A Steeper slope: the Laffer Tax Curve in Developing and Emerging Economies

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Abstract

We argue that the Laffer curve is sensitive to two factors, namely the size of underground economic activities and tax collection costs. The baseline model exhibits counter-intuitive results for developing and emerging economies. Insofar as we find that they are able to extract higher tax rates and revenues in comparison with developed countries, the differences are due to the values computed for structural parameters and steady-state variables. However, when the share of underground activities is taken into account, the Laffer curve is pushed downward, while tax collection costs shift the peak rate to the left.

JEL Codes: H21, H26, H30, E32, E37.

Introduction

Even though it depicts an intuitive and well-documented relationship between tax rates and fiscal revenues, the Laffer tax curve remains a controversial concept in academic and policy-making circles. Contrary to spending, taxes are limited by the tax base from which revenues are extracted. Tax authorities can raise revenues by increasing taxes up to the point where a further increase yields no additional revenues, and may even lead to their decline. The Laffer curve effect laid out in [Laffer 2004] states that when the tax rate goes past its peak, individuals had little incentive to work or produce additional output, which serves as the tax base.

The thrust of the debate in the 1980s focused on the issue whether tax rates in developed countries - mainly in Europe - have reached their peak on the Laffer curve, that is to say, the point where tax cuts could increase revenues. Most of the studies in this area follow the

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intuition later updated in Laffer [2004] by looking at the effects of changes in the marginal income (labour) tax rate on revenues and by implicitly assuming self-financed tax cuts. Laffer [2004] argues that losses from tax cuts generated by reductions in the marginal tax rate are more than offset thanks to changes in income tax brackets that boost economic activities, and thus expand the tax base. Earlier studies were concerned with the level of taxation in developed countries - mainly in Northern Europe- and whether their respective tax rates lay beyond their peak rates. The implication is that these governments can increase revenues through tax cuts. Nevertheless, the literature has quickly restricted itself to study the effects of changes in the marginal income (labour) tax rate on revenues. The focus on labour taxes is mirrored in Prescott [2004], who argues that a substantial share of the discrepancy in worked hours between the United States and Europe can be accounted for by differences in labour tax rates. In his model, Prescott shows that income taxes in Europe are high enough to distort labour supply, and as a result GDP per worked hour is higher in the United States. The immediate conclusion is that an income tax cut in Europe would increase labour supply. Insofar as marginal changes of tax revenues are along the Laffer curve, no mention is made as to whether the tax cut is self-financed, that is, whether labour tax rates in Europe lie to the right of their Laffer curve peaks.

Governments in developing and emerging economies frequently engage in pro-cyclical fiscal policies: they tend to cut taxes in booms, and raise them in recessions. This peculiar fiscal stance stems from the fact that running a budget surplus in booms is politically costly, thus the tax cuts during the expansionary phase of the cycle. By contrast, budget solvency, and subsequent fiscal consolidation measures needed to stench high deficits exert further pressure to raise taxes in recessions. Furthermore, as noted by Talvi and Veggli [2005], because of the high variability in the tax base, governments in developing and emerging economies have no other option but to pursue procyclical fiscal policies. In addition, these policies exacerbate the business cycle in developing and emerging economies, which destabilises further the base from which tax revenues are extracted. An additional feature of the Laffer curve in developing and emerging economies is the narrowness of their tax base. The literature frequently refers to the size of the underground economy as a factor that can explain inefficiencies in tax collection and difficulties in raising additional tax revenues. The inability of tax authorities in developing and emerging economies to raise more tax revenues means that they have access to a smaller tax base and lower peak tax rate as a result. Therefore, it can be argued that countries with a large sector of underground economic activities relative to GDP will exhibit a Laffer curve with a depressed shape, as well as a lower revenue-maximising tax rate. The same argument holds regarding the size of agriculture in the economy, which also implies an elusive tax base. In developing and emerging countries, a shrinking tax base places a disproportionate burden on economic activities that are subject to taxation, which in turn depresses the elasticity to the tax rate. The shrinking tax base tends to push the Laffer curve downwards and shifts it to the left, which corresponds to lower tax revenues for a given tax rate, and a lower revenue-maximising tax rate. As a result, governments in developing and emerging economies would improve their tax revenues by reducing the size of underground economic activities relative to GDP. By incorporating a large share of their tax base for assessment, tax authorities can increase their revenues at constant rate.
In this paper we rely on the framework with which Trabandt and Uhlig [2011, 2012] came up in order to develop a Laffer tax curve specific to developing and emerging economies. We focus on the two main features of these countries, namely the large share of underground economic activities in output, and the collection cost tax authorities face. This allows us to highlight differences in Laffer curve shapes and peak rates between these countries and developed economies. We argue that tax authorities in developing and emerging economies face two broad challenges in implementing their fiscal policy, namely the importance of underground and/or undeclared economic activities relative to GDP, as well as high tax collection costs. Both factors result in either a shrinking tax base, or a variable tax base that prevent governments in these countries from extracting higher tax revenues. We summarise in this paper the differences between the two category groups of countries as follows: first, the Laffer curve is flatter and skewed to the left among developing and emerging economies with respect to developed ones. Second, the former reach a lower peak rate, which translates into lower tax revenues in comparison with the latter. We explain these discrepancies by showing that a large untaxed/undeclared underground sector depresses tax revenues, while high collection costs shift the Laffer curve to the left.

The paper is outlined as follows: the first section provides a review of the literature that focuses on two central aspects of fiscal policy. First, we address the debate in the literature as to how elastic the bases are to tax changes. In particular, we discuss the literature’s predictions on household’s labour supply elasticity. We also look at how the literature identifies and addresses the challenges encountered by tax authorities in developing and emerging countries. The second section introduces the model and its extensions. It presents the baseline model which is an alteration of the Trabandt-Uhlig framework. The baseline model is then upgraded with additional components that take into account the existence of undeclared/untaxed economic activities, as well as a quadratic cost of tax collection. The third section introduces the dataset, its sources and the treatment it goes through as a prelude to model simulation. We calibrate numerical values for structural parameters in our model, then estimate them using the Simulated Method of Moments. We compare estimated results against the usual values adopted in the literature for developed countries, and, to a lesser extent, developing ones. The fourth section reports the Laffer tax curves derived from the simulations of our model. We do observe that Laffer curves are flatter and steeper to the right of their peak rates in emerging countries, with lower tax rates and revenues compared to developed countries. The shift to the left is attributed to tax collection costs, whereas the depressed shape is explained by the existence of undeclared/untaxed economic activities. The section also presents and discusses predictions on the size of tax cuts in consumption, labour and capital that are self-financed. It focuses on the differences of self-financing for each component of the tax base, as well as the varying efficacy of such a policy under the baseline model and its two extensions. The fifth and last section concludes.

1 Literature review

We review in this section bodies of the literature that relate to the main contributions of this paper. We underline the main conclusions that the literature derives regarding the distortionary effects of taxes. We also look at the main conclusions derived by the literature regarding taxation
and its issues in developing and emerging economies. The seminal contributions of Mirrlees [1971], Diamond and Mirrlees [1971] and Atkinson and Stiglitz [1976] have set the theory of optimal taxation in a rigorous analytical framework. The common thread in this pioneering literature is the importance of agent behaviour and how it considered in government policies. They stress what is a cornerstone of the Lucas [1972] critique, namely that fiscal policy needs to take into account individual economic agents’ response to policy changes. Mirrlees [1971] offers an analytical framework where distribution of skill and human capital among the population affects progressive taxation. He also stresses the importance of the consumption/leisure tradeoff in determining labour supply. This paper concerns itself with the amount of fiscal revenues the government can raise through consumption, labour and capital taxes. As such, we are not interested in welfare effects that stem from redistributive taxation, as it is the case in Mirrlees [1971] or Atkinson and Stiglitz [1976].

A more recent body of literature studied the specific distortions of taxation on labour supply. Prescott [2004] studies the determinants of the gap in worked hours between the United States and a set of European countries. He uses a general equilibrium model in order to isolate the wedge effect generated by labour and consumption taxes on household labour supply. Prescott offers predicted volumes of worked hours that fit well with actual levels in Europe and the United States. Using the tax wedge and consumption-to-output ratio at the steady-state, the author concludes that workers in Europe work fewer hours than their American counterparts because the tax wedge is larger due to higher taxes in Europe. Rogerson [2006] agrees that government dynamics - as well as technology- are a prime candidate to account for the gap in worked hours between Europe and the United States. He mentions however that way the government spends its revenues influences the household labour supply schedule. Rogerson identifies two particular cases where labour supply is sensitive to taxation. First, when the government uses tax revenues to fund a lump-sum transfer, it creates an income effect which influences the household labour supply schedule. Second, if the government subsidises leisure instead, there is a substitution effect which alters the household labour supply schedule. The substitution effect is discussed by Langot and Lemoine [2017] in their discussion of shifting the tax burden to consumption and away from labour. They conclude that coordinated fiscal policy can overcome labour market weaknesses brought about by a large tax wedge. Rojas Quintero and Langot [2016] provide an alternative specification to the labour market in order to assess the impact of the tax wedge on labour supply. Using a search & match model à la Mortensen and Pissarides [1994], the authors show that they are able to better assess the time-varying impact of taxation on the labour market. Rojas Quintero and Langot [2016] are able to mimic the dynamics of worked hours - the intensive margin- as well as labour force participation - the extensive margin- in ten OECD countries between 1980 and 2013. Finally, the aftermath of the 2008 financial crisis and the inability of governments in developed economies to use fiscal instruments to mitigate its economic impact prompted a debate in Trabandt and Uhlig [2011, 2012] and Alesina and Giavazzi [2013] to re-assess the Laffer effects of the aggregate fiscal burden.

The household labour supply elasticity conditions the size of distortions generated by the tax wedge on the substitution effect. The literature defines the Constant Frisch Elasticity (CFE) of labour to wages at constant wealth. It measures the sensitiveness of labour supply to exogenous
shocks, such as changes in the tax rate. There is a great deal of debate as to the range of acceptable values it takes. Chetty et al. [2013] review results from micro- and macro-based pieces of evidence collected for developed economies. Their compendium highlights the contradictory results put forward in the literature with respect to household labour supply elasticity. Micro-based estimates rely on household surveys, and increasingly on field and natural experiments in order to give CFE parameter estimates. Chetty [2012] estimates the Frisch elasticity to be around 0.25 for micro-based studies. By contrast, macroeconomic datasets yield a higher estimate for the CFE parameter, ranging from 0.39 in Davis and Henrekson [2005] and values as high as Prescott [2004] at 1.18. On average, macro-based evidence yields a comparatively higher value of 0.71.

Differences in CFE values among developed economies lead to different interpretations of the importance of extensive and intensive margins. A high value for the Frisch elasticity assumes that the household is quite responsive to changes in labour income, at constant wealth level. In particular, the household is more willing to adjust worked hours, which is why we observe that macroeconomic aggregate to be highly procyclical. Chetty et al. [2013] report that as a result, macro-based evidence tends to assign higher values to the CFE parameter in comparison to microeconometric studies. Macroeconomic models mitigate the effects of the discrepancy by introducing indivisible labour à la Hansen [1985] - namely, they take into account the extensive margin of labour supply. In this case, the procyclicality of worked hours is tempered with the much slower dynamics of entrances and exits on the labour market.

1.1 Taxation in developing and emerging economies

There is a host of issues that can account for differences of shape of tax revenues raised by the Laffer curve between developed and developing and emerging economies. The literature frequently refers to the size of the underground economy as a factor that can account for inefficiencies in tax collection and raised tax revenues. Feld and Schneider [2010] underline the importance of underground economic activities relative to GDP. They point out that these are higher among developing and emerging economies in comparison to developed countries. As a result, the tax base is narrower, and results in significant tax revenue losses. The inability of tax authorities in developing and emerging economies to raise more tax revenues means that they have to contend with a smaller tax base and a lower peak rate as a result. The same argument can be made with respect to the size of agriculture in the economy, which also leads to an unreliable tax base. Khan [2001] reports that for a sample of developing and emerging countries, the steady growth in agricultural GDP has not generated a commensurate increase in fiscal revenues. He ascribes this result to the difficulties tax authorities encounter in those economies in assessing agricultural income for taxation. In addition, tax authorities in developing and emerging countries may face significant costs in tax collection. Fiscal inefficiencies are underlined in Agénor and Montiel [2015]. They argue that the government faces a continuum of small-income earners that represent a disproportionately large share of potential taxpayers. Tax authorities therefore face an inadequate tax base, one where revenues cannot be extracted without incurring substantial collection costs. Furthermore, mediocre institutional quality in those countries implies a potential for corruption that further erodes fiscal efficiency. The political economy of
taxation and fiscal policy is also highlighted by Cukierman et al. [1992]. These authors show that tax efficiency is positively correlated with political stability and institutional quality, as well as other economic indicators, such as the sector composition of output, urbanisation and openness to trade. Stern [1991] also studies taxation in developing and emerging economies through the prism of their political economy. This has been mentioned by Buchanan and Lee [1982] when they argue that the government sets its short-run tax rate beyond its long-run peak value due to electoral considerations. The fact that governments in developing and emerging economies may have endogenous preferences in forming their policies may have a significant impact on fiscal policy design. This is critical to these economies, since the government frequently steps in to supply public goods, or implement transfer schemes to support its population.

2 The model

The benchmark setup for our model reprises Trabandt and Uhlig [2011, 2012] where the inter-temporal optimisation programmes of firms and households reflect the distortionary effects of taxation. Households maximise their lifetime utility function subject to resources constraint. The programme writes:

$$\max_{c,n,k,i,b} E_0 \sum_{t=0}^{\infty} \beta^t [u(c_t, n_t) + v(g_t)]$$ (2.1)

subject to:

$$(1 + \tau^c_t)c_t + i_t + b_t \leq (1 - \tau^n_t)w_t n_t + (1 - \tau^k_t)(r_t - \delta)k_{t-1} + \delta k_{t-1} + R^b_t b_{t-1} + s_t$$ (2.2)

$$k_t = (1 - \delta)k_{t-1} + i_t$$ (2.3)

Where $c, n, g$ denote respectively consumption, labour and government expenditure. Capital law of motion (2.3) states that future capital $k$ is equal to its present value net of depreciation factor $\delta$ plus investment $i$. Notice that the government levies taxes on consumption, labour and capital to fund its expenditure. They also issue a state-contingent one-period bond $b$ with coupon $R^b_t$. The government budget constraint writes:

$$g_t + s_t + R^b_t b_{t-1} \leq \tau_t + b_t$$ (2.4)

$$\tau_t = \tau^c_t c_t + \tau^n_t w_t n_t + \tau^k_t (r_t - \delta)k_{t+1}$$ (2.5)

Where $\tau$ refers to tax revenues from consumption, labour and capital, denoted $\tau^c, \tau^n$ and $\tau^k$ respectively. The government spends $g$ and transfers $s$ to households, while it pays $R^b b$ in debt and coupon. Firms maximise their profits subject to technology, denoted $z$ and output $y$. Their maximisation programme writes:

$$\max_{k,n} y_t - r_t k_{t-1} - w_t n_t$$ (2.6)

subject to

$$y_t = z_t k_t^{\alpha} n_t^{1-\alpha}$$ (2.7)
2.1 Constant Frisch elasticity - labour supply wedge

As noted in Rogerson [2006] and Prescott [2004] among others, the standard optimality condition for labour supply for the household implies that the marginal rate of substitution between consumption and labour is equal to the marginal productivity of the latter. Formally:

\[ |MRS_{c,n}| = MPL \quad (2.8) \]

In a model with taxes on consumption and labour however, taxes have a distortionary effect on equation (2.8). The tax wedge, which we denote \( \varphi(\tau) \leq 1 \) can be computed from the household optimisation programme in equations (2.1) through (2.3). The optimality condition is thus:

\[ \left| \frac{\partial U_n}{\partial U_c} \right| = \frac{1 - \tau^n}{1 + \tau^c} \times w \quad (2.9) \]

Where \( w = \frac{\partial y}{\partial n} \) and \( \partial U_x \) denotes the marginal utility with respect to argument \( x \), with \( x \in c, n \).

We also write \( \varphi(\tau) = \frac{1 - \tau^n}{1 + \tau^c} \) for the tax wedge, and \( w \) wages, which are equated with marginal productivity of labour. Equation (2.8) can be rewritten as follows:

\[ |MRS_{c,n}| = \varphi(\tau_t)MPL_t \quad (2.10) \]

As mentioned before, we make a departure from the benchmark model laid out by Trabandt & Uhlig by assuming separability of consumption and labour in the household’s utility function. We propose the following functional form to incorporate in equation (2.1):

\[ u(c_t, n_t) = \frac{c_t^{1-\sigma}}{1-\sigma} - \frac{n_t^{1+\phi}}{1+\phi} \quad (2.11) \]

Where \( \sigma \geq 1 \) denotes the Constant Relative Risk Aversion (CRRA) elasticity of substitution parameter, and \( \phi \geq 0 \) the inverse Constant Frisch Elasticity (CFE) of labour supply to wages. Equation (2.10) can therefore be rewritten as follows:

\[ n_t^{\phi}c_t^{\sigma} = \frac{1 - \tau_t^n}{1 + \tau_t^c} \times \frac{(1 - \alpha)y_t}{n_t} \quad (2.12) \]

We rewrite equation (2.12) in order to provide a tractable expression of after-tax labour supply, which we denote \( n_t^*(\tau) \):

\[ n_t^*(\tau) = [(1 - \alpha)y_t c_t^{-\sigma} \varphi(\tau_t)]^{1/(1+\phi)} \quad (2.13) \]

Equation (2.13) depends on \( \alpha \). We can show that after-tax labour supply decreases with the size of the tax wedge, meaning that the larger consumption and labour taxes, the smaller \( \varphi(\tau) \) gets, and the higher its distortionary effects on the optimality condition of equation (2.9). We can also show that the elasticity of labour supply to the tax wedge is the inverse of \( 1 + \phi \). Although our specification differs from that of Trabandt & Uhlig, we also find that labour supply can be written as a function of its share of output, \( 1 - \alpha \), the tax wedge, \( \varphi(\tau) \) and the Frisch constant elasticity, \( \phi \). However, our expression is more parsimonious.
2.2 The capital tax wedge

In addition to labour and consumption taxes, the government also taxes capital, which introduces a wedge between its marginal productivity and the rent it pays to capital-holders. Namely:

\[ r_t = (1 - \tau^k_t)\left(\alpha y_t / k_{t-1} - \delta\right) \quad (2.14) \]

At the steady-state, the after-tax capital-to-output ratio is:

\[ \bar{k} / y = \left[ \frac{\bar{r}}{\alpha(1 - \tau^k)} + \frac{\delta}{\alpha} \right]^{-1} \quad (2.15) \]

We observe that the after-tax capital-to-output ratio declines with capital tax \( \tau^k \). Since capital stock declines with taxes, its marginal productivity increases as it becomes scarce, and thus rent \( \bar{r} \) increases. We argue that the capital-to-output ratio does not give a meaningful idea of the capital tax base and the distortionary effect beyond that on rent \( \bar{r} \). Instead, we use the Euler equation from the household’s optimisation programme in order to extract an expression for the steady-state after-tax capital stock as a function of its tax \( \tau^k \) as well as other variables and parameters of interest. We write the full Euler equation as delineated in equations (2.1) to (2.3):

\[ c_t^{-\alpha} / (1 + \tau^c_t) = \beta E \left( c_{t+1}^{-\alpha} / \bar{k}_{t+1} \left[ 1 + \left(1 - \tau^k_{t+1}\right) \left(\alpha z_{t+1} n_{t+1} k_{t+1}^{1-\alpha} - \delta\right) \right] \right) \quad (2.16) \]

At the steady state, equation (2.16) is rewritten so as to provide an expression for the after-tax capital stock, which writes as follows:

\[ \bar{k}(\tau^k) = n \left[ \frac{\alpha \beta \bar{z} (1 - \tau^k)}{1 - \beta + \beta \delta (1 - \tau^k)} \right]^{1/(1-\alpha)} \quad (2.17) \]

Balanced growth at the steady-state implies that both capital and labour increase at similar rates. As shown in equation (2.13) after-tax capital stock is also influenced by levels of taxes on labour and consumption. It is also increasing in productivity as measured by steady-state TFP growth rate \( \bar{z} \). High values of \( \beta \), the discount factor, denote low interest rates, and therefore high capital stock. Parameter \( \alpha \) has also a positive impact on capital stock, since a high value means that capital captures a larger share of output. Finally, capital stock is decreasing in depreciation factor \( \delta \) and the tax rate \( \tau^k \).

2.3 Extensions of the Laffer baseline model

The baseline model described in the section above uses a neoclassical setting in order to build a micro-founded Laffer curve. Nonetheless, the model does not make provisions for cases where the government is unable to extract full revenues from its tax bases, or faces collection costs. For instance, the neoclassical model suggests that labour supply shifts entirely to leisure (or non-market activities) when it is taxed at 100%. Such an extreme case does not take into account the possibility that some residual share of household labour supply remains untaxed. This would be the case either because the government cannot tax it, or would bear prohibitive costs in doing so.
The extensions to the baseline model explore two ways to account for imperfect governance in the Laffer curve. The first is to assume that resources are only partially subjected to taxation. The second posits that tax authorities lose a fraction of their fiscal revenues when they are collected.

2.3.1 The benchmark model with untaxed/undeclared tax base

The core components of the baseline are kept in place. We now assume that only a fraction \( p \in [0; 1] \) of the tax base is available for the government to extract fiscal revenues. The rationale behind this model is that underground economic activities exist regardless of current levels of taxation. We argue that factors other than taxation may have an impact on the size of the underground economy relative to GDP. Feige and McGee [1983] argue that the Swedish tax system is too onerous and provides incentives for economic agents to evade taxes through undeclared economic activities. As far as developing and emerging economies go, that may well be also true in their case, though it is not realistic to assume that the underground economy is all about tax evasion. A large shadow economy relative to output could also be the sign of an unhealthy relationship between citizens in a given country, and their government. Per Frey and Schneider [2000] and Schneider et al. [2010], lack of confidence in government institutions may lead agents to hide their resources away from tax authorities. In addition, developing and emerging economies exhibit a higher share of undeclared economic activities relative to GDP either because the dominant sectors are difficult to assess for taxation, or because the government needs to exert costly efforts to assess its tax base. Agriculture is a pertinent example to illustrate the ambiguity of underground economic activities and the difficulties surrounding their tax assessment. We propose to model the share of taxable economic activities as a probability \( \rho \) that an individual economic agent pays taxes on consumption, labour and capital stock. As a result, economic agents adapt their optimisation programme in order to reflect both effects of differentiated taxation and its distortions on their choices. Household optimisation seeks to maximise lifetime utility in equation \((2.1)\) on consumption and labour, subject to the new resources constraints below:

\[
ct(\rho(1+\tau_c)+1-\rho)+it+bt-wtnt(\rho(1-\tau_n)+1-\rho)-(\rho(1-\tau_n)+1-\rho)-R^b_cr_{t-1} \tag{2.18}
\]

The optimisation programme for the household reflects the impact of untaxed/undeclared economic activities. First order conditions for consumption and labour yield the optimality condition which equates the household marginal rate of substitution with marginal productivity of labour, namely:

\[
c^*_tn^*_l = \frac{1-\rho+\rho(1-\tau_n^*\rho)}{1-\rho+\rho(1+\tau_c^*)}w_t \tag{2.19}
\]

The wedge in equation \((2.19)\) is denoted \( \varphi(\tau, p) \) such that \( \varphi(\tau, p) \geq \varphi(\tau) \) the tax wedge derived for equation \((2.9)\). The government’s inability to extract taxes from the full labour tax base results in smaller distortion effects. This means that a government that can only tax a share \( \rho \) of its tax base generates fewer distortions. Indeed, the neoclassical setting of our
model predicts that fraction, $1 - \rho$, of underground/undeclared labour behaves according to the optimality conditions set out in equation (2.8). As a result, the overall distortionary effect of taxation is mitigated. The tax wedge takes into account tax rates for labour and consumption, as well as the share $\rho$ of taxed/declared activities. The steady-state expression for after-tax labour supply, denoted $n^*(\tau, p)$, writes:

$$n^*(\rho, \tau) = \left[ (1 - \alpha) c_{t} \frac{1 - \rho + \rho(1 - \tau^n)}{y \ 1 - \rho + \rho(1 + \tau^n)} \right]^{1/(1 + \phi)}$$

Equation (2.20) shows that the distortion effect is lower in the after-tax labour supply than in the benchmark expression of equation (2.13). By contrast, the labour Laffer tax curve will also be constrained by the fraction $\rho$ of taxed wages. As a result, the effective tax base is now $\tau^n \rho w_n$, implying a narrower labour tax base for any rate $\tau^n$. The labour Laffer tax curve will be therefore flatter than the one predicted in the baseline model.

We proceed with the same steps in writing the after-tax capital stock. We rewrite the Euler equation (2.16) in order to incorporate shares $\rho$ and $1 - \rho$ of taxable and undeclared marginal returns of capital, as well as consumption. We obtain the following expression:

$$\frac{c_t^{-\sigma}}{1 - \rho + \rho(1 + \tau_t^n)} = \beta \mathbb{E} \left[ \frac{c^{-\sigma}_{t+1}/(1 - \rho + \rho(1 - \tau^{k}_{t+1}))}{1 - \rho + \rho(1 + \tau^{k}_{t+1})} \left( 1 + \alpha z_{t+1} n_{t+1}^{-\alpha} k_{t+1}^{-\alpha} \right) \right]^{1/(1 - \alpha)}$$

Equation (2.21) allows us to introduce tax revenue losses with each tax rate change in the model. Parameter $\kappa$ captures the amount of marginal revenue loss as the ratio between actual tax burden and the theoretical contribution of each tax rate to total fiscal revenues.

$$g_t + s_t + R^b_{t} b_{t-1} \leq \tau_t + b_t - \frac{\kappa}{2} \tau_t^2$$

$$\tau_t = \tau_t^c c_t + \tau_t^w n_t + \tau_t^k (r_t - \delta) k_{t-1}$$

2.3.2 The benchmark model with collection costs

In collecting its tax revenues, the government loses a fraction of it, either in the form of bureaucratic processing costs, or because of inherent inefficiencies. We use the quadratic form for the collection cost to incorporate in the budget constraint. Equation (2.23) allows us to introduce tax revenue losses with each tax rate change in the model. Parameter $\kappa$ captures the amount of marginal revenue loss as the ratio between actual tax burden and the theoretical contribution of each tax rate to total fiscal revenues.
Recall that \( \tau \) is total fiscal revenues. When expressed as a percentage of output, it becomes aggregate tax burden \( \tau/y \). For every marginal change in the overall tax burden, the government loses a fraction \( \kappa \), hence the quadratic component \( 0.5 \kappa \tau^2 \). The collection cost encompasses various inefficiencies, ranging from high effort the government needs to exert to extract taxes, to inefficient loopholes in domestic legislation. Given that the quadratic cost is not included in the household’s optimisation programme, enters in the Laffer curve on the revenue side as a result of government tax policy. As a result, the government no longer sets a tax rate \( \tau \) for each component of its tax base. Instead, we replace each tax rate of the baseline model by a new rate denoted \( \tau^\kappa \) such that \( \tau^\kappa = \tau(1 + \kappa \tau/2) \). Instead of taxing at rate \( \tau \) the government taxes at \( \tau^\kappa \) with \( \tau \leq \tau^\kappa \). The collection cost implies a loss of fiscal revenues proportional to the tax rate. Due to their budget constraint, tax authorities increase their tax rate by the same amount. As a result, the Laffer curve becomes more sensitive to tax rate changes: The baseline model predicts \( \partial \tau \), while the extension model implies \( \partial \tau^\kappa = (1 + \kappa) \partial \tau \). This collection cost results not only in higher effective tax rates, it also accelerates the convergence to the peak rate, which generates a reduction in the amount of tax revenues the government can collect. Changes in the tax rate become more expensive as tax authorities need to offset tax collection costs. Consequently, the economy reaches more rapidly its peak rate, which implies a shift of the Laffer curve to the left. Furthermore, as the distortionary effects become larger, the tax base narrows, and tax revenues associated with the peak rate decline.

### 2.3.3 Shapes of the Laffer tax curve

We have defined in the previous section the after-tax expressions of labour supply and capital stock, as well as the distortionary effects of taxation. We are now able to formulate expressions for the labour and capital Laffer tax curves, denoted respectively \( \mathcal{L}(n, \tau^n) \) and \( \mathcal{L}(k, \tau^k) \). For each factor of production, we multiply its tax base \( x \) by its tax rate \( \tau^x \) to get tax revenues \( \mathcal{L}(x, \tau^x) \) such that \( \mathcal{L}(x, \tau^x) = \tau^x x \). Marginal returns from the tax base are computed as follows: \( \frac{\partial \mathcal{L}(x, \tau^x)}{\partial x} \), whereas the marginal tax revenues for the government are written as follows: \( \frac{\partial \mathcal{L}(x, \tau^x)}{\partial \tau^x} \). The Laffer curve for each tax base exhibits a non-monotonic: tax revenues are concave and increasing in the tax rate until the latter reaches its peak value. Beyond this point, tax revenues decline until they reach zero.

The curve, its peak rate and revenues are all function of structural parameters. For labour supply, the literature has discussed exhaustively the impact of the tax wedge \( \varphi(\tau) \) as well as the size elasticity of substitution. By contrast, it has devoted little time to study the impact of other structural parameters and steady-state variables. Other components can also influence the Laffer curve and its shape: for instance, the consumption-to-output ratio, which measures the income effect, may dominate the substitution effect (CFE parameter \( \phi \)). Labour share of output, \( 1 - \alpha \), also contributes to the income effect in determining labour’s share of total output. Similarly, other factors can influence the capital Laffer tax curve. After-tax capital stock is increasing in labour, as well as the steady-state productivity growth rate (\( \bar{z} \)). The capital tax Laffer curve is also sensitive to interest rate net of depreciation (\( \bar{r} - \delta \)), the discount factor, \( \beta \), and the capital share of output \( \alpha \).
3 Data and descriptive statistics

3.1 Data sources

We use data from available open sources and seek to build the largest set possible of countries to incorporate in our sample set. To that effect, we use the World Bank [2018] World Development Indicators (WDI), the Groningen Growth & Development Center database in Feenstra et al. [2015] (formerly the Penn World Table - PWT) and KPMG consultancy firm database of corporate tax rates. These three sources allow us to calibrate and estimate the structural parameters of the model in this paper. These datasets also allow us to compute the effective tax rates that match these of our model. Mendoza et al. [1994] point out that official tax rates do not form a pertinent basis for cross-country comparison due to the plethora of differences in domestic legislation, tax collection enforcement and allowances for tax deductions. As a result, they propose to compute effective tax rates using common tax bases. Fortunately, the WDI dataset has already harmonised to a large degree cross-country tax rates, although we still need to introduce some alterations following the methodology of Mendoza et al. [1994]. The discrepancies between advertised and effective tax rates are well illustrated with the tax rates compiled by KPMG for a fairly large country sample set. Using the Laffer capital tax curve, we investigate whether the corporate tax rate lies beyond its peak rate value for instance. Finally, we also use Schneider et al. [2010] and their measure of the underground economy in GDP for a large set of countries to compute the share of undeclared and untaxed economic activities in GDP.

Table 1 below reports the main macroeconomic variables used for our calibration/estimation exercise. The table also reports the relevant data sources and references, as well as transformations introduced to achieve this objective. Real GDP extracted from the WDI dataset is used as a proxy for output in our model. GDP is expressed in real Dollars for adequate cross-country comparisons. Other macroeconomic aggregates, such as household expenditure and gross capital formation are used as stand-ins for consumption and investment, respectively. We prefer to extract these variables in terms of fractions of GDP from the PWT dataset for two reasons: first, they provide adequate time series in order to compute steady-state values for our model. Second, we can avoid national accounting discrepancies when both variables are incorporated in real Dollars instead. We also use data on capital stock in order to calibrate values for capital share of output $\alpha$ and depreciation factor $\delta$. Capital stock is also expressed in real Dollars for cross-country comparisons. Productivity, defined as Total Productivity Factors (TFP), is measured as relative TFP to the United States in the PWT database. Given that the literature has formed a broad consensus on an annual 2% for the long-run TFP growth in the United States, TFP growth rates for each country is computed as the product of its relative productivity and 1.02 ($1+2\%$). As mentioned earlier, we have argued for incorporating labour in the model as an enrolment rate rather than a share of worked hours. As a result, we look for data on the share of employed individuals in the 15-64 age cohort for each country. Interest rate is computed from lending interest rate adjusted for inflation. Individual values for countries may differ wildly because many developing and emerging economies have experienced episodes of hyperinflation in the past. As a result, we expect structural parameters that are calibrated out of this variable

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to exhibit significant cross-country differences. Finally, taxes are kept unchanged except the variable for labour taxes and contributions. We multiply this variable by \(\frac{\alpha}{1-\alpha}\) in order to substitute the denominator (profits and revenues) with wages. The dataset we have built from these macroeconomic variables reported in table 1 is then used for assigning numerical values to our structural parameters, first by means of calibration, and then with estimation techniques. The dataset also provides long-run averages for steady-state values of our model’s variables.

### Table 1: Core macroeconomic variables used for calibration/estimation of structural parameters.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Set</th>
<th>Reference</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output (y)</td>
<td>WDI</td>
<td>NY.GDP.MKTP.KD</td>
<td>GDP (constant 2010 US$)</td>
</tr>
<tr>
<td></td>
<td>PWT</td>
<td>RGDPO</td>
<td>Output-side real GDP at chained PPPs (in mil. 2011US$)</td>
</tr>
<tr>
<td>Consumption (c)</td>
<td>WDI</td>
<td>NE.CON.PETC.ZS</td>
<td>Household final consumption expenditure, etc. (% of GDP)</td>
</tr>
<tr>
<td></td>
<td>PWT</td>
<td>CSHC</td>
<td>Share of household consumption at current PPPs</td>
</tr>
<tr>
<td>Capital (k)</td>
<td>PWT</td>
<td>CK</td>
<td>Capital stock at current PPPs (in mil. 2011US$)</td>
</tr>
<tr>
<td>Investment (i)</td>
<td>WDI</td>
<td>NE.GDI.TOTL.ZS</td>
<td>Gross capital formation (% of GDP)</td>
</tr>
<tr>
<td></td>
<td>PWT</td>
<td>CSHI</td>
<td>Share of gross capital formation at current PPPs</td>
</tr>
<tr>
<td>Productivity (z)</td>
<td>PWT</td>
<td>CTFP</td>
<td>TFP level at current PPPs (USA=1)</td>
</tr>
<tr>
<td>Labour (n)</td>
<td>WDI</td>
<td>SL.TLF.CACT.ZS</td>
<td>Labour force participation rate (ILO estimate)</td>
</tr>
<tr>
<td></td>
<td>PWT</td>
<td>EMP</td>
<td>Number of persons engaged (in millions)</td>
</tr>
<tr>
<td>Interest rate (r)</td>
<td>WDI</td>
<td>FR.INR.RINR</td>
<td>Real Interest rate</td>
</tr>
<tr>
<td>Tax burden (\tau)</td>
<td>WDI</td>
<td>GC.TAX.TOTL.GD.ZS</td>
<td>Tax revenue (% of GDP)</td>
</tr>
<tr>
<td>Cons. tax (\tau^c)</td>
<td>WDI</td>
<td>GC.TAX.GSRV.VA.ZS</td>
<td>Taxes on goods and services (% value added of industry and services)</td>
</tr>
<tr>
<td>Capital tax (\tau^k)</td>
<td>WDI</td>
<td>GC.TAX.YPKG.RV.ZS</td>
<td>Taxes on income, profits and capital gains (% of revenue)</td>
</tr>
<tr>
<td>Labour tax (\tau^n)</td>
<td>WDI</td>
<td>IC.TAX.LABR.CP.ZS</td>
<td>Labour tax and contributions (% of commercial profits)</td>
</tr>
</tbody>
</table>

**Note:** Data for all sources spans 1950-2015. We use long-run average on available data points for each country in our sample set.

### 3.2 Calibration

Given the sample size of our country group, as well as the constraints on data availability across our data sources, we opt for a streamlined process in assigning numerical values to our parameters. To that effect, we follow the advice given by Kydland and Prescott [1998] where discipline should be exercised as to the calibration strategy of the model’s deep structural parameters. For instance, we expect significant differences in parameter values, even among seemingly homogenous country groups. By contrast, the literature opts for a unique set of calibrated values, as is the case in Trabandt and Uhlig [2011, 2012]. The authors calibrate similar values for EU-14 countries and the United States, even though small but significant differences subsist between the two sets of calibrated values. That is why, in contrast to this avenue, we calibrate...
specific values for each country in our sample set, following [Kydland and Prescott 1998] and [Cooley and Prescott 1995]. Namely, we compute long-run averages and ratios for the relevant macroeconomic aggregates and time series, and extract calibrated values for our structural parameters. We show that for some of these, the Laffer curve is quite sensitive and alter its shape significantly from one country to another. Table 2 below reports the structural parameters for our model, their respective economic interpretations, as well as the support range of acceptable values and calibration formulas. The calibrated values for the structural parameters of our model are computed using steady-state values for the relevant macroeconomic aggregates, as underlined by [Cooley and Prescott 1995]. For instance, we use the Cobb and Douglas [1928] production function in equation (2.7) in order to calibrate the numerical value of $\alpha$, the capital share of output.

Table 2: Structural parameters - benchmark and extension models.

<table>
<thead>
<tr>
<th>Par.</th>
<th>Interpretation</th>
<th>Support</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha$</td>
<td>Capital share</td>
<td>$]0; 1[$</td>
<td>$\ln \bar{y} - \ln \bar{n}$</td>
</tr>
<tr>
<td>$\beta$</td>
<td>Discount factor</td>
<td>$&lt; 1$</td>
<td>$1/(1 + \bar{r})$</td>
</tr>
<tr>
<td>$\delta$</td>
<td>Capital depreciation</td>
<td>$]0; 1[$</td>
<td>$1 + i/k - (1 + g^k)(1 + g^n)$</td>
</tr>
<tr>
<td>$\phi$</td>
<td>Frisch elasticity (CFE)</td>
<td>]-1,1[</td>
<td>$\frac{\partial \ln s}{\partial w} - \frac{\bar{w}}{\bar{s}} = 1 + \phi$</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>CRRA parameter</td>
<td>$\geq 1$</td>
<td>$\frac{\bar{r} - \ln \beta}{\bar{r} - \ln \beta}$</td>
</tr>
<tr>
<td>$\rho$</td>
<td>Declared activities</td>
<td>$]0; 1[$</td>
<td>$\frac{\bar{c}}{\bar{y}} + \frac{\alpha \bar{c}^k + (1 - \alpha) \bar{c}^n}{\bar{y}} - 1$</td>
</tr>
<tr>
<td>$\kappa$</td>
<td>Tax collection cost</td>
<td>$\mathbb{R}$</td>
<td>$\frac{\bar{c}}{\bar{y}} + \frac{\alpha \bar{c}^k + (1 - \alpha) \bar{c}^n}{\bar{y}} - 1$</td>
</tr>
</tbody>
</table>

**Note:** We use long-run averages of macroeconomic variables to approximate the steady-state expressions of model variables. The calibration methods adopted for the hyper-parameter $\theta = [\beta, \delta, \alpha, \sigma, \phi, \rho, \kappa]$ are based on steady-state expressions and ratios. Frisch elasticity parameter $\phi$ is computed using as an elasticity of labour supply relative to real wages. Tax collection cost $\kappa$ measures the gap between actual tax burden and its implied value using calibrated parameters for the frictionless tax burden level.

Similarly, we use capital accumulation to compute the investment-to-capital ratio in order to calibrate $\delta$, the capital depreciation. We use the standard Euler equation in order to calibrate values for the discount factor, $\beta$, as well as the CRRA parameter, $\sigma$. The CFE parameter, $\phi$, affects the extensive margin of labour supply, so we compute it as a function of the employment elasticity to wages. As mentioned earlier, the Constant Frisch Elasticity (CFE) parameter is debated in the literature: values estimated from macroeconomic aggregates differ significantly from those derived from household surveys. [Hall 2009] uses this argument in order to incorporate cross-elasticity between consumption and worked hours. [Trabandt and Uhlig 2011, 2012] use this argument in turns to formulate non-separability in the household’s utility function. In our model however, we ignore cross-elasticity between consumption and worked hours, as labour dynamics are more driven by the extensive margin than the intensive margin in developing and emerging economies. The parameter $\rho$ is calibrated in a straightforward way: we use estimates from [Schneider et al. 2010] to compute the share of declared and/or legitimate economic activities, $\rho$. The fraction, $1 - \rho$, refers to the size of underground economic activities in GDP.
Finally, the parameter $\kappa$ denotes the tax collection cost. We calibrate it to match the discrepancy between the overall tax burden (relative to GDP) and the sum of the contributions of each tax base component with respect to their steady-state values. We use this proxy instead of the indicator used by [Yesin 2004] due to the lack of administrative data on resources allocated to tax collection in developing and emerging countries.

3.3 Summary statistics: structural parameters

We calibrate the numerical values of our sample set of 152 countries using macroeconomic aggregates and formulas reported in tables 1 and 2 respectively. We obtain individual values for each country for the parameter set $\theta = [\beta, \delta, \alpha, \sigma, \phi, \rho, \kappa]$. In this subsection, we start by reporting descriptive and summary statistics for the whole sample. Then, using the subcategories discussed earlier, we compare differences in mean values between the income and regional categories. Table 3 reports summary statistics for the whole sample. We notice that the sample-wide average values for our structural parameters fall within range of acceptable values in the literature. Cooley and Prescott [1995] compute credible values using the calibration methods referred to in Table 2. The parameter $\beta$ denotes the discount factor with a sample-wide average value of 0.929. This implies a long-run average interest rate of 7.6% per annum. This value is pretty high compared to figures used in the literature, namely Cooley and Prescott [1995] and King and Rebelo [1999]. Notice however that there are a couple of countries whose long run average interest rate skew the mean to lower values for parameter $\beta$. Zimbabwe, Brazil, Ecuador and Mongolia exhibit exceedingly low values for parameter $\beta$. By excluding these countries, we reach the higher sample average of 0.942, which is close to the median value reported on table 2.

Table 3: Structural parameters - whole sample

<table>
<thead>
<tr>
<th>Statistics</th>
<th>$\beta$</th>
<th>$\delta$</th>
<th>$\alpha$</th>
<th>$\sigma$</th>
<th>$\phi$</th>
<th>$\rho$</th>
<th>$\kappa$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.929</td>
<td>0.028</td>
<td>0.311</td>
<td>2.710</td>
<td>0.379</td>
<td>0.668</td>
<td>0.252</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>0.055</td>
<td>0.023</td>
<td>0.216</td>
<td>2.077</td>
<td>0.637</td>
<td>0.136</td>
<td>1.254</td>
</tr>
<tr>
<td>Median</td>
<td>0.942</td>
<td>0.024</td>
<td>0.268</td>
<td>1.913</td>
<td>0.372</td>
<td>0.663</td>
<td>0.101</td>
</tr>
<tr>
<td>Maximum</td>
<td>0.999</td>
<td>0.150</td>
<td>0.943</td>
<td>13.127</td>
<td>4.158</td>
<td>0.914</td>
<td>9.711</td>
</tr>
<tr>
<td>Minimum</td>
<td>0.559</td>
<td>0.000</td>
<td>0.010</td>
<td>1.021</td>
<td>-4.379</td>
<td>0.312</td>
<td>-.945</td>
</tr>
</tbody>
</table>

Note: The baseline dataset covers the period 1950-2015. Calibrated values are computed for available data points within this time period. Unweighted averages and other statistics are reported for all 152 countries in the sample. The parameter $\rho$ is computed from Schneider et al. [2010] for the period 1996-2006 and for 132 countries in our sample set. Economic interpretations of structural parameters are reported on table 2.

The literature usually calibrates parameter $\beta$ by using the 3-months maturity for the United States Treasury Bills (T-Bills). Their long-run average being at around 1% quarterly, $\beta$ is calibrated at 0.99 or 0.961 in annual terms. Cooley and Prescott [1995] offer an alternative calibration in which parameter $\beta$ depends on additional parameters. They use the Euler equation at the steady-state in order to extrapolate a value for $\beta$ which is function of capital depreciation.
\(\delta\), capital share of output \(\alpha\) and capital-to-output ratio \(k/y\) at the steady state. Using the numerical values of these parameters, Cooley and Prescott [1995] calibrate an annual value of \(\beta = 0.947\). Hairault and Portier [1995] calibrate \(\beta\) on French quarterly data, at 0.953 using an annual interest rate of 4.9\%. By contrast, Laffargue et al. [1992] and King and Rebelo [1999] calibrate for real interest rate such that \(\beta = 0.98\) on an annual basis. For small open economies, Schmitt-Grohe and Uribe [2005] calibrate \(\beta = 0.96\) for Canada, which implies an annual interest rate of 4.1\%. García-Cicco et al. [2010] calibrate a parameter value \(\beta = 0.922\) for Argentina, using an average interest rate of 8.41\% per annum.

For capital depreciation factor \(\delta\), we adopt the calibration formula of Cooley and Prescott [1995]:

\[
\delta = 1 + \frac{i}{k} - (1 + g^k)(1 + g^n), \\
\frac{i}{k} \text{ denotes the investment-to-capital ratio, } g^k \text{ and } g^n \text{ denote capital stock and demographic growth rates, respectively. By taking into account these growth rates there is a large discrepancy between our calibrated values, and these used in the literature. In our sample, capital depreciation parameter \(\delta\) displays a value of 0.028 on average, which is lower than the value typically found in the literature. Hairault and Portier [1995] reports a quarterly depreciation rate of 0.0125 for the French economy, which yields an annual value of \(\delta = 0.051\). King and Rebelo [1999] assign a close value of \(\delta = 0.06\) on the basis of postwar data in the United States. They also admit that a higher depreciation factor of 10\% can yield similar results. Trabandt and Uhlig [2011, 2012] also calibrate a close average value \(\delta = 0.07\), ranging from 0.048 (Sweden) to 0.098 (Portugal). For emerging economies, Garcia-Cicco et al. [2010] retain \(\delta = 0.1255\) for Argentina, while Aguiar and Gopinath [2007] assign a lower value of \(\delta = 0.05\) in their study of business cycles in emerging economies. Despite lower values on average for capital depreciation \(\delta\), some countries in our sample exhibit double-digits depreciation rates. Azerbaijan, Zimbabwe and Equatorial Guinea all exhibit values larger than 10\%.

Parameter \(\alpha\) refers to capital share of output, and it is calibrated using capital stock and output per capital in log terms, i.e.

\[
\alpha = \frac{\ln y - \ln n - \ln z}{\ln k - \ln n}. \\
\text{The literature calibrates for } \alpha \text{ a usual value of } 1/3, \text{ derived from Solow [1957] and his investigation of the Total Factor Productivity (TFP) residual in the United States. García-Cicco et al. [2010] use a similar value for their simulation of business cycles in Argentina. King and Rebelo [1999] also use the Solow estimate of } \alpha = 1/3. \text{ Schmitt-Grohé and Uribe [2005] use a similar value } \alpha = 0.32 \text{ to calibrate a small open economy. By contrast, Cooley and Prescott [1995] assign a slightly higher value } \alpha = 0.4 \text{ to capital share of output. They obtain this value by excluding government capital stock and income from the macroeconomic aggregates. Hairault and Portier [1995] and Hairault [1995] both calibrate comparatively higher values for the French economy, with } \alpha = 0.46, 0.42 \text{ respectively.}

The literature has therefore formed a consensus on a range of acceptable values for \(\alpha\), belonging to the interval [0.24; 0.43], as reported in Christiano and Fitzgerald [1998]. Our estimates lead to broadly similar values, with a sample average value of 0.31 and a median value of 0.26, which suggests that there are outliers on the upper bound set for parameter \(\alpha\).

Parameter \(\sigma\) denotes the inverse of intertemporal elasticity of substitution among households. It is also the Constant Relative Risk Aversion (CRRA) parameter, with \(\sigma = |U''_c/U'_c|\) the ratio of the second and first utility derivative with respect to consumption. The method adopted to calibrate \(\sigma\) uses the standard growth theory as in Barro and Sala-i Martín [2004]. Household’s
consumption growth rate at the steady state is proportional to deviations of the interest rate from its equilibrium value, \( \Delta \bar{c} = (r - \ln \beta)/\sigma \). CARRA Parameter \( \sigma \) can therefore be written as a function of the average consumption rate and interest rate in long-run, as well as the discount factor \( \beta \). Lucas [2003] estimates consumption growth rate using a linear time trend. We opt instead for the geometric mean to calibrate the average growth rate of household consumption. We observe that 75% of our sample exhibit a \( \sigma \) value of 3.2 and less, which suggest that our calibration method leads to calibrated values consistent with those used in the literature. In the literature, the parameter \( \sigma \) is usually calibrated at a value equal to or greater than one. For instance Cooley and Prescott [1995] use \( \sigma = 1 \) which implies \( U(c) = \ln c \). In his investigation of welfare costs of the business cycle, Lucas [2003, 1990] offers alternative calibrated values for \( \sigma \) ranging from 1 (logarithmic) to 2.5. The consensus in the literature seems to be \( \sigma = 2 \). Schmitt-Grohé and Uribe [2005] calibrate this value for Canada as a small open economy, while García-Cicco et al. [2010] do the same for Argentina. Aguiar and Gopinath [2007] also adopt a similar value in their study of business cycles in a large set of emerging economies. We depart from the literature by using our own calibrated results, which show yield an average value of \( \sigma = 2.71 \). Although the standard deviation is large (2.07), the median value of \( \sigma = 1.91 \) is much closer to the consensus formed in the literature.

The Constant Frisch Elasticity (CFE) parameter denotes changes in labour supply due to an income shock. In our model, \( \phi \) is the inverse of labour supply elasticity, namely \( \phi = 1/\epsilon^{s,n} - 1 \) where \( \epsilon^{s,n} = \frac{\partial n^s}{\partial w} \frac{w}{n^s} \). The literature does not form a clear consensus as to the appropriate set of values for which it calibrates \( \phi \). In fact, micro-based evidence collected from household survey and field experiments contradict results from macroeconomic aggregates. Chetty et al. [2013] find that CFE values for labour supply lie between 0.3 and 0.25 for micro-based studies, and 0.25 to 0.5 for macro-based estimations. García-Cicco et al. [2010] calibrate the CFE parameter at \( \phi = 1.6 \) for Argentina, meaning that the implied labour supply elasticity is 0.384. Aguiar and Gopinath [2007] calibrate their value such that households devote a third of their available time to work at the steady state, which implies a CFE value of 1.77. Our sample value of \( \phi = 0.379 \) implies a labour supply elasticity of 1.64, which is not far away from either the micro- or the macro-based evidence referenced in Chetty et al. [2013]. We should note however that in our sample, 12 countries exhibit a negative value for labour supply elasticity, with an average value of -1.78. Most of these are located in Central & Eastern Europe and the Baltics, as well as Zimbabwe. This negative elasticity assumes that the household actually decreases its labour supply after a positive income shock. Parameter \( \rho \) captures the percentage of declared economic activities over GDP. We report the data compiled by Schneider et al. [2010] as the fraction \( 1 - \rho \) of undeclared or underground economic activities. On average, declared and/or legitimate economic activities make up for 67% of GDP. The median share is at 66.3% which is close enough to suggest that most countries cluster around the mean with no significant outliers. We can report that only 10% of our sample has a share \( \rho \) of declared economic activities below 10% of GDP. Finally, parameter \( \kappa \) captures the inefficiencies or cost of collection of taxes. As shown on table 2 parameter \( \kappa \) captures the gap between the total tax burden, and the contributions of each tax component to total fiscal revenues. The trivial case where \( \kappa = 0 \) refers to an exact match between the aggregate tax burden on one side, and the individual components of tax
revenues on the other. We report a substantial degree of heterogeneity among the countries in our sample. Although average cost of collection is 29.65%, median value is slightly higher at 30.5%. On average, countries in our sample lose a little under 30% of their tax revenues due to a mixture of tax collection inefficiencies, costs and specific domestic legislation. The fact that minimum and maximum values are so far away from each other suggest that there are substantial cross-country differences to discover.

In order to expand on results discussed above, we report in figure 1 the histogram and estimated distribution of the structural parameters for our country sample. The Kernel-based density estimates can provide a visual illustration of how our structural parameters are distributed across our country sample set. Although most parameters congregate within range of the usual values adopted in the literature, there are substantial outliers to the distribution of several parameters. As mentioned before, countries with double-digit average interest rate exhibit a low value for the discount factor $\beta$. In total, 15 countries out 152 exhibit a long run average interest rate of 15% or more. This means that all these countries calibrate their respective discount factors at 0.87 or less. These countries are distributed roughly equally across Central and Southern Latin America, Central Asia, Central & Eastern Europe and the Caucasus, as well as Sub-Saharan Africa. Otherwise, the rest of our sample set calibrates values close to these used in the literature.

Figure 1: Histogram and estimated density - structural parameters

Note: See comments on table 3. Estimated density is computed using the Normal kernel.

Regarding capital depreciation $\delta$, we have explained before why our calibrated values are set lower compared to what the literature usually attributes to this parameter. Nevertheless, we do observe some outliers to the right of the distribution, mainly with $\delta$ values at 10% or higher. Three countries exhibit a large depreciation factor, namely Azerbaijan, Equitorial Guinea and

\footnote{Countries with a low discount factor $\beta$ are: Angola, Armenia, Belarus, Brazil, Ecuador, Ghana, Kazakhstan, Kyrgyzstan, Madagascar, Mongolia, Nicaragua, Paraguay, Uruguay and Zimbabwe. Yemen from The Middle East & North Africa is the only regional outlier.}

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Zimbabwe. The remaining countries in our sample set cluster closely to the reported mean in Table 2. Although parameter $\alpha$ shows a similar shape of distribution, there are more outliers with respect to the usual values of the literature. Using the range $[0.24; 0.43]$ computed by Christiano and Fitzgerald [1998] we find that only 57 countries out of 152 are included. Most of these are High-income countries, which means that the calibration method is sound regardless.

This heterogenous distribution is reflected in the small mode to the left, close to 1 in Figure 1.

CRRA parameter $\sigma$ is more homogenous, with 110 countries out of 152 with a value of 3 or less. Only 16 countries exhibit a CRRA value of 5 or more. Labour supply elasticity and the CFE parameter $\phi$ are closely linked, which is why both are plotted for their respective estimated densities. There is strong clustering of labour supply elasticity around its mean value of 1.86.

Similarly, we observe that many countries in our sample set congregate around the mean CFE value of 0.378. Nevertheless, we observe that there are outliers on both tails of the distribution. Labour elasticity has a small cluster of outliers to the right, with very high elasticity values. We report the same for the CFE parameter $\phi$. The distribution of parameter $\rho$ is more homogenous: 118 countries of 152 are located in the interval $[0.5; 1]$. The remaining countries exhibit lower values, with the smallest $\rho$ begin 0.312. Finally, collection cost parameter $\kappa$ is mostly set on the interval $[-1; 1]$ with 127 countries. The remaining 25 exhibit a higher value for $\kappa$ which implies a highly efficient collection system. Table ?? below reports the calibrated values for our sample set of 152 countries consolidated into sub-categories. We use various sub-groups as proxies for wealthy countries: G7, core OECD, present-day OECD and EMU. The table reports average values for all proxies of developed economies, as well as the remaining countries as stand-ins for developing and emerging ones. We report an average $\beta$ value for the G7 group at 0.964 with a standard deviation of 0.019. It is larger than the core OECD or OECD groups, at 0.957 and 0.953, respectively. Europe also exhibits a large $\beta$ value on average, with 0.958 and 0.957 for the EMU and EU14+US groups, respectively. By contrast, the discount factor $\beta$ value for the remaining 116 countries that are neither in Europe, G7 or the OECD is on average lower with a value of 0.922 and a larger standard deviation of 0.06. The same level of discrepancy is reported for the CRRA parameter $\sigma$. All proxies for wealthy economies exhibit values close to 2, the standard value in the literature. By contrast, average value for $\sigma$ in the rest of the world is higher at 2.9, with a larger standard deviation of 2.29. Another parameter with similar properties is $\rho$, share of declared and/or taxable resources. Average values for our proxies of developed economies range between 0.79 and 0.85 with standard deviations between 0.06 and 0.09. We contrast these values with those computed for the rest of the world, where average $\rho$ stands at 0.62 and a standard deviation of 0.12. Capital share of output $\alpha$ also shares in the same patterns, where we calibrate similar values for all proxies of developed countries. $\alpha$ values for these groups range between 0.33 and 0.36, while developing and emerging economies experience a lower average of 0.31. Parameter $\delta$ offers an additional contrast between our proxies of developed countries, and the rest of the world. Average values for developed countries range between 0.017 and 0.023, while the rest of the world calibrates an average value of 0.03. CFE parameter $\phi$ is relatively low in G7, OECD and European countries, with mean groups ranging between 0.179 and 0.274. For the rest of the world though, the Frisch elasticity parameter is at 0.419, with a larger standard deviation. Finally, we report a heterogenous distribution of $\kappa$. 

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across country groups, whose average value is negative across the board. Given the small size sample of the G7 group, average value for $\kappa$ can be biased by individual countries, such as Italy, whose collect cost is the highest among G7. Nevertheless, all aver values for the proxy groups of wealthy countries are lower than the rest of the world. The remaining 95 countries in our sample exhibit a group mean of -0.388 with a comparatively larger standard deviation of 0.28. Tables ?? and ?? provide further categories using income, regions and Freedom House scores as categories.

Although these comparisons provide us with first-hand evidence of cross-country differences, we cannot conclude as to how statistically significant they are. Our results show that the calibrated values we have computed for G7 countries fit well within the range of acceptable values adopted in the literature. However, we are not sure whether calibrated values for developing and emerging economies are statistically different from G7 values. To that effect, we propose to test group means using the G7 group as a benchmark, against OECD, core OECD and the rest of the world as the remaining groups. We use one-way Analysis of Variance (ANOVA) testing. ANOVA posits a null hypothesis that all mean values for our category groups are equal. This is equivalent to an F-test with $q$ constraints, where $q$ is the number of category groups. Using the G7 and high income countries as base level groups, we test differences in mean values for each parameter. We first start by comparing G7 to core OECD, OECD and the rest of the world, then move to income-based and region-based categories. As far as selected proxies for developed countries go, we report statistically significant differences for some parameters, though many others appear to be similar across group categories. The discount factor $\beta$ is lower in the rest of the world compared to G7 base level, whereas no meaningful differences can be reported as to OECD and core OECD groups.

3.4 Estimation - GMM

Although calibration has been a staple of General Equilibrium models, there is much criticism to be made of its use. Reliance on long run averages and ratios does not always provide accurate measurement of numerical values for structural parameters. Too often, the literature mentioned above does not delve into the rationale behind values assigned to some parameters. In addition, there are frequent contradictions between micro-based estimates derived from panel studies, and macro-based aggregates with time series analysis. CFE parameter $\phi$ in our model is an apropos instance of the limitations of calibration. Finally, as noted in Blanchard [2018], the literature frequently relies on an unconvincing ad hoc mixture of Bayesian estimation and calibration.

We propose to offer an additional set of estimated parameter to the calibration results reported above. Favero [2001] and Canova [2007] discuss at length the pitfalls of econometric misspecification for structural parameters. Bad econometrics may yield a robust or consistent estimator, yet one with no obvious intuitions as to its economic interpretation. To that effect, we use Generalised Method of Moment in order to provide estimates of the parameter set $\theta = [\beta, \delta, \alpha, \sigma, \phi]$. We denote moments $g(\theta, X)$ where X is a matrix of macroeconomic variables. $g(.)$ are moments derived from the optimality conditions of our model. The GMM estimator
seeks to minimise the following criterion:

\[
\arg \min_{\theta} \left[ \frac{1}{T} \sum_{t=1}^{T} g(\theta, X) \right]^T W^{-1} \left[ \frac{1}{T} \sum_{t=1}^{T} g(\theta, X) \right]
\]

(3.1)

Where \( W \) is the variance-covariance matrix, \( T \) is the time period of aggregate macroeconomic variables incorporated in moments \( g(\theta, X) \). \( W^{-1} \) weighs moments inversely commensurate to their variance in order to minimise the GMM criterion in equation (3.1). Given our use of annual data, we are limited in the number of data points per country. The time period \( T \) is short, as we get at most 64 observations per variable. In order to improve our estimator, we adapt the procedure laid out in McFadden [1989] used for a Simulated Method of Moments (SMM). He states that the SMM method is handy when the moment function has an intractable analytical expression, yet is easy to simulate. In our case, intractability comes from the small sample size from which observations are drawn. All conditions for the practical use of SMM are observed in our case: the Monte Carlo simulation are based on well-behaved functions, and are easily calculated using just-identified instruments. The asymptotic variance-covariance of estimator \( \hat{\theta} \) is computable. We use our limited sample to generate a large set from which we draw our GMM/SMM estimator. For each country, we compute the optimisation programme in equation (3.1) using 1,000 draws from the available data points. This allows us to compute an estimator and its standard error. Moments \( g(\theta, X) \) write:

\[
\begin{bmatrix}
\frac{y_t - z_t - n_t}{k_{t-1} - n_t} \\
\frac{1}{1 + r_t} \\
1 + \frac{i_t}{k_{t-1}} - (1 + g_k^t)(1 + g_r^t) \\
\frac{r_t - \ln \beta}{\Delta c_t} \\
(\ln(1 - \alpha) + y_t - \sigma c_t - n_t)
\end{bmatrix}
\]

We then compare our results with those of the standard calibration strategy using estimated densities for both methods. Table 4 below reports the summary statistics of our estimates for the whole sample. GMM estimates are somewhat lower compared to the calibrated values reported in table 3. This can be explained by the fact that there are more outliers to the left-hand side of the distribution for each parameter. Indeed, almost all structural parameters reported in table 4 exhibit a null minimal value, something that was not reported for calibrated values in table 3. Nonetheless, calibrated and estimated median values are much closer to each other, which is a testimony to the robustness of the calibration strategy laid out in the previous section.

Estimated results show that calibration is a parsimonious method for attributing numerical values. Our results also show that calibration can provide meaningful values to the model’s structural parameters. We provide additional evidence that GMM estimates and calibrated values describe the same distribution for core structural parameters in our model. Figure 2 below plots the estimated densities for both GMM and calibrated values.
Table 4: Structural parameters - GMM estimations.

<table>
<thead>
<tr>
<th>Statistics</th>
<th>$\alpha$</th>
<th>$\beta$</th>
<th>$\delta$</th>
<th>$\sigma$</th>
<th>$\phi$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.296</td>
<td>0.881</td>
<td>0.026</td>
<td>2.523</td>
<td>0.361</td>
</tr>
<tr>
<td>Mean (Calibration)</td>
<td>0.311</td>
<td>0.929</td>
<td>0.028</td>
<td>2.710</td>
<td>0.379</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>0.221</td>
<td>0.215</td>
<td>0.023</td>
<td>2.128</td>
<td>0.641</td>
</tr>
<tr>
<td>Median</td>
<td>0.259</td>
<td>0.941</td>
<td>0.022</td>
<td>1.792</td>
<td>0.365</td>
</tr>
<tr>
<td>Median (Calibration)</td>
<td>0.268</td>
<td>0.942</td>
<td>0.024</td>
<td>1.913</td>
<td>0.372</td>
</tr>
<tr>
<td>Min</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-4.379</td>
</tr>
<tr>
<td>Max</td>
<td>0.944</td>
<td>0.999</td>
<td>0.150</td>
<td>13.126</td>
<td>4.157</td>
</tr>
</tbody>
</table>

Note: Baseline dataset spans the period 1950-2015. GMM estimation sampled 1000 non-negative observations from available data points, with replacement. Moments $g(\theta, X)$ are just-identified, using the same number of instruments as there are moments. The parameter set vector $\theta$ minimises the criterion set out in equation (3.1). Yellow rows report calibrated values of table 3 for comparison. Summary statistics are reported un-weighted for economies in the sample set. Standard errors are reported for the whole sample set of 152 countries. Individual standard errors are reported in the annex.

Comparison between densities for calibrated and estimated parameter values suggest that both methods yield essentially the same results. We can describe the same bimodal distribution for parameter $\alpha$ capital share of output. Most countries cluster around the interval [0; 0.4] whereas a small model is observed around 0.8. The discount factor $\beta$ replicate similar properties, with a large cluster around a value of $\beta = 0.95$ (or a long-run interest rate of 5.2%). Estimated values for capital depreciation $\delta$ are for the most part lower than 5%. They replicate adequately the distribution of calibrated values, which suggests that the method advocated by Cooley and Prescott [1995] fits well most countries in our diverse sample set. We report similar estimated results for CRRA parameter $\sigma$ in terms of clustering around acceptable values. Most countries see their estimated $\sigma$ parameter fall within range of [1; 3]. This interval comprises the oft-used value of 2 in the literature mentioned earlier, and the estimated distribution fits that of calibrated values. Our estimations also confirm the calibration strategy adopted for CFE parameter $\phi$. There is significant clustering around the mean value of 0.380 the same way we reported for calibrated values. Overall, GMM estimates confirm the calibration strategy and its results as laid out in the previous section.

Results reported in table 4 are better illustrated with the estimated densities for calibrated and estimated values of the model’s structural parameters. We have used in this section the standard calibration methods advocated in the literature. The parsimonious specifications adopted for this model have yielded adequate values for our sample set. Calibrated values for developed economies fall well within range of acceptable and usual values adopted in the literature, while most developed and emerging economies calibrate comparable values. We have then used GMM estimation to test the robustness of our calibrated values, and confirm that they are. We now move to building the Laffer curve for our model.
4 Results - the micro-founded Laffer curve

In this section, we use calibrated values for our structural parameters to build country-specific Laffer curves. In the baseline model, we use equations (2.13) and (2.17), and calibrated values computed in the previous section. We study the properties of Laffer tax curves, their respective tax peak rates and revenues. We then move to the extension of imperfect governance to our model, and compare their Laffer curves.

Figure 3: Median Laffer curve for capital and labour taxes. Medians are computed for the whole sample set, 152 countries.
Figure 3 reports median Laffer labour and capital tax rate curves for the sample set of 152 countries. We observe the standard shape of the Laffer curve, with increasing revenues for low tax rates, until the curve reaches its peak. Beyond their respective extrema, tax revenues decline until they reach zero at 100% tax rate. Based on the calibrated values of our sample set, the median country exhibits peak tax rates for labour and capital at 19.72% and 34.03%, respectively. We also observe that tax revenues for labour decline at a faster pace when taxes are set past their peak value. Trabandt and Uhlig [2011, 2012] report higher values for their sample set of EU-14 countries and the United States. They compute that maximum labour tax rates in their sample set are set between 51% and 72%. They also compute high peak rate values for capital taxes, set between 44% and 64%. The Laffer curve shapes are also different, both capital and labour tax revenues are skewed sharply to the left, hence the higher peak rates.

4.1 Baseline model

4.1.1 Income group categories

Using the sub-categories delineated in the previous section, we first start by using the World Bank Atlas method of income group. We create a proxy for developed economies with the High-income category, while developing and emerging economies are consolidated into the remaining income category groups. Figure 5 reports median curves for labour and capital taxes per income group. Each subplot compares the Laffer tax curve for High-income and other income country groups.

Middle-Low income countries exhibit the highest median peak labour tax rate at 21.5%. High-income economies are at a lower peak rate of 17.8%, while the median Low-income country computes a peak tax rate of 15.6%. Middle-high income economies exhibit the lowest median of all income groups at 11.2%. In addition, the Laffer labour tax curve, is higher in Low-income countries, compared to that of our proxy group for developed economies. Such a counter-intuitive result runs counter to expectations that governments in developing and emerging economies...
experience more difficulties in extracting fiscal revenues. We would except that non-High-income countries would exhibit a lower Laffer curve and skewed to the left in comparison with High-income economies. On the contrary, the baseline model predicts that developing and emerging economies are able to tax labour at a higher or similar rate, and extract higher tax revenues than High-income countries. We account for this paradoxical result by recalling the after-tax labour supply $n^s(\tau^n)$ expression in equation (2.13). Household labour supply is an increasing function of the consumption-to-output ratio. This means that labour tax revenues themselves are increasing in household consumption share of output. This ratio is highest among low-income countries: High-income countries exhibit an average consumption ratio of 0.56, while low-income countries report a higher average ratio of 0.74. Figure 5 reports the distribution of consumption share of output per income group, and illustrates the discrepancy. At the steady state, a large share of output allocated to consumption means that the household is likely to increase its labour supply if income decreases. This means that it is inelastic to taxes, hence higher tax revenues. Given that low-income countries exhibit on average a high consumption-to-output ratio, it is expected that they would yield commensurately higher labour tax revenues. The importance of consumption share of output is such that it accounts for 80% of the gap in tax revenues between low- and High-income countries. The consumption ratio also explains to a similar degree the gap between developed economies and the other income groups.

![Figure 5: Whisker-plot of consumption-to-output ratio - World Bank Atlas method, income categories.](image)

We observe that peak rate values for our proxies of developed and developing and emerging economies are close to each other. High-income countries exhibit the lowest median value of 29.5%. All other income country groups compute median peak rates between 31% and 33%. Nevertheless, we report significant discrepancies in tax revenues between High-income and other income group economies. The largest gap in fiscal revenues is observed between high- and middle-high income country groups. The latter raise twice as much as the former in the neighbourhood of their respective tax rate peaks. We explain the discrepancy in tax revenues with differences in labour supply, productivity and capital returns (real interest rate). Recall that low-income
countries exhibit a higher consumption share of output, which makes labour in these economies inelastic to taxes. As a result, capital tax revenues are also higher in low- and middle-low income countries. In addition, we also report significant cross-country differences in productivity growth rates. TFP growth is higher in developing and emerging economies on average, as productivity growth rates decrease with real income per capita. According to equation \(2.17\), after-tax capital stock is an increasing function of productivity growth rate at the steady-state. We compute an average High-income productivity growth rate of 2.5\%, while developing and emerging economies experience a higher average growth on average. We find that the productivity differential accounts for 45\% of the discrepancy in capital tax revenues between high- and middle-low income countries. In addition, low- and middle-low income countries exhibit higher interest rates on average than middle high- and High-income economies. Differences in average interest rates contribute positively to capital tax revenues, as differences in interest rate levels contribute an additional 50\% in explaining differences of capital tax rates between developed economies on the one hand, and emerging and developing economies on the other.

### 4.1.2 Regional group categories

We proceed with a similar analysis for regional groups. We use High-income countries as a proxy for developed economies, while the remaining countries in our sample set are consolidated into five regional areas: Latin America & the Caribbean, Sub-Sahara Africa, Middle-East & North Africa, Central & Eastern Europe, Balkans & Central Asia, and South Asia & Pacific. Figure 6 reports Laffer labour tax curves for the median country in each regional group category. It compares the median Laffer tax curve of High-income countries against that of each regional group.

![Graphs showing Laffer labour tax curves for different regions](image)

Figure 6: Median Laffer labour tax curves. Sample set broken down into regional groups.

The common feature to all five regional groups is that their respective median peak tax revenues are higher than the median peak for High-income countries. There are different levels of discrepancy in tax revenues, with Latin America & Caribbean and the Middle-East & North
Africa exhibiting the largest gaps. At peak revenues, the two regional groups raise 2.77 and 1.71 times more tax revenues than the median High-income country, respectively. South Asia & Pacific is close behind with peak revenues at 1.38 times these of High-income countries.

We have shown earlier that household consumption share of output accounts for an important fraction of the gap in median tax revenues. We extend this analysis to all core components of after-tax labour supply for each regional group. Table 5 reports the respective contributions of consumption-to-output ratio, capital share of output $\alpha$ and CFE parameter $\phi$ to the gap in labour tax revenues between each regional group and High-income countries. Table 5 reports countries in Latin America and South Asia with the largest gaps in tax revenues relative to High-income countries. Results in both regional groups are quite sensitive to differences in Frisch elasticity, as can be seen from its contribution to the gap in median tax revenues. In South Asia, differences in CFE value are enough to account for almost 80% of the gap in median tax revenues with High-income countries. Similarly, we report a large effect of CFE parameter $\phi$ in Latin America. Differences in median tax revenues can be explained up to 86% by differences in median values for the Frisch elasticity between that regional group, and those of developed countries. To a lesser degree, labour supply elasticity $\phi$ also plays an important role in the MENA group, since 40% of the gap in median tax revenues can be explained by differences in CFE $\phi$ values.

Table 5: Median gap in tax revenues and relative contributions (%) of labour supply components.

<table>
<thead>
<tr>
<th>Regional group</th>
<th>Median gap</th>
<th>C/Y</th>
<th>$\alpha$</th>
<th>$\phi$</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.E. Europe, Balkans &amp; C.Asia</td>
<td>1.65</td>
<td>20.21</td>
<td>1.97</td>
<td>25.47</td>
</tr>
<tr>
<td>Latin America &amp; Caribbean</td>
<td>3.09</td>
<td>26.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MENA</td>
<td>1.40</td>
<td>27.53</td>
<td>15.17</td>
<td>40.08</td>
</tr>
<tr>
<td>South Asia &amp; Pacific</td>
<td>2.87</td>
<td>2.09</td>
<td>3.12</td>
<td>79.21</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>1.21</td>
<td>70.92</td>
<td>16.17</td>
<td></td>
</tr>
</tbody>
</table>

Note: Median gap reports the ratio of median tax revenues between regional groups and High-income countries. Contributions (%) of structural parameters in after-tax labour supply are computed by substituting each component individually by its median value of High-income countries and plugging it in labour tax revenues for each regional group.

For other regional groups however, consumption-to-output remains a key component to account for differences in peak tax rates with the benchmark group of developed economies. The discrepancy in median tax revenues between developed economies and Sub-Saharan Africa is accounted for at 71% by differences in household consumption ratio C/Y. For labour tax revenues, household supply is determined by two key components, namely consumption share C/Y and Frisch elasticity $\phi$. The income-based criterion suggests that the former matters a lot in the Laffer labour tax curve. The region-based criterion suggests that while the consumption ratio is still an influential factor for some regional groups, most others are more sensitive to the Frisch parameter. In any case, we have presented a convincing argument to account for the counter-intuitive result of higher tax revenues in developing and emerging economies relative to developed ones.
We extend the same analysis to capital tax revenues for regional groups and High-income countries. In contrast to labour taxes, there is a great deal of heterogeneity in tax revenues between developed countries on one side, developing and emerging economies on the other. Some regional groups replicate the same counter-intuitive result of higher tax revenues than developed countries, while others fit the more believable outcome of lower tax revenues. It is expected that developing and emerging economies would raise a lower amount of tax revenues out of capital taxes, because they have a lower level of capital stock to being with. Nevertheless, there are other factors that can belie this prediction, as it is the case for many regional groups reported in figure 7. The figure below reports median Laffer capital tax curves for each regional group, compared against the benchmark category of developed economies. Two outliers exhibit extreme shapes for their respective tax revenues. The median countries in Eastern Europe & the Balkans, as well as Sub-Sahara Africa can raise respectively 8.5 and 3.5 times more tax revenues than High-income economies at peak revenues. Latin America raises 40% more tax revenues than developed economies, while the two remaining regional groups exhibit Laffer curves below that of the median High-income country. Contrary to after-tax labour supply, there are more parameters and steady-state variables involved in the expression of after-tax capital stock. In particular, capital tax revenues are also a function of interest rate (net of depreciation) and labour supply itself. We concentrate on these variables and parameters that are key to explain the gap in capital tax revenues between developed economies and other regional groups. We identify labour, net interest rate and productivity as likely candidates to account for the gap in tax revenues. Labour has been identified through its own dynamics, as discussed above. Net real interest rate accounts for the availability of capital stock.

Paradoxically, high tax revenues from capital may be due to its own scarcity, since it boosts interest rates. Because these are the expression of marginal productivity of capital, high interest rates are at once the expression of low capital stock, and a lucrative source of fiscal revenues for the government. Productivity is the third candidate, with emerging and developing economies
Laffer Curve in Emerging Economies

exhibiting a higher productivity growth rate than developed countries. Other parameters, such as \( \alpha \) and \( \beta \) account for the residual contributions that neither candidates has explained. Table 6 reports the contributions of each component to the gap in median capital tax revenues between each regional group and High-income economies. We focus on these groups with significant positive gaps with the benchmark category. Table 6 shows that Eastern Europe, Balkans & Central Asia could extract more than ten times the amount of tax revenues developed economies can obtain from their capital stock. Labour supply contributes a little over half to this gap in tax revenues, while differences in productivity growth accounts for a little over a fifth. A slightly different contribution breakdown can be reported for Latin America & Caribbean. Differences in productivity are the primary component to explain the gap in tax revenues, with 37% of it attributable to TFP growth. Labour supply contributes about a third of the gap in tax revenues, while net interest rate accounts for almost a fourth of differences in median tax revenues between Latin America and our proxy for developed countries. Sub-Sahara Africa tends to replicate a breakdown similar to that of Eastern Europe & Central Asia, with 61% of the gap between its median tax revenues and those of developed countries attributable to differences in levels of labour supply. All in all, the three candidate variables and parameters can account for 83% to 93% of the gap in median capital tax revenues between developing and emerging economies on the one side, and developed countries on the other.

<table>
<thead>
<tr>
<th>Regional group</th>
<th>Median gap</th>
<th>( n(\tau) )</th>
<th>( \bar{r} - \delta )</th>
<th>( z )</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.E. Europe, Balkans &amp; C.Asia</td>
<td>10.29</td>
<td>50.63</td>
<td>18.29</td>
<td>21.27</td>
</tr>
<tr>
<td>Latin America &amp; Caribbean</td>
<td>1.57</td>
<td>31.17</td>
<td>24.46</td>
<td>37.59</td>
</tr>
<tr>
<td>MENA</td>
<td>0.52</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>South Asia &amp; Pacific</td>
<td>0.34</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>Sub-Sahara Africa</td>
<td>4.56</td>
<td>60.67</td>
<td>12.76</td>
<td>10.32</td>
</tr>
</tbody>
</table>

**Note:** Median gap reports the ratio of median tax revenues between regional groups and High-income countries. Contributions (\( \% \)) of structural parameters in after-tax labour supply are computed by substituting each component individually by its median value of High-income countries and plugging it in labour tax revenues for each regional group.

This section has shown that the Laffer labour tax curve in the baseline model yields counterintuitive results. The median emerging and developing country is predicted to raise more tax revenues than the median developed country. Differences in parameter and ratio values account in large part for this result. Households in countries with high consumption-to-output ratio are likely to exhibit labour supply inelastic to taxes. As a result, governments in developing countries can extract higher tax revenues from labour. Similarly, countries with a high Frisch elasticity parameter \( \phi \) are likely to have a low labour supply elasticity. The respective contributions of consumption share \( C/Y \) and Frisch elasticity \( \phi \) varies cross-categories. The income-based criterion identifies the former as the main driver of discrepancies in median tax revenues, while the region-based criterion attributes differences in labour supply elasticity for the most part.
4.2 Extensions: Underground economy and tax collection costs.

4.2.1 Underground economy: partial access to the tax base.

The baseline model describes the relationship between tax rates and fiscal revenues. These are decreasing in the tax rate when it is set beyond its peak value. Nevertheless, the model assumes that tax authorities can assess the whole tax base for their revenues. Such an assumption is not realistic, in that domestic legislation may allow for deductions and loopholes. Furthermore, the government may be unable to tax these economic activities that are underground and/or undeclared. With that in mind, the first extension of our model assumes that tax authorities can only assess a fraction \( p \in [0; 1] \) of their tax base. The model is run through the numerical values calibrated for our sample set of 152 countries. We compare our results with those of the baseline predicted outcome. Figure 8 reports the median Laffer curves for capital and labour under both specifications. It compares the Laffer curves of the baseline model, where tax authorities have full access to their tax base, against the extension where economic activities are declared only at a fraction \( p \in [0; 1] \).

The baseline model predicts that peak tax rates for capital and labour will be function of country-specific parameters and steady-state variable values. For labour, the peak rate is a function of its share of output \( 1 - \alpha \), consumption ratio \( C/Y \) and CFE parameter \( \phi \). The first two contribute positively to tax revenues through a revenue effect. A high Frisch parameter value denotes a household with low elasticity to taxes, which means that fiscal authorities can extract higher revenues as well. For capital, the same dynamics apply as it is increasing in labour. Capital tax revenues are also increasing in productivity growth rate \( z \) and the discount factor \( \beta \). Countries with low capital stock as most developing and emerging economies are, can make up in revenue shortfall with higher returns on capital.

The neo-classical framework used in this paper predicts ambiguous results. On the one hand, a low value for parameter \( p \) translates into a large share of underground economic activities that go untaxed. As a result, there is a smaller wedge effect, since the tax burden on overall economic activities is low. The tax base, be it capital, labour or consumption, is larger in comparison to the case of full taxation \( p = 1 \). On the other hand, although a low value for parameter \( p \) leads to fewer distortions and a larger tax base, the government does not benefit. Indeed, a low value
for $\rho$ means that the effective tax rate is $\rho \tau$ instead of $\tau$. As a result, tax revenues are low as well.

The extension model builds on the assumption of partial access to the tax base as a way to explain further the counter-intuitive results. In this analysis, we use the High-income country group in the baseline model as a counterfactual for developing and emerging economies. We argue that it is the relevant benchmark because the fiscal systems of our proxy for developed economies, the High-income country group, are reportedly more efficient than those of developing and emerging countries, thanks to the high quality of their institutions. This link has been documented exhaustively in the literature. Borge et al. [2008] establish a link between institutions, democracy and fiscal efficiency. Alonso and Garcimartín [2013] focus on institutional quality and its interactions with sound tax systems. High institutional quality allows citizens to scrutinise the use of taxes the government raises. As a result, fiscal authorities have every incentive to make their tax system as efficient as possible. Pertinent use of fiscal revenues has also been mentioned in Stroup [2007] where economic freedom is found to be well correlated with efficient use of taxes to fund public goods. In this case, economic freedom is equated to the rule of law, protection of patents and property rights, all of which are guaranteed by sound and good quality institutions. Another way the literature deals with the link between institutional quality and taxes is advocated by Tanzi and Zee [2000]. He looks at the constitutional constraints imposed upon governments and their ability to raise taxes. Quality of institutions is determined through how well these constitutional constraints work to prevent governments from raising taxes through ad hoc or arbitrary decisions.

The elements discussed above supply the justification for using the Laffer tax of High-income countries in the baseline model as a benchmark. The significant differences in structural parameter values between High-income and other country groups are such that we need to focus on the exclusive effects of parameter $\rho$ on peak tax rates and revenues. The comparison is only relevant if the benchmark does not exhibit issues related to tax inefficiencies. Given that High-income countries are proven to have fairly efficient tax systems, it makes sense to use the baseline model as a reference point. Furthermore, in using the baseline High-income Laffer curve, we focus on the sole effects of partial access to the tax base. Differences between the High-income baseline Laffer curve and those of developing and emerging economies in the extension model can be accounted for thanks to differences in values for parameter $\rho$. Finally, partial access to the tax base is the only component in the model where policymaking is actionable. In this neoclassical model, there is little in the way of implementing a fiscal policy beyond raising or cutting taxes along the Laffer curve. By using the baseline High-income Laffer curve as a reference, we can assess the importance of gains in tax revenues where governments in developing and emerging economies decide to expand their tax base, rather than raise their tax rates.

A large size of underground economic activities relative to GDP is relevant to our study of the Laffer curve. In comparing values for parameter $\rho$, we find that declared economic activities make up for a larger share of output in developed economies than in developing and emerging ones. Mean and median values for $\rho$ among the High-income country group are 0.782 and 0.803, respectively. For all remaining countries - proxies for developing and emerging economies-the values are 0.601 and 0.598 in mean and median, respectively. Results from the ANOVA
regressions in tables ?? through ?? conclude that there are statistically significant differences between High-income economies and all other countries in our sample set. The importance of underground/undeclared economic activities manifests itself through the government’s inability to raise more taxes than they would like to. The effects of partial taxation are in on themselves ambiguous. On the other hand, a large share of undeclared economy means that they are not subjected to taxation. As a result, the distortionary effects of the tax wedge are limited to share $\rho$. The effective tax burden is such that it encourages an extension of the tax base. Unfortunately, the government does not get to benefit from this happenstance, since it can only tax $\rho \tau$ rate on its base. The neoclassical framework we have adopted to build the Laffer curve predicts that the latter effect will dominate. In order to prove this, we look at the expressions of after-tax labour supply and capital stock of the extension model, namely equations (2.20) and (2.21). Under partial access to the tax base, labour supply $n^s(\tau, p)$ is larger than $n^s(\tau)$ where $\rho = 1$, thanks to the lower wedge effect $\varphi(\tau, p) \geq \varphi(\tau)$. Nevertheless, tax revenues in the extension model are lower because the effective tax rate is $\rho \tau$ and not $\tau$ as in the baseline model. This is due to fact that $\rho \tau$ dominates over the tax base effect. The extent to which the tax effect dominates is determined by the numerical values assigned to CFE parameter $\phi$. A high value means that labour supply is inelastic to taxes and therefore to the wedge effect. As a result, there is likely to be little effect in terms of tax revenues. On the contrary, a low value for parameter $\phi$ means that the household is very elastic in its supply to taxes. As a result, the base effect may be large enough to alleviate the tax effect on revenues.

In addition, when the tax base expands, the peak rate shifts to the right and increases. Similarly, the potential for tax revenues expands with its base. However, because the effective tax rate is $\rho \tau$, the peak tax revenue decreases accordingly. We can therefore predict that countries with a large share of underground - or undeclared - economic activities will have a low parameter value $\rho$. Their potential tax base expands, or is larger than these with a small underground sector. As a result, the peak tax rate shifts to the right, but at the same time, the effective tax rate $\rho \tau$ depresses the Laffer curve. Consequently, the peak tax rate yields comparatively lower peak revenues.

Notwithstanding the high elasticity of labour supply to taxes, median and mean values for parameter $\phi$ we have computed for each category group do not differ significantly from these of the benchmark High-income group. In other words, parameter $\phi$ rarely differs significantly among groups of developing and emerging economies relative to developed ones. As a result, we conclude that the elasticity effect is not high enough among the former group of countries to neutralise the tax effect $\rho \tau$. Regardless, values for parameter $\rho$ can contribute significantly to reduce the gap in peak revenues between High-income and other developing and emerging economies. The counter-intuitive results of the baseline are likely to be reversed for small values of that parameter.

Figure 9 compares the model extension for developing and emerging economies against their benchmark, the baseline Laffer curve for developed economies, as represented by their proxy of the High-income country group. The figure shows substantial improvements on the baseline model, where income groups with significant counter-intuitive results have reversed or bridged their gap with the High-income group benchmark.
Figure 9 above compares the median Laffer curve for each income category in its baseline and extension models against the baseline High-income category group. The figure shows that for all income groups, there is a uniform trend of lower peak revenues for capital and labour. With respect to labour taxes, there is a steep decline in peak revenues with respect to the baseline model. By comparison however, peak tax rates differ significantly across income groups. Differences in values for parameter $p$ affect both the shape of the Laffer curve as well as its peak rate. Low- and Middle-low income countries see their peak rates shift to the right, which implies a dominant effect of parameter $\rho$. Namely, that these countries have comparatively very low shares of declared or taxable economic activities. By contrast, Middle-high income countries shift their peak labour tax rate to the right, which means that there is a large tax base effect. In all cases however, the strongly dominant effect remains the effective tax rate $\rho \tau$ which depresses the Laffer curve. For capital taxes, a similar decline is reported for all income category groups. Notice however that all income groups shift their respective peak rates to the right, which is evidence of a positive tax base effect.

This tax base effect is however still dominated by the effective tax rate $\rho \tau$, since all Laffer curves are depressed. As far as the income-based comparison goes, the model extension contributes significantly to reduce the discrepancies in peak revenues between High-income countries and the other proxies for developing and emerging ones. Differences in parameter values and steady-state variables in developing and emerging economies create a larger tax base in comparison with developed ones. With the model extension, partial access to the tax base dominates over the counter-intuitive results and reduces their respective Laffer curves. Similar dynamics are reported for regional groups. We fit countries in our sample set into regional groups, whose respective median Laffer curves are compared against the High-income benchmark group. Figure 10 reports median Laffer curves for regional groups under baseline and extension models. Each regional group is compared against the High-income baseline median Laffer curve. Just as in the income-based comparison, regional groups all exhibit a decline of varying degrees in
their respective Laffer curves. Similarly, peak rates have shifted in both sides with respect to
the baseline. For instance, countries in Eastern Europe, the Balkans & Central Asia see their
median peak rate shifts to the left with respect to their baseline curve. This is also true for
Latin America & Caribbean, as well as MENA regional groups. By contrast, countries in South
Asia see their median peak tax rate shift right, which suggests a large and positive effect on the
tax base. For Sub-Saharan Africa however, the median peak rate does not change significantly.
Differences in shifts of the labour tax peak rate are due to the impact of parameter $\rho$, and how
it expands the tax base thanks to a lower wedge effect.

Figure 10: Median Laffer labour tax curves. Sample set broken down into regional groups.

As reported in the previous section, developed economies are proxied by the High-income
category group and exhibit high values for parameter $\rho$. The cross-group mean differences are sig-
nificant enough to attribute the changes in Laffer curve shapes to the size of undeclared/untaxed
economic activities relative to output.

Figure 11: Whiskerplot distribution of parameter $p$ per income and region category groups.
Sample set of 132 countries.
As mentioned previously in tables ?? through ??, parameter \( \rho \) in High-income countries exhibits a statistically significant difference with respect to other income and regional groups. Nevertheless, some categories are not that far off from the High-income group. Although the differences are statistically significant, ANOVA results in tables ?? and ?? in particular show only a moderate gap in mean-group value for parameter \( \rho \) between the benchmark group and specific group categories. In particular, we notice that there are slight differences in mean-group between High and Middle-High income groups, as well as South Asia & Pacific and MENA for the region-based category. The lack of large differences between High-income and other group categories explains why the Laffer curve for capital taxes is still counterintuitive for the Middle-High income group, as well as MENA and South Asia & Pacific. These two regional groups still offer counter-intuitive results with respect to the Laffer curve in High-income countries, albeit at a much lower degree, as reported in figure 12.

![Figure 12: Median Laffer capital tax curves. Sample set broken down into regional groups.](image)

The income-based comparison of the Laffer capital tax curve has shown that there are shifts in both ways for the extension model. We observe a similar trend for region-based comparison. There is a uniform decline in peak tax revenues for regional groups with respect to the baseline, though at varying degrees. The median countries in Eastern Europe & Balkans, Latin America and to a lesser degree Sub-Sahara Africa see their respective peak tax rates shift to the left in the extension model. It means that the tax rate effect has been large enough to depress the tax base, even though it expands thanks to a smaller wedge effect. these are all country groups with significantly lower mean-group values for parameter \( \rho \), hence the dramatic shift in peak revenues and tax rates. By contrast, country groups with comparatively high mean-group values for \( \rho \) see their median peak tax rate shift to the right. This is due to the fact that there was a comparatively low tax base effect. After all, their median values for \( \rho \) are close to the High-income group, and they stand to gain little in terms of tax base expansion. As a result, the decline is less pronounced, and their respective Laffer curves remain counter-intuitive in their peak revenues.
4.2.2 Tax collection costs and inefficiencies

In depicting the interactions between the tax rate set by the government and its impact on its tax base, the baseline model assumes that there are no frictions in tax collection. In other words, tax authorities collect revenues as expected, whether they have full access to the tax base or not. In the second extension of the baseline model, we have assumed that the government faces a quadratic cost $\kappa$ when it sets the tax rate. As a result, tax authorities need to raise $\tau(1 + \kappa \partial \tau)$ instead, in order to make up for losses due to the collection cost. Figure 13 plots median Laffer curves for labour and capital taxes. It compares the benchmark case against the two extensions discussed in this section.

Figure 13: Median Laffer curve for capital and labour taxes - baseline vs model extensions. Medians are computed for the sample set of 152 countries for the baseline, 132 for the first extension, and 127 for the second.

The second extension model yields adverse results with respect to the baseline. Collection costs generate a decline in the tax base as well as the tax revenues. Because the government loses a fraction of its revenues, they need to set a higher rate than in the baseline model. As a result, there is a larger wedge effect that adversely affects the tax base. Consequently, they need to set their tax rate higher to extract the same level of revenues. This means that the government sets taxes at higher effective rates than the baseline, shrinking the tax base in the process. The collection cost affects the Laffer curve on both aspects of peak rate and revenues: first, the peak tax rate declines due to the shrinking tax base brought about by the larger wedge effect. Second, the shrinking tax base means that the government cannot extract as much revenue as it expects. The Laffer curve therefore shifts to the left, and is depressed with respect to the baseline curve.

The differences between the baseline and extension models are significant enough to conclude to the importance of tax collection costs in developing and emerging economies. The extension model isolates the effects of an inefficient tax system in order to show its effects, regardless of the size of underground economic activities in GDP. We have shown that developing and emerging economies exhibit higher mean-group values for parameter $\kappaappa$ than developed countries. As a result, the effects of tax collection costs are more significant in the former group, and reflect adversely on their ability to extract tax revenues. Figures 14, 15 and 16 show that compared to High-income countries, developing and emerging economies extract fewer revenues with lower peak tax rates, regardless of the counter-intuitive outcome.

Figure 16 shows that the capital Laffer curve is quite sensitive to collection cost $\kappa$. Some
regions, like South-Asia and the Pacific exhibit significant changes in the median capital Laffer curve, as it declines both in terms of peak tax rate and revenues with respect to its baseline shape. All other regional groups exhibit a decline in their respective median peak rates. The downward side slope of their respective curves becomes steeper due to the introduction of tax collection costs.

This extension affects the Laffer curve in a different manner compared to the first extension model. In this configuration, tax collection cost $\kappa$ brings about only the tax base effect in altering the baseline Laffer curve shape. Because the government needs to set higher tax rates in order to raise the same level of tax revenues, the wedge effect incorporated in the baseline model increases, which has a shrinking effect on the tax base. As a result, the curve shifts left, and for a high enough value for $\kappa$, it is depressed. A secondary effect of the collection cost is a
Figure 16: Median Laffer capital tax curves. Sample set broken down into regional groups.

steeper downward slope for the Laffer curve, which suggests that tax revenues decline even more rapidly because of tax collection costs. In comparison with the first extension model, the second one does little to reduce the gap in Laffer curves between developing and emerging economies on the one side, and developed ones on the other. Nevertheless, the main takeaway is that tax collection costs are high enough in the former due to their tax inefficiencies that they shift their respective Laffer curves significantly. The combination of the two extensions into a third model gives more insight into what the Laffer curve may look like in developing and emerging economies.

Tax authorities also resort to taxing consumption in order to raise revenues. In contrast to capital and labour, governments can put significantly larger taxes on consumption. With an excise tax for instance, authorities can set tax rates larger than unity, though they do not have a marginal effect on the household consumption optimisation programme. Nevertheless, the tax wedge effect still distorts consumption at the steady-state, and peak rates can be computed for the baseline and its two extensions.

4.3 The Consumption tax Laffer curve

Contrary to labour and capital, household consumption is not a shrinking tax base. In other words, the household does not shift its consumption away to non-market activities when the tax rate is set beyond its peak. This conclusion shared in Trabandt and Uhlig [2011, 2012] stipulates that the consumption tax can in fact be set above 100% and still yield increasing revenues. Such a result is however predicated on the assumption that the labour tax rate is set at zero. This is not realistic nor logical with respect to the household’s optimisation programme and the existence of the tax wedge. Instead, when the income tax is also varied, we obtain a similar Laffer-shaped curve with a peak rate. By comparison to labour and capital, the peak rate is higher for the baseline and extension models.

Figure 17 compares the consumption tax Laffer curves across all three specifications. It
compares the sample-wide median against High-income and other countries. In this graph, we use High-income countries as a proxy for developed economies, while the remaining countries are consolidated into a proxy for developing and emerging economies. In all three specifications, High-income countries exhibit the highest peak revenues. The baseline model predicts also that the proxy for developed countries exhibit a higher peak tax rate. The consumption Laffer curve exhibits similar properties in changing between the baseline and the two extensions in this paper. Recall that with partial access to the tax base, there are two contradictory effects on the Laffer curve.

Access to share $\rho$ of the tax base means that the tax wedge is lower, thus having a positive impact and expending it. On the other hand, because the government can tax only a fraction $p$, this negates the tax base effect. As a result, the peak rate is higher in the extension model in comparison with the baseline, while lowering the peak revenue consecutively. The region-based comparison depicted in figure 18 yields more comprehensive results. For almost all regional groups, the peak tax rate increases between the baseline and the extension with collection cost $\kappa$. The differences were low for regional groups like the benchmark High-income countries and South Asia & the Pacific. The peak tax rates differ more significantly for regional groups like MENA and countries in Central Europe, Balkans & Central Asia.
In comparison with capital and labour, there are substantial gains to be made from taxing consumption. First, peak revenues are higher in comparison to the two other tax bases. Second, the peak rate is also comparatively higher. This is due to the fact that the Laffer curve is determined by the CRRA elasticity of substitution - whose inverse makes sure that consumption is quite inelastic to changes in the tax rate. As a result, tax authorities can extract significantly more revenues out of household consumption.

As we have established the dynamics of Laffer tax curves for capital, labour and consumption taxes, we have identified the differences between category groups built out of our country sample. In particular, the shape and peak values for tax rate and revenues are shown to be function of structural parameter values and steady-state variables. In comparing peak rates and steady-state values computed from the dataset, we are able to assess whether a given country - or country group - is below or beyond its peak value. The distance allows us to compute the tax gains (or losses) from a tax cut. The Laffer curve predicts increasing gains when the tax rate is set beyond its peak value. In this case, any reduction in the steady-state tax rate is bound to generate additional revenues. If the steady-state tax rate is below its peak value, then a further tax cut is likely to reduce tax revenues, though not at a commensurate rate. Indeed, the tax revenue loss due to the reduction in the tax rate is partially offset by the expanding tax base due to the lower tax wedge effect. The offset is referred to as the share of self-financed tax cut, i.e. the percentage of tax losses for which the expanding base makes up.

5 Conclusions

Our paper contributes to the literature on the Laffer curve by applying it to emerging and developing countries. Using the model developed in Trabandt and Uhlig [2011, 2012] we argue that the Laffer curve is sensitive to two factors, namely the size of underground economic activities and tax collection costs. More specifically, relative to Trabandt & Uhlig, we assume that household utility function is separable in labour and consumption. This alteration is motivated by the fact that there is no cross-elasticity between consumption and worked hours. Furthermore, empirical evidence shows that households in developing and emerging economies face the extensive, rather than intensive margin. In other words, the labour supply choice is between working and not working, rather than in volume of worked hours. This alters significantly the dynamics of the household optimisation programme. Our model stipulates that the household maximises their utility over consumption and labour, constrained by their resources. Capital, labour and consumption are all taxed at their respective rates, which creates wedges in all three. Labour supply in particular, equates the marginal rate of substitution between consumption and labour with its marginal productivity. The equality is distorted with a wedge tax that reduces labour supply as taxes increase.

The baseline model exhibits counter-intuitive results for developing and emerging economies. The differences in Laffer curve shapes are due to the values computed for structural parameters and steady-state variables. Developing and emerging economies are more likely to exhibit higher share of consumption-to-output ratios, which means that the income effect is large enough for households to be elastic to tax changes. Labour tax revenues are also function of the Frisch
elasticity, a key component given the controversy in the literature as to the range of acceptable values they may take. The same differences are reported with respect to capital tax revenues. Developing and emerging economies exhibit higher levels of real interest rate, and as a result they are likely to exhibit higher tax revenues at the peak level. Furthermore, the same set of countries also exhibits higher levels of productivity growth rates, which have a positive impact on after-tax capital stock. By contrast, consumption tax revenues are higher among developed countries. The baseline model is further extended in two directions: the first extension assumed that tax authorities do not have full access to the tax base. In other words, they would observe only a fraction $\rho$ of their tax base, and tax it accordingly. The model predicts two contradictory effects: partial access to the tax base means that the tax wedge effect is weaker than the baseline, which boosts the former. However, the government can only extract revenues at a smaller effective tax rate. Ultimately, the second effect clearly dominates, which pushes the Laffer curve downwards, while shifting the peak rate to the right. This extension has improved tremendously the model’s ability to predict the Laffer curves of developing and emerging economies with respect to developed ones. Although many of the former improve their respective peak rates, their revenues decline accordingly, more than commensurate to the differences in values of parameter $\rho$ between the two country groups.

In the second extension, we have assumed that authorities face a different kind of limitation, in the form of tax collection costs. The government faces costs that arise from inefficiency or difficulties in identifying the tax base. Given the large values we have computed for parameter $\kappa$, developing and emerging economies face larger costs in setting their tax rates. This has the effect of shifting the Laffer curve to the right and downwards. This is due to the fact that the effective tax rate is higher than expect, and so would the tax wedge effect be on the three tax bases. As a result, the government extracts fewer revenues, and hits a comparatively smaller level of tax peak rate. It also means that the peak tax revenue would be lower as a result.

The main prediction of the Laffer curve in its original specification is that if the tax rate is set beyond its peak value, then any tax cut actually increases revenues. In other words, the reduction in tax rates is self-financed. By contrast, when the tax rate is below its peak value, a further tax cut is only partially self-financed. Two factors can have an impact on the percentage of self-funding when the tax rate is reduced: the distance of its steady-state value from the peak, and the curvature of the Laffer curve. We have found that for most countries, the peak rate is higher than its steady-state value. As a result, tax cuts do not increase revenues, but pay for themselves at higher fractions that usually reported in the literature. For consumption and labour taxes, we explain this by the fact that most countries are either at their respective peak rates and/or exhibit steep curvature that increase self-funding when tax rates are cut. Results are more nuanced for capital taxes, which exhibit the lowest percentage of self-finance. We have explained this by the fact that most countries have engaged in steady reduction of their respective corporate rates. As a result, the steady-state tax rates are much lower than their peak values, and there are comparatively little gains from further tax cuts. As a result, should governments in developing and emerging economies seek to reduce their overall tax burden and boost their tax bases, they would do well to chose a specific combination of tax cuts and increases that would maximise revenues without too much distortion.
In the two extensions, the model offers alternative sets of policies for tax authorities in developing and emerging economies to improve their tax revenues without changing their tax rates. For instance, a larger share of declared/taxable economic activities improves tax revenues without distorting significantly the tax base. Indeed, the governments of these economies can afford to cut taxes when they integrate a higher percentage of underground economic activities. Similarly, reducing tax cost collection reduces the tax wedge effect, and thus boost the tax base as a result. These policy measures are more linked to the political economy of developing and emerging economies. The integration of undeclared/untaxed economic activities, or the reduction tax collection cost call for changes in institutional arrangements, or cracking down on corruption and inefficiencies to improve tax collection. The distance between steady-state tax rates and their peak values would therefore be function of institutional quality indicators, with the more advanced economies bridging the gap at a faster rate than these with institutions of lesser quality.

References


Laffer Curve in Emerging Economies


