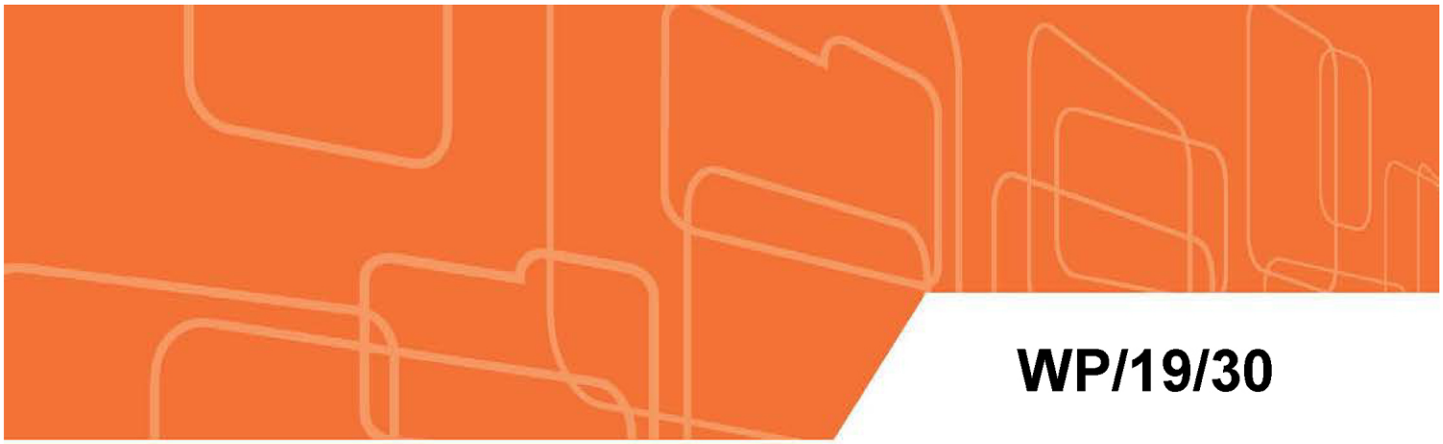

WP/19/30

IMF Working Paper

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Fiscal Affairs Department

Structural Transformation and Tax Efficiency

Prepared by Serhan Cevik, Jan Gottschalk, Eric Hutton, Laura Jaramillo, Pooja Karnane and Mousse Sow*

Authorized for distribution by Era Dabla-Norris

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Abstract

Structural transformation has resulted in an increasing share of services in aggregate value-added in advanced and developing countries across the world. We analyze the impact of this shift into services on countries' efficiency in collecting the value-added tax (VAT). The analysis is based on two alternative measures of VAT efficiency: (1) the VAT C-efficiency, using a broad panel of 134 countries over the period 1970-2014; and (2) the VAT gap using a more granular, proprietary dataset that draws on the results of IMF's Revenue Administraion-Gap Analysis Program covering 24 countries over the period 2004-2016. We find that a higher share of services in aggregate value-added reduces the VAT efficiency, and that this adverse effect is mainly a result of a rise of non-tradable services, which in turn contributes to a narrowing of the VAT base.

JEL Classification Numbers: E32, H2, H21, H25

Keywords: Structural transformation, tax efficiency, value-added tax, C-efficiency ratio, tax gap

Author's E-Mail Address: scevik@imf.org, jgottschalk@imf.org, ehutton@imf.org, ljaramillomayor@imf.org, poojakarnane@gmail.com, msow@imf.org

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I. INTRODUCTION

Structural transformation has resulted in an increasing share of services in aggregate value- added in both advanced and developing economies. Between 1970 and 2014, the share of services in aggregate value-added increased by over 10 percentage points in both advanced and developing countries—with non-tradable services having a rising proportion—and the share of manufacturing has fallen in the case of advanced economies and stagnated among developing countries[1] (Figure 1). Furthermore, both services and manufacturing sectors have become more intensive in services inputs.[2]

There is a growing literature on how structural transformation affects productivity growth and human capital accumulation. However, little research has been done on how structural transformation affects tax efficiency over time and across countries. The process of structural transformation is a multi-dimensional phenomenon that may have diverging effects on a country's efficiency in mobilizing revenue.

In this paper, we examine empirically whether structural transformation alters a country's efficiency in collecting taxes, as structural transformation encompasses many dimensions that may have diverging effects on a country's tax efficiency. Structural transformation is associated with a higher level of per capita income and greater institutional development that are likely to result in improvements in tax revenue collection. Controlling for the quality of institutions, revenue mobilization typically improves as countries reduce their reliance on a large agricultural sector dominated by small farms and a large informal sector. However, changes in consumption and investment patterns may have an adverse effect on tax revenue performance if the tax administration fails to adapt by removing exemptions and improving compliance in services. For instance, services sectors tend to benefit from a broader spectrum of exemptions in taxation than manufacturing. Structural transformation towards services may shift traditional forms of employment to self-employment, which may be more difficult to tax. Furthermore, if the economy shifts into lower-productivity services, this could lower aggregate growth, and thereby affect taxation.

We use panel regression analysis to explore how an increasing share of services in the economy affects value-added tax (VAT) efficiency. We focus on the VAT because it has become a major source of government revenues across the world, and because there are well-defined measures to depict its performance. As of 2017, there were 118 countries with a VAT in place (Table 1). The VAT is levied on the sale of goods and services and, therefore, the ultimate base of the VAT is final consumption. Accordingly, the VAT efficiency captures the departure of actual VAT revenues from the revenues that would be yielded by a perfectly enforced tax levied at a uniform rate on all consumption.

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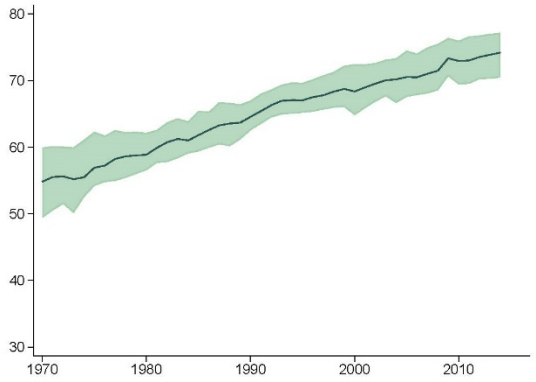
[1] Many countries have also been experiencing a process of premature deindustrialization before achieving a critical mass in manufacturing and reaching high-income status (Rowthorn and Ramaswamy, 1999; Autor and Dorn, 2013; Rodrik, 2016).

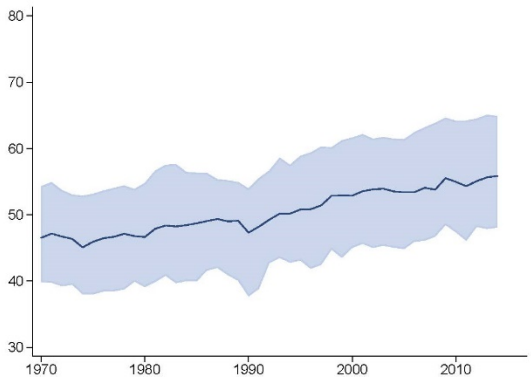
[2] In the U.S. economy, for example, the share of services inputs in manufacturing increased from 26 percent in 1970 to 35 percent in 2010, while the share of services inputs in services rose from 65 percent to 83 percent (Galesi and Rachedi, 2018).

Figure 1. Structural Transformation

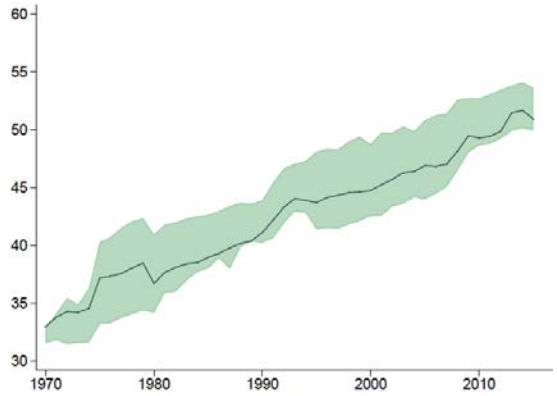
Advanced Countries
(Share of services in total value-added, percent)



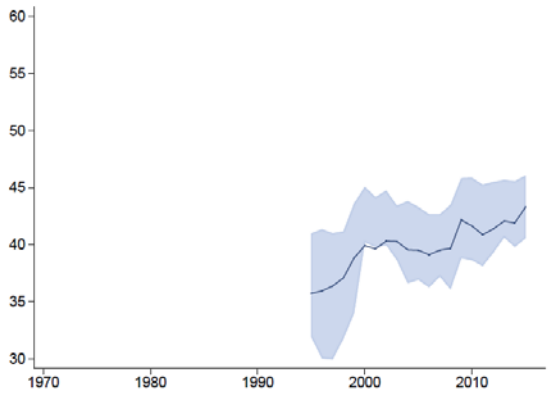
Developing Countries
(Share of services in total value-added, percent)



Advanced Countries
(Share of non-tradable services in total value-added, percent)



Developing Countries
(Share of non-tradable services in total value-added, percent)



Note: The solid lines and shaded areas denote the simple average and interquartile range across countries, respectively, for the sample comprising 42 advanced and 92 developing countries. For developing countries, disaggregated value-added data are not available prior to 1995.

Source: UN Value-Added Database, Authors' calculations.

Table 1. VAT Summary Statistics

	Advanced	Developing
Countries	27	91
VAT Rate	17	20
VAT Revenue (% of GDP)	7.2	7.0

Source: WoRLD database, GFS, OECD Revenue Statistics, Authors' calculations

We rely on alternative measures of VAT efficiency, with different levels of granularity and across two separate databases:

1. *VAT C-efficiency*. This is measured as the ratio of actual VAT revenues to the product of the standard rate and final consumption. We use a panel dataset that covers 134 countries, including both advanced and developing economies, from 1970 to 2014;

2. *VAT gap, compliance gap, and policy gap*. We draw on the estimates of these gaps from the IMF's Revenue Administration Gap Program (RA-GAP) framework applied to 24 countries over the period 2004-2016. The VAT gap is measured as the difference between potential revenues and actual revenues.[3] For greater insight into the drivers of the VAT gap, it can be decomposed into a compliance gap and a policy gap (Keen, 2013; Hutton 2017). While the compliance gap shows the effectiveness of revenue administration and taxpayer compliance, the policy gap captures the impact of tax policy choices, such as adoption of differentiated rates and exemptions.

In an empirical analysis of this nature, it is necessary to address the issues of omitted variables bias and reverse causality. Accordingly, we use the two-stage least squares (2SLS) methodology with instrumental variable (IV), and also implement dynamic modeling with the system GMM approach to take into account persistency in measures of tax efficiency over time.

Our results suggest that existing VAT regimes in both advanced and developing countries will be increasingly challenged by structural transformation that narrows the VAT base. Our empirical findings indicate that an increase in the share of services in aggregate value-added reduces VAT C-efficiency. The effect is significantly higher in advanced economies than in developing economies. We find that the adverse effect is mainly a result of the rise of non-tradable services, such as accommodation and food services, healthcare and social services, and public administration and security-related services. These findings reveal that in several countries non-tradable services are subject to favorable tax treatments: non-market services (such as public education and public healthcare) are typically exempt from VAT, and hospitality services often benefit from reduced VAT rates. Our more granular analysis confirms that a rising share of services leads to a widening of the VAT gap. Moreover, we find a significant impact of structural transformation on the policy gap. This is driven by the fact that a large part of the services sector—namely the public and financial services—are exempt from VAT. Therefore, a shift into services will mean a smaller tax base, and consequently a larger policy gap. Meanwhile, the effect on the compliance gap is insignificant, as there is not such a substantial difference in tax compliance across sectors.

The remainder of this paper is structured as follows. Section II provides an overview of the literature dealing with structural transformation and tax efficiency. In Section III, we provide an overview of the VAT system, discussing the treatment of the manufacturing and services sectors. Section IV presents the datasets used in this paper and the salient trends in structural transformation and VAT C-efficiency across the world. Section V presents the analysis looking at

[3] The VAT gap is analogous to the VAT C-efficiency measure. VAT C-efficiency is the ratio of actual revenues to potential revenues, while the VAT gap is the difference between potential and actual revenues.

VAT C-efficiency, explaining the econometric strategy and empirical results. Section VI develops a more granular analysis looking at the VAT, compliance, and policy gaps. In Section VII, we provide concluding remarks with policy implications.

II. Related Literature

A vast and bourgeoning theoretical literature has examined structural transformation—commonly defined as sectoral reallocations of labor and output as countries develop. In his Nobel prize lectures, Kuznets (1973) listed structural transformation as one of the six characteristics of modern economic growth. Specifically, structural transformation results in a gradual decline in relative size of the agriculture sector and a corresponding rise in manufacturing and services. With an increasing level of income per capita, services become the largest sector of the economy. Recent theoretical studies focus on sectoral differences in factor shares, capital deepening, technological progress, and productivity growth as the drivers of structural changes in the composition of production and employment (Kongsamut, Rebelo, and Xie, 2001; Ngai and Pissarides, 2007; Acemoglu and Guerrieri, 2008; and Duarte and Restuccia, 2010).

Empirical studies generally confirm theoretical predictions, identifying a robust connection between the level of income and diversification of economic activity. A growing number of studies document the transformation of economic activity in terms of output and employment into services in advanced and developing countries (Imbs and Wacziarg, 2003; Buera and Kaboski, 2009, 2012; Alvarez–Cuadrado and Poschke, 2011; and IMF, 2018).[4] Nickell, Redding, and Swaffield (2008) find that the decline in manufacturing as a share of aggregate value-added is a result of differences in total factor productivity (TFP) and changes in the relative price of manufacturing and non-manufacturing goods. More recently, using a large panel of 168 countries over the period 1970-2010, Dabla-Norris and others (2013) show that a sizable proportion of the cross-country variation in sector shares can be accounted for by country characteristics, such as real GDP per capita, demographic composition, and population size. It also finds that policy and institutional variables, such as product market reforms, openness to international trade, human and physical capital accumulation, and financial development improve the baseline model's ability to account for the variation in sectoral shares across countries.

Our study is also linked to the literature on tax capacity. Several studies find a strong negative relationship between the relative size of the agricultural sector, a country's level of per capita income, and tax revenues as a share of GDP (e.g., Tanzi, 1992). Subsequent studies show that a wide range of macroeconomic and demographic factors (such as real GDP per capita, consumer price inflation, share of agriculture in GDP, natural resource rents, trade openness, foreign aid, human capital, and urbanization) explain cross-country differences in tax revenue performance (Ghura, 1998; Teera and Hudson, 2004; Besley and Persson, 2014; Castro and Camarillo, 2014; and Morrissey and others, 2016). These studies also provide compelling evidence indicating that

[4] Lewis and others (2018) find that, as of 2015, trade openness would have been 23 percentage points of world GDP higher if the structure of economic activity had remained unchanged since 1970.

institutional factors (such as bureaucratic quality, corruption, government stability, and the rule of law) shape a country's efficiency in tax mobilization.

With regards to the specific determinants of VAT efficiency, the existing empirical literature identifies the VAT base and rates, administrative efficiency, institutional environment, and the business cycle as important (Bogetic and Hassan, 1993; Aizenman and Jinjarak, 2008; Keen and Lockwood, 2010; Sancak, Velloso, and Xing, 2010; Sarmento, 2016; Ueda, 2017). In this context, the effectiveness of the VAT system, as measured by the VAT C-efficiency ratio, becomes the most important determinant of the evolution of VAT revenues over time and across countries (Keen, 2013; Ueda, 2017). To the best of our knowledge, there is no existing study looking at the effect of structural transformation on VAT efficiency or other measures of tax performance.

III. AN OVERVIEW OF THE VAT SYSTEM

The VAT is a general consumption tax assessed on the value-added to goods and services at each stage of the production process. It applies, in principle, to all commercial activities by registered businesses with annual turnover above a certain threshold as determined by law. One of the principle intents of a VAT system is that, compared to other consumption taxes, it should be more *economically neutral*—that is, it does not implicitly distort prices between different activities. VAT does not tax intermediate production inputs, which prevents distortions in the allocation of factor inputs. If a uniform rate is applied to all final consumption, VAT avoids the distortion of consumption choices (Mankiw, Weinzierl, and Yagan, 2009). In contrast, a simple sales tax distorts prices implicitly due to restrictions in scope of the tax or through *cascading*—where tax might be levied at different points in the supply chain of a commodity, leading to differences in effective tax rates across goods and services at the time of final consumption.

While there is great variance in the specific design features of VAT systems around the world, they all generally adhere to a few common basic principles. Most VAT systems are *destination-based:* they tax imports and remove all the tax on exports. Most VAT systems in the world work on the *credit-invoice* basis: businesses pay VAT on all their sales but receive credit for the VAT paid on their purchases of intermediate goods and services. Most VAT legislation is drafted in an *exclusionary* manner: commercial activity is taxable unless otherwise explicitly excluded, as opposed to having to specifically identify taxable activity. This last feature has resulted in the VAT being generally *broad-based*, at least as compared to other types of consumption taxes.[5]

The economic benefits of VAT are maximized if the tax base is comprehensive, meaning that all final consumption is subject to a uniform tax. VAT exemptions not only distort consumption choices, but they also distort competition (as exempt sectors face different input prices across countries) and create a bias towards self-supply and towards imports (Crawford, Keen and Smith. 2010). [6]

[5] For a more thorough discussion of the economic principles behind the VAT, and the design of VAT systems, see Ebrill and others (2001).

[6] Reasons put forward for taxing some goods and services at different rates are equity concerns (to alleviate the potentially regressive nature of consumption taxes), efficiency (to mitigate distortions that arise elsewhere in the

Most VAT systems do not have a comprehensive tax base due to explicit policy choices. It is quite common for countries to apply favorable tax treatment for certain goods and services through: (1) *exemptions* (a supply that is not taxable, but for which the vendor cannot receive any credit for VAT on associated purchases that went into making the supply); (2) *zero-rates* (a supply that is not taxable, but for which the vendor can still receive credit for VAT on associated purchases that went into making the supply); or (3) *reduced rates* (a supply subject to a rate below the standard VAT rate). Medical supplies and other goods deemed to be basic necessities, certain printed materials, and housing stock are commonly subject to some form of tax reduction.[7] In terms of services, non-market services (such as public administration, medical and dental care, social series, and education) are typically exempt, as are the services of charities, unions, and religious organizations.[8] Most VAT regimes also exempt margin-based financial services and life insurance premiums.[9] It is also quite common to have reduced rates for some hospitality services—hotel accommodations being a little more common than restaurant services.

IV. A First Look at the Data

Data sources

To analyze the link between structural transformation and tax efficiency, we first compile cross-country datasets with alternative indicators for VAT efficiency. VAT C-efficiency is computed as the ratio of the actual VAT revenue over the potential VAT revenue, which is estimated by applying the standard VAT rate to the full VAT base proxied by final consumption of government, households, and corporations. Data on VAT revenues is obtained from the IMF Global Financial Statistics (GFS) database, the OECD Tax Revenue dataset, and the World Revenue Longitudinal Database (WoRLD). Data on statutory VAT rates is taken from an IMF database on tax rates, based on information compiled from the European Commission, Eurostat, International Bureau of Fiscal Documentation, KPMG, ASSI, Inter-American Center of Tax Administrations, Mansour (2014, 2015), and the USAID Collecting Tax Database, and supplemented with information from national sources. Data on public and private consumption is taken from the World Bank's World Development Indicators (WDI) database. We compile an unbalanced panel with annual observations on VAT C-efficiency for 134 countries, both advanced and developing, for the

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tax system), and positive consumption externalities (to promote consumption of goods and services deemed desirable, assuming that consumers do not fully take into account their positive effects when making consumption decisions). Several studies have questioned these justifications. See Institute for Fiscal Studies et al. (2011, 2013), Mathis (2004), and Ebrill and others (2001).

[7] The EU VAT Directive (2006/112/EC) allows for reduced rates on foodstuffs, supply of water, pharmaceutical products, medical equipment, children's car seats, transport of passengers and accompanying luggage, books and periodicals, cultural events, broadcasting, services provided by artists, provision of social housing, suppliers for use in agricultural production, provision of accommodation, sporting events, charities, undertakes, medical and dental equipment, street cleaning and waste treatment, minor repairing, renovation of private dwellings, domestic cleaning, domestic care services, hairdressing, and restaurant services.

[8] Among services in European Union countries, VAT exemptions typically apply to out-patient and hospital services, postal services, education, social protection, insurance services and financial services (IFS et al. 2013).

[9] This is due to the complexity in capturing the value-added generated from these services using a credit-invoice VAT system. Zee (2004) provides a thorough discussion of the application of VAT to financial services.

period 1970-2014. The appendix provides the list of countries (Table A1) and summary statistics (Table A2). We also compile data on the VAT, compliance, and policy gaps, drawing on the estimates from the RA- GAP. The RA-GAP series are based on a proprietary database that covers 24 countries over the period 2004-2016. A detailed description of the RA-GAP methodology is provided in Section VI.

Next, we compute an indicator of structural transformation, measured by services as a share of aggregate value-added. Data on production is taken from the UN Value-Added database (ISIC Rev. 3, covering the period 1970–2014). This database covers 17 subsectors (10 within the services sector). We also use disaggregated indicators of structural transformation in order to better identify the channels through which structural transformation is affecting taxation, focusing on three different services subsectors: (i) wholesale and retail trade (*Trade*), (ii) transport and telecommunication (*Trans-Com*), and (iii) others including financial and real estate activities, education, healthcare and other social services (*Others*). As an alternative measure of structural transformation, we also use the ratio of value-added in services to value-added in manufacturing and mining.

We are able to refine these definitions for a subset of advanced and emerging market countries by identifying tradable and non-tradable services. We draw on more disaggregated sectoral data from the EU KLEMS database (ISIC Rev. 4) that covers 34 subsectors (18 within the services sector) over the period 1973-2012 and Eurostat (NACE Rev. 1) that covers 31 subsectors (10 within the services sector) over the period 1975-2014. We define non-tradable services broadly in line with Hutton (2017), European Central Bank (2012), and Tressel and Wang (2014). Initially, we restrict the non-tradable group to accommodation and food services, public administration and defense, and healthcare and social services. We also use alternative definitions as robustness checks: (1) expanding the above coverage of non-tradable services to include education, postal services, and transportation and storage; (2) using the ratio of exports to value-added to differentiate between tradable and non-tradable (Mano and Castillo, 2015; Amador and Soares, 2012); and (3) following the definition of Jorgenson and Timmer (2011) of non-market services, which include public administration, education, health, and real estate. Given our focus on the link with tax revenues, our indicators are constructed using nominal values, as the VAT base evolves in nominal terms. Table A3 presents summary statistics for the services sector and Table A4 displays the list of services classified as tradable and non-tradable sectors.

With regard to control variables used in the regression analysis, we follow the existing literature and include a wide range of macroeconomic and institutional factors. Data are drawn from multiple sources. The data for real GDP per capita, the GDP deflator, trade as a percent of GDP, and urbanization are taken from the World Development Indicators. The output gap is constructed using an HP filter. Urbanization is measured as the urban population as a percent of total population. Multiple variables are used to capture the quality of institutions: data on corruption is the inverted Corruption Perception Index, taken from the Transparency International and data on government effectiveness is taken from the International Country Risk Guide (ICRG).

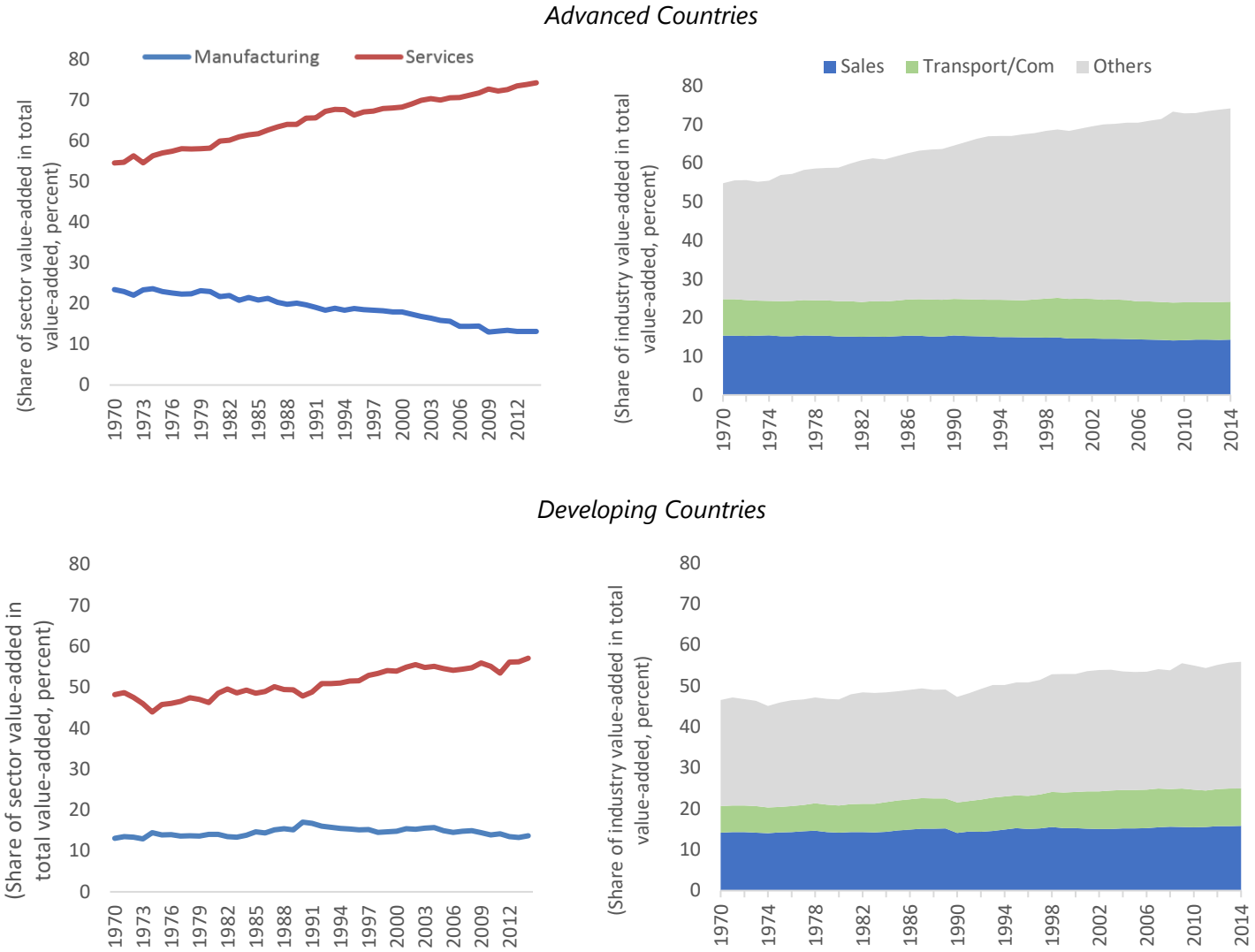
Stylized facts

The decline in manufacturing and rise in services in output has been a longstanding phenomenon in the case of advanced countries. Between 1970 and 2014, the share of services in aggregate value-added increased by an average of 10.7 percentage points in advanced economies, while the share of manufacturing fell by 2 percentage points (Figure 2, panel 1). With respect to the composition of services, it is mostly the category "others" that is driving the increase in the value-added share of services (Figure 2, panel 2). Many of the activities in this category are often excluded from the VAT base—e.g., financial intermediation, public administration, health and education activities—which implies that a shift of economic activity (in nominal terms) from manufacturing to these services tends to undermine efficiency of VAT collection. This is indeed visible when looking at the long-run change in the VAT C-efficiency plotted against the long-run change in structural transformation (Figure 3, panel 1).

In many developing countries, the rising share of services in aggregate valued added has outpaced manufacturing. The value-added share of manufacturing has been essentially flat since the 1970s.[10] At the same time, services have been rising rapidly, increasing by 10.2 percentage points between 1970 and 2014 (Figure 2, panel 3). Taking a closer look at developments in the services sector, the rise in the value-added share of "others" is again an important driver for the overall increase in the share of services, but so is "transport, storage, and communication" activities (Figure 2, panel 4). The former would narrow the VAT base, while the latter would expand it, therefore the impact on the VAT C-efficiency is uncertain (Figure 3, panel 2).

[10] A slight decline in the share of manufacturing is visible since the early 1990s, which is one of the factors that has given rise to the literature on deindustrialization.

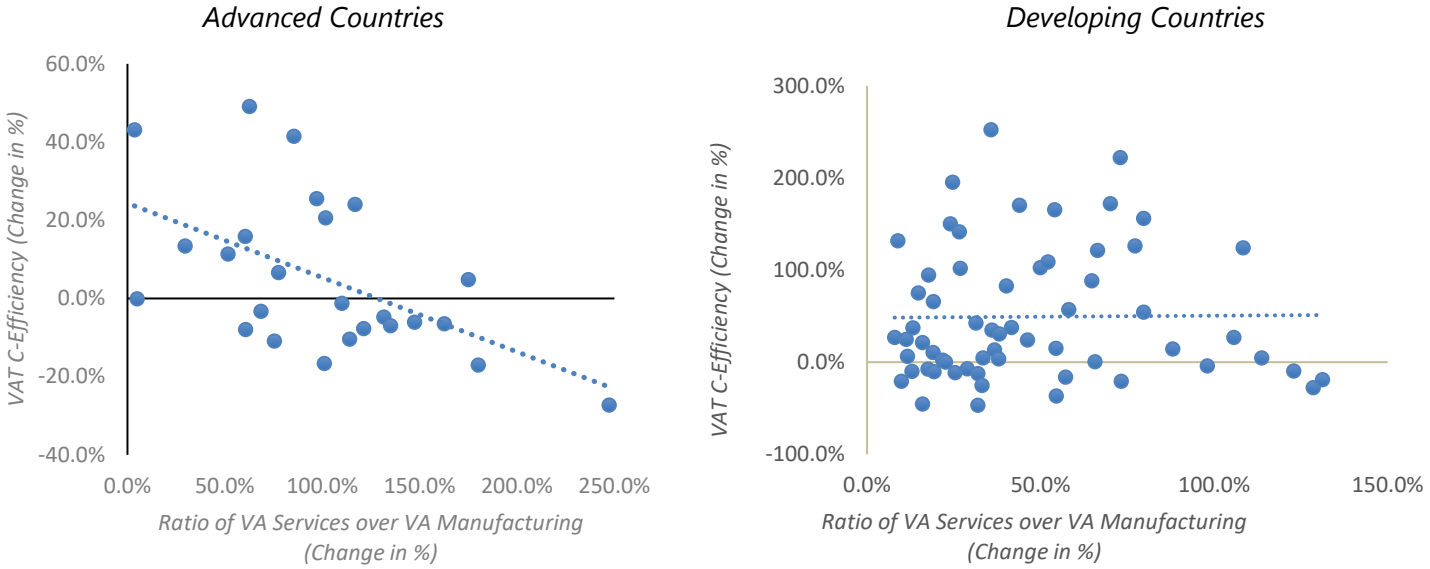
Figure 2. Trends in Services and Manufacturing



Source: UN Value-Added Database, Authors' calculations.

Note : VA=Value-added. The sample comprises 42 advanced economies and 92 developing economies. The sample period covers 1970-2014. Value-added is measured in nominal terms. Left hand side charts show median across country groups. The shaded areas in the right-hand side charts indicate the share of total value-added for each subdivision of services. An outlier correction removes the largest 3-percentile of observations.

Figure 3. Long-Run Changes in Structural Transformation and Tax Efficiency



Sources: Eurostat, UN Value-Added Database, Authors' calculations.
Note: VA=Value-added. The sample comprises 42 advanced economies and 92 developing economies. The sample period covers 1970-2014. Long-run changes correspond to the difference between the values in 2014 and the earliest available observation for both variables. Value-added is measured in nominal terms. An outlier correction removes the largest 3-percentile of observations.

V. Analysis Looking at VAT C-Efficiency

Empirical strategy

Drawing on the existing literature, we explore how an increasing share of services in aggregate value-added affects tax efficiency—measured by the VAT C-efficiency—in a panel setting according to the following model:

$$\begin{cases} VAT_{it}^{C_{eff}} = \alpha + \gamma ST_{it} + \sum_{k=1}^{K} \varphi_k Z_{k,it} + \eta_i + \partial_t + \varepsilon_{it} \\ VAT_{it}^{C\_eff} = \frac{VAT\_rev_{it}}{VAT\_rate_{it} \times \zeta_{it}} \end{cases} \quad (1)$$

where $\mathrm{VAT}_{it}^{C-eff}$ stands for the VAT C-efficiency in country *i* at time *t*. A higher ratio implies a smaller distance between the VAT potential and actual VAT collection, indicating more efficiency in revenue collection.

We include a set of control variables ($Z_{k,it}$) to isolate the impact of the level of per capita income, population size, and terms of trade. Additional controls include the output gap, inflation, the urbanization rate, and quality of institutions (government effectiveness and corruption). The η_i coefficient denotes country-specific fixed effects capturing time-invariant unobservable, while

the ∂_t coefficient denotes time fixed effects capturing common shocks that may affect the VAT performance across all countries in a given year. ε_{it} is an idiosyncratic error term that satisfies the standard assumptions of zero mean and constant variance.

To address endogeneity concerns, we introduce real GDP per capita and the standard VAT rate with a lag, and estimate the model using the 2SLS-IV approach. Following Olney and Pacitti (2017), the contemporaneous measure of structural transformation is instrumented with its first and second lags. All control variables are log-transformed, except for the institutional indicators, which are standardized across all countries in the sample.

Results

Table 2 presents our baseline results. A rising share of services in the economy has a highly significant negative effect on the VAT C-efficiency. The coefficient on structural transformation is negative across all specifications. The results indicate that a 10 percent increase in the share of services in GDP reduces the VAT C-efficiency by as much as 3.6 percent (Table 2, column 1). Including time fixed effects, we show that the effect of structural transformation is not driven by common global shocks that may influence the VAT C-efficiency across all countries (column 2).

To probe further, we use disaggregated indicators of structural transformation. We focus on three different subsectors: (i) wholesale and retail trade (*Trade*), (ii) transport and telecommunication (*Trans-Com*), and (iii) others, which includes financial and real estate activities, education, healthcare and other social services (*Others*) (Table 2, columns 3-5). The results indicate that the reduction in the VAT C-efficiency caused by a higher share of services in aggregate value-added is largely driven by the rise of "other" services, including financial services and real estate. In contrast, the increasing share of wholesale and retail trade appears to improve the VAT C-efficiency. We find no significant impact when structural transformation occurs through an increasing share of transportation and telecommunication services.

The coefficients for the control variables are broadly comparable to the findings in previous cross-country studies on the determinants of tax efficiency. The estimated coefficients on real GDP per capita, trade openness and urbanization have the predicted positive sign with statistical significance. Likewise, the quality of institutions matters for a country's efficiency in domestic revenue mobilization. We also find that tax efficiency tends to improve during economic upswings when real GDP growth is above potential. The estimation results also indicate that an increase in the standard VAT rate has a negative effect on tax efficiency across all specifications.[11]

[11] As shown in Table 4, the estimations using country subsamples indicate that the negative effect of a higher standard VAT rate on the VAT C-efficiency is significant only in developing countries. This may reflect better compliance in advanced economies. There might also be a tendency to increase the standard VAT rate to deal with administrative weaknesses, which result in a significant inverse relationship between the standard VAT rate and C-efficiency in developing countries.

Table 2. Structural Transformation and Tax Efficiency: Baseline Estimations

	(Dependent variable: VAT C-efficiency)				
	(1)	(2)	(3)	(4)	(5)
VA Services / Aggregate VA	-0.361**	-0.333*			
	(-2.193)	(-1.907)			
Sales			0.287***		
			(3.015)		
Trans-Com				-0.102	
				(-1.477)	
Others					-0.366***
					(-3.006)
Real GDP per capita	0.203***	0.212***	0.176***	0.196***	0.218***
	(4.162)	(3.668)	(2.879)	(3.208)	(3.832)
Standard VAT rate	-0.021***	-0.020***	-0.019***	-0.020***	-0.019***
	(-4.859)	(-4.388)	(-4.257)	(-4.548)	(-4.235)
Share of agriculture	-0.093***	-0.037	-0.041	-0.019	-0.06
	(-2.690)	(-0.939)	(-1.088)	(-0.522)	(-1.490)
Trade openness	0.160***	0.112**	0.134***	0.129***	0.098**
	(4.021)	(2.283)	(2.809)	(2.669)	(1.999)
Government effectiveness	0.016***	0.018***	0.018***	0.018***	0.019***
	(2.815)	(3.273)	(3.236)	(3.152)	(3.466)
Urbanization	0.282**	0.229	0.300**	0.291*	0.204
	(2.202)	(1.581)	(2.069)	(1.934)	(1.412)
Corruption	-0.006	-0.007	-0.005	-0.007	-0.007
	(-1.123)	(-1.232)	(-0.982)	(-1.308)	(-1.237)
Output gap	0.874***	0.773***	0.773***	0.819***	0.693**
	(3.637)	(2.645)	(2.734)	(2.854)	(2.385)
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	No	Yes	Yes	Yes	Yes
Observations	1391	1391	1391	1391	1391
Countries	110	110	110	110	110
R^2	0.18	0.21	0.23	0.21	0.22
Fisher (p-value)	0.00	0.00	0.00	0.00	0.00
Hansen OID (p-value)	0.47	0.76	0.79	0.03	0.58
KP Under-ident. (p-value)	0.00	0.00	0.00	0.00	0.00
KP Weak-ident. (F-stat)	94.25	107.40	200.50	328.00	316.70

*, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent level, respectively. T-statistics based on robust standard errors are reported in brackets.

Note: Our main explanatory variable of interest is structural transformation, which is considered to be endogenous. Accordingly, all equations are estimated using the 2SLS-IV method. Following Olney and Pacitti (2017), measures of structural transformation are instrumented using its own lags. All controls are log-transformed, except the government effectiveness and corruption variables which are standardized. Fisher's p-values indicate that the estimated coefficients are jointly significant in all specifications. The diagnosis tests reveal that our instruments are valid. The p-values associated with the Kleibergen-Paap (KP) test reject the null hypothesis that the model is under-identified. Also, the high F-stats associated with the KP weak identification test indicate that our instruments are strongly correlated with the endogenous regressor, thus rejecting the weak identification hypothesis. Finally, we do not reject the null hypothesis of the Hansen overidentifying restrictions (OID) that the instruments are uncorrelated with the error term, and correctly excluded from the estimated equation.

A disaggregation of services allows us to identify more narrowly the industries that contribute to the decline in VAT C-efficiency (Table 3). We use the EU KLEMS database for a subset of advanced and emerging market economies. The negative impact of higher share of services is mainly driven by the increase in the value-added share of health and social services, accommodation and food services, public administration, real estate activities, financial and insurance services, and professional activities. These are precisely the industries that tend to receive more favorable tax treatment. In contrast, the increasing value-added shares of retail trade, telecommunication and postal activities result in higher VAT C-efficiency.

There is significant heterogeneity in the impact of services on the VAT C-efficiency depending on countries' level of income. Although the negative impact on the VAT C- efficiency persists across all countries, the magnitude of this effect is significantly greater—more than double—in the case of advanced economies than in developing countries. The results, presented in Table 4, show that a 10 percent increase in the share of services in value-added leads to a decline of 6 percent in VAT C-efficiency in advanced countries (column 1), compared to a drop of 1.1 percent in the case of developing countries (column 5). The results also confirm that this effect is largely driven by the rise in "other" services, which include financial and real estate activities. A 10 percent increase in the ratio of other services to aggregate value-added lowers tax efficiency by 5.3 in the case of advanced economies (column 4), and by about 2.5 percent in the case of developing countries (column 8).

Non-tradable services are found to a greater negative effect on the VAT C-efficiency than tradable services. The estimation results, presented in Table 5, show that increasing the value-added share of non-tradable services has a negative effect on the VAT C-efficiency, and the magnitude of the effect is higher than for tradable services. A 10 percent increase in the share of non-tradable services to aggregate valued added leads to a reduction of 7 percent in the VAT C-efficiency (column 1). Importantly, the coefficient in this specification is larger than that found in the baseline specification that did not distinguish between the tradable and non-tradable services. This finding remains robust to the three alternative definitions of non-tradable services discussed earlier (expanding the coverage of non-tradable services; using the ratio of exports to value-added; and following the description of Jorgenson and Timmer (2011)), albeit with a slightly lower magnitude.

Our baseline results remain robust to alternative specifications. The findings are comparable when we use the ratio of value-added in services to value-added in manufacturing and mining as an alternative measure of structural transformation. We also find comparable results when we use value-added in real rather than nominal terms. Our results are unsensitive to the number of lags used to instrument the structural transformation variable. We further take into consideration the dynamic aspect of the VAT C-efficiency and perform GMM estimates. Our findings hold, with little change in the magnitude of the estimated coefficients. The results are also broadly unchanged when we use VAT productivity (ratio of actual VAT revenues to the product of the standard VAT rate and GDP) instead of VAT C-efficiency as an alternative indicator.

Table 3. Structural Transformation and Tax Efficiency: EU KLEMS Subsector Estimations

(Dependent variable: VAT C-efficiency)

Retail trade	0.152*																
	-1.658																
Wholesale trade		-0.064															
		(-0.802)															
Wholesale, retail and repair			-0.046														
			(-0.929)														
Transport and storage				-0.230**													
				(-2.269)													
Telecommunications					0.009												
					-0.128												
Postal and courier activities						-0.034											
						(-1.137)											
Other services							-0.068										
							(-0.666)										
Arts and entertainment								0.072*									
								-1.942									
Healthcare and social services									-0.09								
									(-0.864)								
Education										-0.099							
										(-1.042)							
Public services											-0.213**						
											(-2.104)						
IT services												0.077					
												-1.387					
Media													0.091				
													-1.602				
Accommodation and food services														-0.404***			
														(-4.616)			
Real estate															-0.147**		
															(-2.449)		
Financial services																0.053	
																-0.7	
Professional services																	-0.086
																	(-0.745)
Real GDP per capita	0.258***	0.242***	0.342***	0.345***	0.339***	0.292***	0.240***	0.244***	0.214***	0.184**	0.172**	0.218**	0.358***	0.241***	0.190***	0.200**	0.246***
	-3.311	-3.106	-3.769	-4.248	-3.527	-3.709	-2.892	-3.051	-2.71	-2.264	-2.135	-1.995	-4.19	-3.507	-2.616	-2.567	-2.746
Standard VAT rate	0.005	0.003	0.001	0.004	0	0.006	0.001	-0.001	0.003	0.003	0.003	-0.001	0.003	0.001	0.006	0.003	0.004
	-0.573	-0.315	-0.126	-0.426	-0.044	-0.631	-0.061	(-0.073)	-0.378	-0.335	-0.288	(-0.083)	-0.347	-0.079	-0.684	-0.372	-0.413
Share of agriculture	-0.029	-0.031	-0.013	0.008	-0.002	0.034	-0.048	-0.032	-0.059	-0.061	-0.057	0.016	-0.019	0.013	-0.044	-0.037	-0.063
	(-0.743)	(-0.796)	(-0.322)	-0.229	(-0.049)	-0.796	(-1.147)	(-0.770)	-1.411)	(-1.425)	(-1.378)	-0.398	(-0.465)	-0.336	(-1.117)	(-0.811)	-1.428)
Trade openness	0.06	0.066	-0.049	-0.057	-0.082	-0.005	-0.059	-0.051	0.047	0.038	0.022	-0.096	-0.04	-0.048	0	0.06	0.044
	-0.591	-0.553	(-0.402)	(-0.470)	(-0.634)	(-0.044)	(-0.426)	(-0.413)	-0.432	-0.354	-0.211	(-0.721)	(-0.359)	(-0.412)	-0.001	-0.569	-0.383
Government effectiveness	0.007	0.008	0.009	0.006	0.006	0.014**	0.009	0.007	0.009	0.008	0.008	0.006	0.008	0.007	0.009	0.008	0.009
	-1.202	-1.458	-1.462	-1.116	-0.962	-2.101	-1.465	-1.199	-1.503	-1.483	-1.34	-1.043	-1.448	-1.287	-1.528	-1.444	-1.469
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Nb. obs	455	455	429	396	415	388	433	433	459	459	459	425	445	459	459	459	459
Countries	30	30	28	26	27	25	28	28	30	30	30	28	29	30	30	30	30
R-sq.	0.35	0.35	0.35	0.41	0.36	0.36	0.34	0.35	0.34	0.33	0.34	0.37	0.36	0.38	0.35	0.34	0.33
Fisher *(p-value)*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hansen OID (*p-value*)	0.36	0.05	0.00	0.33	0.13	0.99	0.47	0.92	0.44	0.25	0.21	0.77	0.09	0.01	0.62	0.49	0.11
KP Under-ident. (*p-value*)	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
KP Weak-ident. (F-*stat*)	44.20	7.92	17.32	87.44	112.60	149.40	57.73	154.10	98.93	113.60	62.10	108.50	131.60	193.70	270.10	112.90	254.20

*, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent level, respectively. T-statistics based on robust standard errors are reported in brackets.

Note: Our main variable of interest is structural transformation, which is considered to be endogenous. Accordingly, all equations are estimated using the 2SLS-IV method. Following Olney and Pacitti (2017), measures of structural transformation are instrumented using its own lags. All controls are log-transformed, except the government effectiveness and corruption variables which are standardized. Fisher's p-values indicate that the estimated coefficients are jointly significant in all specifications. The diagnosis tests reveal that our instruments are valid. The p-values associated with the Kleibergen-Paap (KP) test reject the null hypothesis that the model is under-identified. Also, the high F-stats associated with the KP weak identification test indicate that our instruments are strongly correlated with the endogenous regressor, thus rejecting the weak identification hypothesis. Finally, we do not reject the null hypothesis of the Hansen overidentifying restrictions (OID) that the instruments are uncorrelated with the error term, and correctly excluded from the estimated equation.

Table 4. Structural Transformation and Tax Efficiency: Advanced vs. Developing Countries

(Dependent variable: VAT C-efficiency)								
	Advanced countries				**Developing countries**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VA Services / Aggregate VA	-0.712**				-0.144			
	(-2.470)				(-0.747)			
Sales		0.208*				0.217*		
		(1.935)				(1.763)		
Trans-Com			-0.207**				-0.05	
			(-2.067)				(-0.524)	
Others				-0.534***				-0.249*
				(-2.947)				(-1.958)
Real GDP per capita	0.103	0.114	0.061	0.138*	0.248***	0.209**	0.237**	0.247***
	(1.232)	(1.436)	(0.707)	(1.710)	(2.733)	(2.228)	(2.428)	(2.705)
Standard VAT rate	-0.01	-0.009	-0.012	-0.006	-0.021***	-0.023***	-0.021***	-0.021***
	(-1.116)	(-0.969)	(-1.331)	(-0.638)	(-3.260)	(-3.540)	(-3.289)	(-3.351)
Share of agriculture	0.042	0.042	0.062	0.024	-0.084	-0.083	-0.078	-0.099
	(0.934)	(1.109)	(1.518)	(0.562)	(-1.268)	(-1.288)	(-1.208)	(-1.481)
Trade openness	-0.240**	-0.160*	-0.148	-0.247**	0.232***	0.242***	0.236***	0.223***
	(-2.331)	(-1.725)	(-1.619)	(-2.495)	(3.871)	(3.967)	(3.904)	(3.704)
Government effectiveness	0.012**	0.009	0.012**	0.011*	0.026***	0.028***	0.025***	0.029***
	(1.999)	(1.539)	(1.984)	(1.856)	(2.876)	(2.993)	(2.798)	(3.121)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	628	628	628	628	874	874	874	874
Countries	42	42	42	42	69	69	69	69
R^2	0.25	0.30	0.28	0.27	0.25	0.25	0.25	0.26
Fisher (p-value)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hansen OID (p-value)	0.27	0.69	0.05	0.39	0.82	1.00	0.44	0.20
KP Under-ident. (p-value)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
KP Weak-ident. (F-stat)	32.42	199.8	75.32	100.6	159.1	145.5	215	215.4

*, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent level, respectively. T-statistics based on robust standard errors are reported in brackets.

Note: Our main variable of interest is structural transformation, which is considered to be endogenous. Accordingly, all equations are estimated using the 2SLS-IV method. Following Olney and Pacitti (2017), measures of structural transformation are instrumented using its own lags. All controls are log-transformed, except the government effectiveness and corruption variables which are standardized. Fisher's p-values indicate that the estimated coefficients are jointly significant in all specifications. The diagnosis tests reveal that our instruments are valid. The p-values associated with the Kleibergen-Paap (KP) test reject the null hypothesis that the model is under-identified. Also, the high F-stats associated with the KP weak identification test indicate that our instruments are strongly correlated with the endogenous regressor, thus rejecting the weak identification hypothesis. Finally, we do not reject the null hypothesis of the Hansen overidentifying restrictions (OID) that the instruments are uncorrelated with the error term, and correctly excluded from the estimated equation.

Table 5. Structural Transformation and Tax Efficiency: Tradable vs. Non-Tradable Services

(Dependent variable: VAT C-efficiency)			
	Value-added share		
	(1)	(2)	(3)
Non-tradable	-0.663***	-0.618***	
	(-3.964)	(-3.841)	
Tradable	-0.469**		-0.403**
	(-2.421)		(-2.429)
Real GDP per capita	0.178**	0.154*	0.231***
	(2.352)	(1.926)	(3.195)
Standard VAT rate	0.003	0.000	0.006
	(0.360)	(0.041)	(0.611)
Share of agriculture	-0.071*	-0.061	-0.059
	(-1.784)	(-1.538)	(-1.481)
Trade openness	-0.078	-0.039	0.026
	(-0.655)	(-0.340)	(0.235)
Government effectiveness	0.007	0.006	0.009
	(1.313)	(1.116)	(1.600)
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	459	459	459
Countries	30	30	30
R^2	0.37	0.37	0.34
Fisher (p-value)	0.00	0.00	0.00
Hansen OID (p-value)	0.54	0.98	0.43
KP Under-ident. (p-value)	0.01	0.00	0.00
KP Weak-ident. (F-stat)	8.49	120.60	10.12
$\lvert\beta\rvert_{\text{Non-tr}} > \lvert\beta\rvert_{\text{Trad}}$ (*p-value*)	0.94		

*, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent level, respectively. T-statistics based on robust standard errors are reported in brackets.

Note: Our main variable of interest is structural transformation, which is considered to be endogenous. Accordingly, all equations are estimated using the 2SLS-IV method. Following Olney and Pacitti (2017), measures of structural transformation are instrumented using its own lags. All controls are log-transformed, except the government effectiveness and corruption variables which are standardized. Fisher's p-values indicate that the estimated coefficients are jointly significant in all specifications. The diagnosis tests reveal that our instruments are valid. The p-values associated with the Kleibergen-Paap (KP) test reject the null hypothesis that the model is under-identified. Also, the high F-stats associated with the KP weak identification test indicate that our instruments are strongly correlated with the endogenous regressor, thus rejecting the weak identification hypothesis. Finally, we do not reject the null hypothesis of the Hansen overidentifying restrictions (OID) that the instruments are uncorrelated with the error term, and correctly excluded from the estimated equation.

VI. Granular Analysis Looking at the VAT, Compliance, and Policy Gaps

Empirical strategy

To better infer a causal relationship between structural transformation and VAT efficiency, we draw on the IMF's RA-GAP framework. In particular, a decomposition of the VAT gap allows us to see whether the effect of structural transformation on revenues is driven by effectiveness of revenue administration and taxpayer compliance (compliance gap), or by tax policy choices (policy gap) (Keen, 2013; Hutton 2017). RA-GAP has been applied in more than 25 countries since 2013 (Figure 4). The VAT, compliance, and policy gaps are calculated as follows:

$$VAT\ gap = \frac{Potential\ VAT, current\ policy\ - Actual\ VAT, accrued\ collections}{Potential\ VAT, reference\ policy}$$

$$Compliance\ gap = \frac{Potential\ VAT, current\ policy\ - Actual\ VAT, accrued\ collections}{Potential\ VAT, current\ policy}$$

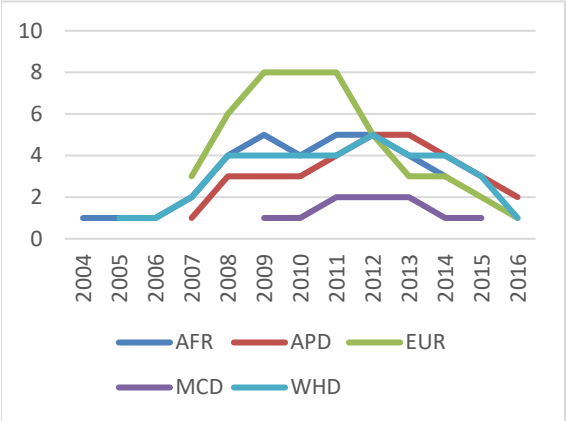
$$Policy\ gap = \frac{Potential\ VAT, reference\ policy\ - Potential\ VAT, current\ policy}{Potential\ VAT, reference\ policy}$$

Figure 5 provides a more detailed illustration of the RA-GAP framework (see Hutton, 2017). Using national accounts data, potential VAT revenues are calculated by estimating the tax applicable on imports by a sector, adding the tax applicable to the domestic output of a sector, and then subtracting any credits for tax applicable to the intermediate demand and gross fixed capital formation (inputs) of the sector used in making taxable supplies.[12] In the case of potential revenues under current policy, the calculation utilizes the current tax rate schedule, therefore taking into account legislated differences in VAT rates across products or services (exemptions, zero-rates, reduced rates) and other treatments (input tax credit restrictions, reverse charge or withholding, presumptive credits, etc.)—in Figure 5, this corresponds to the area within the box ACGD. In the case of potential revenues under the reference policy, the current standard VAT rate is applied to all final consumption—in Figure 5, this corresponds to the area within the box ACHE. Both estimates of potential revenue are under the assumption of full compliance. Actual VAT revenue is calculated using tax administration data, based on actual tax returns and related records. Actual VAT revenue will reflect both the current policy structure, and the current compliance level (box ABFD in Figure 5). The compliance gap can then be estimated as the difference between potential revenue under current policy and actual revenue (box BCGF in Figure 5). The policy gap is estimated as the difference between potential revenue under the reference policy and potential revenue under current policy (box DGHE in Figure 5). Notice that a higher value of the gap indicates less efficiency in revenue collection.

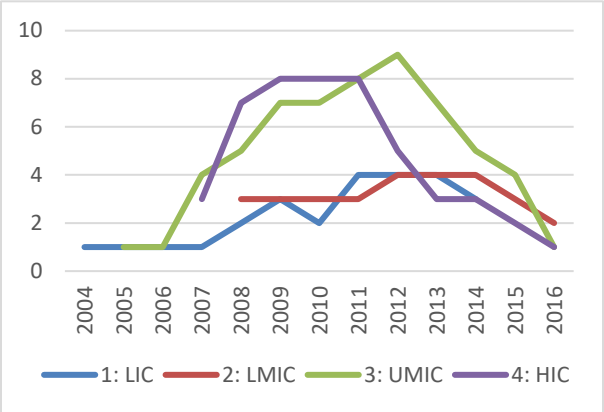
[12] Another common method for estimating potential VAT revenues is to use final consumption and other demand-side data to estimate the VAT paid by final consumers. The two approaches should, in theory, provide the same overall value for the tax gap. The RA-GAP approach, by producing estimates of potential VAT by sector, allows for producing gap estimates on a sector-by-sector basis.

Figure 4. Country Coverage of the IMF's RA-GAP Program

By region
(Cumulative number of countries)

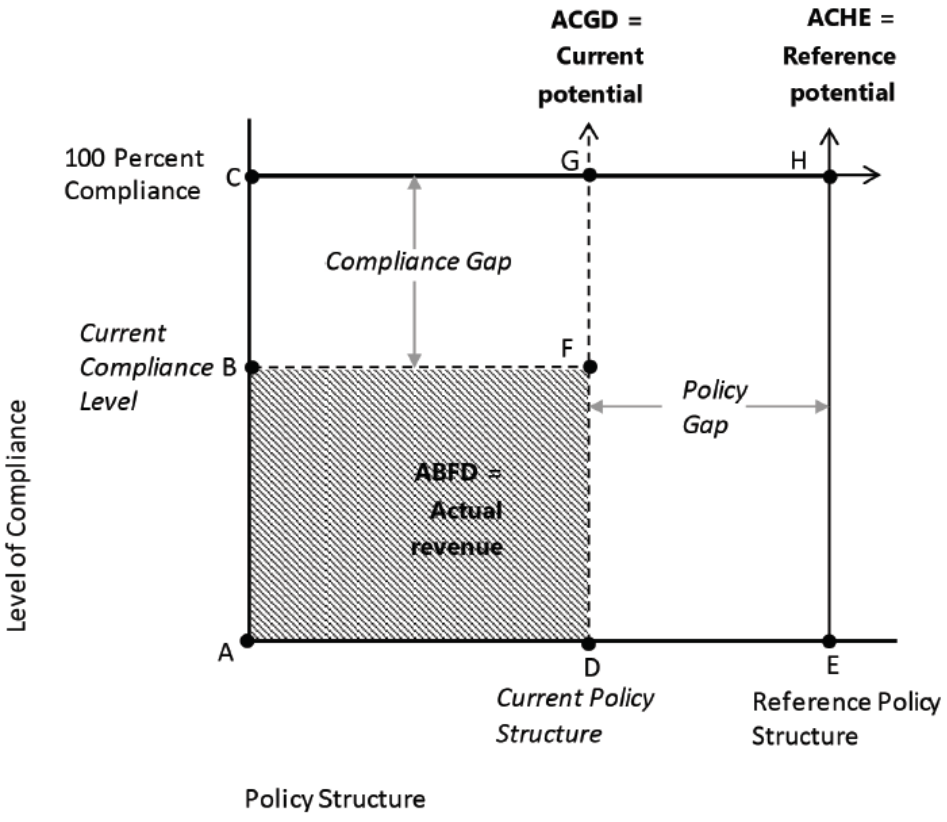


By income group
(Cumulative number of countries)



Source: IMF RA-GAP dataset, authors' calculations.

Figure 5. Breakdown of the VAT Gap into Compliance Gap and Policy Gap



Source: Hutton (2017)

Using the empirical model described in the previous section, we look at the impact of rising services on the VAT, compliance, and policy gaps. Our dependent variable is the VAT gap in Equation (2), and its subcomponents—compliance and policy gaps—in Equation (3). We use the 2SLS-IV method as explained in the previous section:

$$\text{VAT\_Gap}_{it} = \alpha + \gamma ST_{it} + \sum_{k=1}^{K} \varphi_k Z_{k,it} + \eta_i + \partial_t + \varepsilon_{it} \quad (2)$$

$$VAT_{it}^{Comp\_gap}\left[VAT_{it}^{Pol\_gap}\right] = \alpha + \gamma ST_{it} + \sum_{k=1}^{K} \varphi_k Z_{k,it} + \eta_i + \partial_t + \varepsilon_{it} \quad (3)$$

The main explanatory variable of interest remains structural transformation. Similar to the previous models, $Z_{k,it}$ includes several control variables, such as real GDP per capita, the standard VAT rate, trade openness, the share of agriculture in GDP, and a measure for the quality of government institutions.

Results

The findings suggest that a rising services sector, in particular non-tradable services, narrows the VAT base. The estimation results, presented in Table 6, confirm that structural transformation leads to a widening of the VAT gap. In this specification, the results are significant when we use as a measure of structural transformation the ratio of valued added in services to value-added in manufacturing and mining. For every 10 percent increase in services as a share of value-added, VAT gaps are higher by 6 percent (column 4). Moreover, the impact of structural changes in economic activity is larger for the policy gap (column 6), and insignificant for the compliance gap (column 5). Furthermore, disaggregating services into subsectors, we find that the VAT gap and the compliance gap are larger when the economy has a higher share of financial services, real estate, education and healthcare, and other professional services (Appendix Table A5). The results are robust to the change in the number of lags used as instrumental variables.

Table 6. Structural Transformation and Tax Efficiency: VAT, Policy, and Compliance Gap

	Share of total value-added			*Share of value added of manufacturing and mining*		
	VAT gap	*Compliance gap*	*Policy gap*	*VAT gap*	*Compliance gap*	*Policy gap*
	(1)	(2)	(3)	(4)	(5)	(6)
Valued-added share	1.332	-2.933	1.915			
	(-1.238)	(-0.870)	-0.867			
Relative to industry				0.562**	0.194	0.865**
				-2.322	-0.242	-2.136
Real GDP per capita	-0.641*	-0.089	-0.372	-0.523*	0.498	-0.074
	(-1.950)	(-0.083)	(-0.706)	(-1.688)	-0.467	(-0.141)
Standard VAT rate	0.025	0.044	0.036	0.008	0.043	0.016
	-1.023	-0.653	-0.989	-0.371	-0.658	-0.46
Share of agriculture	-0.003	-0.211	0.205	-0.026	-0.003	0.202
	(-0.023)	(-0.429)	-1.193	(-0.256)	(-0.005)	-1.232
Trade openness	0.212	0.14	-0.302	0.314	0.319	-0.152
	-1.002	-0.269	(-0.890)	-1.57	-0.607	(-0.520)
Government effectiveness	-0.022	-0.112	0.018	-0.018	-0.117	0.024
	(-1.182)	(-1.102)	-0.7	(-1.119)	(-1.166)	-0.932
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	118	130	126	118	130	126
Countries	21	24	23	21	24	23
R^2	0.41	0.10	0.20	0.46	0.11	0.21
Fisher (p-value)	0.00	0.00	0.00	0.00	0.00	0.00
Hansen OID (p-value)	0.66	0.29	0.42	0.54	0.52	0.35
KP Under-ident. (p-value)	0.00	0.01	0.00	0.00	0.00	0.00
KP Weak-ident. (F-stat)	6.05	6.18	6.46	10.34	10.74	19.24

*, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent level, respectively. T-statistics based on robust standard errors are reported in brackets.

Note: Our main variable of interest is structural transformation, which is considered to be endogenous. Accordingly, all equations are estimated using the 2SLS-IV method. Following Olney and Pacitti (2017), measures of structural transformation are instrumented using its own lags. All controls are log-transformed, except the government effectiveness and corruption variables which are standardized. Fisher's p-values indicate that the estimated coefficients are jointly significant in all specifications. The diagnosis tests reveal that our instruments are valid. The p-values associated with the Kleibergen-Paap (KP) test reject the null hypothesis that the model is under-identified. Also, the high F-stats associated with the KP weak identification test indicate that our instruments are strongly correlated with the endogenous regressor, thus rejecting the weak identification hypothesis. Finally, we do not reject the null hypothesis of the Hansen overidentifying restrictions (OID) that the instruments are uncorrelated with the error term, and correctly excluded from the estimated equation.

VII. CONCLUSION

This paper offers a new perspective on the impact of structural transformation on tax efficiency as measured by alternative indicators of VAT efficiency. Structural transformation in both advanced and developing countries has resulted in a rising share of the services sector in aggregate value- added. While there is increasing recognition that the process of structural transformation has far-reaching implications, little research has been done on how it affects tax efficiency over time and across countries. In our empirical analysis, we quantify structural transformation by using the share of services in aggregate value-added, and measure tax efficiency through alternative indicators: VAT C-efficiency for a broad panel of 134 countries over the period 1970-2014 and RA-GAP estimates of VAT, compliance, and policy gaps for a panel of 24 countries over the period 2004-2016.

We find that the secular reallocation of economic activity increasingly towards services reduces VAT efficiency. This effect is significantly higher in advanced economies than in developing countries. We find that the adverse effect is mainly a result of the rise of non-tradable services. This is because non-tradable services are often subject to favorable reduced VAT rates and non-market services (such as public education and public healthcare) are typically exempt. These results are consistent, whether looking at VAT C-efficiency or the VAT gap, and also when we focus more narrowly on the policy gap.

Structural transformation is necessary for development, but tax systems need to take into account the evolution of economic dynamics away from traditional sectors. The empirical results presented in this paper suggest that existing VAT regimes in both advanced and developing countries will be increasingly challenged by the rise of non-tradable services in economic activity that narrows the VAT base. As this process of structural transformation deepens, countries will need to adjust their tax regimes in order to maintain and enhance tax efficiency.

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Appendix Tables

Table A1. List of Countries

Advanced	Developing		
Australia	Albania	Equatorial Guinea	Nicaragua
Austria	Algeria	Estonia	Nigeria
Belgium	Argentina	Ethiopia	Pakistan
Canada	Armenia	Fiji	Panama
Cyprus	Azerbaijan	Gabon	Paraguay
Denmark	Bangladesh	Gambia, The	Peru
Finland	Barbados	Georgia	Philippines
France	Belarus	Ghana	Poland
Germany	Belize	Guatemala	Romania
Greece	Benin	Honduras	Russian Federation
Iceland	Bhutan	Hungary	Rwanda
Ireland	Bolivia	India	Senegal
Israel	Botswana	Indonesia	Seychelles
Italy	Brazil	Jamaica	Slovak Republic
Japan	Bulgaria	Jordan	Slovenia
Korea, Rep.	Burkina Faso	Kazakhstan	South Africa
Luxembourg	Burundi	Kenya	Sri Lanka
Malta	Cambodia	Kyrgyz Republic	St. Kitts and Nevis
Netherlands	Cameroon	Lao PDR	Vincent and the Grenadines
New Zealand	Cape Verde	Latvia	Suriname
Norway	Central African Republic	Lebanon	Tanzania
Portugal	Chile	Lesotho	Thailand
Singapore	China	Lithuania	Togo
Spain	Colombia	Madagascar	Trinidad and Tobago
Sweden	Congo, Dem. Rep.	Malawi	Tunisia
Switzerland	Congo, Rep.	Malaysia	Turkey
United Kingdom	Costa Rica	Mali	Uganda
	Cote d'Ivoire	Mauritania	Ukraine
	Croatia	Mauritius	Uruguay
	Czech Republic	Mexico	Venezuela, RB
	Dominica	Mongolia	Vietnam
	Dominican Republic	Morocco	Yemen
	Ecuador	Myanmar	Zambia
	Egypt, Arab Rep.	Namibia	
	El Salvador	Nepal	

Table A2. Summary Statistics

	Obs.	Mean	Std. Dev.	Min.	Max.
Tax capacity					
VAT C-efficiency	2678	0.47	0.18	0.00	1.75
VAT Productivity	2710	0.36	0.26	0.00	8.71
RA-Gap measures					
VAT gap	142	6.33	2.63	-1.48	12.59
Compliance gap	157	2.61	1.57	-0.67	6.88
Policy gap	157	3.72	2.08	-1.91	7.40
Structural transformation					
Value-added shares					
Industry	5551	29.50	11.01	6.00	96.79
Services	5551	53.74	13.48	2.06	87.99
Sales	5551	14.90	5.36	0.57	51.69
Trans-Com	5551	8.31	3.39	0.09	25.66
Others	5551	30.53	10.93	1.40	64.67
Ratio					
Services/Industry	5551	2.14	1.18	0.02	14.03
Sales/Industry	5551	0.61	0.46	0.01	5.88
Trans-Com/Industry	5551	0.32	0.19	0	2.50
Others/Industry	5551	1.21	0.74	0.01	8.14
Control variables					
Real GDP per capita	5507	10724.32	15624.49	163.62	111968.40
Standard VAT rate	2330	16.24	4.82	1.00	35.00
Share of agriculture	4595	16.60	14.47	0.04	74.27
Trade openness	5363	77.45	50.35	0.17	531.74
Urbanization	6204	51.81	23.16	2.85	100.00
Output gap	5507	0.00	0.03	-0.46	0.34
Government effectiveness	2224	0.00	0.97	-3.01	3.17
Corruption	2328	0.00	0.97	-3.43	3.67

Source: IMF, OECD, WoRLD, European Commission, Eurostat, IBFD, KPMG, ASSI, Inter-American Center of Tax Administrations, MARIO, ASUAID, WDI, UN, EU KLEMS, Transparency International, ICRG.

Table A3. Summary Statistics: Service Subsectors

	Obs.	Mean	Std. Dev.	Min.	Max.
Value-added share					
Retail trade	757	1.46	0.44	0.15	4.30
Wholesale trade	810	5.81	1.72	1.58	16.50
Wholesale, retail and repair	810	4.95	1.18	2.15	9.57
Transport and storage	713	5.25	1.81	0.00	12.91
Postal and courier activities	711	0.68	0.52	0.09	2.99
Financial services	836	5.73	3.83	1.50	29.64
Real estate	836	8.22	2.58	2.29	19.13
Arts and entertainment	783	1.27	0.93	0.48	12.06
Public services	836	6.77	1.36	2.45	11.35
Education	836	5.05	0.95	1.85	7.31
Healthcare and social services	836	5.47	2.15	1.02	11.77
Media	811	1.08	0.54	0.33	6.25
Telecommunications	757	1.88	0.66	0.80	4.32
IT services	772	1.26	0.77	0.07	3.45
Accommodation and food services	836	2.69	1.55	0.81	8.39
Professional services	836	7.11	2.59	1.85	14.66
Other services	783	1.42	0.45	0.50	2.80
Non-tradable services	836	14.93	2.94	6.30	21.52
Tradable services	836	49.33	7.75	21.09	69.69
Alternative definitions					
Non-tradable services[§]	836	54.62	7.99	29.97	72.30
Tradable services	836	9.64	4.24	3.20	35.35
Non-tradable services[¥]	836	42.87	7.47	19.58	61.13
Tradable services	836	21.39	5.19	3.20	45.30

Note: Non-tradable group includes only three services: accommodation and food services, public administration, and defense, and health and social work. These services require physical presence to be consumed. In an alternative definition, the non-tradable expands and includes services as postal and courier activities, education, transport and storage, etc. Trade services, financial and insurance activities, and telecommunications are considered to tradable in all specifications.

Table A4. Composition of Services: Tradable vs. Non-Tradable

Tradable services	*Non-tradable services (narrow definition)*
Arts, entertainment and recreation	Accomodation and food services
Education	Healthcare and social services
Financial services	Public services (administration and defense)
Media	
Information technology	
Telecommunications	*Non-tradable services (expanded definition)*
Postal services	Accomodation and food services
Professional services	Healthcare and social services
Real estate	Public services (administration and defense)
Transportation and storage	Postal services
Retail trade (excluding motor vehicles)	Education
Wholesale trade (excluding motor vehicles)	Transportation and storage
Retail and wholesale trade and repair of motor vehicles	

Table A5. Structural Transformation and Tax Efficiency: VAT and Policy Gaps Subsector Estimations

	VAT gap						*Policy gap*					
	Share of total value-added			*Share of value added of manufacturing and mining*			*Share of total value-added*			*Share of value added of manufacturing and mining*		
Sales	0.732			0.647***			-1.516			0.34		
	-1.247			-2.859			(-1.125)			-1.103		
Trans-Com		0.186			0.324			1.501			0.893*	
		-0.614			-1.639			-1.238			-1.731	
Others			0.696			0.516**			1.486			0.876**
			-0.992			-2.187			-0.775			-2.014
Real GDP per capita	-0.860***	-0.790***	-0.697**	-0.593**	-0.625**	-0.522	-0.556	-0.754	-0.172	-0.482	-0.249	0.087
	(-3.245)	(-2.896)	(-2.076)	(-2.272)	(-2.073)	(-1.585)	(-1.237)	(-1.487)	(-0.295)	(-0.886)	(-0.494)	-0.165
Standard VAT rate	0.03	0.027	0.023	0.01	0.017	0.008	0.028	0.017	0.04	0.031	0.004	0.018
	-1.365	-1.106	-0.905	-0.483	-0.756	-0.347	-0.674	-0.426	-1.04	-0.94	-0.095	-0.497
Share of agriculture	0.019	-0.043	-0.045	0.02	-0.027	-0.04	0.018	0.231	0.188	0.158	0.231	0.205
	-0.198	(-0.436)	(-0.432)	-0.209	(-0.264)	(-0.386)	-0.093	-1.121	-1.22	-0.978	-1.226	-1.265
Trade openness	0.134	0.106	0.217	0.308*	0.179	0.333	-0.411	-0.535	-0.236	-0.342	-0.266	-0.094
	-0.739	-0.579	-0.999	-1.673	-0.862	-1.605	(-1.368)	(-1.474)	(-0.641)	(-1.121)	(-0.771)	(-0.306)
Government effectiveness	-0.009	-0.015	-0.025	-0.01	-0.015	-0.022	0.009	0.027	0.009	0.029	0.028	0.018
	(-0.491)	(-0.872)	(-1.200)	(-0.602)	(-0.850)	(-1.321)	-0.413	-0.9	-0.334	-1.156	-1.008	-0.719
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	No	No	No	No	No	No	No	No
Observations	118	118	118	118	118	118	126	126	126	126	126	126
Countries	21	21	21	21	21	21	23	23	23	23	23	23
R^2	0.405	0.365	0.381	0.473	0.386	0.437	0.118	-0.0821	0.181	0.21	0.0799	0.196
Fisher (p-value)	6.99E-10	2.14E-11	1.61E-06	2.94E-12	5.79E-15	3.71E-10	0.178	0.0002	0.0871	0.00613	2.85E-06	0.00287
Hansen OID (p-value)	0.673	0.546	0.741	0.717	0.587	0.735	0.321	0.0882	0.633	0.817	0.176	0.441
KP Under-ident. (p-value)	0.0293	0.0115	0.00413	0.00146	0.000984	0.000236	0.00311	0.0254	0.00101	0.000184	0.00145	0.0000257
KP Weak-ident. (F-stat)	5.858	7.605	3.963	7.819	14.3	7.958	12.26	5.068	8.705	15.42	16.32	20.52

*, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent level, respectively. T-statistics based on robust standard errors are reported in brackets.

Note: Our main variable of interest is structural transformation, which is considered to be endogenous. Accordingly, all equations are estimated using the 2SLS-IV method. Following Olney and Pacitti (2017), measures of structural transformation are instrumented using its own lags. All controls are log-transformed, except the government effectiveness and corruption variables which are standardized. Fisher's p-values indicate that the estimated coefficients are jointly significant in all specifications. The diagnosis tests reveal that our instruments are valid. The p-values associated with the Kleibergen-Paap (KP) test reject the null hypothesis that the model is under-identified. Also, the high F-stats associated with the KP weak identification test indicate that our instruments are strongly correlated with the endogenous regressor, thus rejecting the weak identification hypothesis. Finally, we do not reject the null hypothesis of the Hansen overidentifying restrictions (OID) that the instruments are uncorrelated with the error term, and correctly excluded from the estimated equation.