# Borrowing choices of local governments and the term structure of interest rates: Theory and empirics *

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**Abstract**

We study how local governments' debt financing decisions relate to the term structure of interest rates. Using a community welfare maximization framework, we derive the link between interest rates and the adjustable-rate share of borrowing by local governments. We construct a novel database of loans (including both agency and bank loans) taken out by U.K. local governments and find that the yield spread is the main determinant of the local governments' adjustable-rate loan share. We also find that their decisions to borrow from banks are positively related to the long yield and their ability to generate tax revenue income.

**JEL classification:** D81, E43, G21, H63, H74

**Keywords:** Debt financing, Local Government, Loan Choice, Interest Rates

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# I Introduction

Debt financing is arguably the most important source for central and local governments to fund their capital expenditures. Differently from sovereigns and as a result of fiscal decentralization measures adopted across the world (Hooghe et al., 2010), local governments play a key role in the provision of essential public goods and services (such as education, health and social protection), with spending expected to rise in many countries due to demographic factors (OECD, 2017). On average, local governments in OECD countries constitute about 41%, 23% and 10% of central government's public investments, expenditures and debt, respectively (Vammalle and Bambalaite, 2021). Furthermore, a number of studies have shown how local governments have the potential to destabilize a central government's fiscal position and, subsequently, induce macroeconomic instability (de Mello, 2000; Goodspeed, 2002; Eyraud and Lusinyan, 2013). For these reasons, it is paramount to shed light on the underlying motives driving local governments' financing decisions in order to safeguard their financial sustainability, the sustained provision of their essential services to local communities and the macroeconomic conditions of the country in which they operate.

In order to explore this important topic, we adopt a community welfare maximization framework building on Henderson (1968) to investigate the *pricing* of financing: that is the decision-making process of local governments when they face the financing choice between fixed-rate (FR) and adjustable-rate (AR) forms of borrowing. In a multi-period setting, we show how local governments' borrowing

decisions can be driven by the movements in nominal interest rates, including time-varying proxies for term premia, yield spreads and the long-term yield. In particular, we test two main research hypotheses: long-term cost minimization and current cost minimization. Long-term cost minimization predicts that, in the absence of borrowing constraints, the rational decision between FR and AR loans is driven by the expected future costs borne by the borrower during the life of the loan. Based on this, the term premium, or the difference between the current fixed rate and the expected average adjustable rate during the life of the loan, should represent the main determinant of the AR loan share. On the other hand, current cost minimization predicts that, in the presence of borrowing constraints, the borrowing choice is driven primarily by the pressure to reduce current interest costs. In this case, the primary determinant of the AR loan share should be the yield spread, that is the difference between the current fixed rate and the current adjustable rate.

Investigating the extent to which local governments are exposed to interest rate risk is important for two main reasons, which also highlight the distinctive features of local governments relative to other subjects facing similar debt financing decisions (e.g., central governments, households, corporations). First, local governments in most countries, differently from national governments, must comply with their statutory requirement to balance their revenue budgets in each fiscal year (Guarini, 2013). This implies that one of local governments' key priorities is to minimize the revenue costs of their capital programmes. Second, the main objective of a local government, differently from that of households and corporations, is to maximize a

community's welfare. This complicates the determination of optimal levels of both the production of collective consumption goods and the distribution of tax shares among taxpayers because the latter would rationally understate their preferences for public goods in order to pay a lower level of taxes (Musgrave, 1939; Samuelson, 1954; Tiebout, 1956; Henderson, 1968; Bewley, 1981). This reluctance of the public to pay taxes exerts greater pressure on local governments' managers to minimize interest costs than on their private sector counterparts (including households and firms' managers). Our study is also relevant to examine the local implications of monetary policy decisions: if short-term market interest rates increase, local authorities holding higher proportions of AR debt will have to make higher payments affecting their local budgets, which, in turn, may negatively affect expenditure levels and be detrimental for the effective provision of services to local communities.

For our empirical analysis, we choose the U.K. setting to investigate the debt financing decisions of local governments. We create a unique loan database spanning the period from April 1995 until December 2014 by merging the loans originated by the governmental agency Public Works Loan Board (PWLB) with Lender Option Borrower Option (LOBO) loans offered by commercial banks. PWLB loans include both FR and standard AR loans. LOBO loans have an embedded derivative as they specify an initial interest rate ("teaser rate") that the lender has the option to change at pre-determined future dates over the length of the contract with a certain frequency (e.g., every 2 years), making them non-standard AR loans.

We find that the local governments' share of AR loans (including both bank and agency loans) is driven primarily by the yield spread between the PWLB loan fixed

rate and the bank loan rate. A one-standard-deviation increase in this yield spread increases the AR share by about 4-9 percentage points. This effect is particularly sizeable given that the average AR share in total local government borrowing is 21% in our sample period. Financial constraint proxies also affect the *pricing* of financing. They include the ratio of interest payments over current expenditures, the ratio of the government (revenue support) grant over current expenditure, the ratio of redistributed non-domestic rates over current expenditures and the per-capita gross value added (GVA).

The non-standard contractual features of bank loans and the different loan approval processes adopted by governmental agencies and commercial banks motivate us to test our main hypotheses on the subset of AR loans originated by commercial banks. This also allows us to investigate the *source* of financing or the decision of local governments to prefer a specific type of lender (e.g. bank debt rather than agency debt). In particular, we investigate the determinants of the bank loan share (the ratio of bank loans and total loans) and find that, in addition to the yield spread, the long yield (as proxied by the PWLB loan fixed rate) is highly relevant among the interest rate variables, suggesting that local governments might decide to take out bank loans when long-term PWLB fixed rates have recently increased. One possible explanation for this behavior is that local governments' managers might believe long-term interest rates to be mean-reverting and attempt to predict long-term rates. This is consistent with the empirical evidence against

the expectations theory of the term structure of interest rates[1] and with a similar borrowing behavior also documented for U.S. households when choosing between different mortgage types (Campbell and Cocco, 2003; Campbell, 2006). Although financial constraint proxies seem to be less important, per capita GVA is significantly and positively related to the bank loan share. This suggests that local governments may be more prone to embrace more sophisticated, risky and innovative financial products originated by banks when their capability to generate taxable income in the areas they administer is higher. In other words, greater regional taxable income can be seen as a hedging source against the higher risks embedded in bank loans. To corroborate this explanation, we provide evidence that a significant positive relationship between the bank loan share and per capita GVA is only confined to high-income local governments.

Overall, our results show that local governments' financing decisions are not forward-looking but are driven by yield spread movements. This provides support for the current cost minimization hypothesis and indicates that English local governments are borrowing-constrained institutions facing financial pressure that could impede their ability to invest in long-term capital projects and support the development of their local economies. This result confirms the validity of the arguments on the heightened pressures that local governments' managers face to minimize interest costs (Tiebout, 1956) relative to households whose mortgage decisions have been shown to be affected by borrowing constraints but to a lower

[1]See, for example, Fama and French (1989), Campbell and Shiller (1991), Dai and Singleton (2002), Buraschi and Jiltsov (2005), Ang and Piazzesi (2003), Cochrane and Piazzesi (2005), Ang et al. (2007) for U.S. data; see Cuthbertson (1996) for U.K. data.

extent (Koijen et al., 2009; Bacon and Moffatt, 2012). At the same time, we document elements of heterogeneity in the way local administrators' financing decisions are dependent on the functional type that defines their responsibilities in the provision of public services to the communities (e.g. the share of bank loans for counties is less responsive to interest rate movements than that of single-tier local governments) as well as the type of lending instrument offered to them (e.g. differently from the the total share of AR loans, the share of bank AR loans is less affected by local governments' financial constraint proxies and is positively related to per capita GVA). Hence, our findings justify sustained political efforts towards the development of new viable funding sources (that go beyond the existing forms of agency and bank lending) in order to incentivize a more inclusive access to funding for the local government system as a whole.

Our paper is inspired by the theoretical and empirical literature on household mortgage choice which distinguishes adjustable-rate mortgages (ARM) and nominal fixed-rate mortgages (FRM). Similar to households, local governments' financial decisions involve long horizons, depend on the illiquid nature of their assets (e.g., schools, infrastructure), with potential constraints on their ability to borrow in the private market and are subject to complex taxation (Campbell, 2006). Furthermore, the close link between local governments and homeowners can be identified by property taxes and property values through which local governments internalize their costs and benefits (Serkin, 2006).

On the theoretical front, Campbell and Cocco (2003) are the first to introduce a life-cycle model integrating borrowing constraints, income risk and interest rate risk

and show that ARMs have attractive features for borrowing-constrained households with low risk aversion. Their model implies that mortgage choice should be driven by the yield spread between long-term and short-term bond yields: high values of the yield spread should create incentives for borrowing-constrained households to take out ARMs. Empirical studies include Dhillon et al. (1987) and Brueckner and Follain (1988) that, based on probit models, identify the main determinants of mortgage choice in pricing variables including the yield spread and the long-maturity yield. They also find that borrower characteristics related to income and mobility play a significant role. Koijen et al. (2009) show both theoretically and empirically that most of the time variation in mortgage choice can be related to time variation in the bond risk premium (based on adaptive expectations) and that the economic and statistical effects of financial constraints (such as the loan balance, the FICO score and the loan-to-value ratio) are smaller.

Given the similarity between the debt financing choices of local governments and those of both firms and national governments, our paper relates to the literature on the financing choices of corporates and sovereigns and their dependence on the term structure of interest rates. Consistent with the survey results presented by Graham and Harvey (2001), Baker et al. (2003) and Faulkender (2005) document that the maturity of new debt issues is decreasing with the level of bond risk premia and that firms are more likely to take on AR debt when the yield curve steepens. These findings support arguments in favor of the ability of firms' managers to time the bond market that have been critiqued by Butler et al. (2006). Differently from these studies, Greenwood et al. (2010) develop a new theory assuming no special ability

of corporate managers in their predictions of future bond returns, and show that their comparative advantage lies instead in their greater capacity to absorb supply shocks generated by variations in government financing patterns. Related to this work, Badoer and James (2016) argue that corporate issuers' greatest comparative advantage in exploiting arbitrage opportunities generated by changes in the supply of Treasury securities is in the very long end of the term structure.

More strictly focused on sovereigns, Greenwood and Vayanos (2014) show theoretically and empirically that government bond supply, measured with a maturity-weighted-debt-to-GDP ratio, increases when bond risk premia rise, whereas Guibaud et al. (2013) model the optimal maturity structure of government debt issuance showing also empirically that more long-term debt is issued when the fraction of long-horizon investors increases and that real long-term bonds earn negative bond risk premia.

A number of papers have examined the determinants of borrowing costs for local governments in China (Ang et al., 2016; Liu et al., 2017), in Europe (Derycke and Gilbert, 1985; Pettersson-Lidbom, 2001; Ashworth et al., 2005; Cabasés et al., 2007; Bastida et al., 2014; Grembi et al., 2016; Bastida et al., 2019) and in the U.S. (Green, 1993; Capeci, 1994; Bayoumi et al., 1995; Poterba and Rueben, 1999; Baber and Gore, 2008; Wang et al., 2008; Butler et al., 2009; Longstaff, 2011; Novy-Marx and Rauh, 2012; Ang and Longstaff, 2013; Ang et al., 2014; Cestau, 2018; Schwert, 2017; Gao et al., 2019a,b; Chun et al., 2019; Babina et al., 2021). In addition to default and liquidity risk, these studies find that political risk and affiliation, corruption, real estate value, fiscal policies, state policies and disclosure regulations

are all important drivers of borrowing costs and levels.

Differently from these papers, we are interested in understanding the determinants of the choice between alternative sources of borrowing. Further, we focus on a European country (the U.K.), that unlike China and the U.S., is characterized by the lack of a liquid municipal bond market. In the European context, secondary bond markets and credit ratings for local governments are effectively absent in the majority of countries, with most local authorities instead relying on lending from banks (Boulanger and Vallier, 2012), which could be both private or public, with public-sector-owned entities taking different shapes and forms (e.g., as state development banks in Germany and France, or agencies under the aegis of central government departments in Ireland and the U.K.).

The absence of a highly developed municipal bond market is likely to give rise to borrowing decisions that could differ from those of U.S. and Chinese subnational governments. Additionally, advanced economies share similar trends of financialization at their subnational levels as identified by the adoption of derivatives-based financial instruments by local administrators for the management of their debt obligations (Dodd, 2010; Katz, 2010; Sanderson et al., 2010; Hendrikse and Sidaway, 2013; Lagna, 2015). Because of these institutional features that are commonly shared with other European subnational systems and the high quality and availability of data on both standard and derivatives-based debt agreements of local governments, the U.K. represents a novel and ideal setting to study the debt financing decisions in the public sector. More importantly, our findings on the borrowing decisions of English local governments may extend to other contexts that

are also characterized by the absence or an illiquid municipal bond market as well as a similar local government's financialization process.

While past studies have investigated the *pricing* of financing and debt maturity structure for households, corporations and sovereigns, to the best of our knowledge, no paper has focused on the decision making process of local governments when they are faced with a choice between alternative funding sources. This is surprising given their aforementioned key role in the economy of a country.

The remainder of the paper is organized as follows. In Section II, we develop a simple theoretical framework for the decision-making process of local governments when they are faced with a loan choice, and describe the data. In Section III, we report our main empirical results. In Section IV, we analyze the financing decisions of local governments with different functional types and political affiliations. Section V concludes.

# II Theory and Data

## *A.* Theoretical arguments

In this section we show the theoretical link between interest rates and a local government's debt financing decisions. To this end, we rely on the theory of collective choice which makes use of a social-welfare function introduced by Burk (1938) and apply its concepts to the expenditure and tax decisions of local governments. Similar to Henderson (1968), we assume the following "logex" functional form to describe a

community's welfare ($W$):

$$W = (a_0 + a_1 Y + a_2 R + a_3 P) log_e G + X \tag{1}$$

where $Y$ is the per capita personal income, $R$ represents the intergovernmental revenues, $P$ is the size of the community's population. $G$ and $X$ represent the public and private expenditure levels, respectively.

Local elected representatives are required to maximize their community's welfare subject to a social budget constraint, which is also expressed as a function of $G$ and $X$:

$$X + \delta G = Y + \delta R \tag{2}$$

where $\delta$ defines the proportion of newly issued per capita debt $D$.

We extend Henderson (1968)'s model to a multi-period setting and incorporate the possibility of FR and AR borrowing. Also, AR borrowing includes two different lending contracts: one standard AR lending instrument (that varies depending on the institutional context under investigation and could include a bank loan, an agency loan, a municipal bond or some combination of these) and one non-standard AR lending instrument (that could include a municipal bond with non-standard terms, a derivatives-based form of borrowing such as an interest rate swap or a loan with embedded derivatives such as a LOBO loan). Standard AR borrowing is characterized by the fact that interest rates resets in each time period while non-standard AR borrowing entails a reset of interest rates at longer time intervals

(e.g., every two periods).[2]

We assume that, at time 0, local governments take on debt in the form of a loan to finance their capital expenditures over a four-period horizon which also equals the maturity of the loan.[3] Interest payments on the loans are made in each time period and depend on the type of loan taken out which can be either a FR or an AR loan with associated nominal interest rates $q^i$, $i \in \{FR, AR\}$. In each period, the local government generates revenues by taxing its residents' personal income (net of their private expenditures) and receives government grants that are used to fund its revenue expenditures. This means that at times 1 through 4, the local government does not raise additional debt ($\delta = 1$ in Equation (2)). At time 4 the local government pays its loan balance ($B$).

Given the financial link between a community's households and local governments, we assume that local governments are borrowing-constrained similar to the assumption made for households by Koijen et al. (2009): in each time period, they spend all of their tax and grant revenues after making the loan payment (Equations (4)-(6)). Terminal public expenditure equals revenues (from grant and taxes) after the loan interest payment plus the difference between a provision for principal

[2]Our modelling choice reflects current borrowing practices of subnational governments that combine standard lending agreements with derivatives-based forms of borrowing. In particular, several local governments around the globe have acted as the "receiver" counterparty to interest rate swaps (Katz, 2010; Sanderson et al., 2010). These agreements (similarly to LOBO loans) require the formulation of expectations regarding the future path of interest rates and expose the local government to interest rate risk: gains would be made if future interest rates go down while losses would be incurred if interest rates go up during the length of the contract. Further, similar to a LOBO loan, interest rate swaps typically reset at fixed and longer intervals than reset times of standard AR loans.

[3]Alternatively, the model could be formulated in terms of a municipal bond issued by a local government or a combination of both loans and bonds. For simplicity, we assume that local governments take on debt in the form of loans.

repayments ($PPR$) charged to the revenue account in the previous time periods and the loan balance (Equation (7)).[4]

Each local government maximizes utility with respect to expenditure levels over the four-period time frame. Preferences in Equation (3) are quasi-linear with the subjective discount factor equal to $\beta$. The maximization problem can be represented as follows:

$$\max_{\substack{G,X \\ i\in\{FR,AR\}}} \mathbb{E}_0 \left[ \sum_{t=1}^{4} \beta^t \left( (a_0 + a_1 Y_t + a_2 R_t + a_3 P_t) log_e G_t + X_t \right) \right] \tag{3}$$

subject to:

$$G_1 = Y_1 - X_1 + R_1 - Bq_1^i \tag{4}$$

$$G_2 = Y_2 - X_2 + R_2 - Bq_2^i \tag{5}$$

$$G_3 = Y_3 - X_3 + R_3 - Bq_3^i \tag{6}$$

$$G_4 = Y_4 - X_4 + R_4 - Bq_4^i + PPR - B \tag{7}$$

Based on Equations (3)-(7), we can observe that the loan choice of local governments is driven by their current expectation of the future nominal interest rates over the maturity of the loan.

In order to show a more direct link between interest rates and the optimal loan

[4]Many systems have provisions in place which require subnational authorities to allocate revenues from their annual budget for principal repayment (e.g., the minimum revenue provision in the U.K.). We assume that local governments incur a revenue expenditure at time period 0 through 3 equal to their estimate of the amount of the provision for the repayment of the loan principal. For simplicity, we assume that the total provisional amount is used at time 4 to repay the loan balance and that any overpayment can be used by the local government to increase its revenues or reserves at time 4.

choice of local governments, we compute the expected utility over the four periods under FR borrowing as well as AR borrowing. In the latter case, we assume that the interest rate paid by the local government is an average of the loan rates charged on both the standard and non-standard lending instruments ($q_t^{AR} = \frac{q_t^{AR_{std}} + q_t^{AR_{nonstd}}}{2}$). If the multi-period expected utility under AR borrowing is greater than that achieved under FR borrowing, local governments will prefer AR borrowing. As shown in more detail in Appendix A, this occurs if the following expression holds:

$$\left[q_{4,0}^{FR} - \frac{1}{4}\sum_{i=0}^{3}\mathbb{E}_0\left(q_{1,i}^{AR_{std}}\right)\right] + \left[q_{4,0}^{FR} - \frac{1}{2}\sum_{i=0}^{1}\mathbb{E}_0\left(q_{2,2i}^{AR_{nonstd}}\right)\right] = \phi_{4,1,0}^{std} + \phi_{4,2,0}^{nonstd} > 0 \quad (8)$$

Equation (8) shows that AR borrowing is positively related to two terms: the first one, $\phi_{4,1,0}^{std}$, is a term premium specific of the standard AR loans while the second one, $\phi_{4,2,0}^{nonstd}$, is a term premium specific of the non-standard lending agreements. The former is revealing of local governments' interest rate expectations about the short end of the term structure while the latter reveals their expectations about the longer end of the term structure of interest rates. The presence of these two terms is the result of the distinct characteristics of the available funding options for local governments: in particular, standard AR loans have their interest rate reset at each time period before the maturity (in line with the evolution of market rates) and more frequently than under a non-standard loan under which reset times of interest rates span longer time intervals over the length of the contract.[5]

[5]In unreported derivations, we confirm that the two term premia are also present if the maturity of standard AR loans is assumed to be shorter than the maturity of non-standard AR loans. For example, if we assume that standard AR loans mature after two time periods while non-standard AR loans mature after four time periods, the term premia in Equation (8) would be equal to $\phi_{2,1,0}^{std}$ and $\phi_{4,2,0}^{nonstd}$.

Equation (8) also shows that the choice of AR borrowing is positively related to the long yield ($q_{4,0}^{FR}$) as well as to two yield spread terms: the first term, $q_{4,0}^{FR} - q_{1,0}^{AR_{std}}$, is specific of the standard AR loans, while the second term, $q_{4,0}^{FR} - q_{2,0}^{AR_{nonstd}}$, is specific of the non-standard AR lending. While the long yield and yield spreads can be observed at each time period as they are defined by the respective contractual features of the lending agreements, the term premia require assumptions about the expectations formation process (note the expectation operator $\mathbb{E}$ in Equation (8)). Given the aforementioned financial link between households and local governments also discussed in the introduction, we follow the assumption adopted by Koijen et al. (2009) for households, and assume that local governments follow simple adaptive expectations rules, according to which past short-term interest rates are used to estimate future payments on AR-type loans:

$$\frac{1}{k}\sum_{i=0}^{k-1}\mathbb{E}_t(q_{m,t+mi}) = \frac{1}{\rho}\sum_{u=0}^{\rho-1}q_{m,t-u} \tag{9}$$

This simple mechanism of expectations formation delivers the following proxy $k_t(\rho, n)$ for a time-varying term premium:

$$\phi_{n,m,t} \approx q_{n,t} - \frac{1}{k}\sum_{i=0}^{k-1}\mathbb{E}_t(q_{m,t+mi}) = q_{n,t} - \frac{1}{\rho}\sum_{u=0}^{\rho-1}q_{m,t-u} \equiv k_t(\rho, n) \tag{10}$$

We use Equation (10) to represent the two adaptive decision rules of local governments (one specific of standard AR loans and the other specific of non-standard lending contracts) when choosing the type of borrowing used to sustain

their capital expenditures.

## *B.* Data

This paper draws upon a unique database of loans held by local governments in England. Two main sources have been used to compile a local government's loan portfolio of monthly agency and bank loans for the period that goes from April 1995 until December 2014. First, originated agency loans are published monthly by the PWLB and are available for download from the website of the U.K. Debt Management Office (www.dmo.gov.uk) starting from November 2010. Monthly data prior to November 2010 has kindly been provided by the PWLB. The main information included in each monthly report relates to the advance date and amount, the name of the borrower, the type of loan (FR versus AR), the rate of interest charged and the term of the loan.

We merge this data with LOBO loans data we obtained from the campaign group Debt Resistance U.K. The group obtained detailed data on LOBOs by sending FOI requests to over 250 local authorities in the U.K. in an attempt to obtain the loan agreements and gain a full picture of the overall LOBO debt held by local authorities. The selection of the over 250 local authorities to send the FOI requests to followed from publicly available borrowing statistics published by the Ministry of Housing, Communities and Local Government (MHCLG), which indicate which authorities hold debt and whether they borrowed from the PWLB or private banks. From the FOI responses and the actual loan agreements (also collected by the campaign group), we hand-collect data for the following main variables: the

advance date and amount, the name of the borrower, the rate of interest charged (initial "teaser" rate and step-up rate if pre-determined), the term of the loan, the first call date (the first available date as set in the LOBO contract for the lender to exercise its right to revise the initial interest rate) and the frequency of subsequent calls (the number of months after which the lender has the option to further revise interest rates over the length of the LOBO contract).[6]

We use the earlier years of the sample to compute the interest-rate-based loan decision rules and concentrate on the period from 2002 onwards for most of our empirical analysis because the availability of data on the financial characteristics of local governments becomes easily accessible from this year only. We have 337 local governments which took out any type of loan during the period 1995-2014, but during the restricted period 2002-2014, we have 317 local governments for which borrowing characteristics are also available.[7]

In order to investigate the *pricing* of financing of local governments, we focus on the AR loan share which is computed each month by aggregating the loan-level data as the ratio between the sum of the amounts of both PWLB AR loans and LOBO loans and the total amount of all loans. When we instead narrow the focus of our study on the *source* of financing, our main variable of interest is the ratio between the amount of LOBO loans and the total amount of all loans. These constitute our

[6]We examine each loan agreement and manually record the variables of interest. If loan agreements were not provided by the local government, we rely on the information reported to the campaign group as a response to the FOI requests. The Online Appendix provides a more detailed picture of the institutional context in which English local governments operate and of the loan types available to them.

[7]Unfortunately we do not have data on loan refinancing by local governments. Hence, in this paper, we will not be able to investigate their refinancing decisions.

main dependent variables in the regression models.

We use our merged loan database to compute the loan decision rules (representing the main explanatory variables in our analysis) based on the following interest rate variables: the adaptive decision rules to proxy for the theoretical term premia $\phi_{4,1,0}^{std}$ (constructed using standard FR and AR loans originated by the PWLB) and $\phi_{4,2,0}^{nonstd}$ (constructed using PWLB FR loans and non-standard AR bank loans), the proxies for the yield spreads $q_{4,0}^{FR} - q_{1,0}^{AR_{std}}$ (constructed using standard FR and AR loans originated by the PWLB) and $q_{4,0}^{FR} - q_{2,0}^{AR_{nonstd}}$ (constructed using PWLB FR loans and non-standard AR bank loans), and a proxy for the long yield ($q_{4,0}^{FR}$) based on the use of standard PWLB FR loans.

While we are able to construct the aggregate loan shares at the monthly frequency, we estimate panel regressions using annual observations due to the fact that our proxy variables for borrower characteristics are only available at the annual frequency. Borrower characteristics include the level of reserves held by a local government, its net current expenditure level, interest payments, the amount of revenue support grant received and the redistributed national non-domestic rates, the latter being a business tax charged on the occupation of non-domestic property. Data on these variables is taken from the revenue and capital outturn expenditures which is issued annually by the central government (via the MHCLG) and available in accessible format starting from 2002. We also consider a measure of local economic growth, per capita GVA. In order to compute this, we collect for each local authority the population size as well as the GVA from the ONS.

Table 1 shows that the share of newly originated AR loans presents a very

large variation. It varies between 0% and 99% of all loans (which include PWLB and LOBO loans) over the 1995-2014 period. The mean shares of LOBO loans and PWLB AR loans are 12% and 9%, respectively. Also, PWLB FR loans constitute the most popular financing source for local authorities accounting, on average, for almost 80% of the issued loans.

The mean rate charged on FR loans is 4.75% and higher than both the interest rate on PWLB AR loans of 4.64% and the initial rate applied to LOBO loans which is 4.02%, despite the fact that LOBO loans have a much longer mean maturity of 54 years compared to a mean maturity of almost 26 years for PWLB FR loans. This pattern is due to the optionality feature embedded into LOBO loans that allows lenders to change the initial interest rate at their discretion at pre-set future dates over the length of the contract. This optionality feature is reflected in the first call date and the call frequency which are also included in the loan agreements. On average, the lender is given the option to change the initial interest rate almost 5 years following loan issuance and every 2 years thereafter. LOBO loans have larger mean amounts of almost £10 million which is about £4 million higher than the mean amounts on PWLB FR loans.

# III Empirical Analysis

This section includes the main empirical results of this paper. First, we investigate the determinants of the probability of getting an AR-type loan. Second, we explore the main determinants of the AR loan share and bank loan share.

## *A.* Multinomial logit models of loan choice

We analyze the determinants of the probability of getting an AR-type loan including bank (LOBO) loans and agency loans. We combine our unique loan-level data with annual data on borrowing characteristics used to construct proxy variables for a local government's financial constraints. Given the mismatch in the frequency of observation between the loan-level data and the MHCLG data, we convert the monthly loan data to an annual frequency and estimate a pooled multinomial logit model where the dependent variable is a categorical one with three possible outcomes summarizing whether a local government chooses a PWLB FR loan, a PWLB AR loan or a LOBO loan in a given year. The interest rate variables used as explanatory variables are guided by our theoretical framework and include the loan-specific adaptive expectations rules, $k_{lobo}(1, pwlb)$ computed as the difference between the PWLB fixed rate (used as a proxy for the long yield) and the 1-year moving average of the LOBO loan rate, and $k_{pwlb_{AR}}(1, pwlb)$ computed as the difference between the PWLB fixed rate and the 1-year moving average of the PWLB AR loan rate. We also include the loan-specific yield spread proxies, $r(pwlb) - r(lobo)$ computed as the difference between the PWLB fixed rate and the LOBO loan rate, and $r(pwlb) - r(pwlb_{AR})$ computed as the difference between the PWLB fixed rate the PWLB AR loan rate. We finally include the PWLB fixed rate, $r(pwlb)$, as a proxy for the long yield.

These variables from the monthly loan data are then converted into annual observations by taking the mean monthly value in each given year. We then consider

the following proxies for local governments' financial constraints: the ratio between total reserves and total current expenditure levels ($RESTEXP$), the ratio between total interest payments and total current expenditure levels ($INTTEXP$), the ratio between the total revenue support grant received and total current expenditure levels ($RSGTEXP$) and the ratio between the non-domestic rates and total current expenditure levels ($NDRTEXP$).

Several studies emphasize the importance of local government reserves as a buffer against funding volatility and to enhance local investment capacity (Hendrick, 2006; Pottruff and Macleod, 2012). Hence, we can expect local authorities with lower levels of reserves to be more financially constrained. As local authorities face a legal obligation to balance their current budget, the magnitude of their interest payments as part of their total current expenditure constitutes a relevant proxy for financial constraint (CIPFA, 2011; Guarini, 2013). Given the historical reliance of local authorities on governmental grants and the central decision to gradually reduce the revenue support grant as a main source of revenue income[8], we predict that local governments relying more heavily on governmental grants are those facing greater financial constraints. Similar to other papers on local government which express a local authority's own revenue sources as percentage of total income or expenditure (Feld et al., 2011; Uchimura and Jütting, 2009), we also consider the ratio of non-domestic rates and total current expenditure given the importance of

[8]Revenue income in the form of government grants to English local authorities has been cut by 40% since 2010 (Moore, 2016), making debt servicing costs (including both interest payments and the minimum revenue provisions set aside to repay the loan principal) account for a greater proportion of the total revenue expenditures. Furthermore, the national government has planned that the Revenue Support Grant (a major source of income that can be used to finance revenue expenditures on any service) will soon be phased out.

non-domestic rates as a revenue income source. Local governments with low shares of non-domestic rates are those more financially constrained.

Finally, we combine population size and personal income, which are two exogenous variables based on our theoretical framework described in Section II.*A*., and consider per capita GVA ($GVATPOP$) to measure economic growth at the local level. This measure has been used in previous studies (Henley, 2005) and lower values of it are associated with more financially-constrained local governments. To mitigate the effect of outliers, we winsorize all ratios at the $1^{st}$ and $99^{th}$ percentiles.

Table 2 shows the summary statistics of these ratios representing the main characteristics of local governments. Panel A includes all local governments; Panel B includes only the local governments that have taken out either a PWLB AR loan or a LOBO loan in any year during the 2002-2014 period; Panel C only considers local governments that received the FOI requests sent by campaign group Debt Resistance U.K. in order to obtain their loan agreements with private lenders during the same sample period. From Panel A of the table, we can observe that, on average, interest payments account for almost 3% of local government's current expenditures and that the main source of revenue income is represented by non-domestic rates representing 17.5% of current expenditures, while government grant income accounts for 10.5% of expenditures. Based on a two-sample $t$ test of the equality of means between the full sample and either the AR sample (in Panel B) or LOBO sample (in Panel C), it can be noted that local governments with any AR-type instrument have significantly higher interest-payment-to-expenditure ratios, grant-to-expenditure ratios and non-domestic-rates-to-expenditure ratios but lower reserves-to-expenditure ratios than

the full sample of local governments.

In estimating the multinomial logit, we model the decision to take out a PWLB FR loan, a PWLB AR loan and a LOBO loan.[9] As a base category we select the PWLB FR loan because this represents the most dominant segment of the loan market for local governments.

We standardize each explanatory variable and report in Panel A of Table 3 the multinomial logit estimates, robust $t$-statistic, the pseudo $R^2$ and the number of observations used to estimate each model.

In order to test our two research hypotheses, we focus on the coefficient estimates related to the interest-rate variables. We find that both loan-specific proxies for the term premia (the adaptive rules) are insignificant, while the yield spread proxy $r(pwlb) - r(pwlb_{AR})$, positively affects the choice of PWLB AR loans. Based on these estimates, we find support for the current cost minimization hypothesis, according to which the yield spread should drive the loan choice for borrowing-constrained local governments.

Interestingly, we also find that the long yield proxy, $r(pwlb)$, is positively related to the choice of LOBO loans.

Among the non-interest-rate variables and in line with our predictions, we find that local authorities with higher levels of interest payments relative to expenditures are more likely to take out an AR-type loan. Local governments with higher levels of revenue support grants (relative to expenditures), lower redistributed non-domestic

[9] In a given year, a local government may take out different loan types. In such cases, we categorize the dependent variable with the most prevalent outcome for the given year: for example, a local government that took out £12,000,000 of LOBO loans and £5,000,000 of PWLB FR loans in a given year, would have its dependent variable categorized as LOBO loan.

rates (relative to expenditure) and lower per capita GVA have a higher probability of taking out a PWLB AR loan. Differently from our expectations, per capita GVA positively affects the choice of LOBO loans while the other financial constraints appear less relevant to predict the likelihood of choosing a LOBO loan: only the *INTTEXP* ratio is significant[10].

In Panel B of Table 3, we also report the marginal effects estimated at the mean values of the explanatory variables. The marginal effect estimates show significance patterns that are similar to the logit estimates shown in Panel A. For instance, for a one-standard-deviation increase in either the yield spread proxy $r(pwlb) - r(pwlb_{AR})$ or the long yield proxy $r(pwlb)$, we find a 5% increase in the likelihood of choosing a PWLB AR loan or LOBO loan, respectively.

## *B.* Determinants of loan shares

### *B.1* The pricing of financing

In order to investigate more directly the local governments' financing choice between AR and FR loans, we estimate fixed-effect panel regressions of the AR loan share on the same determinants used for the multinomial logit regressions estimated in Section III.*A*. Including fixed effects allows us to account for time-invariant unobserved characteristics of each local government and then represents a more conservative modelling approach to be used to corroborate our main findings.

[10]The positive relationship between local debt obligations and LOBO loans can also be explained by political constraints (that arise from currently binding financial constraints) whereby local administrators of more indebted authorities face reduced political clout and attempt to regain their political leeway through innovative financial instruments (Pérignon and Vallée, 2017).

In order to shed light on our research hypotheses of long-term versus short-term cost minimization, we focus on the model specification in Panel A of Table 4 that includes the two term premium proxies, the two yield spread proxies and the financial ratios. We can observe that the term premium proxies are both insignificant, while the LOBO-specific yield spread, $r(pwlb)-r(lobo)$, is the only significant interest-rate variable. A one-standard-deviation increase in $r(pwlb)-r(lobo)$ increases the share of AR loans by 4%. This result supports the current cost minimization hypothesis, according to which the yield spread level should be the main interest-rate variable that should matter for a local government that is mostly concerned about current consumption levels. These findings recall those related to the mortgage choice of borrowing-constrained households discussed by Campbell and Cocco (2003, 2015).[11] We are the first to draw this parallel between the financing decisions of local governments and those of households: this link can be explained by the fact that revenue and spending decisions at the local level are dependent on the financial position (personal income levels) of households/taxpayers as discussed in Section II.*A.* on the theoretical arguments, and more generally by Serkin (2006).

In line with the current cost minimization hypothesis, a specification which only includes borrower characteristics, produces a higher adjusted $R^2$ than any specification which only includes one of the interest-rate variables. This is revealing of the importance of financial constraints as determinants of the AR loan share. The signs of the estimates for the financial constraint proxies are generally in line

[11] Furthermore, past papers have discussed the role of the yield spread and its link to households' financial constraints; see, for example, Koijen et al. (2009).

with our expectations. Per capita GVA and the interest payments ratio show the most sizeable effect on the AR loan share: a one-standard-deviation increase in $GVATPOP(INTTEXP)$ reduces (increases) the AR loan share by 4% (3%).

### *B.2* The source of financing

The peculiarities of the AR loans originated by commercial banks and differences in the loan approval process pursued by governmental agencies and traditional banks motivate a focused analysis on bank loans, which represent a subset of the total AR loan share. This is essentially equivalent to studying the *pricing* of financing but for a smaller subset of loans, under the assumption that all AR loans taken out by local governments were exclusively in the form of bank loans. This also allows us to investigate the determinants of the *source* of financing.

To this end, we estimate fixed-effects panel regressions of the bank loan share on the same determinants in order to investigate the local governments' financing choice between bank loans and agency loans.

In order to test our main hypotheses, we refer to the coefficient estimates of a model including the LOBO-specific term premium proxy as well as yield spread proxy, together with the financial ratios as from Panel B of Table 4. We can observe that the yield spread, $r(pwlb) - r(lobo)$, is highly significant, while the adaptive rule (our proxy for the term premium) is insignificant. Hence, consistent with the results discussed in the previous subsection, we find support for the current cost minimization hypothesis also when we limit the sample of AR loans to bank loans. However, differently from the results in Section III.*B.1*, a specification that only

includes the borrower characteristics does not improve the adjusted $R^2$ indicating that financial constraints play a lesser role.

Interestingly, in a model that includes all determinant variables, the long yield proxy is the only interest-rate variable that does not lose its significance. Also, the only financial constraint proxy that is significantly related to the LOBO loan share is per capita GVA but the sign of the relationship is positive and contrary to our expectations.

The positive effect of $r(pwlb)$ suggests that local governments tend to take out bank loans when long-term interest rates have recently increased as they might believe that long-term interest rates are mean-reverting and somehow predictable.[12]

Furthermore, the positive relationship between *GVATPOP* and the share of bank loans may suggest that a possible reason why local governments are likely to take out bank (LOBO) loans may relate to the possibility that they can partially hedge the interest rate risk of LOBOs with increased tax revenues. In order to test this possibility, we partition our sample based on two measures that reflect a local government's revenue income, namely the *NDRTEXP* ratio and per capita expenditures. The former measure reflects the extent to which a council relies on business rate tax revenues resulting from the prevailing business activity in the area they administer. This should be closely related to the local GVA levels. However, this source of income is the result of the redistribution mechanisms performed by the central government rather than the fruit of local autonomous actions directed to

[12]For English authorities, this is supported by anecdotal evidence (Brady, 2018) whilst a similar finding has been observed for U.S. households in their choice between ARM and FRM contracts (Campbell and Cocco, 2003; Campbell, 2006).

promote business activity. For this reason, we also consider per capita expenditures based on the fact that local governments strictly adhere to a balanced budget rule, according to which current expenditure levels must equalize current income levels. The advantage of using this alternative measure lies in its ability to capture the overall level of income including items resulting from more autonomous operating actions taken by local administrators.

Table 5 reports estimates from fixed-effect panel regressions of the bank loan share on its determinants for high-income and low-income local governments in Panel A and B, respectively. As shown, the bank loan share can be explained by *GVATPOP* only for the subsample of high-income local governments at the standard 5% significance level. This suggests that a feasible reason for a council to take out a bank loan is its reliance on a superior level of revenue income.

# IV Further Analysis

In this section we consider whether being classified as a specific type of local government affects the decision to take out AR loans as well as bank loans. We also investigate whether political influence affects borrowing choices.

## *A.* Types of local government

Local government in England is highly heterogeneous. Despite the variety of labels, there is a main distinction between single-tier local governments, which are (largely) responsible for all public services provided in their area, versus two-tier

local governments, where services are split in an upper and lower level and are referred to as counties and districts, respectively. The most important functional distinction in the two-tier type is that counties are the main provider of social care services.

To investigate whether our results apply across the English local government sector, we estimate fixed-effect panel regressions of the AR loan share and the LOBO loan share for the main types of local government. Type 1 authorities refer to single-tier local governments, which include the Unitary Authorities, the metropolitan districts and the London boroughs.[13] Among the two-tier local governments, type 2 refers to district authorities while type 3 to the upper level authorities or counties.

Estimation results for the AR loan share are presented in Panel A of Table 6. We find that the LOBO-specific yield spread proxy, $r(pwlb) - r(lobo)$, is the largest and most significant predictor of the AR loan share for all types of local government after controlling for their financial characteristics, many of which are also significant and particularly so for the district authorities. For districts, we also observe that both yield spread proxies, $r(pwlb) - r(lobo)$ and $r(pwlb) - r(pwlb_{AR})$, are significantly related to the AR loan share. None of the term premium proxies are significant at standard significance levels confirming our evidence in support for the current cost minimization for all types of local governments.

Panel B of the table reports the estimation results for the bank loan share and shows that the long yield proxy, $r(pwlb)$, is highly significant for both single-tier

[13]The London boroughs are largely similar to Unitary Authorities since the most important executive tasks of the Greater London Authority (GLA) - transport, police and fire services - are also delivered by separate authorities outside the London area (Wilson and Game, 2011).

and district authorities, while the term premium proxy, $k_{lobo}(1, pwlb)$, and the yield spread proxy, $r(pwlb) - r(lobo)$, are significant for single-tier authorities (the largest subset of local governments), although the yield spread is dominant in terms of higher t-stat value and coefficient size. None of the interest-rate variables are instead significant at the 5% level for counties. Unlike in Panel A and consistent with the results reported in previous sections, the financial constraint variables are generally insignificant, except for the per capita GVA which is positively related to the LOBO loan share particularly for type 3 local governments (counties).

Overall, while these findings on the *source* of financing by type of local government show consistency with the results presented in previous sections for the entire sample, they also reveal important elements of heterogeneity of the sector that should prompt policymakers to take action for the development of alternative and more inclusive forms of access to finance.

## *B.* Political influence

Past studies have found that political affiliation can affect a state's borrowing costs (Cestau, 2018). We investigate whether political influence can also affect a local government's decision to take out AR loans. We create three dummy variables to identify the local governments led by a Conservative Party majority, those led by a Labour Party majority and those with no overall political control. We include the dummy variables together with all the other main variables of interest in fixed-effects models as well as in the multinomial models estimated in Section III.*A.* but we find that none of them shows a significant effect on the AR loan share. We also study

the effect of these political dummies on the LOBO loan share but again find no significant effect.

# V Conclusion

This paper studies the debt financing decisions of local governments by examining their choice between FR and AR loans and its links with the term structure of interest rates. We build a unique loan database by merging loans for English local governments issued by the PWLB, a public sector body, and bank loans originated by private lenders. We find that a decision rule based on the use of the yield spread proxied by the difference between the PWLB fixed rate and the bank loan rate is the most important interest-rate determinant of the AR loan share. The financial characteristics of local governments also represent important determinants of the AR loan share. We then study the local governments' decisions to take out bank loans (rather than agency loans) and find that, in addition to the yield spread, the PWLB fixed rate (our proxy for the long yield) is a highly significant predictor of the share of bank loans. This suggests that local governments' finance officers may believe that movements in long-term interest rates can be somehow predicted. While we find a lesser role for the borrower characteristics, we document a strong positive impact of per capita GVA pointing to the possibility that areas that are able to generate greater tax income positively impact upon the risk attitudes of their local administrators who become more keen on underwriting more innovative and risky financial instruments. Our findings

support the current cost minimization hypothesis and reveal some elements of heterogeneity in the formulation of the financing choices of the local government sector, which are dependent on the type of available lending instruments as well as the functional types of each local government. These factors stress the importance of developing further and more inclusive funding mechanisms for local governments to help them raise the finance required to implement the long-term capital investments needed to sustain local economies. One such mechanism could be, for instance, the development of a liquid municipal bond market which is still in its infancy. Local governments in England and in many other jurisdictions face increasing financing needs as grant funding from higher government levels is being reduced whilst demand for public services is on the rise, especially amongst young and old inhabitants (OECD, 2017). Given these funding pressures, combined with the prospect of raising interest rates, borrowing choices are having an increasingly important impact on the ability of local governments to provide public services but we have limited knowledge as to how these choices are being formed by public sector organisations. Subject to data availability (which might be scarce particularly on the derivatives-based debt agreements), our modelling framework could be used as a basis for future research on the funding decisions by national and subnational governments (including those characterized by developed municipal bond markets and high levels of financialization such as, for instance, the U.S. and China) and other public sector organisations. This will provide further vital insights into the factors underlying borrowing choices by public sector entities, and the extent to which they differentiate from those in the private sector.

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Table 1: **Summary statistics for the sample of loans**

*This table reports summary statistics for our monthly sample of loans taken out by local governments over the period April 1995 through December 2014. We report the mean, the median, the standard deviation (StDev), the minimum value (Min) and the maximum value (Max) for the loan amounts, loan rates, loan maturities and the additional LOBO terms including the first loan call date and the frequency of the subsequent calls. We also include the loan shares based on monthly aggregation of the loan-level data.*

| | Mean | Median | StDev | Min | Max |
|---|---|---|---|---|---|
| *Based on loan-level data:* | | | | | |
| *Loan amounts (£)* | | | | | |
| LOBO Loans | 9,854,251 | 8,000,000 | 7,677,222 | 500,000 | 60,000,000 |
| PWLB AR Loans | 6,572,207 | 3,481,985 | 9,443,295 | 1,014 | 93,000,000 |
| PWLB FR Loans | 6,150,007 | 4,353,140 | 8,337,601 | 533 | 250,000,000 |
| *Loan rates (%)* | | | | | |
| LOBO Loans | 4.02 | 4.00 | 0.96 | 0.10 | 11.38 |
| PWLB AR Loans | 4.64 | 4.44 | 1.56 | 0.60 | 7.38 |
| PWLB FR Loans | 4.75 | 4.55 | 1.42 | 0.40 | 9.00 |
| *Loan maturities (months)* | | | | | |
| LOBO Loans | 650 | 677 | 160 | 11 | 911 |
| PWLB AR Loans | 53 | 23 | 41 | 23 | 131 |
| PWLB FR Loans | 308 | 311 | 190 | 11 | 731 |
| *Other LOBO terms (months)* | | | | | |
| $1^{st}$ Call Date | 57 | 48 | 45 | 1 | 243 |
| Call Frequency | 27 | 12 | 26 | 1 | 120 |
| *Based on monthly aggregation of loan-level data:* | | | | | |
| *Loan shares* | | | | | |
| AR Loans | 0.21 | 0.12 | 0.23 | 0.00 | 0.99 |
| PWLB AR Loans | 0.09 | 0.00 | 0.18 | 0.00 | 0.89 |
| LOBO Loans | 0.12 | 0.06 | 0.16 | 0.00 | 0.86 |

Table 2: **Summary statistics for local governments' characteristics**

*This table reports summary statistics for various local governments' characteristics. We report the mean, the median, the standard deviation (StDev), the minimum value (Min), the maximum value (Max) and the number of observations (N) for the ratio between the total reserves and the total current expenditures (RESTEXP), the ratio between the total interest payments and the total current expenditures (INTTEXP), the ratio between the total amount of revenue support grant received and the total current expenditures (RSGTEXP), the ratio between the national non-domestic rates collected by each local government and the total current expenditures (NDRTEXP), the gross value added (GVA) and the population size (POP). The statistics are based on annual data from 2002 until 2014 and are reported for the full sample (Panel A), the sample of local governments that hold AR loans (Panel B) and the sample of local governments that hold LOBO loans (Panel C). *** indicates a significant difference (at the 1% level) in the means of either the AR sample or LOBO sample and the full sample of local governments.*

| | Mean | Median | StDev | Min | Max | N |
|---|---|---|---|---|---|---|
| *Panel A: Full sample* | | | | | | |
| RESTEXP | 0.197 | 0.138 | 0.188 | 0.002 | 1.121 | 3,948 |
| INTTEXP | 0.028 | 0.019 | 0.034 | -0.002 | 0.179 | 3,934 |
| RSGTEXP | 0.105 | 0.067 | 0.103 | 0.002 | 0.406 | 3,885 |
| NDRTEXP | 0.175 | 0.169 | 0.084 | 0.038 | 0.496 | 3,877 |
| GVATPOP | 21,178 | 18,858 | 11,234 | 4,175 | 148,746 | 3,795 |
| *Panel B: AR sample* | | | | | | |
| RESTEXP | 0.152*** | 0.109 | 0.145 | 0.002 | 1.121 | 2,428 |
| INTTEXP | 0.033*** | 0.024 | 0.032 | -0.002 | 0.179 | 2,414 |
| RSGTEXP | 0.119*** | 0.079 | 0.115 | 0.002 | 0.406 | 2,393 |
| NDRTEXP | 0.180*** | 0.174 | 0.085 | 0.038 | 0.496 | 2,382 |
| GVATPOP | 21,015 | 18,798 | 10,027 | 4,175 | 116,637 | 2,338 |
| *Panel C: LOBO sample* | | | | | | |
| RESTEXP | 0.122*** | 0.091 | 0.108 | 0.002 | 1.121 | 1,769 |
| INTTEXP | 0.035*** | 0.026 | 0.030 | -0.002 | 0.179 | 1,762 |
| RSGTEXP | 0.128*** | 0.085 | 0.123 | 0.002 | 0.406 | 1,753 |
| NDRTEXP | 0.182*** | 0.175 | 0.085 | 0.038 | 0.496 | 1,723 |
| GVATPOP | 21,060 | 18,818 | 10,131 | 4,175 | 116,637 | 1,736 |

Table 3: **Multinomial logit regressions of loan choice on its determinants**

*This table reports estimation results of a multinomial logit model of loan choice on a constant and other explanatory variables which include the adaptive decision rules $k_{lobo}(1, pwlb)$ and $k_{pwlb_{AR}}(1, pwlb)$, the yield spreads between the PWLB fixed rate and the LOBO loan rate, $r(pwlb) - r(lobo)$, and between the PWLB fixed rate and the PWLB adjustable rate, $r(pwlb) - r(pwlb_{AR})$, the PWLB fixed rate, $r(pwlb)$ and proxies for financial constraints of local governments. $k_{lobo}(1, pwlb)$ is computed as the difference between the PWLB fixed rate and the 1-year moving average of past LOBO loan rates. $k_{pwlb_{AR}}(1, pwlb)$ is computed as the difference between the PWLB fixed rate and the 1-year moving average of past PWLB adjustable rates. RESTEXP is the ratio between the total reserves and the total current expenditures, INTTEXP is the ratio between the total interest payments and the total current expenditures, RSGTEXP is the ratio between the total amount of revenue support grant received and the total current expenditures, NDRTEXP is the ratio between the national non-domestic rates and the total current expenditures, GVATPOP is the ratio between the gross value added and the population size. The dependent variable is categorizes loans as PWLB FR, PWLB AR and LOBO. The base category is comprised by PWLB FR loans and is excluded for brevity. Panel A presents coefficient estimates of the multinomial logit models while Panel B reports the marginal effects estimated at the mean values. Robust t-statistics are given in parentheses. N represents the number of observations. All explanatory variables have been standardized. The sample period is from 2002 until 2014 and the frequency of observations is annual.*

| | (1) | | (2) | | (3) | |
|---|---|---|---|---|---|---|
| | lobo | $\text{pwlb}_{AR}$ | lobo | $\text{pwlb}_{AR}$ | lobo | $\text{pwlb}_{AR}$ |
| *Panel A: Multinomial logit estimates* | | | | | | |
| $\varkappa_{lobo}(1, pwlb)$ | 0.26 | -0.11 | | | | |
| | (1.58) | (-0.61) | | | | |
| $\varkappa_{pwlb_{AR}}(1, pwlb)$ | -0.36 | 0.23 | | | | |
| | (-2.98) | (1.42) | | | | |
| r(pwlb)-r(lobo) | | | 0.20 | 0.14 | | |
| | | | (1.17) | (0.62) | | |
| r(pwlb)-r($\text{pwlb}_{AR}$) | | | -0.38 | 0.89 | | |
| | | | (-3.27) | (4.21) | | |
| r(pwlb) | | | | | 0.52 | -0.74 |
| | | | | | (3.83) | (-3.91) |
| RESTEXP | 0.14 | -0.00 | 0.08 | -0.04 | 0.05 | -0.01 |
| | (1.19) | (-0.02) | (0.69) | (-0.29) | (0.45) | (-0.10) |
| INTTEXP | 0.28 | 0.32 | 0.27 | 0.30 | 0.24 | 0.37 |
| | (2.91) | (2.55) | (2.88) | (2.52) | (2.61) | (2.99) |
| RSGTEXP | 0.06 | 0.41 | 0.15 | 0.38 | 0.11 | 0.43 |
| | (0.48) | (2.18) | (1.46) | (2.25) | (1.17) | (2.82) |
| NDRTEXP | 0.10 | -0.28 | 0.10 | -0.34 | 0.07 | -0.24 |
| | (0.86) | (-1.93) | (0.92) | (-2.48) | (0.62) | (-1.76) |
| GVATPOP | 0.16 | -1.08 | 0.26 | -1.11 | 0.30 | -1.50 |
| | (1.32) | (-6.45) | (1.72) | (-5.96) | (2.32) | (-7.71) |
| Pseudo $R^2$ | 0.10 | | 0.11 | | 0.11 | |
| N | 1,640 | | 1,640 | | 1,640 | |
| *Panel B: Marginal effects at the mean* | | | | | | |
| $\varkappa_{lobo}(1, pwlb)$ | 0.02 | -0.01 | | | | |
| | (1.64) | (-0.77) | | | | |
| $\varkappa_{pwlb_{AR}}(1, pwlb)$ | -0.03 | 0.02 | | | | |
| | (-3.10) | (1.66) | | | | |
| r(pwlb)-r(lobo) | | | 0.02 | 0.01 | | |
| | | | (1.11) | (0.52) | | |
| r(pwlb)-r($\text{pwlb}_{AR}$) | | | -0.04 | 0.05 | | |
| | | | (-3.85) | (4.35) | | |
| r(pwlb) | | | | | 0.05 | -0.05 |
| | | | | | (4.20) | (-4.06) |
| RESTEXP | 0.01 | -0.00 | 0.01 | -0.00 | 0.00 | -0.00 |
| | (1.20) | (-0.13) | (0.72) | (-0.35) | (0.46) | (-0.14) |
| INTTEXP | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| | (2.65) | (2.31) | (2.65) | (2.29) | (2.32) | (2.79) |
| RSGTEXP | 0.00 | 0.02 | 0.01 | 0.02 | 0.01 | 0.02 |
| | (0.23) | (2.15) | (1.18) | (2.16) | (0.81) | (2.73) |
| NDRTEXP | 0.01 | -0.02 | 0.01 | -0.02 | 0.01 | -0.01 |
| | (1.07) | (-2.04) | (1.16) | (-2.63) | (0.81) | (-1.86) |
| GVATPOP | 0.02 | -0.06 | 0.03 | -0.07 | 0.03 | -0.09 |
| | (2.11) | (-6.51) | (2.35) | (-5.97) | (3.35) | (-7.44) |

Table 4: **Fixed-effect regressions of the loan shares on determinants**

*This table reports estimation results of fixed-effect panel regressions of the loan shares on a constant, the adaptive decision rules $k_{lobo}(1, pwlb)$ and $k_{pwlb_{AR}}(1, pwlb)$, the yield spreads between the PWLB fixed rate and the LOBO loan rate, $r(pwlb) - r(lobo)$, and between the PWLB fixed rate and the PWLB adjustable rate, $r(pwlb) - r(pwlb_{AR})$, the PWLB fixed rate, $r(pwlb)$ and proxies for financial constraints of local governments. $k_{lobo}(1, pwlb)$ is computed as the difference between the PWLB fixed rate and the 1-year moving average of past LOBO loan rates. $k_{pwlb_{AR}}(1, pwlb)$ is computed as the difference between the PWLB fixed rate and the 1-year moving average of past PWLB adjustable rates. RESTEXP is the ratio between the total reserves and the total current expenditures, INTTEXP is the ratio between the total interest payments and the total current expenditures, RSGTEXP is the ratio between the total amount of revenue support grant received and the total current expenditures, NDRTEXP is the ratio between the national non-domestic rates and the total current expenditures, GVATPOP is the ratio between the gross value added and the population size. We report coefficient estimates, robust t-statistics (in parenthesis) and the adjusted $R^2$. N represents the number of observations. All explanatory variables have been standardized. The sample period is from 2002 until 2014 and the frequency of observations is annual.*

| $\varkappa_{lobo}(1, pwlb)$ | $\varkappa_{pwlb_{AR}}(1, pwlb)$ | r(pwlb)-r(lobo) | r(pwlb)-r(pwlb$_{AR}$) | r(pwlb) | RESTEXP | INTTEXP | RSGTEXP | NDRTEXP | GVATPOP | Adj-$R^2$ | N |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Panel A: Pricing of financing* | | | | | | | | | | | |
| 0.06 | -0.00 | | | | | | | | | 0.17 | 1,782 |
| (6.26) | (-0.35) | | | | | | | | | | |
| | | | | | 0.00 | 0.03 | 0.03 | -0.01 | -0.06 | 0.20 | 1,640 |
| | | | | | (0.01) | (2.58) | (3.65) | (-0.76) | (-4.30) | | |
| 0.01 | -0.01 | | | | 0.01 | 0.03 | 0.03 | -0.01 | -0.06 | 0.20 | 1,640 |
| (0.86) | (-0.69) | | | | (0.39) | (2.59) | (2.01) | (-0.64) | (-4.16) | | |
| | | 0.09 | 0.01 | | | | | | | 0.19 | 1,782 |
| | | (8.01) | (1.34) | | | | | | | | |
| | | 0.04 | 0.00 | | 0.00 | 0.03 | 0.02 | -0.01 | -0.04 | 0.21 | 1,640 |
| | | (2.51) | (0.44) | | (0.27) | (2.41) | (1.46) | (-0.67) | (-3.05) | | |
| -0.01 | -0.02 | 0.05 | 0.02 | | 0.01 | 0.03 | 0.02 | -0.01 | -0.04 | 0.21 | 1,640 |
| (-0.32) | (-0.69) | (2.30) | (0.73) | | (0.44) | (2.36) | (1.48) | (-0.79) | (-2.85) | | |
| | | | | 0.08 | | | | | | 0.18 | 1,782 |
| | | | | (7.30) | | | | | | | |
| | | | | 0.02 | 0.00 | 0.03 | 0.03 | -0.01 | -0.05 | 0.21 | 1,640 |
| | | | | (1.85) | (0.36) | (2.40) | (2.91) | (-0.78) | (-3.77) | | |
| -0.00 | 0.01 | | | 0.03 | 0.00 | 0.03 | 0.03 | -0.01 | -0.05 | 0.20 | 1,640 |
| (-0.12) | (0.32) | | | (1.26) | (0.23) | (2.22) | (4.25) | (-0.77) | (-3.61) | | |
| -0.01 | -0.02 | 0.04 | 0.04 | 0.03 | 0.01 | 0.02 | 0.02 | -0.01 | -0.03 | 0.21 | 1,640 |
| (-0.49) | (-0.65) | (1.91) | (1.28) | (1.46) | (0.38) | (2.18) | (1.40) | (-0.93) | (-2.48) | | |
| *Panel B: Source of financing* | | | | | | | | | | | |
| 0.02 | | | | | | | | | | 0.15 | 1,782 |
| (2.31) | | | | | | | | | | | |
| | | | | | 0.00 | 0.01 | 0.01 | 0.00 | 0.01 | 0.16 | 1,640 |
| | | | | | (0.48) | (1.13) | (1.38) | (0.15) | (0.72) | | |
| 0.03 | | | | | 0.01 | 0.01 | -0.01 | 0.01 | 0.01 | 0.16 | 1,640 |
| (2.88) | | | | | (1.10) | (1.25) | (-1.09) | (0.54) | (1.02) | | |
| | | 0.02 | | | | | | | | 0.15 | 1,782 |
| | | (2.81) | | | | | | | | | |
| | | 0.05 | | | 0.01 | 0.01 | -0.01 | 0.00 | 0.03 | 0.17 | 1,640 |
| | | (3.93) | | | (1.07) | (0.89) | (-0.81) | (0.29) | (2.68) | | |
| 0.01 | | 0.04 | | | 0.01 | 0.01 | -0.01 | 0.00 | 0.03 | 0.17 | 1,640 |
| (0.69) | | (2.66) | | | (1.18) | (0.96) | (-1.05) | (0.38) | (2.45) | | |
| | | | | 0.03 | | | | | | 0.16 | 1,782 |
| | | | | (3.99) | | | | | | | |
| | | | | 0.05 | 0.01 | 0.01 | 0.00 | 0.00 | 0.02 | 0.17 | 1,640 |
| | | | | (4.55) | (1.43) | (0.73) | (0.24) | (0.10) | (2.55) | | |
| 0.01 | | | | 0.04 | 0.01 | 0.01 | -0.00 | 0.00 | 0.02 | 0.17 | 1,640 |
| (0.49) | | | | (3.59) | (1.49) | (0.78) | (-0.18) | (0.18) | (2.48) | | |
| -0.00 | | 0.02 | | 0.04 | 0.01 | 0.01 | -0.00 | 0.00 | 0.03 | 0.17 | 1,640 |
| (-0.18) | | (1.47) | | (2.95) | (1.48) | (0.69) | (-0.29) | (0.14) | (2.96) | | |

Table 5: **The role of tax revenue income on the relationship between the bank loan share and its determinants**

*This table reports estimation results of fixed-effect panel regressions of the bank loan share on a constant, the adaptive decision rule $k_{lobo}(1, pwlb)$, the yield spread between the PWLB fixed rate and the LOBO loan rate, $r(pwlb) - r(lobo)$, the PWLB fixed rate, $r(pwlb)$ and proxies for financial constraints of local governments. Panel A reports coefficient estimates for a subsample of local governments with high revenue income based on median values of NDRTEXP and per capita expenditures that are above the sample median. Panel B reports coefficient estimates for the subsample of local governments with low revenue income based on median values of NDRTEXP and per capita expenditures that are below the sample median. $k_{lobo}(1, pwlb)$ is computed as the difference between the PWLB fixed rate and the 1-year moving average of past LOBO loan rates. RESTEXP is the ratio between the total reserves and the total current expenditures, INTTEXP is the ratio between the total interest payments and the total current expenditures, RSGTEXP is the ratio between the total amount of revenue support grant received and the total current expenditures, NDRTEXP is the ratio between the national non-domestic rates and the total current expenditures, GVATPOP is the ratio between the gross value added and the population size. We report coefficient estimates, robust t-statistics (in parenthesis) and the adjusted $R^2$. N represents the number of observations. All explanatory variables have been standardized. The sample period is from 2002 until 2014 and the frequency of observations is annual.*

| $\varkappa_{lobo}(1, pwlb)$ | r(pwlb)-r(lobo) | r(pwlb) | RESTEXP | INTTEXP | RSGTEXP | NDRTEXP | GVATPOP | Adj-$R^2$ | N |
|---|---|---|---|---|---|---|---|---|---|
| *Panel A: Local governments with high revenue income* | | | | | | | | | |
| *Based on NDRTEXP* | | | | | | | | | |
| -0.01 | 0.05 | 0.04 | 0.02 | -0.01 | -0.00 | 0.02 | 0.03 | 0.24 | 938 |
| (-0.37) | (2.72) | (2.54) | (1.38) | (-1.14) | (-0.23) | (1.35) | (2.61) | | |
| *Based on per capita expenditures* | | | | | | | | | |
| -0.01 | 0.03 | 0.04 | 0.02 | -0.00 | 0.00 | 0.00 | 0.04 | 0.20 | 1155 |
| (-0.37) | (1.73) | (2.53) | (1.69) | (-0.06) | (0.21) | (0.25) | (3.15) | | |
| *Panel B: Local governments with low revenue income* | | | | | | | | | |
| *Based on NDRTEXP* | | | | | | | | | |
| 0.01 | -0.01 | 0.03 | -0.00 | 0.02 | -0.00 | 0.00 | 0.03 | 0.09 | 702 |
| (0.34) | (-0.53) | (1.41) | (-0.20) | (1.79) | (-0.07) | (0.05) | (1.82) | | |
| *Based on per capita expenditures* | | | | | | | | | |
| 0.01 | -0.03 | 0.04 | 0.02 | 0.03 | -0.02 | -0.02 | 0.00 | -0.03 | 485 |
| (0.22) | (-1.20) | (1.75) | (0.84) | (1.43) | (-1.29) | (-0.66) | (0.06) | | |

Table 6: **Fixed-effect regressions of loan shares by type of local government**

*This table reports estimation results of fixed-effect panel regressions of the AR loan share (Panel A) and the LOBO loan share (Panel B) in a given year for a given type of local government on a constant, the adaptive decision rules, $k_{lobo}(1, pwlb)$ and $k_{pwlb_{AR}}(1, pwlb)$, the yield spreads between the PWLB fixed rate and the LOBO loan rate, $r(pwlb) - r(lobo)$, and between the PWLB fixed rate and the PWLB adjustable rate, $r(pwlb) - r(pwlb_{AR})$, the PWLB fixed rate, $r(pwlb)$ and group-averaged proxies for financial constraints of local governments. $k_{lobo}(1, pwlb)$ is computed as the difference between the PWLB fixed rate and the 1-year moving average of past LOBO loan rates. $k_{pwlb_{AR}}(1, pwlb)$ is computed as the difference between the PWLB fixed rate and the 1-year moving average of past PWLB adjustable rates. RESTEXP is the ratio between the total reserves and the total current expenditures, INTTEXP is the ratio between the total interest payments and the total current expenditures, RSGTEXP is the ratio between the total amount of revenue support grant received and the total current expenditures, NDRTEXP is the ratio between the national non-domestic rates and the total current expenditures, GVATPOP is the ratio between the gross value added and the population size. We report coefficient estimates, robust t-statistics (in parenthesis) and the adjusted $R^2$. N represents the number of observations. Type represents the type of local government: 1 is for Unitary Authorities, metropolitan districts and London boroughs; 2 is for districts and 3 is for counties. All explanatory variables have been standardized. The sample period is from 2002 until 2014 and the frequency of observations is annual.*

| Type | $\varkappa_{lobo}(1, pwlb)$ | $\varkappa_{pwlb_{AR}}(1, pwlb)$ | r(pwlb)-r(lobo) | r(pwlb)-r($pwlb_{AR}$) | r(pwlb) | RESTEXP | INTTEXP | RSGTEXP | NDRTEXP | GVATPOP | Adj-$R^2$ | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Panel A: Fixed-effects panel regressions for the AR loan share* | | | | | | | | | | | | |
| 1. | 0.01 | -0.03 | | | | 0.03 | 0.02 | 0.02 | -0.01 | -0.09 | 0.20 | 869 |
| | (0.61) | (-1.86) | | | | (1.59) | (1.03) | (0.95) | (-0.72) | (-4.75) | | |
| 1. | | | 0.06 | -0.01 | | 0.02 | 0.02 | 0.00 | -0.01 | -0.06 | 0.20 | 869 |
| | | | (2.36) | (-0.49) | | (1.33) | (0.94) | (0.06) | (-0.67) | (-3.49) | | |
| 1. | | | | | 0.05 | 0.03 | 0.01 | 0.01 | -0.01 | -0.07 | 0.20 | 869 |
| | | | | | (3.32) | (1.49) | (0.78) | (1.00) | (-0.76) | (-3.97) | | |
| 2. | 0.03 | 0.03 | | | | -0.07 | 0.04 | 0.04 | 0.07 | -0.05 | 0.28 | 532 |
| | (1.20) | (1.54) | | | | (-2.25) | (2.19) | (1.89) | (2.43) | (-2.32) | | |
| 2. | | | 0.06 | 0.05 | | -0.07 | 0.03 | 0.04 | 0.07 | -0.03 | 0.29 | 532 |
| | | | (2.04) | (2.14) | | (-2.62) | (1.76) | (2.10) | (2.67) | (-1.58) | | |
| 2. | | | | | -0.01 | -0.06 | 0.04 | 0.06 | 0.05 | -0.05 | 0.28 | 532 |
| | | | | | (-0.24) | (-2.28) | (2.24) | (2.86) | (2.03) | (-2.46) | | |
| 3. | 0.02 | 0.06 | | | | 0.00 | -0.03 | -0.02 | 0.07 | 0.09 | 0.14 | 239 |
| | (0.83) | (1.27) | | | | (0.03) | (-1.54) | (-0.63) | (1.76) | (2.29) | | |
| 3. | | | 0.07 | 0.05 | | 0.02 | -0.03 | -0.01 | 0.05 | 0.11 | 0.14 | 239 |
| | | | (2.13) | (1.08) | | (0.64) | (-1.66) | (-0.47) | (1.05) | (2.45) | | |
| 3. | | | | | -0.02 | 0.01 | -0.03 | 0.00 | 0.08 | 0.08 | 0.13 | 239 |
| | | | | | (-0.45) | (0.52) | (-1.44) | (0.12) | (1.80) | (2.04) | | |
| *Panel B: Fixed-effects panel regressions for the LOBO loan share* | | | | | | | | | | | | |
| 1. | 0.05 | | | | | 0.01 | 0.01 | -0.01 | 0.02 | 0.00 | 0.19 | 869 |
| | (2.65) | | | | | (0.93) | (0.42) | (-0.93) | (0.98) | (0.27) | | |
| 1. | | | 0.07 | | | 0.01 | 0.00 | -0.01 | 0.01 | 0.03 | 0.20 | 869 |
| | | | (3.85) | | | (0.91) | (0.17) | (-0.82) | (0.86) | (1.95) | | |
| 1. | | | | | 0.06 | 0.02 | -0.00 | 0.00 | 0.01 | 0.02 | 0.20 | 869 |
| | | | | | (4.79) | (1.49) | (-0.09) | (0.29) | (0.81) | (1.43) | | |
| 2. | 0.03 | | | | | 0.01 | 0.02 | -0.03 | -0.00 | -0.00 | 0.05 | 532 |
| | (1.71) | | | | | (0.70) | (1.37) | (-1.84) | (-0.16) | (-0.21) | | |
| 2. | | | 0.02 | | | 0.01 | 0.02 | -0.02 | -0.00 | 0.00 | 0.05 | 532 |
| | | | (1.27) | | | (0.46) | (1.22) | (-1.50) | (-0.20) | (0.04) | | |
| 2. | | | | | 0.04 | 0.01 | 0.02 | -0.02 | -0.01 | 0.01 | 0.06 | 532 |
| | | | | | (2.12) | (0.73) | (1.27) | (-1.70) | (-0.55) | (0.84) | | |
| 3. | 0.00 | | | | | 0.02 | -0.03 | -0.01 | 0.08 | 0.11 | 0.18 | 239 |
| | (0.01) | | | | | (0.96) | (-1.81) | (-0.14) | (1.82) | (2.87) | | |
| 3. | | | 0.04 | | | 0.03 | -0.03 | -0.02 | 0.07 | 0.13 | 0.18 | 239 |
| | | | (1.56) | | | (1.38) | (-2.03) | (-0.51) | (1.71) | (2.83) | | |
| 3. | | | | | 0.02 | 0.03 | -0.03 | -0.01 | 0.08 | 0.12 | 0.18 | 239 |
| | | | | | (0.53) | (1.09) | (-1.97) | (-0.24) | (1.84) | (3.13) | | |

# Appendix

## A The link between interest rates and the borrowing choice of local governments

In this section we derive the optimal loan choice for a local government. To this end, we compute the expected utility from expenditure levels in the four time periods under each loan contract.

We set $\psi_t = a_0 + a_1 Y_t + a_2 R_t + a_3 P_t$ and compute the expected utility under FR borrowing as follows:

$$\begin{aligned}
&\mathbb{E}_0 \Big\{ \beta \left[ \psi_1 log Y_1 - \psi_1 log X_1 + \psi_1 log R_1 - \psi_1 log \left( Bq_{4,0}^{FR} \right) + X_1 \right] \\
&+\beta^2 \left[ \psi_2 log Y_2 - \psi_2 log X_2 + \psi_2 log R_2 - \psi_2 log \left( Bq_{4,0}^{FR} \right) + X_2 \right] \\
&+\beta^3 \left[ \psi_3 log Y_3 - \psi_3 log X_3 + \psi_3 log R_3 - \psi_3 log \left( Bq_{4,0}^{FR} \right) + X_3 \right] \\
+\beta^4 \left[ \psi_4 log Y_4 - \psi_4 log X_4 + \psi_4 log R_4 - \psi_4 log \left( Bq_{4,0}^{FR} \right) + \psi_4 log PPR - \psi_4 log B + X_4 \right] &\Big\}
\end{aligned}$$

We then compute the expected utility under AR borrowing assuming that the interest rate paid by the local government is an average of a standard AR loan rate

and of a non-standard AR loan rate, $q_t^{AR} = \frac{q_t^{AR_{std}} + q_t^{AR_{nonstd}}}{2}$. We obtain the following:

$$\mathbb{E}_0 \Bigg\{ \beta \left[ \psi_1 log Y_1 - \psi_1 log X_1 + \psi_1 log R_1 - \psi_1 log \left( B \frac{q_{1,0}^{AR_{std}} + q_{2,0}^{AR_{nonstd}}}{2} \right) + X_1 \right] + \beta^2 \left[ \psi_2 log Y_2 - \psi_2 log X_2 + \psi_2 log R_2 - \psi_2 log \left( B \frac{q_{1,1}^{AR_{std}} + q_{2,0}^{AR_{nonstd}}}{2} \right) + X_2 \right] + \beta^3 \left[ \psi_3 log Y_3 - \psi_3 log X_3 + \psi_3 log R_3 - \psi_3 log \left( B \frac{q_{1,2}^{AR_{std}} + q_{2,2}^{AR_{nonstd}}}{2} \right) + X_3 \right] + \beta^4 \left[ \psi_4 log Y_4 - \psi_4 log X_4 + \psi_4 log R_4 - \psi_4 log \left( B \frac{q_{1,3}^{AR_{std}} + q_{2,2}^{AR_{nonstd}}}{2} \right) + \psi_4 log PPR - \psi_4 log B + X_4 \right] \Bigg\}$$

Local governments prefer AR borrowing if the expected utility over the four periods under AR borrowing is greater than that achieved under FR borrowing. After simplifying, we obtain the following expression:

$$\psi_1 \left[ log q_{4,0}^{FR} - log \frac{q_{1,0}^{AR_{std}} + q_{2,0}^{AR_{nonstd}}}{2} \right] + \beta \psi_2 \left[ log q_{4,0}^{FR} - log \mathbb{E}_0 \left( \frac{q_{1,1}^{AR_{std}} + q_{2,0}^{AR_{nonstd}}}{2} \right) \right] + \beta^2 \psi_3 \left[ log q_{4,0}^{FR} - log \mathbb{E}_0 \left( \frac{q_{1,2}^{AR_{std}} + q_{2,2}^{AR_{nonstd}}}{2} \right) \right] + \beta^3 \psi_4 \left[ log q_{4,0}^{FR} - log \mathbb{E}_0 \left( \frac{q_{1,3}^{AR_{std}} + q_{2,2}^{AR_{nonstd}}}{2} \right) \right] > 0$$

Setting $\psi_1 = \beta \psi_2 = \beta^2 \psi_3 = \beta^3 \psi_4$ and using the exponential transformation, we get:

$$4 q_{4,0}^{FR} - \frac{q_{1,0}^{AR_{std}} + q_{2,0}^{AR_{nonstd}}}{2} - \mathbb{E}_0 \left( \frac{q_{1,1}^{AR_{std}} + q_{2,0}^{AR_{nonstd}}}{2} \right) - \mathbb{E}_0 \left( \frac{q_{1,2}^{AR_{std}} + q_{2,2}^{AR_{nonstd}}}{2} \right) - \mathbb{E}_0 \left( \frac{q_{1,3}^{AR_{std}} + q_{2,2}^{AR_{nonstd}}}{2} \right) > 0$$

We can rearrange the terms as follows:

$$q_{4,0}^{FR} - \frac{q_{1,0}^{AR_{std}} + \mathbb{E}_0\left(q_{1,1}^{AR_{nonstd}}\right) + \mathbb{E}_0\left(q_{1,2}^{AR_{nonstd}}\right) + \mathbb{E}_0\left(q_{1,3}^{AR_{nonstd}}\right)}{4} +$$
$$q_{4,0}^{FR} - \frac{q_{2,0}^{AR_{nonstd}} + q_{2,0}^{AR_{nonstd}} + \mathbb{E}_0\left(q_{2,2}^{AR_{nonstd}}\right) + \mathbb{E}_0\left(q_{2,2}^{AR_{nonstd}}\right)}{4} > 0$$

Finally, we can write the optimal loan choice in a compact form:

$$\left[q_{4,0}^{FR} - \frac{1}{4}\sum_{i=0}^{3}\mathbb{E}_0\left(q_{1,i}^{AR_{std}}\right)\right] + \left[q_{4,0}^{FR} - \frac{1}{2}\sum_{i=0}^{1}\mathbb{E}_0\left(q_{2,2i}^{AR_{nonstd}}\right)\right] = \phi_{4,1,0}^{std} + \phi_{4,2,0}^{nonstd} > 0$$

Appendix to

# "Borrowing choices of local governments and the term structure of interest rates: Theory and empirics"

Not Intended for Publication!

Will be Provided as Online Appendix

# A Institutional context of English local governments

With a population size of 55 million people and 353 (out of 418) local governments, England constitutes by far the largest nation of the U.K. English local governments have responsibilities mainly related to transportation, planning, social care, housing and waste management. They strongly rely on central government funding for around 70% of their income (MHCLG, 2017) and their borrowing has historically been strictly monitored via a system of Credit Approvals through which the central government annually sets a credit limit for each local government. This system was changed significantly with the Local Government Act of 2003, which introduced the prudential borrowing framework (PBF) that removed the centrally set capital borrowing limitations. PBF has significantly increased the borrowing autonomy of local governments for capital investment purposes, but continues to prevent them from borrowing for current revenue expenditures (De Widt, 2017).

The prudential regulations have been operationalized in the Prudential Code, which was developed by the accountancy body Chartered Institute of Public Finance and Accountancy (CIPFA) and received legislative backing in 2004. The Code obliges all local governments to base their capital expenditure decisions on a set of 'prudential indicators' which should ensure that local capital investment plans are 'affordable, prudent and sustainable' (CIPFA, 2011). As part of this, local governments have to set an authorized limit for external debt, which establishes the outer boundary of their borrowing based on their own risk assessment. The

Prudential Code does not prescribe a formula for the exact calculation of prudential limits, but relies instead on the judgement of each local government's chief finance officer and on 'generally accepted accounting practices' (Sandford, 2016).

Borrowing by local governments in the U.K. comes largely from the PWLB, which issues both FR and AR loans. The FR loans have a minimum duration of one year and a maximum of fifty years, while AR loans range from one year to a maximum of ten years. As an integral part of the central government, the credit rating of the U.K. directly affects interest rates set by the PWLB. Loans to local governments are generally provided by the PWLB at a slightly higher interest rate than the U.K. government is able to borrow, which in most cases is lower than the rates local governments can achieve through borrowing from private sector banks. Despite the generally favourable rates of interest on PWLB loans, there have been fluctuations in recent years in the margin applied on PWLB loans compared to the government borrowing rates (as reflected by gilt yields). In October 2010, the PWLB issued Circular 147 and implemented an increase of 80 basis points above gilt yields "to ensure that the rate at which loans are available to local authorities better reflects the availability of capital funding post-Spending Review and to encourage optimal borrowing and investment decisions" (PWLB, 2012). Although the PWLB reduced the margin back again in 2013, the increased uncertainty in the PWLB rate incentivized English local governments to explore alternative sources of borrowing.[14]

Councils have also been incentivized to explore alternative borrowing options

[14]More recently, in October 2019, HM Treasury again modified the lending terms by increasing the margin applied to new loans from the PWLB by 100 basis points. See `https://www.dmo.gov.uk` for further details.

following the PWLB issuing Circular 141 in 2007, which implemented a rule change to PWLB repayment policies. Whilst previously the PWLB applied the same set of rates to calculating advances and the premium on early repayment, following the rule change higher rates have been applied for calculating premiums in case of repayments. These early repayment penalties have made it less attractive for councils to restructure their debt, which many have been eager to do in order to take advantage of the significant reduction of average interest rates in the post-2007 period.

The measures introduced by PWLB Circulars No. 141 and 147 had the intent to promote a market-based financing approach by local governments, which would incentivize their use of capital markets that have never taken off in the U.K.[15]

Quite independently from the aforementioned government regulations, over the last 20 years a significant number of local governments have resorted to the private market (as a valid alternative to PWLB funding), taking out what are referred to as Lender Option Borrower Option (LOBO) loans offered by commercial banks. Similar to most PWLB loans, LOBO loans are long-term loans but they feature an initial interest rate ("teaser rate") designed to undercut rates offered on PWLB loans. Unlike PWLB loans, the initial interest rate charged on LOBO loans can be changed at pre-determined future dates over the length of the contract with a certain

[15]Few examples include a £370 million bond issued by Aberdeen City Council in 2016, a £150 million bond issue in 2015 by Warrington Council, a total of £800 million raised with two separate bond issues (in 2011 and 2015) by the Greater London Authority, about £200 million issue by Birmingham City Council in 2005 and, prior to that, a total of £180 million raised with bonds issued by Salford and Leicester city councils in 1994 (Partington, 2017; Sandford, 2016). Despite the recent creation of a municipal bond agency in 2014 (U.K. Municipal Bonds Agency) backed by the Local Government Association, only one bond has been issued by the agency (on behalf of Lancashire County Council) at the time of writing. This suggests that market-based sources of debt represent a longer-term objective for local governments (Moore, 2016; Allen, 2018).

frequency. It is at the discretion of the lender (and the lender only) the decision to exercise its option to modify the initial rate on these dates, while the borrower has the option to either accept the new rate (revised by the lender) or repay the loan in full at par. Hence, it is the lender's option that has economic value, and it is the value of this option that has enabled the headline rate for LOBO loans to be lower than that offered through the PWLB (CLGC, 2015). In other words, a LOBO loan entails a sale of convexity (flexibility) from the local governments to the lenders, who reciprocate by lowering the initial interest rate charged on these loans.[16] The significant reduction in interest rates following the financial crisis has made it increasingly difficult for bank loans to compete with agency loans, leading to a noticeable decline in LOBO use in the final part of our sample period.

Given the way they are structured, LOBO loans are non-standard AR loans that differ significantly from standard AR loans issued by the PWLB. Whilst the embedded option in LOBOs is likely to be exercised only when it advantages the lender and disadvantages the borrower, interest rates of PWLB AR loans change on a daily basis (in line with variations in gilt yields) and rate changes may also advantage the borrower. A further difference relates to the way in which the loans are provided. When issuing loans to local governments, the PWLB will generally not

[16]Starting in the late 1990s, several local governments across Europe and the U.S. have embraced a similar financialization process, relying on financial derivatives or financial products with embedded derivatives akin to LOBOs. These innovative financial products were sold by private banks and were seen by local governments as an opportunity to borrow at rates lower than prevailing market rates and to reduce their interest costs on FR loans. A popular financial contract is an interest rate swap whereby a local government agrees to swap its existing FR lending for an AR lending with private banks (Katz, 2010; Sanderson et al., 2010). Although U.K. local governments were banned from engaging in interest rate swaps by the courts in 1992 after auditors queried the legality of swaps entered into by the London borough Hammersmith and Fulham worth £6bn (Tickell, 1998), swaps have returned since 2020 with Plymouth City Council being the first council to do such a deal in nearly two decades (Calkin, 2020).

examine the purpose of the loan, as long as the authority adheres to the statutory codes in place (as determined by central government), according to which spending and borrowing decisions lie with local politicians. Banks, in contrast, should be expected to scrutinize potential borrowers, even though the level of scrutiny could be limited given the high confidence in the effectiveness of the regulatory regimes applying to local government finances, which minimize the risk of default.[17] Finally, compared to PWLB AR loans, LOBO loans pose more significant refinancing risks due to their very long duration.

Although not advising against taking out LOBO loans, public sector accountancy body CIPFA has warned U.K. local governments of the complexity and refinancing risks posed by LOBOs, and suggested that they should establish a 'cautious limit' (CIPFA, 2015) on their LOBO holdings, including setting a maximum percentage of total LOBO debt that may be repayable in any year. According to the campaign group Debt Resistance U.K., in 2015, at least 240 councils across the U.K. held LOBO debt for an estimated total amount of £15 billion. This accounts for about 17.5 percent of long-term total debt of £85.7 billion held by local governments in the U.K.[18]

[17]This is reflected in the high ratings provided to the few local governments that have applied for an individual rating, partly due to what has been referred to by the rating agencies as the 'strong institutional framework' (Standard and Poor's, 2012) in which they operate and 'central government's good track record of intervention when necessary' (Moody's, 2010).

[18]As from local authority revenue expenditure and financing data for the 2014-2015 financial year provided by the MHCLG.