Interaction Between The Exchange Rate and Tax Policies: The Role of The Exchange Rate Regime

Moussé Sow[♣]

Preliminary draft (do not quote)
(July 2013)

Abstract

This paper addresses the link between exchange rate and tax policies and tests the hypothesis that, countries with pegged exchange rate regimes (ERR) have greater reliance on internal taxation - such as the VAT- to make up the loss of seigniorage revenues and ensure competitiveness. Within a panel of developing countries, including the African economies, we evidence that countries with pegged regimes increase their VAT-to-GDP ratio, the substitution effect (seigniorage vs. VAT). Countries with a pegged ERR lose partially the seigniorage revenues, which threatens significantly the peg. Second, our findings point that the VAT revenues collected in share of Tax revenues increase significantly for peggers, the competitiveness effect (border taxes vs. VAT). Within a peg, countries (have to) apply less border taxation to avoid their distortive effects. In addition, estimationss with a duration model analyzing the pace that governments make-up for their shortfall in fiscal revenues show that pegging the ERR increases significantly the probability of VAT adoption. GMM techniques allow us to avoid the endogeneity problem and describe a causal link between the exchange rate and tax policies.This paper helps understanding the evolution and structure of tax revenues. Since tax policies are closely linked to the ERR at work, tax reforms should be implemented in accordance with the ruling monetary arrangement.

JEL Classification: C33, C36, C41, F13, F33.
Keywords: Exchange Rate Regime, Trade policy, Duration Analysis, Model with Panel Data.

Introduction

Trade liberalization has outpaced protectionism which made its own way during the sixties-seventies with Prebisch's ideas underlying the industrialization by import substitution. This trade liberalization mechanism has led to the globalization phenomenon characterized by greater trade integration between countries, thanks to a freer trade barriers world. However, this phenomenon does not come out without damages.

In the aftermath of trade liberalization, fiscal authorities took the step to recover the resource loss stemmed from trade liberalization[1] and then undertook a tax transition (TT, in short) process[2], which is mainly characterized by the adoption of the value added tax (VAT)[3].

Despite an extensive literature on trade liberalization, there is little work, even theoretical, that have paid attention on the link between exchange rate and tax policies. The exchange rate policies may play a role in this shaping environment in that exchange rate arrangement implemented by a country

[♣] *Corresponding author*: CERDI & School of Economics, University of Auvergne, 65 Bd. Fr. Mitterrand, B.P. 320, 63009 Clermont-Ferrand, France. E-mail: mousse_ndoye.sow@udamail.fr.
[1] A useful discussion is made by Baunsgaard and Keen (2005) to see whether or not countries recovered from their resource losses following trade liberalization reform.
[2] As defined by Berg and Krueger (2003), tax transition mechanism is identified as the process through which governments switch from international trade taxes to internal (domestic) taxation to reduce their dependency on foreign trade taxes.
[3] See Ebrill et al. (2001); Keen and Lockwood (2007) and Emran and Stiglitz (2005) a detailed discussion on this issue.

affects the rest of the world. Besides, the ERR might be influential in the decision to operate TT. To fill the gap, this paper addresses the link between exchange rate and tax policies (taxes recovering strategies) and tests the hypothesis that, countries with pegged exchange rate regimes (ERR) have greater reliance on internal taxation -such as the VAT- to make up the loss of seigniorage revenues and ensure competitiveness in the aftermath of trade liberalization. The rationales behind such an assertion are the following. First, countries with a pegged ERR lose partially (or totally) the revenues that could flow from seigniorage (Fisher, 1981)[4]. This latter (financing) mechanism is constrained by the fixity of the peg, constraint that does not apply when considering the intermediate and floating regimes. Under a peg, seigniorage threatens significantly the fixity of the exchange rate and may lead to the collapse of the peg. This channel corresponds to the substitution effect. Our second rationale is related to the *competitiveness effect*. Within a pegged arrangement, countries (have to) apply less border taxation to avoid the distortive effects of import/export taxation, and promote cross-border trade. By giving up these "easy-to-collect" resources -seigniorage and border taxes-, fiscal authorities turn to the internal taxation as the VAT to cover these losses.

We conduct the analysis within a panel of developing and developed countries over the period 1990-2010. Since an important characteristic of the TT mechanism is the adoption of the VAT[5] and due to the difficulty to build a tax transition index, our analysis is based on the evolution of the level of VAT collected. Our interest variable, the ERR dummy is taken from the Ilzetzki, Reinhart and Rogoff, (2010) *de facto* classification of the ERR. Using appropriate econometric techniques, we find strong supports for the substitution effect (*seigniorage vs. VAT*): our estimates show that countries with pegged regimes increase their VAT-to-GDP ratio, compared to non-pegged regimes. To capture the *competitiveness effect* (import/export taxes vs. VAT), we rather use the VAT-to-Tax ratio to assess the extent to which fiscal authorities increase their reliance to internal taxation in the absence of cross-border taxes. Our findings point that, in countries with pegged regimes, the VAT revenues collected in share of Tax revenues increase significantly, compared to non-peggers. Further, by disentangling within the pegged regimes, we find that the more the regime is constrained (in implementing discretionary monetary policy), the greater is the percent increase in the VAT-to-Tax ratio. These findings are strengthened by the use of the GMM techniques to mitigate the endogeneity bias.

This paper goes a step further and develops a duration model to analyze the pace that countries make-up for their shortfall in fiscal revenues. Here, we estimate the influence of the ERR on the probability to adopt the VAT. Estimates show robustly that pegging the ERR increases the probability of VAT adoption.

Section 2 of this paper displays some stylized facts on the tax revenue structure and the nexus between tax policy and ERR, while section 3 sets out our empirical modeling and details estimation strategies and the data used. Section 4 depicts our estimation results. Section 5 offers sensitivity analyses before drawing some policy implications with the concluding remarks in section 6.

[4] It is also possible that the trade liberalization is accompanied or supported by the currency devaluation (Agbeyegbe et al, 2006). However, such an option is not systematically possible in most developing countries.

[5] Aizenman and Jinjarak (2009) stated that globalization shifts countries tax revenues from "easy to collect" taxes (tariffs and seigniorage) to "hard to collect" taxes (value added and income taxes).

2- Tax transition and exchange rate regimes: some stylized facts

Despite the centrality of the question, it is quite tricky to fine studies, even theoretical assessing the link between ERR and TT. Among the rare papers, Adam et al. (2001) argued that the poor cumulative relative revenue performance of the Franc zone countries is mainly attributable to differences in environmental and structural factors, and to their different responses to change in the real equilibrium exchange rate. Agbeyegbe et al. (2006) addressed the issue but focused on the effects of currency movements and inflation on the tax revenues. They found that currency appreciations and higher inflation show some linkage to lower tax revenues or its components.

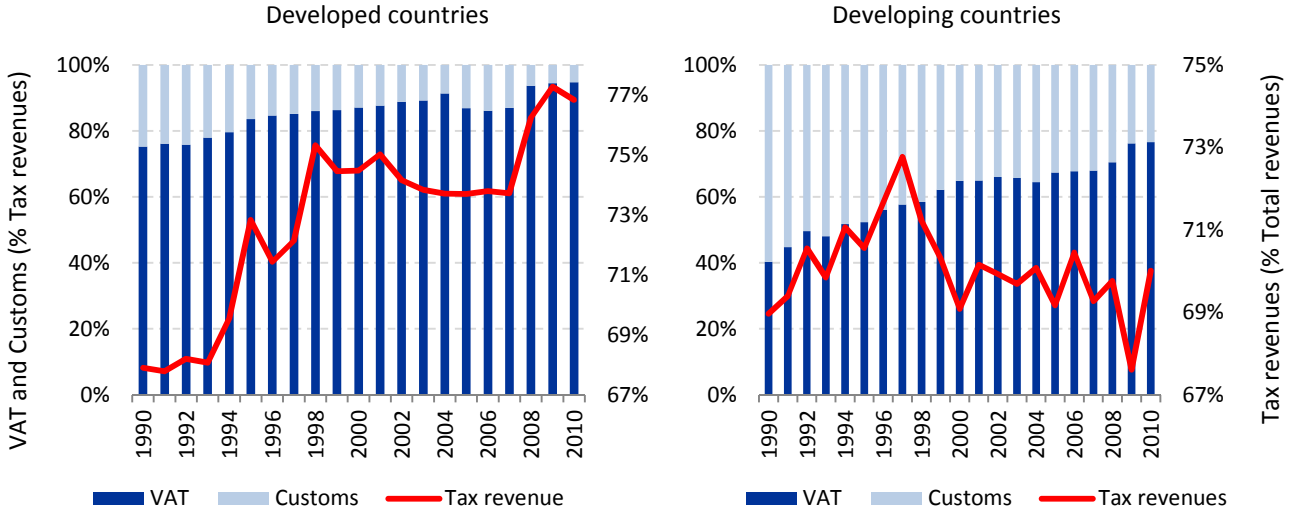
2.1. Tax composition and tax revenues evolution

We present below stylized facts relative to the evolution of the tax revenues and to the tax structure relative to developed and developing countries. Some figures are also presented that display the evolution of the VAT and the tax revenues conditionally to the ERR.

Figure 1 plots the average share of VAT and custom revenues in terms of tax revenues and the evolution of tax revenues in percent of total revenue for developing countries (including low and upper middle income countries). Histogram chart in figure 1 and 2 displays the share of VAT and custom revenues in percent of tax revenues (left scale),whereas line charts graphs the evolution of tax revenues expressed in percent of total revenues (right scale).

We notice for developed countries a stable evolution of the tax revenues. These countries experience an increasing trend of the tax revenues collected. Developed countries also experience a sharp increase in the mid-2000s, thanks to an increasing share of consumption and a widened tax base. The surge of the crisis reversed slightly the trend evolution of the ratio in 2009.

Figure 1 & 2: Tax composition and tax revenues evolution



Let us now consider the developing countries. At first sight, we notice that they experienced a more volatile evolution of the tax revenues, with frequent ups and downs. In contrast to the former group, the mid-90's peak is followed by a sharp decrease of 5 percentage points of the tax revenues, period that corresponds to the early stage of (trade) liberalization. The average level of tax revenue is roughly 70% of total revenue. Despite a period of relatively stable evolution, the late-2000 is

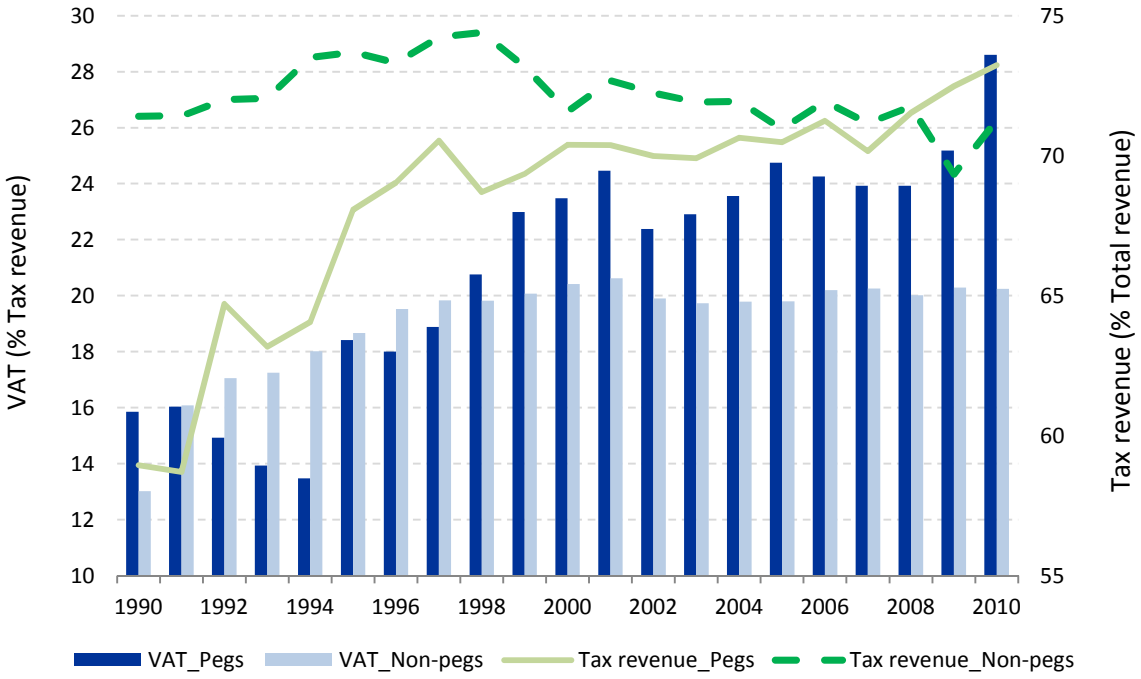
characterized by a sharp decrease in the level of tax revenue which reached its lower bound at 68% in 2009. This decrease might be attributable to the recent episode of financial crisis that ended into a global recession and a slower trade movement worldwide. Afterwards, developing countries seem recovering from the downturn with the tax revenue ratio moving toward its mean value.

We find a noteworthy difference in the level of tax revenues collected between the developed and the developing countries, with the formers outperforming the latters. One might argue that the level of taxes collected seems related with the countries' income level. Despite the substantial difference in terms of collected taxe, the two groups share a common feature of a remarkably decreasing trend of the trade taxes like the custom receipts. This decreasing trend of the trade taxation contrasts with the stable (or slightly increasing) share of the other components of revenues (taxes on goods and services as the VAT). Further, we analyze the correlation that might exist between the tax structure and the ERR.

2.2. Tax revenue, VAT and Exchange rate regime

In *figure 3*, we plot the evolution of VAT and tax revenues with regard to the ERR. Histogram chart corresponds to the VAT revenues in terms of tax revenues of pegged and non-pegged regimes (left scale). We notice that the level VAT revenues is constantly increasing for pegged regimes despite a little decrease in the early nineties. This evolution of the VAT revenues contrasts with the one noticed for countries with non-pegged regimes. The slight increase in the nineties is followed by a stable (non-increasing) evolution of the VAT revenues. A noteworthy remark consists in mentioning that the level of VAT revenues collected by the "peggers" far exceeds the one of "non-peggers", except in the years 1992-94, where the latter outperformed the formers. Besides, the evolution of the total tax revenues (in percent of the total revenues, right scale) displays slightly the same trend. While the "peggers" experiences a remarkable increase, with a sudden jump in the mid-90s, the "non-peggers" displays a relatively volatile evolution of the tax revenues, with a decreasing trend. It is also worth evidencing that the (wide) gap observed in the early nineties between the non-pegs and pegs categories in collecting tax revenues went increasingly shrinking, and ended in a reversal trend with the peg category outperforming the non-peg group. This result should be taken cautiously insofar as it is obtained by the average VAT revenues collected by countries with pegged regimes and non-pegged regimes.

Figure 3: Tax revenues, composition and Exchange Rate Regimes



Figures 1 and 2 provide us with the belief that countries removed –even progressively- trade barriers by decreasing significantly the cross-border taxation which translates into a sharp decline in trade taxation revenues, regardless of the countries income level. In addition, *figure 3* shows that the ERR may influence the composition and evolution of the tax revenues. As an attempt to offset their loss of revenues, an increase of the internal taxation is noted. This assertion is supported by the empirical evidences discussed below.

3- Empirical modeling and estimation strategies

We first present the econometric approach used to test the underlying hypothesis. Then, we detail the estimation strategies and discuss broadly the variable used.

3-1- The econometric model

As a reminder, we probe the following question: how ERR can influence the process of TT? The main hypothesis we test here is that, in adopting pegged ERR, governments give up the resources that could flow from seigniorage (Fisher, 1981). This loss of seigniorage revenues is combined with the loss of tax revenues following the liberalization. As a result, fiscal authorities are willing to offset their losses for instance by operating TT, measured through the evolution of the VAT-to-GDP ratio. We then expect a positive sign of the dummy ERR. To lend credence to such a hypothesis, we specify the following model:

$$Y_{it} = \sim + ¢\, ERR_{it} + \sum_{k=1}^{K} a_k X_{k,it} + ¦_i + £_{it} \qquad (1)$$

where Y_{it} stands as the variable of TT i.e. the VAT-to-GDP ratio. Our variable of interest ERR_{it} corresponds to the dummy variable that characterizes the ERR of the country *i* at time *t*. ERR_{it} is coded 1 if a given country rules under fixed regime and 0 otherwise. This specification allows us to broadly contrast "peggers" and "non-peggers". Furthermore, we adopt a detailed classification of the ERR to better contrast the alternatives ERR.

Besides, we shall control for time-varying country specific characteristics, $X_{k,it}$ and those characteristics that are individual to each country and may help explaining the different performances in collecting tax revenues, μ_i. ε_{it} is the unobserved error term.

We test the hypothesis that $\phi > 0$. We rely on the fixed effect (FE) techniques to estimate *equation (1).* FE techniques address the potential concerns that "peggers" and "non-peggers" are simply different type of countries, and this fundamental difference drives the results[6].

3.2. The Data

We use a data set encompassing data for developing and developed countries, including African economies. The panel consists of countries that have the requisite data for the period 1990-2010.

The main dependent variable: The dependent variable is the VAT-to-GDP ratio. This choice is motivated by the effective experience of developing countries. In fact, VAT is one of the predominant (internal) taxation tool used by fiscal authorities to cover up the resource loss from trade liberalization (see figure 1 and 2 above). While this measure seems to be restrictive to capture tax transition, the main focus of the paper is rather to show that countries with pegged ERR have more reliance on the internal taxation.

The exchange rate regime variable ***(Pegged ERR):*** To assess countries' exchange rate arrangement, we rely upon the Ilzetzki, Reinhart and Rogoff (2010) database of de facto classification of exchange rate regimes.

Among the main determinants of the VAT-to-GDP ratio, we discuss the inclusion and the expected sign of the following variables:
Share of agricultural value added (***Agricultural VA***): as stated by Cukierman et *al.* (1992), the agricultural sector is often dubbed as the "hard to tax sector" as it seems difficult for the authorities to levy any fiscal revenues from this sector, especially in developing countries where the inefficiency of the tax administration exacerbates the revenue loss. In the same line we aim at controlling for the *presence of an informal sector*, which is a relevant feature of the developing countries. Informal sector is almost out of the control of the (fiscal) authorities and usually escapes from paying their tax. Intuitively, we expect a negative significant sign of this variable.

*The growth rate of the GDP per capita (**GDP pc growth**):* GDP per capita proxies country's level of development. The effect of this variable on the VAT-to-GDP ratio is straightforward since an increase in the GDP per capita means that people become wealthier and then the average level of consumed

[6] One shortcoming of FE techniques is that the estimates preclude the use of covariates that are not time-varying. Our estimations shown below do not suffer from this shortcoming since our baseline model includes only time-varying explanatory variables.

goods increases. Increasing consumption directly increases the tax base and accordingly the tax revenues collected.

***Trade openness**:* measured as the ratio of the sum of exports and imports of goods and services over GDP, as named, measures the degree of openness of countries to international trade[7]. The degree of openness appears as a crucial determinant of TT. The effect of trade openness be thought as follow. Greater trade openness may be beneficial in two ways: exporters experience a decrease in the costs, while imported goods and services increase. This increase in the traded goods widens the tax base and makes the government more likely to move from cross-border taxation to internal taxation. We therefore expect a positive impact of the degree of openness on the revenue collected as VAT.

***Inflation**:* inflation $(®)$ is measured as the growth rate of the consumer price index. Its effect commonly known as the Oliveira-Tanzi effect stipulates that this latter impacts negatively the tax revenue due to lags in the tax collection. In fact, inflation causes the real value of the collected taxes to decrease between the time of implementation and the time that the tax is effectively levied. To mitigate the effects of the hyperinflation, we define $(®')$ as the new inflation rate calculated as $®' = (®/1+®)$ and then introduced it in our regressions.

In addition to the above mentioned variables, we introduce sequentially the following variables in our regressions: Deposit interest rate (Deposit IR), Corruption and Natural resources rents in percent of GDP. Monetary policy actions may influence the tax policy through the deposit interest rate. An increase of the deposit rate may boost the saving from private agents instead of consuming insofar as the former option becomes more attractive. The political and institutional environment of the economy is also prominent in the TT process. The effectiveness of the TT depends strongly on the efficiency of the tax administration. While political corruption affects negatively the level of VAT revenue, we expect a positive influence of the government stability on the VAT-to-GDP ratio. While we get relatively unambiguous effect of the political variable, the expected sign of the natural resource rents is, at the best, mitigated.

4. Estimation results

4.1. Main findings

Before diving into our main results, *Table 4.1* displays estimation results relative to the link between total revenues, tax revenues and the ERR.

In *columns (1)*, the dependent variable is the total revenue. As expected, we see that ERR do not impact the level of total revenues collected. Nevertheless, we find that the ERR influences the tax structure of countries that is the way that fiscal authorities implement their tax. *Columns (2)-(3)* show that ERR does matter if one consider the direct and indirect taxes. This finding is strengthened by the statistically significant coefficient of the ERR variable –*pegged ERR*- in specification (4), where the VAT to GDP ratio is taken as left-hand-side variable.

[7] Some authors (Ebrill et al. ,1999; Adam, 2001; Agbeyegbe, 2006) used the internatioanal trade ratio to GDP as measure of trade liberalization.

The hypothesis that countries with pegged ERR, in the aftermath of the liberalization process, increase their reliance to internal taxation such as VAT to compensate their resource seem supported by these early findings.

Table 4.1: Total revenues, tax revenues and the ERR

	Total revenue	Tax structure		
		Direct and indirect taxes	Indirect taxes	VAT
	(1)	(2)	(3)	(4)
Pegged ERR	**0.767**	**0.455****	**0.833*****	**0.853*****
	(1.544)	**(2.236)**	**(7.218)**	**(6.152)**
Trade openness	0.288	0.879***	1.332***	0.852***
	(0.395)	(2.635)	(7.148)	(4.123)
Inflation	-0.023	-0.040	-0.039	-0.060
	(-0.178)	(-0.605)	(-1.249)	(-1.390)
GDP pc growth	-0.091***	0.053***	0.053***	0.044***
	(-2.982)	(3.404)	(6.015)	(4.111)
Natural ress.	1.146***	0.363***	0.019	0.041
	(3.941)	(3.171)	(0.371)	(0.770)
No. Observ.	1375	1325	1453	1209
R squared	0.019	0.035	0.111	0.073
Fischer (*stat*)	5.137	9.212	34.33	18.09
Fischer (*p-value*)	0.000	0.000	0.000	0.000

Significance: * 10%; ** 5% and *** 1% with t-statistics in brackets. The F-test for fixed effects and the Breusch-Pagan LM test for random effects both rejected (with p-value=0.00) the null hypothesis that there are no specific effects. For all specifications, the join significance tests, with p-value=0.00, reject the hypothesis that all slopes are statistically null.

Here, we interpret our main findings. Besides the main interest variable –Pegged *ERR*-, the specifications include four explanatory variables that might be among the core determinants of the revenues collected as VAT. Further, we sequentially introduce various controls to strongly reduce the potential "omitted variable bias".

In the baseline estimates, the dummy *Pegged ERR* is coded 1 if countries have adopted a fixed ERR and 0 otherwise. We notice that all of our coefficients of interest, that is, the *Pegged ERR* dummy variables are statistically significant with the expected positive effect, spanning roughly from 3.4 to 5.8. The positive sign of *Pegged ERR* means that pegged regimes increase the VAT in share of the tax revenues by 4.4 percentage points compared to other regimes (*column 6*).

Besides, our core determinants affect significantly the VAT-to-GDP ratio. As expected, the negative effect of the *Agricultural VA* variable is straightforward insofar as it is often dubbed the "*hard to tax*" sector. The greater the contribution of the agricultural sector to the overall GDP and the less the policymakers have room to collect revenues from the *"hard to tax"* sector. We notice that a 10% increase in the agricultural value added reduces by nearly 0.44 percentage points of the VAT-to-Tax ratio on average. This negative effect is also observed for inflation, a phenomenon consistent with the well-known Oliveira-Tanzi effect, which argues that inflation deteriorates the real tax proceeds being collected by the fiscal authorities, even with non-statistically significant coefficients.

Likewise, monetary policy through deposit interest rate (deposit IR) impacts tax policy[8]. When deposit interest rate goes up, private agents will prefer to save more than they consume as saving

[8] In the robustness checks, the impact of fiscal policy is addressed using the one time lagged public debt as proxy.

becomes more attractive. Reducing consumption leads to a lower tax base and then reduces the VAT revenue indirectly through consumption.

GDP per capita growth, in turn, has a significant positive effect on the level of VAT. Increasing the GDP per capita translates into greater purchasing power that increases in turn the level of consumed goods. As a consequence, fiscal authorities levy more taxes, thanks to the tax base extension. The natural resource variable and trade openness display a statistically null effect.

Table 4.2: Baseline estimates with all countries

	Dependent variable: VAT (% Tax revenue)					
	Baseline estimates					
	(1)	(2)	(3)	(4)	(5)	(6)
Pegged ERR	**5.810*** **	**3.585*** **	**3.583*** **	**3.357*** **	**4.298*** **	**4.368*** **
	(6.857)	(4.059)	(3.955)	(3.667)	(4.205)	(4.105)
Agricultural VA		-6.421***	-6.145***	-5.532***	-6.052***	-4.413***
		(-6.606)	(-5.703)	(-5.171)	(-5.122)	(-3.067)
GDP pc growth		0.179***	0.200***	0.180***	0.127*	0.169**
		(2.840)	(2.991)	(2.786)	(1.765)	(2.215)
Trade openness		0.235	0.878	0.683	-1.546	0.408
		(0.186)	(0.671)	(0.507)	(-0.988)	(0.243)
Inflation		-0.355	-0.346	-0.316	-0.306	-0.257
		(-1.393)	(-1.335)	(-1.236)	(-1.095)	(-0.906)
Natural ress.			-0.180			-0.022
			(-0.519)			(-0.052)
Corruption				-0.738**		-0.515
				(-2.001)		(-1.226)
Deposit IR					-1.340***	-1.161***
					(-3.381)	(-2.776)
No. Observ.	1302	1200	1114	1102	993	851
R_squared	0.036	0.098	0.095	0.100	0.119	0.118
Fisher (stat)	47.02	24.71	18.44	19.18	20.80	13.17
Fisher (p-value)	0.000	0.000	0.000	0.000	0.000	0.000

Significance: * 10%; ** 5% and *** 1% with t-statistics in brackets.

4.2. Further discussions

We conduct several additional tests so as to discuss the validity of our previous findings. In *columns (2)* and *(3)* of table 4.3, we split the sample into developing and developed economies.

The estimated coefficients of the "Pegged ERR" strongly increases in magnitude but remain positive and statistically significant when considering developing countries (*column 3*), while this latter turn to be statistically null for developed economies (*column 2*). Splitting the sample on the basis of the economic development challenged our previous finding. This preliminary finding seems then sensitive to the income level of development.

We also conduct a second wave of robustness checks to assess the extent to which our findings are persistent to changes in either the estimator used or the inclusion of time dummies. *Columns (4)* shows that our results are robust to the inclusion of time dummies. These findings are also persistent to a change in the estimation methodology as shown in *columns (5)-(6)* where the random effect estimator is used.

To assess the extent to which political variables affect the tax collection process we interact our interest dummy, *Pegged ERR,* with political variable as corruption (*Peg ERR*Corruption*) and government stability (*Peg ERR*Gov. stab.*). Our estimation results also show that the political feature indeed. *Table 4.4* below give detailed results.

Our former finding of positive and significant effect of pegged ERR on the VAT-to-Tax ratio persists except for specification (3).

Table 4.3: Developing vs.developed countries, time effects

	Dependent variable: VAT (% Tax revenue)					
	Baseline	Developed	Developing	Time dummies, FE	Random effects	Time dummies, RE
	(1)	(2)	(3)	(4)	(5)	(6)
Pegged ERR	**4.368*** **	**0.137**	**8.311*** **	**4.245*** **	**4.171*** **	**3.947*** **
	(4.105)	(0.158)	(4.541)	(4.009)	(4.065)	(3.876)
Agricultural VA	-4.413***	8.834***	-9.327***	1.320	-3.416***	-0.061
	(-3.067)	(5.368)	(-4.400)	(0.820)	(-2.963)	(-0.050)
GDP pc growth	0.169**	-0.047	0.113	0.238***	0.162**	0.249***
	(2.215)	(-0.512)	(1.082)	(2.941)	(2.135)	(3.094)
Trade openness	0.408	12.699***	-0.384	-5.274***	0.585	-4.221***
	(0.243)	(6.604)	(-0.156)	(-2.911)	(0.394)	(-2.667)
Inflation	-0.257	0.459	-0.382	-0.250	-0.241	-0.246
	(-0.906)	(1.128)	(-1.039)	(-0.905)	(-0.849)	(-0.889)
Other controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
No. Observ.	851	370	481	851	851	851
R_squared	0.118	0.243	0.175	0.196	0.116	0.195
Fisher (stat)	13.17	13.57	11.73	6.962	100.3	185.3
Fisher (p-value)	0.000	0.000	0.000	0.000	0.000	0.000

Significance: * 10%; ** 5% and *** 1% with t-statistics in brackets. For all specifications, the join significance tests, with p-value=0.00, reject the hypothesis that all slopes are statistically null.

The coefficient of the *Peg ERR*Corruption* variable shows that the effect of pegged ERR turns to be strongly negative for highly corrupted countries. Corruption represents a serious threat as it distorts economic environment and reduces strongly the efficiency of government and business by enabling people to assume positions that they do not really deserve through nepotism or job reservation for instance. Government stability assesses government's ability to carry out its declared program and its ability to stay in office through government unity, legislative strength and popular support. Since the higher the score and the greater is the government stability, this latter improves significantly the level of VAT collected. As one might know, the shift from external to internal taxation translates into a shift in the targeted individuals that face the tax burden. While trade taxation is directly supported by the trade market players (usually exporters and importers), internal taxation's burden -as VAT- is faced by the final consumers. Stable government with popular support may have greater tax bargaining power to make the individuals less reluctant to such a new tax policy. Furthermore, natural resource endowments as reported in *columns (4)-(5)* seem to impact significantly the relationship between the ERR and the tax structure. Both the interactive variables *Peg ERR*Oil* and *Peg ERR*Mineral* show that the positive effect of pegged ERR is stronger for naturally-endowed countries.

Column (1) of Table 4.5 below replicates the estimates with pegged regimes used as benchmark. We then replace the Pegged ERR dummy with *Intermediate ERR* (*column 2*) and *Floating ERR (column 3)*. *Column (4)* includes both pegged and intermediate regime dummies in the same specification. As a

reminder, Intermediate ERR (Floating ERR) are dummy variable that take value 1 if country *i* is ruling under an intermediate ERR (floating regime) at time *t,* and 0 otherwise. While we clearly expect a negative sign for the Floating ERR dummy, the expected sign of the middle regimes is less clear cut, insofar as the comparison group includes pegged and floating regimes.

Table 4.4: Additional tests with political and natural resources variables

	Dependent variable: VAT (% Tax revenue)				
	Baseline	Political variables		Natural resources	
	(1)	(2)	(3)	(4)	(5)
Pegged ERR	**3.585*** **	**9.402*** **	**-3.310**	**1.730***	**2.694*** **
	(4.059)	(4.343)	(-1.236)	(1.806)	(3.056)
Pegged ERR * Corruption		**-1.712*** **			
		(-3.079)			
Pegged ERR * Gov. stab.			**0.781** **		
			(2.503)		
Pegged ERR * Oil				**0.533*** **	
				(5.542)	
Pegged ERR * Mineral					**5.524*** **
					(6.340)
Corruption		-0.197			
		(-0.483)			
Government stability			0.609***		
			(3.817)		
Oil				-1.145***	
				(-7.126)	
Mineral res.					-0.253*
					(-1.734)
No. Observ.	1200	1102	1102	1145	1197
R_squared	0.098	0.108	0.129	0.138	0.130
Fisher (stat)	24.71	17.93	21.81	24.53	23.96
Fisher (p-value)	0.000	0.000	0.000	0.000	0.000

Significance: * 10%; ** 5% and *** 1% with t-statistics in brackets. For all specifications, the join significance tests (with p-value=0.00) reject the hypothesis that all slopes are statistically null.

The dummy Intermediate ERR (*column 2*) has no significant effect on the VAT-to-GDP ratio compared to the two corner regimes. Adversely, floating ERR (*column 3*) reduces the level of the VAT collected, even if the coefficient is not statistically significant.

According to our former findings, if pegged regimes have a positive effect on the VAT-to-GDP ratio compared to other regimes, then floating regimes are expected to display the opposite sign. These results should be taken cautiously, however. ERR is not the sole determinant of the level of the tax revenues collected by the fiscal authorities, However these findings support that ERR may have significant effect on the structure of tax policy (on the way that the fiscal authorities implement their tax policy).

On the other hand, instead of contrasting pegged regime with all other alternatives, we make a pairwise comparison of the ERR i.e. pegged regimes against intermediates regimes (*column 5*) and pegged regimes vs. floating regimes (*column 6*). As for the baseline estimation (*column 1*), the dummies *"Peg vs. Intermediate"* and *"Peg vs. Floating*" remain positive and statistically significant. It is worth mentioning that the coefficient of the dummy *Peg vs. Floating* (7.29) is greater than the one of *Peg vs. Intermediate* (3.28) in absolute terms. According to our line of reasoning, floating regimes

have lesser constraints to raise seigniorage revenues compared to intermediates and are known to better accommodate real shocks, thanks to the flexibility of the exchange rate.

Table 4.5: Comparing Pegged ERR to other intermediate and floating regimes

	Dependent variable: VAT (% Tax revenue)					
	Baseline	Intermediate	Floating	Peg and Interm.	Peg vs. Interm.	Peg vs. Floating
	(1)	(2)	(3)	(4)	(5)	(6)
Pegged ERR	**3.585*** **			**5.771*** **		
	(4.059)			(5.243)		
Intermediate		**0.127**		**2.809*** **		
		(0.185)		(3.303)		
Floating			**-0.997**			
			(-1.093)			
Peg vs. Intermediate					**3.285*** **	
					(3.429)	
Peg vs. Floating						**7.294*** **
						(4.461)
Additional controls	Yes	Yes	Yes	Yes	Yes	Yes
No. Observ.	1200	1200	1200	1200	992	647
R_squared	0.098	0.085	0.086	0.107	0.117	0.113
Fisher (stat)	24.71	21.11	21.37	22.59	24.48	15.00
Fisher (p-value)	0.000	0.000	0.000	0.000	0.000	0.000

Significance: * 10%; ** 5% and *** 1% with t-statistics in brackets. For all specifications, the join significance tests (with p-value=0.00) reject the hypothesis that all slopes are statistically null. In column (4), we perform the equality test of the dummies Pegged ERR and Intermediate ERR and also test the hypothesis that these two dummies are jointly null. The p-values of the F-test, which are 0.00, both rejected the null hypotheses of the equality test and the join significance test.

We take the study step further and contrast the evolution of the VAT-to-Tax ratio within the pegged regimes. This allows a more fine-tuned scrutiny, albeit for a reduced country sample. Drawing upon Ilzetzki, Reinhart and Rogoff's (2010) fine classification of ERR instead of the core classification used above, we built new dummies that account respectively for each type of pegged regime:

"Pegged ERR" stays the benchmark. The *Currency board* dummy is coded 1 for countries that are under a currency board arrangement and 0 if the countries adopted either an intermediate or floating regimes. Accordingly, *Conventional peg* carries the effect of countries classified as having a de facto peg arrangement. This latter arrangement is also combined with dollarized countries (*column 4*). Finally, we restrict the definition of the benchmark pegged ERR by dropping out observation classified in the freely falling category[9] (*column 5*).

Estimation results carried in *Table 4.6* show that the expected positive and statistically significant coefficient of the ERR dummies is observed for all our specifications. Note that these estimates are remarkably similar to the baselines. However, it is worth pointing that the estimated effect of pegged regimes in increasing the VAT-to-Tax ratio is larger for countries that have a currency board arrangement (*columns 2*) compared to other pegged regimes. In quantifying these effects, *Table 4.6* shows that being under a currency board increases the VAT-to-GDP ratio by 12.72 percentage points, while conventional peg regime increases the ratio by 2.9 percentage points[10].

[9] Narrow peg: we restrict the definition of the pegged regime by dropping out point of observations identified as freely falling category and those with dual market where data on parallel market are missing. Freely falling refers to a situation where the inflation rate is above 40%

[10] Note that our sample falls from 1200 to 890 observations, due to that, in contrasting each category of pegged regime with the intermediate and floating regimes, the remaining categories of pegs should be excluded from the sample.

Table 4.6: Tax transition within Pegged ERR

	Dependent variable: VAT (% Tax revenue)				
	Baseline		Within pegs		Narrow peg
	(1)	(2)	(3)	(4)	(5)
Pegged ERR	**3.585*** **				
	(4.059)				
Currency board		**12.729*** **			
		(6.558)			
Conventional peg			**2.954** **		
			(2.429)		
Dollarization and CP				**1.673***	
				(1.696)	
Narrow peg					**3.192*** **
					(3.787)
Additionnal controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
No. Observ.	1200	890	965	1137	1132
R_squared	0.098	0.123	0.094	0.086	0.097
Fisher (stat)	24.71	23.14	18.71	20.20	22.85
Fisher (p-value)	0.000	0.000	0.000	0.000	0.000

Significance: * 10%; ** 5% and *** 1% with t-statistics in brackets. For all specifications, the join significance tests (with p-value=0.00) reject the hypothesis that all slopes are statistically null.

These findings are in line with our underlined assumption. As aforementioned, the probability of TT is positively related with the government budget constraint. The more this latter gets tighter and the greater the probability of TT will be. Due to the fact that currency boarder lose total (discretionary) control of their monetary policy, and by the way, their revenues from seigniorage, their budget constraint becomes more tighter once they liberalize. Consequently, they seem more likely to undertake the TT process compared to their peers with more flexible exchange rate arrangements.

4.3. Solving the endogeneity issue: the GMM methodology

As stated in the literature, the choice of the ERR is not exogenous since the choice of any regime may be influenced by the fiscal policy variables, even in a lesser extent. Besides, the GDP per capita growth rate is also assumed to be endogenous. This will lead to a reverse causality problem since we used the ERR dummy and the GDP pc growth as independent variables. The resulting estimates yield misleading coefficients due to the reverse-causality-bias. To address the problem of exchange rate regime endogeneity and the other controls used, we draw upon the Generalized Method of Moments (GMM) dynamic panel data estimator. This latter approach addresses the issues of joint endogeneity of all explanatory variables in a dynamic formulation and of potential biases induced by country-specific effects. The following specification is estimated:

$$Y_{it} = \sim + \quad Y_{it-1} + \text{¢}\, ERR_{it} + \sum_{k=1}^{K} \text{a}_k X_{k,it} + \text{¦}_i + \text{£}_{it}$$

The dynamic feature of the model is captured through the lagged dependent variable Y_{it-1}. The coefficients give the inertia of the tax policy, i.e. the extent to which the actual level of VAT revenue depends on the lagged VAT-to-Tax ratio. We expect to be close to the unit. As in the

baseline specification, this model includes a matrix of explanatory variables $X_{k,it}$ other than the ERR. We also control for country-specific characteristics, ¦ $_i$; £$_{it}$ is the stochastic error term.

Table 4.7 gives details relative to the GMM estimations. We notice that the coefficients of our interest variable display statistical significance, with the expected sign. By replicating the baseline estimation (*column 1*), we remark that countries with pegged regimes increase the VAT-to-Tax ratio compared to those with intermediate or flexible regimes, result in line with our baseline hypothesis.

Table 4.7: IV estimations of the effect of ERR on the VAT-to-Tax ratio: the Dynamic system-GMM

	Dependent variable: VAT (% Tax revenues)					
	Baseline	Within pegs		Narrow peg	Peg vs. Interm.	Peg vs. Float.
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged VAT	0.878***	0.841***	0.872***	0.900***	0.870***	0.867***
	(22.89)	(17.50)	(21.49)	(24.94)	(21.10)	(15.84)
Pegged ERR	**1.472****					
	(2.15)					
Currency board		**5.730*****				
		(2.63)				
Conventional peg			**0.348**			
			(0.76)			
Narrow peg				**1.205***		
				(1.65)		
Peg vs. Intermediate					**1.170**	
					(1.28)	
Peg vs. Floating						**3.776***
						(1.80)
Additional controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
No. Observ.	1138	835	906	1082	941	615
AR(1)	0.000	0.000	0.000	0.000	0.000	0.002
AR(2)	0.224	0.328	0.240	0.258	0.672	0.281
Sargan	0.301	0.666	0.661	0.472	0.401	0.166
Countries	64	56	59	64	60	52
Instruments	15	15	15	15	15	15

Significance: * 10%; ** 5% and *** 1%. T-statistics calculated with robust standard errors are given in brackets. Following Roodman (2006), the number instruments is strongly limited to avoid the overfiting problem. In all specification, we reject the null of AR(1) of no autocorrelation in the error terms, while this latter is not rejected for two time lags, AR(2). The Sargan's p-value validates the overidentification restrictions in all specifications.

Interestingly, the sign and statistical significance of the dummy *Pegged ERR* persist, even when we narrow the definition of the Pegged category and include additional explanatory variable in the specification (*column 4*), although the magnitude of the coefficient changes.

Likewise, estimations performed within the pegged regimes (*columns 2-3*) display significant positive coefficients except for countries and with a conventional peg. Again, it is worth noting that the magnitude of the coefficient is stronger for currency boarders since this latter is more compelling as exchange rate arrangement. *Columns 5 and 6* of *Table 4.7* perform pair-wise. We find that our baseline finding holds only when "Peggers" are compared with "Floaters". The level of VAT collected is higher for countries under pegged regimes, only compared to those with floating regimes. The GMM estimations validate our baseline findings that the ERR influences significantly the TT process, results that are not driven by an endogeneity bias.

5. Robustness analyses

This section presents our sensitivity test aimed at strengthening our baseline findings. To do so, we rely upon a duration model to estimate the probability of VAT adoption conditional to the ERR.

5.1. Qualitative variable estimates: A duration model of tax transition

How alternative ERR can influence the process of TT? Since the VAT is one of the most common tax policy instruments, we rely upon the decision of whether countries adopt the VAT or not during its trade liberalization reform to proxy the TT process.

Knowing that our dependent variable is a dummy coded 0/1 with the VAT adoption, one would like to estimate the probability to adopt the VAT, conditional to the ERR at place and a set of controls with the following specification:

$$\Pr\left(VAT_{it}=1 \middle| ERR_{it}, \sum_{k=1}^{K} X_{k,it}\right)$$

As one might know, countries repeal rarely the VAT once they introduce it[11]. Thus VAT adoption is an "absorbing state" mechanism. With such consideration the VAT dummy takes value 0 before the adoption and 1 afterwards. No changes will be noted further in the dependent variable unless the country repeals the VAT. A more appropriate way to deal with such data-structure is to specify a duration model which estimates the effect of the ERR on the time until the VAT adoption. Such a model can be specified as follow:

$$h\left(t \mid X_i, \mathsf{3}_i\right) = \mathsf{a}_0(t)\exp\left(\sum_{k=1}^{K} {}_k X_{k,i}\right)\mathsf{3}_i \qquad (2)$$

$h\left(t \mid X_i, \mathsf{3}_i\right)$ represents the hazard function. The value of the hazard function is identified as the hazard rate or (VAT) adoption rate, i.e. the rate at which a given country adopts the VAT. In other words the hazard function estimates the effect of the explanatory variable on the time until the country introduces the VAT. $h_0(t)$ refers to the baseline hazard, that is the time path of the probability to adopt the VAT that is the same for all individuals apart from a shift due to variation in the regressors. X_{ki} corresponds to the measurable characteristics of each individuals that is the explanatory variables which will include the ERR dummy and $\mathsf{3}_i$, the time-invariant unobservable heterogeneity[12], with ${}_k$ the parameters to be estimated.

The distribution of the time t until the occurrence of an event *X* (the VAT adoption for instance) is most often asymmetric and possibly bimodal. Thus, estimating *equation (2)* via OLS or Probit/Logit which assumes the normality of the error term may be misleading[13]. Thus, the parameters ${}_k$ are estimated using partial likelihood under specification of the baseline hazard. The partial maximum likelihood displays the advantage of being independent from the baseline hazard function, which can be estimated either parametrically or semi-parametrically.

[11] Only Malta have repealed the VAT in our sample.

[12] Lancaster (1990) argues that $\mathsf{3}_i$ can be seen to some extent as the measurement error.

[13] See (Cleves et al. 2004).

One should note that the duration model estimate a hazard rate that is the rate of exit from a given situation. The sign of the coefficients indicates how a covariate affects the hazard rate. A positive coefficient increases the hazard rate and decreases the duration. To calculate the factor change, coefficients are exponentiated.

Panel A of *Table 5.4* below drops countries that have adopted the VAT before 1990 (first year of the time span) while *Panel B* considers all countries. The negative sign of the baseline dummy Pegged ERR means that this regime affects negatively the hazard rate. In other words, for countries under pegged ERR the time before adopting the VAT is reduced by 62%[14]. As a result, countries with pegged regimes have higher probability to adopt the VAT, compared to those with intermediate or floating regimes. Here, the *rule of thumbs* to interpret the coefficient is that negative (positive) sign has a positive (negative) effect on the probability of VAT adoption. While a growing rate of the GDP per capita also increases the likelihood to adopt the VAT, one should notice that inflation displays a negative impact on the probability of VAT adoption. It is also worth mentioning that the coefficient of Currency board is greater throughout in absolute value, in line with our hypothesis.

However, our estimation outputs show that, among the peg group, countries with conventional pegged regime have lesser probability to adopt the VAT. Therefore, our robustness checks show that there exists some discrepancies in the way that the ERR affects the decision of TT. The effect of the ERR on the tax transition process depends on the category of exchange rate arrangement under consideration.

[14] The magnitude of the change is obtained as follow 0.623=exp(-0.978)-1

Table 5.4: Cox's semi-parametric estimations of duration models of VAT adoption

	Cox's semi-parametric estimation of the VAT adoption											
	Panel A						*Panel B*					
	Baseline	Within pegs		Narrow	Pair-wise		Baseline	Within pegs		Narrow	Pair-wise	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Pegged ERR	**-0.978***						**-0.779**					
	(-1.71)						(-1.59)					
Currency board		**-2.949*****						**-2.359*****				
		(-5.54)						(-3.96)				
Conventional peg			**1.738*****						**1.125***			
			(2.94)						(1.68)			
Dollarization and CP												
Narrow peg				**-0.956***						**-0.718**		
				(-1.70)						(-1.53)		
Peg vs. Intermediate					**-1.064****						**-0.938***	
					(-1.97)						(-1.93)	
Peg vs. Floating						**0.072**						**-0.895**
						(0.06)						(-0.78)
Trade openness	0.094	0.863**	0.641**	0.074	-0.287	-0.553	0.191	0.802**	0.545	0.236	-0.420	0.200
	(0.29)	(2.47)	(2.47)	(0.20)	(-0.85)	(-0.95)	(0.58)	(2.14)	(1.59)	(0.72)	(-1.26)	(0.31)
Agricultural VA	-0.028**	-0.058***	-0.044***	-0.027	-0.036***	0.019	-0.011	-0.030*	-0.024*	-0.006	-0.032**	0.007
	(-2.11)	(-3.04)	(-2.63)	(-1.62)	(-2.62)	(0.38)	(-0.85)	(-1.85)	(-1.70)	(-0.47)	(-2.52)	(0.18)
Inflation	5.976***	10.433***	10.771***	5.867**	3.672*	5.638**	1.220	3.955	5.103	0.593	0.557	3.081
	(2.67)	(3.35)	(3.77)	(2.41)	(1.78)	(2.03)	(0.51)	(1.02)	(1.48)	(0.61)	(0.83)	(0.58)
GDP pc growth	-0.038	-0.153**	-0.083*	-0.037	-0.035	-0.014	-0.010	-0.120**	-0.056	0.014	-0.009	0.034
	(-0.68)	(-2.06)	(-1.74)	(-0.61)	(-0.67)	(-0.20)	(-0.18)	(-1.97)	(-1.21)	(0.24)	(-0.16)	(0.46)
Countries	35	30	29	33	32	16	37	32	30	35	34	17
Pseudo R squared	0.069	0.209	0.128	0.061	0.071	0.140	0.037	0.120	0.044	0.037	0.061	0.069
Pseudo Log likelihood	-80.34	-54.46	-59.98	-74.39	-71.66	-23.82	-86.74	-63.57	-68.55	-79.82	-76.17	-26.92
Wald (p-value)	0.042	0.000	0.004	0.199	0.019	0.062	0.685	0.002	0.312	0.499	0.053	0.905
CU Pseudo-R^2	0.291	0.623	0.460	0.256	0.292	0.395	0.165	0.424	0.192	0.161	0.256	0.215
GH concordance coeff.	0.697	0.806	0.747	0.683	0.684	0.735	0.616	0.694	0.664	0.617	0.662	0.599
PH test (p-value)	0.8938	0.3397	0.9101	0.8848	0.8869	0.8767	0.8708	0.2712	0.7270	0.9859	0.9931	0.5979

Significance: * 10%, ** 5% and *** 1%. Student's statistics, with robust standard errors are given in parentheses. We reject, at 5% level, the null hypothesis of the Wald test that coefficients are jointly null (except in columns 7, 9, 10 and 12). CU stands as the Cragg and Uhler pseudo R-squared. The Gönen and Heller's K concordance coefficient (GH) calculates the proportion of all usable subject pairs in which the predictions and outcomes are concordant. It thus proxy the predictive power of the model, which lies from 60% to 80% of the observations correctly predicted. The null of the PH test assumes that coefficients are constant over time and assumes that the proportional hazard assumption holds. Thus, the non-rejection of the null validates the assumption of proportional model. At 10% level, our models pass the PH test since the p-values >0.1.

Our duration analysis supports that there exists a nexus between the exchange rate and tax policies. Using a dummy variable of VAT adoption, we find that countries with pegged regime have greater probability to adopt the VAT, in response to trade liberalization.

Conclusion

This paper investigates the relationship between tax transition and exchange rate regimes using a panel of developing and developed countries over the period 1990-2010. Our findings evidence that the exchange rate regime matters in the way that government implements its tax policy. Our results point that countries with pegged exchange rate regimes levy more VAT revenues in terms of GDP, compared to countries with either intermediate or floating regimes. The rationale of this finding can be vindicated as follow. In the wake of the trade liberalization, fiscal authorities tried to offset the resource loss entailed by the liberalization, either by mobilizing more seigniorage revenues or operating tax transition with a greater reliance on domestic taxation. Since countries with a pegged exchange rate regime lose partially (or totally in certain cases) the revenues that could flow from seigniorage, they seem more willing to operate tax transition and then mobilize more internal revenues through the VAT for instance. This idea corresponds to the substitution effect. These findings is also be supported by the competitiveness effect, which assumes that countries within a pegged arrangement implement less external taxes to promote cross-border trade. Giving up border taxations may lead the fiscal authorities to increase their reliance on internal taxation. Further, we find that the more the exchange rate regime is restrictive and the greater is the impact of the exchange rate regime on the VAT-to-GDP ratio. This phenomenon is only observed for developing countries. Our estimation results are neither driven by the difference in the exchange rate regime classification, nor by the common temporary shocks that can affect countries simultaneously. Our findings are also robust to the endogeneity bias.

This paper is another step in understanding the evolution and structure of tax revenues. We give light on the nexus between the exchange rate and tax policies. The trade and tax policies are closely linked to the exchange rate regime at work. Therefore tax policy reforms should be implemented in accordance with the ruling monetary arrangement.

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