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Estimating the Revenue Impacts of Tax Harmonisation

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Abstract

This paper reviews studies that attempt to measure empirically, revenue gains from tax harmonisation. Three groups of studies emerge, those that use cross-country regression, partial equilibrium analysis, and applied general-equilibrium (CGE) models—they all suggest (explicitly or implicitly) that the relationship between tax rates and tax revenues is ambiguous. In some special circumstances, there are gains that can be realized from tax harmonization, but those gains are usually modest in scope. Tax harmonization tends to disadvantage certain countries especially when the participating countries are different in size, and disparities in their initial tax structures are wide.

JEL Classification: C68, D78, E16, F13, F15, H20, H25. H 87

Key words: Policy Coordination, Tax Harmonisation, Tax Revenue, Computable General Equilibrium Models, Social Accounting Matrix.

Table of Contents

1	Introduction	4
2	Theoretical analyses	6
2.1	Overview	6
2.2	The tax policy–tax revenue link	7
3	Methodological approaches	10
3.1	Regression analysis	10
3.2	Partial equilibrium models	11
3.3	Applied CGE models	12
3.3.1	Overview	12
3.3.2	Applied static CGE models	14
3.3.3	Dynamic CGE models	17
3.3.4	Micro-simulation models	20
3.3.5	Limitations of the CGE models	21
3.4	Data issues	22
3.4.1	Effective tax rate	22
3.4.2	National accounts data	24
3.4.3	Social Accounting Matrix	24
4	Implementation of policy scenarios	25
5	Summary and conclusions	25
	References	27

1 Introduction

Closer integration of regional and global economies is putting increasing pressure on the national tax systems, which is part of the reason why several economic regions of the world, especially customs and monetary unions, are engaging in some form of tax coordination or harmonisation efforts. As a result, a body of literature is emerging which quantifies the welfare gains or loss arising from such coordination/harmonization efforts or lack of it, in the context of regional integration setting. This paper is a survey of over thirty five studies from this literature. The objective is to clarify the relationship between the tax harmonization reforms and changes in tax revenues involving members of a regional bloc e.g. customs or monetary union.

The EU dominates tax harmonisation discussions, but similar pressure (on the tax system created by the internationalisation of economic activity) is evident in other parts of the world—in both developed and developing economies—and in fact, seems set to become increasingly pressing. For instance, the EU member states agreed to fix a bottom rate for the Value Added Tax (VAT) of 15 percent. In West African Economic and Monetary Union (WAEMU), directives were introduced on tax coordination fixing tax bases and tax ranges of several taxes: VAT, excises, and corporate income tax (Mansour and Rota-Graziosiand, 2013). In the East African Community, there is an ongoing talk on harmonisation of domestic taxes. These restrictions are seen as safeguard measure to curb potential uncompetitive behaviour by national governments or "harmful" tax competition. This is also seen as a concern within federal tax structure, and has received considerable attention in literature (Gordon 1983; Yilmazkuday, 2015).

Tax harmonization is assumed to be achieved when all countries face the same effective taxation regardless of the location of the investment within the regional bloc (Horst, 1980), and may not necessarily mean similarity in statutory tax rates. While not requiring uniformity in tax systems, tax harmonization serves to reduce differences across jurisdictions in effective tax rates or bases that are mobile or which can have inter-jurisdictional implications on investment and trade flows. Is harmonisation desirable? Would a low-tax country insist on a minimum tax requirement on key economic activities in moving to a free trade with its

neighbours? If two countries make it easier for free movement of goods and people between them, how should they adjust their domestic tax structures? These, and other policy related questions motivate this survey.

The first set of issues relate to gains from tax harmonisation. Horne and Masson (1988) and Fischer (1988) survey a number of studies that attempt to measure empirically the gains from policy coordination. Most studies seem to find relatively modest gains from coordination, a fact that Canzoneri and Henderson (1991) attribute to the nature of the exercise.

This paper finds that the relationship between tax rates and tax revenues is ambiguous. There is no clear conclusion that can be drawn about the impact of tax policy coordination or rate harmonization on tax revenues in regional economic bloc. There is abundant literature on tax harmonization that indicates potential detrimental effects of tax harmonization especially when the participating countries are different in size, and disparities in their initial tax structures are wide. However, the way in which the adoption of a common tax base (—common definition of tax base, including a set of common rules on depreciation, loss offset, tax incentives and exemptions, etc.)—affects the distribution of tax revenue has received little attention. Empirical studies haven't yet gone far enough to isolating and providing evidence on the revenue implications of changes in income and consumption tax bases. While some results show that the benefits from harmonizing corporate income tax are uneven among countries, decomposing the results—tax rate—and the base—induced changes—has not been forthcoming.

The paper highlights how emerging evidences from these studies (tax harmonising literature) are already providing fresh insights into long-standing policy debates. While there remains room for novel empirical contributions, there is perhaps even greater demand for theoretical work to improve our understanding of the underlying mechanism that drives changes in tax revenues, GDP and other bases of tax revenue subsequent to specific changes in tax rates and bases, and how it translates into the amount of public services provided by governments.

For papers that incorporate tax base—revenue effects, particular attention is given to the sources of the data, and how existing studies link tax rates to individual tax bases or revenue types. Seen this way, the paper studies the approaches employed by over thirty

five studies from this literature—which it classifies into three methodological categories: cross-country regression, partial equilibrium analysis, and applied general-equilibrium approaches—that encompass a broad range of methodologies in current use. The paper contributes to a better understanding of the various approaches that have been used to assess the revenue and distribution impacts of regional tax harmonisation strategies. It summarizes the methodologies of the diverse strands of research that have been and are currently being conducted.

It is not plausible to provide a comprehensive synthesis of findings of these diverse studies. To keep the survey manageable, and to avoid undue repetition of what has already been covered in other studies, a set of criteria for inclusion was adopted. First of all, papers from the extensive literature on tax competition and investment location decisions are excluded since they are well covered in tax competition literature. Emphases are placed on analyses that involve some sort of “counterfactual” simulation or regression analysis, as opposed to those only documenting how revenue has evolved over time. Why simulation? Because it facilitates understanding of the links between a specific shock and revenue, holding other factors constant (indeed, the vast majority of tax harmonization studies employ some form of simulation analysis).

The rest of the paper is organized as follows. Section two examines the theoretical foundation of tax harmonization discussion. Section 3 focuses on the methodological issues, including data requirements, while Section 4 provides brief description of policy implementation in a CGE framework, and Section 5 concludes.

2 Theoretical analyses

2.1 Overview

Quantifying the revenue impacts of tax harmonization requires clear understanding of how changes in tax rates for example, affect the variables that drive changes in specific tax bases, national income (GDP) and revenues, and how changes in tax rate in one jurisdiction can affect tax revenues in other jurisdictions. Progress in building a

theoretical foundation that link tax policy changes to tax revenue (in an integrated world) has tended to be slow.

There is a long tradition of studies that provide useful insights on the interactions between tax reforms and sectoral allocation of resources, starting from Harberger's (1962) classic analysis of the corporate tax and including Fullerton and Henderson (1987), Gravelle and Kotlikoff (1989), and Diamond and Zodrow (2008), but all of them abstract from some of the central questions, which those interactions raise such as government revenues. Thank to recent contributions by Mendoza (2001), Razin and Sadka (1993), Frenkel, Razin and Symansky (1990) and (1991), among others, which has gone a long way to clarifying the relationship between tax policies and national welfare in a customs of a monetary union. It helps improve our understanding of the mechanism through which the effects of a tax cut or a rate increase is transmitted through the economy—eventually affecting tax revenue. Thus, we start this section by unveiling the potential links between tax policies (e.g. tax rate) and tax revenues.

2.2 The tax policy–tax revenue link

Before describing each of the methodological approaches that have been used to evaluate the revenue effects of tax harmonization policies¹, it is helpful to consider the linkages that exist between tax policy and revenue. In a comprehensive paper on this topic, Razin and Sadka (1993), Frenkel, Razin and Symansky (1990) and (1991), Frenkel and Razin (1986, 1989), and Frenkel, Razin, and Sadka (1991) advance three key linkages, which are reiterated in large part by Mendoza (2001). Potential channels by which changes in country-specific tax policies can affect tax revenues in a foreign country—with close trade ties— include changes in:

- (a) the equilibrium prices of goods and financial assets that the participating countries trade, including the foreign prices of non-traded goods (referred to in literature as the *price channel*).
- (b) the distribution of wealth, factor prices, income, and employment (the so-called *wealth channel*). As Mendoza (2001) explains, depending on tax incidence and

¹ Papers included in the survey are categorized and summarized at the end in Tables 1 through 4.

the structure of financial markets, changes in tax policy can redistribute wealth, that is, the holdings of physical and financial assets, across countries, across heterogeneous individuals, or across generations.

- (c) foreign tax revenue—i.e., domestic tax changes may erode foreign tax revenues and thus force foreign tax hikes or expenditure cuts that are potentially welfare-reducing. This third channel (called, *tax-revenue erosion* channel) is a by-product of the price and wealth channels.

The effects of tax harmonization reforms can thus be broken up conceptually into two distinct parts: First, how the tax changes affect individuals or firms' choices regarding the level of work, consumption, savings, and investment and hence the tax base. Second (—given the integrated world markets for goods and capital), how the changes in individuals and firms' behavior affect the allocation of resources across sectors of the domestic and foreign economies (international spill over of domestic tax policy)—with consequences on the relevant tax bases. Here, domestic taxes and revenues comprise consumption (indirect) taxes (VAT and excise taxes), corporate and labour or personal income tax revenues. This representation of revenues allows for the study of the various tax sources that are subject to regional harmonization programme.

A cut in corporate income tax reduces the cost of capital and increases post-tax return on domestic capital. Capital flows from the high-tax country into the low-tax country, increasing its capital stock (KS), and exerts a positive impact on the marginal product of labour, increasing real wages as well as employment and its ability to raise tax revenue over time. As capital flows out of the high-tax country, it leaves behind a falling wage rate and rising interest rate and cost of capital. It directly reduces the tax base in the high tax country. Tax revenues are most likely to fall in high-tax country because revenues from taxes on capital decline on account of lower tax rates (assuming these tax rates are in the upward-sloping region of their Laffer curves) and eroding tax base as Mendoza (2001) suggests. As tax revenue falls, governments are forced either to reduce expenditures or to raise other taxes, which are potentially welfare reducing (Mendoza, 2001).

The wealth channel reflects the efficiency gains of the domestic tax cut, and borrowing incurred to expand the capital stock, leading to increased consumption benefits as a result of the increased wealth of the economy (Mendoza, 2001). The home country runs a trade deficit accompanied by domestic debt build-ups in the short run, which might raise the world rate of interest if the cut in consumption taxes is the cause of domestic debt. In the process, domestic and foreign investments are crowded out, and the ability of domestic economy to mobilise tax revenue is reduced. The trade balance of the domestic economy may deteriorate. However, if the cut in income tax is the cause for borrowing, it will lower world interest rate, crowding in foreign investment and crowding out home investment. In this case, the domestic trade balance may improve.

The tax–revenue-erosion channel—seen as a by-product of the price– and wealth–channels—operates via the effects of the price and wealth channels on the labour-income, capital-income, and consumption tax bases of the foreign country in response to the change in home-country taxes (Mendoza, 2001). The significance of each of the three transmission channels of tax policy is difficult to isolate in the results of tax harmonization experiments due to inter-related nature of the three transmission channels.

The intuition developed above about the international transmission channels of tax policy fit into discussion of the effects of a cut in the domestic capital income tax. Labour and consumption taxes are not equivalent because labour is not the sole source of factor income. Again, capital and labour incomes are not taxed at the same rates. Labour and consumption taxes have very different effects on tax revenue, welfare and household income. However, changes in the domestic labour income tax or the consumption tax induce effects on the foreign economy that operate through similar channels.

For example, a cut in domestic labour or consumption taxes raises the domestic post-tax effective real wage and induces the classic income and substitution effects on the domestic supply of labour (Mendoza and Tesar, 1998; Mendoza, 2001). The subsequent change in the equilibrium labour allocation has an indirect effect on the domestic marginal product of capital and this introduces the arbitrage effects in the case of changes in the domestic capital income tax. The wealth channel and the tax-revenue-erosion channel are also at work since they reflect the effects of the price channel on the allocations of the world general equilibrium.

As seen, the price channel is less direct because changes in domestic labour or consumption taxes do not have a direct effect on the price variable relevant for the investment margin in the foreign country (as is the case with the capital income tax). Mendoza and Tesar (1998) shows that the less-direct nature of the price channel makes all three channels of international transmission of tax policy weaker when they operate through changes in the consumption taxes (VAT and excise taxes) or labour taxes than through the capital income tax.

The inseparable (inter-related) nature of the transmission channels and inability to isolate the contribution of each of the three transmission channels of tax policy from the results of tax harmonization experiments reflects some of the methodological challenges in tax policy research. It also seems difficult to discern from the results of tax policy harmonisation experiments which of the three channels indeed drives revenues in developed and developing countries. From developing countries perspective, one would imagine that since asset markets in these economies are still in many ways inchoate and less integrated with the main economy, the wealth channel plays relatively smaller role than the price channel. Seen this way, studies estimating the transmission channels of tax policies in developing countries may want to pay more attention to prices of goods that economies trade (than perhaps the interest rates).

3 Methodological approaches

Estimation of revenue (and welfare) impacts of tax harmonisation policies has taken two distinct approaches: studies based on cross-country regression analysis, and those based on general equilibrium (CGE) approaches. Each of these approaches has certain advantages and disadvantages that have been considered by different researchers.

3.1 Regression analysis

The first approach considered in this survey is cross-country regression analysis. Studies that have used this approach are hard to come by, which suggests that there is more preference for other methods in tax harmonisation studies. It is harder to determine one

time impacts of tax changes using cross-country data. Similar models that do attempt to estimate wider economic effects of policy changes are based on a combination of historical trends and economic theory. These macro-econometric forecasting models are estimated statistically and are mainly used for forecasting economic variables. These statistical models can provide a confidence interval around estimates making them suitable for forecasting. The downside of this class of models is that the estimated parameters are not policy-invariant (Lucas, 1976); estimating the effects of new policies by relying on past relationships may not yield useful insights if the policy change itself affects the relationships. They are also predominantly demand-led ignoring the supply side of the economy.

3.2 Partial equilibrium models

The second general methodology identified as a means of estimating the economic and revenue impact of tax policy changes such as tax harmonization is partial-equilibrium models as exemplified in a paper by Kanbur and Keen (1993). The authors focused on the role of country-size in cross-border interactions between national tax systems—in a two-country-single good partial equilibrium model in which governments are assumed to be Leviathans, and the objective of each government is to maximise its tax revenue. Their findings suggest that disparity in size is a source of inefficiency in itself, exacerbating the loss that each country suffers as a consequence of non-cooperative behavior. The first order revenue loss following cuts in domestic tax rates in large country intended to stem the flow of cross-border trade appears to outweigh the dilution of collective revenue that such trade implies (Kanbur and Keen, 1993).

In harmonized scenario (common tax rate), the revenue gain by large country is insufficient to compensate the smaller country for the loss of cross border trade. It is the imposition of minimum tax rate that is seen to benefit both countries. Surprisingly enough, as Kanbur and Keen (1993) has noted, the role of country-size in strategic design of harmonization policies have received no explicit attention in tax harmonization literature. While direct applicability of these results (Kanbur and Keen, 1993) is limited by the structure of the model as the author themselves admit, they nonetheless, provide useful insights into the role of country side in increasingly integrated world and may well remind us, in

particular, about the importance of recognizing the strategic context in which measures of harmonization must be assessed.

We may appreciate how useful partial equilibrium models are for understanding the detailed mechanisms of the market they are examining—assuming the rest of the economy is unaffected. But we also know that the real world is much different; the partial equilibrium nature of the model makes it impossible to analyse the linkages between sectors and impacts of the labour market and main macroeconomic variables—i.e. unlike applied general equilibrium models; partial equilibrium models do not capture the linkages highlighted in Figure 1 below.

3.3 Applied CGE models

3.3.1 Overview

Application of CGE model in analysis of economic effects of tax policies is well established in literature. Arnold Harberger was the first author to investigate tax policy questions numerically in a two-sector general-equilibrium framework (Harberger, 1962).² Other examples of the literature bearing on this subject are Shoven and Whalley (1972), Bradford (1984), Bryant et al (1988), Cnossen (1988), Cnossen and Shoup (1987), Emerson et al (1988), Bouguignon et al (1989), Frenkel, Razin, and Symansky (1990) and (1991), Musgrave (1987), Perraudin and Pujol (1990), Sinn (1990), Frenkel, Razin, and Sadka (1991), Razin and Sadka (1991), Mendoza and Tesar (1998), Mendoza (2001), Baldwin and Krugman (2004).

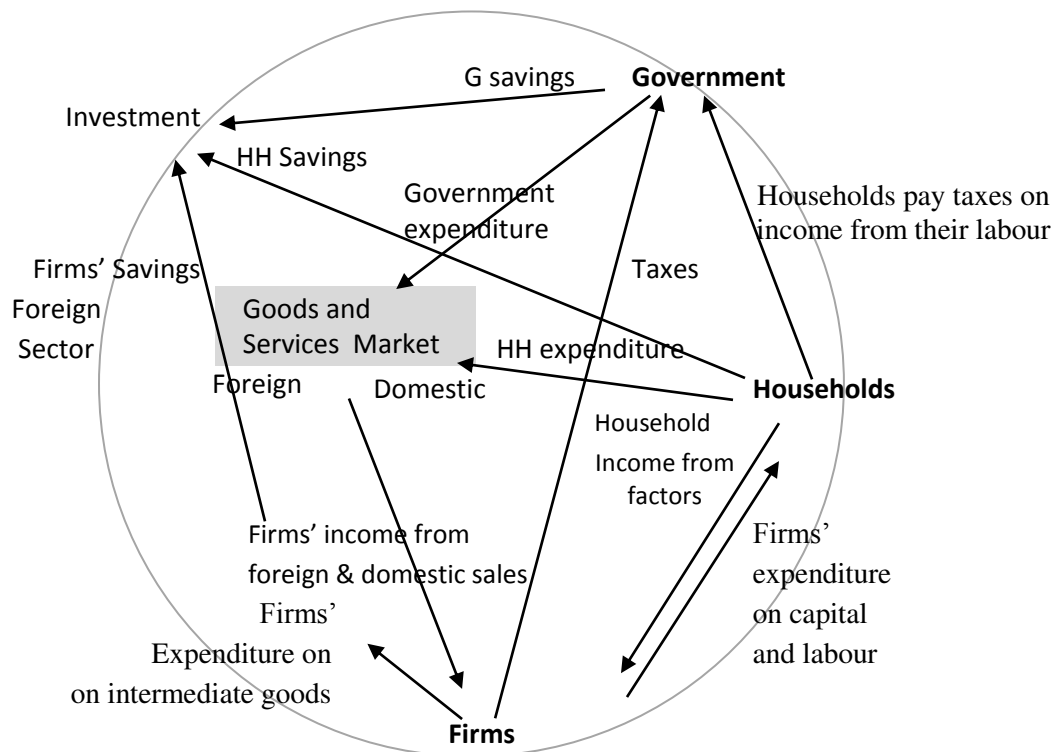
A CGE model is a large-scale numerical model that simulates the core economic interactions in the economy. It uses data on the structure of the economy along with a set of equations based on economic theory to estimate the effects of fiscal policies on the economy. General equilibrium models are typically based on neoclassical theories of firm and household behavior, and have a time frame long enough to achieve equilibrium in markets. CGE models capture the inter-dependencies between the different product and factor markets, and public and private sectors in the economy, enabling analysis of how a policy change targeted in one part of the economy will affect the rest of the economy.

² See Shoven and Whalley, 1984).

Other unique advantage of CGE models over regression models is that the effects of a policy change targeted to one aspect of the economy can be traced, including indirect effects induced by policy changes, which is often difficult with other types of models such as regression models.

It may be useful to mention some of the fiscal policies that have been frequently examined in the context of CGE models. Among tax policies that can be incorporated into CGE models are sales taxes, value added taxes, tariffs on imports, export taxes, personal income taxes, corporate income taxes, wealth taxes, and land taxes. Different types of public spending and subsidies such as price and consumption supports and have been frequently analyzed using CGE framework. They have also proven to be useful, for example, in the analysis of the impact of the provision of public infrastructure on the productivity of the private sector, as well as a variety of other general fiscal policy issues.

Figure 1. Circular flow of income



Dervis et al (1982b) give a good survey of the CGE models that are currently in use. These models follow the tradition of applied general equilibrium tax models pioneered by Shoven and Whalley (1972, 1973). Shoven and Whalley (1972; 1973) extended the

Arrow-Debreu general equilibrium model to allow the introduction of taxes and tariffs (Arrow and Debreu, 1954). These models have evolved from only a few simple taxes in the context of static models, to dynamic models with intertemporal optimization by all agents, and which incorporate a wide variety of fiscal policies, not only taxes. The basic model was extended by incorporating a foreign sector into the previously closed economy models, and more recent versions of the basic CGE model have attempted to incorporate financial assets, in particular money and bonds.

Incorporating financial assets in the model serves to broaden the scope of fiscal policies to be considered. It also help the modeler to avoid the requirement of a balanced budget, since deficits can be financed by a mixture of borrowing and monetization, as well as foreign borrowing. It has also been possible to introduce endogenous central bank behavior, including open market operations, discount lending, and interest rate targeting in some cases.

CGE approaches include static models e.g. Eggert (1998), Sorensen (1999), and European Union (2016) and dynamic models e.g. Mendoza (2001) pioneered by Frenkel, Razin and Symansky (1990 and 1991). Both CGE approaches analyse revenue effect of tax policies via the three transmission channels described in the previous section (2.1).

3.3.2 Applied static CGE models

Over the last three decades computable general equilibrium models of the effects of taxation have grown in both detail and sophistication. Some of the contributions in the recent literature on multilateral tax reforms have focused on the discussion of the welfare effects arising from indirect tax harmonization policies e.g. Keen (1987, 1989), Turunen-Red and Woodland (1990), Keen and Lahiri (1993), Kanbur and Keen (1993), López-García (1996). The papers of Canto, Joines, and Laffer (1978); Ballard, Fullerton, Shoven, and Whalley (1985), and Sørensen (1999), among others, establish the close connection between tax rates and government revenues (or welfare).

Keen (1987) shows that a joint move by two harmonising countries towards a weighted average of their commodity tax rates can yield a weak Pareto improvement—implying, a welfare gain in one nation is not accompanied by a welfare change in another.

Canto, Joines, and Laffer (1978) build a simple equilibrium model with one good, two factors, and a labor/leisure choice on the part of a single consumer group. Their utility function includes discounted consumption and leisure of each future period—a formulation quite similar to the larger empirical general equilibrium model by Ballard, Fullerton, Shoven, and Whalley (1985). Revenue effects of tax rates are transmitted through income effect and substitution effect. Feldstein, Slemrod, and Yitzhaki (1980, p.786) also find that capital realizations are very sensitive to the effective tax rate: A reduction in the tax rate on capital gains would actually increase the total revenue collected.

Ballard et al (1985) examined the relationship between tax rate and revenue for a variety of values of the labor supply elasticity and concluded that the relationship between tax rates and revenues is ambiguous. Broad-based cuts in labor tax rates would not increase revenues. A cut in capital gains tax might unlock a flood of realizations in the short run, without necessarily increasing revenues in the long run. Even where the benefit of capital gains tax ends up in increased corporate-retained earnings, it decreases the dividends paid out, and thus reduce personal tax revenue from dividends. Their models dispel the notion of an inverse relationship between major U.S. tax rates and government revenues although they do not necessarily invalidate the claim that these tax rates should be lowered. Like Canto, Joines, and Laffer (1978), Ballard et al (1985) ignores production encouraging aspects of any public goods made possible through increased revenue. Much of the tax harmonisation literature attempts to correct some of these neglects.

Subsequent papers by Delipalla (1997), Lockwood (1997), Lahiri and Raimondos-Møller (1998) and López-García (1998) and (2003) have discussed the effects of a number of harmonizing rules in the presence of revenue requirements or provision of public goods in a variety of frameworks.

Sørensen (1999) quantify the price and revenue-erosion effects of international tax competition and how EU tax coordination affects equilibrium tax rates when the rest of the world stays outside of the coordination project. His findings indicate that strategic complementarity prevails for reasonable assumptions in general-equilibrium framework.

Bénassy-Quéré et al (2000) examine the relationship between harmonization of tax policy (and corporate tax co-ordination among EU members) and investment. Their findings suggest that EU tax rate competition could attract FDI inflow from Japan and the US, while harmonization would not. They also find that, for those countries that attracted FDI, their tax revenue fell. As for harmonization, the results were mixed, depending on whether nominal or effective rate was used and the rate level prior to harmonization.

Similarly, Gropp and Kostial (2001) have suggested that the effects on FDI net inflow and corporate tax revenue (as percentage of GDP) are strong for countries with tax rates that are much different from the harmonizing level. Countries that had much higher rates could enjoy the FDI inflow and higher tax revenue, while those that had much lower rates would face an outflow of the FDI and reduced revenue.

Sørensen (2004) —using a CGE tax model of the EU—estimates the welfare gain from corporate tax harmonization in the range of about 0.1 to 0.2% of GDP—equivalent to the gain from transaction cost reduction from the introduction of the Euro. This finding was confirmed by Bettendorf et al. (2009), which suggested that reaping a welfare gain is unlikely unless the harmonization involves both the tax base and tax rate.

Bettendorf et al (2009) explore the welfare effects of enhanced cooperation with respect to the common consolidated corporate tax base in Europe. The authors find that the consolidation is likely to yield a small aggregate welfare gain in Europe, but that not all countries benefit. A coalition of winning countries reduces the welfare gain and may induce a process of adverse selection which undermines the possibility of cooperation. They find that a coalition of similar countries (in terms of the size of their multinational sector) is more feasible in achieving agreement and is actually preferred by those countries over a European-wide reform.

Although the ability to apply general- equilibrium techniques to tax policy questions may strike some readers as an accomplishment worth noting in itself, ultimately the most important contributions of the applied models lie in their results, and the new insights these offer into policy issues (Shoven and Whalley, 1984). Comparative static analysis, both local and discrete proves to be relatively straight forward. They also tend to thrive where there are problem of data limitations, but may not be able to yield valuable insights into transmission effects of tax policy to the level achievable with dynamic models.

3.3.3 Dynamic CGE models

The choice between dynamic and static models depends on the problem at hand.³ Mendoza (2001) identified weaknesses in the use of the traditional static models to conduct tax policy analysis in open economies, and at the same time highlighted the complications involved in a theoretically-consistent assessment of the implications of tax policies. The complex dynamic issues inherent to inter-temporal closed economy models, which involve determining whether tax changes are permanent or transitory as well as anticipated or unanticipated, are significantly compounded by the effects that result from three widely-studied international transmission channels of domestic tax policies discussed above.⁴

The articles by Frenkel, Razin and Symansky (1990) and (1991) were pioneering efforts at developing a policymaking framework for tax analysis in open economies consistent with new dynamic macroeconomic theory of international taxation (Mendoza, 2001). Frenkel, Razin and Symansky (1990) apply a dynamic framework to an examination of the international implications of VAT harmonization. Their tax reform experiments like most CGE models surveyed, are simulated under the standard revenue neutrality.

As seen, a revenue-neutral tax reforms are characterized by a change in the composition of a given tax revenue among different tax bases. Alterations in the various tax rates are designed to keep total tax revenue in each period intact. In the home country, the rise in the VAT is accompanied by a reduction in income tax rates, whereas in the foreign country the fall in the VAT rate is accompanied by a corresponding rise in

³ CGE models are similar to Dynamic Stochastic General Equilibrium (DSGE) models in that both model classes are based on microeconomic foundations rather than historical relationships. The main difference between the two types of model is DSGE models attempts to capture fluctuations in business cycles whereas CGE models tend to focus more on medium-run and long-run macroeconomic analysis. Standard DSGE models also tend to have less detailed representation of firms and households than CGE models. On the other hand, DSGE models allow for random variations to account for uncertainty whereas CGE models are deterministic, with agents facing no uncertainty about the future.

⁴ Moreover, dynamic models do not often prove to be superior to static model. In their evaluation of the impact of Chile free trade area (FTA) with NAFTA or MERCOSUR, Thomas Rutherford and David Tarr found that the dynamic small open economy (SOE) model does not produce welfare estimates significantly different from the comparative static SOE model (Rutherford and Tarr, 2003). Their results suggested that, it is possible for a fully dynamic model to produce welfare estimates for a free trade area, which are welfare inferior to those from a comparative static model.

income tax rates (Frenkel, Razin and Symansky, 1990). The narrowing of the international disparities between VAT captures the European Commission's proposal of reducing the disparities of VAT rates among member countries and categories of goods. Table 1 highlights the international diversity of the tax rates in the EC in 1989.

One of the central issues arising from this study is the budgetary consequences of the harmonization in the VAT systems. A few member states in the model (notably Denmark and Ireland) would suffer considerable tax revenue losses, while others (notably Spain, Luxembourg, and Portugal) would see their tax revenue go up considerably (Frenkel, Razin and Symansky, 1990).

Table 1. VAT Rates in the European Community (1989)

(Statutory Rates (%))

Country (year of VAT introduction)	Reduced Rate	Standard Rate	Higher Rate	Revenue Contribution To Total Tax Revenue (%) (1986)	Revenue Contribution To Total Tax Revenue (as % GDP) (1986)
(1) Belgium (1971)	1, 6, 7	19	25, 33	15.5	7.0
(2) Denmark (1967)	0	6	...	19.5	9.9
(3) France (1968)	5.5, 7	18.6	28	19.2	8.5
(4) Germany (1968)	7	14	...	15.3	5.7
(5) Greece	3,6	18	36
(6) Ireland (1972)	0, 2.2, 10	25	...	20.8	8.4
(7) Italy (1973)	2,9	18	38	14.5	5.0
(8) Luxembourg (1970)	3, 6	12	...	13.3	5.7
(9) Netherlands (1969)	6	19	...	16.5	7.5
(10) Portugal (1986)	8	17	30	17.6	5.7
(11) Spain (1986)	6	12	33
(12) United Kingdom (1973)	0	15	...	15.5	6.9
Commission proposal:					
	A:	4 to 9		14 to 20	abolished
	B:	4 to 9		minimum rate	abolished

Sources: Table 6.2 in Frenkel, Jacob., Assaf, Razin and Steve Symansky. 1990 sourced from Table 2.1 in Cnossen and Shoup (1987) and Table 3.5.1 in *European Economy* (March 1988); *EC: The Evolution of VAT Rates Applicable in the Member States of the Community* (Inter-tax, 1987/3, pp. 85-88); and OECD, *Revenue Statistics of OECD Member Countries* (Paris, 1988).

The rise in the home country VAT accompanied by equivalent fall in the income tax broadens the tax base and raises tax revenue in the current period if the home country runs a current account deficit. To restore tax revenue, the income tax rate must be lowered. The opposite changes occur in the future period in which the current account

position is in surplus, reflecting the inter-temporal budget constraint. Similar considerations imply that the path of income tax abroad also steepens. As a result, the tax incentives to investment decline, yielding a fall in the world rate of interest (See Frenkel and Razin, 1987 ch.8).

Frenkel, Razin and Symansky (1990) use two-country model and presume that, prior to the VAT harmonization, the two countries use very different tax systems. The home country tax revenue originates from high income tax, while the foreign country revenue originates from high VAT. The harmonization of VAT entails a rise in the home country VAT rate and an equivalent reduction in the foreign VAT rate. However, because they wanted to make their quantitative framework tractable, the author introduced into their model simplifying assumptions that consequently limited its ability to capture in full the three international transmission channels of tax policy (Mendoza, 2001). The assumptions of unitary inter-temporal elasticity of substitution in consumption and linear production technologies, in particular, restricted the global interaction of tax policies through the equilibrium determination of goods and factors prices, the distribution of wealth, and the dynamics of tax bases (Mendoza, 2001).

Another dynamic approach to tax and revenue modeling is offered by Mendoza (2001). A study by Mendoza (2001) stands out for improving the previous literature, especially Frenkel, Razin and Symansky (1990) and (1991) in assessing the external effects on foreign countries following the changes in country-specific tax rates through the three international transmission channels: relative prices, tax revenues, and wealth distribution. Mendoza (2001) assesses the potential effects of the European harmonization of capital income taxes—based on the workhorse neoclassical general-equilibrium model of exogenous balanced growth driven by labor-augmenting technological change.⁵

The model is calibrated to actual data for the four largest economies of Western Europe (France, Germany, Italy and the United Kingdom), including estimates of their current tax structures. The results led to the conclusion that European capital tax harmonization (as proxied by the convergence of capital tax rates to an ad-hoc weighted average of existing capital income taxes) is undesirable because it fails to yield a Pareto efficient outcome.

⁵ See King, Plosser and Rebelo (1988).

The analysis solely based on efficiency gains within a representative-agent framework is less than perfect, however, because inter-group dynamics limit the pace at which capital migrates across countries. Moreover, we yet do not know the real impact on the results of the within country redistribution effects, which clearly is very important in the overall assessment of alternative tax policies at a *national* level. So far, the model considers only *international* redistribution effects—i.e. that tax changes do not affect the rate of economic growth over the long run (that is yet to be explored empirically).⁶

3.3.4 Micro-simulation models

Micro-simulation models (MSM) are achieved by integrating micro—unit data (such as data on households, individuals, or firms from national household and firm-level surveys) with general equilibrium tax model. MSMs have been used in analysis of tax reforms in both developed and developing countries. By far, the greatest appeal of these models is the detail they provide in terms of distributional analysis.

Perraudin and Pujol (1990) examine the implications of European fiscal harmonization for the French economy using a general equilibrium model, in which households face constraints in their borrowing. The population comprises "rich" and "poor" households with different labor productivities. Their findings suggest that harmonization policy that involves cuts in VAT and savings taxes leads to welfare losses for both rich and poor households approximately equivalent to one percent of GDP.

The relevance of the MSM approach lies in providing in detail the behavior of individual firms and households, observed at a highly disaggregated micro level (Bourguignon and Spadaro 2006), which makes it easier to identify the likely winners and losers of a reform based on sample of economic agents rather than a few aggregate agents. The results obtained with an MSM at the level of individual agents can also be aggregated at the macro level, thereby providing a more accurate evaluation of the impact of the reform at a macro (aggregate) level.

The results rest on type of model used and a particular data imputation procedure and parameterization. Ayoki (2013, p.11) provides a comprehensive appraisal of the various

⁶ See, for example, Peretto (1999).

micro-simulation models in policy use: (i) the *representative household* approach, in which only representative household sub-groups are included in the CGE model (the most widely used approach); (ii) the *integrated multi-household* (IMH) approach includes all households, or a large number of households, from household survey in the CGE model; and (iii) the *top-down* or *micro-simulation sequential* (MSS) approach, a CGE model is used to generate price changes that are fed into a micro-simulation household model.⁷

3.3.5 Limitations of the CGE models

One of the advantages of CGE models is that they are strongly founded in microeconomic theory. They take into account economic flows in a flexible manner, and incorporate explicitly price effects. They are flexible—in that the specifications can be changed according to analytical needs. Besides, they partially avoid the Lucas’ critique, because there are no problems with expectations being incorporated in the estimated parameters used (Petersen 1997).

Despite their strong appeal in policy applicability, the CGE tax models have some limitations, which reflect problems both endemic to all applied general-equilibrium models in other areas (Shoven and Whalley, 1984). These include the difficulties of choosing appropriate elasticity and other parameter values, and the inevitable feature that a tractable model abstracts from important details in producing policy recommendations. In tax areas, are the difficulties of CGE tax models to incorporate fully detailed micro data available to public finance economists, the relatively unsatisfactory distributional modeling, and the average/marginal tax rate issue alluded to earlier. However, a start in this direction has been provided by Mendoza (2001).

Simulation results are very sensitive to specification forms, closure rules and the choice of base-year. In addition, many of the parameters of CGE models are derived from a single year’s Social Accounting Matrix (SAM). The expected structural changes in technology over time are ignored. Moreover, the real world applicability of general equilibrium theory itself has been under scrutiny for a long time (Petersen 1997). From the point of view of application to existing data, the use of representative agents is a

⁷ See Ayoki, Milton. (2013). “Trade Policies and Poverty in Uganda: A Computable General Equilibrium Micro Simulation Analysis”, AERC Research Paper 258, Nairobi: African Economic Research Consortium.

problem. Using only one representative agent (e.g. group of household) makes it difficult to study effects on equality between different households.⁸ Despite these problems, the contribution to policy debate on tax issues that these models have made seems firmly established, and more contributions seem likely in the years ahead. Models are now being used or contemplated in a number of government agencies in various countries, evidence of the potential contribution that policymakers see. Many researchers have linked CGE models to micro-simulation models that do permit the incorporation of a high degree of detailed data, but do not have many of the endogenous modeling features of CGE models.

3.4 Data issues

3.4.1 Effective tax rate

Most CGE tax models estimate the transmission effects of tax policy changes based on effective tax rates, which are typically easier to calculate on a cross-country basis than marginal effective tax rates, which require detailed information on the tax code for each country.⁹ The effective tax rates (e.g. effective tax rates of consumption taxes τ_c , capital income tax τ_k , and labour income tax τ_l) are constructed based on actual tax payments of individual taxes and national accounts, as proposed by Mendoza and Tesar (1998) and Mendoza (2001), which calculate an average effective tax rate by dividing taxes paid as recorded in the benchmark data, by the model tax base—following the theoretical foundations proposed by Razin and Sadka (1993) in their study of optimal taxation for Israel¹⁰, which was in turn based on guidelines¹⁰ suggested by Lucas (1990).

The effective average tax rate on sales of consumption goods τ_c is:

⁸ For example, a country may have survey data on thousands of households, but in order to incorporate this information into the CGE model, the households must be aggregated. That is, instead of thousands of households for which there is survey data, we would have, say, urban and rural representative agents, perhaps divided into income categories. Of course such aggregation discards a significant amount of useful information.

⁹ To the extent that marginal effective tax rates are correlated with average effective tax rates, average tax rates can serve as a rough indicator of the incentive effects as well as the distribution effects of taxation (Sørensen, 2001).

¹⁰ These authors start their analysis by examining the details of the Israeli tax laws, including credits and exemptions, and the effects of the inflation tax on measures of effective marginal tax rates on capital income similar to those of King and Fullerton (1984) and Auerbach (1987).

$$\tau_c = \frac{TRC}{C + G - TRO - \text{Taxes paid by government}} \times 100, \quad (1)$$

The numerator of (1) is the revenue from consumption taxes, which includes value-added-tax plus excise taxes. The denominator, the base of the consumption tax, is the private final consumption (C) derived from national accounts. Government final consumption expenditure (G) is included in the denominator because revenue statistics reports data on indirect tax revenue that includes taxes paid by government (Mendoza 2001). However, this only applies to purchases of goods and non-factor services, and hence the compensation of government employees TRO must be deducted from G.

The effective ad-valorem tax on capital income τ_k (including taxes on income, profits and capital gains of individuals, taxes on property and financial transactions) is given by

$$\tau_k = \frac{TRK}{VA - Y_L} \times 100, \quad (2)$$

where TRK is total revenue from capital income tax. The corporate tax base is obtained by subtracting total labour income Y_L from gross value added (VA) reported on national accounts, thereby correcting for the income from the self-employed. $VA - Y_L =$ total operating surplus of the economy. The effective ad-valorem tax on labour income is given in equation (3): We begin by computing the households' average tax rate on total income (3).

$$\tau_l = \frac{\tau_h W + NSSF(\text{Total}) + PAYE}{W + NSSF} \times 100 \quad (3)$$

In addition to the tax on wages and salaries (W), equation (3) incorporates all (i.e. total) social security contributions $NSSF$ (Total) and payroll taxes ($PAYE$) as part of the revenue derived from labour income taxes, and expands the tax base to include the employers' contribution to social security ($NSSF$)—since households are not taxed on the portion of compensation to employees that represents social security contributions by firms.

The effective tax rate on labour income is computed after dividing the average tax revenue from total collection on corporate payroll and not used to finance retirement pensions in the social security system by the aggregate payroll. The effective tax rate on

capital income (including taxes on income, profits and capital gains of individuals, taxes on property and financial transactions) is obtained by dividing the average tax revenue by aggregate income tax.

$$\tau_h = \left(\frac{\text{PAYE} + \text{TRK} + \text{GK}}{\text{SO} + \text{TP} + W} \right) \times 100, \quad (4)$$

Pre-tax household income is defined as the sum of wage and non-wage individual income (i.e. the sum of wages and salaries, property and entrepreneurial income, and the operating surplus of private unincorporated enterprises). PAYE = tax revenue on personal income, TRK= revenue on capital income tax, GK = capital gains of individuals, SO = operating surplus of private unincorporated enterprises, TP = household's property and entrepreneurial income, W = total wages and salaries. In practice, however, computing this tax rate is difficult because of the manner in which data on income taxes and other taxes based on labor income are reported.

3.4.2 National accounts data

A number of models use National Accounts data published by national statistics office, survey data on households and firms, and other administrative data to capture the complex transactions in the economy. Often this data provides a snapshot of the economy in a single year, which is used as a benchmark data for a baseline to compare policy simulations against.

3.4.3 Social Accounting Matrix

A number of CGE models are calibrated to a Social Accounting Matrix (SAM), which is a complete, consistent, and disaggregated data system. SAM is an accounting framework which encapsulates aggregate structural interrelationships amongst the various agents in an economy. The underlying data is linked together through a set of equations that governs how the economy evolves over time in response to a policy change. These equations, which are based on the economic theory of general equilibrium, ensure supply and demand for goods, services and factors of production in the economy are balanced, and determine how firms and households respond to changes in tax policies and other incentives.

Metin Karadag and Tony Westaway (1999) applied A SAM-Based Computable General Equilibrium Model of the Turkish Economy to analyse the consequences of the approximation of Turkish VAT rates to those within the European Union in preparation for full membership of the European Union and the results of these simulations can be found in Karadag (1997), and Karadag and Westaway (1998, 1999).

4 Implementation of policy scenarios

The pre-policy baseline is generated from the base year data and the impact of a policy is estimated by measuring deviations from the baseline following the policy change. All models seem to consider sensitivity analysis as they explore how robust the results are to alternative values of key parameters in the model.

Given the effective tax rates, the national-level policy analysis consists of investigating the effects of changes in tax rates and bases of personal and corporate income taxes, value added tax and excise taxes on government tax revenue. Tax harmonization is modeled as an agreed common tax rate or base on capital income that is a linear combination of the tax rates currently in place. At current tax rates, tax harmonization implies a capital tax cut for the country with higher effective tax rates than a benchmark average rate for the group and a tax hike for a country with effective tax rate that is lower than the benchmark average effective rate for the group.

5 Summary and conclusions

Quantifying the welfare impacts of tax harmonization has been an area of intense research over the past three decades, and a variety of methodologies have been employed to address the issues involved. This paper surveys over thirty five studies that attempt to measure empirically the revenue gains from tax harmonisation; to document the approaches they employ. Three groups of studies emerge, those that use cross-country regression, partial equilibrium analysis, and applied general-equilibrium (CGE) approaches

—CGE being the most popular among methodologies in current use. While the use of static applied general equilibrium models seems to have been the common practice in the 1980s, the use of dynamic models has since overridden static models—generating useful insights.

This paper finds that the relationship between tax rates and tax revenues is ambiguous especially among similar economies. In most of the cases, gains from tax harmonisation are reaped by countries moving from high tax rate (where harmonisation involves adjustment in rate) to low-tax position. Yet, results vary, depending on whether harmonisation involves only income tax, consumption taxes or both. As such, there is no simple conclusion that can be drawn about the revenue impact of tax harmonisation.

Where the gains are widely distributed among participating countries, studies find that they are usually very modest in scope (a fraction of 1% of GDP). Small countries end up with less tax revenues. In 1988, Jocelyn Horne and Paul Masson surveyed a number of studies that attempted to measure empirically the gains from policy coordination. Most studies found relatively modest gains from coordination (Horne and Masson 1988; and Fischer 1988), a fact that Canzoneri and Henderson (1991) attribute to the nature of the exercise: the studies allow for gains from joint stabilisation, but not from eliminating permanent conflicts. However, most studies uphold revenue neutrality assumption are not able to capture the possibility that some individuals and firms are attracted to higher tax jurisdiction if the ensuing government spending is beneficial to them.

One may speculate that allowing government expenditure to adjust may give rise to larger prospective gains, but only to the extent that revenues from higher tax burden go to solving domestic incentive problems. However, different parameterization and ways of conducting the tax harmonisation make it difficult to compare results.

Finally, while there remains room for novel empirical contributions, there is perhaps even greater demand for theoretical work to improve our understanding of the underlying mechanism that drives changes in national revenues, GDP and other bases of tax revenue due to a country's specific tax policies and that of its trading partners, and how it translates into the amount of public services provided by governments. And, whether there is any parallelism or inherent logical relationship between the degree of harmonisation pursued, and revenue/welfare dynamics.

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