

From Foreign Aid to Domestic Debt:
Essays on Government Financing in
Developing Economies

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Thesis Abstract: “From Foreign Aid to Domestic Debt: Essays on Government Financing in Developing Economies”

The first essay [“Twin Deficits and Free Lunches: Macroeconomic Outcomes In Anticipation of Foreign Aid”] concerns itself with situations in which private agents anticipate a future windfall (free lunch) that will help service the debt resulting from a present fiscal expansion (implemented via a temporary tax cut). Such expectations of a windfall can arise in the context of natural resource discoveries or, more interestingly, due to perceptions by agents in “too important to fail” countries that will be bailed out through higher foreign aid or debt relief. We employ an overlapping generations model featuring credit constraints to study the real effects of such free lunch expectations in a small open economy, drawing contrasts with the standard tax and money finance closure rules. The model is solved analytically and shows that anticipated aid is equivalent to current aid when agents have perfect foresight, so that a temporary tax cut is seen as permanent. Accordingly, agents raise their consumption and indebtedness (at the expense of future generations) by an amount that is an increasing function of their “impatience” (subjective rates of time preference plus probability of death). A worsening of the current account obtains (twin deficits) across a range of plausible closure rules, including those featuring money finance. The introduction of credit constrained households (we study the variant where myopic agents spend their current disposable incomes) does not alter the basic result in the case of full aid finance, but does matter for mixed tax-aid regimes, in more complex settings where agent expectations and donor promises on aid diverge, and when governments face borrowing constraints so that the timing of aid delivery matters.

The second essay [“The Role of Domestic Debt in Economic Growth: An Empirical Investigation For Developing Economies”] focuses on the remaining source of government financing, i.e. domestic debt, and the role it can play in mobilizing private savings, facilitating credit intermediation in higher risk settings (i.e. serving a “collateral” function on bank balance sheets), developing financial markets and supporting economic growth in general. To investigate this question empirically, we set up a new domestic debt database covering about 100 developing economies, going back three decades to 1975; explore Granger causality links between domestic debt and key macroeconomic and institutional variables; and estimate the growth impact of domestic debt using panel regressions, allowing for non-linear effects. Domestic debt, as a share of GDP is found to exert a significant positive impact on economic growth, with potential channels including domestic savings mobilization, provision of risk-insurance on banks’ balance sheets; and greater institutional accountability of the state to its citizens. Although this result countervails more established arguments against domestic debt (i.e. that it leads to crowding out and banks to become lazy), there is some evidence that above a ratio of 35 percent of bank deposits, domestic debt does begin to undermine economic growth. The growth payoff also depends on debt quality, with higher payoffs observed for positive interest-rate bearing marketable debt issued to nonbank sectors.

The third and final essay [“Why Do Banks in Developing Economies Hold Domestic Government Securities?”] explores demand-side determinants of domestic debt, by focusing on commercial bank holdings of government paper, discriminating carefully between voluntary factors (such as mean-variance portfolio optimization) and statutory ones (cash reserve and capital adequacy requirements). The analysis is made possible by the construction of a dataset on government and private returns (real and nominal) for almost 600 banks from 70 emerging and low-income economies, spanning the (pre-Basel II) period 1995-2005. A battery of structural cross-section regressions indicates that banks’ portfolio decisions are at least as significantly influenced by mean-variance considerations as regulatory factors: the actual portfolio share of government securities (λ) responds intuitively, and sizably, to variations in the moments of the distributions for government and private returns as well as in the *minimum-variance* portfolio share (λ^*). Higher cash reserve requirements tilt portfolios away from government securities toward riskier private lending, while higher capital adequacy requirements work the other way. The association between actual portfolios and the identified determinants is noticeably weaker at lower ends of the λ distribution, suggesting the domination of non-CAPM factors in those contexts.

Keywords: Public debt, government finance, government securities, debt sustainability, foreign aid, domestic debt, economic growth, financial development, commercial banks, portfolio choice, CAPM, crowding out, bank regulation, too-important-to-fail, credit constraints, current account, twin deficit, overlapping generations

JEL Classification: D22, E21, E62, F32, F34, F35, G11, G18, G32, H60, H63

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THESIS INTRODUCTION

“From Foreign Aid to Domestic Debt: Essays on Government Financing in Developing Economies”¹

The three essays constituting this dissertation have been written as stand-alone papers, but they all relate to the overarching theme: *methods of government finance in developing economies*. Foreign finance (especially foreign aid), taxes and money finance – the obvious candidates – are the focus of the first essay. The second and third essays are devoted to the remaining financing option, domestic government debt, which, despite its growing importance, has remained relatively unexplored in the literature. The second essay presents new data on domestic debt (covering almost 100 developing economies over three decades) and studies its impact on economic growth; while the final essay investigates demand-side determinants of commercial bank holdings of government paper in developing economies, discriminating between voluntary factors (such as mean-variance portfolio optimization) and statutory ones (cash reserve and capital adequacy requirements).

The **first essay** is titled “Twin Deficits and Free Lunches: Macroeconomic Outcomes in Anticipation of Foreign Aid.” The paper considers the case of a small open economy in which the government runs a temporary debt-financed fiscal deficit by giving a lump-sum tax cut or raising government transfers. Finitely-lived overlapping generations (OLG) of consumption-smoothing private agents with perfect foresight expect the deficit to be fully closed in the future. Critically, however, the government’s anticipated “closure rule” features not only *painful measures*, such as higher taxes and money finance, but also *painless means*, such as foreign aid inflows and windfall commodity revenues. The questions posed are: How will private agents respond under these circumstances? In particular, what will be the implications for consumption and the current account balance? And how will credit constraints impact these results?

¹ Acknowledgments to be added.

The paper takes its motivation from two closely related strands of the public finance literature: the “Ricardian equivalence” proposition (forward-looking private agents will offset, one-for-one, any fiscal expansion/public dissaving), and its mirror image, the “twin deficits” hypothesis (an increase in the fiscal deficit is not offset by higher private saving and thus gets reflected in an equivalent current account deterioration). Empirical studies encompassing developing economies have generally rejected Ricardian equivalence and accepted twin deficits (see for example, Abbas et al, 2011). The reasons postulated range from finite lives, liquidity constraints, agent myopia and distortionary taxation, to intra-temporal wedges (such as real exchange rate appreciations resulting from fiscal expansion).

One plausible reason that has received similar attention is that there may be expectations that future government deficits will be closed in a painless manner (akin to a free lunch). In this situation, agents’ optimal consumption response would also “appear” to be non-Ricardian and result in twin deficits, even though we have not assumed any violation of Ricardian assumptions. An obvious example of such expectations is windfall commodity revenues, but a second more interesting possibility involves “too important to fail” cases: countries (such as Pakistan and Ukraine) that have received repeated bailouts from international lenders and donors, and can continue to count on receiving more in the future because of their strategic importance. Another plausible case is that of the world’s poorest economies, where donors cannot, for politico-moral reasons, credibly commit to zero foreign aid in the future, regardless of the recipient’s reform effort.

Although a number of theoretical studies model the response of private agents anticipating a change in the fiscal regime for deficit closure – Frenkel and Razin (1987); Buiter (1988); Drazen and Helpman (1987, 1988); and Kawai and Maccini (1990, 1995), none introduce the possibility of painless means of finance, such as foreign aid. To do this, the paper builds on the Kawai and Maccini (1995) framework – an OLG model in a small open economy, based on Blanchard’s

(1985) perpetual youth model for a closed economy. It provides an analytical solution for the dynamic response of optimizing private agents to a temporary fiscal deficit (tax cut), given perfect foresight about the future deficit closure rule, which includes (in addition to tax and money finance), foreign aid/windfall revenues. We abstract from growth, investment and real exchange rate issues, but do allow for credit constrained households and governments.

The results are intuitive. Anticipated aid is equivalent to current aid when agents have perfect foresight, so that a current bond-financed tax cut (announced as temporary) is perceived as aid-financed and, thus, as permanent. Accordingly, agents raise their consumption and indebtedness (at the expense of future generations) by an amount that is an increasing function of their “impatience” (subjective rates of time preference plus probability of death). A worsening of the current account obtains (twin deficits) across a range of plausible closure rules, including those featuring money finance. The introduction of credit constrained households does not alter the basic result in the case of full aid finance, but does matter for mixed tax-aid regimes, in more complex settings where agent expectations and donor promises on aid diverge, and when governments face borrowing constraints so that the timing of aid delivery matters.

The **second essay**, “The Role of Domestic Debt in Economic Growth: An Empirical Investigation for Developing Economies” focuses on the ghost at the table, i.e. the method of government finance not covered in the first essay, namely domestic debt. The paper documents long-term trends for this debt type, building a database to that end, which then enables an empirical analysis of the impact of domestic debt on growth and its institutional and factor sub-components (such as investment). While there is a large body of literature on the effects of public debt on capital accumulation and growth in industrialized countries—dating back to Modigliani (1961) and Diamond (1965) on the negative welfare effects of public debt, and Barro (1974) on debt neutrality—the study of public debt and growth in developing economies has mostly happened in the narrower context of external debt. The debt Laffer curve literature à la Sachs (1989) and Husain (1997), and empirical investigations thereof—such as Pattillo, Poirson, and Ricci (2002)—

have all concentrated on the growth impact of “external” debt. Even here, the focus has been the country’s “total” external debt, rather than its publicly owed counterpart.

The lack of interest in formally studying the impact of domestic debt on growth could be attributed, *inter alia*, to (i) data unavailability—reliable datasets on domestic debt either do not exist or are not amenable to empirical analysis; (ii) a wide-spread perception that domestic debt is an “endogenous” variable, not an exogenous policy instrument that governments can tweak to affect macro-financial outcomes: countries’ domestic debt issuance capacity is “determined” entirely by their level of income, pool of savings and level of institutional development; and (iii) the relatively small size of domestic debt relative to external public debt in most developing economies. These factors have, arguably, combined over the years to “crowd out” the amount of attention paid to domestic debt.

But despite this “attention deficit”, policy advice to developing economies on domestic debt has mostly gone one way – i.e. that governments should try to avoid its incurrence. For instance, most programs designed by international financial institutions impose “zero or negative net domestic financing” conditionality, which *de facto* reduces domestic debt as a share of GDP and total debt. This is justified on grounds that most developing economies have shallow financial markets, exhibit fiscal dominance and financial repression propensities, and lack debt management and institutional capacity. Rising domestic debt will, the policy argument goes, either crowd out private investment and/or threaten fiscal sustainability in such circumstances. In addition, given many LICs’ access to cheap external finance, in the form of concessionary loans and grants, domestic borrowing at market rates is seen as expensive. In sum, for policy purposes, domestic debt is seen as negative force for the macro-financial development of developing economies.

However, some researchers have recently begun to echo the positive view of many market participants regarding the importance of domestic debt instruments for monetary and financial systems, as well as the development of political institutions. Compared to other forms of budgetary

finance, market based domestic borrowing is seen to contribute more to macroeconomic stability – low inflation and reduced vulnerability to external real and domestic monetary shocks – private savings generation, and private investment. This seems to be supported by the experience of emerging economies such as China, India, and Chile, which have grown handsomely since the 1990s and avoided major financial or fiscal crises, all while maintaining a relatively high domestic debt share.

Against this backdrop, the essay attempts to throw some empirical light on the possible merits and demerits of domestic debt. It does so by compiling a new domestic debt database, starting in 1975 and covering about 100 developing economies – this database is now fully integrated into the IMF’s “live” Historical Public Debt database (introduced in Abbas et al (2010)) and Mauro et al’s (2013) Public Finance Database. We use panel econometric techniques to examine the endogeneity of domestic debt as well as its impact on growth with a view to obtaining a sense of the optimal size and quality of domestic debt; and present empirically-grounded policy conclusions to guide macro-financial practitioners in developing economies.

Several results from this paper stand out: domestic debt, as a share of GDP and broad money (total banking system deposits), is found to exert a significant positive impact on economic growth, including by raising private sector savings, and increasing the efficiency and volume of investment; seemingly outweighing negative crowding out and bank complacency effects. There is, however, some evidence that, above a ratio of 35 percent of broad money, domestic debt begins to undermine economic growth. Importantly, the calculus on the “optimal” size of domestic debt appears to hinge on its quality: a higher level of indebtedness can be sustained without compromising growth if debt is marketable, bears positive real interest rates, and is issued to the nonbank sector. Finally, the “growth returns” from domestic debt are found to be higher in riskier environments, such as in Sub-Saharan Africa, which seems to support the argument that government securities held on bank balance sheet serve as useful risk insurance against adverse shocks to asset values.

This last finding provides the motivation for the **third and final essay**, which asks the question: “Why do Banks in Developing Economies Hold Government Securities?” for about 600 banks from 70 developing economies over 1995-2005, i.e. the most recent decade in which we had a comparable set of regulatory standards in place across countries (in the form of Basel-I). Although domestic government securities constitute a smaller share of GDP in developing economies than in advanced economies, they traditionally account for a larger share of commercial bank assets and interest income than in advanced economies. Macroeconomic practitioners – consistent with their generally skeptical view of domestic debt – have been wary of these relatively large holdings for two reasons: they signal financial repression and/or contribute to a crowding out of private sector credit.

However, these concerns have subsided somewhat in recent years with enhanced financial liberalisation, fiscal discipline and financial deepening in several developing economies. Attention has thus begun to shift away from the motivations for, and effects of, issuing government securities, to the reasons for holding them. Motivations identified range from “lazy banks” (Hauner, 2006) to the insurance function that government securities serve on banks’ balance sheets when lending is very risky (Kumhof and Tanner, 2005). But the need to meet regulatory requirements (such as central bank prudential requirements for cash and capital adequacy), and plain-vanilla portfolio (risk-return) optimization, could also clearly be at play. The paper takes these hypotheses to the data, using the canonical portfolio optimization framework of the capital asset pricing model (CAPM) as the structural anchor. Importantly, new Bankscope-based series are constructed on banks’ portfolio allocations between government paper and private risk assets, and the corresponding returns: government and private returns.

The casting of banks’ government securities holdings as the outcome of a standard portfolio optimization faces several obvious criticisms, which the paper confronts. First, it could be argued that these holdings are “involuntary” and “risk-free”, so stylized risk-return frameworks cannot apply. Second, even if the holdings were voluntary or risky, the “CAPM” assumptions of perfect

competition and liquidity do not hold in developing economies and especially to their commercial banks. Our analysis – both conceptual and empirical – of these criticisms, suggests that it is not straightforward to dismiss banks’ government securities holdings as riskless or involuntary; nor are CAPM assumptions violated to an extent as to render its predictions useless. Rather, an appropriately-inclusive choice of regressors of interest (and controls) should enable us to reasonably “test” the extent to which banks’ portfolio optimization motives matter or regulatory or other factors dominate.

To provide a robust structural basis to our regressions, we solve several variants of the portfolio-optimization problem, around a basic structure that features three assets: cash (the riskless asset) and two risky assets (government securities and private loans). Corresponding versions of the optimal portfolio share of government securities (λ^*) are generated, keeping in mind important CAPM critiques and the real and nominal nature of returns (a la the discussions in Pyle (1971), Hart and Jaffee (1974), and Freixas and Rochet (1997)). The models give us a structural basis for the regressions of observed on actual portfolio allocations, and provide additional predictions in the presence of regulatory requirements. For instance, the model predicts that banks may respond to forced holdings of the risk-free asset (cash) by increasing their holding of the riskier of the two risky assets (in our case, this turns out to be loans to the private sector), given their objectives to achieve a certain desired risk-return configuration for the aggregate portfolio.

The design of our empirical strategy benefits from the analysis of banks’ portfolio choice of “currencies”, notably by Ize and Levy-Yeyati (2003). All regressions employed banks’ end-2005 portfolio shares of government securities as the dependent variable. The key regressors constituted either the mean-variance parameters of government and private returns, or the optimal λ^* . The regulatory environment, country risk, level of financial development and managerial risk aversion were appropriately controlled for and robustness checked through quantile and TOBIT specifications, by-country regressions, and regressions excluding outliers.

The empirical results suggest that: (i) government securities are taken as risky assets by banks, although they are less risky than banks' private risk assets; (ii) standard minimum-variance portfolio considerations are at least as important as regulatory factors for the determination of banks' portfolio allocations between government and private risk; (iii) higher cash reserve ratios appear to tilt the portfolio away from the low-risk asset (government-securities) toward private loans, while stronger capital requirements prompt intuitively larger government securities holdings; and (iv) the contribution of CAPM factors to portfolio allocation appears to be stronger at higher shares of government securities, indicating the likely dominance of regulatory factors at lower ends of the distribution.

These results potentially connect with a number of important debates in development macroeconomics, such as the importance of bank behavior in monetary policy transmission, the crowding out debate, industrial organization aspects of bank behavior, and intertemporal aspects of fiscal policy and the impact on risk-return structures. The paper elaborates these connections, identifying possible ideas for interesting further research.

BIBLIOGRAPHY

- Abbas, S. M. A., Nazim Belhocine, Asmaa El-Ganainy, and Mark Horton, 2010, "A Historical Public Debt Database," IMF Working Paper 10/245.
- Abbas, S. M. Ali, Jacques Bouhga-Hagbe, Antonio J. Fatás, Paolo Mauro, and Ricardo Velloso, 2011, "Fiscal Policy and the Current Account", *IMF Economic Review*, Vol. 59, No. 4, pp. 603–629.
- Barro, Robert, 1974, "Are Government Bonds Net Wealth?" *The Journal of Political Economy*, 82, 1095-1117.

- Blanchard, Olivier, 1985 "Debt, Deficits, and Finite Horizons," *Journal of Political Economy*, 93(2), 223–247.
- Buiter, Willem, 1988, "Structural and Stabilization Aspects of Fiscal and Financial Policy in the Dependent Economy," *Oxford Economic Papers* 40, pp. 220-245.
- Diamond, Peter, 1965, "National Debt in a Neoclassical Debt Model," *Journal of Political Economy*, 55, 1126-1150.
- Drazen, Allan, and Elhanan Helpman, 1987, "Stabilisation with Exchange Rate Management," *Quarterly Journal of Economics* 102, (November), pp. 835-56.
- _____, 1988, "The Effect of Policy Anticipation on Stabilization Programs," *European Economic Review* (Papers and Proceedings), 32, pp. 680-68.
- Freixas X. and JC Rochet, 1997, *The Microeconomics of Banking*, MIT Press
- Frenkel, Jacob, and Assaf Razin, 1987, *Fiscal Policies and the World Economy*, Cambridge: MIT Press.
- Hart O. and D. Jaffee, 1974, "On the Application of Portfolio Theory to Depository Financial Intermediaries", *The Review of Economic Studies*, Vol. 41, No. 1, pp. 129-147.
- Husain, Aasim, 1997, "Domestic Taxes and the External Debt Laffer Curve," *Economica*, 64, 519-525.
- Hauner, D., 2006, "Fiscal Policy and Financial Development," IMF Working Paper No. 06/26 (Washington: International Monetary Fund).
- Ize, Alain and Eduardo Levy-Yeyati, 2003, "Financial Dollarization", *Journal of International Economics*, Vol. 59, pp. 323-347.
- Kawai, Masahiro and Louis J. Maccini, 1990, "Fiscal Policy, Anticipated Switches in Methods of Finance, and the Effects on the Economy," *International Economic Review*, Vol. 31, No. 4 (November), pp. 913-934.
- _____, 1995, "Twin Deficits versus Unpleasant Fiscal Arithmetic in a Small Open Economy," *Journal of Money, Credit and Banking*, Vol. 27, No. 3 (August), pp. 639-658.

- Kumhof, Michael and Evan Tanner, 2005, “Government Debt: An Essential Role in Financial Intermediation,” IMF Working Paper 05/57 (Washington: International Monetary Fund).
- Mauro, Paolo, Rafael Romeu, Ari Binder and Asad Zaman, 2013, “A Modern History of Fiscal Prudence and Profligacy,” IMF Working Paper 13/5.
- Modigliani, Franco, 1961, “Long-Run Implications of Alternative Fiscal Policies and the Burden of the National Debt,” *Economic Journal*, Dec. 1961, 71, 730-55.
- Pattillo, Catherine, Helene Poirson, and Luca Ricci, 2002, “External Debt and Growth,” IMF Working No. 02/69.
- Sachs, Jeffrey, 1989, “The Debt Overhang of Developing Countries,” In *Debt Stabilization and Development*. Oxford: Basil Blackwell.

ESSAY I

TWIN DEFICITS AND FREE LUNCHES: MACROECONOMIC OUTCOMES IN ANTICIPATION OF FOREIGN AID

ABSTRACT

This first essay concerns itself with situations in which private agents anticipate a future windfall (free lunch) that will help service the debt resulting from a present fiscal expansion (implemented via a temporary tax cut). Such expectations of a windfall can arise in the context of natural resource discoveries or, more interestingly, due to perceptions by agents in “too important to fail” countries that will be bailed out through higher foreign aid or debt relief. We employ an overlapping generations model featuring credit constraints to study the real effects of such free lunch expectations in a small open economy, drawing contrasts with the standard tax and money finance closure rules. The model is solved analytically and shows that anticipated aid is equivalent to current aid when agents have perfect foresight, so that a temporary tax cut is seen as permanent. Accordingly, agents raise their consumption and indebtedness (at the expense of future generations) by an amount that is an increasing function of their “impatience” (subjective rates of time preference plus probability of death). A worsening of the current account obtains (twin deficits) across a range of plausible closure rules, including those featuring money finance. The introduction of credit constrained households (we study the variant where myopic agents spend their current disposable incomes) does not alter the basic result in the case of full aid finance, but does matter for mixed tax-aid regimes, in more complex settings where agent expectations and donor promises on aid diverge, and when governments face borrowing constraints so that the timing of aid delivery matters.

Keywords: Public debt, government finance, government securities, debt sustainability, foreign aid, too-important-to-fail, credit constraints, current account, twin deficit, overlapping generations

JEL Classifications: E21, E62, F32, F34, F35, H60

ESSAY I. TWIN DEFICITS AND FREE LUNCHES: MACROECONOMIC

OUTCOMES IN ANTICIPATION OF FOREIGN AID

Aid leads to a chronic dependency on donors. Because poor countries are dependent on donor handouts they fail to prioritize the generation of domestic resources. This creates a chronic dependency on Aid, stifles creativity and undermines the dignity of people. (Good African)

I. INTRODUCTION AND MOTIVATION

Let us consider a small open emerging or developing economy in which the government runs a temporary debt-financed fiscal deficit (by giving a lump-sum tax cut or raising government transfers). Let us assume that finitely-lived consumption-smoothing private agents have perfect foresight and expect the deficit to be fully closed in the future. Critically, however, let us allow for the possibility that the government's anticipated "closure rule" features not only *painful measures*, such as higher taxes and money finance, but also *painless means*, such as windfall revenue or foreign aid inflows. How will private agents (in particular, consumption and the current account balance) respond under these circumstances? This is the question this paper attempts to answer using an overlapping generations (OLG) model.

To motivate the question, we start from the well-known Ricardian equivalence proposition: i.e. that infinitely-lived forward-looking private agents will offset, one-for-one, any public dissaving (Barro, 1974 is the most popular exposition of the proposition). In other words, when agents have full knowledge of the government's intertemporal budget constraint, a temporary bond-financed tax cut has no impact on demand: the private sector saves the entire tax cut in anticipation of the higher future taxation that would be needed to service the government's interest obligations on debt issued to finance the tax cut.

An important strand of the fiscal policy literature – "twin deficits" can be cast as an implicit rejection of the Ricardian equivalence proposition. The latter states that an increase in net public

dissaving (i.e. an increase in the fiscal deficit) should be fully offset by higher saving by private agents who anticipate higher future taxation by government to service the debt issued to finance the fiscal deficit. Thus, the correlation between the fiscal deficit and net private dissaving is -1 (equivalently, a Ricardian offset ratio of 1), so that the correlation of the fiscal deficit with the current account deficit (which is simply a sum of net public and private dissavings), tends to zero. Clearly then, a Ricardian offset ratio of below 1 implies a twin deficits association: the lower the ratio, the stronger the twin deficits association.

Evidence in support of twin deficits (and thus against Ricardian equivalence) is pervasive, especially in emerging and developing economies. Abbas et al (2011) summarize the generally-strong evidence on twin deficits across a number of studies and, employing vector autoregressions with quarterly government consumption since 1970 for a sample of 30 emerging economies, estimate the current account response to a 1 percent of GDP fiscal shock at 0.54.² Bluedorn and Leigh (2011) find that a 1 percent of GDP fiscal consolidation improves the current account by 0.6-0.8 percent of GDP.³ Direct estimates of Ricardian offset ratios have been in the 0.3-0.5 range, well short of the theory-implied level of 1, but consistent with the above (high) current account response ratios (see Hemming et al, 2002 for a survey).

Theoretical critiques of Ricardian equivalence have centred on finite planning horizons, myopia/bounded rationality, distortionary taxation and liquidity constraints (see Seater, 1993 for a dated, but comprehensive review). These factors drive a wedge between the future and the present, thus undermining the *intertemporal* dimension to decision-making that Ricardian equivalence rests on. The twin deficits literature, however, has, mostly highlighted *intratemporal* factors: government spending raises the relative price of non-tradables (i.e. appreciates the real exchange rate) which, in turn, shrinks tradables production and, hence, opens up a trade deficit. In

² This is equivalent to saying that a 1 percent of GDP fiscal expansion translates into a 0.54 percent of GDP deterioration in the current account.

³ Although this result was obtained for 17 OECD economies, the fact that it has generally been harder to show a strong twin deficits result for advanced economies suggests that the application of a similar methodology to emerging economies would result in even larger coefficients for emerging and developing economies.

a more Keynesian setting, budget deficits raise interest rates, which under open capital accounts, result in currency appreciation and hence a crowding out of net exports. Studies abstracting from relative prices – such as Kawai and Maccini (1995) (see below) – typically do not recover strong twin deficit results.

In this paper, we revert to the original *intertemporal* focus of the Ricardian proposition by analyzing the role of expectations about future government “deficit closure rules”: i.e. the *method* by which a government undertaking a current fiscal expansion expects *to close the deficit in the future* to maintain intertemporal solvency. Specifically, we show that when finitely-lived agents with perfect foresight expect the deficit to be closed (at least in part) via *painless* means, i.e. not just through higher taxes or money finance, but via windfall commodity revenues or foreign aid, their optimal consumption response implies strong non-Ricardian outcomes and, indeed, twin deficits.

The notion of “free lunch”, does not come naturally to economists.⁴ However, we can identify at least two situations in which agents and governments could have a reasonable expectation that such (truly) “painless” means would be available in future:

The first and more straightforward example is that of countries expecting future windfall revenues from the commodity sector. Consider the case of Mexico in the late 1970s, which embarked on a massive borrowing spree just before expanding production in the Gulf of Mexico (Gelb, 1988). More recently, the discovery of oil and/or mineral reserves in Ghana, Mongolia, Tanzania and

⁴ A good example is money finance (seigniorage), which governments are wont to seeing as a relatively painless deficit-reduction tool (compared with taxation), from a political economy perspective. Economists, however, have successfully highlighted the significant costs attached with money finance and inflation, i.e. that it acts as a regressive tax on the poor (as they proportionally hold more cash) and nominal debt holders, and an uncertainty tax on investors and businesses in general. Note that this is true for anticipated inflation. When inflation is unanticipated, the inflation tax is non-distortionary, as shown by Calvo and Guidotti (1993).

Uganda have presented their governments with similar incentives, i.e. to borrow/spend against this future wealth.⁵

The second more intriguing possibility is that of countries that can count on some form of foreign financial assistance package/bailout in difficult times. A number of countries could be argued to fall in this category. Consider the following strategically-important countries:

- Pakistan (a nuclear power) and Ukraine (a key post-Cold War buffer state in Central Europe) have received more than one foreign bailout – often featuring a combination of *preemptive* sovereign debt restructuring and coordinated bilateral and multilateral support (Finger and Mecagni, 2007; and Diaz-Cassou et al, 2008).⁶ In both cases, the restructurings/bailouts were carefully orchestrated to prevent material disruption of economic activity and loss of access to international financial markets.⁷ In particular, the ability of these countries to tap official foreign assistance despite a weak record of IMF program implementation has reinforced perceptions that they are simply “too important to fail” (Dawn, 2011).⁸
- Vietnam (a cautious neighbor of China) has had repeated bouts of overheating (often with double-digit twin deficits) over the last decade, but has been able to

⁵ Ghana’s fiscal deficit shot to almost 10 percent of GDP in 2010 (IMF, 2011).

⁶ Debt restructurings became inevitable as these countries failed to extract the requisite fiscal effort to restore debt sustainability. Whether this failure was due to lack of capacity or lack of willingness is not straightforward to establish. However, the fact that these countries repeatedly ran into off-track IMF programs suggests that lack of political will was at least seen as a contributing factor. Of course, this lack of will is what would precisely be expected in the presence of strong bailout expectations; expectations that appear to have largely been met, given the substantially higher multilateral and bilateral support extended to these countries relative to comparators.

⁷ As noted in Diaz-Cassou et al (2008), Pakistan and Ukraine lost market access for no more than 2-3 years following their *pre-emptive* debt restructurings at the turn of the millennium (see p. 40 for Pakistan, and pp. 62-63 for Ukraine). The ability to regain market access so quickly after the restructurings appears to be linked to the fact that (i) the haircuts imposed on private borrowers were relatively small (8 and 5 percent NPV reduction, respectively, for Pakistan and Ukraine, as noted in Finger and Mecagni, 2007, p. 6), (ii) the share of commercial debt in total public debt was small, and (iii) there was significant relief provided by bilateral and multilateral creditors, including through substantial rescheduling of maturing obligations.

⁸ Pre-“Arab Spring” Egypt, as one of the biggest recipients of U.S. financial assistance over the last three decades, would also constitute a valid example of a strategically important state.

tap timely assistance from international financial institutions (IFIs) and bilateral donors, especially Japan, to remain afloat.

- Georgia (otherwise a small country by population and economic size) secured a 25 percent of GDP financial assistance package from the U.S. in the wake of its 2008 war with Russia (Nichol 2008).
- Mexico (1995) is another case in point: the U.S. Treasury's timely bailout of Mexico through an unconventional \$20 billion advance from the Exchange Stabilization Fund (and followed by substantial IMF support) allegedly reflected the imperative to protect U.S. banks with huge exposures to Mexico at the time of the tequila crisis (Hoskins and Coons, 1995).

As noted in Eichengreen (2000), moral hazard, for both sovereign debtors and private creditors is a natural, albeit undesirable, consequence of such bailouts or extensions of emergency financial assistance. In the case of IMF crisis lending, he argues that the problem applies more generally, i.e. that non-intervention is not a credible option for the Fund if there is a serious perceived risk of the crisis jeopardizing global financial stability and/or impacting the poorest. This connects us with the second large group of countries where strong expectations of future foreign bailouts might be at play: highly indebted poor countries (HIPC) whose debts were halved over the last decade under the Enhanced HIPC and Multilateral Debt Relief Initiatives.

Just as it is impossible for the IMF to stand aside in the face of perceived risks of global financial stability, it is not credible for major bilateral and multilateral donors to commit to reducing aid below a certain floor (by a certain date), lest it jeopardize progress on poverty alleviation. In such a situation, agents in recipient countries could reasonably “anticipate” a continuation of high aid in the future, especially as a backstop against domestic resource shortfalls.⁹

⁹ The specter of large fiscal financing needs re-emerging in post-HIPCs is not hypothetical, given these economies' significant vulnerability to a number of fiscal risks: slower growth, adverse weather and

At the same time, there may be *ceilings* on the quantum of official assistance foreign donors can deliver upfront or “formally” commit to for the future, especially given the post-financial crisis budgetary constraints emerging in several advanced economies. This presents a separate set of issues. For instance, Adam et al (2010) model the optimal central bank response to significant aid-financed spending increases in Sub-Saharan Africa when the long-run sustainability of the underlying aid inflows is suspect, and there are doubts over the government’s capacity or willingness to (adjust expenditures or) raise sufficient non-inflationary taxes to close the implied fiscal gap.

The foregoing suggests that there are plausible circumstances in which private agents’ expectations and behavior about future windfall/aid cannot be ignored. Much of the recent literature on anticipated future windfalls (such as van der Ploeg and Venables, 2011) has, however, focused on the design of optimal *government policy today* – e.g. whether, and how much, to borrow and spend against the future windfall – rather than on *private sector behavior*, per se. A focus on the latter, given knowledge of the future windfall and of the direction of government policy, requires looking at a different class of models, such as the neo-classical regime shift variety that became popular in the 1980s and 1990s. For instance, Frenkel and Razin (1987), Buiter (1988) and Daniel (1993) present OLG models featuring agents endowed with perfect foresight to show the dynamic (and sectoral, in the case of Buiter’s two-good model) effects of a debt-financed fiscal deficit anticipated to be closed in the future by higher taxes.¹⁰

commodity price shocks, conflict, and contingent liabilities arising from the recent surge in public-private partnerships (PPPs) and non-concessional borrowing. Budgetary pressures have already begun to build up: the overall deficit, public debt and external debt rose by about 4, 7 and 10 percent of GDP, respectively, between 2007 and 2011 in the 15 Sub-Saharan African post-HIPCs which reached their Completion Points before 2007.

¹⁰ Buffie (2001) uses a similar approach to analyze the effect of anticipated trade policy regime shifts.

Regime-shift models featuring money and associated seigniorage revenues include Drazen and Helpman (1987, 1988) – although with infinite horizons, their results are constrained to be Barro-Ricardian – and Kawai and Maccini (1990). The latter proffers a more general framework including finite horizons, perfect foresight *and* money, to analyze the impact of fiscal deficits on interest rates and inflation in a closed economy. Kawai and Maccini (1995) modify this framework to one suitable for an *open* economy in order to study the impact of fiscal deficits on the current account. Focusing on net creditor agents, they find that fiscal deficits anticipated to be closed through tax (money) finance induce current account (deficits) surpluses;¹¹ and anticipated distortionary consumption taxes produce a bigger current account deficit (today) than do anticipated non-distortionary taxes.

Building on the Kawai and Maccini (1990, 1995) structure, this paper simulates the dynamic response of optimizing private agents in a small open economy to a temporary fiscal deficit (tax cut), given perfect foresight about future closure rules that feature (non-distortionary) tax and money finance (painful measures), as well as windfall/aid (painless means). Consistent with the notion of a free-luncher/aid-dependent economy (with low domestic private saving rates), our primary focus is on net debtor agents. Abstracting from growth, investment and real exchange rate issues, we are able to derive analytical general solutions for consumption, money balances and the current account as a function of the future deficit closure rule. Critically, we introduce the realistic possibility of credit constrained households and governments which, *inter alia*, enables us to examine the macroeconomic impact of alternate (frontloaded vs. back-loaded) aid delivery strategies..

The rest of this paper is organized as follows. Section II describes the key assumptions and model equations for the base two-regime model without credit constraints. Section III sets out the general solutions for consumption, real money balances and the current account, elucidating their

¹¹ This is their main “twin divergence” result (to borrow terminology from Kim and Roubini, 2003), i.e. a fiscal deficit produces a current account surplus.

macroeconomic intuition using two benchmark closure rules: full tax finance and full money finance, while allowing for the role of upfront aid finance. Section IV focuses on the case of full windfall/aid finance in the future, drawing comparisons with the full tax and money finance cases, and establishing the equivalence of future and upfront aid under perfect foresight. Section V presents the extension of the model with credit constraints. Section VI concludes.

II. MODEL SET-UP

i. General Approach

Our model leverages the framework developed in two papers by Kawai and Maccini (1990, 1995), which we denote by KM90 and KM95, respectively. KM90 is essentially Blanchard's famous closed-economy perpetual youth model of 1985 with one extension: private agents hold money balances in addition to indexed government bonds. This allows the possibility of money finance, non-neutral effects of debt finance, and an analysis of the relationship between deficits, inflation and real interest rates.

KM95 is simply an open economy version of KM90, with the key difference relating to the determination of the real interest rate (which in turn affects the dynamics of consumption vis-à-vis output). In KM90, the real interest rate adjusts in response to changing private wealth to ensure that private consumption continuously equals the national income available after government consumption, i.e. $c - (y_0 - g_0) = 0$.¹² In KM95, the open capital account assumption implies that the real interest rate is fixed at the exogenously given world interest rate. Although consumption is still tied down by

¹² Thus, in KM90, the real interest rate is simply the autarkic version of the conventional model of the current account.

$c - (y_0 - g_0)$, this expression need not be zero: in other words, the constant real interest rate cannot clear the goods markets and so a non-zero current account deficit emerges and is financed by net external borrowing.

It is noteworthy that although money is included in the utility function in both models, its role is relatively passive. For instance, in KM95, the simple Cobb-Douglas specification and the continuous purchasing power parity assumption imply that the price level and nominal exchange rate are isomorphic (inflation = currency depreciation). Given binding transversality conditions on government debt and private bonds – i.e. No-Ponzi-Game rules out debt growing faster than the interest rate – the price level is tied down by the government budget constraint. The latter, in turn, rests on the implicit assumption that the economy is always on the “good side” of the seigniorage Laffer curve.

In sum, the framework seeks to capture the standard public finance setting in which the authorities pursue alternative rules to finance a given level of government spending, choosing (without optimality considerations) between conventional and inflation tax instruments, both of which have well-defined properties but with different distortionary effects at the margin, because of different bases. The key variation is the two-regime structure, which introduces Ricardian considerations: there is a *temporary* (unsustainable) regime in which taxes are cut and public debt is accumulated with fixed spending, followed by a *future* regime, in which the deficit is closed through either tax or money finance. In KM95, a future tax closure rule produces a twin deficit result today (the temporary fiscal deficit is associated with an upward jump in consumption and current account deficit), whereas with future money finance, consumption and the current account jump down, producing twin divergence.

The model below takes the KM95 structure and introduces a third financing source for the government: recourse to (or gift of) foreign aid inflows, i.e. a “free lunch”. It then explores the impact on private sector behavior and macroeconomic outcomes of this free lunch, either offered in full or as part of a closure rule featuring tax and/or money finance.

ii. Model Assumptions

Against the foregoing backdrop, we can formally set out the model’s key assumptions:

- The economy is small and open, and takes both world prices and interest rates as given. With a single good, the constant world price is p_t^* in foreign currency, and the constant world and domestic real interest rate is r_0 . Purchasing power parity (PPP) holds continuously, so that the real exchange rate is fixed at 1. The domestic price level (p_t) equals the nominal exchange rate (s_t) – which is fully flexible – and is determined endogenously.
- The private agents’ utility function is logarithmic, containing both, consumption and real money balances, the latter to reflect the state of the transactions technology. The government impacts agents’ disposable incomes through non-distortionary/lump-sum taxes net of transfers (denoted by τ_t), but non-transfer government spending (denoted by g_t) does not enter their utility functions.
- The OLG specification follows the perpetual youth model of Yaari (1965) and Blanchard (1985) with agents facing a non-zero constant probability of death θ (horizon = $1/\theta$, so that $\theta = 0$ implies infinite horizons). We abstract from bequests (intended or unintended).

- Agents have perfect foresight, so that, inter alia, the timing and nature of all future government policies are fully known in advance, and expected inflation equals actual inflation.
- There are no firms, and thus no capital accumulation or growth. The population is normalised to 1 and is stationary, i.e. the birth rate equals the death rate.
- Financial wealth is assumed to be held by consumers as either real money or bonds. The base model abstracts from capital market imperfections, exchange controls, and real exchange rate issues. Thus there is perfect substitutability between domestic and foreign assets (and liabilities) – the equivalent of saying that interest parity holds continuously and for both government and the private sector.
- In an extension of the base model (presented in section V), we allow for credit constrained households and governments, which are likely to be important in many emerging and developing economies.

Given substantial differences across the various types of free-luncher or aid-reliant economies identified earlier, the above set of assumptions – invoked inevitably for reasons of model tractability – cannot proffer a perfect fit for any individual country. For instance, the impact of non-transfer government spending on growth and private utility – assumed to be zero in this model – could vary significantly by type of spending and across institutional environments (see for example, Adam and Bevan, 2005 and Arslanalp et al, 2010). The abstraction from distortionary taxation and its impact on, say, labor supply, appears palatable for low-income economies (where direct taxes account for less than 5 percent of GDP) and emerging economies

like Pakistan and Mexico (which have generally low tax/GDP ratios), but perhaps not for Ukraine, where such taxes exceed 20 percent of GDP (World Bank, 2008: 243-245).¹³

We hope that future extensions of the model presented here will usefully sharpen the framework to fit individual country characteristics. However, it is also worth mentioning that the world isn't quite so neatly divided into free-luncher and non-free-luncher economies: most economies can expect "some" free-lunch during their "lifetime" just as no country can expect a "full" free lunch at any time.

iii. Model Equations

We now proceed with setting up the aggregate behavioural equations for the economy, taking the case of a government starting with negligible debt and introducing a temporary tax cut to be closed later through a combination of painful and painless means. In this base model, we assume agents are not credit constrained.

Each individual born at time s maximises:

$$\int_t^\infty (\ln c_u^s + \beta \ln m_u^s) e^{-(\rho+\theta)(u-t)} du \quad s.t. \frac{dv_u^s}{du} = (\theta + r_0)v_u^s - i_u m_u^s + y_u^s - \tau_u^s - c_u^s, \text{ where } v_u^s = m_u^s + b_u^s,$$

c_u^s , m_u^s , b_u^s and v_u^s are the consumption, real money balances, real bond-holdings and real financial wealth for time u of an individual born at time s .¹⁴ ρ is the subjective rate of time preference; θ is the instantaneous probability of death (which is constant through the lifetime in this "perpetual youth" formulation of finite lives); $\beta > 0$; r_0 is the fixed real interest rate and i_u its

¹³ The other assumptions (single good, flexible exchange rates, continuous PPP and fixed output) also constitute nontrivial abstractions from reality, but seem acceptable given our focus on intertemporal (rather than intratemporal) issues. On flexible exchange rates, it is true that a number of emerging market crises were rooted in unsustainable pegs, but overwhelmingly, and especially over longer time periods, exchange rate flexibility appears would constitute a safe assumption for emerging and developing economies.

¹⁴ In the same notation, h_u^s is the present discounted value of the stream of future disposable incomes $(y-\tau)$.

nominal counterpart at time u and dependent on inflation π_u ; τ_u^s is the non-distortionary lump-sum tax (net of transfers) collected by the government.¹⁵ The Cobb-Douglas/logarithmic form of the utility function implies that agents allocate a share $1/(1+\beta)$ of available resources to consumption of goods and services, and share $\beta/(1+\beta)$ to “consumption” (holding) of real money balances. A priori, therefore, β would not be expected to be large.

Solving the resultant Hamiltonian, and aggregating over s (with population normalized at 1) yields the equations characterising aggregate and per capita behavior, where a dot above a variable denotes its differential with respect to time:

$$c_t = \frac{\rho + \theta}{1 + \beta} (v_t + h_t) \dots\dots\dots (1)$$

$$m_t = \frac{\beta c_t}{i_t} \dots\dots\dots (2)$$

$$\text{where } m_t = M_t / p_t; \quad i_t = r_0 + \pi_t; \quad \text{and } \pi_t = \frac{\dot{p}_t}{p_t}$$

$$v_t = m_t + b_t \dots\dots\dots (3)$$

$$\dot{v}_t = r_0 v_t + y_t - \tau_t - c_t - i_t m_t \dots\dots\dots (4)$$

$$\dot{h}_t = (r_0 + \theta) h_t - (y_t - \tau_t) \dots\dots\dots (5)$$

$$y_t = y_0 \dots\dots\dots (6)$$

Equation (1) relates consumption to a fixed share of human and non-human wealth, which follows from the logarithmic specification of the utility function. The latter also drives the form

¹⁵ Note that the integrating the flow budget constraint (described by $\frac{dv_u^s}{du}$) yields the individual's

intertemporal budget constraint : $\int_t^\infty (c_u^s + i_u m_u^s) e^{-(r_0 + \theta)(u-t)} du = h_t^s + v_t^s$, which simply states that the present value (PV) of lifetime consumption and the opportunity cost of money holdings equals the PV of total wealth, where h_t^s is *human* wealth (PV of lifetime disposable incomes); and v_t^s is *financial* wealth (subject to the usual no-Ponzi scheme condition: $\lim_{u \rightarrow \infty} v_u^s e^{-(r_0 + \theta)(u-t)} = 0$ to ensure solvency).

of the money demand relationship (2).¹⁶ Finally, equations (4) and (5) are the accumulation equations for financial wealth and human wealth, and (6) is the fixed output condition.

Two noteworthy points about the money demand function: (i) the logarithmic utility function implies a unit elasticity of substitution between consumption and real money balances, and a -1 interest elasticity of money demand; and (ii) m (or its nominal counterpart M) lends itself to a reserve money interpretation, given that it is the base for seigniorage revenues.

We now turn to a characterisation of the government's budget constraint, where, of course we depart from Kawai and Maccini (1995).

The government issues real bonds z_t (domestic or foreign), collects seigniorage revenues $\dot{M}_t/p_t$, raises lump-sum taxes τ_t (net of transfer payments) and receives windfall revenues or foreign aid (a_t). Note that a_t is defined in “above-the-line” terms, both for the fiscal and current account balance. This, of course, follows naturally in the case of commodity “revenues”. For aid inflows or bailouts, the reality is more complex, as these usually come in packages of grants and concessional loans. For simplicity, and to maintain focus on the “free-lunch” aspect of a_t , we assume that these packages are grant-only, i.e. any loans have 100 percent grant element. Finally to keep the parlance simple, from now on, we use the term “aid” only (dropping the word windfall) to connote the free lunch or painless means of finance.¹⁷

Combined, these four sources of funding help finance interest payments on debt and a fixed level of non-transfer government expenditures, g_0 – see (7) below. By setting government spending as constant throughout, we implicitly assume that budget deficits result primarily from policy-induced changes in the level of taxes (net of transfers).

¹⁶ The money demand function obtains by combining (i) $H_c=0$: $\lambda=1/c$; and (ii) $H_m=0$: $\lambda i=\beta/m$, where the H_c and H_m represent the derivatives of the Hamiltonian with respect to consumption and money balances.

¹⁷ As the political economy of commodity windfalls and aid inflows is quite different, there would be some loss of generality here. However, the focus of this and the next section of the paper is largely the macroeconomic response (abstracting from other considerations).

$$\dot{z}_t + \frac{\dot{M}_t}{p_t} + \tau_t + a_t = r_0 z_t + g_0 \quad \dots\dots\dots (7)$$

Note that seigniorage revenues $\dot{M}_t / p_t$ can be expressed equivalently as: $\mu_t m_t$, where $\mu_t =$

$\dot{M}_t / M_t$ the rate of nominal money growth; and as $\dot{m}_t + m_t \pi_t$: the sum of (a) the change in real money balances, and (b) the product of real money balances and the inflation rate (i.e. the inflation tax). Equating the two expressions yields the rate of real money growth in terms of the nominal money growth rate and the inflation rate:

$$\dot{m}_t = (\mu_t - \pi_t) m_t \quad \dots\dots\dots (8)$$

The model can be reduced to a system of four differential equations (9)-(11), by noting that (1), (3), (4) and (5) yield **(9)**; (2) and (8) yield **(11)**; and (4), (6), (7) and (8) yield **(10)** and **(12)**:

$$\dot{c}_t = (r_0 - \rho) c_t - \frac{\theta(\rho + \theta)}{1 + \beta} (m_t + b_t) \quad \dots\dots\dots (9)$$

$$\dot{b}_t = r_0 b_t + y_0 - \tau_t - c_t - \mu_t m_t \quad \dots\dots\dots (10)$$

$$\dot{m}_t = (r_0 + \mu_t) m_t - \beta c_t \quad \dots\dots\dots (11)$$

$$\dot{z}_t = r_0 z_t + g_0 - \tau_t - a_t - \mu_t m_t \quad \dots\dots\dots (12)$$

Finally, the current account balance (x_t) is given by the instantaneous change in net foreign assets ($b_t - z_t$), or equivalently, the difference between national income and domestic demand. This must always obey the economy-wide resource constraint, i.e. that the current account equals the excess supply of goods. The supply of goods is simply the given real output y_0 , the interest earned on net foreign assets and the aid inflow. The demand for goods is given by the sum of private and government consumption.

$$x_t = \dot{b}_t - \dot{z}_t = [y_0 + r_0(b_t - z_t) + a_t] - (c_t + g_0) \quad \dots (13)$$

Note that (9)-(12) is a system of *four* linear differential equations in four endogenous variables c , b , m and z . To solve the system, we need to specify the time paths for the policy variables: τ , μ and a , which brings us to the two fiscal regimes.

iv. The Two Fiscal Regimes

We assume that the economy starts from an initial steady state – detailed in Appendix A – where public debt and the fiscal deficit are exactly zero, and the three policy variables take the values τ_0 , μ_0 , and a_0 . We assume that $\mu_0 = 0$ – i.e. there is no nominal money growth initially – and that this “zero growth rate” is maintained until the final closure rules kick in (at time T).¹⁸ As noted by Kawai and Maccini (1995), this assumption simplifies the algebra significantly, as by setting the μ, m_t term to zero, the dynamic equation for public debt (12) self-solves, leaving a more tractable system of *three* differential equations (9)-(11) in c , b and m .

The policy sequence involves two regimes. In the first regime ($0 < t < T$), the government implements a debt-financed tax cut ($\tau_0 - \tau_1$) at time 0. We do allow for the possibility of a *current* free lunch, i.e. a higher level of aid during the period 0 to T , which attenuates the deficit and debt increasing impact of the tax cut.¹⁹ Denoting this higher level of aid as a_1 (where $a_1 > a_0$) and the share of the tax cut offset by the increase in a as $\alpha [= (a_1 - a_0) / (\tau_0 - \tau_1)]$, where $0 < \alpha < 1$, $(1 - \alpha)(\tau_0 - \tau_1)$ represents the deficit-increasing portion of the tax cut which has to be covered subsequently through higher taxes, money finance or aid in the *future*. In the next section, we will develop more intuition around α , noting that under perfect foresight, future and present free lunches are identical in the absence of credit constraints.

¹⁸ $\mu_0 = 0$ implies (from (8)) that, in the initial steady data, there is no inflation (as $\dot{m}_t = 0$), and hence, no seigniorage revenues. A zero rate of nominal money growth in the period after 0, however, does not imply zero inflation and nil seigniorage revenues, as m_t is not static.

¹⁹ This could be construed as the equivalent of a small inflow of windfall revenues in the early years of oil production, or an interim scaling up of foreign aid (to soften the deficit impact of donor-demanded increases in social transfers) as occurred to HIPC's in the early 2000s.

The implied expressions for deficit and debt at T - (i.e. just before hitting T) are:

$$\bar{d} = r_0 z_T + g_0 - \tau_1 - a_1 \dots \dots \dots \text{ and } z_T = z_0 + \frac{(1-\alpha)(\tau_0 - \tau_1)}{r_0} [e^{r_0 T} - 1]$$

where $z_0 = \frac{\tau_0 + a_0 - g_0}{r_0}$. Assuming, for simplicity, $z_0 = 0$, i.e. initial public debt and deficit

equal to zero, we have:

$$\bar{d} = (1-\alpha)(\tau_0 - \tau_1)e^{r_0 T} \dots \dots \dots (15)$$

$$z_T = \frac{(1-\alpha)(\tau_0 - \tau_1)}{r_0} [e^{r_0 T} - 1] \dots \dots \dots (16)$$

It is clear that as T (the length of the tax cut) increases, fiscal deficits and public debt grow without limit. The private sector, which has full knowledge of the government's inter-temporal budget constraint, therefore, deems the tax cut to be temporary and the regime to be “unstable”, anticipating its closure through some combination of higher taxes, money finance, or aid, in a “stable” regime starting at time T .

This second regime ($t \geq T$) is characterized by the private sector equations (9)-(11), combined with the policy behavior during this period implied by:

$$\tau_t = \tau_1 + n_1 \bar{d} \dots \dots \dots (17)$$

$$\mu_t m_t = n_2 \bar{d} \dots \dots \dots (18)$$

$$a_t = a_1 + n_3 \bar{d} \dots \dots \dots (19)$$

Since the private sector has perfect foresight, it knows at time 0 the values of n_1 , n_2 and n_3 (the contributions, respectively, of tax finance, money finance and aid to closing the deficit $\bar{d}$) and that $n_1 + n_2 + n_3 = 1$. With the deficit fully closed from T onward, debt stabilizes at z_T . The three main variables (c , b and m) converge gradually to their final steady state levels as $t \rightarrow \infty$.

Note that the combined future resources (from tax, money or aid finance) have to be higher than their combined initial (steady-state) level, as interest payments on the debt created from the temporary tax cut *also* have to be covered. Thus, when $n_I=1$ (full tax finance in future), the level of future taxes in (17) will not just need to be higher than τ_I , but also τ_0 . Also, the level of taxes and aid prevailing from T onward will exactly equal their final steady state levels, as τ_I , n_I , a_I , n_3 and $\bar{d}$ are all known constants at $t=T$. For money finance, however, μ_t will adjust to its final steady state level only when m_t has adjusted to its final steady state level (it is the product, rather than individual levels, of μ_t and m_t that has to equal $n_2 \bar{d}$ throughout $t \geq T$).

In the next section, we set out the general solutions for c , b , m , z and x , as functions of the model parameters and, critically, the anticipated closure rule shares: n_I (tax finance), n_2 (money finance) and n_3 (aid finance). We then illustrate the paths for two benchmark/polar cases: full tax finance and full money finance.

III. GENERAL SOLUTION FOR BENCHMARK CASES OF TAX AND MONEY FINANCE

Using the basic equations (9)-(12) and the policy sequence during the two regimes, we can solve the model backward, as is standard in perfect foresight/regime shift models. We first obtain the dynamic equations and final steady states governing the (saddle-path) “stable” regime ($t \geq T$).

Then, utilizing the boundary conditions for c and m at T , we solve for the “unstable” regime ($0 < t < T$). These boundary conditions arise from the *continuity* of consumption and real balances at time T ($c_{T-} = c_{T+}$; $m_{T-} = m_{T+}$), which follows from the assumption of perfect foresight. The continuity of c and m at time T , moreover, implies that these variables are free to jump at time 0 in response to the tax cut, with the size and sign of the jump depending, inter alia, on the form of the anticipated closure rule at time T . Appendix A sets out the detailed solution procedure, beginning with the derivation of the initial and final *steady states*, followed by the *general solutions* for the two regimes, and concluding with expressions for the *initial jumps* and the *dynamic adjustment paths*.

Before illustrating the general solutions for the cases of anticipated tax and money finance, it is useful to develop more intuition regarding model parameters, steady states and jump behaviors derived in Appendix A.

1. Basic intuition of the general solution

We start with γ , the key model parameter determining the initial steady states for consumption

$$(c_0 = \gamma(y_0 - \tau_0)), \text{ and money balances } (m_0 = \beta\gamma(y_0 - \tau_0)/r_0). \quad \gamma = \frac{\theta(\rho + \theta)}{(1 + \beta)(\rho + \theta - r_0)(r_0 + \theta)}. \quad \text{A}$$

positive γ is required to ensure positive initial consumption and real money balances. As θ (instantaneous probability of death), ρ (subjective rate of discount), β (coefficient on money in utility function) and r_0 (real interest rate) are all positive, fulfillment of $\gamma > 0$ rests on $\rho + \theta - r_0 > 0$. As noted in Appendix A, this is simply the condition to ensure the system is dynamically stable.

Next, note from the c_0 expression that γ is the consumption (or absorption) share of permanent disposable income. Only if agents are net bondholders and in receipt of interest income can this share exceed 1. This is indeed confirmed by the expression for initial private bondholding:

$$b_0 = \frac{\gamma - 1}{r_0}(y_0 - \tau_0) \quad ; \text{ if } \gamma \text{ is less (greater) than } 1, \text{ private agents start off as net debtors}$$

(creditors). As most emerging and developing economies are capital importers (net debtors) – especially the free-luncher variety being studied here – an assumption of $\gamma < 1$ would seem appropriate. It can be shown that (given positive β and θ) a sufficient condition for $\gamma < 1$ is $\rho > r_0$, i.e. that agents' subjective rate of time preference exceeds the (objective) real interest rate.²⁰ Note that it is possible for γ to be less than 1 even when $\rho < r_0$, although this translates into a very

²⁰ To see this, note that $\gamma = q/(1 + \beta)$, where $q = \theta(\theta + \rho)/[(\theta + \rho - r_0)(r_0 + \theta)]$. As $\beta > 0$, $q < 1$ is a sufficient condition for $\gamma < 1$. Some algebra steps simplify $q < 1$ as $\rho > r_0$.

narrow range for r_0 above ρ .²¹ To keep things simple, we abstract from this possibility, so that the expressions $\rho < r_0 \Leftrightarrow \gamma > 1$ and $\rho > r_0 \Leftrightarrow \gamma < 1$ are used interchangeably in this paper.

Having developed some intuition around γ it is useful to see how it varies with its constituent parameters. It is straightforward to show that (i) $\partial\gamma/\partial\rho < 0$; (ii) $\partial\gamma/\partial\beta < 0$; (iii) $\text{sign}(\partial\gamma/\partial r_0) = \text{sign}(2r_0 - \rho)$; and (iv) $\text{sign}(\partial\gamma/\partial\theta) = \text{sign}(\rho - r_0)$. The intuition of (i) is that greater impatience to consume would inevitably translate into higher steady state net indebtedness (and consequently lower steady state consumption). (ii) captures the fact that if agents wish to hold larger money balances (say, for transactions purposes) they will need to borrow more resources, which will subsequently translate into higher net indebtedness and lower consumption in the steady state. (iii) indicates that when agents are very highly indebted (γ well below 1, and $\rho > 2r_0$), an increase in r_0 will actually worsen their indebtedness: the adverse impact on net bondholdings of higher debt service costs (due to higher r_0) outweighs the positive impact on net bondholdings of the saving response to a higher r_0 . (iv) implies that an increase in θ (which is equivalent to a shortening of agent horizons) serves to dampen the relative impatience or patience of agents (and always pushes γ toward 1): as agent horizon shortens, myopia dominates intertemporal considerations, and consumption converges on current disposable income.

Note that a realistic range for β – the coefficient on (log) real money holdings in the utility function – can be derived from the initial steady state level of $m_0 (= \beta c_0 / r_0)$. As documented in Baldini and Poplawski-Ribeiro (2011), reserve money has typically averaged around 10-20 percent of GDP in a number of African economies over the past three decades; ratios for other emerging and developing economies are not very different. Given that private absorption in aid-

²¹ With some algebra, $\gamma < 1$ can be re-expressed as $r_0 - \rho < \theta / [1 + r_0 / (\beta(\theta + r_0))]$. Plausible values for β (0.025; see next footnote) and θ (0.03) imply that $r_0 - \rho$ cannot exceed 9 basis points, or, equivalently, that if r_0 is 10 percent, ρ cannot be smaller than 9.91 percent.

receiving developing economies was about three-fourth of GDP over the last decade, a 10 percent real interest rate would imply a β of about 0.025.²²

For numerical illustrations, therefore, we use the following baseline calibration: $\beta = 0.025$, $\rho = 10.25$ percent, $r_0 = 10$ percent and $\theta = 0.03$, which translate into $\gamma = 0.92$.²³ Note that this implies (as per (A2)) initial private net indebtedness of about 80 percent of disposable income, which is within the range of observed private external debt ratios in market access emerging economies over the last decade. While we do not illustrate results for $\rho < r_0$ – which can be found in Kawai and Maccini (1995) – we do draw contrasts between the two cases, as appropriate.

The economy's *final steady states* ($\bar{c}$, $\bar{b}$ and $\bar{m}$) also depend on γ , but there are two additional determinants: the size of the deficit to be closed ($\bar{d} = (1 - \alpha)(\tau_0 - \tau_1)e^{r_0 T}$), and the closure rule: i.e. the proportions of n_1 (tax finance), n_2 (money finance) and n_3 (aid finance). Specifically, for a given deficit $\bar{d}$ the n 's determine the final steady state level of the policy variables $\bar{\tau}$, $\bar{\mu}$ and $\bar{a}$ which, in turn, determine $\bar{c}$, $\bar{b}$ and $\bar{m}$.

Last, but not least, we look at *initial jumps*. As noted earlier and in Appendix A, with two unstable roots in the 3-variable c - b - m system characterized by (9)-(11), two of the variables should be free to jump at time 0 so that they are continuous at T . Private bondholdings are, by definition, backward looking, so cannot serve as the jump variable. Consumption and money balances, therefore, do the necessary jumping (☺) at time 0,

²² Note that broad money averaged around 50 percent of GDP in emerging and developing economies during 2006-10, so that if m were defined as broad money (instead of reserve money), the implied value of β would be around 0.1.

²³ IFI debt sustainability analyses for developing economies typically assume a dollar discount rate of 10 percent (when calculating the present value of external debt), which is a reasonable proxy for the real interest rate from the recipient country's perspective. The assumption of $\theta = 0.03$ implies a planning horizon of about 33 years, which is the approximate working adult life span in most aid-receiving developing economies.

which is mirrored, respectively, in jumps in the opposite direction in the current account (x), and prices (p) – see (A25)-(A27).

The *sizes* of the jumps are proportional to the tax cut and, in the case of consumption, also to $\frac{(\theta + \rho)}{(\theta + r_0)}$. If $\rho > r_0$, i.e. agents value current utility more than future utility, this factor exceeds 1 and thus the jump in response to a given tax cut is bigger, which is intuitive. The direction of the jumps depends on the closure rules, as discussed below. Note, that bigger upfront aid, i.e. a higher α (share of tax cut financed by current aid increase) always pushes consumption in the upward direction (i.e. makes upward jumps bigger and downward jumps smaller).²⁴

We now describe the general solution for the two benchmark cases of pure tax and money finance. Note that, in the parlance of this paper, these cases correspond to expectations of no future increase in aid.

ii. Full tax finance in future ($n_I=1$)

Figure 1 traces out the adjustment paths for c , b , m , current account (x), government debt (z), net external assets ($b-z$) and total financial wealth ($m+b$) for the case when the tax cut initiated at time 0 (and the associated fiscal deficit) is anticipated to be closed fully through higher lumpsum taxation from T onward. Expectedly, we find that consumption jumps up at time 0 as agents spend out of the higher human (and overall) wealth due to the tax cut: with finite horizons, the higher stream of disposable incomes between 0 and T has a larger (positive) effect on lifetime wealth than the (negative) effect of the lower

²⁴ Formally, $\partial(c_{0+} - c_0)/\partial\alpha > 0$ when either n_1 or n_2 equals 1, and exactly zero when $n_3=0$.

stream of disposable incomes anticipated after T . The expression for the jump in

consumption simplifies to: $c_{0+} - c_0 = \frac{(\theta + \rho)}{(\theta + r_0)} \frac{1}{1 + \beta} \left\{ 1 - (1 - \alpha)e^{-\theta T} + \beta \alpha \left(1 + \frac{\theta}{r_0} \right) \right\} (\tau_0 - \tau_1)$

With $\theta = 0$ (infinite horizons) and $\alpha=0$ (no upfront aid), the $\{.\}$ term is exactly zero, implying consumption would not jump at all. For a $\theta>0$, an upward (jump?) emerges, as $1 - e^{-\theta T}$ is always positive. Note that θT is simply the duration of the tax cut as a *proportion* of agent horizon ($1/\theta$). The longer the duration of the tax cut relative to agents' horizons, the bigger the upward jump in consumption. When $T \rightarrow \infty$ (i.e. the tax cut is permanent), and assuming $\alpha=0$, the jump in consumption equals $k^*(\text{tax cut})$, where k is a standard “consumption tilting” constant (for $\beta = 0$, and $r_0 = \rho$, $k=1$).

For the calibrated parameter values noted above, the jump in consumption is only about 14 percent of the size of the tax cut when $T=5$, and 25 percent when $T=10$. As the jump in consumption is mirrored exactly in the current account, this implies a fairly small “twin deficits” coefficient: a tax cut of 1 percent of GDP worsens the current account by about 0.2 percent of GDP. Note, however, that a positive α can significantly strengthen the on-impact response of consumption and the current account (excluding aid). Illustratively, with $\alpha=0.2$, the magnitude of the jump as a share of the tax cut or, equivalently, the twin deficits coefficient, would rise to 0.32 when $T=5$, and to 0.41 when $T=10$.

Unlike consumption and the current account, real money balances and prices remain unchanged at $t=0$, although the jump in consumption induces a steady rate of inflation

that gradually reduces real balances from $t=0+$ onward, even beyond T .²⁵ Despite real balances falling, total financial wealth increases between 0 and T , as agents accumulate government bonds issued to finance the tax cut. Beyond T , however, both human wealth and financial wealth fall, the latter reflecting the continued fall in money balances without an offsetting increase in bondholdings. The resulting decline in total wealth drives the decline in consumption beyond T . Finally, the downward jump and subsequent deterioration in the current account produces a worsening in net external assets from $t=0+$ onward, initially at an increasing rate, but then at a reducing rate, as consumption moderates ahead of the eventual tax increase at T .

Note that consumption begins to decline immediately after the initial upward jump despite the increase in financial wealth between 0 and T . This is because forward-looking agents anticipate the future increase in taxes and start adjusting immediately to ensure consumption remains smooth at T as it declines toward a lower final steady state level beyond T .²⁶ This result differs slightly from Kawai and Maccini (1995) who, for $r_0 > p$, find a hump shaped consumption path between 0 and T (i.e. consumption *rises* after the initial jump before beginning to fall ahead of T).²⁷ The intuition of the result lies in the size of the initial jump, which is much larger when $r_0 < p$ (than when $r_0 > p$). The further up consumption is from its final steady state, the earlier it must begin to decline/adjust toward it.

²⁵ The fact that money balances do not jump down (and prices do not jump up) at time 0 when future tax finance is anticipated (n_I is missing from (A26)) follows from the logarithmic form of the utility function.

²⁶ Formally, it can be shown – using the general solution of c_t (evaluated at $n_I=1$) – that the sign of $\dot{c}$ is unambiguously negative at $t=0+$ if $\gamma > (\rho + \theta - r_0)(\rho + \theta)$. This condition holds for reasonable parameter values.

²⁷ For the case of $r_0 > p$, $\dot{c}$ can be positive at $t=0$ under plausible parameter values. However, as t increases, $\dot{c}$ turns negative and it does so well before $t=T$ to ensure consumption is continuous $t=T$ and declining at a moderating rate toward its steady state level beyond T .

Finally, expressions for the final steady states are:

$$\bar{c} = c_0 + \gamma(\tau_0 - \tau_1)(1 - (1 - \alpha)e^{r_0 T}), \quad \bar{b} = b_0 + (\gamma - 1)\frac{\tau_0 - \tau_1}{r_0} [1 - (1 - \alpha)e^{r_0 T}], \quad \bar{m} = m_0 + \beta\gamma\frac{\tau_0 - \tau_1}{r_0} [1 - (1 - \alpha)e^{r_0 T}]$$

Note that $\bar{c} < c_0$, i.e. final steady state consumption is below the initial steady state level; the condition for this, $1 < (1 - \alpha)e^{r_0 T}$, should normally hold for low α .²⁸ Quantitatively, when $\alpha=0$, a temporary tax cut of 3 percent of GDP for 5 (10) years, will imply aggregate consumption for later generations that is 1½ (4) percent of GDP lower than that for earlier generations (recall that c_0 was 60 percent of GDP). Moreover, a closer look at (A6)-(A8) confirms that $\bar{c}$, $\bar{b}$ and $\bar{m}$ are all increasing in γ as long as $y_0 - \tau_1 - n_1 \bar{d} > 0$, which is true for plausible levels of $\bar{d}$. Thus, the more impatient agents are today (the smaller γ is), the lower will be the final steady-state consumption (inherited by future generations).

This intergenerational *inequity*, a standard feature of finite horizon models, has been a particular bone of contention in the literature on optimal fiscal policy design for resource-rich countries (see for example, Budina and van Wijnbergen, 2011). The benchmark permanent income hypothesis (PIH) model would argue that current government spending should only go up by the amount of “permanent income” increase implied by the oil wealth. The counter view (articulated by Collier et al, 2010) is that higher “productive” government spending can help convert underground assets into aboveground assets (infrastructure, physical capital, human capital) with returns accruing disproportionately to future generations.

The calculus on final vs. initial steady states for real money supply is similar to that for consumption. For bondholdings, however, $(\gamma - 1)$ serves as an additional wedge. For $\alpha = 0$,

²⁸ Illustratively, for $r_0=0.1$ and $T=5$ (10) years, α must be greater than 0.39 (0.63) to violate the condition.

$\bar{b} - b_0$ is positive when $\gamma < 1$, negative when $\gamma > 1$, and zero when $\gamma = 1$. The intuition of this result follows from the fact that consumption settles into a lower steady state level when $\gamma < 1$ (than when $\gamma > 1$), which implies a more gradual erosion of net bondholding beyond T .

iii. Full money finance in future ($n_2=1$)

As Figure 2 shows, real money balances fall on impact (at $t=0$) under expectations of full money financing. The anticipated increase in prices associated with higher future money issuance (from T onward) is brought forward to the present through perfect foresight, causing prices to jump up today. With nominal balances unchanged, m jumps at time 0 by

$$\frac{\beta\alpha - (1-\alpha)}{r_0}(\tau_0 - \tau_1) \text{ which, when } \alpha = 0, \text{ is unambiguously negative.}$$

The size of the jump is independent of γ and corresponds, intuitively, to the perpetuity value of the now-permanent tax cut that has to be paid for by higher money financing. The associated downward jump in financial wealth (given fixed bond holdings) is bigger than the increase in human wealth arising from the tax cut, causing consumption to jump down and the current account to jump up. Thus, even with our $\gamma < 1$ assumption, the twin divergence result – a fiscal deficit leading to a current account surplus – of Kawai and Maccini (1995) does emerge.

However, the result is fragile. First, a full money finance closure rule seems implausible unless the tax cut is miniscule. Seigniorage revenues in a number of African economies were estimated at about 1-2 percent of GDP by Baldini and Poplawski-Ribeiro (2011).²⁹

²⁹ This contrasts somewhat with the much higher levels of seigniorage revenues recently earned on major world currencies (dollar, pound, yen, euro) as well as evidence that the large post-war debt reductions in
(continued)

The figures for other emerging and developing economies – or any reserve currency – are unlikely to be very different. In the context of our model, this means that a tax cut of 0.5 (1) percent of GDP – if closed only through money financing – will wipe out one-third (two-third) of reserve money at $t=0$.³⁰ It is unlikely, therefore, for closure rules relying predominantly on money financing to be perceived as credible if the initial fiscal expansion is larger than 1 percent of GDP.

Second, the size of the downward jump is small, and can be overturned in the presence of small initial upfront aid. To see this, consider the expression for the jump in consumption,

as per (A25), for $n_2=1$: $\left[1 + \frac{(\rho - r_0)}{(\theta + r_0)}\right] \left\{ \frac{r_0 - [1 - \alpha(1 + \beta)](r_0 + \theta)}{r_0(1 + \beta)} \right\} (\tau_0 - \tau_1)$. When $\alpha >$

$\frac{\theta}{(1 + \beta)(r_0 + \theta)}$ ($\leftrightarrow \alpha > 0.22$, for the aforementioned parameter values), the $\{ \}$ term

positive so that consumption jumps *up*, and the current account (excluding aid) jumps *down*, producing twin *deficits*. Moreover, the $[\]$ term amplifies the size of the downward jump in the current account, further strengthening the twin deficits result. The bottomline is that where tax cuts (or social transfer increases) are accompanied by some upfront “free lunch”, the twin divergence result – otherwise obtained for the case of full money finance – disappears.

We now turn to the adjustment paths. Beyond $t=0+$ (and till $T-$), the combination of low consumption and government bond issuance (to finance the tax cut) drives a surge in private bondholdings and financial wealth (even though money balances continue to fall till $T-$ due to rising inflation). Beyond T , the decline in real money balances halts as

advanced economies were driven primarily by a steady dose of inflation and financial repression, along with a seigniorage on long-term local currency domestic debt (see Reinhart and Sbrancia, 2011).

³⁰ As can be seen from (A26), the downward jump in real money balances is sized at $\frac{\tau_0 - \tau_1}{r_0}$.

inflation begins to moderate toward the growth rate of nominal money (this helps generate the inflation taxes $\bar{\mu}\bar{m}$), while consumption rises toward its higher-than initial final steady state level.³¹ The current account remains in surplus (although falling gradually) causing net external assets to rise at a diminishing rate.

Formally, the final steady states are given by: $\bar{m} = m_0 + \frac{\tau_0 - \tau_1}{r_0} [\beta\gamma - (1 - \alpha)e^{r_0 T}]$;

$\bar{c} = c_0 + \gamma(\tau_0 - \tau_1)$; and $\bar{b} = b_0 + \frac{\tau_0 - \tau_1}{r_0} [(\gamma - 1) + (1 - \alpha)e^{r_0 T}]$. Theoretically, money balances

can end up in a higher steady state than m_0 when $\beta\gamma - (1 - \alpha)e^{r_0 T} > 0$, i.e. when the net utility from higher money holdings is positive. However, for net debtor agents, low α , and plausible (low) values of β , this condition is unlikely to be met, and money holdings should end up below their initial steady state level. By contrast, consumption and net bondholdings end up unambiguously higher for $\gamma > 0$.

Overall, for the cases of full tax and money finance, our *initial net debtor* results differ in several respects from the *initial net creditor* results described in Kawai and Maccini (1995).³² For instance, in the case of full tax finance, we find that (i) the initial jumps in consumption and current account are bigger; (ii) consumption follows a strictly downward path from $t=0+$ to settle into a lower final steady state; and (iii) bondholdings are unambiguously higher in the final steady state relative to their initial steady state. In the case of full money finance, and under plausible parameter values, final steady real balances fall short of their initial steady state levels. In addition, the quantitative analysis

³¹ During the stable regime ($t \geq T$) consumption and real money balances ought to move along the same saddle manifold. That this does not visually come out from Figure 2 (c rising but m flat) reflects the limited time horizon shown.

³² For the initial creditor case, the model results are identical to Kawai and Maccini (1995).

of the initial jumps suggests that even moderate amounts of upfront aid can push outcomes *towards* twin deficits, both in the case of full tax finance and full money finance. In the latter case, the twin divergence result is reversed when $\alpha > 0.2$, and the emerging twin deficits amplified when $\gamma < 1$ (or $\rho > r_0$), suggesting a strong interplay of aid and impatience.

Having touched upon the role upfront aid can play in the benchmark cases of tax and money finance, we now turn to the case of future aid finance.

IV. GENERAL SOLUTION FOR THE CASE OF AID FINANCE

We start by recalling that full future aid finance can be modeled as $n_3=1$ in equation (19), i.e. agents foresee the receipt of aid (“free lunch”) in the future (from T onward) in amounts sufficient to close the peak fiscal deficit ($\bar{d}$) caused by the initial tax cut. Note that it is only *future* aid receipts that are being modeled here, not upfront aid (i.e. we assume $\alpha=0$), although toward the end of this section we establish the equivalence of α and n_3 under perfect foresight.

Figure 3 illustrates the dynamic behavior of the economy under anticipated aid financing for $\gamma < 1$. There are two main observations. First, the free gift of aid in the future is deflationary, as it represents an expansion of resources available for consumption; equivalently, it implies a future nominal currency appreciation. As before, this anticipated change in prices is brought forward to the present through perfect foresight, inducing a downward jump in prices at $t=0$ (or nominal appreciation) which, in turn causes real money balances (and financial wealth) to jump up. Second, in the absence of any future tax increase, human wealth jumps up due to the now-permanent tax. Accordingly, *total*

wealth and hence consumption jump up, the latter mirrored in a symmetric worsening of the current account balance. When $\gamma < 1$ ($\gamma > 1$), c , b and m fall (rise) from $t=0+$ onward toward their final steady states and are continuous at $t=T$.³³

Below we take a sequential look at the initial jumps and final steady states; the dynamic adjustment paths; as well as the behavior of the current account at $t=T$.

i. Initial jumps and steady states

The (upward) jump in real money balances (as per (A26)_{| $n3=1$}) turns out to be independent of γ and the duration of the tax cut, which was also true for the downward jump in the case of full money finance. However, the size of the jump is now a small fraction of what was obtained earlier. Specifically, $(m_{0+} - m_0)|_{n3=1} = \beta(\tau_0 - \tau_1)/r_0$. With a β of 0.025, the jump is $\frac{3}{4}$ percent of GDP for a 3 percent of GDP tax cut.

The jump in consumption (A25)_{| $n3=1$} simplifies to: $\left[1 + \frac{\rho - r_0}{\theta + r_0}\right] \left\{ \frac{1 + \beta \left(1 + \frac{\theta}{r_0}\right)}{1 + \beta} \right\} (\tau_0 - \tau_1)$. As for

the jump in real money balance above, but unlike the case of full tax finance, the duration of the deficit regime does not feature in the expression. This is because there is now no tax increase expected to impinge on disposable income in the future (and hence on lifetime human wealth) and so any/every tax cut is permanent, by definition, and ought to be fully consumed.

³³ For $\gamma < 1$, the fact that real money balances fall after $t=0+$ implies that prices must be rising (depreciating nominal exchange rate), with the opposite true in the case of $\gamma > 1$. The direction of change in the nominal exchange rate has no impact on the current account, which deteriorates in either case.

Next, note that $[\] > 1$ if $\rho > r_0$, which is, of course, what is assumed for Figure 3, while the term in $\{ \}$ is always greater than, but very close to, 1.³⁴ Thus, the jump is proportional to $[\]$: it is bigger (smaller) than the tax cut if $\rho > r_0$ ($\rho < r_0$), and equal to the tax cut when $\rho = r_0$. Figure 4 illustrates the consumption and current account jumps (and subsequent adjustment paths) under various configurations of ρ . As can be seen, the twin deficits coefficient is quite large (0.88 to be precise) when agents are relatively patient (first chart, $\rho = 0.085$, vs. $r_0 = 0.1$); exactly equal to 1 when $\rho = r_0 = 0.1$ (second chart); 1.12 when agents are somewhat impatient (third chart, $\rho = 0.115$); 1.46 when agents are quite impatient ($\rho = 0.16$); and 2.23 when agents are super-impatient ($\rho = 0.26$). As long as our prior is for ρ to be not much lower than r_0 , these imply, intuitively, quite a strong twin deficits result.

Figure 4 also captures the usual (inter-generational) tradeoff between the size of the initial jump in consumption and its final steady state level. Specifically, the bigger the initial jump, the sharper the ensuing decline from $t = 0+$ till $t = T$, and the lower the final steady state level beyond T . Formally, the final steady states for consumption, bondholdings and real money balances are given by $c_0 + \gamma(\tau_0 - \tau_1)$; $b_0 + (\gamma - 1)(\tau_0 - \tau_1)/r_0$; and $m_0 + \beta\gamma(\tau_0 - \tau_1)/r_0$ (as per A6-A8).

Importantly, while consumption and money balances always end up above their initial steady states, final bondholdings are below (above) their initial level when $\gamma < 1$ ($\gamma > 1$). In other words, anticipated aid merely *exacerbates* agents' initial debtor/creditor status: net debtors (creditors) end up with higher net indebtedness (bondholdings) in the final steady state.³⁵

³⁴ With a small β and the plausible assumption that θ is small in relation to r_0 , $\{ \}$ approaches 1.

³⁵ Illustratively, for a 3 percent of GDP tax cut, $|\gamma - 1|$ of 0.3, and r_0 of 0.1, $|\bar{b} - b_0|$ is about 10 percent of GDP.

ii. Adjustment paths

The dynamic adjustment paths for c , b and m illustrated in Figure 3 follow from equations (A28)-(A30), i.e. the first and second derivatives with respect to time of the respective general solutions evaluated at $n_3=1$. It is obvious that from $t=0+$, c , b and m all fall (rise) toward their final steady states at a retarding rate when $\gamma < 1$ ($\gamma > 1$). The adjustment path for the current account is more complex, being governed by (A31| $n_3=1$):

$$\dot{x} = -e^{r_0 t} (\tau_0 - \tau_1) \left[r_0 - \frac{(\rho + \theta - r_0)^2 (1 - \gamma)}{r_0} e^{-(\rho + \theta)t} \right]. \text{ Note that for } \gamma > 1, \dot{x} < 0, \text{ i.e. current account always}$$

worsens following the initial downward jump. When $\gamma < 1$, however, $\dot{x}$ may be negative or positive, depending on whether the [] term is positive or negative. It is clear that when t is large (i.e. as time progresses through $0 < t < T$), $e^{-(\rho + \theta)t}$ will tend toward zero, rendering [] positive and $\dot{x} < 0$ (i.e. current account deteriorates from $t=0+$). For low t , however, [] could be negative and $\dot{x} > 0$ (i.e. current account improves from $t=0+$). Formally, a sufficient condition for [] > 0 (and hence $\dot{x} < 0$) is $\rho + \theta - r_0 < r_0$, essentially an upper bound on the stability condition $\rho + \theta - r_0 > 0$.³⁶ The implied lower bound on γ is $2\theta/(1+\beta)(r_0+\theta)$, or around 0.45, for $\theta=0.03$, $\beta=0.025$ and $r_0=0.1$. A γ this low would entail initial steady state consumption of just 45 percent of disposable income, and initial net private indebtedness of 550 percent of disposable income, which appear outside the bounds of plausibility. Accordingly, it would be safe to conclude that $\dot{x} < 0$ when $\gamma < 1$.

The intuition of this somewhat ambiguous theoretical result on $\dot{x}$ when $\gamma < 1$ is borne out from the last chart in Figure 4: super-impatient agents (with $\rho + \theta > 2r_0$) increase consumption upfront by more than twice the tax cut (under anticipation of full aid finance), inducing a very sharp decline in consumption from $t=0+$. This is then reflected fully in a similarly large downward jump in the

³⁶ The condition can be derived by noting that $(1 - \gamma) e^{-(\rho + \theta)t} < 1$. Thus, a “sufficient” condition for [] > 0 is $r_0 > \frac{(\rho + \theta - r_0)^2}{r_0}$, which simplifies to $\rho + \theta - r_0 < r_0$.

current account at $t=0+$, followed first by a slight current account improvement (as consumption initially falls very fast), but eventually a current account deterioration, as interest payments on net external liabilities dominate the impact of falling consumption: the term $r_0^*(b_t - z_t)$ surges in (13) as bondholdings fall and public debt rises.

Assuming $\dot{x} < 0$, we now look at the *rate of decline* of the current account, which is given by

$$\ddot{x} = -e^{r_0 t} (\tau_0 - \tau_1) \left\{ r_0^2 + \frac{(\rho + \theta - r_0)^3 (1 - \gamma)}{r_0} e^{-(\rho + \theta)t} \right\}. \text{ When } \gamma < 1, \ddot{x} \text{ is unambiguously negative}$$

(i.e. there is an exponential deterioration in the current account). However, when $\gamma > 1$, $\ddot{x}$ can be positive initially (i.e. when t is small). In either case, and irrespective of the degree of impatience, the current account deficit would be deteriorating exponentially by $t=T$.

The behavior of the current account at $t=T$ can be analyzed by evaluating its general

solution at T^- for $n_3=1$: $x_{T^-} = -\left\{ 1 + [r_0^{-1}(1-\gamma)(\rho + \theta - r_0)e^{-(\rho + \theta)T^-}] \right\} (\tau_0 - \tau_1)e^{r_0 T^-}$. Thus,

$x_{T^-} \rightarrow -(\tau_0 - \tau_1)e^{r_0 T^-}$ or $(-\bar{d})$ when $||[r_0^{-1}(1-\gamma)(\rho + \theta - r_0)e^{-(\rho + \theta)T^-}]||$ approaches 0. It can be

shown that $||[\cdot]|| < 0.1$ for all T if γ is within a reasonable range (such as between 0.75 and

1.33). Thus, $x_{T^-} \approx -\bar{d}$, so that the additional aid inflow at T of $\bar{a} - a_I$ would be just

sufficient to clear the twin deficits. The *fiscal* deficit closes, because from (19), $\bar{a} - a_I = \bar{d}$

when $n_3=1$; and the *external* deficit closes, because from (13), with both b_t and z_t

backward looking, and c_t constrained to be continuous at $t=T$, the current account jumps

up by $\bar{a} - a_I$ (or $\bar{d}$).

iii. Upfront vs. Anticipated Aid

A key feature of perfect foresight models is that future events are brought forward

seamlessly to the present. We find that this applies to aid inflows as well. In other words,

given perfect foresight, an *upfront* free lunch ($\alpha=1$) and an *anticipated future* free lunch ($n_3=1$) turn out to be equivalent in terms of the behavioral implications for consumption, real money balances, bondholdings and the current account (excluding aid). This is borne out most directly by the fact that α drops out from the equations for initial jumps, dynamic paths and steady states when $n_3=1$. Indeed, the general solutions for $\alpha=1|n_3=0$ and $\alpha=0|n_3=1$ are identical.

This equivalence extends to “mixed regimes” as well: as shown in Figure 5, the trajectories for c , b and m when $\alpha=0.2|n_1=1|n_3=0$ align with those obtained under $\alpha=0|n_1=0.8|n_3=0.2$.³⁷ More generally, any pure (") future closure rule (i.e. with no upfront aid) represented by $n_1'' | n_2'' | n_3''$ can be re-expressed as a combination of tax and money finance and upfront aid ('): $\alpha = n_3'' | n_1' = n_1''/(1 - \alpha) | n_2' = n_2''/(1 - \alpha)$.³⁸ This means that anticipated aid impacts agent behavior by reducing the amount of tax or money finance effort required, and mitigating the associated effects on consumption and money balances, respectively. In the extreme case of a full free lunch (either upfront or in the future), there is no future tax effort or money financing required and, thus, no deleterious impact on disposable incomes and/or future prices impinging on consumption or real money balances today.

The above equivalence between anticipated and upfront aid does not, of course, extend to public debt and the current account (inclusive of aid). When aid is frontloaded, the

³⁷ In the first case, an upfront free lunch (one-fifth of the initial tax cut) is followed by *full* tax financing, while in the latter, there is no upfront free lunch, but the future closure rule is 80 percent tax finance and 20 percent aid finance.

³⁸ Algebraically, the result follows from (15) and (17-19): in the absence of upfront aid, the deficit that must be closed from $t=T$ onward is simply $(\tau_0 - \tau_1)e^{rOT}$, shared between future tax/money/aid as $n_1'' | n_2'' | n_3''$. With upfront aid (α), however, the deficit is $(1-\alpha)(\tau_0 - \tau_1)e^{rOT}$, so that the same tax effort now represents a larger share of the reduced deficit, i.e. $n_1''/(1-\alpha)$, and similarly for the money finance effort, which is now $n_2''/(1-\alpha)$.

increase in public debt and the worsening in current account (including aid) is smaller, as aid enters both the fiscal and external balance equations during $0 < t < T$. When aid is back-loaded, public debt and the current account deficit grow exponentially till T -, lending the “appearance” of an unsustainable regime, until, of course, the arrival of aid at T (Figure 5).

iv. Mixed Tax-Aid Regimes

Pure closure rules ($n_1=1$, $n_2=1$, $n_3=1$) are attractive from the perspective of theory, but would have limited relevance for the real world. For instance, no country, no matter how strategically important, can expect a perfect free lunch. The discussion of full money finance revealed that this method could feasibly cover only small tax cuts. Similarly, IFI attempts at raising countries’ tax and spending effort have often fallen short of targets, resulting in off-track programs (most recently, in Pakistan and Ukraine). From a policy perspective, therefore, it would seem more interesting to simulate macroeconomic outcomes under expectations of mixed, rather than pure, regimes.

Table 1 summarizes the results of some mixed tax-aid finance regimes, where we focus on the real part of the model, i.e. abstract from money, both in the the utility function and as the base for seigniorage revenues.³⁹ The general solution for any mixed regime was derived by weighting the underlying pure regime general solution by the respective shares of tax and aid finance (n_1 and n_3). As before, the simulations assume θ of 0.03, ρ of 10.25 percent and a real interest rate of 10 percent. The tax cut (or increase in transfers) is sized at 3 percent of GDP for 10 years ($= T$). These, then, imply an 8.15 percent of GDP peak

³⁹ The abstraction can be justified given our finding from section III that monetary financing is likely to play a marginal role in closing reasonably-sized deficits.

fiscal deficit (i.e. including the interest on the accumulated debt) in year T (or 10) that is to be closed by a combination of tax and aid finance.⁴⁰

Table 1 - Macroeconomic Response to Varying Degrees of Anticipated Aid					
$n_3 = \text{share of aid finance in anticipated closure rule} = 1 - n_1$					
	0 (full tax finance)	0.25	0.5	0.75	1 (full aid finance)
γ	0.94	0.94	0.94	0.94	0.94
Initial jump in consumption and current account deficit (share of tax cut)	0.26	0.45	0.64	0.83	1.02
Peak current account deficit (share of tax cut)	0.42	0.99	1.57	2.15	2.73
Peak current account deficit (share of peak fiscal deficit)	0.15	0.36	0.58	0.79	1.00
Increase in steady state bondholdings (percent of initial steady state level)	6.44	3.90	1.35	-1.20	-3.75
Increase in steady state consumption (percent of initial steady state level)	-6.44	-3.90	-1.35	1.20	3.75
<i>Memo:</i>					
Tax cut (percent of GDP)	3.00	3.00	3.00	3.00	3.00
Peak fiscal deficit (percent of GDP)	8.15	8.15	8.15	8.15	8.15

As can be seen, the initial positive consumption response to the tax cut is increasing in share of aid finance. When this share is zero, the response coefficient (also the twin deficits coefficient) is 0.26; when it is 0.5, the coefficient is 0.64; when it is 1, the coefficient is around 1 (perfect twin deficits result). A similar pattern obtains for the peak current account deficit

(scaled to the peak fiscal deficit). The results for initial and final steady state consumption and bond-

		Real interest rates (percent)					
		2.5	5.0	7.5	10.0	12.5	15.0
Length of tax cut (T, years)	1	0.02	0.05	0.07	0.10	0.12	0.14
	3	0.07	0.14	0.20	0.26	0.31	0.36
	5	0.12	0.22	0.31	0.39	0.46	0.53
	10	0.22	0.39	0.53	0.63	0.71	0.78
	15	0.31	0.53	0.68	0.78	0.85	0.89

holdings are also intuitive: with tax finance dominating, agents begin to reduce

⁴⁰ From (15), $\bar{d} = 8.15 = 3 * e^{0.1*10}$.

consumption sharply after the initial upward jump, accumulating government bonds in large quantities, so that that final steady state bondholding (consumption) is higher (lower) than the initial level. However, a rising share of aid finance (free lunch) raises lifetime human wealth, raising final steady state consumption, but, by implication, dampening the imperative to accumulate bonds, so that impatient agents ($\rho > r_0$) actually end up more indebted than before.

The “turning point” share of aid finance at which the change in steady state bondholding (consumption) reverses can be derived from (A6) and (A7) as $n_3^* = 1 - e^{-r_0 T}$. The longer the duration of the tax cut and the higher the interest rate, the more the future anticipated taxes weigh on current consumption, and the higher the share of aid finance at which agent indebtedness begins to aggravate. With $r_0=0.1$ and $T=10$, n_3^* computes to 0.63. If the share of anticipated aid finance rises above this level, agents’ steady state bondholding falls. Note, however, that if the real interest rate were 5 percent and the length of the tax cut 3 years, n_3^* would be 0.14. This result implies that *shorter* fiscal expansions are more likely to crowd out private saving, if aid were a large share of the anticipated closure rule. The duration of the fiscal expansions under anticipation of future aid has not been considered in studies of the impact of foreign aid on domestic savings (see Nushiwat, 2007 for a recent survey of this literature).

The key results from this section are as follows: By relieving the pain associated with future tax and/or money finance, but without compromising intertemporal fiscal solvency, upfront or anticipated aid (equivalent under perfect foresight) allows private agents to fully consume *permanent* tax cuts. Whether they consume it one-for-one (exact twin deficits result), or by less or more depends on agents’ relative impatience. The greater their impatience (i.e. the higher is ρ relative to r_0), the stronger is the upfront twin deficits

response, but the lower is final steady state consumption. For plausible parameter values, the current account deficit deteriorates exponentially after the initial downward jump (on account of rising interest payments on net external liabilities) until the arrival of aid at T clears the twin deficits. Importantly, anticipated aid exacerbates net private indebtedness when agents start out as net debtors (i.e. are relatively impatient to consume), and increases their bondholdings when they start out as net creditors (i.e. are relatively patient consumers).

The results with mixed tax-aid regimes show a continuum of twin deficit results from weak to strong, with stronger results for higher shares of aid finance. Because anticipated aid aggravates agents' indebtedness and anticipated taxes reduce it, a threshold share of aid finance exists beyond which indebtedness increases. This threshold is a decreasing function of the real interest rate and the length of the tax cut, so that for a 3-year tax cut with an r_0 of 5 percent, steady state private indebtedness would rise for $n_3 > 0.14$.

So far, we have assumed perfect credit markets, which imply that households and governments can borrow/lend without limit. In particular, households can issue and purchase bonds as needed to ensure that their consumption response remains independent of whether the tax cut is accompanied by *upfront* aid or expectations of *future* aid. It is useful to examine if this perfect substitutability between the present and the future survives in the presence of credit constraints. Below we model the situation where a fraction of the households is credit constrained (i.e. must consume current disposable incomes), and/or the government is subject to some aggregate borrowing constraint.

V. THE MODEL WITH CREDIT CONSTRAINTS

There is a large, but somewhat dated, literature testifying to the importance of credit constraints on households in emerging and developing economies; see for example, Haque and Montiel (1989), Schmidt-Hebbel, Webb and Corsetti (1992) and Carmichael, Kéitab and Samson (1999). Habibullah, Smith and Azman-Saini (2006) – one of the few recent empirical studies focused on this question – find that the share of credit-constrained households in ten Asian economies varies between 0.25 and 0.98. Intuitively, countries that witnessed greater financial liberalization (Korea, Taiwan and Sri Lanka) were found to sit near the lower end of the range, while the least-developed economies at the upper edge.

The definition of credit constraints used for the purposes of this model is slightly different from the above, i.e. in which consumption cannot exceed disposable income, but can undershoot disposable income. The variant of credit constraints we employ, following Buiter (1986) is a symmetric one, in which agents simply consume their current disposable income and can neither exceed nor undershoot their disposable incomes. Put differently, we assume agents are myopic in their consumption behavior.

i. Modeling credit constrained households

A popular parameter to capture credit constraints is the share of credit-constrained households in the economy. However, as Seater (1993) points out, in representative agent models, it is important to distinguish the proportion of credit-constrained households and the *consumption share* of those households. The latter, which is what is economically important, is likely to be much lower than the former, and a decreasing function of income inequality. For the most part, we show our main results with a 0.5 *consumption share* of credit-constrained households, but some results with higher and lower shares are also included.

Next, we need to decide on the nature of credit constraints. A number of variations are possible: for instance, Li and Rocheteau (2011) model credit constraints as endogenous to a state variable (rather than as exogenous), while Carroll and Kimball (2001) model them under “uncertainty” (rather than perfect foresight), which drives their well-known precautionary saving result. It is also possible to think of asymmetric constraints: agents can hold but not issue debt. For tractability, we assume exogenous and symmetric credit constraints represented by a fixed share of credit constrained households in each vintage, while maintaining the assumption of perfect foresight. We continue to abstract from money (by setting $\beta=n_3=0$) for this part of the paper as well.

Formally, then, we partition the expression for consumption (equation 1) between consumption by un-constrained (UC) households, who consume a fixed share total wealth; and by credit-constrained (CC) households, who consume their current disposable income plus a fixed share of any inherited financial wealth:

$$c_t^{UC} = (\rho + \theta)(v_t + h_t) \dots\dots\dots (20)$$

$$c_t^{CC} = (\rho + \theta)v_t + (y_0 - \tau_t) \dots\dots\dots (21)$$

Assuming δ as the fraction of CC households, aggregate (and per capita) consumption is given by:

$$c_t = (\rho + \theta)(v_t + (1 - \delta)h_t) + \delta(y_0 - \tau_t) \dots\dots\dots (22)$$

The above formulation is identical to Buiter’s (1986), although he only solves the model for $\delta=0$. For $\delta>0$, the system of differential equations can be derived following the procedure in section II, where setting $\dot{c} = \dot{b} = 0$, we can recover the initial steady state expressions as $c_0' = \gamma'(y_0 - \tau_0)$ and $b_0' = (\gamma' - 1)(y_0 - \tau_0)/r_0$, where:

$$\gamma' = \frac{\theta(\theta + \rho) + \delta r_0(\rho - r_0)}{(\rho + \theta - r_0)(r_0 + \theta)}$$

Intuitively, when $\delta=0$, $\gamma'=\gamma$, i.e. the model collapses to our base case without credit constraints. When $\delta=1$, $\gamma'=1$, so that $c_0 = y_0 - \tau_0$ (consumption equals initial steady-state disposable income) and $b_0 = 0$ (initial steady state bondholdings are zero), which is what would be expected in the presence of a fully credit constrained household sector. Note that when $\rho = r_0$ (rate of time preference equal the real interest rate), $\gamma'=\gamma$, so that the steady state (although not dynamics) of the model are independent of δ (as noted in Buiter (1986)).

When $\rho > r_0$, $\gamma' > \gamma$: credit constraints act as a drag on aggregate consumer impatience (and consumption), so that steady state bondholdings are higher than what they would have been in the absence of credit constraints ($b_0' > b_0$); accordingly, consumption can be sustained at a higher level in the steady state ($c_0' > c_0$), due to the higher net interest receipts on bonds. This effect is stronger the higher is δ (i.e. $\partial \gamma' / \partial \delta > 0$). The reverse is, of course, true when $\rho < r_0$: credit constraints set a ceiling on household saving (and bond accumulation), so that steady-state bondholding is smaller than the corresponding $\delta=0$ counterfactual level.

It can be shown that $\partial \gamma' / \partial \rho > 0$ as long as $\delta > \theta$ (the share of credit constrained households exceeds the instantaneous probability of death), a condition that would likely hold in developing economies. δ has no effect on $\text{sign}(\partial \gamma' / \partial r_0)$, which continues to equal $\text{sign}(2r_0 - \rho)$, as in the base case; but δ does dampen the magnitude of the marginal effect (i.e. $\partial \gamma' / \partial r_0$ is proportional to $(2r_0 - \rho)(1 - \delta)$).⁴¹

⁴¹ Similarly, the presence on δ has no effect on $\text{sign}(\partial \gamma' / \partial \theta)$ which still equals $\text{sign}(r_0 - \rho)$; it exerts only a dampening effect.

ii. Simulations for anticipated tax and aid finance

The basic model results are illustrated in Figure 6 with $\delta=0$ and 0.5. As can be seen from panel A, in the case of full tax finance, credit constraints materially alter the economy's initial response and subsequent adjustment path. The initial jump in consumption (and the current account) in response to the tax cut is noticeably larger, and both variables step-adjust at $t=T$ (the time taxes rise again) in the opposite direction. This is intuitive, as the consumption of credit-constrained agents would exhibit a one-to-one sensitivity to tax changes at the time they happen. What is, perhaps, surprising is the magnitude of the difference in the current account response: the peak current account deficit at $t=T$ is 4.7 percent of GDP in the case of credit constraints, more than four times the corresponding level without them.

Table 2 summarizes the economy's response under *varying* degrees of credit constraints for the case of anticipated tax finance.⁴² As expected, γ' increases with the share of credit constrained households (δ). In the extreme, when $\delta=1$, $\gamma'=1$, so that agents consume the full amount of the tax cut at $t=0$ and we get the perfect twin deficits result. What is interesting is the close correspondence between the impact of δ on the twin deficits coefficient and of the share of aid finance (in Table 2). The impact of a 0.25 increase in δ in Table 2 is broadly similar to a 0.25 increase in n_3 in Table 1. Why is this so? Well, in the first case, 25 percent of the agents are credit constrained, so those 25 percent fully consume the jump in their disposable income (i.e. the tax cut) at $t=0$, while the 75 percent remaining households consume a much smaller share (anticipating the future tax increase). In the second case, future aid financing is 25 percent of the closure rule, so that all agents consider 25 percent of the tax cut to be permanent and 75 percent of the tax cut to be temporary. The impact on consumption at $t=0$, thus, turns out to be similar in both cases.

⁴² We continue to assume a 10-year tax cut of 3 percent of GDP (as for Table 1).

Table 2 - Impact of Credit Constraints on Macro Response Under Anticipation of Full Tax Finance

	δ (share of credit constrained households)				
	0	0.25	0.5	0.75	1
γ'	0.94	0.96	0.97	0.99	1.00
Initial jump in consumption and current account deficit (share of tax cut)	0.26	0.45	0.63	0.82	1.00
Peak current account deficit (share of tax cut)	0.42	0.98	1.56	2.14	2.72
Peak current account deficit (share of peak fiscal deficit)	0.15	0.36	0.57	0.79	1.00
Increase in steady state bondholdings (percent of [initial steady state level])	6.44	6.44	6.44	6.44	--
Increase in steady state bondholdings (share of tax cut)	1.02	0.76	0.51	0.25	0.00
Fall in steady state consumption (share of initial steady state level)	6.44	6.44	6.44	6.44	6.44
Fall in steady state consumption (share of tax cut)	1.62	1.64	1.67	1.69	1.72
<i>Memo:</i>					
Tax cut (percent of GDP)	3.00	3.00	3.00	3.00	3.00
Peak fiscal deficit (percent of GDP)	8.15	8.15	8.15	8.15	8.15

Where the results differ between aid finance and credit constraints is in the economy's adjustment path and final steady states. In the case of tax finance with credit constraints, steady state consumption (net bondholding) is always 6½ percent below (above) the initial steady state levels. However, as already noted, a high enough share of aid finance (free lunch) eventually produces an *increase* (decrease) in steady state consumption (net bondholding).

We now turn to the impact of credit constraints under anticipation of full aid finance. Panel B of Figure 6 shows a broadly unchanged pattern of results and no discontinuity at T . This is expected, as there is now no future tax increase (or disposable income drop) requiring a step consumption adjustment at $t=T$. There are some differences, though. The initial consumption jump is *smaller* in the presence of credit constraints, confirming their “dampening” effect on consumer impatience, as noted earlier. The smaller initial jump permits a more gradual decline from $t=0$ onward, so that $\bar{c} - c_0$ is higher than in the no-credit constraints case. Thus, interestingly, the introduction of credit constraints in the case of aid finance implies an improvement in the consumption level of future generations. The result, of course, hinges on $\rho > r_0$. If $\rho < r_0$, credit constraints would imply

higher upfront consumption than would obtain if agents were unconstrained, so that the final steady state level of consumption would fall (relative to the unconstrained case).

iii. Credit constrained governments and timing of aid

The model so far has assumed that governments have unlimited borrowing capacity, so that any tax cut, no matter how large, can be financed for as long as the government wishes. In practice, however, this capacity is not unlimited for many emerging and most low-income economies: domestic debt markets are still shallow while international financial markets remain inaccessible for high-risk sovereigns. To capture government borrowing constraints, we assume a highly stylized setting: we assume that governments can only finance a 2 percent of GDP tax cut (or transfer increase) from the market, so that bigger tax cuts require some “upfront” aid. To see how this constraint impacts outcomes when more or less of this upfront aid is available, we assume two different aid programmes, both with the same present value.

- *Programme A (backloaded aid)*: At $t=0$, aid arrives in the amount of $\frac{1}{2}$ percent of GDP, allowing a tax cut of $2\frac{1}{2}$ percent of GDP. The regime lasts till year 7 (inclusive) after which it is replaced by a high-aid/somewhat high-tax regime: aid rises to 3 percent of GDP (increase of 2.5 percent of GDP), and taxes are raised in the requisite amount to close the residual deficit. For $r_0=0.1$, the programme can be described by $\alpha = 0.2 \mid n_1 = 0.44 \mid n_3 = 0.56$.
- *Programme B (frontloaded aid)*: At $t=0$, aid arrives in the amount of 2 percent of GDP, allowing a tax cut of 4 percent of GDP. The regime lasts till year 7 (inclusive) after which it is replaced by a low-aid/high-tax regime: aid falls to 1 percent of GDP, and taxes are raised in the requisite amount to close the deficit. For $r_0=0.1$, the programme can be described by $\alpha = 0.5 \mid n_1 = 1.22 \mid n_3 = -0.22$.

It is easily checked that both programmes have the same present value aid (about $16\frac{1}{3}$ percent of GDP) and result in a peak fiscal deficit ($\bar{d}$) of 4.45 percent of GDP by $t=T$. Both programmes appear to be within the range of plausible financial assistance contracts between donor and recipient countries, in circumstances where the latter are expected to undertake some upfront increase in fiscal transfers (say to meet priority social spending targets).⁴³

In Programme A, modest upfront aid inflows limit the size of feasible fiscal expansion but come with the promise of more substantial foreign assistance in the future to be combined with some fiscal effort. Such a programme would be seen as preferable by donors who harbor concerns about absorptive capacity in recipient countries and/or consider large future carrot (promise of higher future aid) essential for incentivizing reforms. Programme B combines high upfront assistance with expectations of a very sizable tax effort in the future that would have to reverse not just the initial tax cut, but also the wind-down in foreign aid. This programme would be deemed appropriate if the considerations mentioned earlier (in the context of programme A) were less relevant, if the returns from immediately raising social transfers were deemed high, or if large upfront aid were itself seen as a catalyst for reform (including fiscal reforms that would enable the deficit to be closed in the future). Thus, both programmes could be seen as internally consistent from the donors' perspective.

If the donors' committed aid path were believed by private agents in the recipient country, the macroeconomic outcomes would be represented by Figure 7, panels a and b

⁴³ The particular values used in this numerical example do not imply a loss of generality. The intuition of the results described below survives for a range of numerical configurations.

(and also summarized in Table 3 below). For each programme, results are illustrated for three shares of credit-constrained households: 0, 0.5 and 1. A number of insights emerge.

First, the macroeconomic responses differ across the two programmes even in the absence of credit constrained households. Under backloaded aid, we see the familiar pattern of an on-impact upward (downward) jump in consumption (current account). The current account worsens exponentially till T , until the arrival of aid produces a jump improvement at $t=T$. Under frontloaded aid, the jump in consumption is larger in *absolute* terms, but smaller as a *proportion* of the tax cut (compare rows 5 and 9 for $\delta=0$ in Table 3), reflecting the anticipation effect of the very large future tax increase (of 5.4 percent of GDP). In fact, the decline in consumption from $t=0+$ onward is so sharp that the current account begins to improve immediately after its initial downward jump. Although the jump decline in aid at $t=T$ worsens the current account (including aid), the *underlying* current account (i.e. excluding aid) continues to improve beyond T .

Second, the introduction of household credit constraints has a smaller impact on the twin deficits coefficients for Programme A than for Programme B. The initial jump in the current account (excluding aid), which corresponds to the initial jump in consumption is reported in row 9 of Table 3. As can be seen, the coefficient rises from 0.7 to 1 in the case of backloaded aid, but from 0.5 to 1 in the case of frontloaded aid. The intuition of this result is linked to the discussion in the previous para: it is the absolute size of the jump in consumption (rather than its size relative to the tax cut) that ensures consistency with households' intertemporal budget constraint. The twin deficits coefficient *falls out* from whatever the size of the absolute jump is; it does not drive it. Notwithstanding, a possible policy conclusion that emerges from this is: as household credit constraints subside (as would be expected in aid-receiving developing economies undergoing financial development) the current account response to fiscal expansions could materially weaken insofar as the expansions were expected to be closed in future primarily through higher taxes (rather than foreign aid).

Third, and last, we turn to the behavior of consumption and the current account at $t=T$. As before, this depends critically on the extent of household credit constraints. When the latter are tight, consumption would exhibit bang-bang behavior: jumping up a lot at $t=0$ and jumping down a lot at $t=T$.⁴⁴ However, to what extent would the latter jump – a sudden painful reduction in consumption – be feasible or possible in practice? Could private agents be plausibly expected to absorb a 4 percent of GDP (or 7 percent) cut in consumption at $t=T$, as implied under the frontloaded aid programme for $\delta > 0.75$?

These questions are relevant if, in fact, private agents have reasons to believe that donor promises to sharply withdraw aid in the future may not be credible. In this case, agents may impute to their expectations a larger aid commitment in the future than is formally announced. The last column of Table 3 illustrates this possibility: despite an announced policy by donors of $n_3 = -0.22$, agents expect the share of aid to not fall below a “threshold level” corresponding to a downward jump in consumption of 2 percent of GDP (assumed as the maximum feasible cut in this case). This threshold level turns out to be $n_3 = 0.1$, which generates a macro response depicted in Figure 7 panel c. Anticipating higher aid (and lower taxes; n_1 of 0.9 instead of 1.22), the initial upward jump in consumption is larger (3.3 percent of GDP) while the subsequent downward jump is 2 percent of GDP. Importantly, the PV of aid is 22.7 percent of GDP, rather than 16.3 percent of GDP, a 40 percent increase over the level initially committed under Programme A.

Overall, the discussion in this section reveals a number of insights: household credit constraints materially impact the behavior of agents anticipating future tax finance, and in much the same way as anticipated aid does. By contrast, credit constraints do not substantially alter the response of an economy under expectations of full aid finance, barring a marginal dampening of initial jumps. Moreover, the phasing of aid only becomes important when government borrowing constraints are introduced. The twin

⁴⁴ The current account (excluding aid) mirrors these gyrations one-to-one.

deficits coefficient obtaining in the case of a large fiscal expansion facilitated by frontloaded aid (to be withdrawn later and replaced by high taxes) is much lower than the coefficients obtaining under a more backloaded aid programme; a reduction in household credit constraints further suppresses this coefficient. Finally, if agents do not believe an announced aid program that envisages a sharp future reduction in consumption (given credit constrained households), they may act on the expectation of higher aid financing in the future with the result that upfront consumption and current account deficits (excluding aid) would be higher, as will the amount of aid (in PV terms), than if the original programme were believed.

Table 3 - Macro Impact of Aid Phasing With Credit-Constrained Households and Government

	Programme A (backloaded aid)					Programme B (fronloaded aid)					Future aid cut not believed ($\delta=0.5$)
<i>in percent of GDP, except for ratios</i>	$\delta=0$	$\delta=0.25$	$\delta=0.5$	$\delta=0.75$	$\delta=1$	$\delta=0$	$\delta=0.25$	$\delta=0.5$	$\delta=0.75$	$\delta=1$	
1. τ (taxes) jump at 0	-2.5	-2.5	-2.5	-2.5	-2.5	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0
2. τ (taxes) jump at T	2.0	2.0	2.0	2.0	2.0	5.4	5.4	5.4	5.4	5.4	4.0
3. a (aid) jump at 0	0.5	0.5	0.5	0.5	0.5	2.0	2.0	2.0	2.0	2.0	2.0
4. a (aid) jump at T	2.5	2.5	2.5	2.5	2.5	-1.0	-1.0	-1.0	-1.0	-1.0	0.4
5. c (consumption) jump at 0	1.8	2.0	2.2	2.3	2.5	2.1	2.6	3.1	3.5	4.0	3.3
6. c (consumption) jump at T	0.0	-0.5	-1.0	-1.5	-2.0	0.0	-1.4	-2.7	-4.1	-5.4	-2.0
7. x (current account) jump at 0	-1.3	-1.5	-1.7	-1.8	-2.0	-0.1	-0.6	-1.1	-1.5	-2.0	-1.3
8. x (current account) jump at T	2.5	3.0	3.5	4.0	4.4	-1.0	0.4	1.7	3.1	4.4	2.4
9. c jump at 0/ τ jump at 0	0.7	0.8	0.9	0.9	1.0	0.5	0.6	0.8	0.9	1.0	0.8
10. c jump at T/ τ jump at T	0.0	-0.3	-0.5	-0.8	-1.0	0.0	-0.3	-0.5	-0.8	-1.0	-0.5
11. PV of a (aid)	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	22.7

VI. CONCLUSION AND WAY FORWARD

This paper develops a framework for analyzing the role of anticipated “painless” deficit closure rules (or free lunches) in a small open emerging or developing economy facing a fiscal expansion, when agents are finitely-lived, forward looking and, possibly, credit-constrained. It was argued

that such rules may be worthwhile to examine in at least three types of economies: commodity producers expecting future revenue windfalls; strategically-important countries anticipating sovereign bailouts, or low-income countries foreseeing a continuation or scaling up of aid in the future. As few economies can expect a full “free lunch”, or to be totally left to their own devices in the event of, say, a crisis, the framework could potentially be relevant for a wide range of emerging and developing economies.

Our focus was on the response of consumption and the current account, with a view to analyzing the extent to which anticipated windfalls, bailouts or aid (all called aid, for simplicity) drove strong twin deficits outcomes. Accordingly, we can report a number of interesting results:

- The degree of impatience of agents (measured by the excess of their subjective rate of time preference over the real interest rate) is critical: in particular, when agents are relatively impatient, the immediate upward jump in consumption is larger and, hence, the twin deficits results stronger, irrespective of the assumed closure rule. However, the impatience of current generations entails costs for future generations, which inherit a lower steady state level of per capita consumption.
- A small amount of *upfront* aid (covering part of the tax cut) under the case of full tax and money finance goes a long way in tilting outcomes toward twin deficits. Specifically, an increase in upfront aid that is sufficient to cover 20 percent of the tax cut, can double the twin deficits coefficient (to 0.4) in the case of anticipated tax finance, and reverse the twin divergence result in the case of anticipated money finance.
- Anticipated aid is equivalent to upfront aid under perfect foresight. Both work their magic by relieving the pain associated with future tax and/or money finance. Put differently, aid renders temporary tax cuts permanent, so that

consumption rises by exactly the size of the tax cut (abstracting, of course, from consumption tilting effects arising from the real interest rate not equaling the subjective rate of time preference).

- The paper's results reinforce the well-known challenge of interpreting current account balances in aid-receiving developing economies. The IMF typically analyzes external sustainability in such economies using a definition of the current account that excludes aid. This paper shows that when anticipated aid is in play, an additional adjustment is warranted for an accurate assessment of external sustainability, although it may be problematic from a political economy perspective (insofar as it serves to affirm agents' expectations of future aid that is not officially promised by donors).
- Importantly, and consistent with the findings of the much of the literature on foreign aid and domestic savings, we find that higher aid worsens agents' initial indebtedness. Moreover, we find that when agents expect a mixed tax-aid closure rule, shorter fiscal expansions are more likely to worsen their initial indebtedness.
- Household credit constraints (modeled as agent myopia, i.e. full spending of current disposable income) impact the behavior of agents anticipating future tax finance in much the same way as anticipated aid does. By contrast, credit constraints do not substantially alter the response of an economy under expectations of full aid finance, barring a marginal dampening of initial jumps.
- The *timing* of aid (upfront or backloaded) matters for agents' behavioral response to a tax cut in the presence of *government* borrowing constraints. Thus, the twin deficits coefficient obtaining in the case of a *large* tax cut part-financed by frontloaded aid is much lower than the coefficient obtaining under

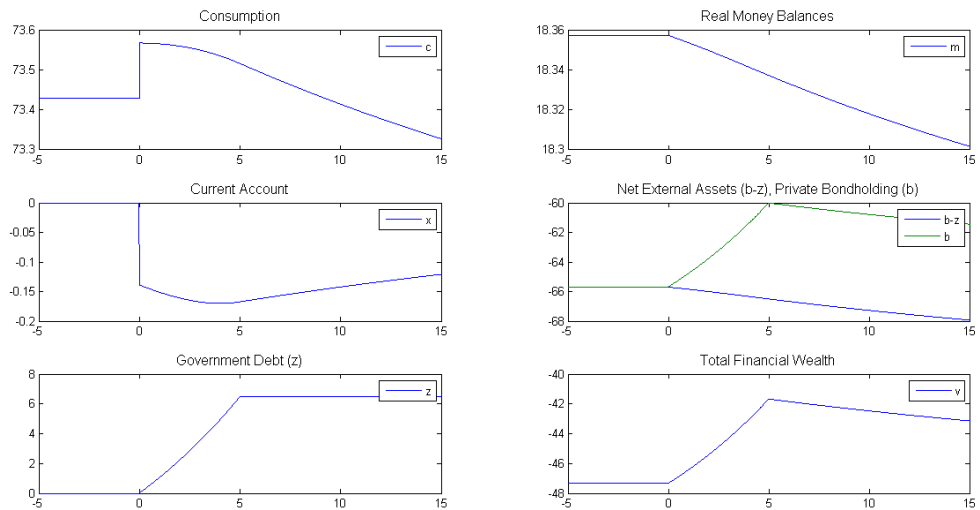
a more backloaded aid programme; a reduction in household credit constraints further suppresses this coefficient.

- Finally, if agents do not believe an announced aid programme that implies (i) a large future reduction (increase) in aid (taxes) and (ii) thus, a sharp future reduction in consumption (given credit constrained households); they may act on the expectation of continued/ higher aid financing in the future. If they are right in their perfect foresight, this would result in consumption and current account deficits (excluding aid), and the amount of aid from donors, being higher than if the original programme were believed.

The last of these above findings (related to the lack of “credibility” of a future withdrawal of aid) is perhaps the most interesting, and illustrates the potential of the framework to investigate similar political economy questions, even in the absence of credit constraints. Indeed, the framework is amenable to modeling situations in which the announcements of the donors and foresight of recipient country private agents diverge ex-ante, but are aligned ex-post (i.e. private agent foresight is proven correct). For instance, we could model situations in which (i) donors punish a non-reforming recipient economy that implements a profligate tax cut by contemporaneously reducing aid, but where this reduction does not kill off agents’ (accurate) expectation of a future return in aid; or (ii) a highly-indebted government receives (avowedly temporary) aid on condition that it also raise taxes simultaneously to help debt, but where agents expect (accurately) the tax increase to be reversed, but aid to endure after the debt has been reduced.

Figure 1. The Case of Full Tax Finance in Future ($\gamma = 0.92$; $n_I = 1$)

Tax cut of 1 percent of GDP for 5 years ($GDP = y_0 = 100$)



Tax cut of 3 percent of GDP for 10 years ($GDP = y_0 = 100$)

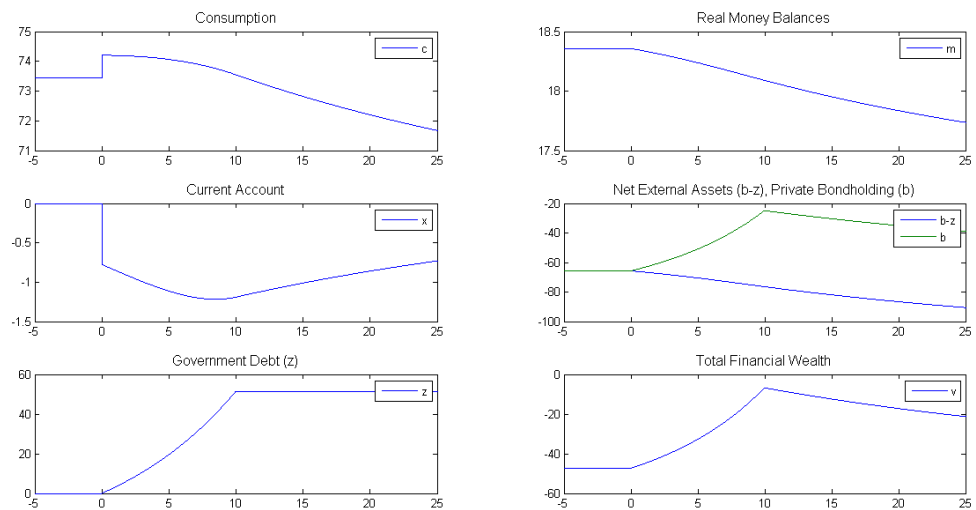


Figure 2. The Case of Full Money Finance in Future ($\gamma = 0.92$; $n_2=1$)

Tax cut of 1 percent of GDP for 5 years ($GDP = y_0 = 100$)

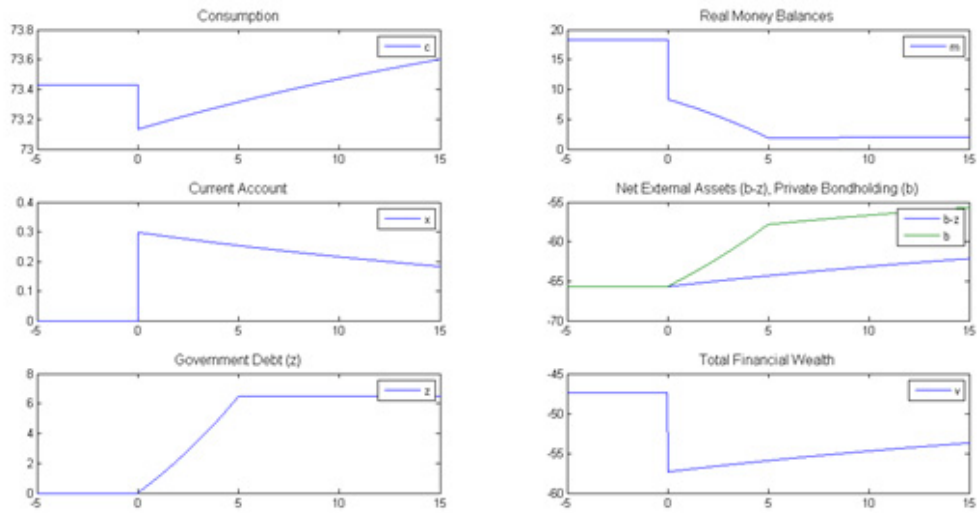
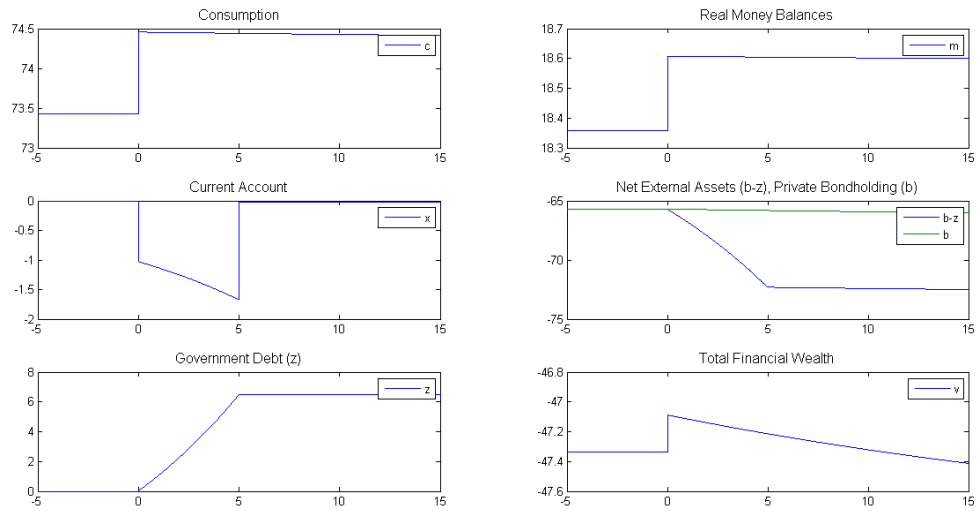


Figure 3. The Case of Full Aid Finance in Future ($\gamma = 0.92$; $n_3=1$)

Tax cut of 1 percent of GDP for 5 years ($GDP = y_0 = 100$)



Tax cut of 3 percent of GDP for 10 years ($GDP = y_0 = 100$)

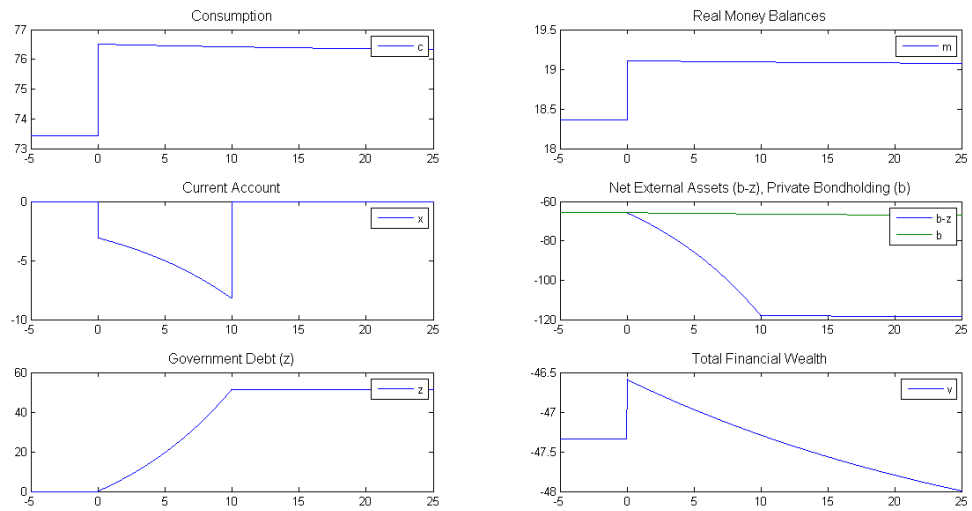
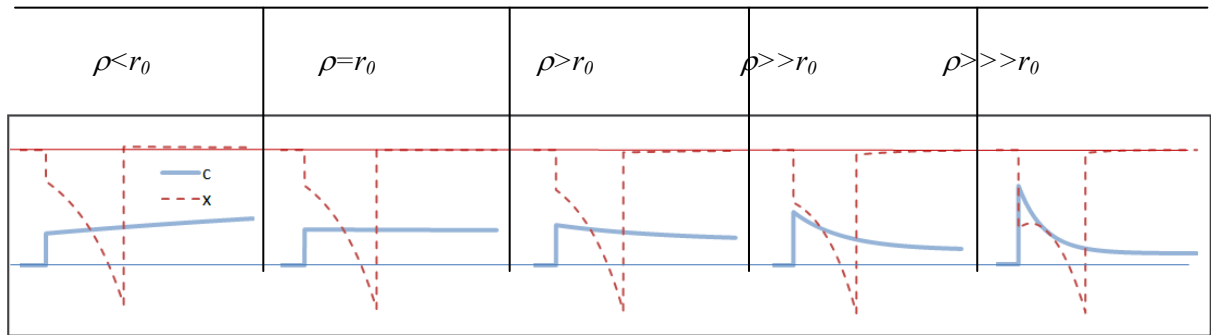
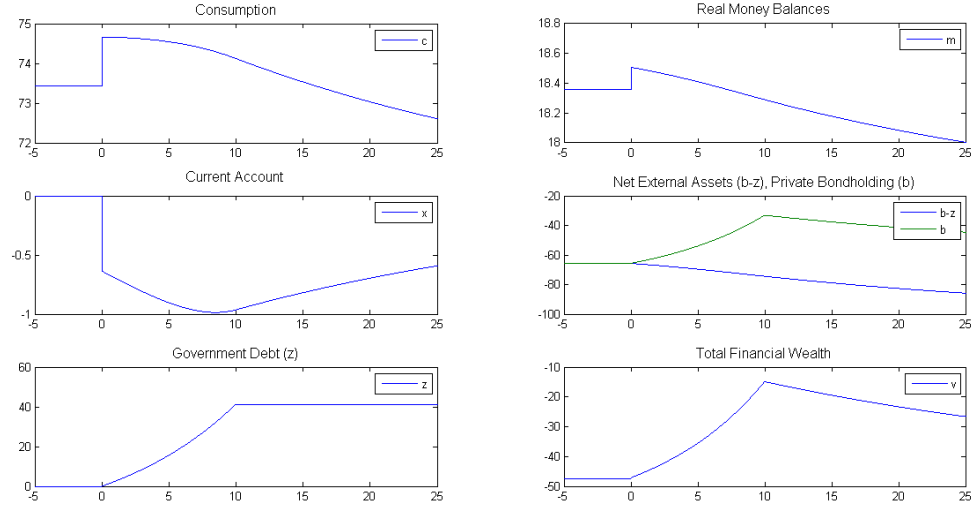


Figure 4. Consumption (c) and Current account (x) Under Different ρ and r_0 ($n_3=1$)

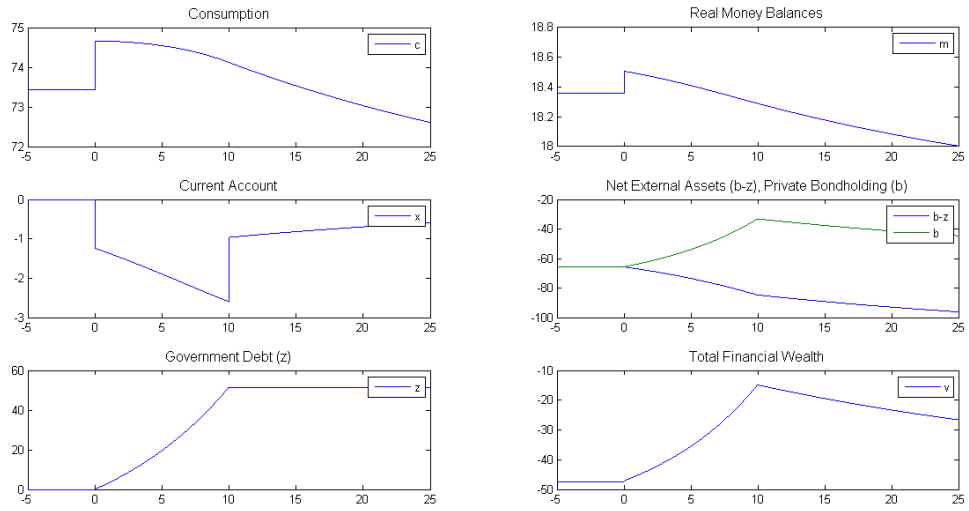
PS: The only variation across the charts is in the values of ρ , which is 0.085 in the first chart, 0.1 in the second, 0.115 in the third, 0.16 in the fourth, and 0.25 in the fifth. r_0 is fixed at 0.1.

Figure 5. *Equivalence of Upfront and Anticipated Aid Under Perfect Foresight*

Front-loaded Aid: $\alpha=0.2|n_1=1|n_2=0|n_3=0$



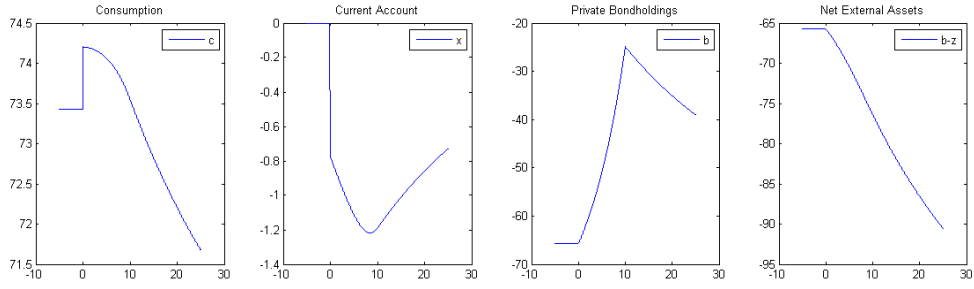
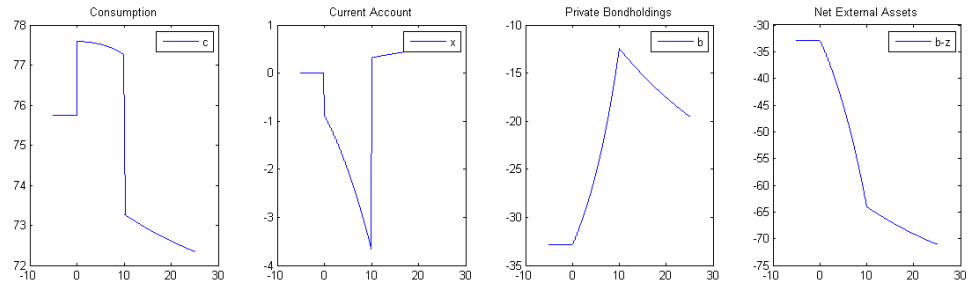
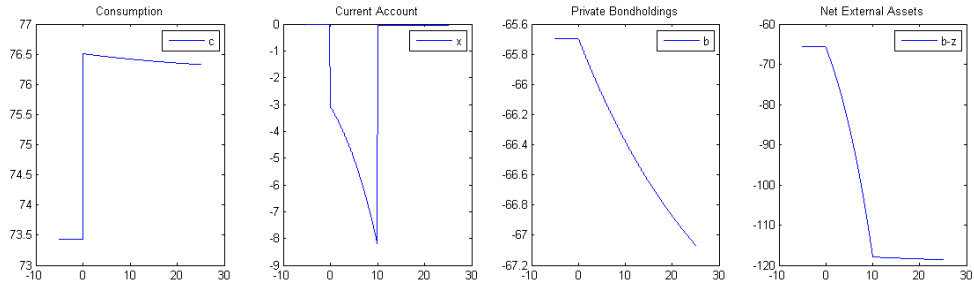
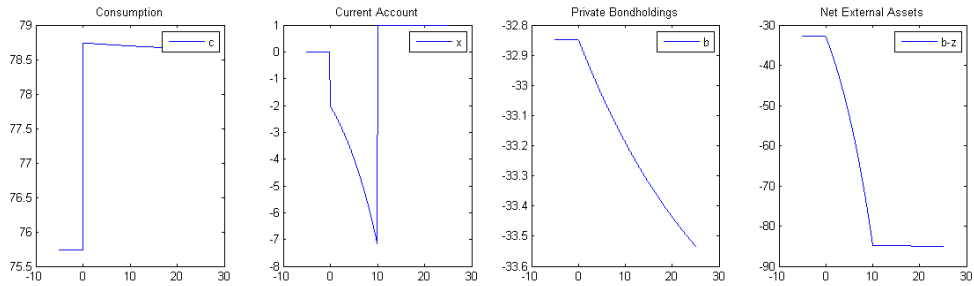
Back-loaded Aid: $\alpha=0|n_1=0.8|n_2=0|n_3=0.2$



$\gamma = 0.92$; tax cut of 3 percent of GDP; $T = 10$ years

α = share of tax cut covered by aid (during $0 < t < T$)

$n_1/n_2/n_3$ are shares of future tax/money/aid finance (during $t \geq T$)

Figure 6. Comparison of Solutions *With/Without Credit Constrained Households* (share= δ)Full Future *Tax* Finance Solution ($n_f=1$) $\delta=0$  $\delta=0.5$ A. Full Future *Aid* Finance ($n_3=1$) $\delta=0$  $\delta=0.5$ 

PS: Tax cut of 3% of GDP tax cut for 10 years; $\gamma=0.94, 0.97$ (when $\delta=0, 0.5$).

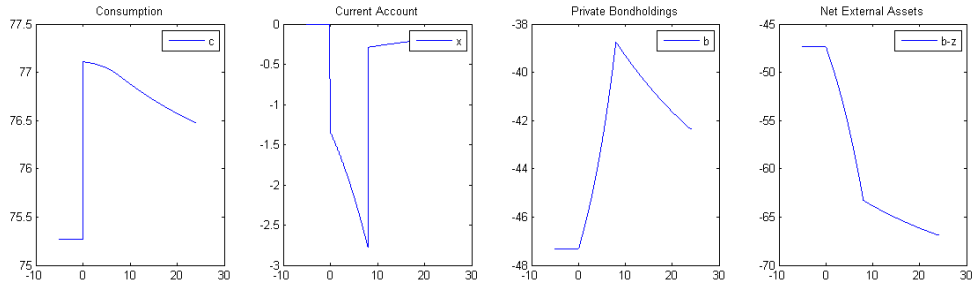
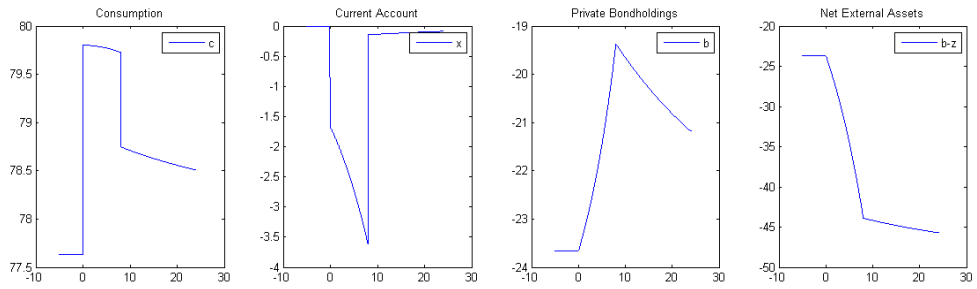
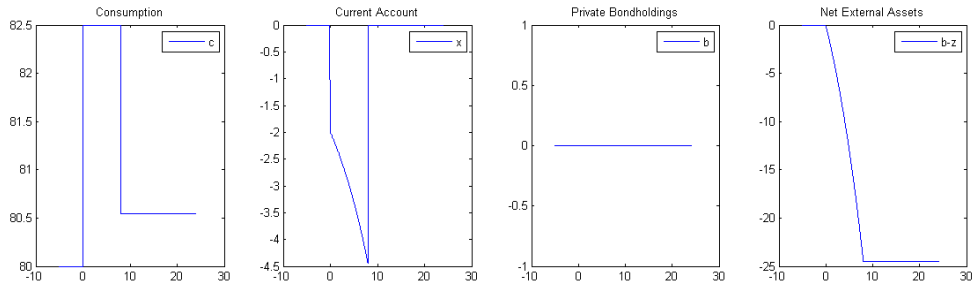
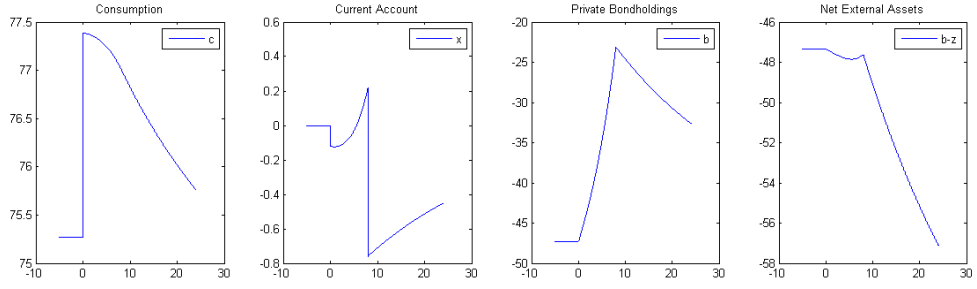
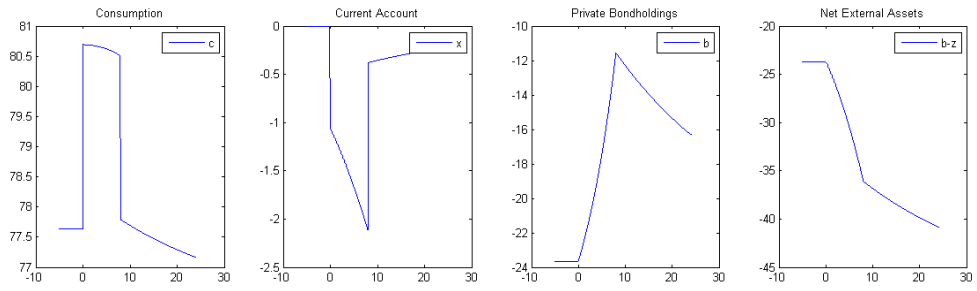
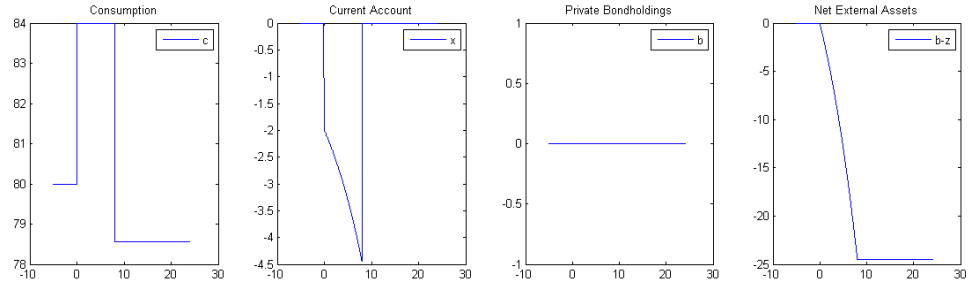
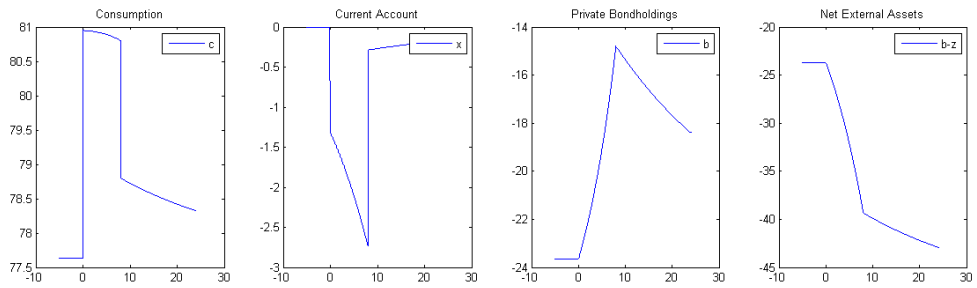
Figure 7. Impact of *Aid Timing with Credit Constrained Households and Government*a. Programme A (*Backloaded Aid*) $\delta = 0$  $\delta = 0.5$  $\delta = 1$ PS: 2.5% of GDP tax cut for 8 years; $\alpha = 0.2$ | $n_I = 0.44$ | $n_3 = 0.56$; $\gamma = 0.94, 0.97, 1$ (when $\delta = 0, 0.5, 1$)

Figure 7 (contd.). Impact of *Aid Timing with Credit Constrained Households & Government*b. Programme B (*Frontloaded Aid*) $\delta = 0$  $\delta = 0.5$  $\delta = 1$ Tax cut of 2.5% of GDP tax cut for 8 years; $\alpha=0.5 | n_I = 1.22 | n_3 = -0.22$; $\gamma = 0.94, 0.97, 1$ (when $\delta=0, 0.5, 1$)

c. Programme B But with Future Aid Cut Not Believed

 $\delta = 0.5$ Tax cut of 4% of GDP tax cut for 8 years; $\alpha = 0.5 | n_I = 0.9 | n_3 = 0.1$; $\gamma = 0.97$

BIBLIOGRAPHY

- Abbas, S. M. Ali, Jacques Bouhga-Hagbe, Antonio J. Fatás, Paolo Mauro, and Ricardo Velloso, 2011, “Fiscal Policy and the Current Account,” *IMF Economic Review*, Vol. 59, No. 4, pp. 603–629.
- Adam, Christopher, Edward F. Buffie and Stephen A. O’Connell, 2010, “Fiscal Inertia, Donor Credibility, and the Monetary Management of Aid Surges,” *Journal of Development Economics*, Vol. 93, No. 2 (November), pp. 287-298.
- Adam, Christopher, and David Bevan, 2005, “Fiscal Deficits and Growth in Developing Countries,” *Journal of Public Economics*, Vol. 89, No. 4 (April), pp. 571-597.
- Arslanalp, Serkan, Fabian Bornhorst, Sanjeev Gupta, and Elsa Sze, 2010, “Public Capital and Growth”, IMF Working Paper 10/175.
- Azman-Saini, W. N. W., Muzafar Shah Habibullah, Peter Smith, 2009, “Testing Liquidity Constraints in ten Asian Developing Countries: An Error-Correction Model Approach,” *Applied Economics*, Vol. 38, No. 21, pp. 2535-2543.
- Barro, Robert J., 1974, “Are Government Bonds Net Wealth?” *Journal of Political Economy*, Vol. 82, No. 6, pp. 1095-1117.
- Blanchard, Olivier, 1985 “Debt, Deficits, and Finite Horizons,” *Journal of Political Economy*, 93(2), 223–247.
- Baldini, Alfredo, and Marcos Poplawski Ribeiro, 2008, “Fiscal and Monetary Anchors for Price Stability: Evidence from Sub-Saharan Africa,” IMF Working Paper No. 08/121 (Washington: International Monetary Fund).
- Bluedorn, John, and Daniel Leigh, 2011, “Revisiting the Twin Deficits Hypothesis: The Effect of Fiscal Consolidation on the Current Account,” *IMF Economic Review*, Vol. 59, No. 4, pp. 582-602.

- Budina, Nina, and Sweder van Wijnbergen, 2011, "Fiscal Sustainability, Volatility and Oil Wealth: A Stochastic Analysis of Fiscal Spending Rules," Tinbergen Institute Discussion Papers 11-068/2, Tinbergen Institute, revised 16 May 2011.
- Buiter, Willem H., 1986, "Structural and Stabilization Aspects of Fiscal and Financial Policy in the Dependent Economy," NBER Working Paper No. 2023 (September), (Cambridge: National Bureau of Economic Research).
- _____, 1988, "Structural and Stabilization Aspects of Fiscal and Financial Policy in the Dependent Economy," *Oxford Economic Papers* 40, 220-245, Oxford
- Buffie, Edward F., 2001, *Trade Policy in Developing Countries* (Cambridge: Cambridge University Press).
- Carmichael, B., S. Keitab, L. Samson, 1999, "Liquidity Constraints and Business Cycles in Developing Countries," *Review of Economic Dynamics* 2, 370-402.
- Calvo, Guillermo and Pablo Guidotti, (1993), "On the Flexibility of Monetary Policy: The Case of the Optimal Inflation Tax", *Review of Economic Studies*, 60(3), pp. 667-87.
- Carroll, Christopher D., and Miles S. Kimball, 2001, "Liquidity Constraints and Precautionary Saving," NBER Working Papers 8496, National Bureau of Economic
- Collier, P., R., van der Ploeg, M. Spence and A. Venables, 2010, "Managing Resource Revenues in Developing Countries", *IMF Economic Review*, vol. 57, pp 84-118.
- Coons, James W., and W. Lee Hoskins, 1995, "Mexico: Policy Failure, Moral Hazard, and Market Solutions," Cato Institute Policy Analysis No. 243 (Washington: The Cato Institute).
- Corsetti, Giancarlo, Klaus Schmidt-Hebbel, and Steven B. Webb, 1992, "Household Saving in Developing Countries: First Cross-Country Evidence," *The World Bank Economic Review*, Vol. 6, No. 3 (September), pp. 529-547.
- Dawn, 2011, "Pakistan ties 'too important' to fail: US", <http://dawn.com/2011/12/24/pakistan-ties-too-important-to-fail-us/> (accessed April 4, 2012)
- Drazen, Allan, and Elhanan Helpman, 1987, "Stabilisation with Exchange Rate Management," *Quarterly Journal of Economics* 102, (November), pp. 835-56.

-
- _____, 1988, "The Effect of Policy Anticipation on Stabilization Programs," *European Economic Review* (Papers and Proceedings), 32, pp. 680-68.
- Diaz-Cassou, Javier, Aitor Erce-Dominguez, and Juan J. Vazquez-Zamora, 2008, "Recent Episodes of Sovereign Debt Restructurings: A Case Study Approach," Documentos Ocasionales No. 0804 (Madrid: Banco de España).
- Eichengreen, Barry, 2000, "Can the Moral Hazard Caused by IMF Bailouts be Reduced?" Geneva Reports on the World Economy Special Report 1, (London: Center for Economic Policy Research).
- Finger, Harald, and Mauro Mecagni, 2007, *Sovereign Debt Restructuring and Debt Sustainability: AN Analysis of Recent Cross-Country Experience*, IMF Occasional Paper No. 255 (Washington: International Monetary Fund).
- Frenkel, Jacob, and Assaf Razin, 1987, *Fiscal Policies and the World Economy*, Cambridge: MIT Press.
- Gelb, Alan, 1988, *Oil Windfalls: Blessing or Curse?* New York: Oxford University Press.
- Habibullah, M.S., P. Smith, and W.N.W. Azman-Saini, 2006, "Testing liquidity Constraints in 10 Asian Developing Countries: An Error-Correction Model Approach", *Applied Economics* 38 (21), pp. 2535-2543.
- Haque, Nadeem U., and Peter Montiel, 1989, "Consumption in Developing Countries: Test for Liquidity and Finite Horizons," *The Review of Economics and Statistics*, Vol. 71, No. 3 (August), pp. 408-415.
- Hemming, R., Michael Kell, and Selma Mahfouz, 2002, "The Effectiveness of Fiscal Policy in Stimulating Economic Activity—A Review of the Literature", IMF Working Paper No. 02/208.
- Hoskins, W. L., and J. W. Coons, 1995, "Mexico: Policy Failure, Moral Hazard, and Market Solutions." Cato Institute Policy Analysis No. 243 (10 October).
- International Monetary Fund, 2011, *Regional Economic Outlook: Sub-Saharan Africa*, September 2011, IMF: Washington, DC.

- Kawai, Masahiro and Louis J. Maccini, 1990, "Fiscal Policy, Anticipated Switches in Methods of Finance, and the Effects on the Economy," *International Economic Review*, Vol. 31, No. 4 (November), pp. 913-934.
-
- _____, 1995, "Twin Deficits versus Unpleasant Fiscal Arithmetic in a Small Open Economy," *Journal of Money, Credit and Banking*, Vol. 27, No. 3 (August), pp. 639-658.
- Kim, Soyoung, and Nouriel Roubini, 2008, "Twin Deficit or Twin Divergence? Fiscal Policy, Current Account, and Real Exchange Rate in the U.S.," *Journal of International Economics*, Vol. 74, No. 2 (March), pp. 362-383.
- Li, Yiting, and Guillaume Rocheteau, 2011, "On the Threat of Counterfeiting," *Macroeconomic Dynamics*, Cambridge University Press, vol. 15(S1), pages 10-41, April.
- Nichol, Jim, 2008, "Russia-Georgia Conflict in South Ossetia: Context and Implications for U.S. Interests", Congressional Research Service, Report No. RL34618 (September).
- Nushiwat, Munther, 2007, "Foreign Aid to Developing Countries: Does it Crowd Out the Recipient Countries' Domestic Savings", *International Research Journal of Finance and Economics*, No. 11, EuroJournals Publishing Inc.
- Seater, John J., 1993, "Ricardian Equivalence," *Journal of Economic Literature*, Vol. 31, No. 1 (March), pp. 142-190.
- Schmidt-Hebbel, Klaus, Steven B. Webb, and Giancarlo Corsetti, 1992, "Household Saving in Developing Countries: First Cross-Country Evidence," *World Bank Economic Review*, World Bank Group, vol. 6(3), pages 529-47, September.
- van der Ploeg, Frederick, and Anthony Venables, 2011, "Harnessing Windfall Revenues: Optimal Policies for Resource-Rich Developing Economies", *Economic Journal*, Vol. 121 (March), pp. 1-30.

World Bank, 2008, *World Development Indicators*, World Bank: Washington, DC.

Yaari, Menahem E., 1965, "Uncertain Lifetime, Life Insurance, and the Theory of the Consumer," *The Review of Economic Studies*, Vol. 32, No. 2 (April), pp. 137-150.

Appendix A – Model Algebra (Section III)

• 1a: Initial Steady States

Putting $\dot{c} = \dot{b} = \dot{m} = \dot{z} = \dot{t} = 0$ in the system of equations (9)-(12), we get:

$$c_0 = \gamma(y_0 - \tau_0) \dots\dots\dots A1$$

$$b_0 = \frac{\gamma - 1}{r_0}(y_0 - \tau_0) \dots\dots\dots A2$$

$$m_0 = \frac{\beta\gamma}{r_0}(y_0 - \tau_0) \dots\dots\dots A3$$

$$z_0 = \frac{\tau_0 + a_0 - g_0}{r_0} \dots\dots\dots A4$$

$$\text{where } \gamma = \frac{\theta(\rho + \theta)}{(1 + \beta)(\rho + \theta - r_0)(r_0 + \theta)} > 0 .$$

• 1b: Final Steady States

To solve for these, we proceed in two steps:

We put $\dot{c} = \dot{b} = \dot{m} = 0$ in (9)–(11), noting that z_t now equals z_T , and denoting steady states as $\bar{c}$, $\bar{b}$, $\bar{m}$, and $\bar{z}$.

Next, we obtain expressions for $\bar{\tau}$, $\bar{\mu}$ and $\bar{a}$ (i.e. the final steady state levels of the policy variables) from the deficit closure rules, as follows:

$$\begin{aligned}\bar{\tau} - \tau_1 &= n_1 \bar{d} \\ \bar{\mu} \bar{m} &= n_2 \bar{d} \quad , \text{ where } \bar{d} = (1 - \alpha)(\tau_0 - \tau_1)e^{r_0 T} \\ \bar{a} - a_0 &= n_3 \bar{d}\end{aligned}$$

Plugging these into the expressions for $\bar{c}$, $\bar{b}$ and $\bar{m}$, we obtain the reduced form final steady states in terms of the parameters:

$$\bar{c} = \gamma(y_0 - \tau_1) - \gamma n_1 \bar{d} = c_0 + \gamma(\tau_0 - \tau_1)(1 - (1 - \alpha)n_1 e^{r_0 T}) \dots\dots\dots (A6)$$

$$\bar{b} = \frac{1}{r_0} \left[(\gamma - 1)(y_0 - \tau_1) - (\gamma n_1 - (1 - n_3)) \bar{d} \right] = b_0 + \frac{\tau_0 - \tau_1}{r_0} \left[(\gamma - 1) - (\gamma n_1 - (1 - n_3))(1 - \alpha) e^{r_0 T} \right] \dots\dots (A7)$$

$$\bar{m} = \frac{1}{r_0} \left[\beta \gamma (y_0 - \tau_1) - (\beta \gamma n_1 + n_2) \bar{d} \right] = m_0 + \frac{\tau_0 - \tau_1}{r_0} \left[\beta \gamma - (\beta \gamma n_1 + n_2)(1 - \alpha) e^{r_0 T} \right] \dots\dots\dots (A8)$$

$$\bar{z} = z_T \dots\dots\dots (A9)$$

• 2a: General Solution for the Stable Regime $t \geq T$

We start from the basic equations (9)-(12) developed in the paper, and combine them with the final steady state levels of c , b , m (and z) derived above in (A6)-(A9). Accordingly, we get the following system of equations:

$$\begin{pmatrix} \dot{c}_t \\ \dot{b}_t \\ \dot{m}_t \end{pmatrix} = \begin{pmatrix} r_0 - \rho & -\frac{\theta(\theta + \rho)}{1 + \beta} & -\frac{\theta(\theta + \rho)}{1 + \beta} \\ -1 & r_0 & 0 \\ -\beta & 0 & r_0 \end{pmatrix} \begin{pmatrix} c_t - \bar{c} \\ b_t - \bar{b} \\ m_t - \bar{m} \end{pmatrix} \dots\dots\dots (A10)$$

This can be equivalently written as:

$$\begin{aligned}
c_t - \bar{c} &= H_1 J_1 e^{\lambda_1 t} + H_2 J_2 e^{\lambda_2 t} + H_3 J_3 e^{\lambda_3 t} \\
b_t - \bar{b} &= J_1 e^{\lambda_1 t} + J_2 e^{\lambda_2 t} + J_3 e^{\lambda_3 t} \dots\dots\dots (A11) \\
m_t - \bar{m} &= K_1 J_1 e^{\lambda_1 t} + K_2 J_2 e^{\lambda_2 t} + K_3 J_3 e^{\lambda_3 t}
\end{aligned}$$

where $H_1 = \rho + \theta$, $H_2 = 0$, $H_3 = -\theta$, $K_1 = K_3 = \beta$, and $K_2 = -1$ are the eigenvectors and λ_1 , λ_2 and λ_3 are the *eigenvalues* of the system. The latter solve, respectively, to: $-(\rho + \theta - r_0)$, r_0 and $r_0 + \theta$. As r_0 and $r_0 + \theta$ are both positive, $\rho + \theta - r_0 > 0$ is required for saddle-path stability (i.e. one negative root). The existence of two unstable roots means there must be two jump variables in the system. In our case, these are c and m , which are both forward-looking; z and b are backward looking.

Assuming saddle-path stability, we set $J_2 = J_3 = 0$ (as they correspond to the two unstable roots), and recover the constant $J_1 = (b_T - \bar{b})e^{-(\rho + \theta - r_0)T}$ corresponding to the stable root, from the boundary condition for b (i.e. by putting $t = T$ in the second equation in (A11)). Thus, we have the general solution for the stable regime as follows:⁴⁵

$$c_t - \bar{c} = (\rho + \theta)(b_T - \bar{b})e^{-(\rho + \theta - r_0)(t - T)} \dots\dots\dots (A12)$$

$$b_t - \bar{b} = (b_T - \bar{b})e^{-(\rho + \theta - r_0)(t - T)} \dots\dots\dots (A13)$$

$$m_t - \bar{m} = \beta(b_T - \bar{b})e^{-(\rho + \theta - r_0)(t - T)} \dots\dots\dots (A14)$$

$$z_t = z_T \dots\dots\dots (A15)$$

• 2b: General Solution for the Unstable Regime $0 \leq t \leq T$

Using (9)-(11), the system for this regime can also be written as:

⁴⁵ Note that once the general solutions have been obtained, it is straightforward to derive the dynamic adjustment paths by taking first (and second) derivatives of the general solutions of c , m , b and x with respect to time (t). The results are illustrated in the main text.

$$\begin{pmatrix} \dot{c}_t \\ \dot{b}_t \\ \dot{m}_t \end{pmatrix} = \begin{pmatrix} r_0 - \rho & -\frac{\theta(\theta + \rho)}{1 + \beta} & -\frac{\theta(\theta + \rho)}{1 + \beta} \\ -1 & r_0 & 0 \\ -\beta & 0 & r_0 \end{pmatrix} \begin{pmatrix} c_t - \tilde{c} \\ b_t - \tilde{b} \\ m_t - \tilde{m} \end{pmatrix} \dots\dots\dots (A16)$$

where $\tilde{c}$, $\tilde{b}$ and $\tilde{m}$ (which replace $\bar{c}$, $\bar{b}$ and $\bar{m}$) correspond to the value of the policy parameters during this period, i.e. τ_t , a_t and $\mu_t (= \mu_0 = 0)$. Thus,

$$\tilde{c} = \gamma(y_0 - \tau_1) = c_0 + \gamma(\tau_0 - \tau_1) \dots\dots\dots (A17)$$

$$\tilde{b} = \frac{1}{r_0}(\gamma - 1)(y_0 - \tau_1) = b_0 + \frac{1}{r_0}(\gamma - 1)(\tau_0 - \tau_1) \dots\dots\dots (A18)$$

$$\tilde{m} = \frac{\beta\gamma}{r_0}(y_0 - \tau_1) = m_0 + \frac{\beta\gamma}{r_0}(\tau_0 - \tau_1) \dots\dots\dots (A19)$$

(A16) can equivalently be written as:

$$\begin{aligned} c_t - \tilde{c} &= (\rho + \theta)\tilde{J}_1 e^{-(\rho + \theta - r_0)t} - \theta\tilde{J}_3 e^{(r_0 + \theta)t} \\ b_t - \tilde{b} &= \tilde{J}_1 e^{-(\rho + \theta - r_0)t} + \tilde{J}_2 e^{r_0 t} + \tilde{J}_3 e^{(r_0 + \theta)t} \dots\dots\dots (A20) \\ m_t - \tilde{m} &= \beta\tilde{J}_1 e^{-(\rho + \theta - r_0)t} - \tilde{J}_2 e^{r_0 t} + \beta\tilde{J}_3 e^{(r_0 + \theta)t} \end{aligned}$$

While the eigenvalues and eigenvectors are the same as in 2a (for the system for $t \geq T$), there is no requirement for the system to be saddle-point stable. Thus, we now have *three* constants, $\tilde{J}_1$, $\tilde{J}_2$ and $\tilde{J}_3$ (corresponding to the three eigenvalues) to determine, using the following three boundary conditions:

- (i) Perfect foresight implies that consumption (which is a jump variable) must be continuous at T : c_{T-} (from regime $0 < t < T$) = c_{T+} (from regime $t \geq T$), so that:

$$\tilde{c} + (\rho + \theta)\tilde{J}_1 e^{-(\rho+\theta-r_0)T} - \theta\tilde{J}_3 e^{(r_0+\theta)T} = \bar{c} + (\rho + \theta)(b_T - \bar{b}) \dots\dots (A21)$$

(ii) Perfect foresight implies that real money balances (also a jump variable) must be continuous at T: m_T . (from regime $0 < t < T$) = m_{T+} (from regime $t \geq T$), so that:

$$\tilde{m} + \beta\tilde{J}_1 e^{-(\rho+\theta-r_0)T} - \tilde{J}_2 e^{r_0 T} + \beta\tilde{J}_3 e^{(r_0+\theta)T} = \bar{m} + \beta(b_T - \bar{b}) \dots\dots\dots (A22)$$

(iii) The initial level of bond-holdings (b_0) relates to $\tilde{b}$ as follows:

$$b_0 - \tilde{b} = \tilde{J}_1 + \tilde{J}_2 + \tilde{J}_3 \dots\dots\dots (A23)$$

Additionally,

$$b_T - \bar{b} = (b_T - \tilde{b}) + (\tilde{b} - \bar{b}) = \tilde{J}_1 e^{-(\rho+\theta-r_0)T} + \tilde{J}_2 e^{r_0 T} + \tilde{J}_3 e^{(r_0+\theta)T} + (\tilde{b} - \bar{b}) \dots\dots\dots (A24)$$

Superimposing (A24) onto (A22), we can solve for $\tilde{J}_2$. Using (A24) with (A21) and the solved expression for $\tilde{J}_2$, we obtain $\tilde{J}_3$. Finally, plugging $\tilde{J}_2$ and $\tilde{J}_3$ into (A23) yields $\tilde{J}_1$:

$$\begin{aligned} \tilde{J}_1 &= - \left[\frac{(\gamma-1)(1+\beta)}{r_0(1+\beta)(1-\alpha)} + \frac{(n_2 + \beta(1-n_3))}{r_0(1+\beta)} + \frac{\gamma n_1(\rho+\theta-r_0)}{\theta(\rho+2\theta)} e^{-\theta T} \right] (1-\alpha)(\tau_0 - \tau_1) \\ \tilde{J}_2 &= \left[\frac{n_2 + \beta(1-n_3)}{r_0(1+\beta)} \right] (1-\alpha)(\tau_0 - \tau_1) \\ \tilde{J}_3 &= \left[\frac{\gamma n_1(\rho+\theta-r_0)}{\theta(\rho+2\theta)} e^{-\theta T} \right] (1-\alpha)(\tau_0 - \tau_1) \\ b_T - \bar{b} &= \left[\frac{n_1(1-\alpha)(\gamma + \beta\gamma - 1) - \{(\gamma + \beta\gamma - 1 + n_2(1-\alpha) - \beta(1-(1-\alpha)(1-n_3)))\} e^{-(\rho+\theta)T}}{r_0(1+\beta)} \right. \\ &\quad \left. + \frac{\gamma n_1(\rho+\theta-r_0)}{\theta(\rho+2\theta)} (1-\alpha)(1-e^{-(\rho+2\theta)T}) \right] (\tau_0 - \tau_1) e^{r_0 T} \end{aligned}$$

• 2c: General Solutions

Combining the solutions for the two regimes, the general solution can be written as:⁴⁶

$$\begin{aligned}
 c_t &= \begin{cases} \tilde{c} + (\rho + \theta)\tilde{J}_1 e^{-(\rho+\theta-r_0)t} - \theta\tilde{J}_3 e^{(r_0+\theta)t}, & \text{for } 0 < t < T \\ \bar{c} + (\rho + \theta)(b_T - \bar{b})e^{-(\rho+\theta-r_0)(t-T)}, & \text{for } t \geq T \end{cases} \\
 b_t &= \begin{cases} \tilde{b} + \tilde{J}_1 e^{-(\rho+\theta-r_0)t} + \tilde{J}_2 e^{r_0 T} + \tilde{J}_3 e^{(r_0+\theta)t}, & \text{for } 0 < t < T \\ \bar{b} + (b_T - \bar{b})e^{-(\rho+\theta-r_0)(t-T)}, & \text{for } t \geq T \end{cases} \\
 m_t &= \begin{cases} \tilde{m} + \beta\tilde{J}_1 e^{-(\rho+\theta-r_0)t} - \tilde{J}_2 e^{r_0 T} + \beta\tilde{J}_3 e^{(r_0+\theta)t}, & \text{for } 0 < t < T \\ \bar{m} + \beta(b_T - \bar{b})e^{-(\rho+\theta-r_0)(t-T)}, & \text{for } t \geq T \end{cases} \\
 z_t &= \begin{cases} z_0 + \frac{(1-\alpha)(\tau_0 - \tau_1)}{r_0}(e^{r_0 t} - 1), & \text{for } 0 < t < T \\ z_0 + \frac{(1-\alpha)(\tau_0 - \tau_1)}{r_0}(e^{r_0 T} - 1), & \text{for } t \geq T \end{cases} \\
 b_t - z_t &= \begin{cases} \tilde{b} - z_0 - \frac{(1-\alpha)(\tau_0 - \tau_1)(e^{r_0 t} - 1)}{r_0} + \tilde{J}_1 e^{-(\rho+\theta-r_0)t} + \tilde{J}_2 e^{r_0 t} + \tilde{J}_3 e^{(r_0+\theta)t}, & \text{for } 0 < t < T \\ \bar{b} - z_0 - \frac{(1-\alpha)(\tau_0 - \tau_1)(e^{r_0 T} - 1)}{r_0} + (b_T - \bar{b})e^{-(\rho+\theta-r_0)(t-T)}, & \text{for } t \geq T \end{cases} \\
 x_t = \dot{b}_t - \dot{z}_t &= \begin{cases} -(\rho + \theta - r_0)\tilde{J}_1 e^{-(\rho+\theta-r_0)t} + r_0 e^{r_0 t} \left[\tilde{J}_2 - \frac{(1-\alpha)(\tau_0 - \tau_1)}{r_0} \right] + (r_0 + \theta)\tilde{J}_3 e^{(r_0+\theta)t}, & \text{for } 0 < t < T \\ -(\rho + \theta - r_0)(b_T - \bar{b})e^{-(\rho+\theta-r_0)(t-T)}, & \text{for } t \geq T \end{cases}
 \end{aligned}$$

• 3a: Initial Jumps

The forward-looking variables, c , m , and x , can jump at time zero and these expressions can be obtained by setting $t=0$ in the $0 < t < T$ solution for these variables and subtracting the initial steady state values therefrom.

$$c_{0+} - c_0 = \tilde{c} - c_0 + (\rho + \theta)\tilde{J}_1 - \theta\tilde{J}_3 = \frac{(\theta + \rho)}{(\theta + r_0)} \left\{ \frac{1 - (1-\alpha)e^{-\theta T} n_1 + [(\beta n_3 - n_2)(1-\alpha) + \beta\alpha] \left(1 + \frac{\theta}{r_0} \right)}{1 + \beta} \right\} (\tau_0 - \tau_1)$$

(A25)

⁴⁶ The general solution can also be expressed as a linear combination of three terms: the first term is n_1 times the $n_1=1$ solution, the second term is n_2 times the $n_2=1$ solution, and the last term is n_3 times the $n_3=1$ solution. Thus, $c_t = n_1 * (c_t |_{n_1=1}) + n_2 * (c_t |_{n_2=1}) + n_3 * (c_t |_{n_3=1})$.

$$m_{0+} - m_0 = \tilde{m} - m_0 + \beta \tilde{J}_1 - \tilde{J}_2 + \beta \tilde{J}_3 = \frac{(\beta n_3 - n_2)(1 - \alpha) + \beta \alpha}{r_0} (\tau_0 - \tau_1) \dots\dots\dots$$

(A26)

$$x_{0+} - x_0 = -(c_{0+} - c_0), \text{ using (13)} \dots\dots\dots \text{(A27)}$$

• 3b: Dynamic adjustment paths

For the variable of interest, the dynamic adjustment paths can be inferred from first and second derivatives of the general solution given above. As these expressions are quite complicated, only the expressions for $n_3=1$ are given below, for illustration purposes. Note that these paths apply to both $0 < t < T$ and $t \geq T$, but this is particular to the case of $n_3=1$ only.

$$\dot{c} = -(\rho + \theta - r_0)(\rho + \theta)(\tau_0 - \tau_1) \left[\frac{1 - \gamma}{r_0} \right] e^{-(\rho + \theta - r_0)t}, \quad \ddot{c} = (\rho + \theta - r_0)^2(\rho + \theta)(\tau_0 - \tau_1) \left[\frac{1 - \gamma}{r_0} \right] e^{-(\rho + \theta - r_0)t} \dots \text{(A28)}$$

$$\dot{b} = -(\rho + \theta - r_0)(\tau_0 - \tau_1) \left[\frac{1 - \gamma}{r_0} \right] e^{-(\rho + \theta - r_0)t}, \quad \ddot{b} = (\rho + \theta - r_0)^2(\tau_0 - \tau_1) \left[\frac{1 - \gamma}{r_0} \right] e^{-(\rho + \theta - r_0)t} \dots\dots \text{(A29)}$$

$$\dot{m} = -\beta(\rho + \theta - r_0)(\tau_0 - \tau_1) \left[\frac{1 - \gamma}{r_0} \right] e^{-(\rho + \theta - r_0)t}, \quad \ddot{m} = \beta(\rho + \theta - r_0)^2(\tau_0 - \tau_1) \left[\frac{1 - \gamma}{r_0} \right] e^{-(\rho + \theta - r_0)t} \dots\dots \text{(A30)}$$

$$\dot{x} = -e^{r_0 t} (\tau_0 - \tau_1) \left[r_0 - \frac{(\rho + \theta - r_0)^2(1 - \gamma)}{r_0} e^{-(\rho + \theta)t} \right], \quad \ddot{x} = -e^{r_0 t} (\tau_0 - \tau_1) \left[r_0^2 + \frac{(\rho + \theta - r_0)^3(1 - \gamma)}{r_0} e^{-(\rho + \theta)t} \right] \dots \text{(A31)}$$

ESSAY II

THE ROLE OF DOMESTIC DEBT IN ECONOMIC GROWTH: AN EMPIRICAL INVESTIGATION FOR DEVELOPING ECONOMIES

ABSTRACT

The second essay focuses on the remaining source of government financing, i.e. domestic debt, and the role it can play in mobilizing private savings, facilitating credit intermediation in higher risk settings (i.e. serving a “collateral” function on bank balance sheets), developing financial markets and supporting economic growth in general. To investigate this question empirically, we set up a new domestic debt database covering about 100 developing economies, going back three decades to 1975; explore Granger causality links between domestic debt and key macroeconomic and institutional variables; and estimate the growth impact of domestic debt using panel regressions, allowing for non-linear effects. Domestic debt, as a share of GDP is found to exert a significant positive impact on economic growth, with potential channels including domestic savings mobilization, provision of risk-insurance on banks’ balance sheets; and greater institutional accountability of the state to its citizens. Although this result countervails more established arguments against domestic debt (i.e. that it leads to crowding out and banks to become lazy), there is some evidence that above a ratio of 35 percent of bank deposits, domestic debt does begin to undermine economic growth. The growth payoff also depends on debt quality, with higher payoffs observed for positive interest-rate bearing marketable debt issued to nonbank sectors.

Keywords: Public debt, domestic debt, economic growth, financial development, crowding out

JEL Classifications: D22, G11, G18, G32, H63

Essay II. The Role of Domestic Debt in Economic Growth:

An Empirical Investigation For Developing Economies¹

The national debt was one of the most contentious issues in the politics of the early United States. The debates that swirled around how to pay the national debt helped to provide the rationale for the writing and ratification of the Constitution and contributed to the development of political parties in the 1790s and early 1800s. The debt also remains one of the most difficult subjects to understand. Indeed, few people—perhaps not even Alexander Hamilton—ever fully comprehended all of the intricacies and complications of the debt that had emerged from the Revolutionary War (1775–83). However, Hamilton's policies successfully transformed the debt from a public liability to a civic asset. In the process, the debt became a driving force behind the creation of the United States and crucial to the moulding of a national identity. (Encyclopaedia of American History: Revolution and New Nation, 1761 to 1812, Revised Edition, vol. III)

I. Introduction and Motivation

While there is a large body of literature on the effects of public debt on capital accumulation and growth in industrialized countries – dating back to Diamond (1965) on the welfare effects of national debt, and Barro (1974) on debt neutrality – the study of public debt and growth in lower income countries (LICs) and emerging markets (EMs) has mostly happened in the narrower context of external debt.² The debt Laffer curve literature *a la* Sachs (1989) and Husain (1997), and empirical investigations thereof – such as Pattillo et al. (2002) – have all concentrated on the growth impact of ‘external’ debt. Even here, the focus has been the country’s total external debt, rather than its publicly owed counterpart.

Indeed, little formal academic or policy interest has been shown in understanding the possible relationship(s) between public ‘domestic’ debt (DD) and economic growth in LICs and

¹ A revised/abridged version of this paper, co-authored with Jakob Christensen, appeared in *IMF Staff Papers* in January 2010 as “The Role of Domestic Debt Markets in Economic Growth: an Empirical Investigation for Emerging Markets and Low-Income Countries”.

² The debt neutrality literature developed in industrialised countries remains agnostic to the external-DD distinction. This is understandable, given that industrialised country governments borrow predominantly from their own citizens and in their own currencies. However, as the “original sin” literature has made clear, the distinction is nontrivial for LICs – see Eichengreen and Hausmann (2005).

EMs.³ Although, some work on local bond markets has been initiated by emerging markets and international financial institutions of late, this predominantly reflects a response to the East Asian financial crisis, which was seen as stemming from, *inter alia*, a mispricing of currency risk and weak financial markets, with a result that there was over-reliance on bank-intermediated external finance.⁴ The arguments made in this literature focus mainly on the benefits of deeper bond markets for reducing the risk of currency crises given volatile capital flows; the implications for DD and/or fiscal financing strategies in general, are not highlighted per se.

Consequently, surprisingly basic fiscal and public debt policy questions have remained empirically unanswered to date, such as: Is there a causal link between DD and growth in LICs and EMs? Controlling for endogeneity, does DD contribute to economic growth, and through what channels? Is the impact linear or non-linear? How is it affected by the “quality” of debt, or the macro-financial and institutional environment obtaining in a country?

Such questions are more pertinent than ever given the increased scope for expanding domestic debt markets in many developing economies following large external debt waivers and a resurgence in international portfolio interest in local currency bond markets, especially since the recent global financial crisis which has pushed yields in advanced economies to historic lows. A meaningful policy response, however, remains constrained by a dearth of comprehensive empirical studies that examine domestic debt’s impact on savings, investment, financial deepening, institutions and, hence, growth.

³ Many categorisations of ‘domestic’ and ‘external/foreign’ are possible in the context of public debt; for instance, by currency (local or foreign), citizenship of holders, citizenship of issuer, place of issue etc. However some of these categorisations are more important for advanced financial systems. For the purposes of this paper, the focus whereof is lower income countries (LICs), it is assumed that public DD mainly represents the government’s total (securitised) indebtedness in domestic currency to its own citizens; public external debt, similarly, is government liabilities in foreign currency, issued to and held by foreign citizens. Some governments, esp. in Latin American, have issued debt in foreign currency (or debt that is index linked) to domestic residents. This category of “DD” is analytically different from the “domestic currency DD” definition that, as mentioned above, this paper focuses on. However, the data does not permit us to discriminate between the two types, and as such, some caution is warranted in deriving policy implications from the ensuing discussion.

⁴ See, for instance: IMF (2002-03).

This dearth of empirical studies reflects a number of factors i) data unavailability – reliable datasets on DD either do not exist or are not amenable to empirical analysis; ii) a wide-spread perception that DD is “endogenous” rather than an exogenous policy choice variable that governments can tweak to affect macro-financial outcomes: countries’ DD issuance capacity is “determined” entirely by their level of income, pool of savings and institutional quality; and iii) the relatively small size of DD relative to external public debt in most LICs and EMs. These factors have, arguably, combined over the years to “crowd out” the amount of attention paid to DD.

In the absence of clear evidence, policymakers have proceeded with taking a conservative, mostly sceptical, view of DD in developing economies. For instance, international financial institutions (IFIs) typically set conditionality in the form of zero or negative net domestic financing, which limits the scope to expand DD. This is justified on grounds that most developing economies have shallow financial markets, exhibit fiscal dominance and financial repression propensities, and lack debt management and institutional capacity. In such circumstances, rising DD would crowd out private investment and/or threaten fiscal sustainability. In addition, given many LICs’ access to cheap external finance, in the form of concessionary loans and grants, domestic borrowing at market rates is seen as expensive. In sum, for most policymakers in developing economies, DD is seen as a negative for the macroeconomy and for financial development.

However, some researchers have recently begun to echo the positive view of many market participants regarding the importance of DD instruments for monetary and financial systems, as well as the development of political institutions. Compared to other forms of budgetary finance, market based domestic borrowing is seen to contribute more to macroeconomic stability – low inflation and reduced vulnerability to external real and domestic monetary shocks – domestic savings generation and private investment. This seems to be supported by the experience of EMs such as China, India,

and Chile, which have grown handsomely and avoided major financial or fiscal crises, all while maintaining a relatively high domestic debt share.⁵

Against this backdrop, this paper attempts to throw some empirical light on the possible merits and demerits of DD. The paper:

- brings together the various arguments for and against DD issuance currently scattered across the literatures on capital markets, public finance, debt management and fiscal sustainability (section 2);
- compiles a new DD database spanning the period 1975-2007 for 93 LICs and EMs, as well as consolidating existing databases on DD (section 3);
- employs panel econometric techniques to examine the endogeneity of DD and its impact on growth with a view to obtaining a sense of the optimal size and quality of DD (section 4); and
- derives policy conclusions that could be relevant for macro-financial practitioners, especially in LICs (section 5).

II. Literature Review and Key Questions

i. Pros and cons of domestic debt

In a Ricardian world, domestic debt is neutral with respect to its effects on the economy. This is because borrowing merely postpones tax liabilities from current to future generations, and so has no impact on private consumption or investment, and hence on and growth. Departures from Ricardian equivalence (due to say, finite horizons, myopia/bounded rationality, distortionary taxation, liquidity

⁵ For evidence favouring internal over external finance reliance in LICs, see Aizenmann, Pinto and Radziwill (2004).

constraints) which would not be unexpected in developing economies must, therefore, underlie the *traditional* (sceptical) view of DD.⁶

In this *traditional* view, government dissaving does not induce a full saving offset from private agents, resulting in a smaller overall pool of savings. This raises interest rates, which lowers investment and, hence, the capital stock – producing a “burden” of domestic debt that rises with each generation (Modigliani, 1961; Diamond 1965). Cast slightly differently, a government’s domestic borrowing consumes domestic private savings that would otherwise have been available to finance productive private investment. As long as public investment is less efficient than private investment, DD issuance is welfare-reducing. In shallow financial markets, especially where firms have limited access to international finance, DD issuance can lead to both swift and severe crowding out of private lending.

Second, critics of DD, especially in developing economies, are also concerned with repercussions on fiscal and debt sustainability. DD is viewed as more expensive than concessionary external financing (Beaugrand et al, 2002).⁷ As a result, the interest burden of DD may absorb significant government revenues and thereby crowd-out pro-poor and growth enhancing spending. In addition, reliance on domestic financing may also delay tax mobilization efforts, which may be necessary but politically costly. Given the short-term structure of the DD portfolio in many LICs and EMs – see, for example, Christensen (2004) on Sub-Saharan Africa (SSA) – governments also face a significant liquidity risk from having to constantly roll-over large amounts of debt.

⁶ Note, that in a Keynesian (short-run) world, any government borrowing (domestic or external) that finances a demand injection into the economy is welfare-improving because there is excess supply in the economy that cannot dissipate through the workings of the price mechanism alone. As this paper is focused on the longer-term relationship between debt and growth, we abstract from near-term Keynesian demand considerations.

⁷ Abbas (2005) questions Beaugrand et al.’s (2002) conclusion that DD is always more expensive than concessionary external debt, noting that they do not take account i) the impact of the higher variance of external debt service (due to currency risk) on the present value burden of external debt; and ii) the fact that the implicit interest rate on external debt – a large part whereof is in default – is not comparable to the implicit interest rate on DD – which is rarely defaulted on.

Third, the cost of DD may rise sharply due to time inconsistency problems when government credibility is low. If the state has weak (direct) tax collection, as is typical in LICs, the state will have a strong incentive to monetise deficits and use the net domestic financing window to both, generate seigniorage, and, reduce the real burden of existing DD. Under these circumstances, the government faces a classic time inconsistency problem and, therefore, either cannot issue nominal debt at all, or has to pay a significant premium to compensate investors for the potential risk of surprise inflation.⁸

Fourth, high-yielding government DD held by banks can make them complacent about costs and reduce their drive to mobilise deposits and fund private sector projects. The incentive to provide credit to the private sector is often weakened by a poor credit environment. Hence, from a risk weighted perspective, government debt is highly attractive, providing a constant flow of earnings, so that banks have less incentive to expand credit to riskier private borrowers or cut their overheads (Hauner, 2006).⁹

Proponents of DD stress its positive impact on growth, inflation, and savings from deeper and more sophisticated capital markets, which enhance the volume and efficiency of private investment. Consequently, they question the wisdom of forever pursuing zero net domestic financing (NDF) policies in countries where marketable DD is already small and capital markets under-developed. Such policies, by reducing the size of DD relative to GDP and deposits, could exert a negative impact on financial market development, and complicate the exit from foreign aid dependency.

DD markets can help strengthen money and financial markets, boost private savings, and stimulate investment. First, government securities are a vital instrument for the conduct of indirect monetary policy operations and collateralized lending in interbank markets; the latter helps banks manage their

⁸ See Agenor and Montiel (1999: chapter 5) on how government incentives to extract seigniorage through high inflation leads to an erosion of the underlying nominal tax base.

⁹ The complacency effect should, however, diminish over time as competition reduces both yields in government securities auctions, and profits in the banking sector. Indeed, yields have fallen significantly lately as international investors have increased competition in African bond markets.

own liquidity more effectively, reducing the need for frequent central bank interventions.¹⁰

Consequently, central banks operating in well-developed DD markets do not have to rely as much on direct controls like credit ceilings, interest rate controls and high reserve requirements, all of which distort financial sector decisions and lead to financial disintermediation at the expense of private sector savings and investments (Gulde et al., 2006). Second, yields on government securities can serve as a pricing benchmark for long-term private debt issued by banks or enterprises and, hence, promote the development of a corporate bond market which boosts competition in the banking sector (Fabella and Mathur, 2003). Third, the availability of DD instruments can provide savers with an attractive alternative to capital flight as well as lure back savings from the non-monetary sector into the formal financial system (IMF, 2001). The possible benefits here can go beyond saving mobilization and extend to a reduction in the size of the black economy, widened tax base, increased financial depth, de-dollarization and improved perceptions of currency and country risk.

In addition to enhancing the volume of investment, DD can also improve the efficiency of investment and help increase total factor productivity. Banks in many developing economies face an inherently risky and unpredictable business environment, which makes them reluctant to engage with the private sector. As a result, banks play only a very limited role in providing longer term financing to important strategic sectors, such as agriculture and manufacturing, and prefer instead to finance consumption related trade activities (in the case of Africa, see Gulde et al., 2006). In providing banks with a steady and safe source of income, holdings of government securities may serve as collateral and encourage lending to riskier sectors. In other words, holdings of government debt may compensate for the lack of strong legal and corporate environments (Kumhof, 2004 and Kumhof and Tanner, 2005). The collateral function of DD may be particularly important when bank overheads cannot be reduced further, and lending risks remain high due to asymmetric information and/or weak contract enforcement (including of foreclosure laws).¹¹

¹⁰ See, for example, IMF (2005b), Detragiache (2005) and Ndikumana (2001).

¹¹ See Chirwa and Mlachila (2004); Barajas et al. (1999; 2000); and Brock and Rojas-Suarez (2000).

Third, in the longer-term, nominal debt contracts enhance political accountability and help governments build a track record to access international capital markets. Increasing the reliance on domestic financing may help mitigate the problems of external borrowing, which has been found to crowd out domestic institutions by weakening the state's dependence on its citizenry and hence severing the accountability channel that forces domestic institutional reform (Moss et al, 2006; Abbas, 2005). Furthermore, developing a track record may promote access to international financial markets. Research shows that countries that have successfully issued sovereign bonds on international markets have typically had a long prior experience with issuing domestic government bonds in their own markets (Kahn, 2005).

ii. Empirical Survey

Studies on DD have been constrained by a lack of reliable data, especially time series data for a large enough panel of countries. Much of the recent post-financial crisis empirical work on the topic has had a “total” public debt and/or advanced economy focus. For instance, Reinhart and Rogoff (2010) – documenting over a century of debt statistics – find growth outcomes to be weaker in years during which “total” public debt exceeded 90 percent of GDP. Kumar and Woo (2010) reach a similar conclusion with a shorter dataset that excludes LICs. A handful of studies on individual developing economies have also mushroomed recently, but with divergent results: Putnoi and Mutuku (2013) find a positive impact of DD on growth for Kenya, Atique and Malik (2012) find the opposite for Pakistan, while Singh (1999) finds nil effect for India.

Fry (1997) is the only panel study on the impact of alternative deficit-financing strategies on economic growth in LICs and EMs. For over 66 LICs and EMs over the 1979-1993 period, Fry finds market-based DD issuance to be the least costly method of financing the budget deficit as opposed to external borrowing, seigniorage and financial repression, all of which are eventually seen to stifle growth, reduce domestic saving, and fuel inflation. Indeed, the real question, according to him, is not “whether” countries should switch to market based domestic financing, but “how” they should do so.

Several studies have examined the impact of domestic financing on bank efficiency and private sector lending. Using bank-level data on 73 middle-income countries over the post-1990 period, Hauner (2006) finds that banks, which allocate more credit to the government, are more profitable, but less efficient. However, applying aggregate country level data on commercial bank holdings of DD, the results are mixed: DD only begins to harm financial development at very high levels. Since Hauner's sample excludes sub-Saharan Africa and other poorer LICs, which typically have low DD, his results are already somewhat biased towards finding a low residual DD capacity. Furthermore, the study does not take into account the fact that the extent to which banks can "sit on" government bond interest income or "pass them on" to depositors and borrowing firms depends on the nature of competition in the financial sector.

Empirical evidence on the crowding out effects of DD at the macroeconomic level is mixed. In a study of the determinants of financial depth, such as loans and deposits scaled to GDP, Detragiache et al. (2005) include government domestic interest payments as a proxy for DD in 82 LICs and EMs over the 1990-2001 period. The coefficient on interest payments is found to be significantly negative, although not robustly so in regressions of bank assets scaled to GDP, thereby suggesting a standard crowding out effect, at first glance. However, domestic interest payments enter the loans to GDP and deposits to GDP regressions positively, significantly and robustly, suggesting a *crowding in* effect in line with Kumhof and Tanner's (2005) collateral argument.

IMF (2005a) explicitly examines the impact of DD on private sector credit in the context of 40 LICs (including 15 mature stabilisers) over the 1993-2002 period.¹² Overall, the study finds "limited evidence of government recourse to domestic financing crowding out private sector borrowing in the mature stabilizers" (p. 34). Higher "levels" of DD are found to be associated with lower levels of corporate lending, but the relationship breaks down when first

¹² No explicit definition of DD is provided in the report; however, it appears that, like Hauner (2006), commercial bank credit to government is used as a proxy.

differences of the variables are used. The report also finds no robust evidence of a negative correlation between real T-bill rates and changes in DD for either the mature stabilizers or the broader LIC group. However, the report notes that crowding out may occur through channels other than interest rates, such as credit rationing, and cautions against a rapid buildup in DD, especially in the context of the availability of concessionary external financing.

iii. Testable hypotheses

The foregoing suggests a complex cost-benefit calculus for DD and a series of plausible hypotheses (A-C) must be tested in order to unravel it. For instance:

A. DD may have either a positive or negative net impact on growth. Furthermore, the impact of DD on growth may well be “non-linear”.

DD could both have positive and negative effects on economic growth. These contrary views may be bridged by the existence of a non-linear impact of debt: at moderate levels, DD boosts growth but beyond a certain level, more traditional crowding out concerns may dominate. Hence, it may be important to identify whether such threshold exists, which could help evaluate whether debt in a given country has reached inappropriate levels.

B. The macroeconomic impact of DD may work primarily through the investment efficiency channel rather than capital accumulation.

It is easy to see the direct (volume) channels: higher DD either crowds out investment given an unchanged pool of saving, or promotes more private saving (with positive knock-on effects on investment volume). But there could also be efficiency effects: for example, spill-over effects from DD markets to broader capital markets that promote more risk taking and support better

allocation of capital to productive sectors. If these sectors have been underfinanced in the past, DD markets could help raise total factor productivity and expand the economy's production frontier.

- C. *The institutional environment as well as the quality and span of DD markets may have a significant bearing on the growth impact of DD.*

The institutional environment could have a complex interaction with DD. On one hand, better institutions can imply a competent policy framework, featuring optimal use of fiscal resources for the provision of public services, infrastructure development, maintenance of law and order, and property rights protection. This would tend to make the growth impact of DD, or any source of budgetary finance for that matter, higher. On the other hand, DD markets may be less important in stable institutional environments as the collateral or risk-diversification function that DD performs on banks' balance sheets will play a smaller role. Furthermore, the risk-diversification benefit will become less important as the overall magnitude of risk in the economy falls. A priori, it is not clear which of two effects dominates: i.e., whether good institutions complement DD for public service provision, or whether they substitute for the collateral and risk-underwriting functions that DD performs on banks' balance sheets.

The quality and breadth of DD markets could also be important. It would be interesting, for example, to explore if the growth impact of DD depends on i) the composition of DD in terms of arrears and overdrafts versus auctioned securities (marketable T-bills and bonds) and ii) the holding of DD in terms of bank versus nonbank sectors. Indeed, many of the benefits of DD discussed above: safe asset and collateral functions, monetary policy and liquidity management benefits, and benchmark yield curve for private lending, all clearly apply to securitized DD and not to debt issued in captive markets or accumulated due to past fiscal irresponsibility or crises.

Commercial bank holdings of DD are likely to be associated with lower financial system efficiency and greater crowding out, than when debt is held by the non-bank sector.¹³ As indicated in Christensen (2004) and Gulde et al. (2006), the ability of LICs, in particular in SSA, to expand DD without crowding out bank lending to the private sector partly depends on the importance of the contractual savings sector (pension and insurance companies etc.). The participation by individual and contractual savings institutions in the government securities market boosts competition in the financial sector alleviating some of the concerns by Hauner (2006).¹⁴

III. Data and Econometric Framework

i. A new domestic debt database¹⁵

As mentioned earlier, reliable DD data has been, and still is, a serious problem in LICs and some EMs. Only a handful of governments in these countries properly maintain and report public DD data. Even among this small subset, regular reporting has been instituted only recently and consistent time series on DD are not available for a decent stretch of time. The absence of such data has also effectively precluded, in our view, serious research on DD, the consequent emergence of a “total” public debt (i.e. domestic + external) view on debt management and fiscal policy, and an understanding of how debt structure choices are affected by and affect macro, fiscal, financial and institutional variables.

¹³ See Hauner (2006) on the possible efficiency concerns associated with commercial bank holdings of government securities.

¹⁴ Other interesting attributes of DD could also matter for its growth impact, but are not covered here. These include whether the debt is short-term vs. long-term, index-linked, held by local or foreign residents, fixed or floating, backed by an active secondary market, and issued in benchmark maturities to enhance instrument liquidity. For the purposes of this paper, however, and given the data constraints, we are able to focus only on the marketability and holder-profile of DD.

¹⁵ The database developed in this paper has since been incorporated in a number of “live” and regularly updated public debt databases, most notably the IMF’s *Historical Public Debt Database* (introduced in Abbas et al, 2010) and the *Public Finance Database* of Mauro et al (2013).

Researchers at IMF have recently attempted to collect DD data on subsets of LICs and EMs.¹⁶

Christensen (2004) collected annual data on central government domestic securities from 1980-2000 on 26 Sub-Saharan African countries; however the data has many gaps, effectively covering only 20 countries. *Mellor* collected securitized and non-securitized central government DD on 70 IMF “program” countries from 1996-2004. The data is also usefully disaggregated by holder (banking system vs. nonbank sectors) and securitized vs. unsecuritized. A third database introduced by *Jeanne and Guscina (2006)* compiles securitized central government securities on 19 emerging markets, disaggregated by maturity and currency since 1980.¹⁷

An important contribution of this paper is to complement the above databases with an IFS-based annual DD series spanning 93 LICs and EMs over three decades, starting in the 1970s (1975) and running till the global financial crisis (2007). The series is based on the following DD definition: commercial banks’ gross claims on the central government *plus* central bank liquidity paper.¹⁸

Formally:

Public sector domestic debt (DD) =

DMB & OBI claims on CG + DMB & OBI holdings of liquidity paper

IFS lines (22a & 42a) + IFS lines (20c&40c)

¹⁶ This data has usually been extracted from IMF’s country statistical appendices and staff reports, which contain useful data on domestic government securities for IMF member countries. However, it is quite difficult to extract continuous and consistent DD series from these documents, as the coverage and timeliness of the appendices and staff reports varies significantly from program to non-program countries and from program to non-program ‘periods’ for each individual country.

¹⁷ We make selective use of the Mellor and Christensen databases in this paper.

¹⁸ Formally, public sector domestic debt (DD) = DMB & OBI claims on CG + DMB & OBI holdings of liquidity paper; or the lines in IFS: DD= (22a & 42a) + (20c&40c), where DMB is deposit money banks, OBI is other banking institutions, and CG and CB denote central government and central bank, respectively.

where DMB is deposit money banks, OBI is other banking institutions, and CG and CB denote central government and central bank, respectively. Appendix A provides further details on the extraction methodology.

Note that the chosen DD definition *excludes central bank holdings of central government securities*. This is partly due to data limitations: IFS monetary data contains central bank claims on government, but does not provide a split thereof into its *securitised* and *overdraft* components. To the extent that securitised central bank claims on government facilitate the conduct of monetary policy through indirect open market operations, the omission is likely to bias downwards any observed growth impact of DD. On the other hand, if such holdings of securities by the central bank essentially reflect fiscal dominance, the growth impact of a DD variable excluding them may be biased upwards.

Moreover, the definition *includes liquidity paper issued directly by the central bank*, which appears appropriate for the following reasons:¹⁹

- It is the aggregate of liquidity and financing paper that captures the overall volume of risk-free public securities issued to the private sector and available for collateralised lending (repos) in inter-bank money markets, for increasing the liquidity of local bond markets (if they exist), for helping develop a benchmark yield curve for pricing longer-term corporate loans or bonds, and as risk-mitigating collateral on banks' balance sheets.²⁰
- All liquidity paper is ultimately backed by central government revenues, and hence, an implicit central government liability. In a number of countries facing high interest rates, the cost of

¹⁹ Some of these equally constitute reasons for excluding central government claims held by the central bank.

²⁰ The term private sector is interpreted broadly as representing the non-central government/central bank sectors. Thus state-owned commercial banks and public sector enterprises are included in the notion of private sector, consistent with IFS principles.

domestic sterilization operations is often transferred directly to the central government – Tanzania (2005-06) is a case in point.

- This measure is also most likely to capture the crowding out and complacency effects associated with DD. Liquidity paper issued by the central bank drains monetary liquidity, while central government financing paper issuance reduces savings left over for private sector investment.²¹ Both channels tend to push up interest which can ratchet up the cost of financing for firms.
- The adoption of this measure is essential in countries where the central bank conducts treasury auctions on behalf of the Treasury (or government), and makes use of “add-ons” in the process, i.e. uses ‘treasury bill’ auctions for liquidity management purposes. Depending on the ‘liquidity share’ in total amount auctioned, the central bank will book that share to its own liabilities and the remaining ‘budget financing’ share to the Treasury’s account. This practice is quite popular in developing economies and makes it impossible for buyers to distinguish between central bank liquidity paper and Treasury financing paper.²²

It is important to recall that our DD definition does not include DD holdings by nonbank sectors (pension funds, retail investors etc.). In countries where banks dominate the financial sector and government debt markets, these are unlikely to be major omissions. However, this is unlikely to be true in countries where nonbank sectors actively participate in government securities markets, and/or where the government issued saving instruments (special retail bonds) earmarked for individual investors. For our group of 93 countries, the nonbank sector has become increasingly important, especially since the turn of the millennium due to deregulation and privatisation in the insurance and

²¹ In the case of central government securities, the contraction in liquidity is temporary, as eventually the money finds its way back into the banking system as the government begins to spend. However, time lags between debt issuance and fiscal spending can result in nontrivial monetary tightening.

²² Although this practice has the potential to create enormous tensions between the fiscal and monetary authorities, it is justified on the grounds of preventing market fragmentation, a concern in countries where the central bank enjoys higher credibility than the Treasury -- see IMF (2001: 80-84).

contractual saving sectors. Given this, we can expect our DD measure to be biased downward by the amount of government debt held by the domestic nonbank sector.

Regardless of the exact size of this bias, there could be nontrivial implications for our conclusions about the growth contribution of DD. For instance, it is generally accepted that nonbank holdings of government securities are a) associated with less direct crowding out of private investment, and b) arguably skewed towards longer-dated T-bonds which usually play an important role in financial market development by providing a benchmark yield curve.²³ Also, where banks have to compete with the government for nonbank funds, nonbank holdings of government debt may induce a positive “competitive” effect on banks’ deposit rates, forcing them to reduce overheads and tighten intermediation margins. We make use of the *Mellor* database to test, over a smaller panel of countries, the hypothesis that nonbank held DD is more beneficial for (or less injurious to) growth than debt held by the banking system.

The DD series extracted from the IFS is scaled to both GDP (DOMdebt) and commercial bank deposits (DD2dep). Table 1 provides a by-country breakdown of the evolution of these two ratios over three decades, starting in 1975. DD, as share of GDP, appears to have risen over time from 5½ percent to 9 percent, but, as a share of deposits, has remained relatively stable around one-fifth. The ratios for both DOMdebt and DD2dep for the most recent period are higher in EMs 15 percent and 33 percent, respectively, compared with SSA’s 6 percent and 22 percent, respectively. Since substantial scope for economic expansion and financial deepening remains in SSA, the implied DD issuance capacity may be significant, going forward. Also, while the distribution of key DD ratios across SSA countries has been stable over time, the same in EMs has become significantly more dispersed, indicating increased heterogeneity among EMs; Figure 1 compares the ratios for the pre- and post-1990 periods for both SSA and EMs.²⁴

²³ Pension funds and retail investors have more longer-term liabilities to maturity match than commercial banks.

²⁴ These period correspond broadly to the financial repression and financial liberalization eras, even though we recognize that the latter is an ongoing process.

Figure 2 provides scatterplots of the two ratios of DD against per capita growth. The figure suggests that the relationship may be non-linear.²⁵ In other words, growth may have a Laffer curve relationship with DD2dep, and a linear relationship with DOMdebt. This appears realistic in low financial depth contexts, where the *financial* size of a country would place a more binding constraint on DD capacity than *economic* size.

ii. Controls and causality variables

We use four variables to investigate (via Granger causality regressions) the endogeneity of DD, and the channels through it may affect the economy: per capita income, private savings rate, institutions and financial development. Since reliable series on the latter two variables do not exist in IFI databanks, we invoke suitable proxies. For institutions, we use the International Country Risk Guide (ICRG) “composite index”, which tracks countries’ political economic and financial risks over time; the index rises as the risk reduces and stability increases. The series runs from 1986 onwards, is available for most of the 93 countries, and is denoted as “stability”. Although we use it as a proxy for institutional quality, it can be construed as such only insofar as good institutions affect risk and stability.

To proxy for financial development, a “financial depth index” was constructed using the approach in Huang and Temple (2005). The index was developed from three underlying series – liquid liabilities of the financial system; private sector credit; and commercial bank share in banking system assets, using principal component analysis techniques – see Appendix B (I) for details on extraction

²⁵ Although scatter plots are useful for “prior”-formation, they capture unconditional relationships between country means (over time) and, thus, should not be over-interpreted.

methodology.²⁶ With private sector credit included as an integral part of the index, the latter's response to DD would also shed light on any crowding out effects.

Our control variables for the growth regressions are similar to those used in Pattillo et al. (2002): lagged income, population growth, investment, budget balance, openness to trade and terms of trade growth and the additional controls, inflation and external debt.²⁷

The summary statistics, definitions and correlation matrix for the main regression variables are presented in Appendix C.

iii. Econometric specification for growth regressions

Preliminary support for the non-linear relationship hypothesized (in section 2 iii) between DD and growth is provided by the scatterplots in Figure 2.²⁸ The plots suggest that growth may have a Laffer curve relationship with DD2dep, and a linear relationship with DOMdebt. This appears realistic in low financial depth contexts, where the *financial* size of a country would place a more binding constraint on DD capacity than *economic* size.

Employing non-linear specifications for both ratios, the empirical analysis is modelled on Pattillo et al. (2002) who investigate the nonlinear growth effects of external debt on a panel of 93 developing economies over the 1969-98 period, using 5-year averaged data and a conditional convergence

²⁶ The three series are reported from 1960 onwards for all countries in our sample in the Financial Structure Database of Beck et al. (2006; updated from 2000).

²⁷ Education (lnEDU) was dropped as a control for two reasons: i) due to the poor measure of education (gross enrolment rates) the variable has been found insignificant in many cross country growth regressions. This was the unfortunate result we obtained as well, and it persisted over lagged specifications (i.e. lnEDU_1 and lnEDU_2); ii) there were many data gaps in the schooling series, so that the variable's inclusion would have resulted in a reduction of over 100 degrees of freedom.

²⁸ Although scatter plots are useful for "prior"-formation, they capture unconditional relationships between country means (over time) and, thus, should not be over-interpreted.

framework.²⁹ Like them, we employ fixed effects, system GMM (generalized method of moments) and pooled OLS regressions of PPP per capita real income growth on linear and non-linear debt terms and the set of controls already described.³⁰

For hypothesis (A) identified in section 2 (iii), we estimate the following two equations:

$$g_{it} = \alpha_i + \beta'X_{it} + \gamma DOMdebt_{it-1} + \phi_t + \varepsilon_{it} \dots (i)$$

$$g_{it} = \alpha_i + \beta'X_{it} + \gamma DOMdebt_{it-1} + \delta (DOMdebt * quart_DOM)_{it-1} + \phi_t + \varepsilon_{it} \dots (ii)$$

where g is growth in PPP GDP per capita, X is a vector of control variables, $DOMdebt$ is the domestic debt/GDP ratio, α_i captures country heterogeneity and ϕ_t are period dummies. Similar regressions are run for the domestic debt/deposits ratio ($DD2dep$).

Our specification differs from Pattillo et al's (2002) in that we work with the actual DD ratios (as opposed to logs) while using quartile dummy interaction variables (instead of squared terms) to study non-linear growth effects.³¹ For the case of $DOMdebt$, the corresponding quartile dummy is named $quart_DOM$, and for $DD/deposits$ ($DD2dep$), $quart_DD2dep$. Our choice of specification is driven by the particular constraints posed by the DD database. For instance, many of the DD ratios in the sample – especially for LICs – were less than “1.00” (i.e. less than 1%). This precluded taking logs (which would have produced negative values), or squaring the non-logged ratios (as the squaring

²⁹ Non-linear specifications are not new to the literature on foreign aid and fiscal deficits. See, for e.g. Clemens and Radelet (2003) who uses a quadratic specifications to recover the growth maximizing aid/GDP. Adam and Bevan (2005) employ the Bruce Hansen method for identifying threshold effects for the fiscal deficit/GDP ratio.

³⁰ Note, that like Pattillo et al. (2002), we also lag the DD variables and their interaction terms to avoid possible regressor endogeneity.

³¹ The dummy variable takes the value 0 if the relevant DD ratio is in the bottom (i.e. first) quartile, 1 if it is in the 2nd quartile, 2 if in the 3rd quartile and 3 if in the 4th quartile.

numbers less than 1.00 yields smaller not larger values). Moreover, given the high dispersion of the DD ratios, squaring the ratios would have increased outlier problems.

For hypothesis (B): whether DD impacts growth through investment efficiency of capital accumulation, investment is removed from the control set and the difference in results from the *with*-investment regressions observed.

And finally, for (C): the extent to which the growth impact of DD depends on the institutional environment in which the debt is issued, we have:

$$g_{it} = \alpha_i + \beta'X_{it} + \gamma DOMdebt_{it-1} + \theta (DOMdebt * quart_STABILITY)_{it-1} + \phi_t + \varepsilon_{it} \dots (iii)$$

The regressions with attributes of DD were similar in structure to the above, except that, instead of quart_STABILITY, the following ratios were used for interaction:

- Share of securities in total DD stock (SDD2DD) [range 0-100]
- Share of DD held by banking system (shBANK) [range 0-100]
- a period dummy (ERA) taking the value of 0 for pre-1990 observations (corresponding roughly to financial repression years) and 1 for 1990 onwards (corresponding to the financial liberalization years)
- dummy variable (REALi) taking the value of 0 for observations where the real interest rate (deposit rate minus inflation rate) was zero or negative, and 1 when it was positive

We also run regressions using Christensen's (2004) DD data on 20 SSA countries over 1980-2000. This dataset *covers* central government securities (unsecuritized debts excluded) and both bank and nonbank holdings of this debt, enabling us to indirectly test if these features have the expected positive impact on any observed growth effect of DD.

The priors on the coefficients of our control variable follow from the large number of empirical growth studies. GDP per capita growth should, in accordance with Solow's convergence hypothesis, have a negative impact on growth. High inflation and population growth rates are also expected to undermine real economic growth. Robust empirical evidence (Elbadawi et al., 1997 and Pattillo et al., 2002) suggests that external debt impacts growth negatively. In contrast, gross fixed capital formation, fiscal balance, terms of trade growth, and openness should have positive effects on growth.

The primary attraction of using *panel data* methods in these cross-country regressions is their ability to deal with time-invariant individual effects (α_i). If the effects are random, we can use the random effects (RE) estimator for unbiased and efficient estimation. However, if the effects are fixed, or if they are correlated with the regressors, RE is inconsistent, and fixed effects (FE) methods, which wipe out the individual heterogeneity altogether, must be employed to recover consistent estimates of β , γ and δ .

FE methods, however, are biased and inconsistent in dynamic panel data models of the type we are estimating. In particular, the coefficient on the lagged dependent variable ($\ln Y_{-1}$) will be severely downward biased (numerically).³² Reverting to OLS and RE for estimating this coefficient is also unhelpful as both are severely upward biased, as discussed in Bond et al. (2002). Secondly, FE models (like OLS or RE) cannot deal with endogenous regressors, a key concern in the present context. For these reasons, we rely, in the main, on system generalised method of moments (system GMM) estimation of our regressions, which can simultaneously address the problems of endogeneity and lagged dependent variable.

IV. Empirical Results

³² Dynamic panel data models feature a lagged dependent variable as regressor. In the context of our income growth equation, $\ln Y_{-1}$ can be viewed as the lagged dependent variable. This is because growth is simply $\ln Y - \ln Y_{-1}$; so that regressions of growth on $a \ln Y_{-1} + bX$ can equivalently be written as $\ln Y - \ln Y_{-1} = a \ln Y_{-1} + bX$ or $\ln Y = (a+1) \ln Y_{-1} + bX$, which is clearly a lagged dependent specification.

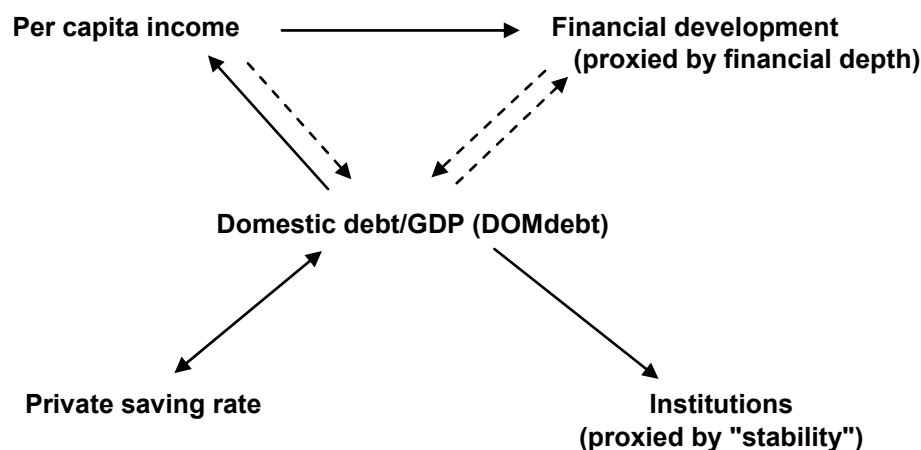
i. Granger-causality tests on the endogeneity of DD

As a precursor to the growth regressions, we run a battery of GMM Granger-causality panel regressions to study the extent to which DD is endogenous to, or drives, income, private savings, institutions (politico-economic stability) and financial development – see Appendix B (II) for details on the empirical methodology employed. Although these tests are very widely used, and in a range of contexts, they offer insights into “statistical” rather than economic causality.

Table 2 presents the results of the Granger-causality regressions – also summarized in the following causality map – and suggest support for two-way statistical causality links between DD and the other variables.³³ Institutions are not causal, income and financial depth are weakly causal, while private savings are strongly causal for DD. Evidence on reverse-causality suggests that DD is an important explanatory variable for private savings and institutions and, to a lesser extent, for financial development and income. Overall, this appears to weaken the case for approaching DD as a purely endogenous variable.³⁴

³³ Key diagnostic tests are explained in the footnotes to Table 2 and appear to be fine for the reported regressions. The joint significance test on the β s of the causal (or x) variables is the Granger-causality test. Formally, our null hypothesis is: *Ho = x does not Granger cause y (joint β test is insignificant)*; so that a low p-value on the joint β test allows us to reject the null in favour of the alternative, i.e. a causal channel exists from x to y .

³⁴ The intermediating channels from DD to private saving in particular could be complex, ranging from a) Ricardian equivalence to b) widened pool of investment grade instruments to c) a strong collateral function of DD on bank balance sheets leading to private savings in the financial system, and d) strengthened accountability channels leading to greater policy credibility and increased public confidence in the economy.



[An arrow from X to Y implies that the null of “X does not Granger-cause Y”

is rejected at the 5% level of significance (at 10% in case of broken arrow).]

DD and private savings were found to be closely associated. Higher private savings increase the scope for DD issuance while a larger supply of DD instruments provides incentives to increase private savings. Strengthening and expanding DD markets can, therefore, form a potentially virtuous cycle of higher private savings and stronger capital markets. Note that the size of the *long-run* marginal effect of DD on private saving: β_{LR} [= 0.82] in panel c of Table 2 far exceeds the rather low estimates [around 0.5] for the Ricardian offset ratios floating in the savings literature, ruling out a pure Ricardian explanation for the positive association – see Masson et al. (1998).

DD was found to weakly and positively Granger-cause financial depth positively. However, financial depth had a surprisingly weak causal contribution to income (panel e, Table 2), which seems at odds with other empirical studies that find a significant impact of financial development on economic growth.³⁵ The inconsistency can be resolved, partly, by noting that financial depth – which is highly sensitive to short-term credit and deposit booms – is only a crude proxy for financial development, which may be regarded as a “longer-term” concept. In that context, insofar as expanding DD markets are also a long-term phenomenon (especially when measured in relation to GDP), DD can serve as a

³⁵ We see this as a puzzle because i) financial development is generally believed to be an important causal variable for income, and ii) DD, which we find to be causal for income, is likely to owe this at least partly to the agency of financial development.

better proxy for financial development than financial depth. Indeed, Beck et al.'s (2006) financial development dataset includes both data on financial depth and local bond market capitalization. To the extent that the latter is driven primarily by outstanding government bonds in LICs and EMs – see World Bank (2006: Fig. 2.2) – this seems like an implicit acknowledgement that the development of DD markets is, in and by itself, an integral part of the process of financial development.³⁶

ii. The behaviour of control variables in growth regressions on DD

Coefficient signs and magnitudes for the control variables all appear to be empirically plausible, and broadly in line with our stated priors (Tables 3-4). For lagged income ($\ln Y_{-1}$) and population growth (gPOP), a one percentage point rise corresponds to a decrease in per capita growth of about $\frac{1}{2}$ of a percentage point. The INFLATION coefficient is negative and significant (although not in all regressions), confirming conventional wisdom that low inflation is a pre-condition for lasting growth. Gross fixed capital formation or investment ($\ln \text{INVEST}$) is highly significant in all regressions and has the usual high semi-elasticity of around 3.5 -- similar to Pattillo et al. (2002), but significantly higher than Mankiw et al.'s (1992) range of 2.1-2.2. The coefficient on fiscal balance (FISBAL) is, expectedly, significant and positive in all regressions hovering in the 0.1 to 0.2 range, and virtually identical to the range found in Pattillo et al. (2002). The benefits of fiscal austerity underlined here will inform the policy implications on DD derived in section 5. Finally, the results on EXTdebt are also in line with expectations to the extent that the sign on all significant coefficients thereof is negative – consistent with the finding in Pattillo et al (2002).³⁷

³⁶ We could not incorporate the series on bond market capitalization in our financial development/depth index as continuous data on the former was only available for a handful of LICs.

³⁷ Other variables had unstable and insignificant coefficients. Terms of trade growth (gTOT) has an unstable sign and is insignificant in most regressions. The result appears to corroborate both the earlier scepticism on optimal management of commodity price booms and the more recent concerns on natural resource curses in lower and middle income countries. The results on openness or trade/GDP ($\ln \text{OPEN}$) are complicated, and vary across both specifications and estimation methodologies.

iii. The growth impact and optimal size of DD

Results here suggest broad support for a positive overall contribution of “moderate” DD levels to economic growth. For the first DD ratio measured in percent of GDP, DOMdebt, we find a positive significant linear coefficient. The range for the coefficient was between 0.04 with OLS, 0.06 for FE and 0.07 for RE and GMM (Table 3A). Taking 0.06 as the average, increasing DD by one standard deviation (9.70%), implies an increase in the growth rate by 0.58 percentage points (0.13 standard deviations). The non-linear specification in this case (Table 3B) neither adds to overall explanatory power, nor throws up significant non-linear effects. That said, the linear coefficients are higher and the sign on the DOMdebt*(quart_DOM) term consistently negative in all four regressions, so that the possibility of a Laffer curve relationship between growth and DD, perhaps in a slightly richer group of countries, cannot be ruled out. In the current sample, however, with the fourth DOMdebt quartile beginning at 7.36%, there does not appear to be any evidence of diminishing returns to public DD.

However, regressions with DD/deposits (DD2dep) suggest a non-linear growth impact. The linear specification in Table 4A produces positive and significant coefficients for DD2dep in all but the FE regression, with the coefficients being smaller than those obtained for DOMdebt. This may partly be because of stronger in-sample non-linearities in the growth-DD2dep relationship compared with DOMdebt; in line with the scatterplots in Figure 3. The results on the non-linear specification (Table 4B) do indeed suggest support for this hypothesis. The coefficient of the linear DD2dep term strengthens noticeably compared with its counterpart in Table 4A, while the non-linear interaction term DD2dep*quart_DD2dep is negative and significant in all regressions. The turning points, or growth-maximizing levels of DD2dep, in the OLS and RE regressions are *out-of-sample*, but for the FE and GMM regressions are 35.7% and 65.4%, respectively. The FE maxima also appear closer to the 35-40% turning point suggested by the growth-DD2dep scatterplot in Figure 2.³⁸

³⁸ This suggests, in line with earlier discussion, that the supply of bank deposits may act as a more binding constraint, than economic size (GDP), on a government’s capacity to issue DD without severely crowding out the private sector. To that extent, therefore, regressions with DD2dep may be more insightful than those with DOMdebt regarding the optimal level of DD in an economy. Note, however, that this line of reasoning

(continued)

iv. The channels of influence: Investment volume vs. efficiency

The foregoing raises important questions about the channels through which DOMdebt might affect growth. A causality-centred treatment of this question proffered important causal links from DD to institutions, savings and financial depth. As far as growth is concerned, these channels could feature both volume effects that work primarily through the quantity of investment, and efficiency (quality of investment) effects that work through total factor productivity.

By including both investment and DD in our growth specifications, we have thus far been focusing on the efficiency contribution of DD, rather than its investment volume effect, currently picked up by the investment coefficient. To establish the relative weight of the volume and the efficiency contributions, we run regressions excluding investment as a regressor and study the difference. As can be seen from Table 5, the DOMdebt coefficient is consistently higher in such regressions. The ratio of the *with-investment* to the *without-investment* DOMdebt coefficients is 78.6% (average across all four regressions), indicating that the primary contribution of DD is through investment efficiency; mirroring Pattillo et al.'s (2002) conclusions on external debt.^{39 40} This, in turn, suggests, that should other determinants that constrain the quality of investment improve, such as private sector risk, the contribution of DD to growth will weaken. Some evidence of this emerges below.

v. Does DD complement, or substitute for, good institutions?

does not take into account possible endogeneity of financial depth (and the supply of deposits) to the DD stock, as suggested by the Granger-causality regressions (Table 2, panel a).

³⁹ The context, of course, in Pattillo et al. (2002) is how external debt *reduces* (not increases) growth.

⁴⁰ One must be careful with this inference, however, since our proxy for investment, gross fixed capital formation/GDP, only captures physical capital accumulation (and possibly with measurement error), while excluding the human, public, and institutional dimensions to capital.

Results on the interaction of DD with institutions (STABILITY), suggest a substitutive rather than complementary relationship. For our preferred GMM estimation (regression 3, Table 6), the marginal growth effect of DD becomes negative at the 60th percentile (ICRG index = 62), indicating a non-linear relationship in the variable. Interpreted in economic terms, this suggests that the collateral and risk-diversification functions of DD might be more relevant in high-risk countries where banks cannot lend to the private sector as freely as they would wish to. To further understand this result, we look at the composition of the sub-sample for which the STABILITY index was greater than its optimal threshold of 62.

	Proportion in full sample	Proportion in sub-sample: ICRG>62
Sub-Saharan Africa	43%	19%
Emerging Markets	18%	33%

SSA countries make up 43 percent of the total observations in the full sample ($930=93*10$), but only 19 percent of the *sub-sample* for which $STABILITY>62$. By contrast, EMs are significantly over-represented in this *sub-sample*. This seems to confirm Kumhof and Tanner's (2005) argument that DD has more of a positive role to play when there are structural and institutional factors constraining good quality lending. If one of these factors is the high undiversifiable risk arising from politico-economic instability, then a country that reduces such instability through improved governance and stronger domestic institutions is less likely to need, and/or benefit from, DD.

vi. The impact of DD quality on its optimal size

The signs on the relevant interaction regressors employed here appear to underscore the importance of DD quality for its growth impact. Debt that is securitized, bears positive real interest rates and is diversely held is found robustly friendlier to growth. Some of these results, summarized in Table 7 (a-b), are obtained from data spanning 70 IMF program countries over the 1996-2004 period (the Mellor database). Similarly, regressions (e-f) employ data on 20 SSA countries since 1980

(Christensen's 2004 database). Less than 200 observations were available for each of these four regressions, so the results, especially the coefficient "sizes", should be interpreted with caution.

Regression (a) tests the *interaction* of the share of securitized DD in total central government DD (SDD2DD) *with* all banking system claims on the central government (ALLonCG). The linear ALLonCG term, which includes the central government's inflationary overdrafts from the central bank is negative and almost significantly so. However, the securitized component of central government DD [ALLonCG*SDD2DD] has a strongly positive coefficient, indicating the benefits of issuing DD as marketable securities. The positive coefficients on the interaction terms with ERA (financial liberalization post-1990 =1) and REALi (positive real interest rates =1) in regressions (c) and (d), respectively, provide further confirmatory evidence of this result.⁴¹ Further as can be seen from the summary statistics on SDD2DD (right panel, Table 7), only about 27% of central government DD in IMF program countries is securitized, representing substantial scope for marketization, going forward.

The careful selection and interaction of terms in regression (b) test the hypothesis that the growth contribution of DOMdebt decreases in the share of DD held by the banking-system.⁴² Summary statistics on this shBANK series indicate a median share of 50% and an interquartile range of 5.3 percent to 85.2 percent. The results indicate that DOMdebt becomes less growth-enhancing as shBANK rises.⁴³ The most obvious policy implication of this result is that public debt issuers should attempt to diversify debt holdings beyond commercial banks by encouraging participation from institutions (pension funds etc.), the retail sector, and if appropriate, foreign investors. Fortunately,

⁴¹ The real interest rate at which the marginal impact of DD becomes positive is +0.66% [= 0.0307÷0.047], which is not too far off from the -0.01% median observation for REALi in the right panel of Table 7.

⁴² Formally, the expression DD in this sentence refers to all central government (CG) domestic debt (including CG securities held by the central bank). Liquidity paper is naturally excluded.

⁴³ Since the data on shBANK is not broken into central bank and commercial banks, we cannot ascertain whether this result reflects i) the negative effects of higher inflationary finance by the central bank, or ii) the adverse efficiency and crowding out effects of high bank holdings of government debt. Since the latter would be inconsistent with the positive growth effects of bank-held DD documented in Tables 1-3, we are inclined to attribute the negative coefficient on shBANK to (i).

with private domestic savings rebounding in LICs and EMs, contractual saving institutions expanding and foreign interest in their DD markets increasing, the conditions are quite conducive for undertaking such diversification.

Regressions (e) and (f) suggest that the result on positive overall growth payoff of DD documented earlier remains robust to the SSA subgroup and with an important alternative definition of DD, i.e. “all central government securities”.⁴⁴ The estimated linear marginal effect for the DDSSA/GDP ratio is 0.16 and for DDSSA/deposits is 0.02, matching the earlier pattern of higher growth payoffs to DOMdebt compared with DDdep. The quadratic terms are negative but insignificant in both regressions, suggesting that current perceptions of DD capacity in SSA may be unnecessarily bearish. The fact that the quadratic term is not significant – even for DDSSA/deposits – may partly reflect i) the exclusion from the DDSSA measure of a less desirable component of DD: unsecuritized liabilities, overdrafts of the central bank etc.; and ii) the inclusion in the measure of a relatively desirable component: nonbank-held DD.

Indirectly, therefore, these results support the same hypotheses that regressions (a) and (b) lean towards: DD is more growth-friendly when issued as marketable securities and, to a diverse investor base, including the nonbank sectors.

vii. Selected robustness tests

Before discussing any policy conclusions, the results reported here should be tested for robustness i) across estimation methods, ii) over different horizons and country sub-groups; and iii) after removing outliers. By using OLS, random effects, fixed effects and system GMM and establishing the stability of the results over this broad range of estimation techniques, (i) has already been addressed. For (ii),

⁴⁴ The summary statistics for this “DDSSA” variable, reported in Table 7, indicate median DDSSA/GDP and DDSSA/Deposits ratios of 11% and 66% respectively. These are quite high, respectively, in relation to the DOMdebt ratio (2%) and the DD2dep ratio (19%) for SSA reported in Table 1, the difference caused by large central bank holdings of central government securities in these countries.

the regressions (e) and (f) on the SSA sub-sample partly addresses the issue of robustness over country-groups. Further, to test for robustness over horizon length, 3-year data is aggregated into 6-year data, to make sure that any residual cyclical effects are also smoothed out. As a result of the conversion, the total number of observations halves. Table 8 summarizes the results of OLS, FE and system GMM regressions of growth on DD/GDP (DOMdebt, linear, panel a) and DD/deposits (DD2dep, non-linear, panel b) using 6-year data. As can be seen, the DOMdebt coefficient strengthens compared with the 3-year case. By contrast, the evidence for a non-linear growth impact of DD2dep weakens: all the non-linear terms are insignificant while the linear coefficients are lower than their 3-year counterparts in two of the three regressions.

The final robustness check – sensitivity to outliers – based on the DFBETA post-estimation command in STATA is also green.⁴⁵ The command works with OLS and LSDV (FE) regressions, and computes the *influence* of each observation (country-period) on the coefficient of interest. DFBETA series for all three measures of DD were generated after running their corresponding OLS and FE regressions. Observations with $|DFBETA| > \sqrt{2/N}$ (N being the total number of observations) were then dropped from the sample and the regressions re-run on the new smaller samples. Table 9 reports the results from these *outlier-cleansed* regressions for regressions with DOMdebt. As can be seen, the coefficients remain significant and are, in fact, larger in both the OLS and FE cases.⁴⁶

Overall, the foregoing permits a more confident restatement of our earlier results on the growth contribution of DD, i.e. that the contribution is generally positive for DOMdebt, with some evidence of diminishing returns to DD2dep above a ratio of 35%.

⁴⁵ This robustness check was applied to the 3-year averaged data.

⁴⁶ Unfortunately, we do not have the benefit of DFBETA-adjusted GMM regressions, which would have enabled a fuller comparison.

V. Policy Conclusions and Way Forward

As noted at the start of this paper, deriving the policy implications of DD in developing economies has traditionally been complicated by one of four factors: (i) traditional pessimism about the role of DD in shallow markets and/or financially repressed economies; (ii) lack of DD data amenable to empirical analysis; (iii) the perception that a government's DD capacity is fully endogenous to the country's level of income, financial development, saving and institutions (including government credibility), and cannot be chosen independently by policymakers; (iv) fears that active market-based domestic borrowing in small LIC markets would prove expensive relative to concessionary external finance, risking fiscal sustainability and leading to crowding out of private sector activity.

This paper has attempted to address these limiting factors, respectively, by:

- highlighting the more recently researched links between DD markets and growth, including: the “collateral” or safe-asset function of DD on banks' balance sheets in high risk environments, and the importance thereof for deposit mobilisation and private sector lending; establishment of a benchmark yield curve for corporate bonds and longer-term private sector lending by banks; stronger institutions and domestic accountability, including over surprise inflation; and more general benefits of internal vs. external finance dependence;
- introducing an IFS monetary survey based new DD panel database on 93 countries over the 1975-2007 period;
- running Granger-causality tests to investigate the extent to which DD is caused by, or causes, financial depth, saving, institutions and income; and
- empirically studying the growth impact of DD in a conditional convergence framework to robustly test hypotheses such as crowding out/in, as well as study the sensitivity of the growth impact of DD to a) the quality of the debt issued, and b) the macroeconomic, financial and institutional conditions under which it is issued.

The data compilation exercise in Section 3 revealed both the difficulties and opportunities facing researchers in extracting workable DD series from secondary data sources. The key contribution of the section was to extract from the IFS an annual series on domestic public debt, comparable across both countries and time, and fine-tune it for quantitative analysis. Our definition of DD: *all commercial bank claims on the central government plus all securities issued by the central bank*, was based on a careful consideration of the costs and benefits of using alternative definitions and data sources.

The chosen DD series was then scaled to GDP and deposits, to yield three important ratios, respectively: DOMdebt (mean of 6.4%) and DD2dep (21.7%). The ratios were generally found to be between 3-5 percentage points higher in emerging markets compared with SSA. Trends in the ratios over time suggested a significant increase in DOMdebt in emerging markets since the mid-1990s, but a more moderate increase for SSA. By contrast, the DD2dep ratio was roughly similar for both SSA and emerging markets, and relatively stable over time, providing first signals of the importance of financial savings in determining DD issuance capacity.

The empirical section began with an investigation of the question of causality between DD and key macroeconomic, financial and institutional variables. Financial development was proxied by a financial depth index, extracted through principal component analysis of three related variables – private sector credit/GDP, share of DMB assets in combined DMB and central bank assets, and share of liquid liabilities/GDP. The results indicated weak Granger causality from financial depth and income to DD, but strong causality from private savings to DD. More controversially, reverse causality was found from DD to financial depth (weak) and saving, institutions and income (strong). Overall, the analysis suggested that while a government's DD issuance capacity may be affected by the available pool of savings and, to a lesser degree, the level of income and financial depth, these variables as well as the underlying processes of financial and institutional development are also likely to respond positively to DD issuance, forming a potentially virtuous circle.

Next, a battery of panel growth regressions were run using data on 93 developing economies over the three decades since 1975 (divided into 3-year periods), using extensive controls, different estimation methods (OLS, FE and GMM) and rigorous robustness tests including a 6-year horizon for averaging, outlier treatment and regressions over country sub-samples like SSA.

Our basic regressions suggest a robust positive linear growth contribution of DD when scaled to GDP (DOMdebt). The standardised marginal effects suggest nontrivial orders of magnitude, with 1 standard deviation increase in DOMdebt driving a 0.1 standard deviation increase in the per capita growth rate. The growth contribution of DD scaled to deposits (DD2dep) appears more complex, with DD seen to support growth up to a ratio of 35% but strangling it at higher levels.⁹³ This lends some credence to the crowding out argument against DD, but also proffers a sense of what the optimal level of DD is. Given an average DD2dep ratio of one-fifth in developing economies, and considering significant scope for financial deepening and nonbank and foreign participation in LIC DD markets, the result suggests more substantial DD issuance capacity than is currently perceived.

Importantly, the optimal size of DD was found to be highly sensitive to its quality. A higher level of DD can likely be sustained without compromising growth if DD is issued in the form of marketable securities, bears positive real interest rates, and is issued to the nonbank sectors (contractual saving institutions and retail investors etc.). The latter result supports the hypothesis that nonbank participation in the government securities market boosts competition in the financial sector, both on the deposit-taking side – as banks have to compete with government for nonbank deposits – and, on the investment side – as banks compete with nonbanks in public securities auctions. This increased competition should put downward pressure on banks’ overheads and intermediation margins, partly alleviating the efficiency concerns of high bank holdings of DD highlighted by Hauner (2006).

⁹³ These results were obtained with a DD definition that excludes nonbank holding of government securities. Although this omission is likely to be unimportant quantitatively (as the holdings are typically small in LICs), qualitatively it should downward bias any positive growth effects of DD, for reasons discussed towards the end of section 3.2 (in the context of regressions on the “quality” of DD).

The growth regressions in Table 8A reveal that $\frac{3}{4}$ of the estimated impact of DD on growth occurs through the investment efficiency or factor productivity channel, rather than the volume of capital accumulation itself. Intuitively, this could imply that the main function DD performs is that of protecting banks' profitability against the possibility of downside risks, thus permitting more aggressive risk-taking vis-à-vis private sector lending. If risks are already manageable in the economy, say, due to a stable political economy, high private saving rates (reduced external reliance), and a good degree of financial development and economic openness, the benefits of DD should be more nuanced. This seems to be confirmed by the four interaction regressions in Table 8B, where the growth effect of DD was found to be diminishing in the above-noted variables, especially, institutions.

The foregoing seems to imply that countries which have the greatest capacity for DD issuance (high savings and financial depth, better institutions etc.) probably have the least need for it; while countries which are unable to expand DD issuance have probably the most to gain from it. Moreover, since the coefficient on fiscal balance is consistently positive in all our growth regressions, such countries are additionally constrained to find non-deficit increasing methods of expanding DD. This is especially true for post-HIPC SSA countries which have recently received large external debt waivers, and are under pressure to not undertake any non-concessionary financing, either from abroad or domestically.

The purpose of this paper has been to highlight, and partially fill, the gap that existed in understanding the relationship of DD with key macroeconomic, financial and institutional variables. While the paper hopes to have answered some key questions relating to this relationship, it has also generated fresh questions. For instance, the magnitude of the growth impact of DD, and the observation that this impact falls in lower risk environments, suggests support for the collateral function of risk-free debt holdings on banks' balance sheets, as postulated by Kumhof and Tanner (2005).

It seems natural to investigate banks' incentives for holding DD at the micro level in order to contextualise this paper's conclusions on the macroeconomic effects of DD. If indeed banks' holdings of government securities are not so harmful for the economy in the aggregate, there must be some motivation(s) for holding these securities at the micro-level that can be construed as socially optimal or desirable. The next paper concerns itself with precisely such micro-foundational questions.

I. Bibliography

- ABBAS, S. M. A. (2005) Public debt sustainability and growth in post-HIPC sub-Saharan Africa: The role of domestic debt.
http://cloud1.gdnnet.org/cms.php?id=document_download&document_id=10906. Global Development Network Project on "Macroeconomics Challenges of Low Income Countries."
- ABBAS, S. M. A., BELHOCINE, N., EL-GANAINY, A. & HORTON, M. (2010) A Historical Public Debt Database. IMF Working Paper 10/245. International Monetary Fund, Washington, DC.
- ADAM, C. & BEVAN, D. (2005) Fiscal Deficits and Growth in Developing Countries. *Journal of Public Economics*, 89, 571-597.
- AFDB (2005) Supranational domestic debt issuance. *African Stock Exchange Association Conference*. Cairo.
- AGENOR, P. & MONTIEL, P. (1999) *Development Macroeconomics*, Princeton University Press.
- AIYAGARI, S. & MCGRATTAN, E. (1998) The optimum quantity of debt. *Journal of Monetary Economics*, 42, 447-469.
- AIZENMANN, J. & NOY, I. (2003) Endogenous Financial Openness: Efficiency and Political Economy Considerations. National Bureau of Economic Research.
- AIZENMANN, J., PINTO, B. & RADZIWIŁ, A. (2004) Sources for Financing Domestic Capital: Is Foreign Saving a Viable Option for Developing Countries? *NBER Working Paper w10624*.
- ARELLANO, M. & BOVER, O. (1995) Another Look at the Instrumental Variable Estimation of Error Component Models. *Journal of Econometrics*, 68, 29-51.
- ATIQUE, R. & MALIK, K. (2012) Impact of Domestic and External Debt on the Economic Growth of Pakistan. *World Applied Sciences Journal* 20 (1): 120-129.
- BARAJAS, A., STEINER, A. & SALAZAR, N. (2000) The Impact of Liberalization and Foreign Investment in Colombia's Financial Sector. *Journal of Development Economics*, 63, 157-196.
- BARAJAS, A., STEINER, R. & SALAZAR, N. (1999) Interest Spreads in Banking in Colombia. *IMF Staff Papers*, 46, 196-224.

- BARRO, R. J. (1974) Are Government Bonds Net Wealth? *The Journal of Political Economy*, 82, 1095-1117.
- BEAUGRAND, P., LOKO, B. & MLACHILA, M. (2002) The Choice Between External and Domestic Debt in Financing Budget Deficits: The Case of Central and West African Countries. *IMF Working Paper WP/02/79*.
- BECK, T., DEMIRGUC-KUNT, A. & LEVINE, R. E. (2006) A New Database on Financial Development and Structure. *World Bank Finance Research Working Paper Series 2146*.
- BEVAN, D. (2005) An Analytical Overview of Aid Absorption: Recognizing and Avoiding Macroeconomic Hazards. Maputo, Paper presented at Seminar on Foreign Aid and Macroeconomic Management.
- BLUNDELL, R. & BOND, S. (1998) GMM estimation with persistent panel data: an application to production functions. *IFS Working Papers W99/04*.
- BOND, S. R., HOEFFLER, A. & TEMPLE, J. (2002) GMM Estimation of Empirical Growth Models. *CEPR Discussion Paper 3048*.
- BOWSHER, C. G. (2002) On Testing Overidentifying Restrictions in Dynamic Panel Data Models. *Economics Letters*, 77, 211-220.
- BOYD, J. H., LEVINE, R. E. & SMITH, B. D. (2001) The Impact of Inflation on Financial Sector Performance. *Journal of Monetary Economics*, 47, 221-248.
- BROCK, P. L. & ROJAS-SUAREZ, L. (2000) Understanding the Behaviour of Bank Spreads in Latin America. *Journal of Development Economics*, 63, 113–134.
- BURGER, J. & WARNOCK, F. (2006) Local Currency Bond Markets. *IMF Staff Papers*, 53, 115-132.
- CHIRWA, E. W. & MLACHILA, M. (2004) Financial Reforms and Interest Rate Spreads in the Commercial Banking System in Malawi. *IMF Staff Papers*, 51.
- CHRISTENSEN, J. E. (2004) Domestic Debt Markets in Sub-Saharan Africa. *IMF Working Paper No. 04/46*.
- CLEMENS, M. A. & RADELET, S. (2003) The Millennium Challenge Account: How Much is Too Much, How Long is Long Enough? *Centre for Global Development Working Paper No. 23*.

- COHEN, D. (1997) Growth and External Debt: A New Perspective on the African and Latin American Tragedies. *Centre for Economic Policy Research Discussion Paper, No. 1753*.
- DEMIRGUC-KUNT, A. & SOBACI, T. (2001) Deposit Insurance Around the World: A Data Base. *The World Bank Economic Review*, 15, 480-490.
- DETRAGIACHE, E., TRESSEL, T. & GUPTA, P. (2005) Finance in Lower Income Countries: An Empirical Exploration. *IMF Working Paper No. 05/167*.
- DIAMOND, P. (1965) National Debt in a Neoclassical Debt Model. *Journal of Political Economy*, 55, 1126-1150.
- DRAZEN, A. (1997) Towards a Political-economic Theory of Domestic Debt. *NBER Working Paper* 5890.
- DURLAUF, S. N., JOHNSON, P. A. & TEMPLE, J. R. W. (2005) Growth Econometrics. *Handbook of Economic Growth*. Elsevier B.V.
- EICHENGREEN, B. & HAUSMANN, R. (1999) Exchange Rates and Financial Fragility. *NBER Working Paper No. W7418*.
- EICHENGREEN, B. & HAUSMANN, R. (2005) *Original Sin: The Road to Redemption*, Chicago, University of Chicago Press.
- EICHENGREEN, B., HAUSMANN, R. & PANIZZA, U. (2003) The Pain of Original Sin. IN EICHENGREEN, B. & HAUSMANN, R. (Eds.) *Other People's Money: Debt Denomination and Financial Instability in Emerging Market Economies*. Chicago.
- ELBADAWI, I., NDULU, B. & NDUNG'U, N. (1997) *Debt Overhang and Economic Growth in Sub-Saharan Africa*, IMF Institute, Washington DC.
- FABELLA, R. & MADHUR, S. (2003) Bond Market Development in East Asia: Issues and Challenges. *Asian-Pacific Economic Literature*, 18, 183-190.
- FISMAN, R. & LOVE, I. (2003) Financial Development and Growth in the Short- and Long-Run. Columbia Business School, New York.
- FLASSBECK, H. (2004) Saving, investment, debt and the transfer problem. UNCTAD, Geneva.
- FRY, M. (1997) *Emancipating the Banking System and Developing Markets for Government Debt*, Routledge.

- GULDE, A., PATTILLO, C., and CHRISTENSEN, J., with CAREY, K., and WAGH, S. (2006) Sub-Saharan Africa: Financial Sector Challenges, International Monetary Fund.
- GUPTA, S., POWELL, R. & YANG, Y. (2006) Macroeconomic Challenges of Scaling Up Aid to Africa: A Checklist for Practitioners. International Monetary Fund.
- HAUNER, D. (2006) Fiscal Policy and Financial Development. *IMF Working Paper 06/26*.
- HUANG, Y. & TEMPLE, J. R. W. (2005) Does External Trade Promote Financial Development? *CEPR Discussion Paper No. 5150*.
- HUSAIN, A. M. (1997) Domestic Taxes and the External Debt Laffer Curve. *Economica*, 64, 519-525.
- IMF (2001) Developing Government Bond Markets: A Handbook. International Monetary Fund and the World Bank, Washington, D.C.
- IMF (2002-03) Chapter 4. *Global Financial Stability Report*.
- IMF (2005) Monetary and Fiscal Policy Design Issues in Low-Income Countries. Policy Development and Review Department and the Fiscal Affairs Department.
- IMF (2005) Monetary Policy implementation at Different Stages of Market Development. *IMF Occasional Paper 244*, Section III.
- JAIMOVICH, D. & PANIZZA, U. (2006) Public Debt around the World: A New Dataset of Central Government Debt. *Inter-American Development Bank Working Paper No. 561*.
- JEANNE, O. & GUSCINA, A. (2006) Government Debt in Emerging Market Countries: A New Data Set. *IMF Working Paper No. 06/98*.
- JIANG, G., TANG, N. & LAW, E. (2001) Cost-benefit analysis of developing debt markets. *Hong Kong Monetary Authority Quarterly Bulletin No. 29*.
- KAHN, B. (2005) Original sin and bond market development in SSA. FONDAD.
- KITABIRE, D. (2005) Implications of a substantially increased development aid: The case of Uganda. *IDS Bulletin*, 36.
- KUMAR, M. & WOO, J. (2010) Public Debt and Growth, IMF Working Paper No. 10/174, International Monetary Fund, Washington, DC.

- KUMHOF, M. (2004) Fiscal Crisis Resolution: Taxation Versus Inflation. *Society for Economic Dynamics, Meeting Papers* 874.
- KYDLAND, F. E. & PRESCOTT, E. C. (1977) Rules Rather Than Discretion: The Inconsistency of Optimal Plans. *Journal of Political Economy*, 85, 473-491.
- LEVINE, R. E. (1997) Financial Development and Economic Growth Financial Development and Economic Growth: Views and Agenda. *Journal of Economic Literature*, XXXV, 688-726.
- LEVINE, R. E. (2005) Finance and Growth: Theory and Evidence. IN AGHION, P. & DURLAUF, S. (Eds.) *Handbook of Economic Growth*. Elsevier Science.
- MANKIW, N. G., ROMER, D. & WEIL, D. (1992) A Contribution to the Empirics of Economic Growth. *Quarterly Journal of Economics*, 107, 407-437.
- MASSON, P. R., BAYOUMI, T. & SAMIEI, H. (1998) International Evidence on the Determinants of Private Saving. *The World Bank Economic Review*, 12, 483-501.
- MATHIESON, D., ROLDOS, J., RAMASWANNY, R. & ILYINA, A. (2004) Emerging Local Securities and Derivatives Markets. *Proceedings of the G-20 Workshop on Developing Strong Financial Markets*. Washington D.C., International Monetary Fund.
- MAURO, P., ROMEU, R., BINDER, A. & ZAMAN, A. (2013) A Modern History of Fiscal Prudence and Profligacy. IMF Working Paper 13/5. International Monetary Fund, Washington, DC.
- MCCAULEY, R. N. (2006) Unifying government bond markets in East Asia. *BIS Quarterly Review* December 2003.
- MCKINNON, R. I. (1973) *Money and Capital in Economic Development*, Washington, The Brookings Institution.
- MODIGLIANI, F. Long-Run Implications of Alternative Fiscal Policies and the Burden of the National Debt. *Economic Journal*, Dec. 1961, 71, 730-55.
- MOSS, T., PETTERSSON, N. & WALLE, N. V. D. (2006) An Aid-Institutions Paradox? *Review Essay on Aid Dependency and State Building in Sub-Saharan Africa, Working Paper* 74. Centre for Global Development, Washington, DC.

- NDIKUMANA, L. (2001) Financial Markets and Economic Development in Africa. *Working Paper*, Political Economy Research Institute, University of Massachusetts, Working Paper 17.
- NORTH, D. & WEINGAST, B. (1989) Constitutions and Commitment: The Evolution of Institutions Governing Public Choice in Seventeenth Century England. *Journal of Economic History*, 49, 803-832.
- PATTILLO, C., POIRSON, H. & RICCI, L. (2002) External Debt and Growth. *IMF Working No.* 02/69.
- PUTONOI, G. & MUTUKU, C. (2013) Domestic Debt and Economic Growth Nexus in Kenya. *Current Research Journal of Economic Theory* 5(1): 1-10, 2013.
- RAJAN, R. G. & SUBRAMANIAN, A. (2005) Aid and Growth: What Does the Cross-Country Evidence Really Show? *IMF Working Paper* 05/127.
- REINHART, C. & ROGOFF, K. (2010) Growth in a Time of Debt, NBER Working Paper No. 15639 (January).
- ROSEN, H. S. (2005) *Public Finance*, Irwin Professional Publishers.
- SACHS, J. (1989) The Debt Overhang of Developing Countries. *In Debt Stabilization and Development*. Oxford: Basil Blackwell.
- SAXEGAARD, M. (2006) Excess Liquidity and the Effectiveness of Monetary Policy: Evidence from Sub-Saharan Africa. *IMF Working Papers* 06/115.
- SCHUMPETER, J. A. (1912) *The theory of economic development*, New York, Oxford University Press.
- SHAW, E. (1973) Financial Deepening in Economic Development. New York: Oxford University Press.
- SINGH, C. Domestic Debt and Economic Growth in India. *Economic and Political Weekly*, June 5, 1999, 1445-1453.
- SUMMERHILL, W. (2005) Inglorious Revolution: Political Institutions, Sovereign Debt, and Financial Underdevelopment in Imperial Brazil. UCLA.
- WORLD BANK (2006) *Global Development Finance*.

Appendix A: New Domestic Debt Database

I. Defining domestic debt

A survey of the existing DD databases mentioned above indicates that the most commonly used definition of DD is: ‘all domestically-held claims on the central government’. This definition would nicely compliment the corresponding *Global Development Finance* (GDF) definition for ‘public and publicly guaranteed *external* debt’, which purports to include all external debts owed or guaranteed by the central government. However, for public DD, it is difficult, if not impossible to determine exactly what *non*-central government debts actually carry an implicit government guarantee. Debts of local and regional governments, potential bailout costs of failing public (or even strategic private) sector entities, debts of liquidated public sector enterprises, future pension liabilities of the state, compensation arising from past nationalisations or imminent future denationalisations (“golden handshakes”), liquidity papers issued by the central bank and costs arising from its quasi-fiscal operations are just a few examples of the kind of liabilities that stare most governments in the face but are seldom officially recorded – even in industrialised countries – as part of the government’s DD stock.⁹⁴ As a result, reported figures for public DD can, by definition, be seen as biased downwards.

Importantly, although this downward bias is a permanent feature of official DD statistics, the bias caused by any individual omission is likely to be temporary. This is because the “off-balance sheet” fiscal strains driving the bias realise sooner or later, pushing up the fiscal deficit, and raising the government’s recorded debt stock (domestic or external) by the full amount of the realised liability.⁹⁵

⁹⁴ Government finance statistics conventions allow regional and local governments to be consolidated with the central government (CG) into the category “general government” (GG). However, the coverage on local country debt is not consistent across most countries and time complicating comparative analysis. As such, we ignore this distinction and focus on central government obligations only.

⁹⁵ This, of course, assumes an unchanged primary balance.

⁹⁶ This process of unrealised or unsecuritised items coming on-balance sheet and new off-balance sheet liabilities being created is continuous and, in practice, governments usually only report their outstanding securities like i.e. Treasury bills, bonds, notes, stocks etc. on official debt statements. *In light of the foregoing, it appears sensible, then, to focus on central government securitised liabilities.*

Next, there is the issue of reporting DD on a net or gross basis. The central government maintains cash balances at the central bank and other commercial banks, and may have, occasionally, loaned out funds to semi-government or non-governmental entities. Subtracting from the claims *on* government, these claims *of* government would produce a more accurate picture of *net* government indebtedness. Since data on government deposits at the central bank and commercial banks is readily available from the IFS database, moving from *gross* to *net* is not difficult. The choice therefore depends on the research question being investigated. If our focus is the financial market impact of DD, which is determined by the gross stock of government securities outstanding, it is important to use gross claims. Similarly, if it is intended to combine domestic and external public indebtedness to get a measure of total public debt: a gross claims series would add on nicely to the *gross* external public debt series reported in the World Bank's GDF database.

On the other hand, if our interest is in the government's net domestic financing (flow series), we would need to *first-difference* the net claims on government series. This series would track, more closely, the net withdrawal of loanable funds from the credit market – to the extent that the focus is DMB claims on government. If government deposits held at DMBs vary a lot over time, the variation in DMB net claims on government will be significantly higher than the variation in the gross claims series – owing to the variation in the 'government deposits at DMB' series. We computed the average coefficient of variation in the deposits/GDP series for 93 developing economies over the three decades since 1975. This turns out to be 0.78 (or 78%) which is less than 1, indicating a variation that is relatively small. *Consequently, we conclude, that any benefit of using net over gross claims is*

⁹⁶ This off-balance sheet and on-balance sheet terminology is standard in public finance literature. See, for instance, Rosen (2005).

unlikely to be significant. In addition, insofar as we are interested in the financial market impact of DD and total public indebtedness, a focus on gross claims is analytically appropriate.

Taking aboard the insights from above, we can narrow our preferred definition of government (public) DD to ‘gross securitised claims on the central government’, which would comprise both marketable and non-marketable securities.⁹⁷ At this stage, however, we must address the important issue of ‘central bank domestic debt’, especially liquidity paper, which in the case of some countries (e.g. Chile) is the only type of “public sector” domestic debt.

A disaggregation of claims (CL) on the central government offers a good starting point [claim-holders are indicated by subscripts].

$$\text{CLCG} = \text{CLCG}_{\text{CB}} + \text{CLCG}_{\text{DMB+OBI}} + [\text{CLCG}_{\text{NBFI}} + \text{CLCG}_{\text{RETAIL}}] \dots \text{---(i)}$$

[.] reflects the unavailability of this data from the IFS.

This appears to come closest to the definition of DD used in the Christensen, Mellor and Jeane-Guscina databases. Focusing on the central government, it captures the extent to which past fiscal deficits have been financed by borrowing from the central bank, banks and nonbanks. However, (i) also includes the central bank’s “overdraft” claims on government, which are not regarded as part of the central government’s DD stock. Importantly, the IFS database does not split central bank claims on government into their securitised and overdraft components; as such, an IFS based series can never replicate fully the definition of central government DD used in existing databases.⁹⁸

Proceeding, we have the claims on the central bank:

⁹⁷ As such, therefore, any recapitalisation bonds issued by governments to ailing state-owned banks would be included in “securitised DD stock”, even though such bonds are neither issued through market-based methods nor are tradable.

⁹⁸ IFS line item 12a is for gross central bank claims on the central government.

$$\text{CLCB} = \text{CLCB}_{\text{DMB+OBI}} + \text{CLCB}_{\text{CG}} + [\text{CLCB}_{\text{NBFI}} + \text{CLCG}_{\text{RETAIL}}] \dots\dots\dots \text{---(ii)}$$

(ii) includes, desirably, liquidity paper, but undesirably, “banks’ reserves at the central bank” which are, for the most part, unremunerated and unsecuritised. Fortunately, IFS has a line item 20c for securitised claims on the central bank, which enables us to include only central bank securities issued to DMBs and OBIs.

Consolidation of (i) and (ii) yields ‘claims on the public sector (NPUB)’, as follows:

$$\text{CLPUB} = \text{CLCG}_{\text{DMB+OBI}} + \text{CLCB}_{\text{DMB+OBI}} + [\text{CLCG}_{\text{NBFI}} + \text{CLCB}_{\text{NBFI}} + \text{CLCB}_{\text{RETAIL}} + \text{CLCG}_{\text{RETAIL}}] \dots\dots \text{---(iii)}$$

(iii) is analytically closer than (i) to the notion of ‘public’ DD, as it nets out the claims of the central bank on the central government and vice versa on the one hand; and includes central bank liquidity paper, on the other (Rosen 2005: 458).⁹⁹

II. Extraction of series from IFS

Form the foregoing, public sector domestic debt (**DD**) =

$$\begin{aligned} \text{CLPUB} &= \text{CLCG}_{\text{DMB+OBI}} + \text{CLCB}_{\text{DMB+OBI}} \\ &= \text{IFS} \quad 22\text{a}+42\text{a} \quad 20\text{c}+40\text{c} \end{aligned}$$

Thus, we are able to extract this series for 93 developing economies (featuring 17 emerging markets, 40 SSA countries and 36 other LICs) over the time period 1975-2007 – see Table 1.

⁹⁹ Hauner (2006) who adopts a similar approach to define DD excludes central bank liquidity paper. Since, other than choice of countries, this is the major difference between our DD measure and Hauner’s, the ensuing discussion in favour of including central bank paper quite important.

A number of other interesting DD stock and flow ratios can now be developed:

1. **DOMdebt**: public domestic debt to income = $100 \cdot [DD/GDP]$
2. **ppgEXTdebt**: public & publicly guaranteed external debt to income (from GDF)
3. **TOTdebt**: total public debt to income = $100 \cdot [(DD + \text{ppgEXTdebt})/GDP]$
4. **DDCR**: public domestic debt composition ratio = $100 \cdot [DOMdebt/TOTdebt]$
5. **DD2dep**: public domestic debt to demand + time, saving and foreign currency deposits = $100 \cdot [DD/(24+25)]^{100}$

¹⁰⁰ This ratio (DD2dep) provides a measure of DD holdings in relation to the total deposits pool of the banking system. For two countries with the same economic size, but different deposits/GDP ratios (financial depth), DOMdebt and DD2dep are likely to diverge, with the former ratio being higher in the country with greater financial depth.

Appendix B: Domestic Debt and Growth - Causality Issues

I. Extracting an index for “financial depth” using principal component analysis

Huang and Temple (2005) use liquid liabilities of the financial system/GDP (**LLY**), private sector credit provided by commercial (and other) banks/GDP (**PRIVO**) and commercial bank assets as a ratio of total banking system assets (**BTOT**) as the *principal components* of the underlying latent financial depth variable.¹⁰¹ They also constructed other measures of financial development related to financial intermediation efficiency, and the existence and size of stock and bond markets, but the data on these had too many gaps for the countries we are interested in, i.e. LICs and EMs. As such, we focus on financial depth, which, indeed, is also the variable they use in their panel regressions.

Principal component analysis consists in taking N specific indicators (with LLY, PRIVO, BTOT, $N=3$) and solving for their uncorrelated principal components ($P_1 \dots P_N$), that capture different dimensions of the underlying series. We only use the first component (P_1), formally defined by a vector of weights $a = (a_1, a_2, \dots, a_N)'$ on the (standardized) indicators such that $a'X$ has the maximum variance for any possible weights, subject to the constraint $a'a = 1$.

The method is applied to the “log normalized” LLY, PRIVO and BTOT series to obtain the principal components (below). As can be seen, the weights are roughly similar for the three series, indicating that they are indeed highly correlated and hopefully capturing the same underlying latent variable, financial depth. P_1 explains about 84.6% of the variation in the series, and therefore sufficient for our purposes.

¹⁰¹ Combining the individual variables can also help alleviate measurement errors and outlier problems that might arise if only a single variable is used.

Principal components (weights)			
	P_1	P_2	P_3
LLY	0.561	0.776	0.288
PRIVO	0.575	-0.617	0.539
BTOT	0.596	-0.137	-0.791

Weights P_1 were applied to LLY, PRIVO and BTOT and used to construct the financial depth index referred to in the text (see also Figure 2).

II. Econometric Framework for Granger-Causality Tests

The starting point for Granger-causality tests is dynamic single equation panel data regressions of the form:

$$y_{it} = \alpha_1 y_{it-1} + \alpha_2 y_{it-2} + \beta_1 x_{it-1} + \beta_2 x_{it-2} + n_i + \phi_t + v_{it} \dots \dots (i)$$

where y and x denote, respectively, the endogenous and exogenous variables of interest; n_i denotes unobserved country heterogeneity; ϕ_t period dummies;¹⁰² v_{it} the error term; $i = 1, 2 \dots 93$; and for the chosen lag length of 2, $t = 3 \dots 10$, where $t=1$ corresponds to 1975-77. A joint significance Wald test on β_1 and β_2 [= 0] helps ascertain if y is *Granger-caused* by x . Since panel regressions of this form involve a lagged dependent variable, it is problematic to employ standard fixed effects (FE) estimators to eliminate n_i .¹⁰³ Instrumental variable estimators, like the generalized method of moments (GMM) offer a robust solution to these problems by first-differencing (i) to produce:

$$\Delta y_{it} = \alpha_1 \Delta y_{it-1} + \alpha_2 \Delta y_{it-2} + \beta_1 \Delta x_{it-1} + \beta_2 \Delta x_{it-2} + \phi_t - \phi_{t-1} + \Delta v_{it} \dots \dots (ii)$$

and using appropriate lags of y and x to instrument for Δy and Δx .¹⁰⁴ The problem with these simple “difference GMM” estimators is that lagged levels of regressors are often weak instruments of the differenced variables. This is especially true when the underlying series are persistent, or the variance of the individual effects (n_i) is high relative to the variance of the transient shocks (v_{it}). These

conditions are likely to be met for the data we are using: the time series process for income (or GDP

¹⁰² Period dummies are extremely important in these regressions to control for the financial repression “years” and other common shocks, such as the intermittent debt and financial crises.

¹⁰³ The within-transformed lagged dependent regressor becomes correlated with the transformed error term, rendering the FE estimator biased.

¹⁰⁴ The Anderson-Hsiao difference estimator, can also circumvent the fixed effects bias, but performs badly with highly persistent series, such as income.

per capita) is known to be highly persistent; the variance of country heterogeneity is likely to be very high in our sample since it includes Asian emerging markets like China, Latin American oil-producers like Venezuela and very poor SSA countries like the Democratic Republic of Congo.

For precisely such cases, Arellano and Bover (1995) and Blundell and Bond (1998) have developed “system GMM” estimators, which can deliver significant improvements to model identification. Such estimators utilize additional assumptions about the initial conditions of the data process. In the context of growth regressions of the type we will be running later, the additional assumption pertains to there being no correlation between output growth and the country-specific effect in the absence of conditioning on other variables. Such an assumption is consistent with Solow’s conditional convergence growth framework, and its violation would tend to have implausible long-run implications.

The system GMM estimator then uses lagged differences to instrument the level variables appearing in the extra moment conditions permitted by the additional initial condition assumptions. Simulations have suggested that system GMM deals with weak instrument biases more robustly than difference GMM. As a result, the former has become increasingly popular in cross-country panel econometric studies.

Appendix C: Summary Statistics for Variables Used In Regressions

Summary Statistics for Main Regression Variables

	N	min	max	mean	sd	cv	median
gY	930	-16.20	23.47	5.00	4.50	0.90	4.57
Y	930	171	20261	2669	2764	1.04	1644
gPOP	928	-8.63	8.20	2.25	0.99	0.44	2.32
INFLATION	807	-10.86	98.87	13.95	16.02	1.15	9.33
INVEST	852	2.08	61.51	20.32	7.38	0.36	19.75
FISBAL	930	-63.54	27.03	-4.78	6.02	-1.26	-4.03
gTOT	922	-50.01	78.44	0.86	10.60	12.31	-0.07
OPEN	919	0.69	239.35	64.43	38.71	0.60	54.85
DOMdebt	844	0	89.72	6.34	9.70	1.53	3.61
DD2dep	843	0	94.40	21.21	17.17	0.81	17.43
EXTdebt	791	6.06	384.61	74.21	59.15	0.80	57.64
prSAVING	733	-52.05	41.80	13.29	9.45	0.71	13.43
STABILITY	526	23.80	81.70	58.22	11.70	0.20	59.15

Note: N = no. of observations; sd = standard deviation; cv = coefficient of variation; "DD2dep" is domestic debt/deposits (in percent).

Correlation Matrix for Main Regression Variables

	gY	lnY_1	gPOP	INFLATION	lnINVEST	FISBAL	gTOT	lnOPEN	DOMdebt	DD2dep	EXTdebt	prSAVING	STABILITY
gY	1												
lnY_1	-0.10	1											
gPOP	-0.04	-0.43	1										
INFLATION	-0.16	0.01	0.04	1									
lnINVEST	0.38	0.31	-0.16	-0.13	1								
FISBAL	0.09	0.24	-0.08	-0.11	0.13	1							
gTOT	0.05	-0.01	-0.04	-0.02	0.00	0.09	1						
lnOPEN	0.07	0.26	-0.10	-0.10	0.40	0.09	0.02	1					
DOMdebt	0.03	0.33	-0.23	-0.04	0.22	-0.13	-0.05	0.24	1				
DD2dep	-0.01	0.07	-0.05	-0.03	0.04	-0.21	-0.02	0.02	0.68	1			
EXTdebt	-0.32	-0.24	0.14	0.10	-0.13	-0.17	-0.04	0.20	-0.05	0.03	1		
prSAVING	0.19	0.44	-0.23	0.03	0.45	0.01	0.08	0.14	0.26	0.14	-0.31	1	
STABILITY	0.25	0.60	-0.39	-0.16	0.45	0.38	0.03	0.36	0.28	0.02	-0.38	0.38	1

Note: Since there were noticeably fewer observations for prSAVING and STABILITY, the correlation matrix for the "remaining variables" was computed by excluding the two variables.

Variable	Description	Source
gY	100*(per capita PPP GDP growth)	World Bank: WDI
lnY_1	log of [lagged per capita PPP GDP]	World Bank: WDI
gPOP	100*(growth rate of population)	World Bank: WDI
INFLATION	100*[$\pi/(1+\pi)$], where π is the annual % change in in CPI	World Bank: WDI
lnINVEST	log of [100*(gross fixed capital formation/GDP)]	IMF: IFS 93e
FISBAL	100*(fiscal balance/GDP)	IMF: WEO
gTOT	100*[growth in terms of trade (goods)]	IMF: WEO
lnOPEN	log of [100*(trade/GDP)]	World Bank: WDI
DOMdebt	100*[(banks' claims on CG) + (central bank securities)/GDP]	IMF: IFS [(22a+42a)+(20c+40c)]
DD2dep	100*[DOMdebt/ All bank deposits (current, time, saving)]	Deposits: World Bank: WDI
EXTdebt	100*[(public + private) external debt/GDP]	World Bank: GDF
prSAVING	100*(Private savings/GDP)	IMF: WEO
STABILITY	ICRG "composite" risk index to proxy for politico-economic stability PRS group: www.icrgonline.com of domestic institutions; high value of index indicates low risk	

Table 1 - Public Domestic Debt Trends in Developing Economies, 1975–2007

	Domestic Debt/GDP (percent)			Domestic Debt/Deposits (percent)		
	1975-86	1987-95	1996-2007	1975-86	1987-95	1996-2007
Sub-Saharan Africa Average	3.2	3.9	6.0	22.4	20.8	22.4
Benin	0.5	2.5		2.9	14.6	10.5
Botswana	2.9	4.3	5.0	15.4	27.0	22.4
Burkina Faso	2.2	1.8	1.2	24.2	15.4	10.8
Burundi	0.6	1.1	1.8	9.1	10.2	12.6
Cameroon	1.9	3.4	2.2	12.5	26.1	21.5
Cape Verde		19.0	21.8		35.6	37.5
Central African Rep	2.5	0.8	1.2	36.2	19.4	27.5
Chad	0.1	0.8	0.5	1.4	20.5	12.8
Comoros	1.0	0.5	0.4	20.4	8.3	6.3
Congo, Dem. Rep	0.2	0.1	0.3	8.5	3.1	8.4
Congo, Rep.	4.6	4.4	1.1	38.4	38.3	17.4
Cote d'Ivoire	0.8	4.8	4.4			
Djibouti		2.0	1.0		3.7	1.8
Ethiopia	4.8	11.2	11.1	31.3	50.7	29.4
Gambia, The	2.9	5.2	12.3	19.0	29.8	43.4
Ghana	2.7	3.4	9.8	28.6	26.4	
Guinea		0.2	2.0		4.1	25.4
Guinea-Bissau		0.7	0.8		27.5	8.0
Kenya	4.3	6.7	9.6	21.5	33.6	30.3
Lesotho	8.8	7.5	6.4	24.7	22.1	26.7
Madagascar	1.4	1.4	2.8	11.7	9.5	18.7
Malawi	5.8	5.1	6.3	34.4	30.4	42.2
Mali	0.4	0.7	1.1	5.0	6.6	7.2
Mauritania	0.2	0.3	2.0			
Mozambique	4.6	0.5		22.9	5.6	
Namibia		1.8	5.0		5.9	13.4
Niger	2.5	2.1	0.9	29.3	17.9	16.6
Nigeria	6.2	3.3	5.1	35.1	22.1	30.8
Rwanda	1.2	2.4	1.3	17.4	23.4	10.4
Senegal	2.0	1.8	3.2	11.3	11.1	15.9
Seychelles	6.5	32.8	67.0	25.1	76.7	78.2
Sierra Leone	4.7	1.7	4.9	38.2	24.1	47.3
Sudan	3.0	0.1		22.1	0.9	
Swaziland	2.0	0.8	1.3	7.1	2.9	6.2
Tanzania	10.1	2.9	5.3	40.9	18.2	32.1
Togo	0.8	0.7	1.8	3.9	3.3	9.7
Tunisia	5.6	5.4	4.8	17.6	14.0	10.2
Uganda	1.5	0.3	5.4	23.8	3.8	38.2
Zambia	8.6	6.7	5.3	40.5	36.9	30.3
Zimbabwe				58.7	60.1	

Table 1 (concluded) - Public Domestic Debt Trends in Developing Economies, 1975–2007

	Domestic Debt/GDP (percent)			Domestic Debt/Deposits (percent)		
	1975-86	1987-95	1996-2007	1975-86	1987-95	1996-2007
OTHER LICs average	6.9	6.1	9.0	18.1	17.1	20.0
Algeria	4.5	8.8	12.7	13.5	27.3	39.7
Bahrain	3.3	9.1	12.0	6.5	14.6	17.5
Bangladesh	2.1	3.2	6.6	15.5	15.0	19.9
Bolivia		0.3	7.6		1.0	18.7
Cambodia		0.0	0.1		0.6	0.3
Costa Rica	4.3	2.4	7.7	14.0	7.9	22.1
Dominican Rep	3.3	1.2	4.1	19.8	6.5	13.2
Ecuador	0.1	0.3	2.4	1.1	1.9	13.6
Egypt, Arab Rep	15.5	17.1	18.6	45.4	24.3	25.6
El Salvador	1.6	3.5	6.2	4.8	10.5	15.1
Fiji	4.6	5.5	4.9	16.3	12.1	12.3
Guatemala	1.4	2.2	2.6	7.8	12.7	12.8
Guyana	46.1	28.3	24.4	48.9	50.4	40.7
Haiti	0.4	0.1	2.1	2.8	0.7	6.6
Honduras	5.4	6.9	1.0	27.9	30.0	2.7
Iran, Islamic Rep	7.0	3.3	1.4	20.1	7.1	3.8
Jamaica	8.8	8.4	15.1	26.9	23.2	42.2
Lao PDR		1.9	1.2			
Lebanon	41.4	32.2	79.6	12.5	24.3	42.1
Libya	7.5	17.3	6.4	31.1	42.8	19.6
Morocco	11.5	19.5	17.5	43.7	50.9	27.3
Myanmar			0.0			
Nepal	2.7	5.1	6.6	17.4	22.1	17.4
Nicaragua	2.6	0.1	9.8	10.5	0.4	20.0
Panama	7.7	2.4	1.9	25.4	6.3	2.6
Papua New G.	3.8	6.9	12.2	17.3	23.4	40.0
Paraguay	0.2	0.2	2.4	1.2	0.9	9.7
Peru	7.4	4.1	2.2	45.5	28.0	8.8
Sri Lanka	1.8	3.6	6.8	9.3	14.8	19.4
Suriname	0.5	0.0				
Syrian Arab Rep	2.5	3.9	8.9	10.8	14.5	21.1
Trinidad & Tobago	3.2	5.3		9.9	13.1	
Uruguay	5.1	5.1	5.5	13.1	12.2	
Venezuela, RB	2.0	4.9	5.0	6.6	19.1	30.8
Vietnam		1.5	4.1		45.4	30.6
Yemen, Rep.		0.2	4.6		0.9	22.7
EM average	7.8	8.5	14.6	25.8	25.6	32.9
Argentina	5.9	8.1	12.8	32.0	63.0	26.4
Brazil	6.1	8.6	36.9	54.3	25.4	81.7
Chile	14.1	15.1	9.3	23.3	49.9	25.8
China		1.0	9.5		3.9	19.5
Colombia	1.7	0.9	6.5	13.0	6.7	26.8
Cyprus	5.8	12.0	19.2	9.5	16.2	
India	6.3	10.2	17.9	23.0	27.9	35.5
Indonesia	0.2	1.9	16.5	1.7	5.7	38.2
Korea, Rep.	5.8	5.4	8.6	19.9	16.1	14.7
Malaysia	31.9	18.2	8.3	73.4	30.9	9.8
Mauritius	10.0	19.5	20.0	26.4	31.3	24.6
Mexico	10.4	12.7	20.1	37.5	36.7	72.2
Pakistan	7.4	9.8	10.5	34.2	45.3	35.0
Philippines	3.5	7.2	13.2	17.1	23.2	25.0
South Africa	6.8	4.7	11.2	14.5	9.7	17.0
Thailand	6.2	4.2	4.6	17.1	7.1	5.1
Turkey	3.2	5.7	23.7	15.5	35.9	69.6
All LICs & EMs	5.5	5.6	8.7	21.4	20.2	23.4

Table 2 : Granger causality tests for domestic debt, financial depth, stability, income & saving
(system GMM regressions; all variables are log-normalised; coefficients of interest in **bold**)

a: Financial Depth & Domestic Debt			
Dependent variable	(1) FINDEPTH	(2) DOMdebt	(3) DOMdebt
Regressors			
DOMdebt_1	-0.0433 -1.56	1.0033 ** 7.10	0.8648 ** 7.80
DOMdebt_2	0.1272 * 1.91	-0.3748 ** -3.26	-0.3851 ** -4.13
FINDEPTH_1	1.3448 ** 18.74	0.3339 ** 2.54	0.2547 * 1.84
FINDEPTH_2	-0.3551 ** -2.93	-0.1523 -1.54	-0.1352 -1.21
INCOME_1			0.4055 ** 2.08
Hansen's χ^2 test (prob> χ^2)	0.371	0.432	0.174
AR(1) test (prob>z)	0.006 (-)	0.006 (-)	0.007 (-)
AR(2) test (prob>z)	0.885 (-)	0.713 (+)	0.366 (+)
Joint test for $H_0: \beta_1 = \beta_2 = 0$ (prob> χ^2)	0.158	0.019 **	0.143
$H_0: \beta_1 + \beta_2 = 0$; prob> χ^2	0.085 *	0.235	0.426
$\beta_{LR} = (\beta_1 + \beta_2) / (1 - \alpha_1 - \alpha_2)$	8.15	0.49	0.23
Roots; for stability	2.77; 1.02 Stable	1.34 $\pm$ 0.94i Stable	1.12 $\pm$ 1.16i Stable

b: Stability (Institutions) & Domestic Debt			
Dependent variable	(1) STABILITY	(2) STABILITY	(3) DOMdebt
Regressors			
DOMdebt_1	0.2474 ** 3.24	0.2873 ** 2.58	0.7709 ** 5.69
DOMdebt_2	-0.0297 -0.60	-0.0708 -1.53	-0.1835 ** -2.71
STABILITY_1	0.7758 ** 7.36	0.7532 ** 9.37	0.0718 0.83
STABILITY_2	-0.1942 ** -3.21	-0.2180 ** -3.30	-0.0207 -0.20
INCOME_1		0.1926 ** 2.11	
Hansen's χ^2 test (prob> χ^2)	0.941	0.223	0.619
AR(1) test (prob>z)	<0.001 (-)	0.001 (-)	0.011 (-)
AR(2) test (prob>z)	0.491 (-)	0.694 (-)	0.306 (-)
Joint test for $H_0: \beta_1 = \beta_2 = 0$ (prob> χ^2)	0.003 **	0.034 **	0.701
$H_0: \beta_1 + \beta_2 = 0$; prob> χ^2	0.023 **	0.029 **	0.699
$\beta_{LR} = (\beta_1 + \beta_2) / (1 - \alpha_1 - \alpha_2)$	0.52	0.47	0.12
Roots; for stability	2.00 $\pm$ 1.08i Stable	1.73 $\pm$ 1.26i Stable	2.10 $\pm$ 1.02i Stable

c: Private Saving & Domestic Debt		
Dependent variable	(1) prSAVING	(2) DOMdebt
Regressors		
DOMdebt_1	1.0631 ** 11.07	0.1518 ** 3.03
DOMdebt_2	-0.314 -4.85	0.0417 0.74
prSAVING_1	0.1430 * 1.69	0.6400 ** 7.3
prSAVING_2	0.0638 * 1.65	0.0116 0.25
Hansen's χ^2 test (prob> χ^2)	0.528	0.778
AR(1) test (prob>z)	0.004 (-)	0.005 (-)
AR(2) test (prob>z)	0.399 (-)	0.372 (-)
Joint test for $H_0: \beta_1 = \beta_2 = 0$ (prob> χ^2)	0.089 *	0.003 **
$H_0: \beta_1 + \beta_2 = 0$; prob> χ^2	0.035 **	0.003 **
$\beta_{LR} = (\beta_1 + \beta_2) / (1 - \alpha_1 - \alpha_2)$	0.82	0.56
Roots; for stability	1.69 $\pm$ 0.57i Stable	1.52; -56.69 Stable

d: Income & Domestic Debt		
Dependent variable	(1) INCOME	(2) DOMdebt
Regressors		
DOMdebt_1	0.0671 ** 2.45	0.7436 ** 6.77
DOMdebt_2	0.0195 0.98	-0.141 ** -2.31
INCOME_1	1.3568 ** 16.13	0.2920 * 1.65
INCOME_2	-0.3838 ** -3.74	-0.0044 -0.03
Hansen's χ^2 test (prob> χ^2)	0.075 *	0.344
AR(1) test (prob>z)	<0.001 (-)	0.002 (-)
AR(2) test (prob>z)	0.659 (-)	0.394 (-)
Joint test for $H_0: \beta_1 = \beta_2 = 0$ (prob> χ^2)	0.048 **	0.098 *
$H_0: \beta_1 + \beta_2 = 0$; prob> χ^2	0.031 **	0.04 **
$\beta_{LR} = (\beta_1 + \beta_2) / (1 - \alpha_1 - \alpha_2)$	3.207	0.72
Roots; for stability	2.49; 1.05 Stable	2.64 $\pm$ 0.38i Stable

e: Financial Depth & Income		
Dependent variable	(1) FINDEPTH	(2) INCOME
Regressors		
INCOME_1	0.2998 ** 2.31	1.4868 ** 26.53
INCOME_2	-0.3806 -0.96	-0.4857 ** -6.90
FINDEPTH_1	1.3435 ** 18.61	0.0009 0.05
FINDEPTH_2	-0.5504 ** -4.46	0.0038 0.21
Hansen's χ^2 test (prob> χ^2)	0.414	0.316
AR(1) test (prob>z)	0.009 (-)	<0.001 (-)
AR(2) test (prob>z)	0.253 (+)	0.373 (+)
Joint test for $H_0: \beta_1 = \beta_2 = 0$ (prob> χ^2)	0.059 *	0.858

Notes:

(i) INCOME is PPP GDP per capita from WEO; DOMdebt is 100*domestic debt/GDP (see text); FINDEPTH index is developed using Beck et al (2000) data (see text); prSAVING rate is from IMF; WEO database; STABILITY is ICRG composite risk index capturing a country's political, economic and financial risk (higher value denotes lower risk) (ii) z-statistics in italics, unless otherwise stated; constant and time dummies included in all regressions (iii) ** significant at 5%, * at 10% (iv) data spans 93 countries and 10 three-year time periods constructed from 30-year annual data (1975-2004) (v) GMM results reported here were obtained using the xtabond2 two-step command in STATA; z-statistics are based on heteroskedasticity-consistent errors and the finite-sample adjustment of Windmeijer (2005). AR(1) and AR(2) are tests for first-order and second-order serial correlation. First order (negative) serial correlation is expected due to first-differencing, but identification of the models relies on the absence of second-order correlation. Hansen's chi-squared tests the additional moment conditions used by the system GMM estimator (vi) GMM instrumentation: for the difference equation, levels dated t-2 and t-3 are used as instruments; while for the moment conditions in levels, first differences dated t-1 are used as instruments (vii) the joint test for significance of β s relates, in any given column, to the coefficients appearing in bold in that column (viii) for regressions in panel c, variables enter in non-normalised form (ix) β_{LR} captures the LR effect of the explanatory variable on the regressand; where $\beta_{LR} > 1$, the beta and the associated $\beta_1 + \beta_2 = 0$ test are not reported; the coefficients on regressand lags are denoted by α_1 and α_2 (x) Stability requires that the roots of the polynomial $1 - \alpha_1 L - \alpha_2 L^2 = 0$ are outside the unit circle (xi) The test $H_0: \beta_1 + \beta_2 = 0$ checks if there is support for the long-run "levels" relationship (captured by β_{LR}). Failure to reject the null implies $\beta_1 = -\beta_2$, so that $Y_{it} = \beta_1(X_{it-1} - X_{it-2})$; in other words Y depends on changes in X, not the level of X; the relationship, therefore, is not long-term but short-term. A rejection of the null implies the opposite, and provides support for a long-run "levels" relationship.

Table 3. Growth Regressions on DOMdebt (Domestic Debt/GDP)

A. LINEAR					B. NONLINEAR (using interaction of DOMdebt with a DOMdebt quartile dum)				
Dependent variable: per capita income growth (gY=100*growth rate in PPP per capita income)					Dependent variable: per capita income growth (gY=100*growth rate in PPP per capita income)				
	(1) OLS	(2) RE	(3) FE	(4) GMM-sys		(5) OLS	(6) RE	(7) FE	(8) GMM-sys
lnY_1	-0.8275 ** -4.17	-1.0733 ** -4.43	-7.2849 ** -8.86	-2.3040 ** -2.49	lnY_1	-0.8253 ** -4.11	-1.0574 ** -4.31	-6.3615 ** -9.00	-1.9714 ** -3.24
gPOP	-0.5021 ** -3.36	-0.4342 ** -2.71	-0.1671 -0.91	-0.6990 -1.33	gPOP	-0.4825 ** -3.17	-0.4396 ** -2.73	-0.1888 -1.07	-0.5526 -1.15
INFLATION	-0.0237 ** -2.47	-0.0236 ** -2.26	-0.0005 -1.55	-0.0156 -0.33	INFLATION	-0.0220 ** -2.25	-0.0233 ** -2.21	-0.0317 ** -2.59	-0.0092 -0.22
lnINVEST	3.4373 ** 9.00	3.3271 ** 7.90	2.0932 ** 3.53	5.7036 ** 3.11	lnINVEST	3.3317 ** 8.65	3.3219 ** 7.87	2.4884 ** 4.83	3.7973 ** 2.99
FISBAL	0.1159 ** 3.77	0.1305 ** 4.02	0.1394 ** 3.73	0.1611 * 1.83	FISBAL	0.1126 ** 3.54	0.1265 ** 3.82	0.1032 ** 2.91	0.1575 ** 2.43
gTOT	-0.0015 -0.11	-0.0031 -0.23	-0.0063 -0.46	-0.0114 -0.61	gTOT	-0.0003 -0.02	-0.0034 -0.25	-0.0050 -0.39	0.0024 0.12
lnOPEN	0.0453 0.16	0.2851 0.83	3.2017 ** 4.63	2.2311 * 1.82	lnOPEN	0.0568 0.20	0.2855 0.83	2.6352 ** 4.26	2.1346 ** 2.15
EXTdebt	-0.0091 ** -3.38	-0.0095 ** -3.08	-0.0226 ** -4.57	0.0063 0.51	EXTdebt	-0.0089 ** -3.24	-0.0093 ** -3.02	-0.0140 ** -3.06	-0.0079 -1.54
DOMdebt	0.0406 ** 2.22	0.0724 ** 2.95	0.0637 * 1.73	0.0742 * 1.77	DOMdebt	0.0909 ** 2.40	0.0894 ** 2.41	0.0667 * 1.79	0.0981 * 1.93
					DOMdebt*(quart_DOM)	-0.0075 -0.65	-0.0070 -0.62	-0.0155 -1.36	-0.0054 -0.25
R ² overall	0.42	0.42	0.07	0.203	R ² overall	0.42	0.41	0.07	0.656
R ² within		0.41	0.51	<0.001 (-)	R ² within		0.41	0.48	<0.001 (-)
R ² between		0.47	<0.01	0.329	R ² between		0.46	<0.01	0.277

Note: (i) t-statistics (FE & OLS) and z-statistics (RE & GMM) in italics; (ii) constant; time dummies included in all regressions; (iii) ** significant at 5 percent, * at 10 percent; (iv) data spans 93 countries and 10 three-year time periods constructed from 30-year annual data starting 1975; (v) Results obtained using STATA's reg (OLS), xtreg (RE; FE) and xtbon2 (GMM-system; two-step) commands; (vi) Domestic debt regressors are lagged one period; (vii) z-statistics for GMM are heteroskedasticity-consistent; (viii) Arellano-Bond AR(1) and AR(2) tests are for 1st and 2nd-order serial correlation in errors. 1st order negative; serial correlation is expected due to first-differencing; model identification requires absence of 2nd-order correlation; (ix) Hansen's chi-squared test checks if the moment conditions used by the system GMM estimator are valid; (x) GMM instrumentation: (a) gTOT and gPOP were assumed exogenous, while the domestic debt variables, lnINVEST, lnOPEN and FISBAL were treated as endogenous; (b) instruments used for the difference equation: Xt-2, where X denotes an endogenous variable; (c) additional instruments used for the levels equation: ΔXt-1, where X is an endogenous variable; (xi) "quart_DOM" dummy = 0 if DOMdebt falls in 1st quartile, 1 if DOMdebt falls in 2nd quartile, 2 if DOMdebt falls in 3rd quartile, and 3 if DOMdebt falls in the 4th quartile; relevant DOMdebt percentiles are: p25 = 1.26%, p50 = 4.61% & p75 = 7.36%. relevant DOMdebt percentiles are: p25 = 1.26%, p50 = 4.61% & p75 = 7.36%.

Table 4. Growth Regressions on Domestic Debt to Deposits Ratio [DD2dep: Domestic Debt/(Current, Time, and Saving Deposits)]

A. LINEAR						B. NONLINEAR (Using interaction of DD2dep with a DD2dep quartile dummy)					
Dependent variable: per capita income growth (gY=100*growth rate in PPP per capita income)						Dependent variable: per capita income growth (gY=100*growth rate in PPP per capita income)					
	(1) OLS	(2) RE	(3) FE	(4) GMM-sys			(5) OLS	(6) RE	(7) FE	(8) GMM-sys	
lnY_1	-0.8382 ** -4.27	-1.0932 ** -4.55	-6.6924 ** -9.58	-1.8499 ** -2.42		lnY_1	-0.8415 ** -4.19	-1.1021 ** -4.48	-6.6446 ** -9.35	-1.7925 ** -2.24	
gPOP	-0.5338 ** -3.52	-0.4788 ** -2.98	-0.1802 -1.01	-0.4083 -1.12	gPOP	-0.5044 ** -3.3	-0.4517 ** -2.78	-0.1460 -0.81	-0.4699 -1.34		
INFLATION	-0.0289 ** -2.95	-0.0291 ** -2.74	-0.0339 ** -2.73	-0.0500 -1.47	INFLATION	-0.0256 ** -2.54	-0.0272 ** -2.5	-0.0387 ** -3.00	0.0023 0.05		
lnINVEST	3.6083 ** 9.33	3.6611 ** 8.63	2.9434 ** 5.78	5.5998 ** 3.44	lnINVEST	3.6396 ** 9.36	3.6777 ** 8.6	2.8784 ** 5.59	6.7292 ** 4.73		
FISBAL	0.1145 ** 3.64	0.1254 ** 3.84	0.1003 ** 2.89	0.0924 1.33	FISBAL	0.1018 ** 3.12	0.1116 ** 3.29	0.0754 ** 2.08	0.2407 ** 2.58		
gTOT	0.0025 0.18	0.0003 0.02	-0.0001 -0.01	0.0013 0.08	gTOT	0.0035 0.25	0.0009 0.07	-0.0037 -0.30	-0.0052 -0.27		
lnOPEN	0.0581 0.20	0.2598 0.76	2.3124 ** 3.81	0.8511 0.64	lnOPEN	0.0601 0.21	0.2768 0.8	2.4235 ** 3.92	1.5334 0.93		
EXTdebt	-0.0095 ** -3.48	-0.0099 ** -3.20	-0.0142 ** -3.09	0.0028 0.2	EXTdebt	-0.0100 ** -3.60	-0.0104 ** -3.33	-0.0131 ** -2.75	0.0019 0.19		
DD2dep	0.0146 ** 2.03	0.0133 * 1.71	0.0042 0.47	0.0322 ** 2.12	DD2dep	0.0280 ** 2.56	0.0258 ** 2.38	0.0188 * 1.70	0.0513 ** 2.13		
					DD2dep*(quart_DD2dep)	-0.0056 * -1.67	-0.0056 * -1.68	-0.0067 ** -1.97	-0.0151 * -1.65		
					Maxima @ DD2dep percentile @ DD2dep ratio	out-of-sample -do-	out-of-sample -do-	83 rd 35.71 %	97 th 65.40 %		
R ² overall	0.42	0.42	0.07	0.215	Hansen's χ^2 : prob> χ^2	R ² overall	0.42	0.42	0.06	0.294	Hansen's χ^2 : prob> χ^2
R ² within		0.41	0.49	<0.001 (-)	A-Bond AR(1): prob>z	R ² within		0.42	0.47	<0.001 (-)	A-Bond AR(1): prob>z
R ² between		0.46	<0.01	0.440	A-BondAR(2): prob>z	R ² between		0.44	<0.01	0.469	A-BondAR(2): prob>z

Note: (i) t-statistics (FE & OLS) and z-statistics (RE & GMM) in *italics*.

(ii) constant; time dummies included in all regressions.

(iii) ** sig. at 5%, * = at 10%.

(iv) data spans 93 countries and 10 three-year time periods constructed from 30-year annual data, starting 1975.

(v) Results obtained using STATA's *reg* (OLS), *xtreg* (RE; FE) and *xtabond2* (GMM-system; two-step) commands.

(vi) Domestic debt regressors are lagged one period.

(vii) z-statistics for GMM are heteroskedasticity-consistent.

(viii) Arellano-Bond AR(1) and AR(2) tests are for 1st and 2nd-order serial correlation in errors. 1st order negative serial correlation is expected due to first-differencing; model identification requires absence of 2nd-order correlation.

(ix) Hansen's chi-squared test checks if the moment conditions used by the system GMM estimator are valid

(x) GMM instrumentation:

(a) gTOT and gPOP were assumed exogenous, while the domestic debt variables, lnINVEST, lnOPEN and FISBAL were treated as endogenous.

(b) instruments used for the difference equation: $X_{i,t-2}$, where X denotes an endogenous variable.

(c) additional instruments used for the levels equation: $\Delta X_{i,t-1}$, where X is an endogenous variable.

(xi) "quart_DD2dep" dummy = 0 if DD2dep falls in 1st quartile, 1 if DD2dep falls in 2nd quartile, 2 if DD2dep falls in 3rd quartile, and 3 if DD2dep falls in the 4th quartile;

relevant DD2dep percentiles are:

p25	8.54 %
p50	17.43 %
p75	29.93 %

Table 5. Linear Specifications Excluding Investment (lnINVEST)

Dependent variable: per capita income growth (gY = 100*growth rate in PPP per capita income)			
	(1) OLS	(2) FE	(3) GMM-sys
lnY_1	-0.5199 ** -2.51	-7.4156 ** -7.06	-1.9597 ** -2.06
gPOP	-0.5829 ** -3.67	-0.1444 -0.72	-0.7959 -1.24
INFLATION	-0.0263 ** -2.69	-0.0006 * -1.92	-0.0110 -0.19
lnINVEST	---	---	---
FISBAL	0.1450 ** 4.52	0.1628 ** 3.94	0.2033 ** 2.62
gTOT	-0.0015 -0.10	0.0009 0.06	-0.0173 -0.73
lnOPEN	0.7101 ** 2.58	3.3762 ** 4.82	2.4579 1.63
EXTdebt	-0.0097 ** -3.45	-0.0206 ** -3.74	0.0054 0.36
DOMdebt	0.0542 ** 2.80	0.0801 ** 2.10	0.0990 ** 2.31
memo: DOMdebt with lnINVEST included	0.0406 ** 2.22	0.0637 * 1.73	0.0742 * 1.77
R ² overall	0.34	0.05	0.151
R ² within		0.48	<0.001 (-)
R ² between		<0.01	0.260

Table 6. GMM Regressions including DOMdebt Interactions with STABILITY

	(1) OLS	(2) FE	(3) GMM-sys
lnY_1	-0.9877 ** -4.17	-5.2696 ** -7.44	-1.4576 * -1.76
gPOP	-0.8217 ** -3.65	-0.4041 -1.07	-1.2352 ** -2.70
INFLATION	-0.0006 ** -2.14	-0.0402 ** -3.22	-0.0001 -0.12
lnINVEST	3.7385 ** 7.69	2.5725 ** 3.47	5.1745 ** 4.47
FISBAL	0.1628 ** 4.12	0.1636 ** 3.46	0.2918 ** 3.05
gTOT	-0.0007 -0.04	-0.0222 -1.31	-0.0265 -1.23
lnOPEN	-0.3619 -1.05	2.7658 ** 3.10	1.5609 0.98
EXTdebt	-0.0078 ** -2.54	-0.0045 -0.79	-0.0027 -0.24
DOMdebt	0.1204 ** 3.56	0.0757 ** 1.94	0.1568 * 1.83
DOMdebt*(quart_STABILITY)	-0.0288 ** -2.1	-0.0143 -0.89	-0.0826 * -1.69
Maxima @ STABILITY percentile @ STABILITY value	out-of-sample	out-of-sample	60 th 62
R ² overall	0.30	0.03	0.258
R ² within		0.30	<0.001
R ² between		<0.01	0.947

Hansen's χ^2 : prob> χ^2
A-Bond AR(1): prob>z
A-BondAR(2): prob>z

Note: (i) t-statistics (for OLS and FE) and z-statistics (for RE and GMM) in italics; (ii) Constant; time dummies included in all regressions; (iii) ** significant at 5 percent, * at 10 percent; (iv) Data spans 93 countries and 10 three-year time periods constructed from 30-year annual data, starting 1975; (v) Results obtained using STATA's reg (OLS) xtreg (FE; RE) and xtabond2 (GMM-system; two-step) commands; (vi) Domestic debt regressors are lagged one period; (vii) z-statistics for GMM are heteroskedasticity-consistent; (viii) Arellano-Bond AR(1) and AR(2) tests are for 1st and 2nd-order serial correlation in errors. 1st order negative serial correlation is expected due to first-differencing; model identification requires absence of 2nd-order correlation; (ix) Hansen's chi-squared test checks if the moment conditions used by the system GMM estimator are valid; (x) GMM instrumentation: (a) gTOT and gPOP were assumed exogenous, while the domestic debt variables, lnINVEST, lnOPEN & FISBAL were treated as endogenous. (b) instruments used for the difference equation: Xt-2, where X denotes an endogenous variable. (c) additional instruments used for the levels equation: ΔXt-1, where X is an endogenous variable; (xi) The "quart_STABILITY" dummy = 0 if the STABILITY variable (ICRG composite index) falls in the 1st quartile, 1 if it falls in 2nd quartile, 2 if it falls in 3rd quartile, and 3 if it falls in the 4th quartile; the relevant "STABILITY" percentiles are as follows:

	p25	p50	p75
STABILITY (ICRG composite index)	50.8	59.15	66.9

Table 7. Interactions with Attributes of Domestic Debt (DD) Quality

Dependent variable: per capita income growth (gY=100*growth rate in PPP per capita income)						
Attribute of DD Being Tested through Interaction (INT Variables =>)	Share of Securities in DD (SDD2DD)	Banking System Share in DD (shBANK)	Financial Repression vs. Financial Liberalization (ERA)	Bearing Positive or Negative Real Interest Rate (REALi)	Regressions with Christensen's (2004) DD Data on 20 SSUB-Saharan Countries: DD includes CG Securities Held by Central Bank, Banks, and Nonbanks (DDSSA)	
	A	Banking system's share in DD (shBANK)	C	D	E: as % of GDP	F: as % of deposits
Control variables:						
lnY_1	-6.7032 ** -2.37	-5.4523 * -1.85	-6.2995 ** -14.86	-7.0100 ** -9.15	-8.4418 ** -4.05	-7.0812 ** -3.43
gPOP	-0.2329 -0.85	0.0846 0.20	-0.2860 -1.58	-0.1282 -0.71	-0.2416 -1.11	-0.2571 -1.12
INFLATION	0.0044 1.00	0.0414 0.65	-0.0007 ** -2.66	-0.0014 -1.59	-0.0645 * -1.86	-0.0535 -1.48
lnINVEST	4.1701 ** 7.15	1.9955 * 1.85	3.3646 ** 6.52	2.8014 ** 5.33	3.5150 ** 2.43	4.3390 ** 2.66
FISBAL	-0.0240 -0.42	0.0735 0.83	0.1288 ** 3.70	0.0820 ** 2.19	0.0288 0.34	0.0452 0.49
gTOT	-0.0135 -0.70	-0.0196 -0.73	-0.0006 -0.05	0.0077 0.58	-0.0079 -0.30	-0.0027 -0.10
lnOPEN	-0.7008 -1.48	-1.5980 -0.93	2.4805 ** 4.03	3.3450 ** 5.17	2.7712 * 1.78	2.0907 1.22
EXTdebt	-0.0070 * -1.95	-0.0042 0.41	-0.0049 -1.34	-0.0188 ** -3.79	-0.0164 -1.33	-0.0095 -0.72
DD variables:						
ALLonCG	-0.0187 -1.64					
ALLonCG*SDD2DD	0.1677 ** 2.57					
DOMdebt		0.0515 * 1.66	-0.0319 -0.91	-0.0307 -1.04		
DOMdebt*INT		-0.0017 ** -3.60	0.0587 * 1.72	0.0470 * 1.74		
DDSSA					0.1590 ** 3.09	0.0214 ** 2.04
DDSSA*quart_DDSSA					-0.0114 -0.82	-0.0002 -0.06
No. of observations:	186	176	623	558	130	124

Summary Statistics for New Variables Introduced on DD Quality

in %	SDD2DD	shBANK	REALi	DDSSA/ GDP	DDSSA/ Deposits
p25	0	5.29	-6.01	3.96	34.35
p50	26.84	50.75	-0.01	10.58	65.55
p75	74.70	85.22	3.76	24.99	96.02

SDD2DD = Share of "securities" in total CG DD [Mellor's 2006 database on 74 IMF program countries over the period 1996-2004]; CG denotes central government.

shBANK: Banking system's (including central bank's) share of total CG DD [-do-].

ERA: Dummy variable taking the value 0 for the "financial repression" era (1975-89) and 1 for the "financial liberalisation" period (1990-2004).

REAL i: Deposit rate minus inflation [WDI and IFS].

DDSSA: CG securities [Christensen's 2004 database on 20 SSA countries; 1980-2000].

Note: (i) FE regressions reported only (due to space considerations); t-statistics in italics; (ii) constant; time dummies included in all regressions; (iii) ** significant at 5 percent, * at 10 percent; (iv) for regressions A and B, data spans 70 IMF program countries over 1996-2004, i.e., four three-year periods (using Mellor's 2006 database); for regressions C and D, the full 93 country (1975-2004) sample was used; for regressions E and F, Christensen's (2004) domestic debt data on 20 sub-Saharan Africa countries (1980-2000) was used; (v) ALLonCG = 100*[all banking system claims on central government/GDP].

Table 8. Robustness Check 1: Selected Regressions with Six-Year Data

Dependent variable: per capita income growth (gY=100*growth rate in PPP per capita income)						
	A. DOMdebt (domestic debt/tGDP) LINEAR (counterpart of Table 3, panel A)			B. DD2dep (domestic debt/deposits) NONLINEAR (counterpart of Table 4, panel B)		
	(1) OLS	(2) FE	(3) GMM-sys	(1) OLS	(2) FE	(3) GMM-sys
lnY_1	-0.9394 ** <i>-4.09</i>	-5.4120 ** <i>-6.21</i>	-1.7637 ** <i>-2.22</i>	-0.8094 ** <i>-3.86</i>	-5.1443 ** <i>-6.21</i>	-1.5416 <i>-1.59</i>
gPOP	-0.6717 ** <i>-3.04</i>	-0.3216 <i>-0.94</i>	-1.8077 ** <i>-2.08</i>	-0.7903 ** <i>-3.82</i>	0.0310 <i>0.09</i>	-0.9176 ** <i>-2.05</i>
INFLATION	0.0000 <i>-0.09</i>	0.0002 <i>0.42</i>	0.0001 <i>0.04</i>	-0.0013 ** <i>-3.02</i>	-0.0012 ** <i>-2.54</i>	-0.0023 <i>-0.69</i>
lnINVEST	3.8625 ** <i>8.65</i>	1.8400 ** <i>2.70</i>	5.2615 ** <i>3.77</i>	2.8337 ** <i>6.82</i>	0.9883 <i>1.60</i>	4.0645 ** <i>2.72</i>
FISBAL	0.1683 ** <i>4.44</i>	0.1094 ** <i>2.36</i>	0.1153 <i>1.35</i>	0.1202 ** <i>3.11</i>	0.0941 ** <i>2.09</i>	0.1016 <i>1.50</i>
gTOT	-0.0052 <i>-0.27</i>	0.0004 <i>0.02</i>	0.0569 <i>0.71</i>	0.0448 ** <i>1.98</i>	0.0024 <i>0.11</i>	0.0393 <i>1.64</i>
lnOPEN	-0.5231 ** <i>-2.06</i>	2.2988 ** <i>3.07</i>	-0.7815 <i>-1.05</i>	0.1094 <i>0.38</i>	2.5828 ** <i>3.53</i>	1.8763 <i>1.24</i>
EXTdebt	-0.0054 * <i>-1.89</i>	-0.0102 ** <i>-1.98</i>	0.0006 <i>0.04</i>	-0.0072 ** <i>-2.71</i>	-0.0058 <i>-1.19</i>	-0.0031 <i>-0.25</i>
<u>Domestic debt</u>	0.0732 ** <i>2.92</i>	0.0587 * <i>1.66</i>	0.1302 * <i>1.76</i>	0.0208 ** <i>2.13</i>	0.0262 ** <i>2.39</i>	0.0421 ** <i>2.09</i>
<u>Domestic debt*quartile</u>				-0.0018 <i>-0.60</i>	-0.0040 <i>-1.15</i>	0.0036 <i>0.33</i>
<i>Memo (with three-year data):</i>						
<u>Domestic debt</u>	0.0406 **	0.0637 *	0.0742 *	0.0280 **	0.0188 *	0.0513 **
<u>Domestic debt*quartile</u>				-0.0056 *	-0.0067 **	-0.0151 *
R^2 overall; Hansen's χ^2	0.40	0.03	0.402	0.39	0.02	0.090
R^2 within; AR(1)		0.41	<0.001 (-)		0.41	0.057 (-)
R^2 between; AR(2)		0.01	0.495		<0.01	0.595

Note: (i) t-statistics (FE & OLS) and z-statistics (GMM) in italics; (ii) constant; time dummies included in all regressions; (iii) ** significant at 5 percent, * at 10 percent; (iv) data spans 93 countries and five six-year time periods constructed from 10 three-year period data, starting 1975-77; (v) results obtained using STATA's reg (OLS), xtreg (RE; FE) and xtabond2 (GMM-system; two-step) commands; (vi) regressor Domestic debt means DOMdebt (domestic debt/GDP) for panel a regressions, and DD2dep (domestic debt/deposits) for panel b regressions; quartile means quartiles of DD2dep; (vii) z-statistics for GMM are heteroskedasticity-consistent; (viii) Arellano-Bond AR(1) and AR(2) tests for GMM regressions check for 1st and 2nd-order serial correlation in errors. 1st order negative serial correlation is expected due to first-differencing; model identification requires absence of 2nd-order correlation; (ix) Hansen's chi-squared test checks if the moment conditions used by the system GMM estimator are valid; (x) GMM instrumentation: (a) gTOT and gPOP were assumed exogenous, while the domestic debt variables, lnINVEST, lnOPEN and FISBAL were treated as endogenous; (b) instruments used for the difference equation: Xt-2, where X denotes an endogenous variable; (c) additional instruments used for the levels equation: ΔX_{t-1} , where X is an endogenous variable.

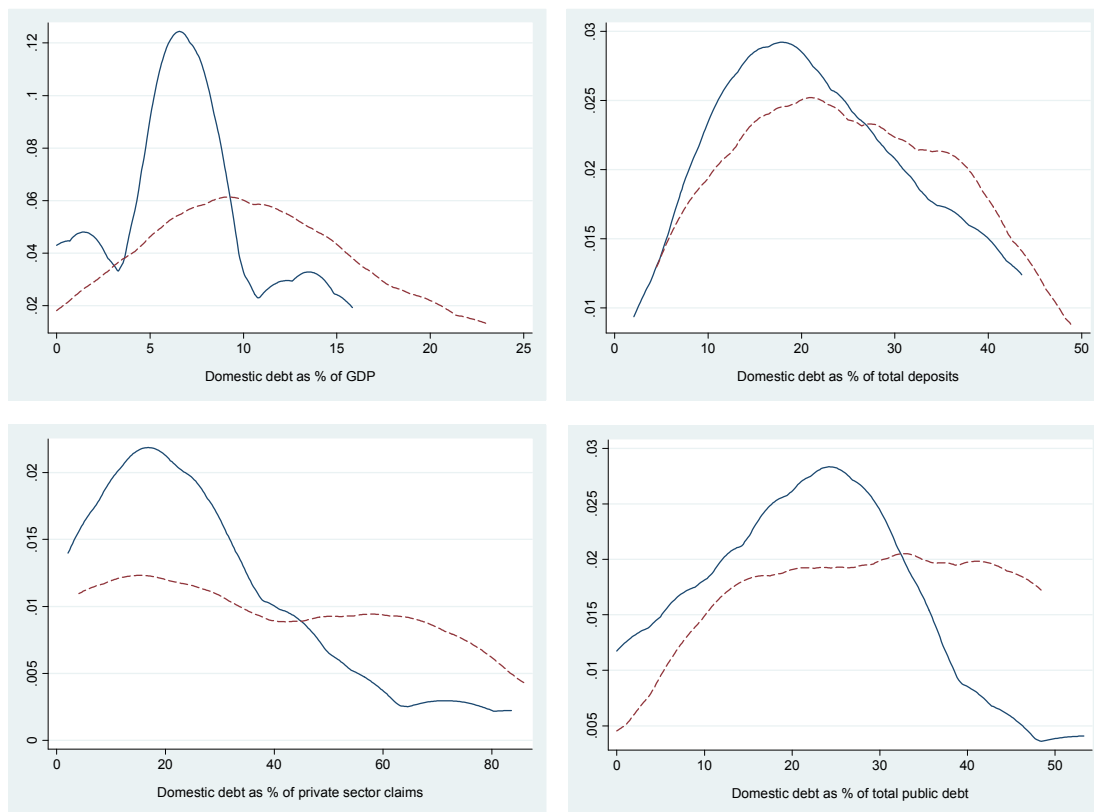
Table 9. Robustness Check 2: Selected Regressions with DFBETA Outliers Removed

Dependent variable: per capita income growth (gY=100*growth rate in PPP per capita income)		
	DOMdebt (domestic debt/GDP) LINEAR (counterpart of Table 3, panel A)	
	(1) OLS	(2) FE
lnY_1	-0.7929 ** <i>-4.05</i>	-8.2050 ** <i>-7.91</i>
gPOP	-0.7148 ** <i>-4.03</i>	-0.1369 <i>-0.75</i>
INFLATION	-0.0288 ** <i>-3.11</i>	-0.0004 <i>-1.46</i>
lnINVEST	3.2133 ** <i>8.60</i>	2.2811 ** <i>3.20</i>
FISBAL	0.1243 ** <i>4.09</i>	0.1499 ** <i>3.65</i>
gTOT	-0.0111 <i>-0.84</i>	0.0032 <i>0.22</i>
lnOPEN	-0.1122 <i>-0.41</i>	3.3060 ** <i>4.12</i>
EXTdebt, TOTdebt	-0.0073 ** <i>-2.79</i>	-0.0244 * <i>-4.36</i>
<u>Domestic debt</u>	0.0541 ** <i>2.10</i>	0.1213 * <i>1.93</i>
<u>Domestic debt*quartile</u>		
Memo (without DFBETA outliers removed): <u>Domestic debt</u> <u>Domestic debt*quartile</u>	0.0406 **	0.0637 *
R^2 overall	0.44	0.06
R^2 within		0.53
R^2 between		<0.01
Obs. in original regressions (Tables 5-7)	618	530
DFBETA threshold	0.08	0.09

Note: (i) *t*-statistics in *italics*; (ii) constant; time dummies included in all regressions; (iii) ** significant at 5 percent, * = at 10 percent; (iv) data spans 93 countries and 10 three-year time periods constructed from 30-year annual data, starting 1975; (v) results obtained using STATA's reg (OLS) command; since DFBETA is a post-estimation command that works only after reg, the FE regressions had to be simulated using least squared dummy variable specifications (i.e., by including country dummies); (vi) DFBETA series for each domestic debt coefficient in a particular regression were generated; DFBETA outliers were then defined as those observations for which $|DFBETA| > (2/\sqrt{n})$ where n is the total number of observations in the original regression. For example, take regression 1 above: the original regression (Table 3, panel A1) corresponding to regression 1 had 618 observations, implying a DFBETA threshold of $\pm 2/\sqrt{618} = \pm 0.08$. All observations with DFBETA outside this range (24 in this case) were construed as "outliers." Regression A1 (reported here) was run after dropping these outlier observations; (vii) regressor Domestic debt means DOMdebt (domestic debt/GDP).

Figure 1. Public Domestic Debt Trends, Pre-1990 vs. Post-1990 (dashed line)

Emerging Markets



Sub-Saharan Africa

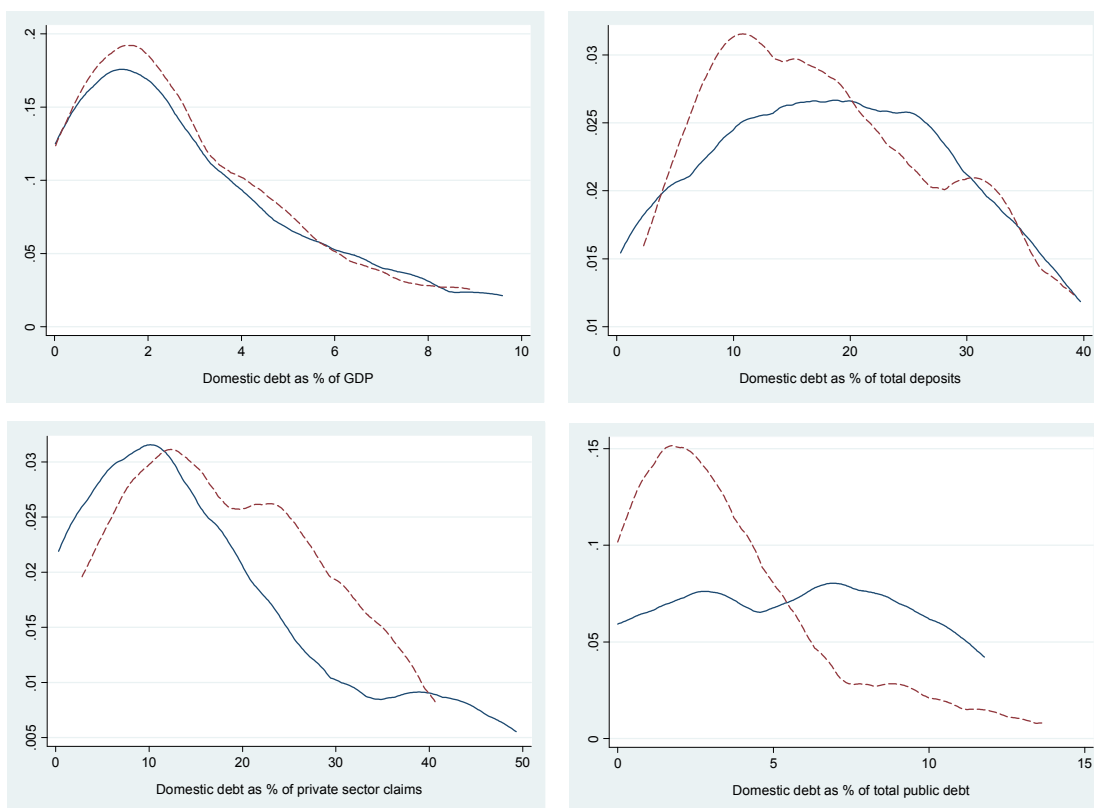
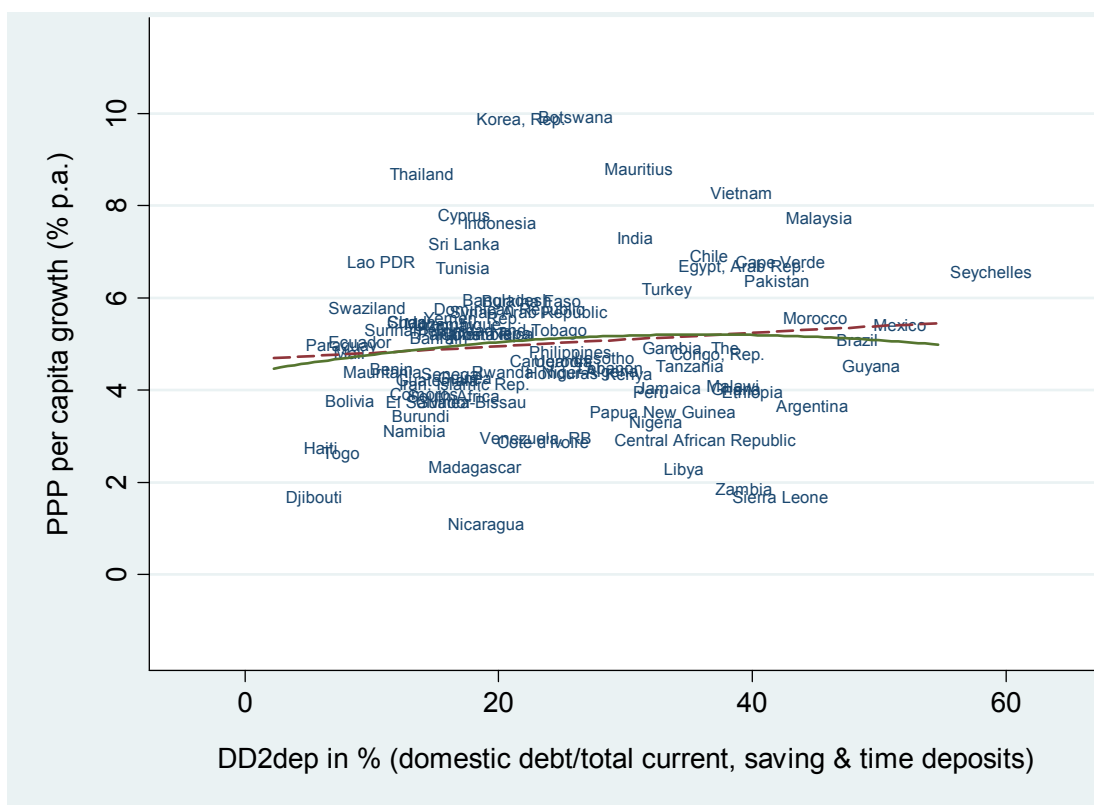
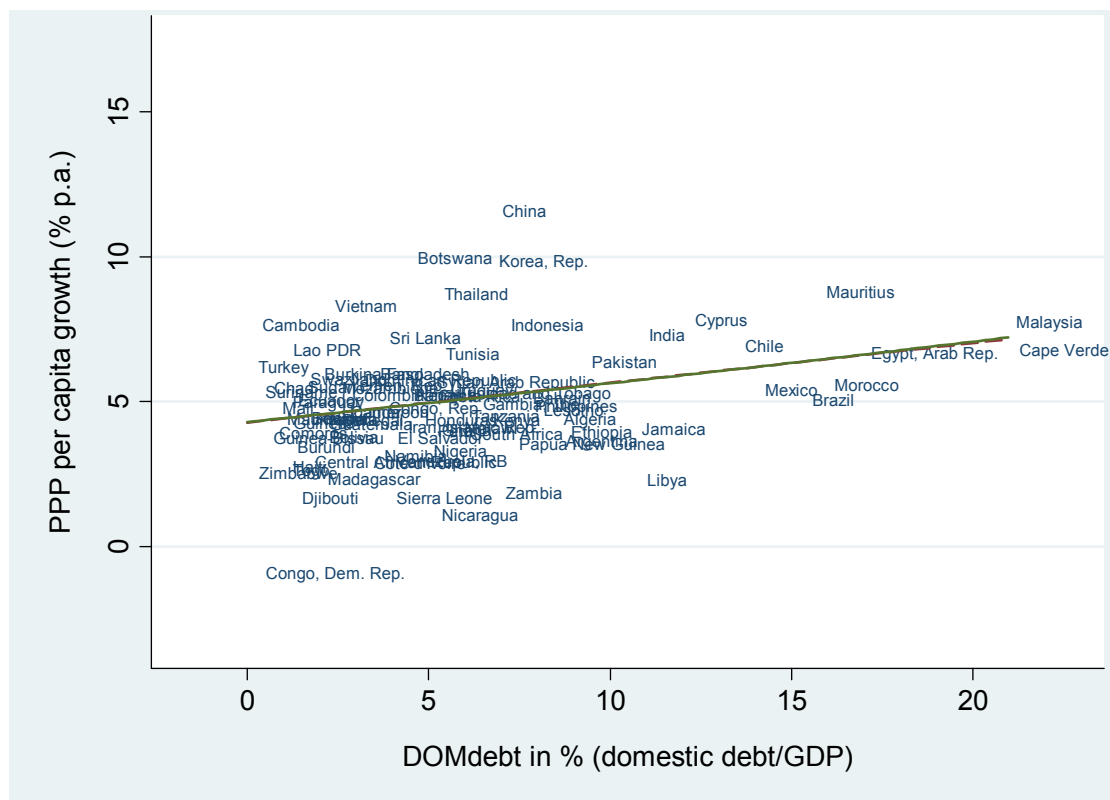


Figure 2. Growth - Domestic Debt Scatter Plots,
(Country means over full sample period)



Note: Dashed line is linear prediction and unbroken line is quadratic prediction.

ESSAY III

WHY DO BANKS IN DEVELOPING ECONOMIES HOLD GOVERNMENT SECURITIES?

ABSTRACT

The third and final essay explores demand-side determinants of domestic debt, by focusing on commercial bank holdings of government paper, discriminating carefully between voluntary factors (such as mean-variance portfolio optimization) and statutory ones (cash reserve and capital adequacy requirements). The analysis is made possible by the construction of a dataset on government and private returns (real and nominal) for almost 600 banks from 70 emerging and low-income economies, spanning the (pre-Basel II) period 1995-2005. A battery of structural cross-section regressions indicates that banks' portfolio decisions are at least as significantly influenced by mean-variance considerations as regulatory factors: the actual portfolio share of government securities (λ) responds intuitively, and sizably, to variations in the moments of the distributions for government and private returns as well as in the *minimum-variance* portfolio share (λ^*). Higher cash reserve requirements tilt portfolios away from government securities toward riskier private lending, while higher capital adequacy requirements work the other way. The association between actual portfolios and the identified determinants is noticeably weaker at lower ends of the λ distribution, suggesting the domination of non-CAPM factors in those contexts.

Keywords: Government bonds, government securities, commercial banks, portfolio choice, CAPM, bank regulation, crowding out

JEL Classifications: D22, G11, G18, G32, H63

ESSAY III. WHY DO BANKS IN DEVELOPING ECONOMIES HOLD GOVERNMENT SECURITIES?

The person who risks nothing, does nothing, has nothing, is nothing, and becomes nothing. Only the person who risks is truly free. (Leo Buscaglia)

I. INTRODUCTION AND MOTIVATION

In the decade preceding the global financial crisis, government securities holdings (GSH) generally accounted for a larger share of the assets and interest income of commercial banks in developing economies than of banks in advanced economies (Table 1a).^{1 2} Macroeconomic practitioners remained quite wary of these large holdings because they tended to signal financial repression: i.e., governments using the banking sector as a captive market for public debt through the imposition of high statutory requirements or moral suasion – McKinnon (1973) and Shaw (1973); and crowded out private sector credit: i.e. government domestic borrowing eating into banks’ pool of loanable funds, and/or discouraging investment by raising interest rates in shallow financial markets – Tanzi (1991).³

However, these concerns have subsided somewhat since the turn of the millennium with the spread to many developing economies of financial liberalisation, fiscal consolidation and financial deepening and openness. This, in turn, has permitted an attention shift away from the motivations

¹ Since external public debt has traditionally dwarfed domestic debt in developing economies, the stronger presence of GSH on banks’ balance sheets could reflect either low nonbank participation in government domestic debt markets, or more concentrated banking sectors, or both. Table 1b (III) and Table 1c, respectively, confirm the relevance of both these factors over the past two decades.

² Our sample period for this paper is 1995-2005. 1995 is earliest starting year for most developing economy banks in Banskope. The reason for not extending the sample beyond 2005 relates to the introduction of the Basel-II regulatory standard (published in June 2004) which allowed banks to calculate risk-weighted assets on the basis of “internal” models rather than the Basel-I prescribed “fixed” risk weights. Basel-II was adopted during 2006-09 by several major banks, including parents of many foreign subsidiaries operating in emerging economies, before it was effectively superseded by Basel-III in 2010-11. Holding the sample till 2005 ensures that all banks in our dataset operated under the same regulatory regime (Basel-I), and helps avoid the comparability issues that would otherwise have arisen both in the time series and cross-sectional dimensions.

³ Crowding out concerns would be seen as particularly relevant in countries with shallow financial markets, short debt duration, and lending rates that are benchmarked to short-term government yields. Table 1b (I-II) confirms the relatively short maturity of domestic debt in developing economies compared with that in advanced economies.

for, and effects of, “issuing” government securities (GS), to the reasons for “buying” them. In particular, researchers have begun to study factors driving the “voluntary” demand for GS by commercial banks – the major players in developing economy domestic debt markets – and the policy implications arising from that study.

Kumhof (2004) and Kumhof and Tanner (2005) were the first to address this question directly. Their contention is three-tiered: (i) banks’ GSH in most developing economies were now of a largely “voluntary” nature; (ii) banks see GS as essential insurance against credit default risks in countries where such risks were high and uncollateralisable; and (iii) a reduction in GSH – the “safe asset” – could, in fact, *reduce* banks’ ability to attract and intermediate funds – an antithesis of the crowding out hypothesis. Their own macroeconometric analysis appears to lend support to their thesis: banks’ GSH were found to be higher and more growth-friendly in country-periods characterized by high risk and weak institutions. However, they do not study the question at the micro (bank) level, which is really where the hypothesized demand behavior is located. Hauner (2006) do this, using Banscope data on over 3000 banks to document the “lazy bank” syndrome: banks maintaining a higher proportion of assets as GS tend to have high overhead costs.

We take this conversation forward by investigating the following set of *first-order* empirical questions at the bank-level: Why do developing economy banks hold GSH as opposed to private risk assets? To what extent is this portfolio choice affected by “optimal” portfolio (i.e. standard mean-variance) considerations? How do central bank prudential requirements aimed at ensuring bank liquidity and solvency, affect the mix of public and private risk held on bank balance sheets. Answers to these questions have natural macro-financial and fiscal relevance in developing economies, where banks still account for a large part of the government domestic debt market.

An obvious starting point for studying the above questions would be the hypothesis that banks behave like portfolio optimizers when choosing between different investible assets – say, cash, government securities and private loans. This hypothesis could be empirically tested by regressing

the “observed” asset allocations on the “optimal” shares (i.e. those consistent with mean-variance optimization), or directly on the underlying risk-return characteristics of the assets: i.e. means, standard deviations, and correlations of asset returns. The exact priors on the relationship between the observed and optimal shares (or underlying risk-return characteristics) would, of course, depend on the particular form chosen for the optimal portfolio. In the case of the minimum variance portfolio (MVP), for instance, an asset’s share would typically be increasing in its mean return and the variances of rival asset returns, and decreasing in the variance of its return and the means of rival asset returns.

Surprisingly, however, no empirical investigation for banks in developing economies on the above lines has been attempted to date. Insights from the literatures on the capital asset pricing model (CAPM) – the stylized mean-variance optimization framework – bank supervision, and public debt, help us identify at least four reasons for this omission. We discuss these reasons upfront in the form of *hypothetical* critiques of a CAPM formulation of the problem, to motivate a more precise and robust outline of the paper.

i. Banks’ GSH are largely involuntary in developing economies, so that CAPM is irrelevant.

Empirical tests on MVP-type behavior would only make sense if all or some part of banks’ GSH are voluntary/purposive, and banks’ portfolio decisions are not fully constrained by regulatory limits, such as floors on cash holdings or capital adequacy ratios. Since such restrictions, along with other capacity, institutional and agency factors (explained below) inhibiting risk-return analysis or behaviour on the part of banks, are generally thought to abound in developing economies, CAPM tests in these contexts are meaningless.

In order to address this critique, we set up Text Table A (below), which organizes the different possible motivating factors for banks’ GSH in developing economies along the voluntary/involuntary scale, highlighting three broad regimes:

(1) *Regulatory constraints bind*, such as cash reserve ratios⁴ and capital adequacy requirements, and CAPM-type risk-return considerations do not explain the holding of the constrained asset; however, the demand for other assets is still affected by such constraints, depending on asset return correlations. An interesting example is the cash-reserve ratio, which decreases the voluntary demand for government bonds if government securities and cash are close substitutes – see section IIB(ii). However, high cash-reserve ratios could also signal a more general propensity for financial repression, where the government forces banks to hold government bonds, either through liquid asset requirements or moral suasion. The effect of higher cash-reserve ratios on banks' GSH is therefore an empirical question, which requires a portfolio framework. The effect of higher capital adequacy requirements, by contrast, is likely to be simpler: the demand for government bonds will rise at the expense of private loans, as the former's low (or zero) risk-weight, helps lower risk-weighted assets (and boost the capital-to-risk-weighted asset ratios).

(2) *Some purposive behavior on the part of banks is permitted*, but other kinds of constraints – limited capacity to assess and collateralise private sector risks (a-b), and bank managers' personal risk aversion – come into play, generating more demand for government paper than would obtain from using pure risk-return criteria; and

(3) *Banks free to invest the marginal dollar on CAPM-type risk-return considerations*. Deviations from CAPM might still result, of course, due to violations of other CAPM assumptions, such as perfect competition, full information, zero transactions costs, perfect liquidity etc.

The degree of voluntariness/purposiveness on the part of banks holding GS appears to increase as we move from (1) to (3). Whether banks in developing economies are stuck in regimes (1) and (2) where CAPM is irrelevant, or whether (3) is also significantly in play, is essentially an empirical question. To this end, evidence from regressions of actual GSH on key CAPM variables while controlling for the constraint factors identified in (1) and (2) can be instructive. The discussion

⁴ It is useful to distinguish, upfront, between statutory cash reserve requirements and statutory liquid asset ratios. The former exist in almost all developing economies, are for the most part comparable, and help define the floor for banks' cash holdings. By contrast, liquid asset ratios exist in only a few countries, but in a variety of forms that are not easily comparable (see Barth, Caprio and Levine 2008). Where they exist, they typically define a "suggested" (not strictly binding) floor on cash and other liquid assets (which includes short-term GS and money market holdings). Accordingly, we only focus on the cash reserve ratio in this paper.

here can clearly focus more usefully on how the appropriate controls for these factors should be defined, rather than to assume that conditioning on these factors would render CAPM's explanatory role insignificant.

Text Table A: The Various Reasons Why Banks Hold Government Securities*Degree of voluntariness increasing*

(1) Regulatory restrictions constrain purposive behaviour	(2) Some purposive behavior, but various capacity, institutional and agency constraints bind			(3) Un-constrained purposive behaviour
	(a) Inability to assess private sector credit risk.	(b) Collateral to back risky private lending	(c) Agency issues: managers prefer common-risk" assets.	
Government securities, like cash, are deemed risk-free (under Basel-I ⁵) and, thus, help banks meet capital adequacy requirements. Binding cash reserve ratios may further impinge on free portfolio allocation.	Managers may lack information (due to absence of functioning credit information bureaux) or capacity (due to weak finance training) to undertake proper risk-return analysis on private lending. As a result, their asset demand may be biased towards seemingly "credit-risk-free" GS. ⁶	If private lending risks are high and uncollateralisable, GS may serve as an alternative collateral cushion against bad debts (Kumhof, 2004).	Risk-averse managers demand GS over private (or nonzero-credit-risk) assets insofar as their own performance is assessed (or perceived to be assessed) <i>relative</i> to industry average. ⁷	No restriction on portfolio optimization based on risk-return considerations. Deviations from CAPM might still occur if other CAPM assumptions of perfect competition/liquidity etc. are violated.

Moreover, as Kochhar (1996) and Saxegaard (2006) show in the case of excess bank reserves, drawing clear distinctions between voluntary and involuntary holdings is not a simple matter. This

⁵ The Basel I prudential framework required total capital (core capital) to be at least eight (four) percent of risk-weighted assets. Since GS, like cash, usually have a zero weight in the calculation of risk-weighted assets, they are an attractive method of boosting capital adequacy, as defined by regulation. Basel-I is still the applicable framework for banks in the United States and most developing economies. Many banks in Europe and advanced Asia, including parent banks of many subsidiaries operating in developing economies, moved to Basel-II over 2006-09 and some are now migrating to Basel-III.

⁶ As noted later, it is not appropriate to view nominal domestic debt as credit-risk-free, because surprise inflation or currency devaluation which, although not constituting outright legal default, are the *technical* equivalents thereof.

⁷ Such a strategy works for managers as the risk on GS is borne equally by peers, whereas the exposure on private lending applies individually to each bank manager, thus exposing any individual manager to the risk of ending up with a worse portfolio performance relative to the industry average. Calvo and Mendoza (1999) identify such risk aversion on the part of foreign fund managers as a rational contagion channel in the East Asian crisis.

difficulty also applies to the case of banks' GSH. For instance: are securities held for "collateral" reasons (*a la* Kumhof (2004)) to be regarded as voluntary – since they are the result of purposive bank behaviour; or involuntary – insofar as the choice to hold them is driven by unfavourable "institutional" constraints, such as uncollateralisability of land and mobile assets.⁸ Conversely, should GS held to help meet capital adequacy requirements be characterised as "involuntary", even if there are sensible reasons for banks to maintain adequate capital – simple prudence, risk aversion, the need to signal robust financial strength to depositors – even in the absence of regulation? This is analogous to the question: would banks cease to hold cash reserves for prudential purposes if reserve requirements were abolished. The answer to this latter question is not a simple "yes", as we know from the experiences of countries that have actually abolished reserve requirements.⁹

Thus, to the extent that GSH are not meaningfully separated along voluntary/involuntary lines, attempts at estimating that separation quantitatively are likely to be problematic. The rest of this paper, therefore, casts the research question more broadly as: "what is the universe of significant determinants of banks' GSH?" The results from this inquiry will, as shown in section III, though, still permit us to make some useful "qualitative" judgments on the involuntary/purposive separation.

⁸ The obstacles to using land as collateral in developing economies are well-known – see, for instance, UNDP (2004). Fleisig (1996; 1998) similarly, highlights the inability to use movable capital as collateral as another key constraint on bank lending in developing economies. He compares the U.S., where 50 percent of credit is backed by movable collateral, with Argentina, where the comparable ratio is close to zero.

⁹ In the pre-abolition years in the UK, for instance, required reserve ratios fell short of banks' daily clearing needs so that, at the margin, the latter essentially determined their demand for reserves, rendering the apparently involuntary reserve requirement entirely voluntary (Feinman 1993).

ii. GSH are “risk-free” and, thus, the stylized risk-return frameworks do not apply.

Alternatively, GS are perfect substitutes with private sector assets and thus agents are indifferent between holding either asset.

On the one hand, GS have typically been cast as risk-free assets in most CAPM applications in advanced economies, primarily because credit risk thereon has (until the recent sovereign debt crisis in the Euro Area) been seen as negligible, and because ex-post government yields appear quite stable in relation to other asset returns.¹⁰ On the other hand, modern macroeconomic models have tended to blur the difference between assets in general (and between GS and private sector assets in particular), a distinction that existed in the earlier – but not microfounded – Keynesian literature (Buiter and Tobin, 1978). This evolution was likely due to technical difficulties: maintaining a determinate demand for two assets requires a stochastic structure (otherwise all assets are equivalent and have to pay the same rate of return in equilibrium), which is difficult to build within the intertemporal dynamic approach that has been favoured by the literature (in particular, linearization around the steady-state, the preferred solution method for modern macroeconomic models, kills the stochastic properties of the model because of certainty equivalence after linearization). The Keynesian portfolio approach to the crowding-in crowding-out debate (Friedman, 1977), that sought to analyze the effect of government borrowing on portfolio choices and private investment, meanwhile, lost currency early on as well.

As Table 1d shows, however, neither risk-freeness nor perfect substitutability seem to carry over to developing economies. Ex-post real government yields appear markedly volatile, both in

¹⁰ Basel-I assigns a zero risk-weighting to sovereign domestic debt in calculations of banks’ risk-weighted assets. However, the narrow “outright default risk” focus of this approach has been challenged in Basel-II and Basel-III. Basel-II considers, additionally, liquidity and market (interest rate) risks, which generally apply to both government and private bonds – see English (2002). However, in most developing economies the transition from Basel-I to Basel-II is ongoing. Developed economies are, on the other hand, still making the transition from Basel-II to Basel-III, where uncertainties remain over some aspects of the latter.

relation to deposit and lending rates¹¹, while the correlation between government bond yields and private sector returns is about 0.4 (see Tables 2 and 3B). Note that the real returns in Table 1d only adjust the nominal rates down for “*technical*” default (i.e., due to surprise inflation) on domestic debt, and not for the occasional outright defaults, as have been witnessed in, say, Russia (1998), Pakistan (1998) and Tanzania (1999).¹² Conceptually, both types of default are relevant from a “credit risk” point of view and, together with currency risk, help explain why developing economy sovereign domestic debt is usually assigned junk bond status by international rating agencies.¹³

It is important to clarify here, however, that bank managers would “worry about” the volatility of yields on GS even if the latter “were” credit-risk-free. This is because, given the relatively short duration of domestic debt in developing economies – see Table 1b – banks are subject to significant reinvestment risk on redeeming bonds. Since bankable private sector projects cannot “instantly” replace these redemptions, banks are often constrained to roll over a substantial portion of their maturing GSH, even when reinvestment yields fall below ex-ante expectations.¹⁴

A rational bank manager would take this “reinvestment risk” – linked directly to the in-year volatility of government yields – into account when choosing, ex-ante, the optimal portfolio allocation between GS and private sector loans. While this allocation is likely to be updated at regular frequencies, the dearth of ready-to-invest-in alternatives will typically render banks’ incomes vulnerable to sudden declines in government yields. Indeed, *earnings-at-risk*, and its counterpart for the debt issuer, *cost-at-risk*, are two widely used probabilistic measures that practitioners use to quantify this vulnerability.

¹¹ This is not unsurprising, given that developing economies are generally characterized by more volatile budgetary financing needs (and associated risk premia), shallower domestic debt markets and more uneven monetary policy implementation in the face of unstable money demand (see for instance IMF 2007).

¹² See IMF (2002) for a survey of some of these sovereign debt restructurings.

¹³ To the extent that there is a purchasing power parity-induced comovement between inflation and currency depreciation, real ex-post nominal returns may explain most of the credit risk associated with nominal debt in developing economies.

¹⁴ This mid-year rollover constraint is likely to become more binding when banks are disallowed from investing abroad and/or when alternative low-credit-risk financial assets, such as AAA corporate bonds, are locally unavailable – conditions which typically hold in developing economies.

Volatile government yields would also be a concern in developing economies where banks' GSH are longer-term and secondary markets more developed (see Sy's 2005 study of India). The bank manager would, in this case, however, be primarily concerned about an unexpected "rise" in market yields and the impact thereof on the "market value" of his asset portfolio and equity. The relevant vulnerability measure here is the well-known *value-at-risk*.

Thus, there is good reason to expect bank managers at both ends of the financial market development spectrum to "care about" about the variation of short-term government yields around their expected level. It is largely for this reason that "stress-tests" applied to developing economy banking sectors in the context of IMF-World Bank-led financial sector assessment programs (FSAPs) typically distinguish between private sector assets and GS to analyse scenarios of credit risk (for the loans to the private sector) and interest rate risks (changes in government yields) – see, for instance, Karasulu (2003) or Cihak (2007). However, the academic literature has tended to focus on other disaggregations of banks' holdings, in particular, by currency denomination and the maturity structure.

iii. The CAPM assumptions of perfect competition and liquidity do not hold in developing economies in general, and to commercial banks therein, specifically.¹⁵

When asset returns are affected by an individual manager's portfolio choice (due to market power or illiquid markets), the choice can no longer be cast as a function of the mean and variance of asset returns, as these are not exogenous parameters. Since developing economy financial systems are often dominated by a few large banks (and, by implication, markets are shallow) – as evinced by Tables 1b(III) – the perfect competition and liquidity assumptions break down. This is,

¹⁵ CAPM applications to commercial banks' portfolio behaviour, generally, are surveyed in section II.

perhaps, one reason why empirical portfolio models have generally not been used to model commercial bank portfolio choice in developing economies.

The focus of portfolio choice models in developing economies, has, instead, been phenomena like international capital flows to developing economies (Dumas 1994), and capital flight/brain drain from developing economies (Collier et al 2004; Ize and Levy-Yeyati 2003) etc. In the former, each individual foreign fund manager is assumed too small to affect host (or home) country returns; in the latter, the choice of a *single* representative household (saver) or emigrant is modelled, which permits taking the distribution of returns as exogenous.

Although concerns about key CAPM assumptions, especially the one on competition, being violated in developing economies are valid, the extent to which they render the framework irrelevant may be overstated. Table 1c shows summary Herfindahl concentration indices for total deposits and government securities held by the banking system over 1995-2005 (our sample period) for various groups of countries. Although the indices are, expectedly, higher for emerging and low-income economies (shown by region) as compared with advanced economies, the differences do not look as large – especially in the case of government securities holdings – as to render the CAPM framework irrelevant.

Also, the privatization and liberalization of financial sectors, adoption of competitive auction methods for issuance of government securities, reform/revival of the contractual saving sectors, and moves towards greater financial openness by most developing economies over the last decade or so, suggest that concerns about competitiveness or market illiquidity may not be as serious as they were in the early 1990s. This is supported by the recent rise in foreign investor interest in the local currency debt markets of developing economies, including of SSA, and the favourable trends in Figure 1 – as regards nonbank participation and marketisation of government debt.

It is also important to clarify that the “perfect liquidity” assumption is only required in cases where the investor’s portfolio horizon is shorter than the maturity of the underlying asset – something we would expect in markets featuring longer-term instruments, i.e. advanced and emerging economies. However, longer yield curves and market depth usually go hand in hand, so that illiquidity is rarely an issue in such countries. In low-income countries (LICs), on the other hand, financial markets “are” often illiquid, but because commercial banks’ portfolio horizons are longer than the maturity of the underlying assets, mean-variance optimization can still be applied.¹⁶

iv. The requisite bank-level data to test for MVP-behavior on the part of banks is not available.

This constraint may have served as the major bottleneck for researchers, although as discussed below, the problem is no longer as insurmountable as it once was. To appreciate the severity of this constraint, let us list the data requirements for approaching the question: “To what extent is the ratio of banks’ GSH to their private assets informed by MVP considerations?” For each of the banks in the sample, we would need, data on:

- (a) holdings of GS
- (b) private risk assets (mainly loans, in developing economies)
- (c) mean and standard deviation of government returns
- (d) mean and standard deviation of ex-post private returns
- (e) correlation between government and private returns

Until recently, data were available on none of these except (c), which could be computed from annual country-year data on Treasury yields reported in the IMF’s International Financial

¹⁶ Commercial bank GSH in LICs typically constitute T-bills (maturities out to a year), while private lending is mostly short-term (annually renewable credit lines), or long-term with floating rates. Thus, only if bank managers’ horizons were less than one year – which is highly unlikely – would the illiquidity assumption in the “CAPM sense” be violated.

statistics (IFS) database.¹⁷ In recent years, however, the Bankscope database has emerged as an important data source for (a) and (b), covering annual balance sheet and income statement data on almost 6000 banks in developing economies, going as far back as 1995.

That said, banks' private returns (d) have remained an elusive concept, since data on individual banks' lending rates is generally not available. In principle, IFS lending rate data (at the country level) could be combined with Bankscope data on individual banks' non-performing loans (npl) to obtain a proxy for private returns, i.e. = Lending rate * (1 - npl). However, central banks in many developing economies have altered, over time, the criteria for banks to categorize loans as non-performing, thus complicating time-series comparison of npl ratios or npl-based variables.

Moreover, as Subrahmanyam (2003) notes, the benchmark criteria differ significantly *across* countries.

In this context, an important contribution of this paper is to develop, using Bankscope data, a workable *bank-year* series on "private returns", by netting from banks' total interest income the interest income earned on government securities, and dividing the residual by the average stock of risk-weighted assets.¹⁸ Appendix A details the extraction and refinement of the series at the *bank-year* level and also its aggregation to the *country-year* level. The series appears to approximate

¹⁷ Note that the ex-ante Treasury yield offered by the government in a country for a particular year can differ from the "ex-post yield earned by any individual bank in that year" for two reasons:

(i) outright domestic debt default by government, i.e. nonrepayment or delayed payment of interest and/or principal. However, as Kumhof (2004) notes, outright defaults on domestic debt are rare, especially if there are concerns about the effect of a default on the health of the banking sector, typically the largest holder of GS in developing economies.

(ii) differences across banks in yields earned due to (a) multiple price bidding in GS auctions, or (b) differences in the mix of securities held. Since data on actual interest income earned by individual banks on GS is generally not available, it is impossible to discriminate between banks. However, even if such discrimination were possible, it is not clear the gains would be significant. On (a), it is unlikely for any individual bank to deviate widely and sustainably from the weighted average yield obtaining at an auction, or the secondary market yield on government securities. On (b), the menu of GS types issued in developing economies is fairly narrow, with banks' preference for shorter-dated paper further narrowing the selection (Table 1b).

¹⁸ Since, as mentioned, GS are assigned a zero risk weight under the Basel-I prudential framework, and thus risk-weighted assets are likely to be a good proxy for credit to the "private sector" lending. The correlation between total loans and risk-weighted assets for the 5713 developing economy banks covered in Bankscope (over 1995-2005) was 0.94.

well, the concept of banks' "ex-post private returns" and can be combined with the government yield data to compute (d) and (e) in the list above.

With data constraints addressed and in light of the preceding discussion on i-iii, the rest of the paper is outlined as follows:

- Section II surveys the literature on CAPM or MVP models applied to commercial bank portfolio choice (albeit mainly in advanced economies) and generates a number of plausible theoretical priors for the MVP-implied ratio of GSH to private risk assets;
- Section III discusses data issues and reports results on a battery of cross-section regressions to test the priors generated in Section II, employing appropriate non-CAPM controls such as statutory cash reserve ratios, capital adequacy requirements, and level of country risk.
- Section IV concludes, while elucidating some policy implications and research directions emerging from the paper's findings.

II. BANKS AS PORTFOLIO OPTIMIZERS

A. Literature review

The CAPM framework has been used to analyse management of risk by commercial banks, with the first theoretical models analysed in Pyle (1971) and Hart and Jaffee (1974) – Freixas and Rochet (1997) provide a good survey. The justification behind a *portfolio* analysis of banks' asset holdings is that financial intermediaries engage in the buying and selling of risky assets, and are, therefore, likely to be concerned about both

the average return and the risk taken.¹⁹ In most cases, researchers have used mean-variance optimization, as formalized in the MVP/CAPM framework, as the starting point for modelling banks' portfolio choice.

Theoretically, the justification for using a mean-variance approach for banks – as opposed to the standard “shareholder equity maximization” framework used for firms – is three-tiered.

First, it is likely that bank *depositors* (or bank *owners*) are unable, themselves, to diversify risks across financial assets – due to, say, participation restrictions in GS auctions, underdeveloped corporate bond markets, lack of access to foreign markets etc. Then, insofar as there is competition for deposits in the banking industry, banks will have *both* the ability and the incentive to diversify their portfolio risk and offer the best safe rate possible to depositors.²⁰ *Second*, even if depositors (or owners) can diversify risk, the *managers* might be risk averse, due to their inability to diversify significantly their own income (in most cases, a simple salary). *Finally*, even if managers themselves are not risk-averse, regulators will intervene and force the objective function to be decreasing in risk (although risk-management constraints may not be equivalent to a smooth mean-variance objective function). As such, in the case of financial intermediaries, risk is likely to be costly for either the owners, managers or regulators.

¹⁹ Returns are almost always uncertain because they are composed of two components (capital gains and flow yields), and one of which is necessarily uncertain at any portfolio horizon. As discussed earlier, if the maturity of the bond is shorter than the portfolio horizon, the investor has to roll over the bond and is vulnerable to reinvestment risk. On the other hand, if the maturity of the bond is longer than the portfolio horizon, the investor profits come only from capital gains, and are therefore uncertain because these capital gains depend on the re-trading prices.

²⁰ These conditions are quite likely to be met in developing economies.

The first paper using a CAPM to analyse financial intermediation is Pyle (1971), who develops a three asset model - deposits and loans with risky returns, and a third safe asset, and shows that a sufficient condition for a financial institution to act as an intermediary (i.e. borrow from depositors and lend to firms) is that loans benefit from higher average returns than the safe asset and, at the same time, deposits pay less on average than the safe asset.²¹ In our model, where we are interested in discussing holdings of two risky assets (GS and private assets), the safe asset can correspond to deposits (or cash, when using nominal returns) and therefore Pyle's result does not apply. Instead, our financial intermediary is viable when (at least) one of the risky asset returns is greater than the return on deposits.

We follow Pyle in assuming the existence of a risk-free asset (cash) for some of our empirical specifications (see derivations in next section), but not all. Hart and Jaffee (1974) relax this assumption, which normally would have important consequences for the way CAPM works. In particular, the "Tobin separation theorem" usually holds only in the presence of a risk-free asset. The separation theorem will be important in our analysis, because it states that the mix of risky securities in the optimal portfolio is independent of the risk preferences (i.e. risk aversion) – in other words, that a capital market line exists. Preferences over risk only matter then in the choice between holding the optimal mix of risky securities and the safe asset.²² The absence of a clear prior on whether the separation theorem holds or not in emerging and low-income countries, would warrant inclusion of a

²¹ This is a necessary condition only when asset returns are independent. If asset returns covary, a financial intermediary may be viable even when this condition does not hold, because there are further gains from diversification.

²² Hart and Jaffee are, however, able to recover the separation theorem assuming that banks have zero net worth. This is justified on the grounds that in general net worth is small compared to deposits. The assumption of zero net worth is important in their case because the bank is then able to expand assets and liabilities in proportion, which is key to ensuring that the separation theorem holds.

proxy for risk aversion even in regressions where the regressand is a ratio of holdings of two risky assets.

Finally, Hart and Jaffee (1974) show that the comparative statics are intuitive under the Arrow-Pratt hypothesis of non-increasing risk aversion (which implies that risky assets are not inferior, i.e. their demand does not decrease when income increases). The implied prior for the empirical estimation would be that higher variance and lower mean returns would decrease the demand for a risky asset.

Empirical applications of mean-variance frameworks to macroeconomic issues are fairly recent. Closer to our interest on banks' portfolios, Buch and Lapp (2001) use a CAPM applied to German banks to estimate the consequences of the Euro on banks' country composition of assets. They hypothesize that the introduction of the common currency should increase the share of Euroland bonds in the optimal portfolio because of the removal of exchange rate risk and reduction of operating costs when going abroad, although the increased covariance between Euroland assets may decrease the hedge provided by these assets, and hence limit the extent of Euroland diversification. They do not, however, have data on private versus government lending, as their focus is on domestic versus foreign assets and deposits.

On methodology, Buch and Lapp (2001) use ex-post nominal realised returns as predictors of actual future returns (rational expectations hypothesis) and compute the covariance matrix using a GMM beta estimator on monthly returns. Even when assuming a high risk aversion of 30, the authors find that German banks' holdings in the pre-Euro phase were characterised by a very strong bias in favour of Deutschmark-denominated

assets, with the share of German bonds in the total bond portfolio exceeding 95 percent compared with an “optimal” share of 14 percent.²³ The authors argued that following the Euro’s introduction, these bond holdings would be rebalanced in favour of non-Euro assets for diversification purposes.

Buch (2003), working with BIS data, uses the same framework to analyse the relative importance of regulation and information in determining banks’ choices for international assets and liabilities. The author models a simple CAPM to derive proper demand functions, although there is no emphasis on the diversification role of foreign assets and deposits. The author shows how the EU Single Market and the Basel Capital Accord had a positive impact on intra-EU asset holdings. Information costs (proxied by distance, a common language, or a common legal system) were also seen as having a significant impact on holding decisions.²⁴

Buch and Lapp (2001) and Buch (2003) do not further their analysis in terms of the optimal portfolio and, in particular, they neglect the covariance between asset returns. One reason for this might be the general failure of CAPM to explain international flows, compared to gravity models for instance – see Faruquee, Li and Yan (2004). Indeed, Buch (2003) concludes that amendments to the CAPM are needed to take into account regulation and cross-border information asymmetries. While it would, indeed, be important to control for the impact of regulation (such as SLR in our case) on portfolio decisions, problems of information asymmetries are likely to be smaller when the focus is on the choice between two “domestic” assets, as in our case.

²³ The initial picture for equity holdings was similar, with actual Deutschmark-denominated holdings at 96 percent, against a theoretical share of less than 4 percent. The authors argued that changes would be small after the introduction of the Euro since equity markets have always been strongly correlated.

²⁴ For instance, a large share of Spanish banks’ assets corresponded to activities in Latin America.

Ize and Levy-Yeyati (2003) use a three-asset CAPM (with deposits in domestic and foreign currencies, and foreign deposits) to explain financial dollarisation, as a result of hedging needs by domestic agents.²⁵ In particular, they explain that dollarisation may be persistent even after inflation stabilisation because real exchange rate targeting (that often accompanies stabilisation episodes) improves the hedging benefits of dollar assets. Their empirical analysis, from which we take our modelling inspiration, shows that the theoretical shares predicted by the three-asset CAPM model indeed partly explain the actual extent of financial dollarisation.

Studies on banks' portfolio holdings since the global financial crisis have, understandably, focused on advanced economies. Andritzky (2012) documents the rise in banks' government securities holdings in euro area and G-20 advanced economies since 2008, a trend seen to mimic that observed in Japan following the 1990s crisis. Among the leading explanations is the one presented by Aoki and Sudu (2012). They argue that because banks have to honour their liabilities in full regardless of actual returns on assets, greater uncertainty about the "maximum losses" they can incur – which typically rise in/around crisis periods – can severely curtail their risk-taking capacity. They respond by contracting their balance sheets and rebalancing portfolios toward government bonds.

B. Optimal asset shares and comparative statics

In this section, we derive the standard mean-variance demand equations, for different asset structures (2 risky assets, one safe asset and 2 risky assets, 3 risky assets with a regulatory

²⁵ They define financial dollarisation as the share of deposits held in foreign currency.

constraint) to make explicit the dependence of the share of GSH on the risk-return characteristics of the assets and the regulatory constraint. The latter could take the form of a capital adequacy requirement, in which case the result is straightforward (a higher portfolio share of the zero-Basel-1-risk GS follows, in order to lower total risk-weighted assets, and hence meet the higher capital adequacy target); or a cash reserve ratio requirement in which case the solution is more complex. Subsections ii and iii refer.

Since asset demands depend on whether the agents maximize nominal or real returns (Manaster, 1979), subsections ii and iii cover both cases. In practice, financial agents in advanced countries are almost always presented as maximizing nominal returns, especially in the short-run. However, assuming that banks would not see through the effects of inflation seems unrealistic in emerging and low income countries, where inflation is high. Accordingly, we study for both cases (when optimization is on nominal or real variables), theoretically and empirically.

(i) Two risky assets: x_g and x_p

The bank's portfolio (of size 1) is composed of two risky assets, government securities holdings (x_g) and private loans (x_p), where x_g and x_p are also the portfolio shares. The assets bear stochastic returns, R_g and R_p , such that:

$\mathbf{E}[R_g] = r_g$ and $\text{var}(R_g) = \sigma_g^2$; $\mathbf{E}[R_p] = r_p$ and $\text{var}(R_p) = \sigma_p^2$; $r_g < r_p$ and $\sigma_g^2 < \sigma_p^2$; $\text{covar}(R_g, R_p) = \sigma_{gp} = \omega_{gp} \sigma_g \sigma_p$, where $-1 < \omega_{gp} < 1$ is the correlation coefficient binding R_g and R_p .²⁶

With $x_g = 1 - x_p$, the mean-variance problem is:

Max $(1 - x_g)r_p + x_g r_g - \rho [(1 - x_g)^2 \sigma_p^2 + x_g^2 \sigma_g^2 + 2(1 - x_g) x_g \sigma_{gp}]$, where ρ is the coefficient of absolute risk aversion.²⁷

²⁶ We implicitly assume that the portfolio shares are constrained between 0 and 1 (i.e. shorting is not permitted). For this two-asset case, only the interior solution is presented, as the corner solution is trivial.

The first-order condition with respect to x_g yields:

$$r_g - r_p = 2\rho [x_g \sigma_g^2 + (x_g - 1) \sigma_p^2 + (1 - 2x_g) \sigma_{gp}], \text{ so that:}$$

$$x_g = (1/\Delta) [-(1/2\rho)(r_p - r_g) + (\sigma_p^2 - \sigma_{gp})], \text{ where } \Delta = \sigma_p^2 + \sigma_g^2 - 2\sigma_{gp} > 0.^{28}$$

It is easy to see that x_g is, intuitively, increasing in ρ , r_g and σ_p^2 , and decreasing in r_p and σ_g^2 .²⁹

$\partial x_g / \partial \sigma_{gp}$ is positive (negative) if $v = \rho(\sigma_p^2 - \sigma_g^2) - (r_p - r_g)$ is positive (negative).³⁰

Note that as long as R_g and R_p are deemed “risky”, the solution does not depend on whether bank managers optimize over real or nominal returns.

(ii) *Three risky assets: x_g , x_p and cash (x_c) – “real” portfolio return maximized*

We now extend the model to include liquid cash (x_c) as a possible third asset. If bank managers maximize the “real” risk-adjusted portfolio return, x_c will bear a stochastic return, R_c (mirroring the rate of inflation, π), and be most likely held for regulatory reasons; i.e., any statutory cash reserve floor will normally bind.³¹

²⁷ ρ is constant for a negative exponential utility function and if R_g and R_p are normally distributed. Otherwise, the mean-variance problem corresponds to a second-order approximation.

²⁸ Since $\Delta > \sigma_g^2 + \sigma_p^2 - 2\sigma_g\sigma_p$ for $\omega_{gp} < 1$, and given that $\sigma_g^2 + \sigma_p^2 - 2\sigma_g\sigma_p = (\sigma_g - \sigma_p)^2 \geq 0$.

²⁹ $\partial x_g / \partial \sigma_p^2 = (1/\Delta)(1 - x_g) > 0$; $\partial x_g / \partial \sigma_g^2 < 0$ so long as $[-(1/2\rho)(r_p - r_g) + (\sigma_p^2 - \sigma_{gp})]$ is positive, which it is since both x_g and Δ are positive.

³⁰ Thus, the portfolio share of the less risky asset (x_g) is increasing in σ_{gp} – a measure of the association between the two assets, but also, in this case, of the overall riskiness of the portfolio – as long as the excess utility cost of holding x_p vs. x_g , i.e. $\rho(\sigma_p^2 - \sigma_g^2)$, exceeds the corresponding excess expected return, $r_p - r_g$.

³¹ We abstract here from the real positive return banks may derive from holding cash for speculative or precautionary reasons (which could, in principle, exceed the negative real return implied by inflation). This is equivalent to imposing the assumption that any positive real returns from holding a liquid position are small and nonstochastic.

Thus, $\mathbf{E}[R_c] = r_c = -\mathbf{E}[\pi] < r_g$; $\text{var}(R_c) = \sigma_c^2 = \sigma_\pi^2$; $\text{covar}(R_c, R_g) = \sigma_{cg}$; and $\text{covar}(R_c, R_p) = \sigma_{cp}$.

Introducing a statutory minimum cash reserve requirement, $x_c \geq \alpha$, so that, with the constraint binding ($x_c = \alpha$), the maximisation problem becomes:³²

$$\begin{aligned} \text{Max } & \alpha r_c + x_g r_g + (1-\alpha-x_g) r_p \\ & - \rho [\alpha^2 \sigma_c^2 + x_g^2 \sigma_g^2 + ((1-\alpha)^2 + x_g^2 - 2(1-\alpha)x_g) \sigma_p^2 + 2\alpha x_g \sigma_{cg} + 2\alpha(1-\alpha-x_g) \sigma_{cp} \\ & + 2x_g(1-\alpha-x_g) \sigma_{gp}] \end{aligned}$$

The first order condition with respect to x_g is:

$$-\frac{r_p - r_g}{2\rho} = x_g \sigma_g^2 + (x_g - (1-\alpha)) \sigma_p^2 + \alpha \sigma_{cg} - \alpha \sigma_{cp} + (1-\alpha) \sigma_{gp} - 2x_g \sigma_{gp}, \text{ which can be solved as}$$

$$x_g = -\frac{r_p - r_g}{2\rho\Delta} + \frac{(\sigma_p^2 - \sigma_{gp})(1-\alpha) - (\sigma_{cg} - \sigma_{cp})\alpha}{\Delta}$$

The share of x_g (the less risky asset) in the unconstrained portfolio ($x_g + x_p = 1-\alpha$) is, therefore:

$$\frac{x_g}{x_g + x_p} = -\frac{r_p - r_g}{2\rho\Delta(1-\alpha)} + \frac{(\sigma_p^2 - \sigma_{gp}) - (\sigma_{cg} - \sigma_{cp})\alpha / (1-\alpha)}{\Delta}$$

x_g 's share in the unconstrained portfolio is decreasing in α if R_c covaries more strongly with R_g than it does with R_p (i.e. if $\sigma_{cg} > \sigma_{cp}$).³³ In practice, cash is likely to be a much closer substitute for GS than for private assets, especially in developing economies, where GS are noticeably more short-term and/or more liquid compared with private loans

³² Note that if $x_c > \alpha$, the corner solution with either x_g or $x_p = 0$ is nontrivial in this three asset case, but collapses to a two-asset portfolio optimization (akin to IIB(i)).

³³ The condition, $\sigma_{cg} > \sigma_{cp}$, is sufficient, but not necessary. It can be restated as $\omega_{cg} > (\sigma_p/\sigma_g)\omega_{cp}$ where the ω 's denote correlation coefficients, bounded between -1 and 1. This latter expression highlights the importance of the relative size of the individual standard deviations, σ_p and σ_g . With $\sigma_p/\sigma_g > 1$ (assuming x_p as the riskier asset), the correlation coefficient ω_{cg} must exceed ω_{cp} sufficiently (i.e., by at least $[(\sigma_p/\sigma_g) - 1]\omega_{cp}$) to deliver a negative $\partial[x_g/(x_g+x_p)]/\partial\alpha$.

(Kumhof and Tanner 2005). Accordingly, a tighter cash liquidity requirement should tilt the portfolio choice towards private lending (assumed here as the riskier asset).³⁴

(iii) *Three risky assets: x_g , x_p and cash (x_c) – “nominal” portfolio return maximized*

With the bank manager focusing on nominal returns, cash assumes the status of a non-risky (or safe) asset bearing a deterministic return, $R_c = 0$. Note that it is no longer reasonable to assume that the cash reserve requirement will bind. We must, therefore, solve for two possible cases:

- *Case 1: $x_c = \alpha$ (cash reserve requirement binds):*

With $x_g = 1 - \alpha - x_p$, the mean-variance problem is:

$$\text{Max } \alpha(0) + (1 - \alpha - x_p)r_p + x_g r_g - \rho [(1 - \alpha - x_g)^2 \sigma_p^2 + x_g^2 \sigma_g^2 + 2(1 - \alpha - x_g) x_g \sigma_{gp}]$$

which solves to:

$$x_g / (x_g + x_p) = (1/\Delta) [-(1/2\rho(1 - \alpha))(r_p - r_g) + (\sigma_p^2 - \sigma_{gp})].$$

The intuition of IIB(i) above carries over, with the additional insight that the share of x_g in the unconstrained risky portfolio ($1 - \alpha$) is decreasing in α : the forced holding of a riskless asset swings the composition of the remaining portfolio towards the riskier asset.

- *Case 2: $x_c > \alpha$ (cash reserve requirement does not bind):*

³⁴ Note that the solution is symmetric if the binding constraint applied to x_g (say $x_g = \beta$, where β is derived from capital adequacy and/or statutory liquidity requirements) rather than to x_c . In that case, the share of “ x_c ” in the unconstrained portfolio, $x_c + x_p (= 1 - \beta)$, would be given by:

$$\frac{x_c}{x_c + x_p} = -\frac{r_p - r_c}{2\rho\Delta(1 - \beta)} + \frac{(\sigma_p^2 - \sigma_{cp}) - (\sigma_{gc} - \sigma_{gp})\beta/(1 - \beta)}{\Delta}$$

In this case, a higher regulatory floor on government securities holdings would tilt the portfolio choice towards the riskier private lending, assuming, as before, close substitutability between government securities and cash.

In this case, we obtain the special case of the “separation theorem” holding; i.e. the composition of the risky portfolio ($x_p + x_g$) becoming independent of the coefficient of risk aversion, ρ .

The bank’s problem is:

$$\text{Max } (1-x_p-x_g)(0) + x_p r_p + x_g r_g - \rho (x_g^2 \sigma_g^2 + x_p^2 \sigma_p^2 + 2 x_g x_p \sigma_{gp})$$

which solves to:

$$x_g/(x_g+x_p) = 1/(1+\{(r_g \sigma_{gp} - r_p \sigma_g^2)/(r_p \sigma_{gp} - r_g \sigma_p^2)\}), \text{ where } 1/\{.\} \text{ equals } x_g/x_p.$$

Note that, unlike the three previous cases, we are able to obtain a form for the optimal composition of the cash-excluded portfolio that does not depend on the coefficient of risk aversion (the Separation Theorem).

Since $x_g/(x_g+x_p)$ is monotonically increasing in x_g/x_p , the comparative statics of the latter naturally extend to the former. It is easy to see, then, that x_g/x_p is increasing in r_g and σ_p and decreasing in r_p and σ_g . For the derivative with respect to σ_{pg} , we have:

$$\partial(x_g/x_p)/\partial\sigma_{gp} = v' k / (r_g \sigma_{gp} - r_p \sigma_g^2)^2, \text{ where } v' = (\sigma_p/r_p) - (\sigma_g/r_g) \text{ and } k = [(\sigma_g/r_g) + (\sigma_p/r_p)] \cdot [r_p^2 r_g^2] > 0.^{35}$$

Thus, $\partial(x_g/x_p)/\partial\sigma_{gp} > 0$, if $v' > 0$, i.e. if the coefficient of variation for private returns (σ_p/r_p) exceeds that for yields on government securities (σ_g/r_g). This resembles closely the IIB(i) result.

To sum up, we expect, according to the mean-variance demand equations above, that the share of government securities on banks’ balance sheets is a positive function of r_g and σ_p , and a negative function of r_p and σ_g . The effects of σ_{gp} depend on whether the excess

³⁵ The latter inequality holds because, using nominal returns, r_g and r_p are bounded from below by zero.

return of holding private sector assets more than compensates for the utility cost of higher risk, while risk aversion should increase the share of GS. Higher cash reserve requirements will decrease GS as long as cash is perceived as a closer substitute for GS than for private loans. Finally, higher capital adequacy requirements should increase the demand for GS as government assets have lower risk-weights.

III. ECONOMETRIC ANALYSIS OF BANKS' PORTFOLIO CHOICE

A. Data and econometric issues

Before launching into an empirical exercise to test if the aforederived hypotheses hold for banks in developing economies, it is useful to briefly inspect the data at hand. Appendix A describes the extraction from Bankscope (and IFS) of our cross-sectional database of 594 banks (representing 68 countries) for the CAPM tests. We also generate a corresponding panel of 69 countries spanning 11 years: 1995-2005.³⁶ The fruit of these databases is a hitherto unavailable series on banks' private returns in developing economies, and (their correlation with) government yields. Table 2 presents a country-wise summary of these variables, alongside ratios of GSH to banks' private assets, and of income on GSH to income from private assets.

An examination of Table 2 reveals several interesting, intuitive, patterns:

- Banks' private returns (with median 14 percent), generally exceed government returns (with median 9 percent). This also holds broadly for the real versions of the series and for the various country groups.

³⁶ The reason for ending the sample in 2005 was the availability of a key regressor

- Higher median returns are associated with higher standard deviations. Thus, both the volatility of private returns is higher than that of government returns, and countries with higher rates of return have higher standard deviations.
- The ratio of banks' GSH to the "sum of banks' risk-weighted assets (i.e. claims on private sector) and GSH" is around 11 percent, which appears low, compared with the average domestic debt-to-deposits ratio computed in the previous paper (20 percent). Since the sample of countries is different, the figures are not comparable. But a sample selection problem may also explain this difference. Most of the banks that survive in our dataset (due to the requirement that they report data continuously for a number of years) originate from the more advanced emerging markets, where banks are typically expected to hold a smaller share of government securities; both because of significant nonbank participation in government debt markets, and higher private sector credit/deposit ratios.
- Adjusting the nominal returns for ex-post inflation reduces their level by 6-7 percentage points. The resulting real yields of 3.1 percent on GS and 6.7 percent on private risk assets suggest a much more modest spread over comparable returns in advanced economies.
- Real rates have roughly the same standard deviation as nominal rates, which, given the lower mean for the former, suggests a much higher coefficient of variation than that obtaining in advanced economies – see also Table 1d. This could point, inter alia, to greater difficulties in forecasting inflation (ex-ante) in developing economies, as well as the latter's higher vulnerability to unexpected inflation shocks (ex-post).
- Asset return correlations are generally positive and similar for both real and nominal returns (median across countries is about 0.4), indicating that it is fair to see GS and private loans as substitutes, but not as perfect substitutes.

Tables 3A and 3B describe and summarize the data and variables needed for testing the hypotheses developed in the previous section. Also included are our theoretical priors on coefficient signs for key statutory and CAPM variables, which seem to find some early support

from the unconditional correlations reported in panel II of Table 3B. Two additional controls are also presented: financial depth and country stability and the expected sign on both of which is negative. Banks operating in higher financial depth environments (proxied by broad money/GDP ratios) are likely to possess the skills required to undertake complex credit risk assessments and, therefore, less predisposed to hold government securities (which typically offer lower returns, but are easier to price, and carry little credit risk). Similarly, following Kumhof and Tanner (2005), banks operating in stabler environments are less likely to hold government securities for “collateral reasons.”

Our empirical methodology is modeled on Ize and Levy-Yeyati (2003), who, as already mentioned, study the portfolio choice problem of households facing three investible assets: domestically held local currency deposits, domestically held foreign currency deposits and foreign currency deposits held abroad. Using quarterly asset returns for 1990-95 for a cross-section of 46 advanced and developing economies, they regress the observed dollarisation ratio the “underlying” (or optimal) dollarisation ratio, as well as the variances and covariances used to computer the optimal ratio.

There is good reason, in our case as well, to *supplement* regressions of λ – the “actual” $x_g/(x_p+x_g)$ ratio (expressed in percent) – on the CAPM-implied (or optimal) λ^* , *with* regressions of λ on the individual components of λ^* (the comparative statics whereof were solved in section IIB). The reason is that although the CAPM is a powerful tool to analyse asset substitution and asset holdings, the particular form of λ^* is likely to be prove restrictive for purposes of empirical analysis. Indeed, as discussed previously, CAPM abstracts from many real-world frictions – transaction costs, restrictions on short-selling, imperfect information, illiquid instruments,³⁷ as well more structural problems such as time-varying covariances.³⁸

³⁷ CAPM shares are optimal shares in a “static” equilibrium framework: assets that have a long maturity in illiquid markets may be held for several periods, which creates a wedge between actual and desired shares.

³⁸ Engle and Rodriguez (1989) show in their cross-country study of debt holdings and interest rates show how time-varying covariances can lead to a failure of CAPM.

Also, banking is a highly regulated sector and any individual bank is unlikely to be able to hold a portfolio that is too divergent from an “average” portfolio, as regulators may consider it to be risky behaviour. Management is also unlikely to accept a portfolio that seems overly “speculative” or shifts dramatically due to a change in some underlying parameter. Hence, although the desired shares may include short positions, specialisation in some assets, this is unlikely to be implemented by banks to the extent suggested by a simple CAPM. Banks may also consider that past mean and covariance estimates are poor predictors of future returns. And if, indeed, there are expectations of parameters reverting to some long-term stable level, then a λ^* that is based on the average level of parameters in the past few years, may predict too much divergence in portfolio shares.

In the context of the foregoing, we develop a two-stage empirical strategy summarized below and discussed in detail in the next sub-section.

- In STEP 1 [Tables 4-7], we run OLS regressions of the actual bank λ s on key CAPM variables: r_g^+ , r_p^- , σ_g^- , σ_p^+ , $\sigma_{pg}^{-/+}$, where the signs shown match the signs of the partial derivatives obtained from section IIB (Table 4a).³⁹ Appropriate controls are employed for non-CAPM factors affecting banks’ demand for GS: cash reserve ratio, capital adequacy requirement, financial depth, country risk. The same procedure is applied to real returns (Table 4b). Robustness is tested by outlier-excluded regressions (Table 5); quantile regressions (Table 6); and TOBIT specifications (Table 7).
- In STEP 2 [Tables 8-9], we run cross-section regressions of actual bank λ s on CAPM-implied λ^* . For each bank, we compute a λ^* – the CAPM-implied optimal share of GSH

³⁹ Although the OLS approach here is technically inferior to full non-linear estimation of the equations in IIB, uncertainty over the exact functional form of the equations renders the former approach more robust. In any case, we do regress λ on λ^* in the second stage, which does capture the nonlinearity imbedded in the equations.

in the total portfolio, as derived under Case 2 of section IIB(ii), where the observed sample means, variances and covariances of *nominal returns* are used as a proxy the expected future distribution of returns.⁴⁰ The actual λ ($=100 \cdot x_g / (x_g + x_p)$) for the year 2005) is then regressed on λ^* using both the full sample (Table 8) and country sub-samples (Table 9). Given its expected wide range, values of λ^* outside the 0-100 (percent) range are dropped for regression purposes.

A number of empirical challenges arise when implementing the above strategy. We briefly discuss how these were addressed before proceeding to the results.

(i) *The use of “past” asset returns to compute the “optimal” asset shares (the regressor), raises endogeneity concerns as the “actual” portfolio choice (the regressand) could have influenced those asset returns, especially in shallow markets with few banks operating.*

We minimize this problem by defining our regressand, λ as $100 \cdot (x_{g2005} / (x_{g2005} + x_{p2005}))$, i.e. as the “end-period” ratio of GSH to private assets for each banks, while calculating the means, standard deviations and correlations strictly over 1995-2004. Ize and Levy-Yeyati (2003) also adopt the same approach.

(ii) *It is important to control for unobserved country heterogeneity, but with country-level variables (like MU[Rg], SD[Rg], FDEPTH etc.) included, the regression, country dummies drop out due to perfect multicollinearity.*

We are unable to control for unobserved country heterogeneity by including dummies. The inclusion of a large number of country-level variables, however, helps minimize the importance of

⁴⁰ Portfolio choice problems are forward looking, but because forecasts on the expected values, standard deviations and covariances of asset returns (and hence the forward-looking optimal portfolio) are not available, we can only use past data as the best predictor for the future – a rational expectations assumption for agents. Also employed by Ize and Levy-Yeyati (2003).

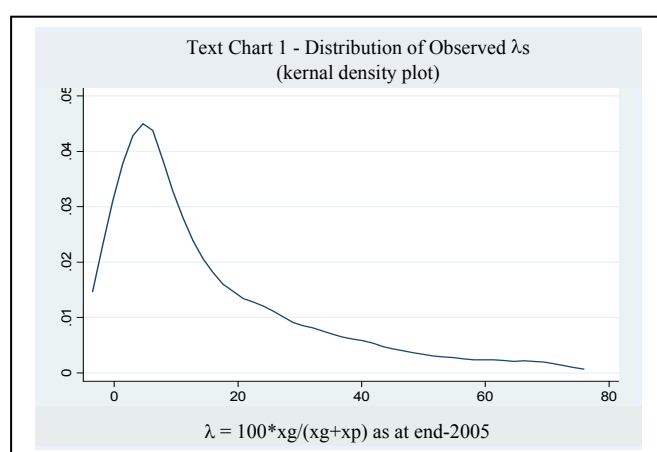
any residual heterogeneity. We also run cross-section regressions on banks in *individual* countries (Table 9), and control for the clustering bias in standard errors in all our full sample regressions.

(iii) *How is banks' risk aversion captured?*

Since no public estimates of banks' risk aversion are available, we have to rely on second-best proxies. To this end, we computed banks' ratios of actual-to-required capital as a crude index of their risk aversion. The median value of this ratio across the 594 banks was 1.11 (mean 1.48), but with ratios varying from 0.08 to 8. Since the size of this variation would likely reflect other factors, such as profitability, we convert the index into a binary dummy taking the value 1 when the index > 1.11 and zero otherwise.

(iv) *In choosing its portfolio, a bank may pay particular attention to its NPL ratios, which are often revealing of deeper problems, rather than the computed private returns, which is a function of both lending rates and NPL ratios.*

Although, we argued earlier that NPL ratios cannot be reliably used to construct ex-post private return series – due to reporting differences across countries and the fact that not all npls translate



into actual provisions – insofar as they are the most widely used (and best understood) indicators of portfolio quality, banks *will* pay attention to them when choosing their portfolios. Moreover, as per Kumhof and Tanner (2005), the collateral motive for holding

GS is likely to be stronger when npl ratios are high. We, therefore, include in our regressions, the median NPL ratio observed for each bank over 1995-2005 as a second variable (in addition to MU[Rp]) proxying for their expected private return. Our prior on the coefficient for NPL ratio, therefore, is positive.

(v) *The observed λ s are likely to be censored, especially from below.*

The distribution of the actual end-2005 portfolio shares of GS (Text Chart 1) suggests that the data might be censored from below. There is a nontrivial amount of density concentrated near zero, indicating that some banks might have wished to “short” government securities but could not do so for statutory reasons. Although statutory variables are part of in the regressor vector $\mathbf{x}$, the likely “censoring” of the data “from below” opens the possibility that errors from an OLS regression of portfolio shares on a constant and $\mathbf{x}$ are non-normal, and hence do not satisfy the condition $E(\varepsilon_t)=0$ that is required for the unbiasedness of the estimated beta coefficients (the bias would be downward in this case). It is important to note that the problem in our case is not one of “truncation”, i.e. banks being excluded from the sample because of non-positive holdings of government securities. Banks reporting in the Bankscope dataset invariably report some number for government securities. To address this possible censoring issue, we include a full set of regressions with an appropriate TOBIT correction (Table 7). The “lower limit” threshold for λ in these regressions is chosen as 1 percent (5th percentile of the distribution). Moreover, the non-normality of the λ distribution suggests that standard errors would be biased, complicating inference. To avoid this, we use bootstrapped standard errors in all regressions.

(vi) *The relationship between λ and the regressors may not be stable across all λ ranges.*

It could be reasonably postulated that actual GS shares are likely to respond differently to portfolio considerations depending on how big or small the shares themselves are. For example, a bank manager will be more sensitive to changes in the relative risk-return attributes of GS and private loans, when GS are substantially represented on his/her portfolio. Given the particular distribution of λ s, and the concentration of shares at around 10 percent, it is plausible to expect the significance and strength of estimated coefficients to rise as we move across the distribution. To this end, and as an additional robustness test, Table 6 and Figure 2 report system quantile regressions.

B. Empirical results

- *STEP 1: Cross-section regressions of actual bank λ s on the parameters of the return distributions*

Table 4a suggests support for MVP-consistent behavior by banks across a variety of specifications with both nominal and real returns and different control sets. The main observations are as follows:

- The coefficients are positive and significant on MU[Rg] and SD[Rp], negative on SD[Rg] and significant on MU[Rp]. The orders of magnitude appear intuitive: illustratively, a 1 percentage point increase in MU[Rg] is associated with a 0.8 percentage point increase in λ (expressed in percent). The fact that the coefficient for SD[Rg] is stronger than that for SD[Rp], suggests that the second moments of GS are relatively important for banks' portfolio decisions, and that such securities are not considered risk free.
- One interpretation of the insignificant coefficient on MU[Rp] could be that banks use other proxies for expected private return, such as the NPL ratio. The latter is indeed generally significant and appears with the correct sign (+) in all regressions.
- The sign on COV[Rp;Rg] is negative, but significant only in the nominal regression. Recall from section IIB that $\partial x_g / \partial \sigma_{gp}$ is negative if $v = (r_p - r_g) - \rho(\sigma_p^2 - \sigma_g^2)$ is positive, and therefore the sign of the regression gives an estimate of whether the spread in returns is large enough to compensate for the utility cost due to higher volatility. In the regression with nominal returns, this seems to be the case. But the result does not extend to regressions with real returns. A speculative interpretation of this result could be that for banks that do consider real returns when choosing portfolio shares, the cost of real risk taking $\rho(\sigma_p'^2 - \sigma_g'^2)$ is larger than the real excess return (which also equals the nominal excess return $r_p' - r_g' = r_p - r_g$), a hypothesis that finds support in

the data: almost three-fourths of the banks in our sample have $\sigma_p^{n,2} - \sigma_g^{n,2} > \sigma_p^{r,2} - \sigma_g^{r,2}$ (where superscripts n and r refer to nominal and real, respectively).

- The coefficient on the statutory capital adequacy requirement is expectedly positive and highly significant. Sized at about 3, it implies that a 1 percentage point increase in the statutory ratio would raise λ (expressed in percent) by 3 percentage points. Interestingly, the coefficient on the cash-reserve ratio is consistently and significantly negative in all regressions. This indicates that the ratio is less of a proxy for general financial repression in our sample period, and its impact on the xg/xp mix is primarily through the correlation effect: the forced holding of cash tilts the residual portfolio away from the asset that is the closest substitute for cash (in our case, government securities) – see section IIB(ii). The coefficient size indicates that a 1 percentage point increase in the cash-reserve ratio lowers portfolio share of GS (expressed in percent) by just over $\frac{1}{2}$ a percentage point.
- The coefficients on financial depth and the binary risk aversion regressor are insignificant. We mustn't over-interpret this result for risk aversion, however, given the crudeness of our proxy.
- The country stability regressor has the expected sign (negative), although significance is higher in the regressions with real returns. This lends *micro* support to Kumhof and Tanner's (2005) "collateral" motivation for holding government debt in riskier politico-economic environments.
- Robustness tests were performed by removing outlier observations – defined as those where any coefficient's DFBETA value $> 2/\sqrt{n}$. A number of observations are lost, but the signs, sizes and significance of the variables broadly survive, both for the real and nominal regressions (Table 5).

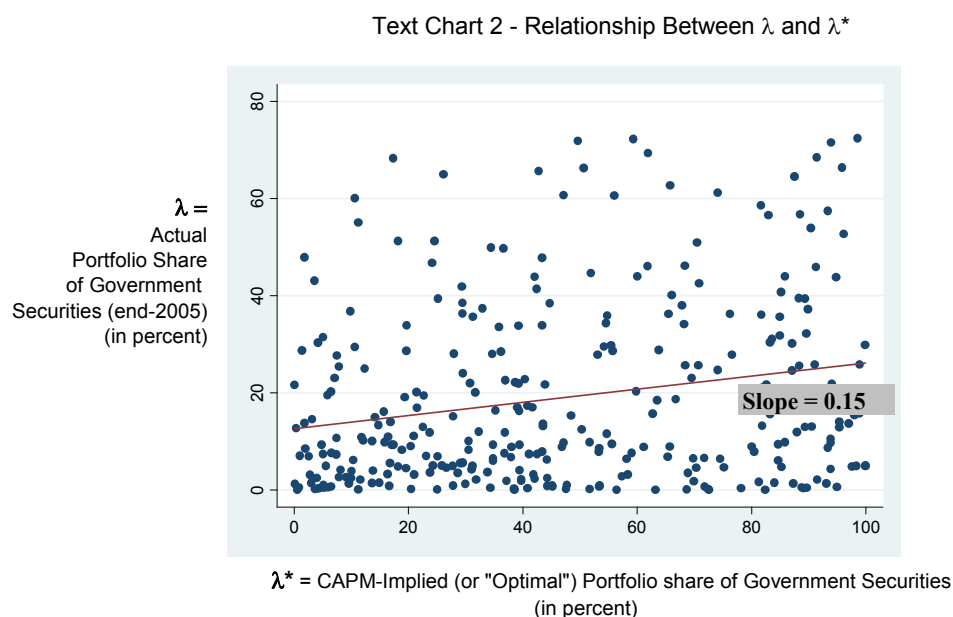
The quantile regressions summarized in Table 6 serve as an additional robustness check, as well as confirm our thinking about the associations being stronger at higher quantiles of λ . As Figure 2

shows, most of the key coefficients become stronger as we move up the λ quantiles. But at very high quantiles, the trend appears to reverse. This appears intuitive since extreme portfolio configurations (too much x_g or too little) are likely to be influenced more by supply-side factors. Similarly, the TOBIT regressions reported in Table 7 seem to lend some support to our censoring-from-below prior: the coefficient sizes are consistently stronger, although not by a lot, when compared with Table 4.

- A final but important result relates to the relative importance of statutory and CAPM variables in explaining banks' x_g/x_p portfolio mix. A comparison of the R-squared statistics across columns (vi) and (vii) in Tables 4a, 4b, 7a and 7b suggests that the addition of statutory variables (cash reserve ratio and capital adequacy requirement) more than doubles the explanatory power of regressions. This would seem to suggest that statutory factors are more significant than the CAPM variables. Note, however, that the impact of one of the statutory factors (the cash reserve ratio) on λ itself works through an “optimal” adjustment in the residual unconstrained portfolio. For this reason, it may also be useful to look at standardized coefficients. As the discussion on Table 10 below notes, the sizes of the standardized coefficients are roughly the same for both CAPM and regulatory variables.

- *STEP 2: Regressions of λ on λ^* (Tables 8-9)*

It is important to disclaim, upfront, that the results of these regressions should be interpreted with care, given that λ^* straightjackets the form that the optimal portfolio can take, a constraint that appears rather strict. Recall that the particular form was derived in section IIB(iii) for the case where actual cash holdings exceed the statutory requirement in the case of nominal returns. Nevertheless, the reported results can serve as a further robustness test of our earlier results; in particular, the by-country regressions allow us to circumvent the unobserved country heterogeneity problem that our STEP 1 regressions were subject to.



Before reporting the regression results, it is useful to plot λ against λ^* to see capture the broad relationship. The scatter plot (Text chart 2) suggests two things: that the association is likely positive, but not strongly so – the slope is about 0.15, which can be interpreted as an elasticity measure. Note that we have excluded here observations (about half the sample) where λ^* falls outside the 0-100 range.

The regressions reported in Tables 8a imply elasticity estimates in the same range (0.14 in the regression with all the controls). The quantile regression (Table 8b) bear out a similar story as before – the coefficients are stronger (0.22) at higher ends of the distribution. Finally, in the by-country regressions reported in Table 9, the median elasticity is 0.35, but this masks a wide range, from 0.25 (Egypt) to 0.84 (Lebanon). Given the differences in the relative size of the λ s in these countries (Egypt = 13%, Lebanon 38%), the higher “responsiveness” for the case of Lebanon is consistent with the intuition of the quantile regressions.

C. Summary of results

We close the section by taking a birds-eye view of the key results from the various estimations — see summary Table 9 below. Several broad conclusions emerge:

- The consistently large size and strong significance of the regression coefficients on the CAPM regressors (columns 1-3) across the OLS, quantile and TOBIT specifications seem to underline the importance of mean-variance considerations in banks' portfolio choice. Moreover, the magnitudes of the “standardized” coefficients (or pseudo-elasticities) – averaging 0.2 for regressions with λ^* and 0.5 across the five CAPM parameters vs. 0.3-0.4 for the cash reserve and capital adequacy ratios – suggest that it is not correct to assume that regulatory factors outweigh MVP considerations in the determination of banks' private vs. public risk apportionment.⁴¹
- On average, the portfolio share of government securities rises by 1 percentage point in response to a 1 percentage point increase in the expected government yield, and falls by 1.5 percentage points in response to a similar increase in the expected private returns. The average coefficients on the standard deviations for government and private returns are -0.80 and 0.57, respectively. The smaller sizes of the standardized coefficients for second moment parameters indicate, perhaps, that they command somewhat less attention than the means during portfolio allocation decisions. However, the fact that the coefficient for SD[Rg] is as large as for SD[Rp] supports our earlier view that banks do consider government securities as a risky asset for the purposes of their ex-ante portfolio allocation decisions.
- While our proxies for country risk, financial development and managerial risk aversion did not show robust significance, the importance of regulatory factors was clearly: a 1 percentage point increase in the capital adequacy requirement

⁴¹ As mentioned in the footnote of Table 10, standardized coefficients capture the number of standard deviations change in the dependent variable induced by one standard deviation change in the regressor.

induces a 4.2 percentage point increase in the portfolio share of government securities. By contrast, an increase in the cash reserve ratio (i.e. forced holding of a riskless asset) tilts the portfolio in favor of the riskier asset, i.e. private loans (the share of government securities falling by about 5 percentage points).

- The results also suggest that the censoring-from-below problem discussed earlier is not likely severe (as the TOBIT coefficients are only marginally, although consistently, bigger than the OLS coefficients), but that the relevance of CAPM-regressors is significantly greater at higher levels of government securities holdings (as the quantile p75 coefficients are noticeably larger than the OLS coefficients). The latter result is intuitive, as it indicates that at relatively higher shares of government securities, when regulatory considerations have likely become less binding, portfolio allocations become more responsive to changes in the mean-variance configuration of returns. Figure
- Regressions of actual government securities share on the CAPM-implied optimal shares (λ^* s) suggest an average coefficient (elasticity) of about 0.2, not too far from the unconditional correlation coefficient of 0.15 shown in Text Chart 2, but somewhat weaker than the standardized coefficients for CAPM parameters (averaging 0.5). However, the λ^* coefficient is significantly higher in the 8 by-country regressions, ranging from 0.25 to 0.84, with a median of 0.35.

Table 10 – Summary of Regression Results Across Specifications 1/

(Dependent variable: actual end-2005 portfolio share of government securities)

Regressors		Regressions using CAPM parameters as regressors				Regressions using λ^* as regressor		
		(1) OLS cross- section	(2) Quantile	(3) TOBIT	Average coefficient ; standardized coefficient 2/	(4) OLS cross- section	(5) Quantile	(6) By- country 4/
C	MU[Rg]	0.83***	1.37***	0.88***	1.0 ; 0.5	0.14***	0.22***	0.25 to 0.84 (average =0.35)
A	SD[Rg]	-0.70**	-0.98***	-0.71**	-0.8 ; -0.4			
P	MU[Rp] 3/	-1.22(**)	-2.11(**)	-1.33(**)	-1.5 ; -0.8			
M:	SD[Rp]	0.50***	0.75**	0.51***	0.6 ; 0.4			
λ^*	cov[Rp,Rg]	-0.82**	-1.29**	-0.92**	1.0 ; 0.5			
Cash reserve ratio		-0.58***	-0.77***	-0.69**	-0.7 ; -0.3	-0.25	-0.54**	
Capital adeq. Ratio		3.46***	5.35***	3.76***	4.2 ; 0.4	3.03**	5.02***	
R-squared		0.25	0.23	0.04		0.60	0.13	
No. of observations		594	594	594		269	279	20

*** = $p < 0.01$, ** = $p < 0.05$, * = $p < 0.10$

1/ Results are reported for the regressions using nominal returns. Table references to the column entries here are as follows: 1: Table 4 (a) iv; 2: Table 6 (q75); 3: Table 7 (a) iv; 4: Table 8 (a) i; 5: Table 8 (b) q75; 6: Table 9.

2/ Standardized coefficients were computed using Table 3BI. The average coefficient was multiplied by the standard deviation of the respective variable; and then dividing the standard deviation of λ (16.5).

3/ As discussed in the text, the NPL ratio was used instead of MU[Rp] in our preferred regressions. The two variables were closely correlated in the sample, but the former exhibited consistently stronger significance (perhaps reflecting the importance bank managers attach to it when assessing the health of their private sector lending portfolios). The coefficient size reported here (e.g. -1.22 on col.1) for MU[Rp] is therefore derived from the NPL coefficient (0.22 in this case). The mathematical relation between 0.22 and -1.22 is as follows: we know that $MU[Rp] \approx \text{Gross_MU}[Rp] \cdot (1 - \text{npl})$, so that a jump in the NPL ratio from its mean level (of 0.077) to 0.087 will produce a corresponding decline in MU[Rp] of $0.18 = 16.6[1 - (1 - 0.077)/(1 - 0.087)]$, where 16.6 percent is the mean of MU[Rp] (as reported in Table 3B(I)). Dividing the induced increase in the portfolio share of government securities of 0.22 percentage point by the increase in MU[Rp] of -0.18, we recover an approximation for the implied coefficient on MU[Rp] of -1.22.

4/ 0.25 to 0.84 shows the range of the CAPM coefficients across the 8 country regressions. 0.35 is the median of the 8 regressions, of which 6 produced significant coefficients at the 5 percent level (**). The average number of observations in the 8 regressions was 20.

IV. CONCLUSION AND WAY FORWARD

This paper has motivated, and attempted to address the question: is CAPM-type mean-variance optimization a relevant framework for analysing developing economy banks' (portfolio) allocation between government securities and private risk assets. The major data hurdle – the absence of a reliable series on banks' government and private returns – was overcome through the construction of new Bankscope-based panel data series on these returns, which were then amenable to the derivation of key CAPM variables: means, standard deviations and covariances over the period 1995-2005 for about 600 banks from 70 developing economies.

The empirical strategy was based on the optimal portfolio choice equations derived from a simple mean-variance optimization theoretical framework, but one in which regulatory factors – minimum requirements for cash reserves and capital adequacy – were accorded due importance. Different versions of the optimal (minimum variance) portfolio share of government securities (λ^*) were generated, keeping in mind important CAPM critiques – such as violation of the separation theorem, the real and nominal nature of returns. All regressions employed banks' end-2005 portfolio shares of government securities as the dependent variable. The key regressors constituted either the mean-variance parameters of government and private returns, or the optimal λ^* . The regulatory environment, country risk, level of financial development and managerial risk aversion were appropriately controlled for and robustness checked through quantile and TOBIT specifications, by-country regressions, and regressions excluding outliers.

The key results, summarized at the end of the previous section, are as follows: (i) government securities are seen as a risky asset by banks; (ii) standard MVP considerations are at least as important as regulatory factors for the determination of developing economy banks' portfolio allocations between government and private risk; (iii) higher cash reserve ratios appear to tilt the portfolio away from the low-risk asset (government-securities) toward private loans, while stronger capital requirements prompt intuitively larger government securities holdings; and (iv)

the contribution of CAPM factors to portfolio allocation appears to be stronger at higher shares of government securities, indicating the likely dominance of regulatory factors at lower ends of the distribution.

These results connect with a number of important debates in development macroeconomics. We list some of these, primarily with a view to identifying directions for future research.

Importance of bank behavior in monetary policy transmission: In a recent paper, Mishra, Montiel and Spilimbergo (2010) argue that key monetary policy transmission channels (as they apply in advanced countries) are significantly impaired in developing economies on account of their “weak[er] institutional frameworks, reduced role of securities markets, imperfect competition in the banking sector and the resulting high cost of bank lending to private firms” (p.1). In other words, the structure and behavior of the banking system is critical to understanding the link between central bank actions and aggregate demand. In this context, our paper has shown that, just as in advanced economies, developing country bank behavior does pay attention to standard portfolio optimization considerations, even when regulatory and institutional differences are controlled for. The real difference perhaps lies in the way government securities are viewed: riskless in advanced economies, but risky in developing economies. Any micro-founded modeling of the financial sector’s role in monetary policy transmission could usefully take account of this finding.

Domestic debt and crowding out: Arguments for domestic debt crowding out private investment (or private lending by banks) have rested strongly on the assumption that government and private securities are substitutes, so that, by implication, the underlying asset returns positively covary. However, this assumption has not been as rigorously tested in developing economies as in advanced economies. A glance at the correlations of government and private returns in Table 2 shows a real mix, with some countries reporting very high correlations but others low or even negative associations (sample median is 0.4). Could this be due to shocks that push government

yields and private returns in opposite directions? A preliminary candidate for such a shock could a *corporate profitability-boosting productivity shock* which strengthens public finances through higher revenue collections and lower risk premium on public debt (thus, *lowering* government yields), but lowers NPL ratios for banks (thus, *raising* private returns). Notwithstanding the specific reasons underlying it, insofar as a low or negative covariance is viewed favorably by risk-averse banks, there could be general equilibrium effects operating via higher deposit mobilization that nuance the crowding out effects, consistent with the findings of the second essay in this thesis.

Industrial organization aspects of bank behavior. Our model is essentially a partial equilibrium model which does not endogenise the size of financial institutions. Nor were we able to model the effect of imperfect competition on portfolio allocation. However, given that markets are shallower and more concentrated in developing economies than in advanced economies, there would be merit in revisiting this issue. Abbas and Sobolev (2009), for instance, found that rising and volatile government yields in Tanzania during 2005-08 were, in part, driven by collusive behavior among the three largest banks. To what extent does this pattern generalize to other countries; do banks invest more heavily in government securities in the presence of less competitive settings.; is the behavior of large and small banks systematically different in this respect? These are all questions that could be usefully looked at in further research.

Intertemporal aspects of fiscal policy and the impact on risk-return structures: Finally, it would be interesting to identify the drivers of the risk-return structure that CAPM takes as exogenous. For example, a current rise in government securities issuance (aimed at smoothing the tax/GDP ratio) that is predicated on the anticipation of a future tax increase, may raise uncertainty over private disposable incomes, and hence of the tax revenue stream itself, thus elevating the riskiness of the government security. Locating the sources of the risk-return structure, especially in an intertemporal context, would make for timely research at a time of rising government debts around the world.

BIBLIOGRAPHY

- Abbas, S.M.A. and Yuri Sobolev, 2009, “High and Volatile Treasury Yields in Tanzania: The Role of Strategic Bidding and Auction Microstructure”, *South African Journal of Economics*, 77: 257–281.
- Adam, Christopher S. and David Bevan, 2005, “Fiscal deficits and growth in developing countries,” *Journal of Public Economics*, Elsevier, vol. 89(4), pages 571-597, April.
- Andritzky, Jochen, 2012, “Government Bonds and Their investors: What Are the Facts and Do They Matter?” IMF Working Paper 12/58, International Monetary Fund, Washington, D.C.
- Aoki, Kosuke and Nao Sudo, 2012, “Asset Portfolio Choice of Banks and Inflation Dynamics”, Bank of Japan Working Paper, July 2012.
- Aschauer, David A., 1989, “Does Private Capital Crowd Out Public Capital”, *Journal of Monetary Economics*, 24, pp. 171-188.
- Blanchard, Oliver and Mary Kay Plantés, 1977, “A note on the Gross Substitutability of Financial Assets.” *Econometrica* 45, 769-71, April.
- Bos, J.W.B., Kool, C.J.M., 2001, “Bank Size, Specialization and Efficiency in the Netherlands: 1992–1998”, Meteor Research Memorandum, Maastricht University, RM/01/018.
- Brownbridge, Martin and Emmanuel Tumusiime-Mutebile, 2007, “Aid and Fiscal Deficits: Lessons from Uganda on the Implications for Macroeconomic Management and Fiscal Sustainability”, *Development Policy Review*, 25 (2): 193-213.
- Buch C.M., 2003, “Information or Regulation: What Drives the International Activities of Commercial Banks”, *Journal of Money, Credit and Banking*, Vol 35(6), pp. 851-869.
- Buch C.M. and S. Lapp, 2001, “Bank Portfolios in Euroland”. In: T. Moser and B. Schips (eds.). *EMU, Financial Markets, and the World Economy*. Kluwer Academic Publishers: 109–142

- Buiter, Willem and James Tobin, 1978, "Debt Neutrality: A Brief Review of Doctrine and Evidence," Cowles Foundation Discussion Papers 497, Cowles Foundation for Research in Economics, Yale University.
- Cihák, Martin, 2007, "Introduction to Applied Stress Testing," IMF Working Papers 07/59, International Monetary Fund.
- Calvo, Guillermo, and E. Mendoza, 1999, "Rational Contagion and the Globalization of Securities Markets," *Journal of International Economics*, 51, 79-113.
- Cole, David and B. Slade, 1999, "Premature Liberalization of Government Debt Markets." Available on World Bank Web site
www.worldbank.org/research/interest/confs/past/papers18/ColeSladeNew.pdf
- Collier, Paul, Anke Hoeffler and Catherine Pattillo, 2004, "Africa's Exodus: Capital Flight and the Brain Drain as Portfolio Decisions," *Journal of African Economies*, Oxford University Press, vol. 13(02), pages ii15-ii54, December.
- Cullison, William, 1993, "Public Investment and Economic Growth," *Economic Quarterly* 79, 19-33
- Dumas, B., 1994, "Partial Equilibrium Versus General Equilibrium Models of the International Capital Market" pp. 301 – 334' in F van der Ploeg (ed) *The Handbook of International Macroeconomics* (Oxford: Blackwell).
- Engel, Charles and Anthony Rodriguez, 1989, "Tests of International CAPM with Time-Varying Covariances", *Journal of Applied Econometrics* 4(2), pp. 119-138.
- English, William. B., 2002, "Interest Rate Risk and Bank Net Interest Margins", *BIS Quarterly Review*, December, pp. 67-82.
- Faruquee H., S. Li, and I.K. Yan, 2004, "The Determinants of International Portfolio Holdings and Home Bias", IMF Working Paper, WP/04/34.
- Feinman, Joshua N., 1993, "Reserve requirements: history, current practice, and potential reform," *Federal Reserve Bulletin*, Board of Governors of the Federal Reserve System (U.S.), issue Jun, pages 569-589.

- Fleisig, H.W., 1996, "Secured Transactions: The Power of Collateral," *Finance and Development* (June), pp. 44–46.
- _____, 1998, "Economic Functions of Security in a Market Economy," in Norton, J.J. and Andenas, M., eds., *Emerging Financial Markets and Secured Transactions*, *International Economic Development Law Volume 6*, London, The Hague, Boston: Kluwer Law International.
- Frankel, Jeffrey A, 1985, "Portfolio Crowding-out, Empirically Estimated," *The Quarterly Journal of Economics*, MIT Press, vol. 100(5), pages 1041-65, Supp.
- Freixas X. and J.-C. Rochet, 1997, *The Microeconomics of Banking*, MIT Press
- Friedman, Benjamin M., 1977, "Crowding Out Or Crowding In?", *Brookings Papers on Economic Activity*, Vol. 9(3), pp. 593-641.
- Hart O., and D. Jaffee, 1974, "On the Application of Portfolio Theory to Depository Financial Intermediaries", *The Review of Economic Studies*, Vol. 41, No. 1, pp. 129-147.
- Hauner, D., 2006, "Fiscal Policy and Financial Development," IMF Working Paper No. 06/26 (Washington: International Monetary Fund).
- International Monetary Fund, 2003, "Sovereign Debt Restructurings and the Domestic Economy—Experience in Four Recent Cases." Available on the IMF's Web site, www.imf.org/external/np/pdr/sdrm/2003/02803.pdf
- _____, 2007, "United Republic of Tanzania: 2007 Article IV Consultation and First Review Under the Policy Support Instrument - Staff Report; Staff Supplement; Public Information Notice and Press Release on the Executive Board Discussion; and Statement by the Executive Director for the United Republic of Tanzania" (IMF Country Report No. 07/246).
- Ize, Alain, and Eduardo Levy-Yeyati, 2003, "Financial Dollarization", *Journal of International Economics*, Vol. 59, pp. 323-347.
- Karasulu, Meral, 2003, "Assessment of the Korean Financial Sector by the IMF and the World Bank", The Korea Economic Institute.

- Kearns, Allan, 2004, "Top-Down Stress Testing: The Key Results," *Financial Stability Report* 2004. Available on [http://www.cbfsai.ie/data/FinStaRepFiles/Top-Down%20Stress%20Testing%20The%20Key%](http://www.cbfsai.ie/data/FinStaRepFiles/Top-Down%20Stress%20Testing%20The%20Key%20Results.pdf)
- Kochhar, Kalpana, 1996, "The Definition of Reserve Money - Does It Matter for Financial Programs?" IMF Papers on Policy Analysis and Assessments No. 96/9.
- Koutsougeras, L.C. and K. G. Papadopoulos (2004), "Arbitrage and Equilibrium in Strategic Security Markets," *Economic Theory*, Vol. 23. pp. 553-568.
- Kumhof, Michael, 2004, "Fiscal Crisis Resolution: Taxation versus Inflation," Meeting Paper No. 874 (New York: Society for Economic Dynamics).
- Kumhof, Michael and Evan Tanner, 2005, "Government Debt: An Essential Role in Financial Intermediation," IMF Working Paper 05/57 (Washington: International Monetary Fund).
- Manaster, S., 1979, "Real and Nominal Efficiency Sets", *Journal of Finance*, Vol. 34, No. 1., pp. 93-102.
- McKinnon, Ronald I., 1973, *Money and Capital in Economic Development*. Washington, D.C. Brookings Institution.
- Saxegaard, Magnus, 2006, "Excess Liquidity and the Effectiveness of Monetary Policy: Evidence from Sub-Saharan Africa," IMF Working Papers 06/115, International Monetary Fund.
- Mishra, Prachi, Peter Montiel and Antonio Spilimbergo, 2010, "Monetary Transmission in Low-Income Countries", IMF Working Paper 10/223, International Monetary Fund.
- Naastepad, C.W.M., 1999, *The Budget Deficit and Macroeconomic Performance - A Real-Financial Computable General Equilibrium Model for India*, Oxford University Press.
- Podpiera, Richard, 2006, "Does compliance with Basel Core Principles bring any measurable benefits?" *IMF Staff Papers* 53(2), June.
- Pyle, D., 1971, "On the Theory of Financial Intermediation", *The Journal of Finance*, Vol. 26, No. 3., pp. 737-747.
- Reinhart, Carmen and Vincent Reinhart, 1998, "Some Lessons for Policy Makers Dealing with the Mixed Blessing of Capital Inflows", In M. Kahler, (ed.) *Capital Flows and Financial Crises*, (New York: Council on Foreign Relations), pp. 93-127.

- Roley, V. Vance, 1983, "Asset Substitutability and the Impact of Federal Deficits", NBER Working Paper No. 1082, February. National Bureau of Economic Research, Massachussets.
- Shaw, Edward S., 1973, *Financial Deepening in Economic Development*. New York: Oxford University Press.
- Subrahmanyam, V., 2003, "A Note on the Treatment of Non-Performing Assets (NPAs) in Macroeconomic Statistics." Available on the IMF Web site
<http://www.imf.org/external/np/sta/npl/eng/2003/051603.pdf>
- Sy, Amadou N. R., 2005, "Managing the Interest Rate Risk of Indian Banks' Government Securities Holdings," IMF Working Papers 05/78, International Monetary Fund.
- Tanzi, Vito, 1991, *Public Finance in Developing Countries*, pp. 91-98.
- United Nations Development Program, 2004, "Constraints on the Private Sector in Developing Countries" In *Unleashing Entrepreneurship: Making Business Work for the Poor*, UNDP Commission on Private Sector and Development Report to UN Secy Gen (March).

APPENDIX A:

NEW DATASET ON GOVERNMENT AND PRIVATE RETURNS

Our starting point is the Bankscope database, a repository of annual bank balance sheet and income statement data for 5,713 banks covering 70 developing economies over the period 1995-2005.¹⁴⁶ As noted in the main text, our objective is to develop two databases:

(i) a *bank cross-section* which includes, inter alia, the means, variances and covariances of asset returns computed over the 11-year period. Adjusting for outliers, data errors, and data gaps in the underlying series, and dropping banks with too few observations through time (this was needed to rule out unstable estimates of these statistics), reduced the number of banks to 594, representing 68 countries – see Table 3A.

(ii) a *country panel*, featuring time series variation in government and private returns, the latter aggregated from bank-year data into country-year. Data cleaning, and the dropping of country-years with less than 4 reporting banks, and countries with less than 8 years of observations through time, reduced the panel to 57 countries – see Table 2.¹⁴⁷

First, we identify the key Bankscope and IFS line items needed to generate holdings of government securities, private risk assets and the returns thereon [*all ratios are multiplied by 100 and expressed in percent*].

¹⁴⁶ Bankscope coverage extends to banks in advanced economies as well (and over a longer period of time), although our interest remains in developing economies.

¹⁴⁷ It is straightforward to collapse the country panel into a *country cross-section* consisting of 57 observations.

xg1	Treasury bills;	xg2:	Government securities
xp	Risk-weighted assets ¹⁴⁸		
tassets	Total assets		
intinc	Total interest income		
Rg	Government return ¹⁴⁹ (<i>average of T-bill and T-bond yield (from IFS)</i>)		

Second, we generate the refined series for GSH, “xg”, ensuring elimination of double counting.

This concern arises because GSH can appear under two heads in Bankscope: “T-bills”

(denoted here by xg1) and “Government securities” (xg2). For banks which report under the new *International Financial Reporting Standards* (IFRS) accounting standard, xg2 subsumes xg1. For banks still reporting under the *Generally Accepted Accounting Principles* (GAAP; international or local), the two are mutually exclusive, with “Government securities” including all paper other than “T-bills”.

The refined series,

xg Government securities holdings (GSH)

was generated as follows:

- i. $xg = xg1$ for bank-years where only xg1 was available.
- ii. $xg = xg2$ for bank-years where xg1 was not available but xg2 was.

¹⁴⁸ As mentioned earlier, a zero credit risk-weight for government securities is assumed under the Basel-I prudential framework in use in most developing economies.

¹⁴⁹ Note that the ex-ante Treasury yield offered by the government in a country for a particular year can differ from the “ex-post yield earned by any individual bank in that year” for two reasons: (i) outright domestic debt default by government, i.e. nonrepayment or delayed payment of interest and/or principal. However, as Kumhof (2004) notes, outright defaults on domestic debt are rare, especially if there are concerns about the effect of a default on the health of the banking sector, typically the largest holder of GS in developing economies. (ii) differences across banks in yields earned due to (a) multiple price bidding in GS auctions, or (b) differences in the mix of securities held. Since data on actual interest income earned by individual banks on GS is generally not available, it is impossible to discriminate between banks. However, even if such discrimination were possible, it is not clear the gains would be significant. On (a), it is unlikely for any individual bank to deviate widely and sustainably from the weighted average yield obtaining at an auction, or the secondary market yield on government securities. On (b), the menu of GS types issued in developing economies is fairly narrow, with banks’ preference for shorter-dated paper further narrowing the selection (Table 1b).

- iii. $xg = xg1 + xg2$ where both $xg1$ and $xg2$ were available but $xg1 > xg2$. Imposing this condition ensured that $xg1$ was not subsumed in $xg2$ and so it was safe to add the two numbers.
- iv. $xg = xg1$, where both $xg1$ and $xg2$ were available but $xg1 < xg2$. In this case, it was not obvious if $xg2$ subsumed $xg1$ or not; to be cautious and to avoid double-counting, therefore, we set $xg = xg1$ in these cases. This does open the sample to the possibility of understating xg (if $xg2$ indeed did subsume $xg1$) in these cases. However, we expect the impact to be small since such cases only accounted for about one-twentieth of the universe of observations.

In most cases, we found that $xg2$ was either zero, missing or well below $xg1$, suggesting that T-bills accounted for the major share of banks' GSH. The share of xg in total risk assets is obtained as:

xgshare = $100 * [xg / (xg + xp)]$ and referred to as.

Third, we generate each bank's private return (Rp) for a given year as follows: we net out the interest income earned on GSH from total interest income for a given year and divide the residual by the average stock of risk assets for that year. Thus:

Rp	Private return
	$100 * \{ [intinc - (xg * Rg / 100)] / xp \}$

This completes the *bank-year* dataset on private returns.

Fourth, we aggregate the Rp 's over each country-year using the total assets ("tasset") weight of each bank for that year. Denoting banks within any country-year by i , we have:

RP Aggregated private return over each country-year

$$\sum_i R_{p_i} * (tassets_i / \sum_i tassets_i)$$

For consistency, we also denote Rg as **RG** at this stage, although the two variables are, of course, identical.

A similar procedure is used to extract the real counterpart of RP, **rRP**.

Banks' shares of government securities to total risk assets are also similarly aggregated over each country-year to produce a country time series of the ratio: **XGshare**:

Table 1a: Contribution of govt. securities to commercial banks' assets and incomes

Ratios (in percent) based on bank-level data for 1995-2005 1/		Income from government securities as share of total interest income 2/	Government securities holdings as a share of risk-weighted assets plus government securities holdings 3/
<i>Mean</i> 4/	OECD	3.2	6.9
	Developing countries	12.1	18.2
<i>Median</i> 5/	OECD	1.6	3.9
	Developing countries	9.1	12.5

1/ Derived from bankscope balance sheet and income statement data on 12,304 banks in OECD countries and 5,713 banks in developing countries (all 120 non-OECD countries covered by Bankscope).

2/ Reported holdings of government securities holdings were multiplied by the prevailing government yield (average of T-bill and T-bond rates) and the product divided by total interest income.

3/ We add government securities holdings to risk-weighted assets to obtain the appropriate balance sheet denominator for the calculation of the share of government securities because under Basel-I (the framework applying during 1995-2005) assigned a zero "credit-"risk-weight to government securities (see Sy, 2005).

4/ The reported means for the OECD country group were obtained by averaging the (respective) ratio over all banks in the group. For developing countries, the banks' ratios were averaged over each of the eight IFS geographical zones; the average of those eight means is reported here.

5/ The reported medians for the OECD country group were obtained by taking the 50th percentile of the (respective) ratio over all banks in the group. For developing countries, the banks' ratios were "medianed" over each of the eight IFS geographical zones; the average of those eight medians is reported here.

Table 1b: Characteristics of public debt in selected LICs and EMs (1995-2005)

I <i>Jeanne & Guscina (2006) database on selected emerging markets</i>	II <i>Christensen (2004) database on Sub-Saharan Africa</i>	III <i>Mellor & Guscina (2007) database on IMF program countries</i>
Short-term and floating rate debt share in total public debt (in percent) 1/	Average maturity of central government domestic debt (in days) 4/	Share of central government domestic debt held outside banking system (in percent) 7/
Indonesia 13.6 Poland 32.4 Philippines 41.1 Russia 46.3 Mexico 48.1 Thailand 50.2 China 51.2 Turkey 52.4 Venezuela 76.7 Israel 78.3 Hungary 84.7 Colombia 86.5 Czech Republic 91.9 Brazil 95.2 Chile 98.9 Argentina 99.2	Burundi 77 Uganda 93 Gambia 112 Ghana 122 Malawi 177 Sierra Leone 190 Lesotho 203 Nigeria 228 Cape 256 Tanzania 262 Zambia 296 Rwanda 351 Kenya 382 Namibia 859 Average 258	Benin 3.1 Eritrea 4.6 Mauritania 5.9 Ethiopia 6.5 Sierra Leone 8.1 Sudan 9.8 Nigeria 13.0 Uganda 14.6 Burundi 15.4 Lesotho 20.6 Cape Verde 21.1 Senegal 22.7 Ghana 28.4 Zambia 30.6 Rwanda 34.9 Niger 37.4 Malawi 38.1 Kenya 46.1 Madagascar 47.2 Tanzania 55.7 Gambia 57.7 Zimbabwe 59.5 Cameroon 62.4 Average 28.0
Average 65.4	UK 5/ 5,168 US 6/ 1,790	UK 8/ 88.7 US 9/ 89.9
UK 2/ 33.6 US 3/ 30.6		

- 1/ Public debt redeeming in one year plus all floating rate and index-linked government securities divided by total public debt. Means over 1995-2005.
- 2/ Share of "index-linked" and "<1 year maturity" Treasury gilts in total stock outstanding thereof at end-March-2007. (UK Debt Management Office (DMO) Annual Review 2006/07).
- 3/ Share of "<1 year maturity" Treasury securities in outstanding privately held federal debt at end-June-2006 (Haver database on privately held US public debt).
- 4/ Figures as at end-2000.
- 5/ Average maturity applies to outstanding Treasury gilts as at end-March-2007 (UK Debt Management Office 2006/07).
- 6/ Average maturity applies to privately held public debt as at end-June-2007 (Haver database).
- 7/ Banking system includes central bank and depository institutions. Means over 1995-2005.
- 8/ Data as at end-March-2007; includes holdings by Bank of England, commercial banks, building societies and other financial institutions (UK Debt Management Office 2006/07).
- 9/ Data as at end-December-2006. Federal Reserve and commercial bank holdings were deducted from total public debt (defined here as privately held public debt plus Fed's holdings) to derive the non-bank share. (Federal Reserve Statistical Release 8.4.1. available on <<http://www.federalreserve.gov/releases/h41>>; Treasury Bulletin, June 2007).

**Table 1c: Herfindahl indices for total deposits
and government securities holdings**

Bankscope data (1995-2005)	Deposits	Government securities
<i>Higher income countries</i>	0.08	0.13
<i>Lower income countries</i>	0.27	0.28
Latin America	0.12	0.24
Central and Eastern Europe	0.22	0.29
Middle East	0.26	0.28
Asia	0.28	0.26
Caribbean	0.31	0.44
Sub-Saharan Africa	0.33	0.48

Note: Herfindahl indices (HI) were generated for each "country-year", medianed over 1995-2005, and then "medianed" over country-groups. The index for deposits for a particular country-year (say India-2004) was computed as: $\Sigma(sh_i / \Sigma_i sh_i)^2$; where sh_i is Indian bank i 's dollar holding of deposits in 2004. Herfindahl indices exceeding 0.18 are usually indicative of high concentration (and hence, potential market power).

Table 1d: Deposit rates, government yields and lending rates

In percent; 1995-2005		<i>Nominal</i>		<i>Real</i>	
		OECD	Developing countries	OECD	Developing countries
<i>Mean</i>	Deposit rate	2.9	7.3	1.3	1.2
	Government yield	5.0	9.8	3.1	3.9
	Lending rate	6.7	15.2	4.8	10.1
<i>Standard deviation</i>	Deposit rate	0.5	1.9	0.7	3.1
	Government yield	0.8	3.4	0.8	3.5
	Lending rate	0.6	2.0	0.7	3.0
<i>Coefficient of variation</i>	Deposit rate	18	34	42	69
	Government yield	17	35	29	80
	Lending rate	15	17	22	39

1/ For each OECD country, the mean, standard deviation and coefficient of variation were computed over the 1995-2005 period. For each of the three statistics, the median country was identified and its value reported here. The same was done for developing countries, except that medians were taken over geographical zone, rather than individual countries.

2/ Government yields are the average of T-bond and T-bill rates; although only the latter were reported for most developing countries.

Source: *International Financial Statistics (IFS) database of the International Monetary Fund (IMF)*

Table 2: Banks' government and private returns in selected developing countries
(in percent; country averages computed over 1995-2005)

Country 1/	Share of govt securities in total risk assets 2/	Treasury yields (RG) 3/				Private returns (RP) 4/				Correlation (RP, RG) 7/	
		nominal		real 5/		nominal		real 5/		nominal	real
		mean	stdev	mean	stdev	mean	stdev	mean	stdev		
Algeria	21.8	5.7	3.4	3.1	2.8	10.3	4.0	7.6	3.4	0.8	0.7
Argentina	10.1	5.3	4.2	2.4	4.2	6.9	1.3	4.0	1.8	0.8	0.7
Armenia	3.2	1.5	0.6	0.6	0.9	8.1	2.9	7.2	3.4	0.0	0.5
Azerbaijan	11.4	10.2	6.7	2.8	6.8	18.1	10.2	10.1	9.0	0.4	0.4
Bahamas	18.3	22.1	16.3	16.0	9.6	12.5	7.6	7.3	7.2	0.5	-0.1
Bangladesh	13.8	20.3	14.4	10.3	18.0	16.3	16.8	9.0	16.3	-0.2	-0.1
Botswana	8.2	9.7	2.9	7.9	3.9	15.4	3.0	13.6	4.6	0.1	0.6
Bulgaria	6.4	7.4	3.0	1.0	1.3	12.8	2.7	5.1	2.7	-0.4	-0.5
Chile	9.7	27.5	20.5	22.1	17.8	19.1	9.0	14.4	11.0	0.5	0.4
Colombia	2.9	12.5	4.7	10.5	9.7	11.7	1.7	6.1	4.3	-0.2	0.7
Costa Rica	13.4	2.3	1.5	0.6	1.8	4.5	0.9	2.8	1.2	0.1	0.5
Croatia	6.4	12.2	2.9	5.8	2.0	15.5	3.8	8.9	4.8	-0.4	-0.1
Cyprus	14.2	18.3	3.8	5.7	3.2	12.9	2.6	0.9	3.6	0.2	0.4
Czech Republic	4.8	11.4	3.4	3.7	5.5	17.8	7.2	9.7	7.5	-0.6	0.1
Ecuador	6.0	6.6	1.1	1.4	1.9	8.1	1.7	2.8	2.6	-0.8	0.4
Egypt	15.0	8.0	5.5	4.6	5.4	11.1	1.8	7.6	1.2	0.5	0.6
El Salvador	17.1	12.6	1.0	4.5	1.1	11.8	4.2	3.7	4.4	0.2	0.7
Georgia	15.0	3.2	2.2	2.1	2.1	13.8	6.5	12.6	6.2	0.3	0.2
Hungary	11.3	9.0	3.6	0.4	3.6	20.2	4.1	11.9	1.5	0.4	0.1
India	12.8	15.1	7.7	2.7	1.3	19.2	3.2	6.7	6.7	0.4	0.4
Indonesia	6.5	8.2	2.6	1.9	2.2	11.8	3.3	5.4	4.3	0.0	0.4
Israel	10.8	5.0	1.0	2.2	1.4	24.7	24.4	21.3	23.7	0.6	0.4
Jamaica	26.1	25.7	38.2	-10.1	25.0	16.6	6.7	-1.2	18.2	0.5	0.4
Jordan	6.2	6.4	3.6	1.4	1.4	14.0	8.0	8.6	5.0	0.8	0.0
Kazakhstan	13.8	7.4	2.7	3.7	1.8	9.1	3.9	5.5	3.7	0.5	0.4
Korea	12.9	17.6	11.1	3.8	5.0	20.7	7.7	7.1	9.7	0.6	0.7
Kuwait	8.8	7.3	3.4	-14.6	13.7	24.7	16.0	-2.1	14.7	0.8	0.8
Latvia	8.6	68.2	41.8	8.4	9.7	40.2	28.9	-6.0	24.7	0.0	-0.3
Lebanon	13.9	8.6	1.5	3.1	1.8	11.7	1.0	6.0	2.5	0.4	0.8
Lithuania	3.3	10.2	3.2	5.2	3.1	31.1	7.6	25.2	7.7	0.2	0.3
Macedonia	5.3	22.9	21.2	4.1	18.1	60.7	56.7	37.7	53.1	0.6	0.8
Mauritius	22.8	8.9	2.4	3.2	1.6	13.5	4.4	7.5	4.5	-0.3	-0.3
Nepal	4.5	9.5	3.9	4.7	1.7	7.5	2.3	3.0	5.8	-0.6	0.4
Pakistan	18.9	21.4	6.1	8.5	5.5	16.1	4.8	3.8	4.9	0.3	0.4
Philippines	9.4	5.1	2.3	2.9	2.3	8.8	2.4	6.5	3.2	0.6	0.7
Poland	16.8	31.7	13.9	-1.1	11.5	24.9	8.3	3.3	7.5	0.7	0.6
Singapore	14.3	9.3	7.1	0.3	6.6	16.7	6.6	7.0	3.6	0.5	0.4
Slovak Republic	5.7	6.6	2.2	2.5	3.3	14.7	10.4	10.8	10.8	-0.6	0.3
Slovenia	5.3	14.2	2.8	2.7	3.8	49.6	48.0	34.6	42.1	-0.4	-0.4
South Africa	17.7	13.5	7.4	3.7	3.4	16.1	6.1	6.3	6.6	0.6	0.6
Sri Lanka	8.2	8.4	3.2	4.5	2.6	9.2	3.0	5.3	2.9	0.4	0.3
Taiwan	26.8	4.1	2.5	2.5	2.8	9.5	5.1	7.7	5.5	0.6	0.7
Tanzania	10.3	5.9	1.0	1.2	2.8	10.7	3.8	5.8	3.7	0.7	0.6
Thailand	7.3	7.4	8.9	0.0	3.9	5.4	1.0	1.6	2.0	-0.5	0.5
Turkey	16.9	28.9	9.8	5.1	6.9	37.1	23.8	12.4	21.9	-0.4	-0.2
Uganda	9.6	8.0	4.2	1.0	3.0	10.1	4.6	3.0	4.7	0.4	0.4
Uruguay	11.2	7.1	3.8	2.7	3.2	12.5	3.6	7.9	1.9	0.8	0.7
Venezuela	11.5	15.4	9.6	5.8	4.4	12.6	3.4	3.5	2.1	0.8	-0.7
Vietnam	42.7	12.4	4.1	9.0	3.3	15.1	1.3	11.7	3.5	0.5	0.4
Yemen	19.6	3.6	0.5	0.4	0.9	9.8	3.4	6.4	3.8	-0.5	0.4
Zambia	12.1	10.9	3.0	4.2	2.0	12.5	2.5	5.8	2.6	-0.1	-0.5
Median	11.3	9.3	3.6	3.1	3.2	13.5	4.1	6.7	4.6	0.4	0.4

Notes:

1/ A number of banks and countries were dropped due to (a) concerns about double counting of GSH; (b) too few reporting banks in any year (<4); (c) too few observations for each country through time (countries with less than 8 years data were dropped); (d) missing treasury yield data. See Appendix A.

2/ Total risk assets = Risk-weighted assets (loans, investments etc.) + government securities (which have a risk-weighting of zero).

3/ Treasury yields are T-bill rates where only this rate was available in the IMF World Economic Outlook (WEO) database.

Where bond yields were "also" available, an average of the two was taken. Where only bond yields were available, that rate was taken.

4/ The ratio of banks' interest income on private assets to average risk-weighted assets (see Appendix A).

5/ The "ex-post" real rates were generated as $100 * [(1 + \text{nominal} / 100) / (1 + \text{inflation} / 100)] - 1$, where inflation is the rate of change of the consumer price index for the same year.

6/ The "ALL" median for the share of government securities ratio to risk-weighted assets does not exactly match that reported in Table 1c as the country sets are different.

7/ Correlation of RP and RG for each country over 1995-2005. The real and nominal columns refer to correlation between real and nominal returns, respectively.

TABLE 3A: List of Banks, Variable Definitions and Sources¹⁵⁰**I : SAMPLE OF BANKS***594 banks (country distribution in parenthesis below)*

- (1) Algeria, Armenia, Bahamas, Belize, Fiji, Kazakhstan, Latvia, Lesotho, Philippines, Seychelles, Solomon Islands, St. Kitts and Nevis, Swaziland and Vietnam
 (2) Georgia, Indonesia, Mauritius, Pakistan, Turkey and Uruguay
 (3) Albania, India, Jamaica, Korea, Namibia and Nepal
 (4) Botswana, China, Czech Republic, Ethiopia, Malawi, Papua New Guinea, Romania and Slovak Republic
 (5) Bahrain, Bangladesh, Barbados, Cyprus, Israel, Macedonia, Singapore and Trinidad and Tobago
 Lithuania (6), Costa Rica (7), Moldova (7), Zimbabwe (7), Jordan (9), Honduras (10), Kuwait (10), Sri Lanka (10), Bulgaria (12), Mexico (13), Kenya (14), South Africa (14), Colombia (15), Hungary (15), Ecuador (16), Poland (18), Russia (22), Chile (23), Croatia (24), Thailand (24), Egypt (26), Malaysia (30), Taiwan (31), Lebanon (34), Argentina (40), Nigeria (41)

II : VARIABLE DEFINITIONS AND SOURCES

<i>Variable</i>	<i>Definition</i>	<i>Data source</i>
λ [regressand; end-period “xgshare”]	100 * [Ratio of end-2005 government securities holdings (xg) to total risk assets (xp+xg)]	Bankscope
Rg	100 * [Average of T-bill and T-bond yields]	IFS
Rp	100 * [(Interest income - (Rg/100)*xg)/xp]	Bankscope/IFS
rRp (real Rp)	100 * [(100+Rp)/(100+inflation)-1]	Bankscope/IFS
rRg (real Rg)	100 * [(100+Rg)/(100+inflation)-1]	IFS
npl	100 * [Ratio of nonperforming loans to gross loans]	Bankscope
Cash reserve ratio	Statutory cash reserve ratio (end-2005, percent)	Barth, Caprio and Levine (2008)
Capital adequacy requirement	Statutory capital adequacy ratio (end-2005, percent)	Barth, Caprio and Levine (2008)
Risk aversion [high=1; 0=low)	Takes the value of 1(0) for bank i if its actual/required capital ratio is greater (smaller) than the median actual/required capital ratio for the whole sample	Bankscope; and Barth, Caprio and Levine (2008)
Country stability	Proxy for "country stability" = International country risk guide composite index (0-100; high value = low risk) medianed over 1995-2005 for each country	International Country Risk Guide
Financial depth	Proxy for “financial depth” = 100 * [broad money/GDP]; medianed over 1995-2005 for each country	IFS

¹⁵⁰ Appendix A has further details on how the final data sample and variables were obtained, and how the data was cleaned.

TABLE 3B : Descriptive Statistics for Variables Used in Cross-Section Regressions on 594 banks

I : Summary statistics						
Regressand = λ = end-2005 share of government securities holdings = $100 \cdot x_g / (x_p + x_g)$						
MU=mean; SD=standard deviation; CORR = correlation coefficient; MED = median						
Statistics computed over 1995-2004, except for cash reserve ratio, capital adequacy reqt and λ which are all end-2005						
In percent, except for correlations	Prior on coefficient sign	mean	standard deviation	min	median	max
λ		15.5	16.5	0.0	9.3	72.4
MU[Rg]	+	12.0	8.6	1.5	11.4	64.8
SD[Rg]	-	6.4	7.7	0.4	3.5	38.8
MU[Rp]	-	16.6	14.2	0.4	13.1	157.7
SD[Rp]	+	7.1	12.5	0.4	3.9	137.3
CORR[Rg,Rp]	?	0.3	0.5	-0.8	0.4	0.8
MU[rRg]	+	4.8	5.2	-9.3	3.7	23.3
SD[rRg]	-	4.6	4.0	0.8	3.1	21.3
MU[rRp]	-	9.3	10.3	-11.0	7.3	98.6
SD[rRp]	+	6.7	10.4	0.9	3.8	123.2
CORR[rRg,rRp]	?	0.3	0.4	-0.8	0.4	0.8
Capital adequacy requirement	+	9.5	1.5	8.0	10.0	15.0
Cash reserve ratio	?	9.4	7.0	2.0	7.5	47.5
NPL ratio (median, in percent)	+	7.7	8.5	0.0	5.4	78.0
Financial depth (M3/GDP, in percent)	-	72.1	59.2	11.0	45.9	230.5
Country stability (ICRG index; 0-100)	-	68.9	8.5	40.2	69.5	89.2

II : Correlation matrix of regressand (λ) and core CAPM regressors

a. with nominal returns

	MU[Rg]	MU[Rp]	SD[Rg]	SD[Rp]	CORR[Rg,Rp]	NPL ratio	λ
MU[Rg]	1.00						
MU[Rp]	0.52	1.00					
SD[Rg]	0.75	0.36	1.00				
SD[Rp]	0.38	0.84	0.31	1.00			
CORR[Rg,Rp]	-0.04	0.05	0.02	0.05	1.00		
NPL ratio	-0.05	0.08	-0.06	0.05	-0.03	1.00	
λ	0.03	0.12	-0.12	0.14	-0.22	0.15	1.00

b. with real returns

	MU[rRg]	MU[rRp]	SD[rRg]	SD[rRp]	CORR[rRg,rRp]	NPL ratio	λ
MU[rRg]	1.00						
MU[rRp]	0.26	1.00					
SD[rRg]	0.29	0.07	1.00				
SD[rRp]	0.14	0.75	0.28	1.00			
CORR[rRg,rRp]	-0.26	-0.11	-0.12	-0.13	1.00		
NPL ratio	0.02	0.13	-0.00	0.05	-0.03	1.00	
λ	0.15	0.21	-0.04	0.20	-0.20	0.14	1.00

Table 4 - Cross-section Regressions of λ (end-2005 portfolio share of government securities) on Key CAPM and Statutory Determinants for 594 banks

	a. using nominal returns							b. using real returns						
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)
<i>Regressors (in percent, except where otherwise indicated)</i>														
MU[Rg]; MU[rRg]	0.68** [0.33]	0.61** [0.26]	0.81*** [0.21]	0.83*** [0.27]	0.81*** [0.29]	0.83*** [0.24]	0.45 [0.35]	0.63 [0.39]	0.72** [0.30]	0.63 [0.42]	0.72** [0.36]	0.63 [0.54]	0.88** [0.43]	0.43 [0.46]
SD[Rg]; SD[rRg]	-0.57 [0.36]	-0.58* [0.31]	-0.69*** [0.27]	-0.70** [0.34]	-0.69** [0.34]	-0.70** [0.29]	-0.52 [0.47]	-0.71 [0.54]	-0.87** [0.38]	-0.7 [0.57]	-0.87** [0.43]	-0.7 [0.66]	-0.56 [0.53]	-0.59 [0.50]
MU[Rp]; MU[rRp]	-0.03 [0.20]		0.04 [0.14]		0.04 [0.17]		-0.02 [0.16]	0.06 [0.26]		0.06 [0.22]		0.06 [0.28]		0.01 [0.23]
NPL ratio	0.21 [0.14]	0.22 [0.14]	0.22 [0.14]	0.22** [0.11]	0.22 [0.14]	0.22* [0.13]	0.26* [0.15]	0.20* [0.11]	0.21* [0.11]	0.19* [0.11]	0.21** [0.10]	0.19 [0.13]	0.23* [0.12]	0.25 [0.16]
SD[Rp]; SD[rRp]	0.50*** [0.14]	0.49*** [0.17]	0.47*** [0.11]	0.50*** [0.16]	0.47*** [0.14]	0.50*** [0.13]	0.40** [0.18]	0.47** [0.19]	0.50*** [0.13]	0.47*** [0.17]	0.50*** [0.12]	0.47*** [0.18]	0.54*** [0.12]	0.42** [0.20]
COV[Rg;Rp]; COV[rRg;rRp]	-0.80** [0.37]	-0.81* [0.42]	-0.84*** [0.32]	-0.82** [0.40]	-0.84** [0.39]	-0.82** [0.35]	-0.93** [0.43]	-0.68 [0.61]		-0.68 [0.69]		-0.68 [0.54]		-0.43 [0.44]
Risk aversion <i>binary (1 = high; 0=low)</i>	1.42 [1.91]		0.45 [1.85]					0.14 [1.45]		0.14 [1.45]				
Cash reserve ratio statutory; in percent	-0.53** [0.25]	-0.55*** [0.20]	-0.58*** [0.19]	-0.58*** [0.19]	-0.58** [0.23]	-0.58*** [0.17]		-0.53** [0.24]	-0.48*** [0.16]	-0.53*** [0.17]	-0.48*** [0.15]	-0.53*** [0.20]	-0.42** [0.18]	
Capital adequacy requirement statutory; in percent	3.09*** [1.10]	3.15*** [1.02]	3.49*** [0.96]	3.46*** [1.00]	3.45*** [0.97]	3.46*** [1.04]		3.27*** [1.04]	2.98*** [0.82]	3.25*** [0.90]	2.98*** [0.77]	3.24*** [0.87]	3.72*** [0.93]	
Country stability <i>(ICRG index; 0-100)</i>	-0.2 [0.22]	-0.22 [0.21]						-0.5 [0.32]	-0.47** [0.19]	-0.50** [0.25]	-0.47** [0.20]	-0.50** [0.25]		
Financial depth <i>(M3/GDP ratio, in percent)</i>	0.02 [0.05]							0.00 [0.05]						
Constant	-3.52 [19.93]	0.1 [16.75]	-20.44** [8.95]	-19.71** [9.23]	-19.80** [9.09]	-19.71** [9.37]	12.32*** [2.59]	19.9 [23.89]	19.65 [16.94]	19.87 [22.83]	19.65 [16.59]	19.98 [20.74]	-22.66*** [8.03]	12.53*** [3.31]
Adjusted R-squared	0.26	0.26	0.25	0.25	0.25	0.25	0.12	0.26	0.27	0.26	0.27	0.26	0.23	0.09
Robust bootstrapped standard errors in brackets														
*** p<0.01, ** p<0.05, * p<0.10														

Notes:

1/ Results obtained using stata's reg command; standard errors were obtained by bootstrapping (due to non-normality of regressand) and were corrected for by-country clustering.

2/ All regressors were scaled to be interpreted in comparable percentage point terms. For the means and standard deviations, this was automatic since the underlying variables [Rp; Rg etc.] were defined in percents (i.e. multiplied by 100). For the covariance regressor, a sign-preserving square root was taken: Thus, the COV[Rp,Rg] regressor used above was obtained by multiplying CORR[Rp;Rg] by the square root of (SD[Rg]*SD[Rp]).

3/ The regressor "NPL ratio (median)" represents the median value of the NPL ratio over the 1995-2004 period for each bank. The regressor is used here to accommodate the possibility that (i) bank managers may look at NPL ratios as an indicator of the risk-adjusted profitability of Rp, rather than MU[Rp] or SD[Rp]; and (ii) that the author-computed Rp series (based on a number of simplifying assumptions) may not always correspond closely with any Rp series actually tracked by bank managers.

Table 5 - Selected Cross-section Regressions with DFBETA Outliers Removed*Regressand: λ = end-2005 portfolio share of government securities (in percent)*

	<i>with nominal returns</i>		<i>with real returns</i>	
MU[Rg]; MU[rRg]	0.71*** [0.15]	0.76*** [0.16]	0.40** [0.17]	0.34*** [0.13]
SD[Rg]; SD[rRg]	-0.59*** [0.14]	-0.63*** [0.14]	-0.75*** [0.22]	-0.84*** [0.18]
MU[Rp]; MU[rRp]	0.13 [0.12]	0.06 [0.10]	0.0 [0.12]	-0.01 [0.10]
NPL ratio (median, in percent)	0.11 [0.08]	0.17* [0.09]	0.09 [0.07]	0.08 [0.06]
SD[Rp]; SD[rRp]	0.22 [0.18]	0.33** [0.13]	0.45*** [0.11]	0.28* [0.16]
COV[Rp,Rg]; COV[rRp,rRg]	-0.70*** [0.24]	-0.72*** [0.24]	-0.48 [0.32]	
Cash reserve ratio statutory; in percent	-0.52*** [0.11]	-0.55*** [0.10]	-0.49*** [0.10]	-0.44*** [0.08]
Capital adequacy requirement statutory; in percent	2.10*** [0.43]	2.07*** [0.44]	1.86*** [0.48]	1.71*** [0.37]
Country stability (ICRG index; 0-100)			-0.62*** [0.10]	-0.62*** [0.08]
Observations	344	348	344	452
Adjusted R-squared	0.20	0.21	0.28	0.26
Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.10				

1/ An observation was deemed an outlier if the DFBETA value for any of the regressor coefficients was greater than $2/\sqrt{n}$, where n is the sample size.

Table 6 - Quantile Regressions of λ (end-2005 portfolio share of GS) for 594 Banks

USING NOMINAL RETURNS							
	q25		q50		q75		F-test: q25[x] - q75[x] = 0
	Coef.	Std. Err	Coef.	Std. Err	Coef.	Std. Err	F-value
MU[Rg]	0.10	0.165	0.27	0.308	1.37	0.413 ***	10.21 ***
SD[Rg]	-0.18	0.117	-0.37	0.252	-0.98	0.271 ***	8.47 ***
MU[Rp]	-0.03	0.128	-0.08	0.105	-0.15	0.140	0.5
NPL ratio	0.04	0.037	0.28	0.154 *	0.38	0.176 **	4.38 **
SD[Rp]	0.23	0.241	0.50	0.149 ***	0.75	0.361 **	1.97
COV[Rg,Rp]	-0.34	0.227	-0.74	0.236 ***	-1.29	0.514 **	4.33 **
Cash reserve ratio	-0.19	0.100 *	-0.44	0.113 ***	-0.77	0.147 ***	15.8 ***
Capital adeq. reqt.	0.88	0.479 *	3.15	0.842 ***	5.35	0.921 ***	18.17 ***
Country stability	-0.25	0.131 *	-0.38	0.150 **	-0.06	0.269	0.47
Constant	16.25	13.249	10.29	16.570	-29.80	24.353	
No. of banks	385		385		385		
Pseudo R ²	0.07		0.16		0.23		
USING REAL RETURNS							
	q25		q50		q75		F-test: q25[x] - q75[x] = 0
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	
MU[rRg]	0.21	0.098 **	0.46	0.169 ***	1.13	0.34 ***	7.35 ***
SD[rRg]	-0.31	0.121 **	-0.94	0.270 ***	-1.25	0.43 ***	3.88 **
MU[rRp]	0.03	0.065	0.12	0.210	0.04	0.28	0.00
NPL ratio	-0.01	0.047	0.07	0.219	0.38	0.29	2.07
SD[rRp]	0.12	0.154	0.46	0.192 **	0.54	0.35	0.97
COV[rRg,rRp]	-0.21	0.159	-0.60	0.323 *	-0.29	0.66	0.01
Cash reserve ratio	-0.22	0.052 ***	-0.48	0.123 ***	-0.76	0.11 ***	20.66 ***
Capital adeq. reqt.	0.91	0.282 ***	3.16	0.828 ***	4.34	0.83 ***	15.09 ***
Country stability	-0.27	0.089 ***	-0.61	0.151 ***	-0.73	0.18 ***	4.75 **
Constant	17.21	9.069 *	27.65	14.981 *	31.48	19.41	
No. of banks	398		398		398		
Pseudo R ²	0.07		0.14		0.24		

Notes:

1/ Results obtained using stata's sqreg command (i.e. systems quantile regression).

2/ All regressors were scaled to be interpreted in comparable percentage point terms. For the means and standard deviations, this was automatic since the underlying variables [Rp; Rg etc.] were defined in percents (i.e. multiplied by 100). For the covariance regressor, a sign-preserving square root was taken: Thus, the COV[Rp,Rg] regressor used above was obtained by multiplying CORR[Rp;Rg] by the square root of (SD[Rg]*SD[Rp]).

3/ The regressor "NPL ratio (median)" represents the median value of the NPL ratio over the 1995-2004 period for each bank. The regressor is used here to accommodate the possibility that (i) bank managers may look at NPL ratios as an indicator of the risk-adjusted profitability of Rp, rather than MU[Rp] or SD[Rp]; and (ii) that the author-computed Rp series (based on a number of simplifying assumptions) may not always correspond closely with any Rp series actually tracked by bank managers.

Table 7 - TOBIT Regressions of λ (end-2005 portfolio share of government securities) on Key CAPM and Statutory Determinants for 594 banks

	a. using nominal returns							b. using real returns						
<i>Regressors (in percent, except where otherwise indicated)</i>	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)
MU[Rg]; MU[rRg]	0.70** [0.34]	0.66** [0.26]	0.84*** [0.26]	0.88*** [0.25]	0.85*** [0.32]	0.88*** [0.31]	0.43 [0.42]	0.75 [0.50]	0.83** [0.41]	0.73* [0.41]	0.83** [0.36]	0.74 [0.45]	1.01** [0.39]	0.5 [0.60]
SD[Rg]; SD[rRg]	-0.60* [0.34]	-0.61** [0.25]	-0.72** [0.32]	-0.73** [0.36]	-0.71** [0.35]	-0.73** [0.34]	-0.54 [0.58]	-0.8 [0.66]	-0.92* [0.56]	-0.74 [0.54]	-0.92* [0.48]	-0.73 [0.62]	-0.64 [0.50]	-0.72 [0.57]
MU[Rp]; MU[rRp]	-0.01 [0.21]		0.06 [0.19]		0.07 [0.22]		-0.01 [0.24]	0.1 [0.27]		0.09 [0.26]		0.09 [0.26]		0.03 [0.28]
NPL ratio (median)	0.23 [0.14]	0.24* [0.14]	0.23 [0.15]	0.24 [0.16]	0.23 [0.18]	0.24* [0.14]	0.28* [0.15]	0.21* [0.12]	0.22* [0.11]	0.2 [0.12]	0.22** [0.11]	0.2 [0.13]	0.24** [0.12]	0.25 [0.16]
SD[Rp]; SD[rRp]	0.50*** [0.17]	0.50*** [0.15]	0.46*** [0.16]	0.51*** [0.14]	0.46*** [0.17]	0.51*** [0.16]	0.38* [0.23]	0.46** [0.22]	0.53*** [0.15]	0.47*** [0.16]	0.53*** [0.13]	0.47** [0.18]	0.57*** [0.14]	0.42* [0.24]
COV[Rg;Rp]; COV[rRg;rRp]	-0.90** [0.36]	-0.90** [0.41]	-0.95** [0.43]	-0.92** [0.44]	-0.94** [0.44]	-0.92** [0.46]	-1.03* [0.53]	-0.68 [0.65]		-0.67 [0.59]		-0.67 [0.65]		-0.41 [0.65]
Risk aversion <i>binary (1 = high; 0=low)</i>	2.16 [1.82]		1.26 [2.04]					0.5 [1.50]		0.52 [1.56]				
Cash reserve ratio statutory; in percent	-0.63** [0.25]	-0.65** [0.30]	-0.68*** [0.25]	-0.69** [0.27]	-0.69** [0.27]	-0.69*** [0.24]		-0.67*** [0.24]	-0.59** [0.25]	-0.65*** [0.23]	-0.59*** [0.22]	-0.66*** [0.22]	-0.56*** [0.20]	
Capital adequacy requirement statutory; in percent	3.50*** [0.99]	3.47*** [1.07]	3.86*** [1.16]	3.76*** [1.17]	3.73*** [1.19]	3.76*** [1.17]		3.67*** [1.01]	3.29*** [0.86]	3.57*** [0.87]	3.29*** [0.79]	3.52*** [0.94]	4.05*** [0.91]	
Country stability <i>(ICRG index, 0-100)</i>	-0.21 [0.31]	-0.22 [0.25]						-0.51* [0.27]	-0.48** [0.23]	-0.51* [0.28]	-0.48** [0.22]	-0.51* [0.29]		
Financial depth <i>(M3/GDP ratio, in percent)</i>	0.02 [0.06]							-0.01 [0.06]						
Constant	-7.79 [22.42]	-3.4 [19.52]	-24.77** [10.95]	-22.85** [10.86]	-23.02** [11.33]	-22.85** [10.63]	11.37*** [3.65]	17.14 [23.42]	16.79 [20.27]	17.03 [23.83]	16.79 [17.40]	17.48 [25.08]	-25.97*** [8.40]	11.41*** [4.28]
Adjusted R-squared	0.04	0.04	0.04	0.04	0.04	0.04	0.02	0.04	0.04	0.04	0.04	0.04	0.04	0.01
Robust bootstrapped standard errors in brackets														
*** p<0.01, ** p<0.05, * p<0.10														

Notes:

1/ Results obtained using stata's tobit command; standard errors were obtained by bootstrapping (due to non-normality of regressand) and were corrected for by-country clustering.

2/ All regressors were scaled to be interpreted in comparable percentage point terms. For the means and standard deviations, this was automatic since the underlying variables [Rp; Rg etc.] were defined in percents (i.e. multiplied by 100). For the covariance regressor, a sign-preserving square root was taken: Thus, the COV[Rp,Rg] regressor used above was obtained by multiplying CORR[Rp,Rg] by the square root of (SD[Rg]*SD[Rp]).

3/ The regressor "NPL ratio (median)" represents the median value of the NPL ratio over the 1995-2004 period for each bank. The regressor is used here to accommodate the possibility that (i) bank managers may look at NPL ratios as an indicator of the risk-adjusted profitability of Rp, rather than MU[Rp] or SD[Rp]; and (ii) that the author-computed Rp series (based on a number of simplifying assumptions) may not always correspond closely with any Rp series actually tracked by bank managers.

4/ Censoring-from-below was assumed for the regressand (λ) at 1 percent.

Table 8 - Cross-sectional Regressions of λ on λ^* (using nominal returns)
(λ^* bounded between 0 and 100)

<i>a. Simple OLS</i>			
	(i)	(ii)	(iii)
λ^*	0.14***	0.12***	0.33***
(CAPM-implied share of x_g)	[0.04]	[0.04]	[0.04]
Cash reserve ratio	-0.25	-0.36	
(statutory, in percent)	[0.30]	[0.23]	
Capital adequacy reqt.	3.03**	1.90***	
(statutory, in percent)	[1.37]	[0.46]	
Risk aversion	0.01		
(binary dummy, 1 is high)	[2.38]		
Country stability	0.03		
(ICRG index; 0-100)	[0.08]		
Financial depth	0.03		
(M3/GDP ratio, in percent)	[0.08]		
Observations	269	279	309
R-squared	0.60	0.58	0.46

Robust bootstrapped standard errors in parenthesis; ** $p < 0.01$, * $p < 0.05$, $p < 0.10$

<i>b. Quantile</i>			
	Coefficient	Standard Error	F-value
<i>q25</i>			$q(25)-q(75)=0$
λ^*	0.05	[0.022]**	[7.04]***
Cash reserve ratio	-0.11	[0.044]**	[2.68]
Capital adequacy reqt.	1.35	[0.536]**	[4.18]**
Pseudo R-squared	0.04		
<i>q50</i>			
λ^*	0.13	[0.049]**	
Cash reserve ratio	-0.31	[0.105]***	
Capital adequacy reqt.	4.01	[1.471]***	
Pseudo R-squared	0.09		
<i>q75</i>			
λ^*	0.22	[0.079]***	
Cash reserve ratio	-0.54	[0.269]**	
Capital adequacy reqt.	5.02	[1.815]***	
Pseudo R-squared	0.13		
No. of observations	279		

Standard errors in brackets; *** $p < 0.01$, ** $p < 0.05$, $p < 0.10$

Notes:

1/ $\lambda = 100 \cdot [x_g / (x_g + x_p)]$ for end-2005.]

2/ $\lambda^* = 100 / [1 + \{MU[R_p] \cdot VAR[R_g] - MU[R_g] \cdot COV[R_p; R_g]\} / \{MU[R_g] \cdot VAR[R_p] - MU[R_p] \cdot COV[R_p; R_g]\}]$

where the MUs, VARs and COVs have been computed over 1995-2004.

3/ The coefficient of 0.128 on λ^* in regression a(i) can be interpreted as follows:

A 1 percentage point increase in λ^* is associated with a 0.128 percentage point increase in λ .

4/ Standard errors are corrected for by-country clustering in data in the OLS regressions but not the quantile regressions.

5/ Constant was included but is not reported.

6/ Quantile regressions were run using stata's sqreg command.

Table 9 - By-Country Cross-Section Regressions of Actual Portfolio Share of Government Securities (λ) on CAPM-Implied Share (λ^*)

Country	Coefficient on λ^*	t-value	No. of banks	R-squared
Argentina	0.50	[4.52]**	31	0.41
Nigeria	0.35	[9.45]**	30	0.75
Lebanon	0.84	[8.44]**	27	0.73
Egypt	0.25	[6.13]**	26	0.60
Poland	0.51	[4.32]**	14	0.59
Malaysia	0.27	[3.90]**	13	0.56
Russia	0.35	[1.55]	10	0.23
Mexico	0.27	[2.57]*	10	0.45
Median	0.35			

* significant at 5%; ** significant at 1%.

Notes:

1/ $\lambda^* = 100 / [1 + \{MU[R_p] \cdot VAR[R_g] - MU[R_g] \cdot COV[R_p; R_g]\} / \{MU[R_g] \cdot VAR[R_p] - MU[R_p] \cdot COV[R_p; R_g]\}]$

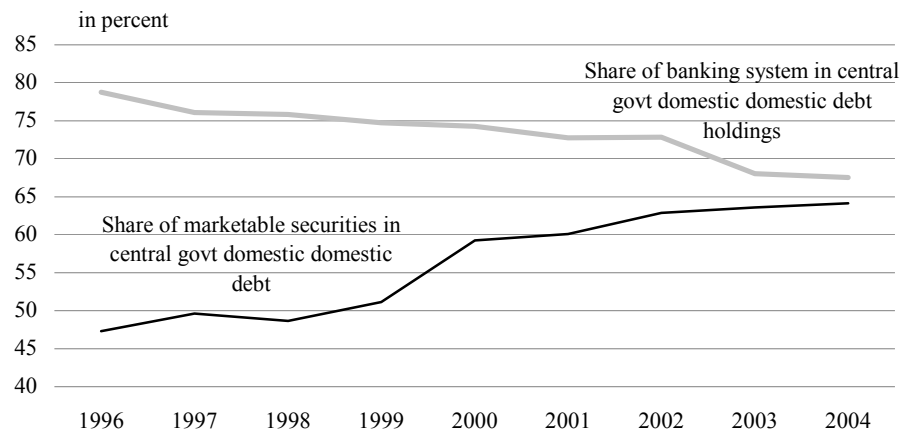
where the MUs, VARs and COVs have been computed over 1995-2004.

2/ $\lambda = 100 \cdot [x_g / (x_g + x_p)]$ for end-2005.

3/ To ensure adequate degrees of freedom, regressions were run only for those countries which had more than 10 banks reporting at least 8 years of data on all underlying variables needed to compute λ^* .

4/ Banks with λ^* outside the [0-100] percent range were excluded from the regression. The number of banks shown in the column above represents the banks remaining after this exclusion.

5/ A coefficient of 0.5 on λ^* for Argentina means that a 1 percentage point increase in the CAPM-implied optimal portfolio share of x_g raises the actual share by 0.5 percentage points.

Figure 1: Domestic debt market development in IMF program countries

Source: Mellor and Guscina (2007) database; 66 countries included.

Figure 2 - Value of Fitted Regressor Coefficients Across Regressand Quantiles