	8.5	0,21	10.500	23.529	0, 15.77	7.885	-7.235
S_26	7.5,17	12.250	10,21	15.5	26.530	15.77	15.77	28.734
S_27	7.5,17	12.250	10,21	15.5	26.530	15.77	15.77	28.734
S_28	17	17	21	21	23.529	15.77	15.77	-7.235
S_29	0,7.5,17	8.166	0,10,21	10.333	26.540	0, 15.77	7.885	-3.441
S_30	17	17	21	21	23.529	15.77	15.77	-7.235
S_31					0.000			
S_32	0,17	8.500	0,21	10.500	23.529	0,15.77	7.885	-7.235
S_33	0,7.5	3.75	0,10	5	33.333	0,15.77	7.885	110.266
S_34	17	17	21	21	23.529	15.77	15.77	-7.235

Source: Own Elaboration from the information provided by the INE and BADESPE

Appendix

Table_A: Sectoral Breakdown: Spanish Social Accounting Matrix 2010		
Sector Code	**CPA_2018 Codes**	**Sector Description**
S_1	01,02, 03	Agriculture, Hunting, Forestry and Fishing Products
S_2	05, 09	Mining and Quarrying Products
S_3	10,11,12	Food, Beverages and Tobacco Products
S_4	13,14,15	Textile, Leather and Footwear Products
S_5	16,17,18	Wood, Cork, Pulp, Paper Products, Printing and Publishing
S_6	19	Coke, Refined Petroleum and Nuclear Fuel
S_7	20,21	Chemical and Pharmaceutical Products
S_8	22	Rubber and Plastic Products
S_9	23	Other Non-Metallic Mineral Products
S_10	24	Basic Metals and Fabricated Metal Products
S_11	25	Metallic Products not including Machinery and Equipment
S_12	26,27	Electrical and Optical Equipment
S_13	28	Transport Equipment
S_14	29	Motor Vehicles and Trailers
S_15	30	Other Transport Equipment, Nec
S_16	31,32	Furniture and other manufacturing products, nec
S_17	33,95	Repair and Instalation activities
S_18	35	Electricity and Gas
S_19	36	Water Supply
S_20	37,38,39	Sewerage, Waste management and remediation services
S_21	41,42,23	Construction
S_22	45,46,47,48,49,50, 51,52	Wholesale, Retail Trade and Transport Services
S_23	53,59,60,61,62,63	Post Services and ICT services
S_24	55,56	Accommodation and Food Services
S_25	64,65,66	Financial and Insurance Services
S_26	68	Real State Activities
S_27	69,70,78	Corporate Legal and Accounting Consultancy Services and Employment Related Services
S_28	77	Rental Services
S_29	79	Travel Agencies' activities and related activities
S_30	80,81,82	Professional,Scientific and Technical Services
S_31	84	Public Admin and Defence; Compulsory Social Security
S_32	85	Education activities
S_33	86,87,88	Health and Social Work activities
S_34	90,91,92,93,94,96,97,98,99	Other services. Nec.