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The Tectonics of Debt, Expectations, and Fiscal Policy
A Dissertation on Fiscal Credibility

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Chapter 1

General Introduction: Towards a Concept of Fiscal Credibility

"Not that you lied to me but that I no longer believe you has shaken me."

— Friedrich Nietzsche (1886) *Beyond Good and Evil*

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1.1 Confidence and subjectivity in fiscal policy

Once considered a less potent tool than monetary policy, fiscal policy has resurged with the 2008–09 Global Financial Crisis (GFC). This was then motivated by the exhaustion of conventional monetary policy instruments (*i.e.*, central bankers' hitting the effective lower bound of interest rate) and the need for asymmetric policy responses in monetary unions. The European debt crisis curtailed this revived glory of fiscal policy, and highlighted how, like monetary policy, fiscal policy too had limits. Nonetheless, after almost of decade of heated talks about—and mostly failed attempts of—consolidation, the fiscal bazookas had to be drawn again to lead the fight against CoViD-19 and its economic consequences. Fiscal policy remains a key item in the macroeconomic stabilization policy toolkit.

Fiscal policy has far-reaching economic implications, at home and abroad, which makes it a double-edged sword. The accumulation of public debt does not come without risks: Sutherland and Hoeller (2012) argue that, while accumulating debt can help level out business cycles, high debt levels create weaknesses in corporate, household, and government balance sheets, leaving less space to absorb shocks, thus amplifying macroeconomic fluctuations. High debt can also generate indeterminacy and expectation-driven volatility.[1] On the other hand, debt is associated with better performance when it finances good-quality public spending (Nishimura et al., 2015). Public investment and automatic stabilizers can pay for themselves, especially in a low interest rate environment (DeLong et al., 2012; Mourougane et al., 2016; Blanchard and Summers, 2020).

Wielded in the right hands, fiscal policy is a high-precision tool to achieve the famous triad of objectives Musgrave (1959) posits for policymakers—stabilization, redistribution, and allocation. But governments are often driven by political and electoral incentives that economic rationale, which makes them an unreliable custodian of the fiscal power and exposes countries to fiscal backfire. For the lack of reliability of governments not only undercuts the efficiency of fiscal policy: it generates instability and uncertainty and fuel liquidity and sustainability risks. As I will explore in chapter 2, there have been plenty of episodes in economic history when the fallacies of fiscal and debt management policies led to economic turmoil.

The limits of fiscal policy (and its financing manifestation: sovereign debt) are twofold. First, public debt bonds are not as legally enforceable as private contracts—especially since gun-boat diplomacy fell out of fashion (Mitchener and Weidenmier, 2010). However, there are costs associated with sovereign defaults (as documented for instance in Borensztein and Panizza, 2009; Trebesch and Zabel, 2017). This has fueled a considerable literature on optimal

[1] This is for instance the case when debt is fixed as a policy parameter or by a fiscal rule (Nishimura et al., 2015; Cheron et al., 2019).

and strategic defaults, which usually models the government's rational arbitrage between rolling debt over virtuously and bearing costs associated with defaults (Collard et al., 2015; Stähler, 2013; Wright, 2011).[2] Second, the government might run into liquidity or solvency issues. Blanchard and Weil (2001) told how governments could run Ponzi games—the metonymy with the 19th century Italian con artist is telling about how governments could trick and swindle their flocks. The literature explored at length the existence of debt (starting with the infamous Reinhart and Rogoff, 2010, and later Collard et al., 2013; Fournier and Fall, 2017) and fiscal limits (Bi, 2012), above which the government is likely to run into troubles.

These apparently objective considerations fail to explain how countries with similar fundamentals in terms of debt level or macroeconomic conditions are unequally prone to fiscal stress. For instance, Japan has had a much higher debt-to-GDP ratio than Italy, for roughly similar prospects in terms of potential growth, neutral interest rate, and inflation. Why, then, do markets seem to be sanguine about the former and sanction the latter for any bad surprise? Italy faces much larger and more volatile interest rate and CDS spreads than Japan. A similar apparent injustice separates emerging from advanced economies: while the former, on average, have better growth prospects, lower public debt, and more space to ramp up tax revenue, they face in general more adverse financing conditions than advanced economies. Beyond the mechanics of the debt accumulation identity and the associated transversality condition (summarized in Escolano, 2010), the way market operators effectively assess sovereign creditworthiness seems rather heuristic. Likewise, sovereign liquidity (*i.e.*, the ability for the sovereign to roll over its debts) depends on market confidence and risk perceptions.

From the practitioner's viewpoint, fiscal sustainability is a matter of judgement. As OECD chief economist Laurence Boone said: "*Your debt is sustainable when people have trust in your institutions and that policymakers will deliver on what they have promised.*" Since sustainability is a forward-looking notion, any sustainability assessment, which pertains to whether the government is able and willing to *credibly* pursue the policies necessary to ensure long-term solvency, inevitably contains a subjective element.[3] The solvency condition is "*very much like honesty: it can never be fully certified, and proofs are slow to materialize*" (Calvo, 1996). Servicing the debt is a strategic, political choice (Debrun et al., 2019), with cases of governments that defaulted without being insolvent (D'Erasmo et al., 2016). Therefore, sustainability depends on policymakers' preference for a certain debt level (Romer and Romer, 2019), and more importantly on market beliefs about that preference and the cost-benefit analysis underlying the government's commitment to meet its obligations.

[2] See also Aguiar and Amador (2013) for a review of the pre-GFC literature.

[3] This explains why institutions in charge of international surveillance, such as the IMF or the European Union, as much as credit rating agencies, struggle to define a one-size-fits-all approach.

In sum, the sustainability and feasibility of fiscal policy depend in part on whether the government can be trusted to be reasonable. However, a common theme, almost a commonplace, runs through the recent economic literature: against the backdrop of the reliability of monetary science, fiscal "*alchemy*" pales into insignificance (to use Leeper's, 2009, metaphor). This is because fiscal policymakers are not seen as credible as monetary authorities, at least in advanced economies where central banks enjoy long-established reputation, operations, and communication channels.

This dissertation is an attempt to define more precisely this subjective element, which seems determinant to the success or failure of fiscal policy: the *credibility* of the government and its policy actions. As in monetary policy literature, the concept of credibility is rooted in the idea that policymakers commit to certain policies with a view to achieving certain objectives. When economic agents (voters, financial markets) expect that this commitment will be fulfilled, the policies and policymakers are deemed credible. On the contrary, if economic agents believe that policymakers will deviate because of some bad incentives or because of the costs involved, policies are less credible. Whether the promise is ultimately carried out depends also on the state of the economy: deviations from *ex ante* policy commitments may be required to respond to unforeseen, exogenous shocks and should not undermine credibility (quite the contrary; Drazen and Masson, 1994).

Definition 1 (Credibility)**.** Policymakers are credible when agents expect them to fulfill their commitment towards given objectives, as much as possible.

Credibility is thus the *ability*, as much as the *desire* to reach targets.[4] It covers two main aspects. The first is the *credibility of a commitment* and boils down to the public's confidence in policymakers' ability and determination to keep their promises (Backus and Driffill, 1985a).[5] This aspect relates to the fact that optimal policies can be dynamically inconsistent—leaders may have incentives to deviate (Persson and Tabellini, 1999)—or can conflict with other policy objectives. And the costs of deviating might be large as this is a repeated game in which agents can observe the government's behavior to decide whether to trust it. This brings me to the second aspect of credibility: *reputation*. Beliefs about policymakers' preferences are central to how observers anticipate their behaviors (Backus and Driffill, 1985b; Kreps and Wilson, 1982). As

[4]Some papers refer to "*budget credibility*" as a synonym for budget reliability and focus on the ability to reach targets, thereby overlooking the subjective component of credibility (Simson and Welham, 2014; Sarr, 2015).

[5]There are various reasons why a government may fail to convince: either the policy is reputed ill-advised or unsustainable, or the policy is good but there are incentives for the government to deviate. Yet, a credible policy may not be sufficient to confer credibility to those policymakers who committed to it (for instance, if the commitment is too easy to achieve); thus, there is a difference between credible policies and credible policymakers.

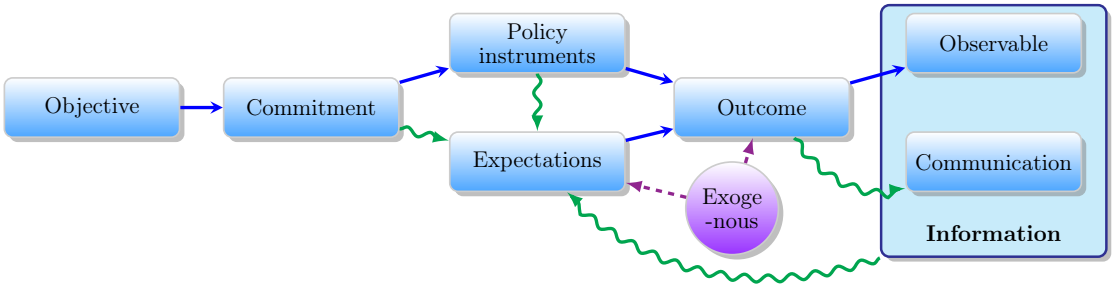
less virtuous authorities might gain from temporarily mimicking virtue, for instance to generate inflation surprises, private agents have to infer the hidden *type* of their authorities from observed actions and track record. Conversely, excessively adamantine policymakers can be less credible than those who flexibly accommodate shocks before returning to initial targets, especially when intransigence fuels the risk of eventually missing objectives (Drazen and Masson, 1994).

1.2 A parallel to monetary policy

The seminal literature on the role of anticipations in monetary policymaking helps setting the stage for fiscal credibility. Schematically, monetary authorities focus on stemming inflation, which gives rise to a time consistency issue, as, outside the restrictive conditions permitting the occurrence of the *divine coincidence*, there may be a tradeoff between inflation and output stabilization, as well as financial stability and public and external debt sustainability. Therefore, agents are left to guess whether and for how long their authorities will be hawkish.

As Cukierman (1986) explains, credibility matters as soon as expectations influence economic outcomes, which is typically the case with monetary policy: future inflation depends on inflation expectations today, which in turns depend on how credible the commitment to the inflation objective is. Plus, once established, credibility allows policymakers to respond less strictly to exogenous shocks without baffling expectations. In fact, the "*credibility hypothesis*" states that the output cost of disinflation is smaller if the policy is credible (Fellner, 1976). In other words, credibility is important because it affects the effectiveness of the pursued policy. The importance of credibility increases when economic agents' access to and analysis of information is partial, asymmetric, distorted, or not fully rational.

Figure 1.1. *Conceptual framework*



Note: While straight edges map regular economic relations, the squiggly arrows represent links, such as the formation of expectations or communication decisions, where there is some level of subjectivity and partiality.

The concept of credibility has become mainstream in the context of monetary policy, enshrined in a clear conceptual framework (summarized on Figure 1.1). Why not for fiscal policy?

Fiscal policy is more entangled than monetary policy (Table 1.1). First, the objectives and decision-makers of fiscal policy are not as centralized nor as well defined. For monetary policy, a single decision-maker, the central bank, is entrusted with a small number of objectives—mainly price or money inflation, the output gap, the exchange rate, and financial stability—and relies on a handful of instruments—the interest rate, its foreign exchange (FX) reserves, and/or reserve requirements.[6] The definition of an optimal monetary policy is therefore relatively straightforward, and can for instance be summarized in a formula as simple as a Taylor rule. On the contrary, the objectives of fiscal policy are manifold (Musgrave, 1959); as the financial arms of other public policies, budget and tax policies also aim at growth and productivity, management of externalities and geographical disparities, education, health, urban and cultural development, *etc*. Social preferences and history determines the size of government, the level of public services, and the overall tax rate. But the levels of debt and deficit are rarely primary objectives——they rather emerge from the government's financing constraints (liquidity or intertemporal budget constraint). Besides, the fiscal decision is shared between multiple players: different levels of government, agencies, state-owned enterprises, and other off-budget entities, with a typical common pool issue: fiscal policy is somehow similar to monetary policy in the pre-Hamilton U.S., when each state could mint its own money. Therefore, the accountability of each decision-maker is limited.

Second, it is more difficult to judge the adequacy of fiscal policy. Adding to the absence of a clear norm, fiscal information is also murky. For monetary policy, inflation outcomes are available in a timely manner, and usually provided by an independent statistical agency. In other words, information on monetary policy performance is clear, reliable, and readily available. By contrast, fiscal outcomes are less clearly communicated, and consequently less understood by economic agents, which is problematic, as fiscal is found to be the main source of policy uncertainty (Baker et al., 2016). Communication about the objectives and outcomes of fiscal policy is lagged, unstructured, scattered across various media and sources, and potentially manipulated. For example, the annual fiscal balance, which is arguably the most commented metrics, is known at best four months after the end of the year (and this is just a first estimate). Depending on national definitions, the "*overall*" fiscal balance might not cover the entire extent of the general government's borrowing and it reflects a large array of non-policy factors (*e.g*., cyclical developments and shocks). Besides, because they also are policy objectives, these metrics are bad indicators of policy outcome, as per Goodhart's (1984) law—they can be reached at the expense of something else and manipulated easily (by changing definitions, *e.g*.).

Third, fiscal policy is intrinsically tarnished by electoral motives, while monetary policy is more independent from politics. Most countries have entrusted monetary policy to non-elected

[6] In fact, the central bank can also play on collateral rules and asset-liability management operations, but these are not found to have but a marginal impact.

Table 1.1. *Monetary* vs. *fiscal policy—A summary comparison*

	Monetary	Fiscal
Decision	Single entity: central bank	Fragmented across actors and legal instruments: ▪ Budget law ▪ Local government budgets ▪ Off-budget items, contingent liabilities ▪ Public agencies and corporations ▪ External events
Objectives	Restricted, explicit list: ▪ Low inflation ▪ Stabilization	Numerous : ▪ Fiscal sustainability ▪ Delivery of public services with reasonable tax burden ▪ Stabilization ▪ Redistribution
Commitment	Clearly formalized (inflation target)	Possibly: ▪ No default ▪ Medium-term fiscal path ▪ Finance other policies
Instruments	A handful: interest/exchange rate, money	Multidimensional: tax rates, budget appropriations, financing mix
Information	Visible, timely ▪ Inflation ▪ Transparent communication	Murky, fragmented ▪ Infra-annual budget execution data ▪ Delayed public accounts ▪ Political communication ▪ Watchdogs' reports
Deviations	▪ Time inconsistency ▪ Fiscal dominance	▪ Cyclical and exogenous shocks ▪ Electoral incentives, deficit bias

officials, with a long mandate, an autonomous budget, and specific legal and regulatory powers, keeping it at arm's length of the political sphere. Tax and budget decisions, on the other hand, result from political bargains, trade-offs, and policymakers' desire to be reelected.

These differences between monetary and fiscal policy—independence of decision, autonomous agency with a restricted list of goals and tools—arose historically when economists and the various stakeholders realized that stabilizing monetary conditions credibly was crucial (Persson and Tabellini, 1999). They set out on transferring monetary policy responsibilities from the political to the bureaucratic sphere to avoid that political influence might undercut credibility and effectiveness (Alesina and Tabellini, 2008).

Since such a deep transformation has not yet been feasible for fiscal policy—which, at the end of the day, finances all other public policies—, the literature on fiscal institutions has blossomed since the GFC. For multiple political economy reasons, governments tend to accumulate

excessive debt. This *debt bias* finds several, overlapping explanations (Calmfors, 2011): politicians' acting in their own interests, shortsightedness (from voters and policymakers alike), time inconsistency in a limited-commitment environment (Aguiar and Amador, 2013), and common-pool problems. Against this backdrop, the literature, international institutions, and capacity development providers have looked for institutional fixes that could enhance fiscal discipline. They have particularly focused on (a) injecting a dose of independence with fiscal councils (Rogoff and Bertelsmann, 2010; Debrun, 2011); (b) reinforcing commitments with fiscal rules (Debrun et al., 2008; Wyplosz, 2012); and (c) improving communication with medium-term fiscal, budget, revenue, and debt frameworks (Harris et al., 2013). Fiscal institutions at large were found to impact fiscal outcomes (Rose, 2010; Yaker and Lienert, 2018).

All this literature and the mutations it has triggered in practice hinge implicitly on the premise that governments need restore or improve their fiscal credibility. Fiscal councils have burgeoned in many advanced economies and medium-term budgeting and fiscal rules have blossomed across the globe. Remarkably, these institutions somewhat circumvent the distinction between credible and non-credible governments and impose uniformly the same constraints to everyone. Similarly, the successive reforms of the fiscal surveillance exerted within the European Monetary Union (EMU) tried (rather unsuccessfully) to tighten nuts and bolts by imposing increasingly complex rules on all member states. By contrast, conditionalities under IMF programs, meant to induce virtuous policies and ensure the beneficiary country's capacity to repay, patch up damaged credibility on a more *ad hoc* basis.

1.3 A fiscal credibility hypothesis

This dissertation sets off with two premises. First, the premise that the concept of monetary credibility can be transposed to the fiscal realm: economic agents observe fiscal actions and announcements, form expectations about future decisions, and do not trust governments equally. For one, the government is supposed to be disciplined by its financiers, with sovereign yields that increase when fiscal deficits and the public debt ratio grow. Ratings agencies and markets started to scrutinize sovereign risks more carefully after the GFC and the subsequent debt crisis. A substantial literature attempted to understand better the determinants of sovereign yields or spreads, ratings, and credit default swaps (CDS); there remains a substantial unexplained residual (even after controlling for a plethora of structural, cyclical, and macro-financial factors Poghosyan, 2014; Hilscher and Nosbusch, 2010; End et al., 2016; Born et al., 2020) and the conundrum that some high-fiscal-imbalance governments still face favorable financing conditions. Government credibility—its ability to persuade markets of its creditworthiness—probably shapes some of this residual.

My second postulate is that the credibility of policymaking and policymakers—their ability to anchor expectations *credibly*—matters for the effectiveness and efficiency of fiscal policy. As section 1.1 underlined, perceptions and expectations unavoidably shape sustainability assessments. Even for defaults, costs are empirically found to be lesser when the government can promptly and *credibly* restructure its liabilities. So credibility contributes to push fiscal limits and expand fiscal space. But it may also make economic policy more effective.

Such a credibility hypothesis is implicitly present in some of the fiscal policy literature. The efficiency of fiscal policy in terms of macroeconomic stabilization, especially, depends on expectations. The two-way linkages between fiscal and growth are influenced by expectations and confidence effects. Thus, the debate on the size and sign of fiscal multipliers relates to the impact of fiscal policy—and, more importantly, that of expectations about future decisions—on precautionary savings (see Ramey, 2016, for a literature review). In particular, those, following Giavazzi and Pagano (1990); Barry and Devereux (1995), who find that fiscal contractions can in some cases be expansionary (*e.g.* Guajardo et al., 2014), argue that consolidation today reduces fears of consolidation tomorrow. Differences in credibility may potentially explain some of the large dispersion of empirical estimates of the fiscal multipliers.[7] Furthermore, uncertainty about fiscal policy has direct consequences on economic decisions: Baker et al. (2016) for instance finds that shocks in policy uncertainty foreshadow declines in investment, output, and employment.

The central bank can also operate more easily when the sovereign is credible. In fact, monetary and fiscal credibility could be complementary, because the two share the objective of macroeconomic stabilization. If the government keeps its promises, it is easier for the central bank to carry out its mandate—and conversely. Loose fiscal policy undermines the credibility of monetary policy (Blinder, 2000); and using central bank's resources to relax the government's budget constraint potentially leads to fiscal dominance, even in the presence of fiscal rules (Jeanne and Wang, 2013; Blommestein and Turner, 2012; Kumhof et al., 2010).[8]. Similarly, a credible central bank is conducive to greater fiscal discipline, as (a) it puts more pressure on the government (no monetization); and (b) the decline in inflation expectations lowers interest payments and fiscal deficits (Blinder, 2000). If monetary policy is not credible, inflation expectations increase, raising the long-term interest rates and the debt burden, possibly undermining fiscal credibility.[9]

[7] Along with the host of macroeconomic, fiscal, financial, and country-specific control variables the literature has already accounted for (Ilzetzki et al., 2013; Corsetti et al., 2012; Alesina et al., 2015).

[8] Seminal contributions include the dichotomy between dominant fiscal or monetary regimes in Sargent and Wallace (1981), polar Ricardian and non-Ricardian regimes in Aiyagari and Gertler (1985), and Leeper (1991)'s characterization of active and passive fiscal and monetary policies.

[9] Monetary and policy credibility could also be substitutes, when objectives of fiscal and monetary policy conflict each other, in which case one has to give (Blackburn and Christensen, 1989). For example,

The question has been particularly acute within monetary unions, where the need to coordinate budgets goes beyond fiscal spillovers. Within monetary unions, countries can compensate a lack of fiscal credibility by a strong central bank (End et al., 2016). Implicitly, countries are importing credibility from other member states, which raises a number of coordination and free-rider problems.

In turn, since macroeconomic performance affects fiscal policy outcomes, credibility feeds back into fiscal efficiency through its impact on the economy. Better and more stable growth means a higher chance for the sovereign to be deemed sustainable. Thus, credibility could complement the literature on state-dependent effects of fiscal policy (Auerbach and Gorodnichenko, 2013; Caggiano et al., 2015). Ricco et al. (2016) find for instance that a high level of disagreement among private forecasters is conducive of lesser impact of public spending shocks on output. Another feedback loop can be found in the literature on macro-financial linkages: deep and sound financial markets provide stable financing to the government and less contingent liabilities, while fiscal and banking stress can fuel each other (Amaglobeli et al., 2017). Thus, a sovereign credibility shock (such as that that hit Greece in 2010), can contribute to tank the banking sector, which in turn imperils the fiscal situation (at home and abroad, through cross-border financial linkages).

Last, as fiscal policy announcements can impact private agents' expectations and macro-fiscal outcomes, this leaves room for governments to play on this expectation channel. This is usually the explanation put forward by policymakers when asked about the optimistic bias of their budget forecasts.

1.4 Research approach

To the best of my knowledge, there is little research that has ever tried to define, conceptualize, or measure the underlying concept of fiscal credibility. Drawing intuition from the monetary policy literature, this dissertation aims at filling this gap and shedding some light potential ways to make fiscal policy less of an alchemy and more of a science. It digs into the concept of fiscal credibility along three main axes.

First, looking at historical experience, can credibility explain a diversity of outcomes in high-debt situations? If there is such a thing as fiscal credibility, countries should cope unevenly with difficult situations. Credible governments should be able to roll over higher levels of debt, even

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fiscal policy cannot be credible in its ability to support growth if monetary policy is very credible in its hawkish focus on inflation (Alesina and Tabellini, 1987).

in volatile environments, whereas less credible governments should be more finance-constrained and more prone to default.[10]

Chapter 2 examines how governments coped, in the aftermath of World War I (WWI), with war, reparation, and reconstruction debts, which stood beyond any modern sustainability metrics. In the face of such high debt levels, what policies can enhance, restore, or (at least momentarily) forge credibility? Few alternatives were available: the authorities could either (a) change fundamentals (*i.e.*, spending and taxing behaviors), or (b) reinforce their commitment to repay through mechanisms to make default more costly, or else (c) rely on tricks to siphon liquidity from domestic and foreign savers. I find that, while, in their announcements, interwar governments tried to improve their fiscal stance and put in place credibility-enhancing mechanisms, in reality they mostly cheated their way out until World War II (WWII).

The interwar period also sheds light on how credibility can spill over, not only from monetary to fiscal authorities, but also among countries. While fiscal spillovers is a well-understood topic (Auerbach and Gorodnichenko, 2013; Canova et al., 2013), Chapter 2 shows how fiscal credibility and debt (mis)management can also spread from one country to another. A large network of official lending built up from support among allies during WWI and reparation liabilities winners imposed on losers *via* the Versailles treaty. Within this debt web, a government's ability to repay its debts was contingent on other governments' behaviors. This provides a contrasting intuition with that of Cole and Kehoe (1998), where a government's incentive to repay relies instead on its reputation *vis-à-vis* other investors.

Second, as credibility seems to matter for outcomes, how to quantify it? A measure is useful to understand what country or government is seen as credible. It is helpful to understand how credibility evolves over time—builds up and fades away, depending on performance and other factors. In chapter 3, I develop such a measure, based on the idea that credibility is synonym of anchored expectations.

Expectation formation is the result of a complex process of data gathering, selecting (among the ample flow of data about budget and tax policy that I have described in section 1.2), and processing (among a large variety of forecasting models available). Economic agents thus observe governments' communication, decisions, actions, and results. The fiscal foresight literature has evidenced how tax and spending shocks impacted economic decisions (Leeper et al., 2012; Mertens and Ravn, 2012; Leeper et al., 2013), and in turns the fiscal multiplier, through for instance Ricardian and crowding-out effects (Forni and Gambetti, 2010; Ramey, 2011). Yet, public understanding of fiscal variables is limited (Bernasconi et al., 2009), so that some re-

[10] In a broad definition of default, which includes restructuring, partial default, financial repression, willful inflation, and opaque mechanisms for reducing debt through restrictive regulations and taxes (Reinhart and Rogoff, 2011a).

search, such as Leeper (2009), has investigated how to better anchor fiscal expectations. Amidst this complex information, announcements by a credible government should be able to simplify the expectation formation process and cover the white noise.

Potential factors that can affect the authorities' reputation are: the current and targeted fiscal stance, the past track record of meeting targets, and commitment-enforcing devices such as fiscal rules or fiscal watchdogs (as well as the broader macroeconomic and institutional setting). With my measure, I am able to verify which of these factors foster most trust between fiscal policymakers and private agents.

Should governments care about their credibility? From the fiscal policymakers' perspective, confidence in their policy targets is important for at least too reasons. First, they need to convince markets to lend them the money necessary to finance their current budget, as well as pay back old debts (rollover needs). Part of the government's financing costs reflect a risk premium that reflect markets' subjective views on the risk of default and the loss given default. So credibility matters simply as it can reduce interest rates and alleviate financing constraints. Second, governments may want to provide an environment in which private agents feel safe enough to consume and invest. With too much uncertainty, agents tend to build up precautionary savings and cash buffers, which undermines growth. Even selfish governments care about growth, for growth generates tax revenues that finance popular policies without the political cost of a tax rate hike. Lower-than-expected growth is empirically associated with derailed fiscal objectives (Mauro and Villafuerte, 2013), and some papers find that fiscal policy directly affects consumers' confidence (Bachmann and Sims, 2012). I investigate in chapter 3 whether credibility is indeed associated with more favorable outcomes.

How to model theoretically this virtuous circle between credibility and macro-fiscal outcomes? This is the third direction in which I explore fiscal credibility. While one of the normative roles of governments is macroeconomic stabilization, interactions between governments and agents and their distinct preferences and time horizons could undermine growth and destabilize the economy—at least in the absence of coordination mechanisms. In chapter 4, I develop a model where the government is an agent maximizing its own, separate utility. Under certain conditions, this model leads to multiple equilibrium, which are not equivalent for household's welfare. This means that agents do not necessarily know, *a priori*, towards which equilibrium the economy may converge, bringing in debt-related instability.

In a nutshell, this dissertation attempts to somewhat echo monetary well-oiled framework for fiscal, with a measure of credibility, convincing evidence that credibility matters for outputs, and a theoretical foundation where forward-looking behaviors lead to the emergence of multiple equilibria. While my main focus is on advanced economies, my findings can also ap-

ply to emerging and developing countries, especially those with access to international financial markets.

The remainder of this introductory chapter summarizes the approach and main results of each chapter in turn.

1.5 Debt Cathedrals during the Interwar Period

In chapter 2, I construct a new, comprehensive instrument-level database of sovereign debt that covers 18 advanced and emerging countries during the interwar period.[11] This database is the first to provide public debt time series with a high degree of comparability across countries and time, and the first to document the characteristics of each debt instrument. It thereby offers unique insights about the role of debt management policies in building and maintaining fiscal credibility (or palliating the lack thereof), during an eventful period characterized by notoriously high debt levels.

At the aggregate level, the dataset provides an accurate estimate of the financing costs and financing needs facing governments. Interwar governments were looking at a "*wall of money*" —the recurrent, ominous liquidity risk that markets could suddenly stop financing such high public debts. I find clear quantitative signs that governments faced persistent sustainability and liquidity issues during the period.

The instrument-level qualitative information sheds light on the debt management technologies and shenanigans that helped interwar governments compensate for their lack of credibility and successfully roll over unsustainable debts. They did this through the segmentation of their investor base, the adoption of credibility-enhancing devices, and the complacent support of monetary authorities. Central banks played a critical role, by putting their own credibility at stake (which explains why most countries failed to commit lastingly to the gold standard and generally fell into various degrees of fiscal dominance and financial repression). Some countries relied on international oversight—surveillance by expert committees, "*money doctors*" , and sometimes private bankers—to signal their creditworthiness. I find debt management was of paramount importance during the interwar period. It pursued different objectives: enhancing the credibility of sovereign bonds, managing short-term financing pressures, and financing ambitious spending defense and social programs. The financial engineering of sovereign bonds appear to have been key:

[11] This chapter draws largely from an IMF working paper I coauthored with M. Marinkov and F. Miryugin (End et al., 2019), and the two chapters that I wrote on France and Japan during the interwar period (End, 2019a,b).

- The wide variety of debt instruments issued during the interwar suggests that the design of debt instruments in terms of promised cash flows and embedded options mattered—especially so when the investor base was diverse and when governments failed to credibly go back towards debt sustainability.[12] To make bonds more appealing, governments played on propaganda and moral suasion, preferential tax treatments, and fancy add-ons, such as early redemption options, lotteries, and various bonuses that added to the coupon rate.

- Governments relied heavily on a variety of mechanisms to enhance their credibility, or the credibility of specific debt issuances. First, organizing regular restructuring of the debt portfolio when conditions were favorable was common practice. These conversions helped governments extend maturity and reduce liquidity risks, while rewarding loyal investors. Second, various state-contingent bonds were used. Indexations to a foreign currency or to gold were meant to address the risk of devaluation or inflation. Pledging tax revenues to the service of specific bonds, directly or through a sinking fund, imposed an implicit seniority structure among government liabilities but also linked repayment obligations to tax revenue performance. Third, amortization schedules (often randomized across investors) made it more credible that the government would repay, by contrast with bullet bonds.

- Less gloriously, interwar governments also used tricks to counterfeit credibility. At times, they falsified or obliterated part of their liabilities, deploying accounting tricks to move some liabilities off their balance sheets (using state-owned companies or banks, *e.g.*). If the Greek episode in 2010 proves that this can still be the case today, it was certainly easier during the interwar period, when statistical institutes and national accounts were still in their infancy. Thus, it is possible to *fake* credibility, at least temporarily.

Thanks to my instrument-level information, I was able to draw the international debt linkages that built up during WWI between allies, and further grew with the various war reparations and associated loans, reconstruction bonds, and refinancing arrangements in the aftermath of the war. Sovereign debt was contracted abroad in significant amounts. The accumulation of foreign debt by France, Germany, Italy, the U.K., and several smaller European and Commonwealth countries generated a vast international network, with significant implications for many private investors, governments, and central banks in the world. At the core of the network, the architects of the Versailles Treaty created unwittingly a circularity: the French had claims on Germany, which they intended to use to settle their debts towards the U.S. and the U.K.; however, Germany struggled to repay, which enticed the U.S. into pumping new loans into the system to

[12] With hindsight, this might look like a risky strategy in the long run, as standardization of bonds usually fosters deeper financial markets and easier restructuring in case of default.

keep it afloat. After several rounds of unsatisfying international negotiations, the whole network collapsed with the Great Depression, and countries henceforth wrote off their bilateral debts and switched to financial autarky. Thus, the public debt network was built on a certain level of credibility initially, but as credibility progressively eroded, the network remained, grew, and went awry. It is interesting to see how some countries tried to lend credibility to others, and how the credibility of some countries was dependent on that of their debtors.

Using network analysis, I examine in depth in chapter 2 the structure and evolution of the external public debt network. Looking at network metrics, such as centrality, closeness, and betweenness, I document how the structural weaknesses of this network contributed to the collapse of the international financial system in the early 1930s. Absent thorough statistical reporting and international surveillance, contemporaries probably failed to acknowledge how entangled the sovereign debt network had become. And they eventually failed to enforce sovereign debt commitments.[13] This highlights that debt credibility relies on transparency and coordination, absent proper enforcement mechanisms (especially at the international level).[14] This episode also highlights how vested interest in maintaining the *status quo* in the U.S., where private banks had much to lose, undermined the credibility of creditor countries.

1.6 Walking the Crusaders' Way Towards the Holy Grail: Measuring Credibility

Chapter 2 provides a narrative of the role played by credibility, especially in times of fiscal stress. More recent examples exist as well, such as the European debt crisis or the heterogeneity of response of emerging market spreads and capital inflows to tightening global liquidity (*e.g.*, during the 2013 "*Taper Tantrum*" episode). To study more quantitatively the evolution of fiscal credibility in modern times, it is desirable to quantify how credible a government is at a given time.

In chapter 3, I develop an explicit measure of fiscal credibility, building on the intuition that a credible government should succeed in anchoring expectations through the release of official forecasts. My main measure is the divergence between private expectations and official targets about the fiscal deficit. I compile complementary indicators, including to filter out disagreements about growth forecasts (which is one of the main source of disagreements between governments and markets). Using the documents governments prepare for the European surveillance stability and convergence programs (SCPs) and draft budgetary plans (DBPs) and the Consensus

[13] Even the French attempt to invade the industrial part of Germany to levy repayment in kind was a fiasco.

[14] Other than the costs of default alluded to in section 1.1.

Economics forecasts as main sources, I collect data for 27 European countries over the 1995–2019 period, totaling more than 4,250 observations. Going forward, this indicator can easily be computed in real time.

I find that, on average, governments fail to convince markets that they may reach their announced targets by a substantial margin (0.8–0.9 percent of GDP overall in the sample). Moreover, the indicator shows some persistence, confirming the intuition that credibility, alike a stock of trust, is a path-dependent variable, which adjusts slowly to shocks. A credible government is able to miss targets for good reasons without de-anchoring expectations, while it takes time for agents to consider seriously targets set by governments with a bad track record or a bad reputation. Credibility responds to new announcements, as well as budget and electoral cycles, revealing that these events are important in agents' treatment of available information and update of their beliefs.

Credibility heterogeneity across countries stem from multiple factors: the macroeconomic, institutional, and political environments, the direction and size of planned fiscal policy adjustments, and the track record of missed or frequently revised targets (a proxy for the policymaker's reputation). These determinants of fiscal credibility are confirmed through panel regressions. Among them, the most influential factors are the policy variables: credibility erodes when the government runs a higher public debt or a larger deficit, when there have been larger slippages in the past, and when the planned fiscal adjustment is more ambitious. Institutions, such as fiscal rules and fiscal councils that sets macroeconomic assumptions for the budget and monitors budget implementation, can contribute to improve credibility, as they impose constraints on the government's discretion. But too tightly defined constraints may be counterproductive: I find that softer rules are preferable.[15]

This innovative way to measure fiscal credibility thus provides interesting insights about how well governments influence markets' and agents' opinions about public finances. But does it matter whether agents believe the government? As explained above, my working assumption is that fiscal credibility yields better fiscal and macroeconomic outcomes. Once their credibility is established, fiscal policymakers can have more flexibility to respond to shocks and temporarily deviate from their objectives, improving the effectiveness of fiscal policy, in particular its macroeconomic stabilization function. Moreover, fiscal credibility affects expectations and thereby intertemporal allocations; uncertainty about future policy and concerns about sustainability can push upwards sovereign financing costs. Chapter 3 finds a strong confirmation that credibility affects market perception and prices of sovereign risk.

[15]By contrast, the history of the European Stability and growth pact (SGP) since its inception goes towards stricter, rule-based fiscal coordination among member States.

1.7 The Council of Clermont: A Theoretical Model of Fiscal Commitment

Building upon this axiomatic idea that agents observe their government's behaviors, form expectations about future fiscal policy, and adjust their own decisions accordingly, I try in chapter 4 to model theoretically this feedback loop between fiscal foresight and fiscal outcomes. To that end, I introduce in a model *à la* Barro (1990) a government maximizing its own, separate objectives.

While the government aims at financing growth-enhancing spending through income taxes and public debt, its preferences are unaligned with households', which can yield an allocation of resources that is Pareto sub-optimal, from the perspective of households' welfare. The main features of the model are as follows:

- The government is assumed to be less patient than households, accounting for the political economy issue of myopia and electoral incentives. While the government mostly derives utility from its own spending (with a positive impact on productivity), it also gets a positive externality from private consumption.[16]
- An endogenous interest rate spread between private capital and sovereign debt makes these two assets imperfect substitutes, in the absence of any other financial instrument and in a context where only households can invest in capital and arbitrage between the two assets. This spread exacerbates the tension in the economy between consumption, investment, and public expenditure allocations; it makes possible the emergence of multiple equilibria.

With these elements, the economy admits two stationary equilibria. Households can trade off consumption against investment; but these two decisions are not equivalent inter-temporally and impact the government differently. In parallel, the government can either spend or let households consume more. As public spending increases, growth is higher, but private consumption drops. By contrast to the classical crowding-out effect that transits through credit availability and cost, crowding out here occurs because of households expect governments to be more impatient and it becomes better for them, in terms of welfare, to smooth out consumption inter-temporally.

Even though, in the simple framework of the model, the local dynamic analysis of the two steady states highlights that no rational expectation path leads to the low-public spending one, the fact that the heterogeneity of preferences between private agents and government makes it more difficult for agents to understand the structure and steady state of the economy they operate in. This in turn gives rise to possible coordination issues between the policymaker and private

[16]Such a modeling can apply indifferently to virtuous and selfish governments, as both types have reasons to care for public spending and private consumption.

agents. Against this risk, the government would need to signal clearly its preferences—like the central banker who commits to a nominal anchor. Besides, the government's relative impatience is a key ingredient of this instability.

Chapter 4 therefore provides a theoretical backbone to fiscal credibility. Compared with most of the existing theoretical literature on fiscal policy—which focuses on the stabilizing role of fiscal policy—this models highlight how the presence and dynamic decisions of the government could destabilize the economy. Further, this model helps justify the use of credibility-enhancing tools embedded during the interwar period and and the current spread of fiscal accountability and medium-term budget frameworks—meant to enhance communication around fiscal policy and objectives.

Chapter 2

Debt Cathedrals: Public Debt Management and Networks during the Interwar Period

"Trust is like a mirror, you can fix it if it's broken, but you can still see the crack in [the] reflection."

— Lady Gaga (2010) *Telephone*

We construct a new, comprehensive instrument-level database of sovereign debt for 18 advanced and emerging countries during 1913–46, an eventful period characterized by notoriously high debt levels. This database is thus the first to provide public debt time series with such a high degree of comparability across countries and time. Documentation of qualitative instrument characteristics offers unique insights about the debt management policies that were implemented and the broader policies they helped finance. We document how interwar governments rolled over debts that were largely unsustainable and how the external public debt network contributed to the collapse of the international financial system in the early 1930s.[1]

Contents

[1]This chapter draws largely from a working paper coauthored with M. Marinkov and F. Miryugin in 2019 (End et al., 2019) and the two chapters on public debt policy and management in France and Japan during the interwar period that I wrote in Sargent et al. (2019).

2.1 Introduction—*Making bricks without clay*

Governments' liabilities are complex and involve different types of securities, domestic and external commitments, with varied characteristics (*e.g.*, denomination, maturity, coupon rates, and marketability). Even under benign economic conditions, public debt management requires a deep understanding of these elements to ensure that governments can borrow when they need to and that the sovereign is not overly exposed to risks. Debt management is more complicated during times of high and rising debt levels and when global interconnectedness is high. From this perspective, the interwar period, the focus of our chapter, lends itself as a natural case study for investigating debt management.

The interwar period was rich in macroeconomic events, including times of hyperinflation, deflation, depression, liquidity constraints, debt conversions, and debt defaults. It was a transition period between two international monetary systems and a laboratory for experiments in adjusting monetary and foreign exchange rate policies and regulating the global financial and trade architecture.

However, since this period was politically and economically turbulent, available data on sovereign debt are often sparse, aggregated, or hard to interpret. Even so, several researchers have compiled historical databases on public finance, enabling a review of past policies and comparisons with present day. These studies typically rely on country-specific sources to compile fiscal and debt aggregates.[2] Yet they do not account for the fact that in the past national statistics varied greatly in terms of definitions and that it was not uncommon for countries to manipulate definitions over time to serve political purposes or conceal problems.[3] This absence of generally-accepted statistical standards to ensure comparability of aggregates can obscure cross-country comparisons. The coverage of aggregate debt data also varies across time and countries.

This chapter describes a new historical database on public debt for 18 countries, which adds to existing databases in two ways. First, we provide instrument-level data on debt issued domestically and abroad for a relatively large group of countries. Second, we construct public debt aggregates using this instrument-level data. We believe that this database is not only rich

[2]We refer the reader to Abbas et al. (2011, pp.719–20) for a broad review of databases on public debt published up to 2010. Since then, there have been others, including Abbas et al. (2010), Reinhart and Rogoff (2011b), Reinhart et al. (2012), Abbas et al. (2014), Mauro et al. (2015), and Jordà et al. (2017). While these databases cover more countries and a longer timeframe than we do, they focus on debt-to-GDP ratios, with aggregate breakdowns (external *vs.* domestic and long *vs.* short-term). The World Wars and interwar period are generally covered with substantial gaps; and since historical GDP statistics are heuristic and of varying quality, we argue that debt ratios are not reliable.

[3]In the interwar period, we came across examples of countries falsifying central bank balance sheets, concealing debt service costs in other spending items, and modifying the length of fiscal years.

in detail, but allows for a greater degree of comparability of aggregates across countries. The debt security can be thought of as a common denominator of public finance across countries for this period, providing objective, contractual, cash-based information on public debt and fiscal policy. This is because a debt contract by its very nature corresponds to a series of predictable cash flows. By contrast, aggregate debt data is less reliable because its coverage varies across time and country. As for flow data, such as spending and revenue, it was generally presented in budgeted terms as opposed to the amounts actually spent or collected. Budgets were also often scattered across different accounts, as special accounts were common practice, making consolidation of the overall budget a difficult exercise, particularly a century later.

The resulting database (the interwar debt database, or IDD, henceforth) contains data on amounts outstanding for some 3,800 individual debt instruments as well as detailed instrument-level characteristics. The latter include the nature of the instrument, coupon rates (the nominal interest payment promised on issuance, excluding the various premia that were often granted upon issuance or redemption), maturity dates, currency denomination, and taxation regimes. From an international perspective, the database also sheds light on who owed what, and to whom (that is, to which country). To our knowledge, this is the first cross-country database that captures instrument-level information on debt obligations for a large sample of countries and for the entire gamut of debt instruments.[4]

The period is limited to 1913–1946, but we focus on 18 key economies that provide a reasonable geographic coverage and constitute majority of public debt issued in the interwar period.[5] The focus on sovereign bonds is appealing as bonds, and particularly sovereign and quasi-sovereign bonds, constituted a large share of financial instruments, both domestically and internationally (Eichengreen and Portes, 1989).[6] The qualitative information included in the database provides useful information about the nature of the public debt instruments and the purpose for which they were issued, thereby giving useful insights about policies that were pursued. The IDD complements existing databases by improving the breadth and depth of instrument coverage and addressing data gaps (especially the two World Wars). Section 2.2 describes the IDD, while the extensive appendices documents precisely the data compilation strategy.

[4]Hall and Sargent (2015) and Hall et al. (2018) compile instrument-level information on government debt for the U.S. over the period 1776–1960. Ellison and Scott (2020) construct a dataset for public debt over the period 1694–2017 for each individual bond issued in the U.K. Kaminsky (2017) and Meyer et al. (2019) compile cross-country instrument-level data, but only for external debt bonds that were traded on international markets.

[5]In 1935, for example, our sample covers some 88 percent of the total debt reported in the League of Nations publications

[6]Equity markets were much less developed and syndicated bank lending did not yet generalize; the gold standard period is thus often described as the era of bond finance—even firms primarily financed their investment projects through debt (Mitchener and Weidenmier, 2010).

During the interwar period, sovereign debt in most countries was sizable and comprised a large number of instruments. The level of detail contained in the IDD provides new insights on debt management in the interwar period—for example, what types of instruments were most widely issued, what was the maturity structure of debt, in what currency public debt was denominated, and what kind of incentives were offered to bondholders. Studying debt instruments offers new insights on debt management policies, while the literature usually considers debt management either irrelevant or a question of maturity and currency.[7] As summarized by Sargent (1993), this irrelevance no longer holds when taxes are accounted for (Missale, 1997) and when the government operates under imperfect commitment, so that the risk premium increases with debt maturity. Debt also implicitly constrains the set of tax policy choices available to future governments. In other words, debt management matters when the government's credibility—about future taxes or future inflation—is in question or when taxes are distortionary. This was clearly the case for many countries in the interwar period.

Moreover, debt management matters for political economy reasons. First, it implicitly constrains the set of tax policy choices available to future governments Lucas and Stokey (1983). Second, debt management underpins liquidity and interest rate risks (through the structure of future payments that the government contractually commits to)—as opposed to sustainability risk (the ability to eventually repay the stock). In other words, debt management is important to level off promised repayment cash flows, while fiscal policy cares about the level and dynamics of public debt. Third, investors seem to care about bond design—this was well-acknowledged by interwar governments. Andritzky (2012) shows that the composition of bondholders influences bond pricing. Fourth, the choice between foreign and domestic bonds entailed tapping very different sorts of markets. Foreign capital markets were relatively sophisticated and careful (see End (2019a) and Metzler (2006) for an account of the Morgan's intrusion into Japan's domestic policies), whereas domestic investors were generally captive, not as well-informed (Bassetto and Galli, 2019), and vulnerable to inflation or financial repression.

We show how interwar governments rolled over debts that were largely unsustainable (subsection 2.3). We find clear signs that governments faced persistent sustainability and liquidity issues during the period and could roll over their debt and their ambitious spending plans only through the segmentation of their investor base, the adoption of credibility-enhancing devices, and the complacent support of their central banks. The wide variety of debt instruments issued during the interwar suggests that the design of debt instruments in terms of promised cash flows and embedded options matters—especially so when the investor base is segmented and when

[7]This is a consequence of term structure formulas *à la* Hicks (1939). The irrelevance of debt management also arises from Barro's (1974) Ricardian equivalence proposition, which postulates that it is irrelevant whether the government decides to finance itself using debt or taxes, or whether the government borrows using short-term or long-term debt. Theories of optimal debt management hinge on failures of one or more of the assumptions underpinning this proposition.

governments fail to credibly secure towards debt sustainability. Debt management in the interwar period entailed pursuing different objectives: enhancing the credibility of sovereign bonds, managing short-term financing pressures, and financing ambitious spending defense and social programs. Central banks also played a significantly supportive role, which highlights fiscal dominance.[8]

Using graph (network) analysis, we then examine the structure and evolution of the external public debt network, initially generated by World War I (WWI) and reparation loans (subsection 2.3). Sovereign debt was issued abroad in significant amounts. The accumulation of foreign sovereign debt by France, Germany, Italy, the U.K., and several smaller European and Commonwealth countries generated a vast international network, with significant implications for many private investors, governments, and central banks in the world. We document how the structural weaknesses of this network contributed to the collapse of the international financial system in the early 1930s. Absent thorough statistical reporting, contemporaries probably failed to acknowledge how entangled the sovereign debt network had become. Such a systematic analysis of the public debt network could not be undertaken without instrument-level information. In our view, this is another contribution of this chapter to the literature, which bridges the gap between two separate streams of research: the one about the international financial system around the Great Depression and that about war debt sustainability. We draw heavily from the narrative developed in Sargent et al. (2019).

2.2 The Interwar Debt Database—*Elements of Art*

Methodology

This subsection outlines our broad methodological approach to compiling the IDD (Figure 2.1). More details are provided in Appendices 2.B–2.F.

We took the League of Nations publications as a starting point to construct the IDD. The League compiled information on public finances for about 60 countries over the 1913–1946 period. The data on public debt, in particular, are quite detailed, with amounts outstanding reported for various instruments and debt aggregates. Figure 2.2 provides a snapshot of a public debt table for the U.K.: in addition to aggregates such as domestic and floating debt (*i.e.*, short-term debt of maturity that is usually two years or less), the tables published by the League of Nations would also include amounts outstanding for each instrument (for example, "4% Victory Bond").

[8]Further research could investigate whether a specific combination of debt instruments, financial repression, or debt restructuring affected debt sustainability, and could inform current episodes of fiscal stress.

Figure 2.1. *Data collection strategy for each country*

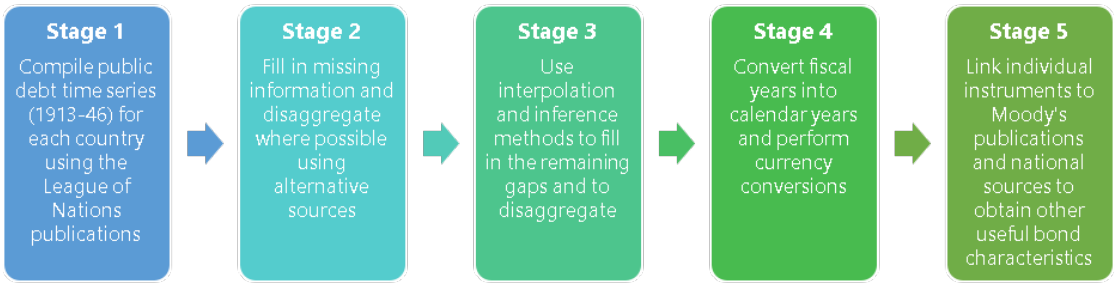

Figure 2.2. *A snapshot of a League of Nations table on public debt*

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The following table gives particulars regarding the Public Debt as on March 31st, 1922 and 1923.

(£'s (000,000's omitted).

	Maturity.	March 31st, 1922.	March 31st, 1923.
DOMESTIC DEBT:			
Funded Debt:			
Consols, etc.	Permanent	314.5	314.2
Terminable annuities *	For life and terms of years	16.2	13.4
3 1/2 % Conversion Loan	Permanent	266.1	684.–
3 1/2 % War Loan	1925–28	62.7	62.7
5 % War Loan	1929–47	1,886.9	2,030.5
4 % War Loan	1929–42	65.5	64.8
4 1/2 % War Loan *	1925–45	12.8	12.8
4 % Funding Loan *	1960–90	403.–	400.6
4 % Victory Bonds	Annual drawings	355.9	353.9
3, 5, and 5 1/4 % Exchequer Bonds	1922–30	185.–	150.–
5 and 5 1/2 % Treasury Bonds	1925–35	453.–	409.–
4 and 5 % National War Bonds	1922–29	1,201.–	956.–
National Savings Certificates	—	342.–	354.2
Sundry debts	—	2.1	1.8
Other capital liabilities	—	66.2	68.–
Total Funded Debt		5,632.9	5,875.9
Floating Debt:			
Treasury bills		873.6	616.–
Ways and Means advances		147.3	193.9
Total Floating Debt		1,020.9	809.9
Total Domestic Debt		6,653.8	6,685.8

Source: League of Nations (1923b)

To compile such data, the Financial Section and Economic Intelligence Service of the League (in many ways a precursor to the International Monetary Fund) sent regular questionnaires for countries to complete. Countries used information from several sources, including national accounts, budgetary accounts, central bank reports, and statistical yearbooks. This created several statistical challenges, which include varying definitions of fiscal years, different recording standards for revenue and expenditure items (cash versus commitment bases, gross versus net), lack of comprehensiveness of national budgets, and nature of the national debt figures.[9] For national debt data in particular, the League highlighted two reasons that make international comparisons difficult: (1) there are differences in what various countries included in their aggregates for public debt (*i.e.*, inclusion or otherwise of debts of special funds, debts to national banks, *etc.*), and (2) there are differences in how public debt is organized into various classifications (*i.e.*, domestic versus foreign debt, classifications according to currency of issue, classifications according to terms of repayment, *etc.*). The IDD circumvents a bulk of these issues by focusing explicitly on instrument-level data.

Despite the League of Nations' efforts to produce regular and comprehensive coverage of public debt statistics, there were gaps in reporting. In most cases, there are years for which amounts of debt outstanding are not reported or disaggregated information is unavailable (such as "Treasury bills" in Figure 2.2). To fill these gaps, we supplemented the League of Nations data with several other sources. These typically consisted of national sources, such as budget documents, statistical yearbooks and other specific resources (an exhaustive list of sources is in Appendix 2.B).

Where even additional sources were insufficient to fill the gaps, we used inference and interpolation methods. We also decided to convert fiscal years into calendar years and all amounts into common currencies to ensure cross-country comparability. Details are in Appendix 2.C.

The final step in the data compilation strategy for the interwar database was to use Moody's publications and national sources to obtain qualitative information for each instrument. Taking once again the example of the U.K. 4-percent Victory Bond, Moody's provided additional information for this instrument, such as interest payable, maturity, rating, whether the instrument had a sinking fund, and where it was listed. Although Moody's publications covered a significant portion of the instruments included in the IDD, it excluded information on instruments that were not traded on the largest stock exchanges or instruments that were of less interest to the American investors (Moody's target audience).[10] In these instances, we used the alternative sources listed in Appendix 2.B.

[9] See for example the methodological notes in League of Nations (1922b, 1924c).

[10] For instance, nominative bonds (which were sold over the counter; Thomson and Christian, 1911), pension-like instruments, annuities, or debt issued through state-owned enterprises or banks.

Although the IDD is a fairly comprehensive database, some caveats apply.

(a) The IDD is based on the *amount outstanding* concept of government debt debt (reported in the database in local currency units, U.S. dollars, or gold equivalent), not the *market value* of government debt. Collecting price data for the individual instruments included in the IDD requires more extensive efforts that fall beyond the scope of this chapter. There are recent studies focusing on single countries that provide instrument-level price and quantity data[11]

(b) The IDD does not include information on the ownership of the individual instruments either. We do, however, supplement IDD data with detailed information on central bank balance sheets for the countries included in the database (Appendix 2.F). This gives an idea about the extent of central bank exposure to sovereigns and fiscal dominance during the interwar period.

(c) Some information included in the IDD remains incomplete despite our best efforts. Data quality is inevitably worse during times of war and political tensions. Many interwar governments also hid or misreported items they felt uncomfortable disclosing.

Nevertheless, for the above-mentioned reasons, we still consider the IDD as the best starting point for research on individual bonds and debt management practices for a wide range of countries during the interwar period.

Resulting database

The IDD covers 18 countries for the period 1913–1946. Some salient features of the IDD are discussed in this subsection, thereby showcasing the various characteristics of instruments included in the IDD, details of which are presented in Appendices 2.D–2.E.[12]

Country coverage. Our choice of countries was strategic. First, we picked countries for which the LoN provided relatively long times series and that also had a comparatively large cross-section of debt instruments. Our initial focus were Western European countries, the U.S., Japan, and selected members of the British Commonwealth.[13] Therefore, the database includes countries that were considered the biggest players at the time, while also making room for other countries which were not as covered as comprehensively in other studies on histories of public debt (*e.g.* Japan and some of the Commonwealth countries). All in all, the IDD has a reasonable

[11]For example, Hall and Sargent (2015) and Hall et al. (2018) compile detailed data on the market value of debt for the U.S. and Ellison and Scott (2020) for the U.K.

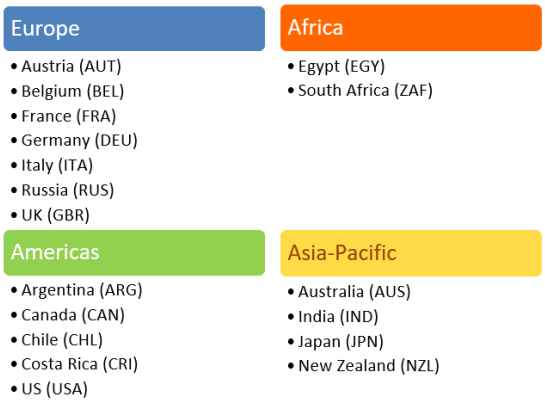
[12]But this is a non-exhaustive list of lenses to examine public debt: since the IDD includes data on individual instruments, other representations of interwar debt are also possible.

[13]Sargent et al. (2019) studies in-depth the history of public debt in some of these countries.

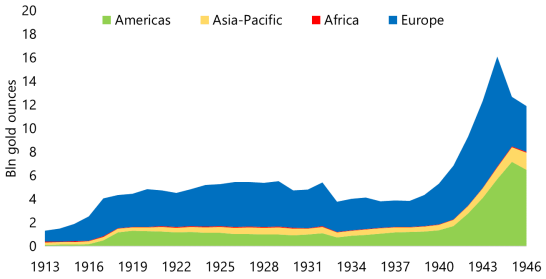
geographic coverage while also accounting for majority of public debt issued in the interwar period (Figure 2.3a).[14] In terms of contributions to global debt in the interwar period, Europe and the Americas were by far the two most dominant regions (Figure 2.3b).

Figure 2.3. *Country coverage*

(a) Countries and country codes



(b) Total sovereign debt, by region



Notes: In this chapter, we use gold as the common currency, as this was the reference at the time; even countries outside of the gold standard used gold in the formulation of their monetary policy and diplomatic negotiations. This also prevents us from choosing a reference currency to describe a period where leading international currencies competed for that status.

Instruments. Public debt in this database refers to debt contractually incurred by the central government of a country. This definition excludes municipal and other sub-central government debts, as well as debt merely guaranteed by the government. The IDD contains some 3,800 individual debt instruments, which were classified into eight different types, defined by the nature of promised cash flows (see Appendix 2.D for details):[15]

Bond Debt instrument that obligated the government to two types of cash flow: (1) a principal when the bonds were presented to the paying agent on or after their maturity date; (2) interest payments when attached coupons were presented to the paying agent.

[14]For example, some 88 percent of the total debt reported by the League of Nations for 1935 was that of the 18 countries in our sample.

[15]The LoN standard classification, as reflected in the questionnaire they would prepare for data collections, mixes considerations for residency, maturity, redeemability, and whether the debt was funded or floating. Another classification is Tobin (1963)'s: (a) transferable demand obligations, (b) marketable short-term securities, (c) marketable long-term securities, (d) non-marketable securities, and (e) other commitments (such as pensions or social security benefits). Interestingly, both classifications can be retrieved by combining several descriptors of our database.

Perpetual These instruments, also called *consols* or *rentes*, had no maturity date, which means that the principal was never paid unless the government or the bondholder activated their potential options to redeem it.

Bill These are debt instruments without coupons, generally with a shorter-term maturity than bonds. The interest was implicitly or explicitly pre-counted, that is, deducted upfront, as a discount between the issue price and the principal.

Credit These instruments were generally contracted with financial institutions or in the form of bilateral trade credits and entailed annual payments of some principal and interest. They came in the form of either one-off borrowing, or as lines of credit on which governments could draw on demand.

Advance These financing facilities were arranged with local bodies, government departments (e.g., Treasury, central bank), savings banks, or foreign authorities. They generally involved a low or null interest rate, and an open-ended maturity.

Account Governments often had access to demand or term deposits. This instrument is similar to a credit line, but it is up to the account owner (*e.g.*, public companies) to change the outstanding amounts.

Annuity Annual budget payments could be pledged by law (*e.g.*, compensation for old-age or war pensions) and were recorded as capitalized annuities. It differs from a perpetual because the annual payment is not a contractual coupon rate, but a lump-sum allocated in each annual budget.

Other Public debt instruments or aggregates for which no decomposition was possible fit in none of the above categories (*e.g.*, arrears).

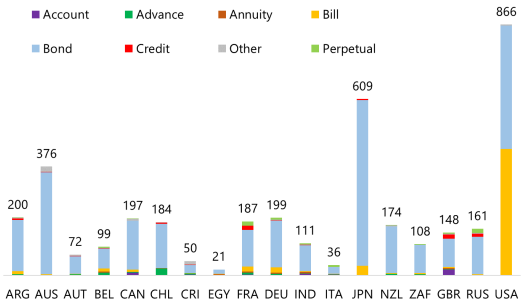
Although bonds were most popular, other instruments such as bills, advances and perpetuals also featured in the interwar period (Figure 2.4). Shorter-term instruments, such as bills and advances, were used in difficult financial circumstances.

Instrument characteristics. The database contains a wealth of detailed information on characteristics of individual instruments (see Appendix 2.E for details).

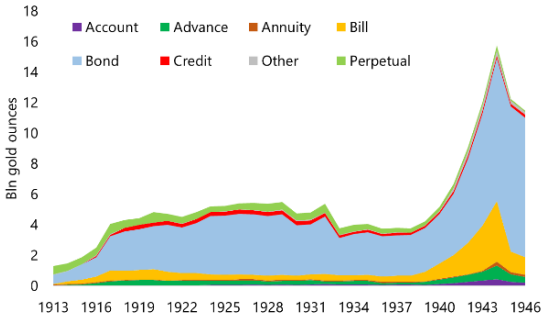
Residency and currency. As today, there is only anecdotal information about sovereign bond ownership. However, it appears that interwar governments segmented and tailor-made their debt instruments to specific investor bases. Consequently, we can as a first approximation assume that the currency of issuance of an instrument was a good indication of where it was held. In particular, we classify a security as "foreign" when it was issued mainly on foreign stock

Figure 2.4. *Typology of instruments*

(a) Number of instruments by country



(b) Total debt by instrument



exchanges, in foreign currency, or with exchange rate guarantees (typically, a "gold clause"). Majority of the bonds were issued in the United Kingdom and United States. Although the latter gained prominence at the start of WWI, it was not until the mid-1930s that United States overtook the United Kingdom as a dominant market (Figure 2.5a).

Coupon rates. Almost half the debt between 1920 and 1930 had coupon rates of 5 percent or higher (Figure 2.5b). Low-coupon debts (or prepaid interest bills) represented a large number of instruments but only a small portion of the outstanding amount of debt.[16] However, average coupon rates decreased in the 1930s as financial repression policies were implemented by many interwar governments.

Maturity. Longer-term maturity debt dominated the first half of the interwar period (with perpetuals and maturities above 20 years). However, governments were progressively issuing more shorter-term debt into the 1940s (Figure 2.6).

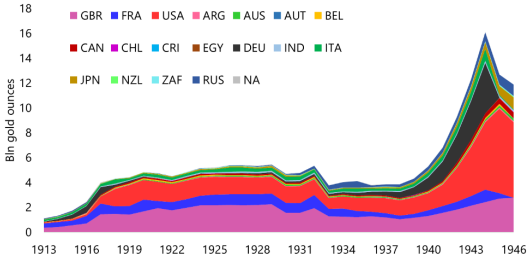
Redeemability. Since debt instruments were largely very long term, they contained an embedded option, for either the government or the lender to trigger principal repayment earlier than maturity. This was necessary for the government to be able to restructure its debt, smooth its repayment profile, and ensure some liquidity for investors, as secondary markets were underdeveloped. Government's early redemption could involve lotteries or randomization, as well as generosity when computing the current latent value of the bond. More than half of the instruments in the IDD, in value, were redeemable (Figure 2.7a).

Sinking fund. Permanent or funded debt was usually debt for which a sinking (redemption) fund had the liability to pay the interest. This was an important feature that helped in placing long-term bonds because it served as a commitment-enhancing mechanism. Earmarked revenues or budget transfers were allocated to these funds. During the interwar period, these mechanisms

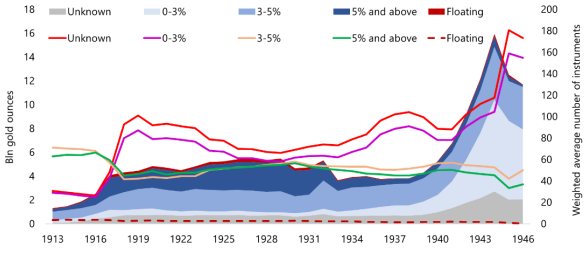
[16] These instruments were likely used as adjustment variables.

Figure 2.5. *Breakdown by residency and coupon rate*

(a) Decomposition by residency



(b) Coupon rates

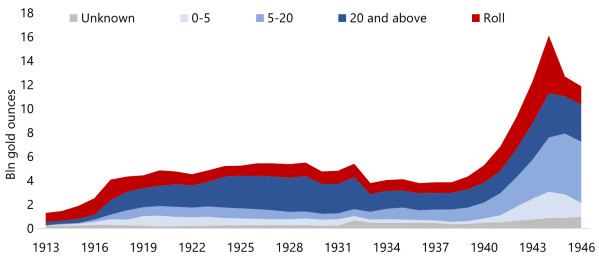


Notes: All charts in this section are based on the entire database, excluding instruments for which the examined characteristic is unknown. Precisely, the formulas used for numbers and amounts at time t of all instruments i having a characteristic $X_i = x$ are respectively: $D_{x,t} = \sum_{i|X_i=x} D_{i,t}$ and $N_{x,t} = \sum_{i|X_i=x \text{ and } D_{i,t}\neq 0} \omega_{i,t}$. We need indeed to account for the fact that some countries have lots of small instruments, while other focus on a handful of large issuances. Hence, we weigh observations using a country-specific weight $\omega_{i,t} = |\{j|C_j = C_i \text{ and } D_{j,t} \neq 0 \text{ and } X_j \text{ is known}\}|^{-1}$ where C_i is the country that issued i and $|\cdot|$ is the cardinality function. Lines represent numbers, shaded areas amounts.

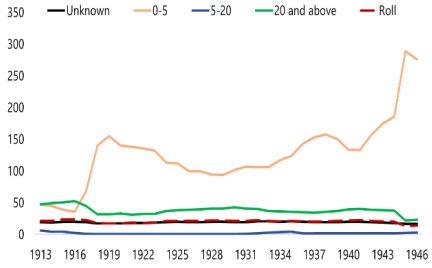
The "unknown" category includes indexed or floating rates—typically, this is the case for credit lines or short-term T-bills for which we do not have the breakdown by instrument.

Figure 2.6. *Debt instruments by maturity*

(a) Amounts



(b) Number of instruments

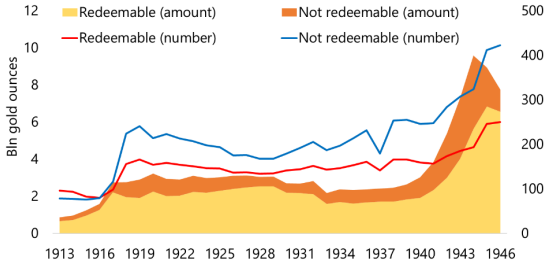


Note: Roll refers to instruments that were issued on tap and often renewed automatically unless lenders opted out.

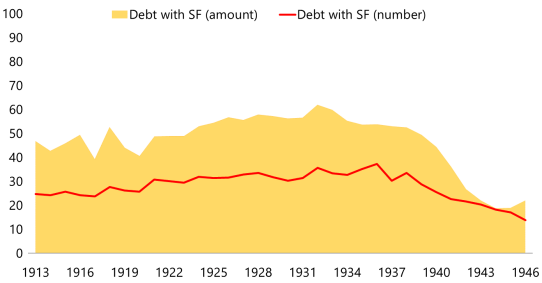
were instrumental in enhancing the credibility of public debt management. Almost half of the instruments in the IDD for which information was available had sinking funds (Figure 2.7b).

Figure 2.7. *Debt instruments by maturity*

(a) Redeemable versus non-redeemable instruments



(b) Debt with sinking fund (in percent of total debt)



Tax. Tax incentives to hold sovereign debt were common at the beginning of the interwar period but became progressively less important (Figure 2.8a). Tax exemptions could be granted for interest gains under the income tax or for capital gains related to holding sovereign bonds; blanket exemptions were almost always granted to foreign bondholders. Such tax incentives changed the debt instruments' effective rate of return.

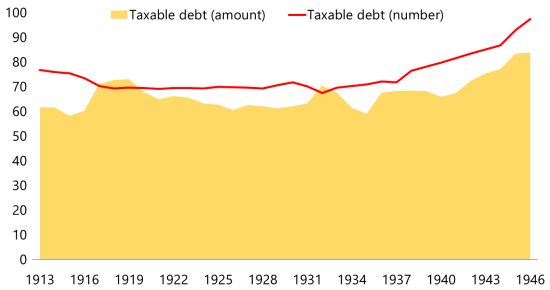
Purpose. Interwar governments often earmarked a specific instrument to a specific purpose, as parliaments often had to approve each issuance. This was also a marketing tool for investors, who liked to know what they were contributing to finance (*e.g.*, war or liberty loans). Figure 2.8b provides a broad categorization of the purposes for which debt was issued. Unsurprisingly, war and reconstruction took the lion's share of financing resources during the interwar period. By contrast, the number of bonds that were explicitly issued to support banks through the banking crises that occurred in the 1920s and 1930s does not stand out, but the related amounts provide a rough quantification of the fiscal cost of these banking crises.

2.3 Debt and credibility management during the interwar—*Stone lace and walls of light*

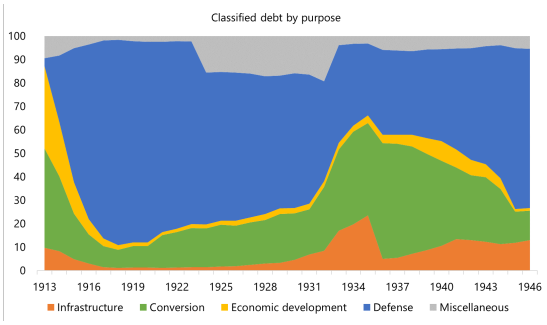
In this section, we use the IDD to illustrate how, from houses of financial cards, governments were able to build cathedrals of public debt. Interwar governments uncannily rolled over overwhelming war-related debts, infringing on any liquidity and sustainability limits. External indebtedness was an unavoidable component of the toolkit used by governments to maintain debt credibility in the midst of large shocks, even though currencies were not as well anchored by the gold standard as before WWI. We look successively at: (1) how interwar governments

Figure 2.8. *Debt instruments by maturity*

(a) Taxable instruments (in percent of total debt)



(b) Purpose of public debt (in percent of total debt)



rolled over debts that were largely unsustainable, and (2) the manner in which the external public debt network contributed to the collapse of the international financial system in the early 1930s.

Managing rollover risks and reputation in the interwar period

Public debt unsustainability—a house of cards?

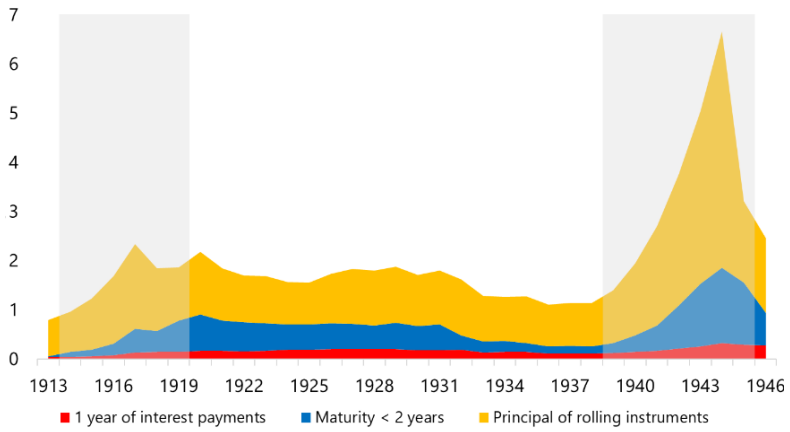
Interwar governments regularly faced liquidity and refinancing issues (Sargent et al., 2019). Financing would dry up during confidence crises or international financial tightening episodes, and governments would struggle to smooth out the maturity structure of their public debt portfolio. Most countries ended WWI with a massive stock of public debt, often exceeding their national income and revenues by several multiples. Was public debt unsustainable for many of the belligerent countries in the interwar period? There is no easy answer to this question as a universally acceptable indicator of fiscal sustainability does not exist.

In Appendix 2.G, we draw on sustainability tests from the empirical literature to show that public debt was unsustainable for most belligerent countries.[17] We first we run stationarity tests on our series of government debt for each country, as well as panel unit root tests. We then use Bohn (1998)'s sustainability criterion, which is based on a time series regression of the primary surplus of debt on public debt and other controls for each of the countries in our sample. Our results suggest that for most countries in our sample, the response of the primary fiscal surplus to variation in our measure of government debt was not consistent with meeting the intertemporal budget constraint, and the debt ratio was not stationary.

[17]These are distinct from insolvency tests; they test whether current fiscal and debt policies were unsustainable rather than the immediate ability to face financing needs.

The IDD also sheds light on how governments managed the imminent refinancing needs that they faced—the so-called *wall of money* that contemporary commentators described.[18] As shown in Figure 2.9, the short-term debt-servicing needs were sizable, representing 2 billion of gold ounces in the overall international system (or two fifths of 1920 U.S. GDP). What was the reason behind such large short-term financing needs? Was it because average maturity was short, interest payments were large, or governments were simply too indebted? The IDD allows us to compile average maturities and effective interest rates to address this question.

Figure 2.9. *International financing needs*



Notes: This chart plots the total financing needs required annually by the 18 countries in my dataset, denominated in gold equivalent. As a reference, U.K. GDP stood at around 1 billion gold ounces in the early 1920s. Shaded areas are for WWI and WWII.

To proxy effective interest rates since interwar budgets did not report debt service consistently, we average the coupons serviced by each instrument. Figure 2.10a demonstrates on a European sample how the average rate could vary and differ across sovereigns. However, the resulting rates are surprisingly low, by comparison with levels sometimes observed today. This is in part because bond payoffs included other forms of remuneration than coupons.[19] Further, some countries relied on monetary policy incentives to issue discounted short-term Treasury

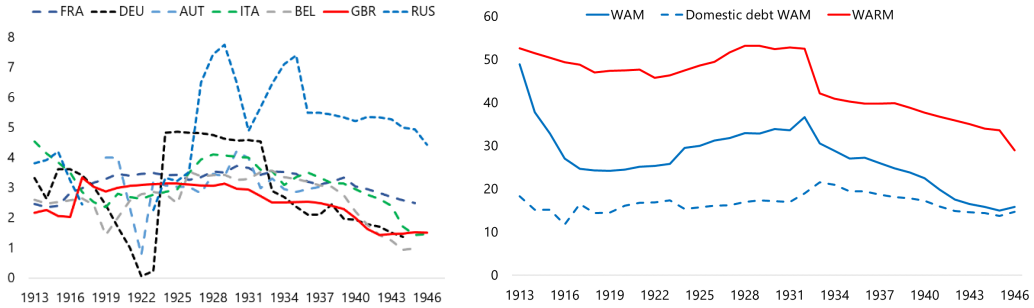
[18] For example, Sauvy (1965).

[19] For instance, the dollar-indexed zero-coupon Treasury bills that Germany issued during the hyperinflationary period promised to repay the indexed principal with a premium. The latter could in some instances be as high as 70 percent, which, for a maturity of twelve years, and leaving aside compounding, roughly corresponds to a 6 percent annual interest rate.

bills, which do not carry any coupon—these instruments were typically used by central and commercial banks for liquidity management purposes.[20]

Figure 2.10. *Liquidity indicators*

(a) Average coupon rate (in percent) **(b)** Average maturity (in years)



Notes: Coupon rates are weighted by the outstanding amounts of the respective instruments. Only those instruments with available coupon information are part of the average. WAM (WARM) = weighted average (remaining) maturity.

As for maturity, there are different ways to envisage the maturity of a security D issued in t_0. First, the contractual maturity is $\tau = t_f - t_0$ where t_f is the latest payment date (typically, when all the principal has been paid back). This measure underpins the general classification of short-term versus long-term bonds. Second, at any point in time t, it is possible to account for the remaining maturity $t_f - t$. Third, duration is a measure of the average maturity of all future cash flows, weighted by these cash flows. For a bullet bond, duration and maturity are identical. Figure 2.10b plots two maturity measures at the aggregate level.[21] We find that, even though average maturity declined throughout the interwar period (especially during the war when emergency short-term financing had to be promptly tapped), maturities were much longer than those found today in most emerging countries.

Credibility-enhancing devices and financial innovation

How did countries manage to roll over unsustainable public debts, while doling out new and costly spending (either social protection policies or military spending)? One piece of the answer lies in debt management policy choices and the design of debt instruments. While financial market development in the second half of the twentieth century contributed to the creation of

[20] It is well-documented that the Austrian and German Finance Ministries forced their central banks to hold large amounts of such discounted Treasury bills during the period of high inflation/hyperinflation. This explains the low average coupon rate for these two countries on Figure 2.10a.

[21] To aggregate the maturity of a debt portfolio composed of n_t instruments $(D_{it})_{1\leq i\leq n_t}$, we weigh each instrument by its outstanding amount. Therefore, the weighted average maturity is $WAM_t = \frac{\sum_i \tau_i D_{it}}{\sum_i D_{it}}$; and the remaining maturity is $WARM = \frac{\sum_i (t_{if} - t) D_{it}}{\sum_i D_{it}}$.

new financial instruments, debt practices today use fewer and simpler instruments than they did in the past. The wide variety of bonds during the interwar period is evidence that bond engineering sophistication played a role.

The methods used to sell domestic debt were similar across countries (Dornbusch et al., 1990). The Treasury and the central bank would organize auctions to place long-term debt, announce the rate to be paid, and hold the subscription open for a given period. By contrast, T-bills would be continuously on sale (on *tap*) at predetermined rates of interest. In-kind payment was possible for both types of debt, namely, using older bonds to subscribe to new ones, sometimes at a discount. External debts, apart from intergovernmental debts and small bank credits, were mostly in the form of syndicated loans. Sovereign bond offerings would go through a lead underwriter and a consortium of banks, which would help the government in exchange for a substantial commission.[22]

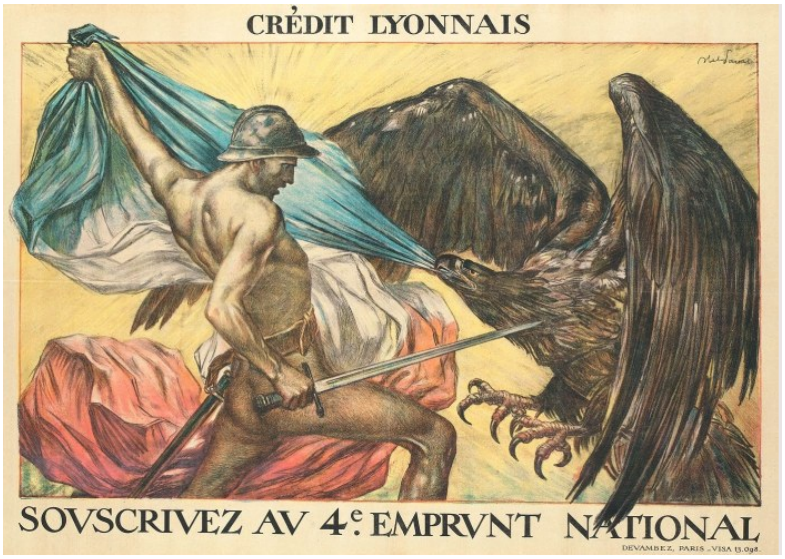
Bond design was often complex as bonds were tailor-made for different classes of investors, at odds with today's standardization of bonds.[23] According to contemporary sources, short term bonds were for example intended for institutional investors and perpetuities for small savers. Features such as lotteries, perpetual annuities, indexation mechanisms, tax incentives, and premia also targeted different investors, in a context where banking sectors were relatively small, money markets shallow, and private savings primarily hoarded in cash. Marketing of public debt auctions was a crucial part of debt management strategies. Many public bonds had a moniker or nickname, either related to specific events (*Liberation bonds*) or purposes (*conversion bond*). Patriotic feelings were frequently invoked: financing the government was marketed as a nationwide effort "for the motherland" (Figure 2.11).

In terms of debt management, governments could not manage their debt portfolio or hedge risks as actively as today, given relatively underdeveloped secondary markets. Interwar governments optimized the debt profile through conversion operations and were able to secure relatively long average maturities and low interest rates. When prevailing conditions were deemed favorable, long-term bonds were issued to replace selected securities with higher coupon rate or shorter maturity. Preferential prices were generally set to provide an incentive to subscribe and remit older securities.

[22]Fees of 5 to 7 percent of the issued amount were common.

[23]In France, for instance, the number of active public debt instruments was around 72 in 1938. By way of comparison, less than ten different types of bonds feature on the website of France's debt management office in 2019. This is not surprising when seen from the perspective of financial market development: the sovereign market usually matures first, targeting market players' needs, then private markets develop and the variety of sovereign instruments tends to decrease (Chami et al., 2010).

Figure 2.11. *Propaganda for the National Defense Loans by the Lyon Credit*

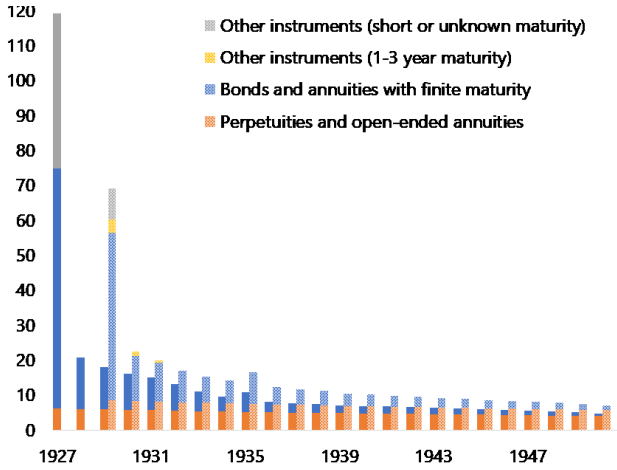


Note: "Lyon Credit—Subscribe to the Fourth National Loan." The reader will admire the simplicity of the allegory...

Taking advantage of the granularity of our database, we can simulate what the expected debt service structure was at any given point in time. This requires making some assumptions, as most instruments included stochastic and discretionary elements. As an illustration, Figure 2.12 shows how the 1926 Poincaré debt conversion in France succeeded in reducing short-term expected repayments by half. Implementing such conversions was a common practice at the time as a means for governments to reprofile their debt maturity structure and benefit from favorable market prices. Many sovereign bonds included a call option that could be triggered in good times, in which case a markup was generally paid. Moral suasion and premiums were also used to entice bondholders to swap old instruments for new ones. Less benign debt conversions occurred as well in several countries on the eve of WWII, in conjunction with financial repression (*e.g.*, in Japan, Italy, and France).

Another perennial challenge was to convince creditors that the government would pay back debt—in other words, how to establish the government's credibility. As the average public debt maturity was quite long, it was not only about the current government's reputation; they needed to convince investors that the debt contract would be honored, thereby tying the hands of future governments that would have to service it. Adding a form of collateral (*e.g.*, an implicit claim on future taxes through a sinking fund) to the debt contract was used to lower the risk premium.

Figure 2.12. *The effect of the Poincaré conversion on expected debt service*



Source: End (2019b)

Note: The plain/dotted bars show the expected debt service profile before/after the conversion.

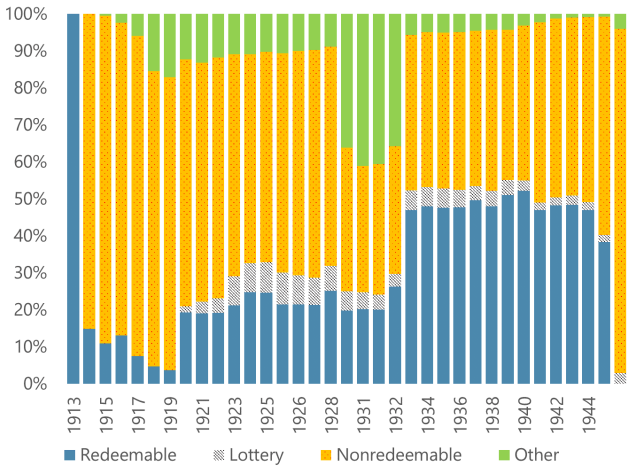
The most formalized commitment mechanisms were sinking funds.[24] Upon issuance, the government would commit to paying back the bonds by provisioning a share of the budget surplus or tax revenues to redeem the bonds in accordance with a pre-announced schedule. Typically, a price ceiling below which the sinking funds were authorized to buy the bonds back was established. While some sovereign sinking funds can still be found today, their use during the interwar period was much more systematic and represented around half of total debt until 1940 (*cf*. Figure 2.7b). We do not find any evidence that they were created ahead of contentious elections to tie future governments' hands; instead, they must have resulted from the sole need to make issuances more appealing for investors. Their popularity seems to decline after 1940. In fact, sinking funds had been initially designed to capitalize the fiscal surpluses generated during good years (Ross, 1892); with WWII needs, the emergence of Keynesian theories, and the development of financial markets, sovereign bonds proliferated, making it difficult to associate each with a specific sinking fund.

Even without an explicit sinking fund, the government could commit, as part of a bond's design, to buy back (redeem) some of the principal regularly, with quantitative limits on how much the government could call back at each period. These regular redemption payments helped to

[24]The first occurrence of sinking fund in history can be traced back to Italian city-states in the 14th century. Richelieu advocated such a sinking fund for sovereign debt to avoid costly and disruptive defaults, and Colbert was the first to attempt it at the end of the 17th century. It later became customary in the U.K. in the 18th century and London imposed this practice as it grew into the world financial center in the 19th century (Price, 1816).

level off the amortization schedule but also convince investors that governments were willing to repay. The desire to lengthen debt maturity also underpinned the rationale for redemption funds. For investors to accept longer maturities, bonds should generally be redeemable at predetermined rates long before maturity, and carry a higher return the longer investors have held them (Chami et al., 2010). The share of such redeemable debt increased during the interwar period (Figure 2.13).

Figure 2.13. *French public debt by redemption mechanism (in percent of total debt, 1913—45)*



Source: Sargent et al. (2019)

Notes: Redeemable debt are bonds that the government had the option to amortize earlier than the face maturity, which was usually permitted only after a contractual grace period. "Other" includes bonds for which no information is available.

Non-government public entities helped roll over the public debt. Public banks and corporations were instrumental in canvassing investors, making the market for sovereign bonds, and smoothing out confidence shocks. Public banks served as guarantors and played a promotional role in debt placements. Likewise, the government could utilize non-financial public companies to borrow on its behalf (the epitome was Germany's *Mefo* bill scheme, involving the Metallurgische Forschungsgesellschaft company).[25]

The central bank played in most countries a key role as well. While the Treasury was the government's main financial representative and accountant in charge of debt issuance and service, the central bank could assume several debt policy responsibilities. It provided deficit

[25]The fragmentation of issuances likely contributed to deceiving market players about the true extent of public indebtedness and consequently obfuscated the pricing of sovereign risk.

financing—directly through advances and portfolio investments and through repurchase agreements. It behaved as the government's broker, leveraging its regional and foreign branches to promote sovereign chapter, sometimes granting advances to subscribers. It could commit financial repression or manipulation of security prices by intervening on the market or changing its discount rate (especially ahead of conversions).

Bignon and Flandreau (2018) note that there were two alternative credibility models before WWI: either the central bank was focused on monetary policy and the government relied on sinking funds; or the central bank was actively involved in financing sovereign debt. War financing created the need for both. Figure 2.14 uses our central bank balance sheet data to illustrate how central bank exposure to government rose steadily in the interwar period. As the monetary policy standard was to adhere to the gold standard (or a gold exchange standard), a large central bank exposure implied fiscal dominance. During the interwar period, adherence to the monetary rule was "a good housekeeping seal of approval," which signaled to international capital markets that the country was committed to pursuing prudent monetary and fiscal policies (Bordo and Rockoff, 1996). Confidence that the value of the currency would be stable, and particularly that debt would not be inflated away in the future, provided assurances to both domestic and external creditors. Yet, fiscal dominance meant for the central bank the existence of multiple, possibly contradicting objectives and a reputational cost—a tradeoff between fiscal and monetary credibility.[26]

The external public debt network in the interwar period

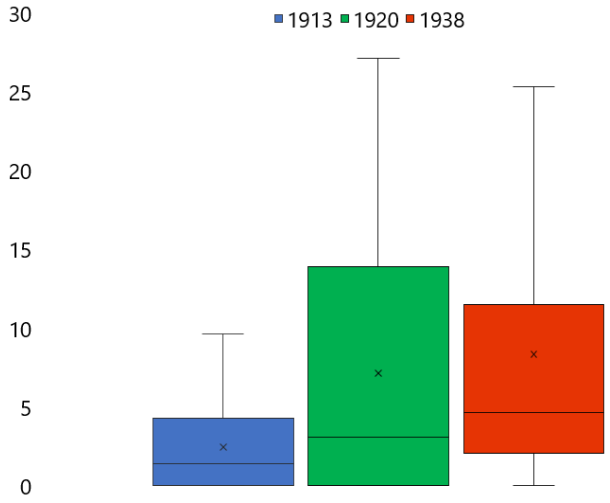
Buildup and collapse of the external sovereign debt network

The 1920s are often viewed as an earlier period of globalization. Studying the interwar period from the public debt perspective can provide interesting insights into international financial linkages between private and public agents. Existing research on this period mostly focused on overall external imbalances and the role of monetary and exchange rate policies, thereby largely ignoring the role of sovereigns.

The role of sovereign debt in the intensifying financial network and its collapse in the early 1930s is not to be neglected. Large foreign borrowing during WWI and the following reconstruction resulted in a complex sovereign debt network (Figure 2.15). In 1928, continental European sovereigns owed 10 percent of U.S. GDP to the U.S. government and 27 percent of U.K. GDP to the U.K. government (De Broeck et al., 2018). By 1933, most of this debt had been written off from governments' balance sheets; when WWII started, foreign debt represented but a few

[26]See End (2019a) for an account of how Japan went from a regime of monetary dominance (with the objective to return to the gold standard) to one of fiscal dominance and financial repression (led by militarism).

Figure 2.14. *Central bank exposure to government (percent of total public debt)*

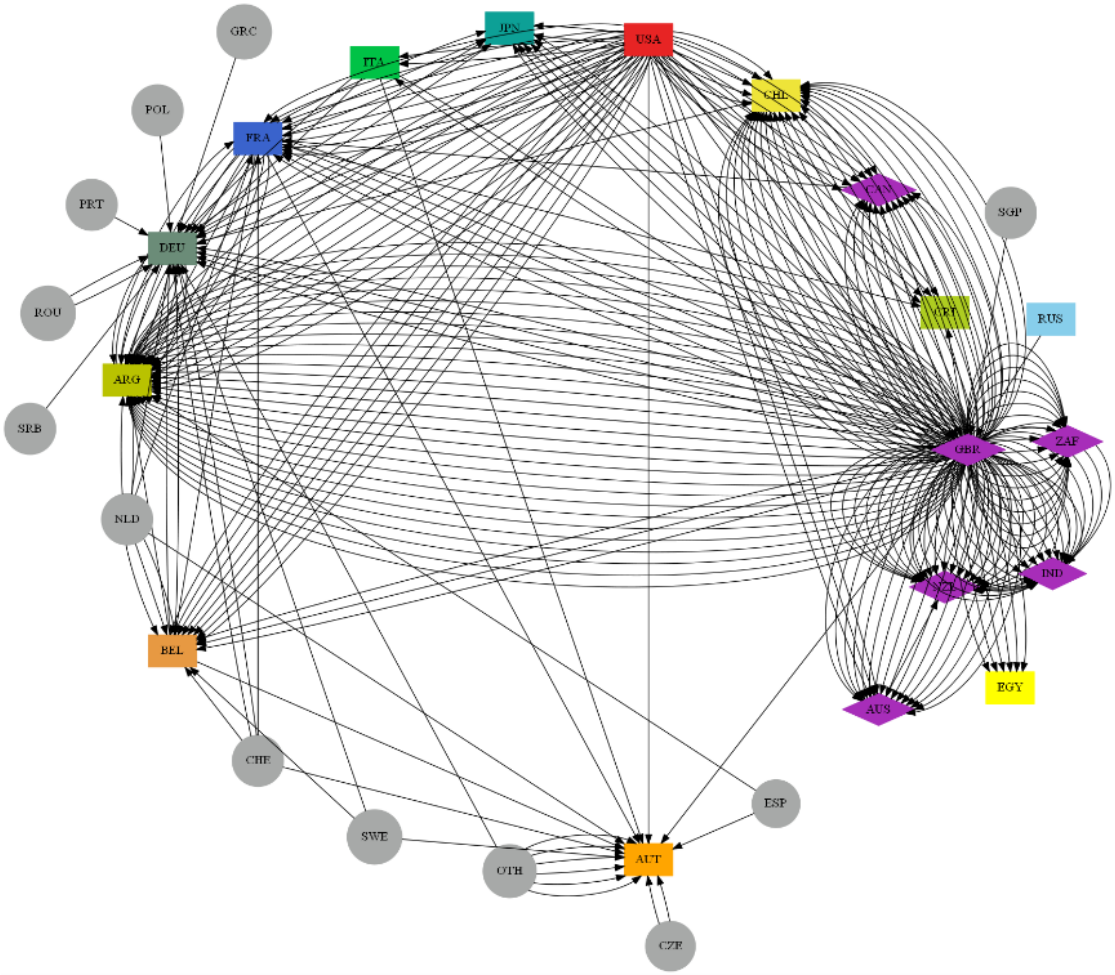


Notes: This chart shows the distribution of ratios of central bank claims on the government to public debt in 1913, 1920, and 1938. The crosses represent mean average values.

percent of total public debt (Figure 2.16). In addition to initial large intergovernmental debt flows, the period between WWI and WWII saw sharp movements in private external financing of sovereigns. The stage of the interwar finance drama was set with constant renegotiations of the reparation payments from defeated (mainly Germany) to Allied countries. Appendix 2.A sketches the timeline of negotiations, and Figure 2.17 illustrates how the network evolved over time. The rest of this section examines these evolution in a systematic way.

This interconnectedness brought benefits such as improved financial intermediation and broader access to finance. But this is assuming that the debt exchanges were based on rational financial decisions, which was not necessarily the case. External debt was often issued in countries that shared historical or geopolitical relationships. For instance, the Commonwealth countries had close financial links with the U.K., and countries helped finance their allies (or were indebted to nations that defeated them). In many cases, such links are entangled with similarities in legal systems. Besides, choice of issuance location was a reflection of what the main financial centers were at the time (London and New York) and of active policies by some governments to become such financial centers (*e.g.*, Tōkyō tried to become a financial hub in Asia). More importantly, the network was vulnerable in many ways and created risks. Shocks in one part of the network could be amplified and transmitted through common linkages, thus heightening the potential for systemic risk.

Figure 2.15. *The sovereign debt network at the instrument level, in 1928*



Notes: Each edge is a foreign debt instrument. The picture is dominated by the links between Commonwealth countries, indicated with purple diamonds.

Figure 2.16. *Share of foreign debt and average maturity*

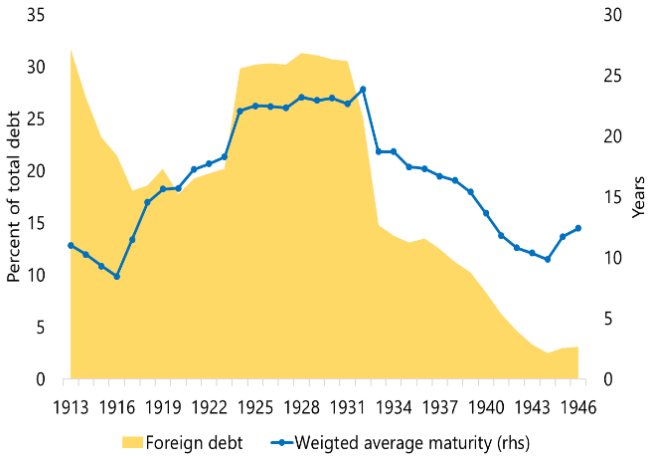
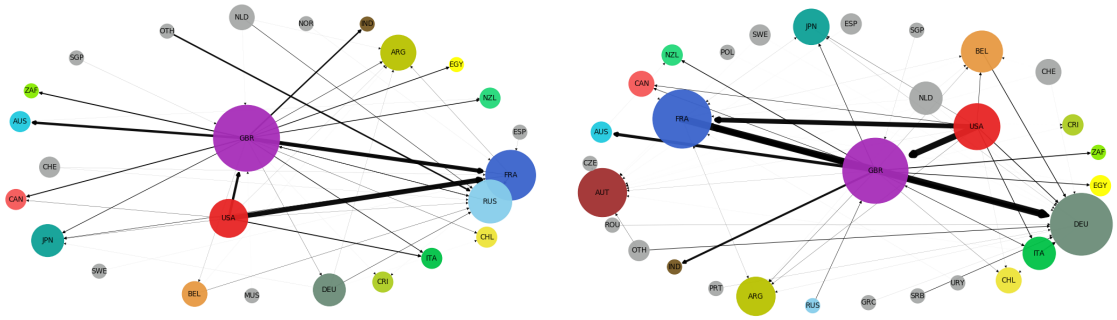
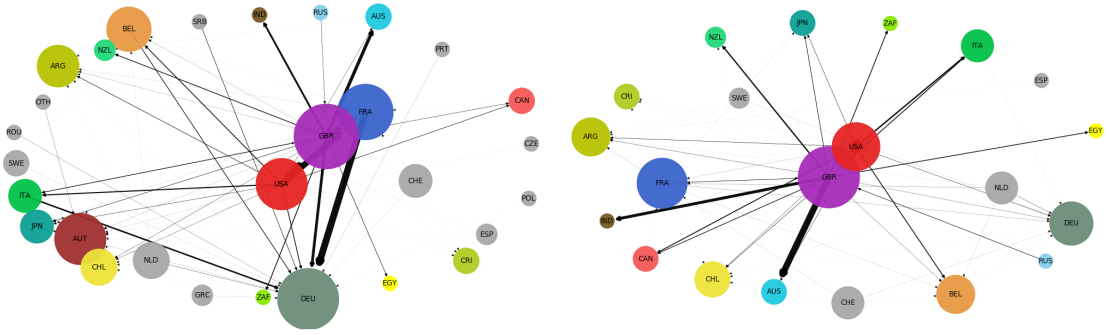


Figure 2.17. *The evolution of the external public debt network at the aggregate level*

(a) 1917 **(b)** 1924



(c) 1930 **(d)** 1938



Note: Contrary to Figure 2.15, edges here represent the aggregate bilateral debts, with the width of each edge being proportional to its gold equivalent amount.

The IDD allows us to describe the external sovereign debt network in a systematic way. Formally, the external debt network is a dynamic, directed graph whose nodes are countries and whose directed edges are the outstanding public debts owed to each other.[27] Drawing on graph theory and topology metrics, we analyze the evolution over time of some graph metrics. Specifically, we examine the role played by some countries and bilateral financial bonds in the overall network, and the transformation of that network during the successive rounds of international negotiations and the advent of the Great Depression.[28]

This approach closely relates to the literature that employs graph analysis on the network of financial flows among institutions or countries to assess the resilience of financial systems and the level of systemic risk (see for instance Minoiu and Reyes, 2013, and the references therein). That literature shows how the response of a network to shocks depends on its structure, thereby providing a rationale for documenting the topological properties of such networks. While complete networks are more resilient thanks to risk-sharing properties (Allen and Gale, 2000), dense networks can lead to trend reinforcement mechanisms and in some cases risk diversification can increase systemic risk (Battiston et al., 2012a,b). Plus, complexity prevents network members from getting the information needed for a proper risk assessment, thereby allowing for panic-fueled contagions (Caballero and Simsek, 2013). Therefore, this section, by looking at the public debt network structure, implicitly measures systemic risks.

First, we look at the topology of the network. As shown on Figure 2.18a, the cross-country sovereign debt network was enlarged tremendously in 1924, probably as a consequence of the Dawes plan, which restored confidence in the system while adding a new layer of loans to existing liabilities. We find also new evidence that the Great Depression was precipitated by the cross-country public debt network: the number of elementary circuits, that is the number of debtor-creditor paths that involved distinct countries and formed a cycle, spiked dramatically in 1931.

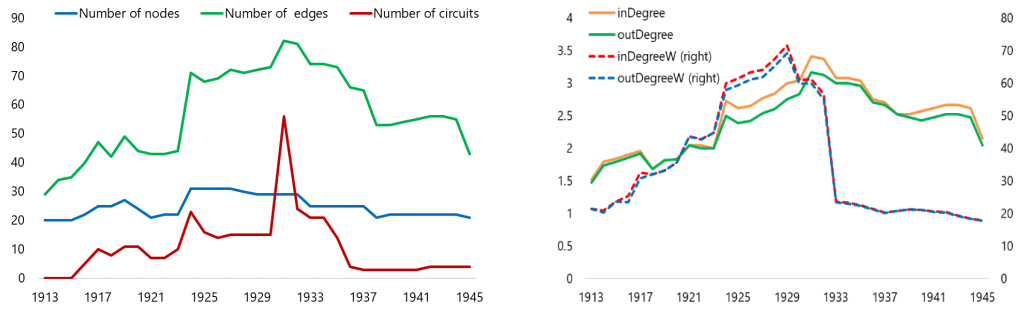
To measure the extent to which the *number of connections* increased in the network, we compute several statistics. The degree of a node is the number of nodes in direct connection and can be interpreted as the number of countries that directly depended on a given country. The in-degree is the number of incoming connections to a country (the number of countries lending to it), while the out-degree is the number of countries borrowing from a country. The degree can also be weighted by the size of each connection—*i.e.*, by the amount of outstanding debt. Figure 2.18b plots the evolution of the average degree metrics over time. It confirms that the

[27] Either on each instrument as in Figure 2.15 or in aggregate terms as in Figure 2.17. The Young loans are not part of the network, as it was mostly subscribed by domestic investors.

[28] Appendix 2.H provides a graph theory background and the formal definitions of the graph concepts used in this section.

Figure 2.18. *Intensity of connections in the network*

(a) Number of participants and connections **(b)** Average degrees



Notes: Nodes are countries involved in the network, edges are their debt links, circuits are circular debt dependencies. *inDegree* is the number of countries a country is borrowing from; *outDegree* is the number of countries a country is lending to; and *inDegreeW* and *outDegreeW* are respectively the amount borrowed and lent by each country.

network became more intricate in the mid-1920s. Unsurprisingly, we observe that the network collapsed in terms of volumes in the wake of the Great Depression, with total external sovereign debt in the network dropping by approximately two thirds and returning to pre-WWI levels. However, there were always some satellite countries that were not connected to all others—in graph theory terms, the network was never *strongly connected*.

Second, we investigate what countries dominated the network, either as a source or as a recipient of funds in the form of sovereign debt. Figures 2.19a–2.19b show that the network was dominated (until the early 1930s) by:

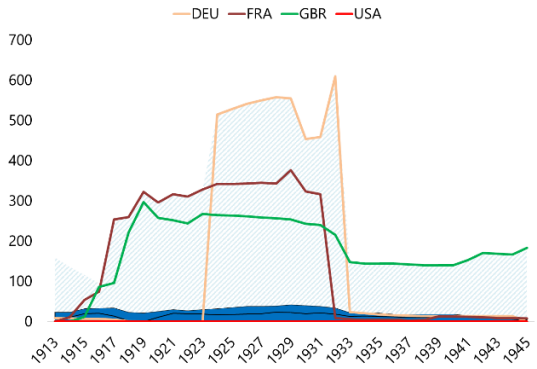
- Germany, France, and the U.K. as sovereign borrowers. External debt in these countries was mostly related to war financing and subsequent reconstruction.

- The U.S. and the U.K., and to a smaller extent France, as the main lenders to other sovereigns. This reflects both the dominance of London and New York as international financial centers as well as the financing provided to their allies during the war. Contrary to the recent literature on international currencies (Chiţu et al., 2014; Eichengreen and Flandreau, 2009), we find no clear evidence that the United States dominated the external sovereign debt market since WWI. Instead, our analysis suggests the United Kingdom maintained its prominent role, regularly outpacing the United States during the interwar period. This finding thus goes along with the conventional historical narrative (Triffin, 1960).

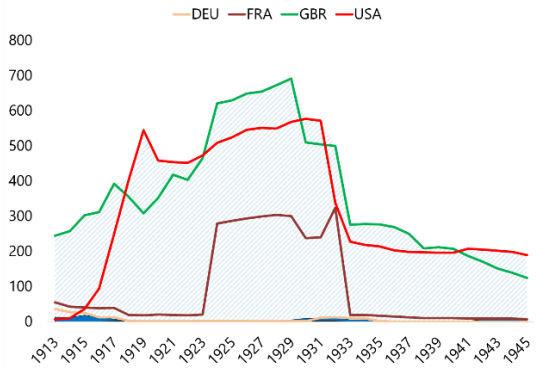
Degree centrality—the unweighted in/out-degree normalized by the number of possible connections—is another informative measure of connectedness as it quantifies how many coun-

Figure 2.19. *Country connectedness*

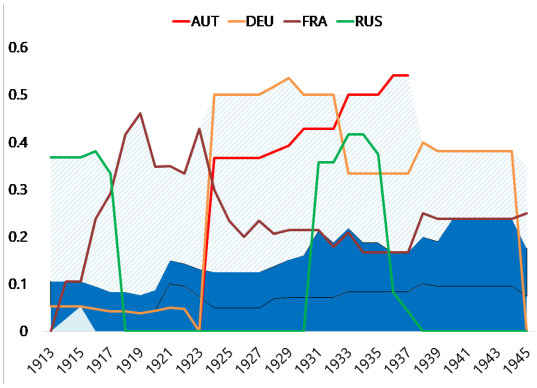
(a) Importance of countries as borrowers (weighted in-degree)



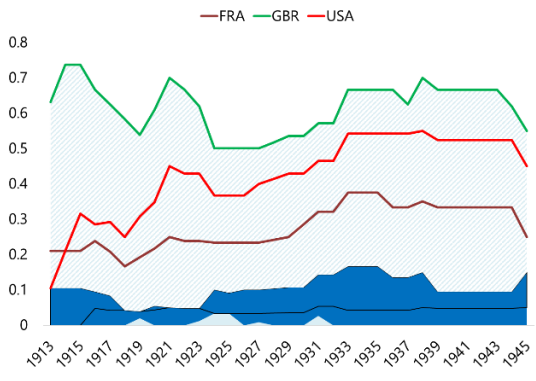
(b) Importance of countries as lenders (weighted out-degree)



(c) Centrality as borrower (in-degree centrality)



(d) Centrality as lender (out-degree centrality)



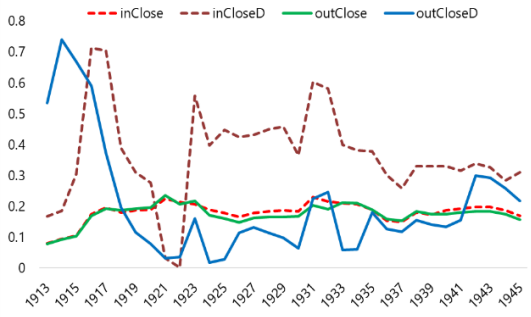
Note: On these charts as well as those that follow, the light blue shaded areas represent the range of results for the entire sample, and the dark blue ones the central half of the distribution (from the 25^{th} to the 75^{th} percentile).

tries were exposed to a given sovereign's default or to a sudden stop from a given country. On the one hand, there was no clear universal borrower; most countries had a constant in-degree centrality, apart from Russia's sudden appearance in the first half of the 1930s and the high number of creditor countries to Germany, Austria, and post-WWI France (Figure 2.19c). On the other hand, the out-degree centrality exhibits the same outsiders as the weighted out-degree: United Kingdom, United States, and France (Figure 2.19d). Notably, while in terms of amounts the United Kingdom and United States were roughly on equal footing; the United Kingdom financed more countries than the United States, in part owing to its close ties within the Commonwealth.

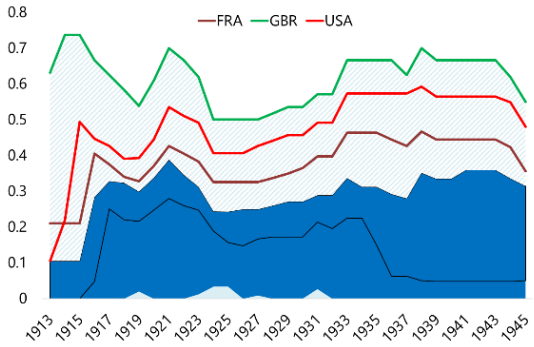
Next, we turn to the importance of a country, as debtor or creditor, for the overall system. The overall *systemicity* and exposure of a country can be proxied by its *closeness* to other nodes in the network, which is larger when a country can reach other countries in the network in fewer steps.[29] While the average exposure (in-closeness) built up during WWI and in the runup to the Great Depression, the average weighted systemicity remained low (Figure 2.20a). Such an asymmetry between a high number of borrowers and a small and central number of lenders likely contributed to propagate the shock in the early 1930s. Surprisingly, the U.K., the United States, and France were not only the main lenders (and thereby closely exposed to the network), but they were also close in the sense that their default would have quickly impacted most countries in the network (Figure 2.20b).

Figure 2.20. *Closeness*

(a) Average



(b) Systemicity by country (out-closeness)



Notes: inClose and *outClose* are the in-closeness and out-closeness measures, our proxies for exposure and systemicity, respectiviely. *inCloseD* and *outCloseD* are their weighted equivalents.

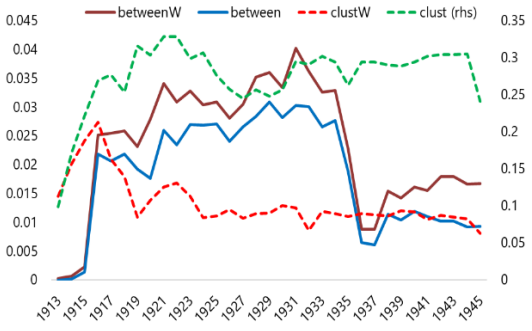
So far, we have only looked at countries that could generate or receive a shock. Next, we investigate the importance of a country as a vector of contagion, that is its *betweenness*. Betweenness can be understood as the number of direct connections between two countries that

[29] Closeness can also be computed by replacing the number of steps to reach other nodes with a measure of distance between nodes, namely the inverse of the outstanding debt tying countries together.

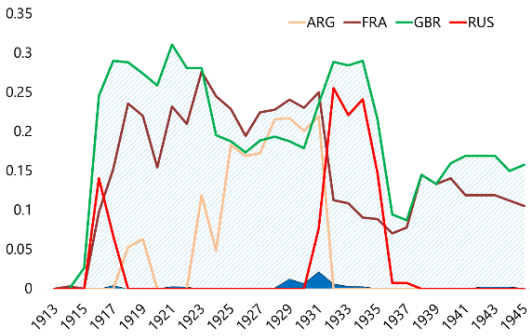
transit through a give country.[30] Figure 2.21a shows how betweenness increased with WWI and decreased only with mounting isolationism in the mid-1930s. Figure 2.21b sheds light on the role of specific countries, as it reveals that Argentina in the 1920s and Russia in the 1930s were possible financial stress conduits, along with France and the U.K. This is yet another result that narrative evidence had so far overlooked.

Figure 2.21. *Betweenness and clustering*

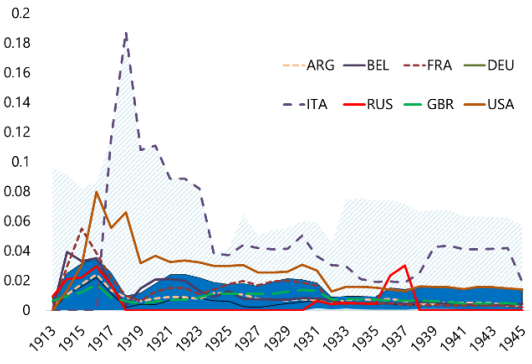
(a) Average betweenness and clustering



(b) Importance as contagion vector (weighted betweenness)



(c) Circularity of the network (weighted clustering)



(d) Vulnerability to a central country (central point of dominance)

Notes: between is the betweenness measure, our proxy for the role of countries in propagating default risks through the network; *clust*, for clustering, is our measure of circular dependencies in the system; *betweenW* and *clustW* are the weighted equivalents.

The last systemic weakness we investigate is the extent of clustering, which is indicative of circularities in the financial dependencies among countries. Such circularities can potentially transmit and amplify shocks in the overall financial system and complicate the workout of defaults or stress episodes. To measure this, we rely on a clustering coefficient that can be understood as the probability that two neighbors of a node are neighbors themselves. On Fig-

[30] It can also be weighted by the debt oustanding.

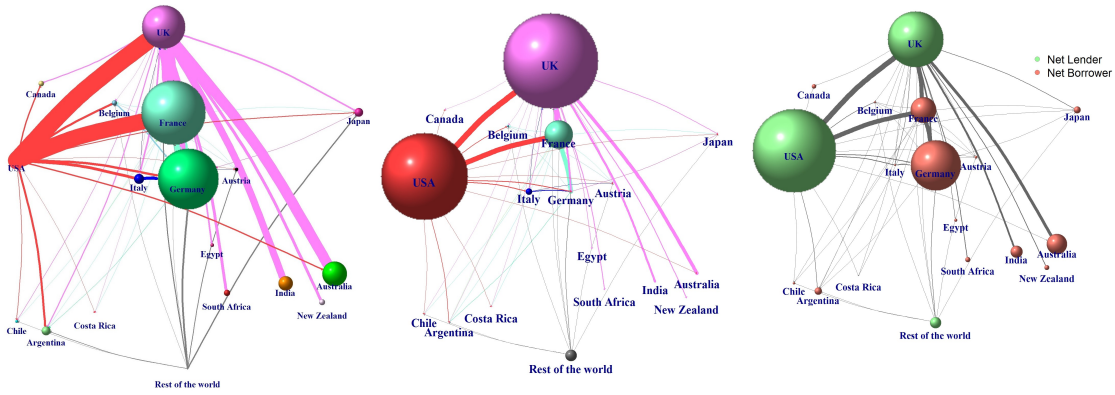
ures 2.21c, we observe the high values obtained by Australia and Italy. These countries, even though not outstanding in terms of external public debt or credit to other sovereigns, found themselves in the middle of intricate networks.[31]

We can also measure to what extent the network was vulnerable to a few nodes using the central point of dominance statistics. As can be seen from Figure 2.21d, the Dawes plan was successful in that it broadened the network to more players (simultaneously diffusing the risks). After the Great Depression hit, the network became once again much more centralized, with a small number of countries upon which the entire system became dependent.

In conclusion, graph theory shows how the network was vulnerable to the dominance of a small number of influential actors, while the actual exposure of each country was blurred by an intricate network. We thus confirm that the extent of interconnectedness was greater than what one would infer from net positions alone (Figure 2.17). In addition, various manifestations of interconnectedness fed into each other, rendering the global financial system vulnerable to sovereign stress (De Broeck et al., 2018).

Figure 2.22. *The sovereign debt network in 1931*

(a) Borrowers **(b)** Lenders **(c)** Net position



Source: De Broeck et al. (2018).

Notes: The width of each link represents the amount of outstanding debt, while the size of the nodes represent the outstanding stock of debt borrowed by sovereigns on chart (a), lent to sovereigns on chart (b), and in net terms on chart (c) (based on amounts converted in U.S. dollars, with the same scaling parameter for all charts).

[31] Incidentally, the maximum k-core of the network, that is the list of countries with maximal degree, happens to be quite stable and contains not only France, Germany, the U.K., and the United States, but also Argentina, Belgium, Italy, and for some years the U.S.S.R.

Inherent institutional weaknesses

How could such a network develop in the first place? While it is mostly a legacy of WWI (war financing and reparations) and the need to rapidly finance a joint fight against common enemies, some institutional deficiencies certainly vulnerabilities.

First, the interwar period was characterized by lack of cooperation and gaps in the mandate and membership of such new international organizations as the League of Nations and the Bank of International Settlements. Forceful economic and political events, including the Great Depression and eventual abandonment of the gold standard, contributed to an atmosphere of growing international isolationism in the 1930s and led eventually to WWII. There was a clear coordination problem, as epitomized by the failure of the Reparations Committees.

Second, there was a conflict of interest for countries who held debt from two countries that were also in a debtor-creditor situation. There was for instance a US vested interest in maintaining the *status quo*, for their private bankers were refinancing some of the largest sovereign liabilities in Europe (Chernow, 2010).

Third, although the LoN contributed somewhat to the exchange of information, they failed short of auditing the data. Absent a fiscal watchdog and transparency standards, countries could thus easily make up their balance sheets. We have already mentioned the issue of the unit of account for foreign bonds. Belgian debt was reported in issuing currency, while Canada and Australia reported everything in GB£ (including bonds issued in US$). Argentina, Australia, Canada, Chile, Costa Rica, Egypt, France, India, Japan all resorted to a mix of legal and contractual parities, instead of market rates. None of these conventions seems fit in a world where only gold equivalents mattered.

The reasons underpinning what can appear *ex post* as misreporting are unclear. Was it a deliberate obfuscation about the true extent of sovereign indebtedness? Or were these accounting choices a consequence of some more subtle political motives? For instance, France kept using pre-WWI gold standard parity until 1928, while market quoted the franc as low as one-fifth its prewar value (De Broeck et al., 2018). Yet, it is unclear whether French governments meant to hide to 80 percent of their external debt or whether the goal was to provide assurance that the gold parity would be somehow restored—which, before Minister Poincaré's 1926 policies, was the official baseline.

Consequence of the asymmetry of information between governments and bondholders about the actual amount of public debt, sovereign bonds were probably ill-priced, and sovereign risk underestimated. Not unlike today, there seemed to be a disconnect between sovereign spreads

and fundamentals—meaning: the level of debt, fiscal discipline, growth prospects, international liquidity—that the geopolitical background alone cannot explain.

Anecdotal evidence shows also that rating agencies failed to anticipate sovereign crises: Table 2.23 for instance highlights how on the brink of a default, some Commonwealth Dominions were still rated as safe while arguably stronger European countries had some bonds rated as having significant credit risks (Sargent et al., 2019).

Figure 2.23. *Ratings of bonds issued in London*

	1918	1925	1930	1935	1938
			Dominions' inscribed stock		
Australia	Aaa	Aaa / Aa	Aaa / Aa	A / Baa	A / Baa
Canada	Aaa	Aaa	Aaa	Aa	Aa
New Zealand	Aaa	Aaa	Aaa	-	-
South Africa	Aa / A	Aa	Aa	A	A
			Other countries' sovereign debt		
Belgium	…	Aa / Baa	Aa / Baa	A	A / Baa
France	Aaa	A / Ba / Baa	Aa / A	Aa	A / Baa
Italy	…	A / Baa	A / Ba	A / Baa	Baa / Ba
The Netherlands	A	Aaa	Aaa	A	A

Source: Sargent et al. (2019).

2.4 Conclusion

This chapter describes a new, instrument-level database of sovereign debt for 18 countries over the period 1913-46. The interwar debt database contains data on amounts outstanding for some 3,800 individual debt instruments as well as the associated qualitative information, including instrument type, coupon rate, maturity, and currency of issue. We believe that this is the most comprehensive and comparable data to conduct research on public finances during the turbulent interwar period. The information contained in the database can provide unique insights into macroeconomic and sovereign debt policies implemented in the interwar period. We show for instance how interwar governments rolled over debts that were largely unsustainable.

The database sheds new light on public debt management policies, which could be useful today. Essentially, there are three ways to deal with sustainability: changing the fundamentals (spending less, taxing more), reinforcing commitments by increasing the cost of default, and using shenanigans to keep investors interested. While interwar governments survived thanks to a sweeping mix of such policies, today's governments often focus on fiscal consolidation.

Admittedly, part of the toolkit is not viable anymore—the accounting tricks or the lotteries would unlikely work today, as public accounts are audited and scrutinized and buyers sovereign debt are professional investors rather than households. However, others could be of use. For instance, sinking funds could be used again for specific public debts, such as CoViD-19-related debt or green recovery bonds. Governments could organize a conversion operation of the bonds they issued during the CoViD-19 crisis, in which case perpetuals could be considered for those bonds held by central banks.

We document how the external public debt network contributed to the collapse of the international financial system in the early 1930s. The graph analysis conducted in this chapter highlights the inherent vulnerabilities of debt networks, somewhat similar to the interconnectedness between financial institutions that can lead to contagion. The dominant or exposed positions of some influential players and the circularity of some financial dependencies posed risks. These risks were underestimated because of the intricacy of the network. Incidentally, such an analysis is not possible for today's network, which is most likely even more intricate, because data on bond ownership is fragmentary. Our findings call for data transparency in that regard. It would be desirable to compile data on locational public debt (in the similar vein as the locational banking data that the BIS compiles). The finding that a dense debt network can fuel risks provides a contrasting intuition with both the idea of risk diversification and Cole and Kehoe's (1998) model, where the existence of a third-party prevents governments from defaulting.

We believe the IDD 's rich quantitative and descriptive content will find different users. Historians might find it useful to quantify their narratives, in particular about war financing. Potential links with broader policies—agricultural, social, financial—and the development of providence states are multiple. Economists should also be able to draw interesting parallels with today's economies, particularly since numerous episodes of macro instability happened during the interwar period. Future work could also extend the database, compiling data to the other countries that reported to the League of Nations—chiefly Latin American countries and smaller European countries— and collecting price data for marketable government debt securities.[32]

[32]Such extensions would also contribute to digitize rare information contained in publications that have long been out of print.

Appendices

2.A The evolution of financial interconnectedness during the interwar period

WWI U.S. government financial links with Europe intensified

- Prior to this point, main worldwide lenders were UK and France
- During the war, U.S. lent more than US$ 10bn to the Allies through Liberty Loans Acts
- After the war, U.S. continuously rejected calls to cancel these debts, but gradually accepted to renegotiate

Treaty of Versailles Conclusion of the Paris Peace Conference and establishment of the Reparation Commission

- Allies demanded that Germany compensated war costs and damages
- Reparation Commission determined the amount and nature of reparation and schedule payments in Spring 1921
- As soon as December 1921, Germany requested a partial postponement of the scheduled payments. Germany found it increasingly difficult to make the payments, repeatedly activating its escape clause and eventually defaulting in January 1923 (thus triggering France and Belgium's invasion of the Ruhr)
- U.S. endorsed only partially the treaty and requested amendments, particularly on the issue of collective security and the League of Nations (which the U.S. never joined)

Dawes Plan Formalization of interconnectedness, including war debt and reparation payments, proposed by Reparation Commission

- Lower annual reparation payments by Germany (become higher as economy recovers), although the total amount was not determined
- Germany's economic policy was to be supervised by foreign powers, and new currency adopted
- U.S. (mainly) banks lent to German government to help economic recovery; Germany started reparation payments to the European Allies, who in turn repaid their war debts to the U.S.

Kellogg-Briand Pact International agreement to renounce war as an instrument of national policy

- Originally signed by Germany, France and the U.S. in 1928; most other nations followed (including the historically belligerent Japan)
- Limited prospects to enforce debt contracts through military invasion

Bilateral negotiations on debt rescheduling Buildup of the web between war, reconstruction, and reparation debts

- Under pressure to repay its significant debt to the US, the UK formally addressed its European debtors with the Balfour note, pointing out that U.K. cannot really be expected to meet its obligations to the U.S. without some international settlement that would address Ally obligations to the U.K. and German reparation payments (i.e. an attempt to link reparations to interallied war debt); U.S. rejected this proposal and formed its World War Foreign Debt Commission in 1922, to negotiate repayment plans with debtor countries (on concessional terms)
- France and Italy used the same strategy of conditioning its debt service to German payments

Young Plan Reviewing German reparations once more

- Some of the earlier terms were revised, most notably the total amount of reparations was reduced
- Another loan would be floated on the foreign markets (the "Young Bond")
- The Young Plan also established the Bank for International Settlements, tasked with facilitating payment of reparations in lieu of the ad hoc Reparation Commission

Wall Street Crash Beginning of a breakdown in the financial system

- U.S. banks had to recall flows to Europe; German and Austrian banks failed
- Hoover moratorium issued in 1931, suspending reparation payments for one year

Lausanne Conference New attempt to extract reparations from Germany

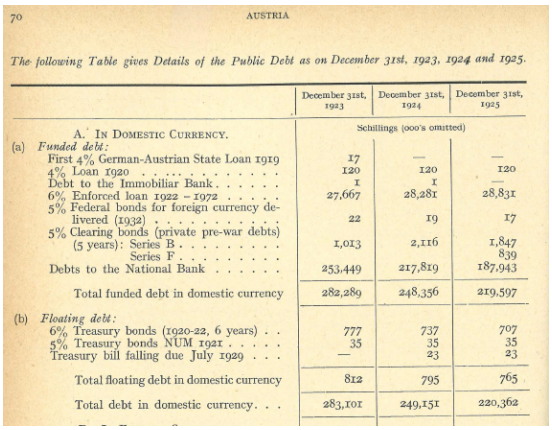
- Total amount of reparations reduced even further; interallied debt implicitly repudiated
- Agreement rejected by U.S. congress, but Germany nevertheless suspended all payments shortly thereafter (Hitler elected in early 1933)

2.B Sources

When WWI ended, the economic and financial conditions in Europe were in dire straits. The newly-founded League of Nations (LON) organized a large economic conference in Brussels in Fall 1920 and later established the Financial Section and Economic Intelligence Service, including several Committees (Nichols, 1942). The Statistical Committee was designed to collect and publish economic and financial statistics. It progressively steered statistical cooperation between member countries, leading to the 1929 International Convention on Economic Statistics that imposed on ratifying countries to publish certain classes of economic statistics according to common principles.

Figure 2.24. *Examples of* LON *data*

(a) Public debt, Austria



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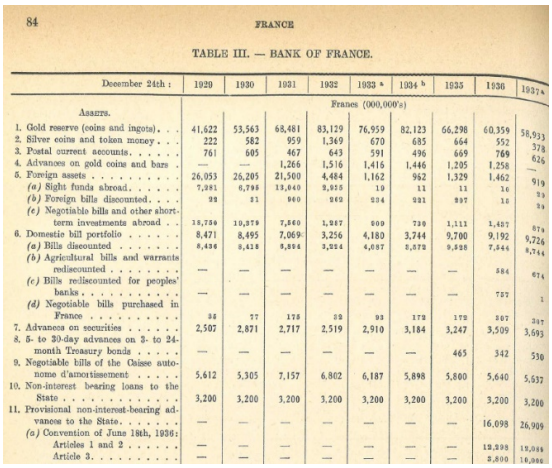
The following Table gives Details of the Public Debt as on December 31st, 1923, 1924 and 1925.

	December 31st, 1923	December 31st, 1924	December 31st, 1925
	Schillings (000's omitted)		
A. In Domestic Currency.			
(a) *Funded debt:*			
First 4% German-Austrian State Loan 1919	17	—	—
4% Loan 1920	120	120	120
Debt to the Immobiliar Bank	1	1	—
6% Enforced loan 1922 – 1972	27,667	28,281	28,831
5% Federal bonds for foreign currency delivered (1932)	22	19	17
5% Clearing bonds (private pre-war debts) (5 years): Series B	1,013	2,116	1,847
Series F			839
Debts to the National Bank	253,449	217,819	187,943
Total funded debt in domestic currency	282,289	248,356	219,597
(b) *Floating debt:*			
6% Treasury bonds (1920-22, 6 years)	777	737	707
5% Treasury bonds NUM 1921	35	35	35
Treasury bill falling due July 1929	—	23	23
Total floating debt in domestic currency	812	795	765
Total debt in domestic currency.	283,101	249,151	220,362

(b) Central bank balance sheet, France



84 FRANCE

TABLE III. — BANK OF FRANCE.

December 24th :	1929	1930	1931	1932	1933 [a]	1934 [b]	1935	1936	1937 [a]
	Francs (000,000's)								
Assets.									
1. Gold reserve (coins and ingots)	41,622	53,563	68,481	83,129	76,959	82,123	66,298	60,359	58,933
2. Silver coins and token money	222	582	959	1,369	670	685	664	552	378
3. Postal current accounts	761	605	467	643	591	496	669	769	626
4. Advances on gold coins and bars	—	—	1,266	1,516	1,416	1,446	1,205	1,258	—
5. Foreign assets	26,053	26,205	21,500	4,484	1,162	962	1,329	1,462	919
(a) Sight funds abroad	7,281	6,795	13,640	3,915	19	11	13	16	93
(b) Foreign bills discounted	93	31	960	262	234	221	237	16	93
(c) Negotiable bills and other short-term investments abroad	18,756	19,379	7,560	1,287	909	730	1,111	1,427	879
6. Domestic bill portfolio	8,471	8,495	7,069	3,256	4,180	3,744	9,700	9,192	9,726
(a) Bills discounted	8,436	8,418	9,894	3,254	4,057	3,872	9,898	7,844	8,744
(b) Agricultural bills and warrants rediscounted	—	—	—	—	—	—	—	384	674
(c) Bills rediscounted for peoples' banks	—	—	—	—	—	—	—	727	1
(d) Negotiable bills purchased in France	35	77	175	99	93	172	175	237	307
7. Advances on securities	2,507	2,871	2,717	2,519	2,910	3,184	3,247	3,509	3,693
8. 5- to 30-day advances on 3- to 24-month Treasury bonds	—	—	—	—	—	—	465	342	530
9. Negotiable bills of the Caisse autonome d'amortissement	5,612	5,505	7,157	6,802	6,187	5,898	5,800	5,640	5,537
10. Non-interest bearing loans to the State	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200
11. Provisional non-interest-bearing advances to the State	—	—	—	—	—	—	—	16,098	26,909
(a) Convention of June 18th, 1936:									
Articles 1 and 2	—	—	—	—	—	—	—	12,298	19,098
Article 3	—	—	—	—	—	—	—	3,800	10,800

Sources: LON (1926), LON (1937).

The IDD draws mostly from the League's *Public Finance* and *Public Debt* publications (Figure 2.24).[33] These publications compile information on public finances of 61 countries over the 1913–1947 period. To the best of our knowledge, few physical copies of the League publications are still available today and we are the first ones to digitize the information they contain on public debt instruments.[34] We also used the *Money and Banking* and *Statistical Yearbook* to infer credit lines and advances offered by central banks to governments, as well as exchange rates.[35] Although the League of Nations publications contain surprisingly detailed information,

[33] League of Nations (1923b, 1927, 1929, 1936b, 1948)

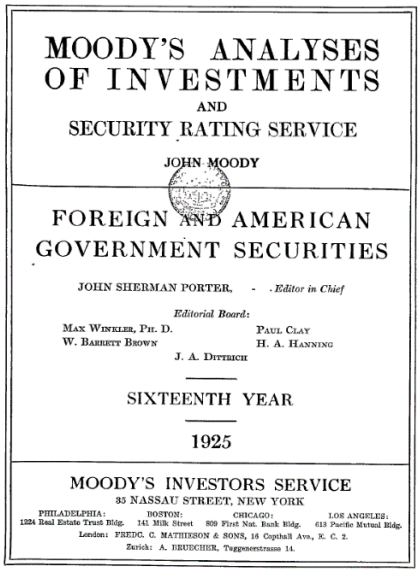
[34] Chiţu et al. (2014) compile an interwar database on global foreign debt using the LON sources. However, this information is aggregated and does not include instrument-level information for both domestic and foreign public debt.

[35] League of Nations (1931b, 1935, 1936a, 1945)

they were only sporadic, resulting in data gaps. Plus, coverage was not equally comprehensive for each country.

Figure 2.25. *Examples of Moody's publications*

(a) Cover page



MOODY'S ANALYSES OF INVESTMENTS
AND
SECURITY RATING SERVICE
JOHN MOODY

FOREIGN AND AMERICAN GOVERNMENT SECURITIES

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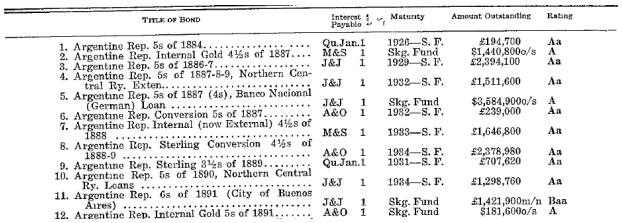
SIXTEENTH YEAR

1925

MOODY'S INVESTORS SERVICE
35 NASSAU STREET, NEW YORK
PHILADELPHIA: 1234 Real Estate Trust Bldg. — BOSTON: 141 Milk Street — CHICAGO: 809 First Nat. Bank Bldg. — LOS ANGELES: 613 Pacific Mutual Bldg.
London: FREDC. C. MATHIESON & SONS, 16 Copthall Ave., E. C. 2.
Zurich: A. BEUDICHER, Tiggenestrasse 14.

(b) Summary table of traded bonds



Title of Bond	Interest Payable		Maturity	Amount Outstanding	Rating
1. Argentine Rep. 5s of 1884	Qu.Jan.	1	1926—S. F.	£194,700	Aa
2. Argentine Rep. Internal Gold 4½s of 1887	M&S	1	Skg. Fund	$1,440,800o/s	A
3. Argentine Rep. 5s of 1886-7	J&J	1	1929—S. F.	£2,394,100	Aa
4. Argentine Rep. 5s of 1887-8-9, Northern Central Ry. Exten.	J&J	1	1932—S. F.	£1,511,600	Aa
5. Argentine Rep. 5s of 1887 (4s), Banco Nacional (German) Loan	J&J	1	Skg. Fund	$3,584,900o/s	A
6. Argentine Rep. Conversion 5s of 1887	A&O	1	1932—S. F.	£239,000	Aa
7. Argentine Rep. Internal (now External) 4½s of 1888	M&S	1	1933—S. F.	£1,646,800	Aa
8. Argentine Rep. Sterling Conversion 4½s of 1888-9	A&O	1	1934—S. F.	£2,378,980	Aa
9. Argentine Rep. Sterling 5½s of 1889	Qu.Jan.	1	1931—S. F.	£707,620	Aa
10. Argentine Rep. 5s of 1890, Northern Central Ry. Loans	J&J	1	1934—S. F.	£1,298,760	Aa
11. Argentine Rep. 6s of 1891 (City of Buenos Aires)	J&J	1	Skg. Fund	£1,421,900m/n	Baa
12. Argentine Rep. Internal Gold 5s of 1891	A&O	1	Skg. Fund	$181,600o/s	A

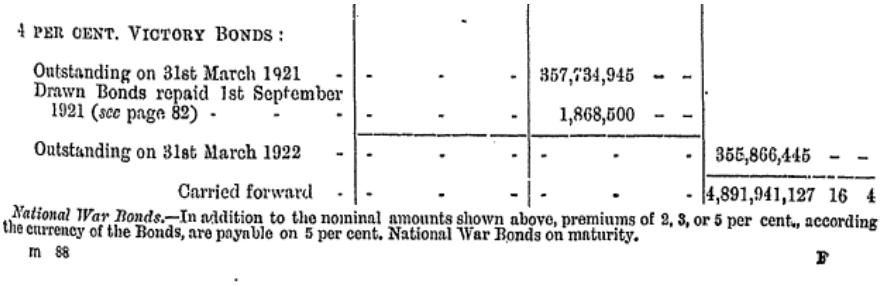
Sources: Moody's (1918).

Our second systematic source of information was John Moody's publications for Mergent Inc. (Figure 2.25).[36] In 1918, the corporation started publishing an annual series of manuals describing foreign and American government securities. From this source, we mainly extract the characteristics of sovereign debt instruments (typically, the date, location, and rate of interest payments, maturity year, redemption rules, taxation regime, and marketplaces). But their reporting was not watertight. In some instances, instruments were sometimes forgotten, or outstanding amounts were not correctly updated. Some other instruments were listed before their actual issuance—and sometimes they eventually failed to be issued. Therefore, as a rule, we use Moody's outstanding amounts only in cases where no other source was available or in conjunction with aggregates provided in other sources. Moody's also attributed a rating to each security; however, the narrative analysis provided in De Broeck et al. (2018) suggests that these ratings proved ex post not to be a good proxy for the underlying risk of default. For instance, they failed to anticipate the early 1930s sudden stop on external borrowing that followed the Great Depression.

Apart from the League of Nations' and Moody's publications, other sources of information useful in the compilation of the IDD generally fell into three main categories: (1) national

[36] Moody (yearly issues).

Figure 2.26. *A snapshot of information from national sources*



4 PER CENT. VICTORY BONDS :			
Outstanding on 31st March 1921 -	- - -	357,734,945 - -	
Drawn Bonds repaid 1st September 1921 (*see* page 82) - - -	- - -	1,868,500 - -	
Outstanding on 31st March 1922 -	- - -	- - -	355,866,445 - -
Carried forward -	- - -	- - -	4,891,941,127 16 4

National War Bonds.—In addition to the nominal amounts shown above, premiums of 2, 3, or 5 per cent., according the currency of the Bonds, are payable on 5 per cent. National War Bonds on maturity.

m 88 F

Source: Finance Accounts of the United Kingdom of Great Britain and Ireland for the Financial Year 1921-22, ended 31st March 1922.

sources,[37] (2) literature and commentaries (often contemporary),[38] (3) international treaties and conventions (for example, the Dawes and Young Plans).[39] National sources used include Statistical Yearbooks, Government Manuals, Central Bank Bulletins, and other statistics compilations (Figure 2.26). Detail by country is listed in Table 2.1. The IDD documents clearly the source underpinning each number.

Table 2.1. *Additional sources used to compile the* IDD*, by country*

Country	National sources	References
Argentina	▪ Memoría de la Contaduria de la Nación (1913–1926) ▪ Memoría del Departamento de Hacienda (1913–1926) ▪ Revista de Economía Argentina (1918–1922)	
Australia	Year Book Australia: Section 19—Commonwealth Finance (1913–1927)	
Belgium	Annuaire statistique de la Belgique et du Congo belge (1913–1922)	
Canada	Public Accounts (1914–1927)	
Chile	▪ Anuario Estadistico—Hacienda (1913–1922) ▪ Chilean Public Finance (1932)	
Costa Rica	Memoria de la Secretaria de Hacienda y Comercio (1913-1922)	

[37] Including, at times, physical bonds and archived advertisement billboards

[38] This included speeches or articles delivered by contemporary economists, finance ministers, central bankers, or journalists. Private bankers, who played the role of governments' advisers ("money doctors"), underwriters, and investors' representatives, also had at times interesting insights on public debt.

[39] Reparation Commission (30); Young Committee (1930); The Hague Agreement (1930).

Table 2.1. *Additional sources (continued)*

Country	National sources	Academic sources
France	▪ Annuaire Statistique by INSEE ▪ Archives of the French MOF (CAEF) ▪ Compte général de l'administration des finances by MOF	Fisk (1922); Huet (1935); Laufenburger and Baudhuin (1947); French Ministry of Finance (1946); National Shawmut Bank (1915); Sauvy (1965); Teillard (1921)
Germany	▪ Reichstagsprotokolle (1913–1924) ▪ The Hague Agreement (1930) ▪ Reichsanzeiger	Lotz (1927); Will (1921)
India	▪ Combined finance and revenue accounts of the central and provincial governments in India (1913–1922) ▪ Accounts and Estimates (1923)	Dubey (1930)
Italy	Banca d'Italia Annual Reports (1923–1938)	
Japan	▪ Financial and Economic Annual of Japan by the Okurashō ▪ A Financial History of Shōwa [Shōwa Zaisei Shi] (Tōkyō: Tōyō Keizai), 20 volumes ▪ Bank of Japan (1962); Bank of Japan (1966)	Metzler (2006); Tomita (2005); Fujino and Teranishi (2000); Mitzakis (1939)
New Zealand	▪ Statistical Year Book (1913–1926) ▪ Public Accounts (1913–1946)	
Russia	▪ Statistical Year Book of the Russian Empire (1913–1915) ▪ Statistical Year Book of the Soviet Union (1922–1926, 1934–1945) ▪ Statistical Book "State Budget vol. I (1918–1937) and vol. II (1938–1950)" ▪ Russian State Archive of Economy (misc) ▪ MOF Notes on the Execution of the Budget (1934–1937)	Dyachenko (1978)
South Africa	Official year book of the Union (1916–1921)	
U.K.	Bank of England, *A millennium of Macroeconomic Data for the* U.K.	Pember and Boyle (1950); Wormell (2002)
U.S.	Monthly Treasury reports (1913–1946)	

2.C Methodological notes

General assumptions

Sources described in Appendix 2.B contributed to the bulk of the information contained in the IDD, but there were some remaining gaps. Although these could potentially be filled with other sources that require more extensive efforts to obtain and process, the IDD relies on several inference methods. Besides, to make the information in the IDD comparable across countries, we also applied fiscal-to-calendar year and currency conversions.

Bond life cycle A typical debt instrument has an outstanding amount that can only decline over time, going to zero after the maturing date. This property is respected in the IDD, except for the following categories: (a) credit lines and advances, whose amounts could fluctuate over time; (b) bonds issued in foreign currency, in which case the amount in issuing currency would respect the declining property over time; (c) rolling short-term bonds that were quasi-automatically reissued and that were hard to disaggregate into separate issuances.

Linear interpolation Interpolation made sense in some cases—for example, gaps between two points with the same amounts outstanding, or between two points with declining values.

Disaggregation In some instances, various bond issuances were aggregated into one broad category (for example, Treasury bills, whose coupon rate changed at each issuance). We denote such bonds in the database as `Rolling` issuance dates and `Floating` coupon rate. As far as possible, we tried to break these categories down into separate issuances, particularly for categories constituting a sizable portion of public debt. To do so, we relied on Moody's publications which reported amounts outstanding for each issuance and applied the breakdown to the aggregates reported in the League of Nations publications.

Fiscal to calendar year conversions Fiscal years differed for the sample of 18 countries included in the IDD, and in some cases fiscal years changed over the interwar period (Table 2.2). All the series in the IDD were converted to calendar years (ending December 31), thus reflecting the end-of-year amounts outstanding for all instruments. That allows us to apply December exchange rates to the underlying series and obtain the amount of debt in any available currency.

Currency conversions The League of Nations reported amounts outstanding in domestic currency, even for instruments that were issued in foreign currencies and/or on foreign markets. Country-specific methods of debt conversion used by the League of Nations undermine the comparability of debt series across countries. When compiling IDD data, we first expressed outstanding debt amounts in currencies of issue, then performed interpolation and end-of-period harmonization. The resulting series were finally converted to nominal U.S. dollars, a common

Table 2.2. *Fiscal years of countries included in the* LoN *publications*

Country	Coverage	End of fiscal year	Exceptions
EUROPE			
Albania		March 31	
Austria		December 31	1918 and 1919 = June
Belgium		December 31	1922 = Oct
U.K.		March 31	
Bulgaria		December 31	1927-1933, 1934 = March; 1935 = Aug
Czechoslovakia		December 31	December, except 1938 = March
Denmark		March 31	
Estonia		March 31	1928 = Jan
Finland		December 31	
France		December 31	1921, 1929-1932 = Mar; 1920 = May; 1923, 1925 = Apr; 1924 = Jun; 1926 = Mar and Dec
Germany		March 31	1922 = June
Greece		March 31	1911 = Sep; 1913-1918 = Dec; 1922 = Jul; 1935 = Jan; 1940 = Feb
Hungary		June 30	1940-1943 = December
Ireland		March 31	
Italy		June 30	1923 = March
Latvia		March 31	
Lithuania		December 31	
Luxemburg		December 31	
Netherlands		December 31	
Norway		June 30	
Poland		March 31	1919-1924, 1933-1934 = Dec; 1934 = July; 1945-1946 = Sep
Portugal		December 31	1913-1934 = June
Romania		March 31	1923-1931 = Dec
Spain		December 31	Floating debt not available for 1924
Sweden		June 30	1914-1922 = Dec
Switzerland		December 31	
Turkey		May 31	1945-46 = December
U.S.S.R.		December 31	1921-1929, 1934-1935 = Sep
Yugoslavia		June 30	
AFRICA			
South Africa		March 31	
Egypt		April 30	

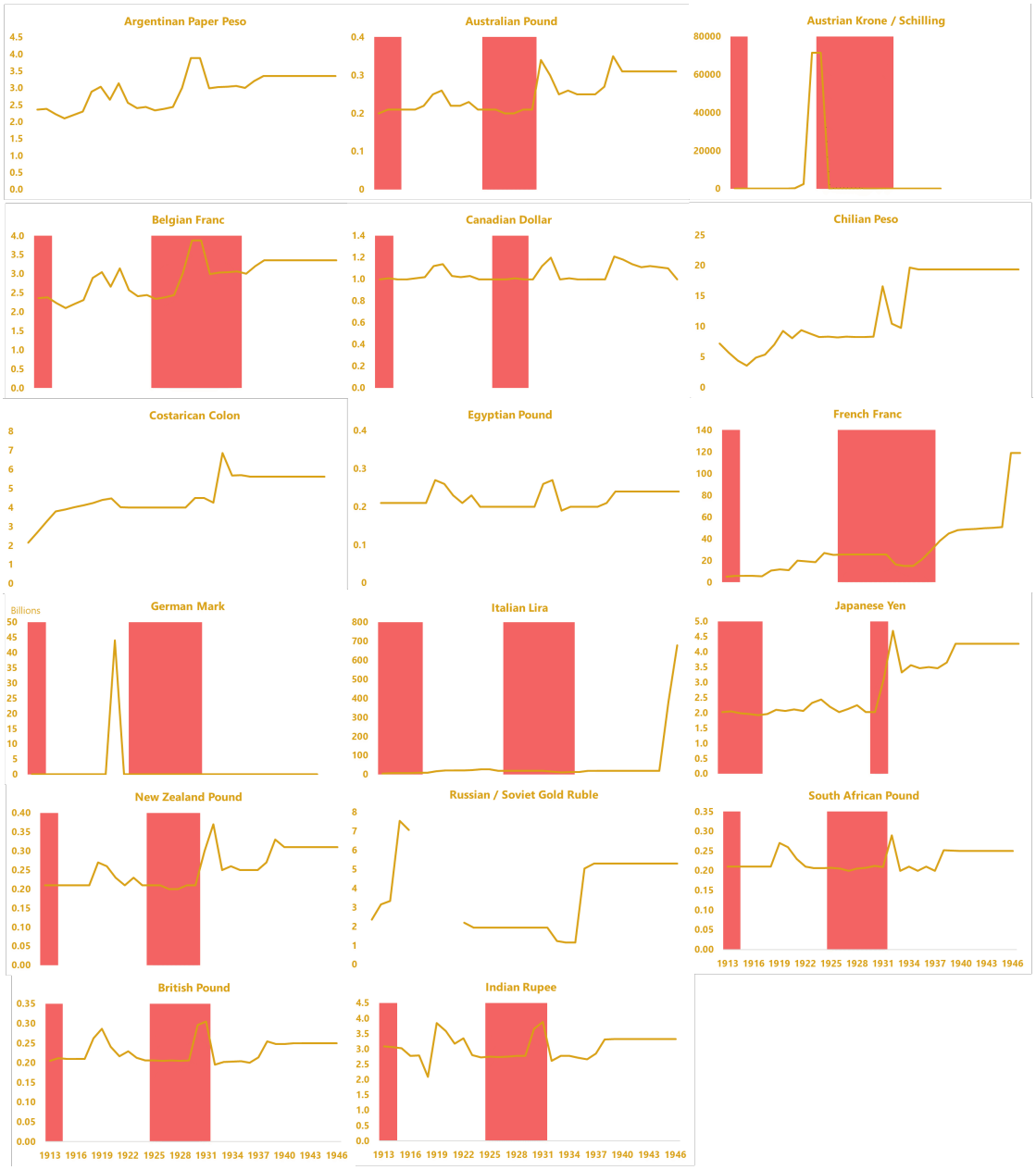
Country	Coverage	End of fiscal year	Exceptions
AMERICAS			
Argentine		December 31	
Bolivia		December 31	
Brazil		December 31	1933 = March
Canada		March 31	
Chile		December 31	
Colombia		December 31	
Costa Rica		December 31	
Cuba		June 30	
Dominican Rep.		December 31	
Ecuador		December 31	
Guatemala		December 31	1944 = June
Haiti		September 30	
Honduras		July 31	1937-1945 = June
Mexico		December 31	1914-1916 = June
Nicaragua		December 31	1916 = October; 1921 and 1929 = March; 1930-1936 = Feb; 1937-1938 = Jan
Panama		June 30	1926, 1932 = Sep; 1931, 1935 and 1939-1944 = Dec
Paraguay		November 30	1935, 1936, 1946, and 1947 = Dec; 1939-1945 = Oct
Peru		December 31	
Salvador		December 31	
U.S.		June 30	
Uruguay		December 31	
Venezuela		June 30	
ASIA-PACIFIC			
Australia		June 30	
China		??	
India		March 31	
Iran		??	
Iraq		??	
Japan		March 31	March, except 1946 = Feb
New Zealand		March 31	
Siam		Various*	March, except 1940 = Dec, 1940 = Sep, 1946 = Oct

currency. However, accounting for the fact that the U.S. dollar was unpegged from gold in 1934 and consequently depreciated, we introduced another proxy for the universal currency—gold. For currency conversions we used the exchange rates published by the Federal Reserve (Board of Governors of the Federal Reserve System (1943); League of Nations (misc) and Figure 2.27).

Country-specific issues

Argentina Several instruments reported by the government and included in the domestic component of the public debt possess all features of foreign obligations. Three instruments called *Credito Argentino Interno* were included in the internal debt section, while they were issued on European markets with the option of for both principal and interest payments to be made abroad. Even though some of these bonds were also issued domestically, we assume that these instruments were foreign in their full amount. Besides, the League of Nations reported Argentinian debt under "legal parity" and "contractual exchange rates." We relied on information on

Figure 2.27. *The evolution of various exchange rates during the interbellum period*



Sources: Board of Governors of the Federal Reserve System (1943), Reinhart and Rogoff (2011b), authors' calculations.

Note: End-of-period exchange rates, national currency per U.S. dollar. These are comparable to the exchange rates provided as of end of fiscal year published in the League of Nations publications. If no data is available for the end-of-period, fiscal year exchange rates are used instead. Shaded areas indicate years in which a country adheres to the gold or gold exchange standards.

amounts of debt issued in the original currency to back out amounts by instruments in a common convertible currency.

Australia Australia issued substantial amount of war loans that only are vaguely described in the League of Nations' books, while representing a substantial chunk of debt. We used the amount of loans issued and aggregates reported by Moody's and assumed the shares of each instrument to be constant.

(1) The Commonwealth of Australia agreed to take over the foreign debt issued by the States in 1928. The League of Nation did not report debt of the States up until this year, while they represented a sizable portion of the overall Australian financial obligations. We retropolated individual State debt instruments by using Moody's articles covering the Australian States as well as the State Finance section of Australian Yearbooks.

(2) Most instruments summarized in the League of Nations tables do not have issuance date, only the maturity date, which complicated the interpolation process.

Austria Changing country borders led to complex arrangements for the settlement of the pre-Austria imperial debt and of the relief loans received after the first World War.

Chile The League reported foreign debt, which was entitled in various currencies, after converting to domestic currency under the assumption of the fixed exchange rate, because the spot exchange rate fluctuated considerably. By contrast, we applied flexible end-of-year exchange rates, so that our aggregates are substantially different from that of the League.

France A number of complementary sources were used.

(1) Both League of Nations and national sources relied on a changing public debt perimeter—in particular, some debts were issued or bought by public banks and corporations, and the government at times assumed the debt service of public companies (such as railways), guaranteed local and colonial governments, and built financial liabilities in the form of annuities rather than public debt. We included any instrument that seemed to ultimately be a central government liability.

(2) In the 1920s, the French realized they could not service their debt towards allies and investors in allied countries if Germany did not honor its war reparation obligations. Consequently, the French stopped reporting their foreign liabilities transparently. In 1924, they stopped reporting foreign debts in actual francs and referred only to the gold franc value—thereby underestimating them roughly fivefold. As international negotiations to solve the war debt issue stalled, national statistics stopped reporting these debts altogether.

(3) Most of the WWI and WWII accounting occurred ex post and is complicated by changing borders and the German occupation. It is especially difficult to gauge (a) the implicit debt

imposed by the Reich onto the Vichy government through the occupation levy, (b) the money borrowed in 1945 from the U.S.[40]

Germany Estimation of German reparation stock required us to refer to original agreements, since the League of Nations books do not provide such information. We split the period from 1924 to 1936 into three sub-periods.

(1) According to the Dawes plan introduced in 1924, Germany had to pay RM 1 billion in 1925, RM 1.22 billion in 1926, RM 1.5 billion in 1927, RM 1.75 billion in 1928, and RM 2.5 billion RM annually over the period of 45 years from 1929. The volume of reparations using the Dawes plan annuities is RM 41.6 billion in 1924 prices, which is consistent with Ritschl's (2012) estimation.

(2) The German economy proved incapable of servicing the reparations, which resulted in several rounds of renegotiation. In 1930, the Young plan lowered the annual reparation payments and spread them over a period of 58 years. Using the annuities from the Young plan, we could identify the sharp decrease in outstanding reparations from 46.9 billion in 1929 to 37.5 billion in 1930. The German tranches of the 1930 Young loan were issued in British pounds, distributed among the domestic investors, and thus recorded under domestic debt, while League of Nations statisticians considered as part of foreign obligations. We decided to follow the residency criterion and classify these loans as domestic.

(3) With the rise of the Nazi party in 1933, reparation payments were substantially reduced, followed by an indefinite halt of payments in 1936. The reparation stock for the remaining period (1933–1936) is calculated based on the actual transfers to the BIS from Germany.

Japan Japanese bonds used to be characterized by a mark or a counter—letters in the *hiragana* alphabet (*e.g.*, *ro, tsu, ne*), ordered in a specific way. The League reports were widely incomplete and missed the differences between all these instruments. Using national sources, we managed to disentangle aggregates and get a fuller picture.

New Zealand The League of Nations publications do not contain sufficient information for disaggregation or interpolation. For example, debt instruments were reported without issuance dates. Turning to national sources, we encountered some issues with the lack of information on whether a debt instrument was issued locally or abroad. We therefore supplemented national sources with Moody's publications, matching instruments with their descriptions using the due date. Furthermore, instruments were grouped differently across various vintages of national sources. In earlier vintages, the amounts were grouped by authorization acts, while the same instrument could be divided across several different acts in later vintages.

[40] Which was ultimately washed down by the 1947 Paris Peace Treaties and devaluations.

Russia/U.S.S.R. The stock of debt contracted under the tsarist regime stopped being published in 1915 and the Soviets repudiated it formally in February 1918. To fill in the gaps between 1915 and 1918, we used data on debt service to infer the evolution of the stock of imperial debt. For a couple of years after repudiation, no debt was apparently issued, until the first bread loan in 1923. Detailed annual information on outstanding external debt in the 1930s, which mostly took the form of mostly governmental loans, is sparse. When unavailable, we assumed that the credit amount remained unchanged for the entire initially agreed period. Moreover, we exclude the liability created by the 1941 Lend-Lease agreement with the U.S., absent a reliable valuation. Several attempts were made to assess the value of goods, equipment, vehicles and food delivered by the U.S. during WWII, but the various estimates differ widely. Eventually, after several decades of negotiation about the amount of goods received, Russia agreed to repay the U.S. a small fraction of what was delivered and outlived the war.

2.D Taxonomy of debt instruments

Public debt in this database refers to debt contractually incurred by the central government of a country. This definition excludes municipal and other sub-central government debts, as well as debt guaranteed by the government (typically, securities issued by state-owned industries or banks).[41] However, debt taken over explicitly by the central government are part of our database starting on the date of debt assumption. Hence, some instruments can appear in this database well after their issuance dates. The database also includes non-marketable debt—obligations that specific agencies or individuals (*e.g.*, a central bank advance or a pension annuity) hold nominatively and cannot sell either over the counter or on a secondary market.

Since domestic debt markets were not yet internationalized during the interwar period, instruments were not harmonized across countries and time. Bond denominations did not follow any specific standards and were not necessarily in line with today's understanding. For instance, a sovereign "loan" was a security, not a credit. Against this backdrop, liabilities in the IDD were classified by the nature of promised cash flows into the following instrument types:

Bond Debt instrument that obligated the government to two types of cash flow: (1) a principal when the bonds were presented to the paying agent on or after their maturity date; (2) interest payments when attached coupons were presented to the paying agent. During the interwar period, bullet bonds were rare; most bond principals could be paid before the maturity date. In addition to principal, some premiums or prizes could be given away

[41] The data for Australia include the information for the states from 1931 (the year of the Commonwealth Debt Conversion Act, i.e. conversion of the internal public debts of the Commonwealth and the states). Newfoundland's debt is included in total debt for Canada from 1934.

by the government. They could be called *loan* or *notes*, depending on national traditions. Some bonds, such as the British *stocks*, were inscribed or held at a deed register; they could only be transferred through a deed, which was considered a more secure method of transferring ownership of the claim. Inscription entailed a process of writing ownership into the lenders' books.

Perpetual A particularly popular type of bond in the beginning of the twentieth century were perpetuals. These *consols* or *rentes* had no maturity date, which means that the principal was never paid—unless the government or the bondholder activated their potential options to redeem it. Formally, the promised cash flow is an infinite series of interest payments.

Bill Debt instrument without coupons, generally with a shorter-term maturity than bonds. The interest was implicitly or explicitly pre-counted, that is, deducted upfront, as a discount between the issue price and the facial principal. This category includes numerous Treasury bills. Some of the bills, generally very short-term ones, were implicitly rolled-over unless creditors objected.

Credit These instruments were generally contracted with financial institutions and provided annual payments of both some principal and interests. It came either as a one-off borrowing, or as lines of credit on which governments could draw on demand (within pre-agreed ceiling). Another type of credit that common during wars was trade credits agreed with the intercession of allied governments; for instance, Morgan & Co. would provide trade credits to France for war supplies during WWI, with the Commerce and Treasury Secretaries' implicit approvals. By contrast with bonds and bills, where multiple small-denomination contracts were signed with a myriad of lenders, credits were by nature bilateral and more sizable. Consequently, they were probably more likely renegotiated on an ongoing basis. The debt reported in the IDD corresponds to the outstanding amount to be repaid

Advance These financing facilities were arranged with local bodies, other government departments (*e.g.*, Treasury, central bank), savings banks, or foreign authorities. They generally involved a low or null interest rate, an open-ended maturity, and were at best governed by by-laws rather than commercial contracts. A peculiar sort of advance was tax bonds; taxpayers gave the government an advance on future tax payments.

Account Demand or term deposits were sometimes made available to the government, either regulatorily or voluntarily. Typically, the government compelled or enticed through moral suasion state-owned enterprises (SOEs), colonial and subnational governments, to make their cash available to the government. This instrument is alike a credit line, but it is up to the account owner (*e.g.*, SOEs) to change the outstanding amounts.

Annuity Annual budget payments could be pledged, by law, as compensation for several reasons. For instance, old-aged or war pensions were recorded as capitalized annuities. Such debt had no set maturity date, and the government could amend its cash flow by law. It is different from a perpetual in that the annual payment is not a contractual coupon rate, rather a lump-sum allocated in each annual budget.

Other Some public debt instruments or aggregates for which no decomposition was possible fit in none of the above categories. This particularly includes arrears, a less trackable form of debt were payment delays, that were sometimes recorded as part of public debt. Arrears could be securitized—*i.e.*, suppliers could be paid in sovereign securities instead of cash, what some authors describe as forced loans. This category also encompasses debt transferred from provinces to central government, which it is typically not trivial to decompose into individual instruments. Unidentified small portions of public debt without any characteristic reported in the official documents were added to this category as well.

2.E Instrument characteristics

In addition to the amounts outstanding and the typology detailed in Appendix 2.D, the IDD includes a variety of instrument characteristics. Below are detailed definitions for each characteristic. The IDD also contains more detailed information, upon availability.

Table 2.3. *List of currencies*

Currency	Code	Currency	Code
Argentinean Paper Peso	ARS	Greek Drachma	DRA
Australian Pound	AUP	Indian Rupee	INR
Austrian Krone	AUK	Italian Lira	ITL
Austrian Schilling	ATS	Japanese Yen	JPY
Belgian Franc	BEF	New Zealand Pound	NZP
British Pound	GBP	Norwegian Krone	NOK
Canadian Dollar	CAD	Russian (gold/soviet) Rouble	RUB
Chilean Peso	CLP	South African Pound	SAP
Costa Rican Colon	CRC	Spanish Peseta	PTA
Czechoslovak Koruna	CZK	Swedish Krone	SEK
Dutch Guilder	NLG	Swiss Franc	CHF
Egyptian Pound	EGP	Uruguayan Peso	UYU
French Franc	FRF	United States Dollar	USD
German Mark	DEM	Gold	Gold

Issuer The country whose sovereign issued or guaranteed the instrument (*i.e.*, 18 countries included in the IDD).

Instrument name Taken directly from the LoN publications, Moody's and/or national sources. Names typically contained information about the type of instrument, the coupon rate, and either issuance date or maturity. They were also useful for tracking different instruments across various sources used to compile the database.

Entity The entity issuing the instrument. In the database, this column contains the following values: `bank`, `CB` (central bank), `CG` (central government), `LG` (local government), and `SOEs`.

Residency and Currency The market on which the instrument was issued and the currency of issue (see Table 2.3 for the various currencies in the database). This can be any one of the values under "Issuer", or a combination of the values for bonds that were issued on multiple markets. For instruments issued in multiple currencies, we were generally able to break down exactly between each—but sometimes we relied on equal share assumptions. Foreign debt refers primarily to residency, which we define somewhat subjectively. Since there is no information about the ownership of individual bonds, we classify a security as foreign when it was intended for foreign investors—typically, when it was issued mainly on foreign stock exchanges, in foreign currency, or with exchange rate guarantees (*e.g.*, a 'gold clause'). Sometimes, the same instrument was issued in several countries. Whenever possible, we tried to break the instrument down between the various countries of issuance.

Transferability Refers to whether (or not) the debt was transferable through secondary markets. The dataset includes the following values: `Y` (transferable), `N` (non-transferable), `NA` (no information available) and `T` (for inscribed stocks).

Coupon rate Interest rate associated with the instrument (expressed in percent). Coupon rate is generally the easiest characteristics to report. This is the nominal interest payment that was promised upon issuance, given on a yearly basis (interest payments were generally semi-annual or quarterly).[42] Therefore, it does not include the various premia that were often granted upon issuance or redemption. If interest rates were pre-counted (*i.e.*, paid upfront at issuance), then we assume the coupon rate was nil. If interest rates were readjusted regularly, in the case of either short-term bills that were automatically or regularly reissued or formal indexation to a reference rate (which were quite rare), then we would classify them as `floating`.

Interest payable Months in which interest was paid to the instrument bearer. This information is always mainly for tradable bonds.

[42]Technically, coupons were pieces of paper attached to bonds, which holders had to exchange at given dates for cash at the Treasury. Hence, it is used as shorthand for the nominal rate of interest on a security (Wormell, 2002).

Issuance Date on, or year during which the instrument was issued. For the few instruments that were issued on tap, this would be the time of first issuance.

Maturing date Ultimate redemption date for the principal. When the instruments were semi-automatically rolled over, this is coded as `rolling`.

Maturity Difference between "Maturing date" and "First issuance". Items where no information was provided on maturity were classified based on the instrument type, *i.e.* bills, credit, notes, advances and allied bonds and miscellaneous borrowings considered as short-term obligations, while loans, bonds, stocks, and annuities as long-term. Perpetual bonds, which were quite common until WWII, are classified as long-term bonds, even though they technically never pay any principal back. Implicitly, the maturity can be found as the date at which interest payments total the initially borrowed amount P. For an annualized coupon rate c, the implicit maturity is: $\tau = 1/c$. For a 5-percent perpetual, for instance, this is 20 years. Alternatively, the duration would be a function of bondholders' average life expectancy.

Redemption Some debt instruments had embedded options that let either the government or the lender trigger principal repayment earlier than the maturity date. Government's early redemption could involve lotteries or randomization, as well as largess when computing the current latent value of the bond. Possible values are `Y`, `N`, and `NA`, with additional details in the adjacent column—who could call the redemption option (`Holder`, `Issuer`, `Issuer/Holder`) and how redemption was organized (`Lottery` or `SF` for sinking fund).

Start Redemption Usually, governments kept the option the redeem their bonds to benefit from improving market conditions; however, this type of redeemability would often start a few years after issuance (thereby respecting some sort of grace period) and involve a randomization (or lottery) to decide which bonds would be redeemed first.

Grace period Difference between "Start redemption" and "First issuance".

Sinking Fund These were cash reserves established to assist in the redemption of public loans on maturity. Portions of budget revenues were sometimes devoted to these funds. Permanent or funded debt was usually debt for which a sinking (redemption) fund had the liability to pay the interest. Possible values are `Y`, `N`, and `NA`.

Tax Taxability is an important characteristic of debt management, although often overlooked by the literature. Tax incentives to hold sovereign debt were common and changed the effective return on such an investment. Tax exemptions could be granted for interest gains under the income tax, for capital gains related to holding sovereign bonds, or more generally for all taxes. Blanket exemptions were almost always granted to foreign bondholders. Possible values are `Y`, `N`, and `NA`.

Purpose A broad categorization of the purposes for which instruments were issued. Indeed, it was common at the time that Parliament had to approve each issuance, and that was generally done within the context of a legal instrument that implemented specific policies. In addition, it was part of the advertisement of the bond placement to familiarize the buyer what they were contributing to finance (*e.g.*, war or liberty). Possible values are: `Conversion`, `Defense`, `Economic development`, `Infrastructure`, `Miscellaneous`, and `NA`.

Miscellaneous information Complementary information is added on an *ad hoc* basis. For instance, the rare cases of bond indexation, details on taxation regimes, or the debt's official purpose are recorded, whenever it was possible. More detail on any of the other columns is also provided here. For Japan, we document the mark given to each series of securities—a Japanese character used in Imperial Japan to enumerate things. For Argentina and Chile, we add law or decree number that authorized the issue if available.

2.F Central bank balance sheet data

To gauge the central bank's exposure to the sovereign—in other words, the extent of monetary financing and fiscal dominance—, we also compile itemized balance sheet data for the central banks of the countries in our dataset.

The main source for this is the League of Nations publications on Money and Banking.[43] Since these publications were sporadic, we cannot cover the entire 1913–46 period and generally miss 1914–17, 1926–28, and the outer years of WWII. In addition, the League of Nations changed its standardized balance sheet classification after the Great Depression. In the IDD, we document clearly how we approximate the post-Great Depression classification into that prevailing before 1929. For instance, we assume implicitly that collateral involved in *repo* transactions or discounted by central banks had to be mostly constituted of sovereign or quasi-sovereign papers. Similarly, we recorded deposits under other deposits by default, unless it was obvious that it was a current account.

2.G Assessing public debt sustainability

As in Bohn (1998), sustainability can be related to the intertemporal financing constraint that the government faces. This relates the increase in public debt D_t to the primary fiscal balance PB_t and the interest rate r:[44]

[43] League of Nations (1922a, 1923a, 1924a,b, 1926, 1931a, 1934, 1935, 1936a).

[44] The same equation holds in nominal and real terms. The empirical literature general favors macroeconomic variables in real terms. Deflating by a price index could however hide complacent monetary

$$D_t = (1+r)D_{t-1} - PB_t \tag{2.1}$$

Iterating this debt dynamics equation forward yields a transversality condition, also known as non-Ponzi game condition:

$$\lim_{t\to+\infty} \frac{D_t}{(1+r)^t} \leq 0 \tag{2.2}$$

It would be verified, for instance, if debt grew slower than interest rates. When the transversality condition holds, equation (2.1) can be rewritten in terms of the net present value of future primary surpluses:

$$D_t \leq \sum_{s=t+1}^{+\infty} \frac{PB_s}{(1+r)^{s-t}} \tag{2.3}$$

To test whether these relations hold, empirical studies run stationarity tests on fiscal variables. For example, first of a prolific literature, Hamilton and Flavin (1986) conclude that the U.S. debt was sustainable between 1962 and 1984 by showing that annual series of government debt and deficit were both stationary. in line with this, we run stationarity tests on our series of government debt. We find that the public debt was not stationary for the vast majority of the countries in our sample, and in some cases not even $I(1)$ (Table 2.4).[45] Since our sample covers 1913–46, the sharp increases in public debt during the World Wars could bias this finding. However, running the same stationarity tests on the interwar sub-sample leads to comparable results. Last, to account for the limited number of annual observations we have for each country (at most 33 years), we also run panel unit root tests. Table 2.5 shows the results for the Im et al. (2003) test, as well as Choi (2001)'s Fisher-type tests, which allow for unbalanced panels and country-specific autoregressive factors. They confirm that public debt was globally unsustainable during the period.

Another strand of empirical studies uses cointegration techniques to test whether debt is sustainable. Haug (1991) demonstrates that a sufficient condition for the transversality condition to hold is that the primary deficit and debt series be cointegrated. We run cointegration tests using the fiscal series compiled by Mauro et al. (2015) and government revenue data from Mitchell (1998). Results are shown in Table 2.6. Columns (2)–(3) report Engle-Granger tests for debt, primary balance and revenue as a percent of GDP, while columns (4)–(5) report the same but for nominal amounts in local currency. We do not find any evidence of cointegration. Additionally, we estimate Bohn equations to see whether the fiscal deficit is negatively correlated with the

policies that help inflating debt away. In this presentation, we omit stock-flow adjustments and suppose interest rates constant.

[45] As a robustness check, we run the same tests on different debt series: in local currency units *vs.* U.S. dollars gold equivalent, and for foreign vs domestic debt, finding each time broadly similar results.

Table 2.4. *Unit root tests on debt in local currency*

	Level					First difference				
	ADF_{nc}	ADF_{c}	PP_{nc}	PP_{c}	$KPSS_{c}$	ADF_{nc}	ADF_{c}	PP_{nc}	PP_{c}	$KPSS_{c}$
Argentina					**					*
Australia					***	*		***	***	
Austria					*	***	***	***	***	
Belgium					**	**		**		
Canada					**	***	**	**	*	
Chile					***	***	***	***	***	
Costa Rica		*		**	*	***	**	***	**	
Egypt					***	***	**	***	***	
France					*	**				
Germany			*			**		***	***	
India						**	*	***	**	
Italy					*					
Japan					**					**
New Zealand					**	**	*	***	***	
South Africa					*			***	***	
UK					*			**		
US					**	***	***	**	*	

Notes: DF, ADF, PP, and KPSS stand for Dickey-Fuller, Augmented Dickey-Fuller, Phillips-Perron, and Kwiatkowski-Phillips-Schmidt-Shin tests. `nc` and `c` denote without and with constant. ***, **, and * indicate rejection of the null hypothesis at the 1, 5, and 10 percent level of confidence respectively, while the tests fail to reject it when the cell is empty. The null hypothesis is the existence of a unit root, except for the KPSS test where it is that the series is stationary.

level of debt in the previous year. For most countries of our sample, the primary balance is at best weakly responsive to public debt. Lastly, since countries reformed their tax systems during the period, we examine debt-to-revenue ratios and find them to be non-stationary as well, confirming that debt was not sustainable.

2.H Some concepts of network analysis

The external debt network is formally a dynamic, directed graph whose nodes are the countries $(i)_{1\leq i\leq n}$ and whose directed edges are the debts: $D_{i\to j,k,t}$, the outstanding debt lent by country i to country j on the k-th instrument at time t, expressed in gold equivalent. An aggregate version is the (simpler) network composed of the bilateral debts $D_{i\to j,t} = \sum_k D_{i\to j,k,t}$.[46]

[46]To simplify the presentation, we keep all debt instruments at all time; there outstanding value is simply nil before they are first issued or after they are fully amortized. At year t, the adjacency matrix is therefore $A_t = \left(\delta_{D_{i\to j,t}\neq 0}\right)_{i,j,t}$ and the number of active nodes is $n_t = \sum_i \min\left\{1; \sum_j \delta_{D_{i\to j,t}\neq 0} + \delta_{D_{j\to i,t}\neq 0}\right\}$. The Dirac function δ_x is 1 if x and 0 otherwise.

Table 2.5. *Panel unit root tests*

	Level					First difference				
	ADF_{nc}	ADF_c	PP_{nc}	PP_c	$KPSS_c$	ADF_{nc}	ADF_c	PP_{nc}	PP_c	$KPSS_c$
Argentina					**					*
Australia					***	*		***	***	
Austria					*	***	***	***	***	
Belgium					**	**		**		
Canada					**	***	**	**	*	
Chile					***	***	***	***	***	
Costa Rica		*		**	*	***	**	***	**	
Egypt					***	***	**	***	***	
France					*	**				
Germany			*			**		***	***	
India						**	*	***	**	
Italy					*					
Japan					**					**
New Zealand					**	**	*	***	***	
South Africa					*			***	***	
UK					*			**		
US					**	***	***	**	*	

Note: This table reports the p-values for each test, the null hypothesis being that all panels contain unit roots.

The **degree of a node** is the number of nodes in direct connection and can be interpreted as the number of countries directly dependent on a given country. In a directed graph, the in- and out-degrees of a node are respectively the number of edges directed into and out of that node, in other words the number of countries lending to and borrowing from a specific country. They can formally be written as:

$$Deg_{\rightarrow i,t} = \sum_j \delta_{D_{j\rightarrow i,t}\neq 0} \quad , \qquad Deg_{i\rightarrow,t} = \sum_j \delta_{D_{i\rightarrow j,t}\neq 0} \tag{2.4}$$

where the Dirac function is $\delta_x = \begin{cases} 1 & \text{if } x \\ 0 & \text{otherwise} \end{cases}$. The degree can also be weighted by the size of each connection—*i.e.*, by the amount of outstanding debt. The average in- and out-degrees are simply the average amount of outstanding debt per country.

The **maximum k-core** of the network is the sub-graph of countries with maximal degree.

Table 2.6. *Cointegration Tests and Bohn Estimates*

	Bohn coefficient	Cointegration tests			
		D/Y+B/Y	D/Y+R/Y	D+B	D+R
	(1)	(2)	(3)	(4)	(5)
Argentina	-0.036			na	
Australia	0.039 **			na	
Austria	0.192 **				
Belgium	0.123 **			*	*
Canada	0.060 **				
Chile	0.076 **				
France	0.040 *				
Germany	0.091 ***				
India	0.062 *				
Italy	0.066 *				
Japan	0.003 *				**
New Zealand	0.003 *			*	*
South Africa	0.072 **				
UK	0.083 ***				
US	0.051 ***				***

Notes: The Bohn coefficient is the estimator β in the Bohn equation $\frac{B_t}{Y_t} = \alpha + \beta \frac{D_{t-1}}{Y_{t-1}} + \gamma \frac{B_{t-1}}{Y_{t-1}}$. B/Y, R/Y, and D/Y are respectively the primary balance, revenue, and debt ratios to GDP. ***, **, and * respectively indicate the 1, 5, and 10 percent level of confidence for statistical significance in column (1) and the Engle-Granger test rejection of the null hypothesis that there is no cointegration in columns (2)-(5). Empty cells are for non-rejection and `na` for insufficient data availability.

Degree centrality is the unweighted in/out-degree normalized by the number of possible connections:

$$DegCentr_{\rightarrow i,t} = \frac{1}{n_t - 1} \sum_j \delta_{D_{j \rightarrow i,t} \neq 0} \quad , \qquad DegCentr_{i \rightarrow,t} = \frac{1}{n_t - 1} \sum_j \delta_{D_{i \rightarrow j,t} \neq 0} \tag{2.5}$$

While it does not account for the amounts involved, it quantifies how many countries were exposed to a given sovereign's default or to a sudden stop from a given country.

Closeness to other nodes in the network is a measure of the importance of a node for the overall network, rather than direct neighbors. If $H_{i \rightarrow j,t}$ is the hop-count (*i.e.*, the length of the shortest path) from country i to country j, we can compute measures of systemicity and exposure as the out- and in-closeness:

$$Systemicity_{i,t} = \frac{(n_{i \rightarrow,t} - 1)^2}{n_t - 1} \left(\sum_{j \neq i} H_{i \rightarrow j,t} \right)^{-1} \tag{2.6}$$

$$Exposure_{i,t} = \frac{(n_{\rightarrow i,t} - 1)^2}{n_t - 1} \left(\sum_{j \neq i} H_{j \rightarrow i,t} \right)^{-1} \tag{2.7}$$

Since our graphs are in general not strongly connected and may have several disconnected components, we apply Wasserman and Faust (1994)'s correction, attributing small components a smaller closeness value. Thus, $n_{i\rightarrow,t}$ and $n_{\rightarrow i,t}$ are the number of reachable nodes from/to i. These two measures can also be computed by replacing the hop-count with the distance between nodes; namely, the inverse of the outstanding debt tying countries together.

The **betweenness** represents the importance of a node as a vector of contagion. If $P_{j\rightarrow i,t}(k)$ is the number of shortest paths from j to i that transit through k, then we have:

$$Betweenness_{k,t} = \underset{i,j}{\text{Average}} \frac{P_{j\rightarrow i,t}(k)}{\sum_\ell P_{j\rightarrow i,t}(\ell)} \tag{2.8}$$

Clustering is another source of systemic weakness. The existence of clusters hosting circular dependencies potentially conducts and amplifies shocks. To measure this, we rely on a clustering coefficient that can be understood as the probability that two neighbors of a node are neighbors themselves. The weighted, directed definition of this clustering coefficient is (Fagiolo, 2007):

$$Clust_{i,t} = \frac{1}{\sum_{j,k} D_{j\rightarrow k,t}} \sum_{j \neq i, k \notin \{i,j\}} \frac{\sqrt[3]{D_{j\rightarrow i,t} D_{i\rightarrow k,t} D_{k\rightarrow j,t}}}{Deg_{i,t}\left(Deg_{i,t} - 1\right) - 2Deg_{i\leftrightarrow i,t}} \tag{2.9}$$

The total degree is $Deg_{i,t} = Deg_{i\rightarrow,t} + Deg_{\rightarrow i,t}$ and $Deg_{i\leftrightarrow i,t}$ is the number of nodes with which i forms a simple loop.[47]

The **central point of dominance** is a measure of how much the network is vulnerable to a few nodes:

$$Dominance_t = \frac{1}{n_t - 1} \sum_i \max_k Betweenness_{k,t} - Betweenness_{i,t} \tag{2.10}$$

[47] A simple loop is one without node repetitions.

Chapter 3

Rousseau's Social Contract or Machiavelli's virtue? Measuring Fiscal Credibility

"A statement is persuasive and credible either because it is directly self-evident or because it appears to be proved by statements that are so."

— Aristotle (4th century BC) *Rhetoric*

*The concept of fiscal credibility is a watermark of some of the fiscal policy literature, but beyond an intuitive parallel with monetary policy, it remains not well defined, nor measured. This chapter provides an explicit measure of fiscal credibility, based on the anchoring of private expectations onto official targets. I document how credibility varies among a sample of 27 European countries and evolves over 1995–2019. I find that private agents do not trust all governments uniformly. Country differences are mainly driven by past fiscal performance and institutions (fiscal rules and councils). Conversely, I find that credibility impacts sovereign financing conditions. Governments should thus strive to be (*à la *Rousseau) or appear (*à la *Machiavelli) credible.*

Contents

3.1 Introduction

Compared with monetary policy, fiscal policy is often seen as the prodigal son of the macroeconomic policy toolkit. The literature seems to consider it a less powerful tool than monetary policy—an "alchemy" rather than a "science" (Leeper, 2010)—even though during crises, such as the 2008–09 Global Financial Crisis and the current CoViD-19 crisis, fiscal policy emerges as easier and faster to deploy. At the root of fiscal policy's bad reputation, the fundamental time-inconsistency of elected governments make their announcements and commitments difficult to trust. In other words, there is a common belief that most governments, by their political nature and relatively short-term incentives, lack credibility.

The concept of credibility is rooted in the simple idea that policymakers commit to certain policies with a view to achieving certain objectives. When economic agents (*i.e.* voters, markets, consumers, investors) expect that this commitment will be fulfilled, the policies are deemed credible. Therefore, credibility is synonymous for "anchored expectations," meaning that private agents believe that what governments announce will happen, at least within a reasonable margin of error and with a certain likelihood. Conversely, there are reasons why private expectations may differ from the government's announcements. If stated policy objectives were overtly unsustainable or unrealistic, markets and other observers would expect them to promptly fail to materialize, as financing constraints would soon face the undisciplined government and trigger a market-forced adjustment in fiscal policy. On the other hand, even when stated policies are virtuous, private agents can see reasons, such as political incentives and costs, for governments not to implement them, which is also a lack of credibility. A government, which pursues multiple, non-explicit objectives, has plenty of reasons to deviate from its official plan, thus generating instability in the formation of people's expectations.[1] Thus, both situations are not credible: a government that announces bad policies, or a bad government that has incentives to deviate, that is, time inconsistencies under limited commitment.

The literature has so far failed short of coining precisely the concept of fiscal credibility. One reason is that, contrary to monetary policy, it is more difficult to associate fiscal targets with a reputable norm. In the monetary policy literature, credibility is achieved when expectations are anchored *and* that anchor is optimal (*e.g.*, low and stable inflation). A central bank is typically not perceived as credible if it convinces private agents that it will pursue a hyper-inflationary or deflationary policy. However, the argument cannot be easily transposed in the fiscal world, as there is no clear optimal benchmark for fiscal policy. This is primarily because fiscal policymakers generally pursue multiple objectives and face complex trade-offs—the famous stabilization, allocation, and distribution functions outlined by Musgrave (1959).

[1]The monetary policy equivalent, even though in a much simpler context of dual objectives, is the inflation surprise framework.

This chapter fills a gap in the literature by providing an explicit measure of fiscal credibility. Mimicking the monetary literature, my main measure is the divergence between private expectations and official targets about the overall fiscal deficit. The intuition is that a credible government should succeed in anchoring expectations through the release of official forecasts. Anchoring not only means a relatively small spread between private and official forecasts, but also a low dispersion and overtime stability of private forecasts (Capistrán and Ramos-Francia, 2010; Dovern et al., 2012; Demertzis et al., 2012; Kumar et al., 2015). In particular, credibility should not vary across the business cycle. Building on these principles, I compile several other, complementary indicators of fiscal credibility. Using the governments' stability and convergence programs (SCPs) and draft budgetary plans (DBPs) and the Consensus Economics forecasts as main sources, I collect data for 27 European countries over the 1995–2019 period, totaling more than 4,250 observations.

The chapter derives some regularities about this credibility indicator. I discuss first how countries are performing from a static perspective; I look at what countries are the most credible, on average over the sample—that is, whose official forecasts have been the most successful at anchoring private expectations. I find substantial differences across countries. For some, there is a systematic bias between official announcements and market players' beliefs (up to 1 percent of GDP on average). This, in itself, confirms that agents are more wary about some countries than others and raises questions as to what makes agents trust some countries more. Then, I show that credibility behaves like a stock of trust that builds up and fades only slowly over time.

I identify correlations between fiscal credibility and the macroeconomic, institutional, and political environment, along with fiscal policy objectives and track record. I confirm, through panel regressions, that these factors influence agents' opinions about how credible a government and its fiscal targets are. I find that credibility is a mean-reverting process that responds to shocks such as the release of new official targets. I confirm that credibility is influenced simultaneously by the macroeconomic environment, policy decisions and results, and the institutional setup—but among those, policy variables are the most influential. Credibility erodes when the government runs a high public debt or a large deficit, when there have been recurrent slippages in the past, and when planned fiscal adjustment is too ambitious. Institutions, such as fiscal rules or the fiscal councils that are in some countries in charge of setting macroeconomic assumptions for the budget or monitoring budget implementation, can contribute to improve credibility. Yet, they are not enough, *per se*, to ensure credibility, and rather operate by improving policymaking practices. The structure of the economy and the composition of public debt, as well as electoral cycles, economic uncertainty, and the government's political orientation play but a marginal role. This in turn proves that the credibility indicator developed in this chapter captures well the agents' responses to policy announcements and track record and truly reflects the confidence in the government's announcements rather than the strength of the economy.

Fiscal policy announcements play an important role of in catalyzing expectations. The publication of new official targets comes with a sizable (although short-lived) credibility dividend. Regular communication is thus important to anchor private agents' expectations against the backdrop of imperfect and noisy information and pervasive uncertainty. To that end, I find that budgetary institutions, a good track record, and limits to government discretion render the release of new targets more effective in unlocking this credibility dividend, and for longer.

I form the hypothesis that fiscal credibility is conducive of better fiscal and macroeconomic outcomes. Once fiscal credibility is established, fiscal policymakers can have more flexibility to respond to shocks and temporarily deviate from their objectives, improving the effectiveness of fiscal policy (similarly to the credibility hypothesis in the monetary policy literature). By contrast, the lack of credibility might put a budget off track: because financing might become scarcer or more expensive, because agents refuse to comply with tax legislation, or because they save more than optimal to prepare for future tax hikes. Fiscal credibility affects expectations and thereby intertemporal allocations; it should thus impact the sovereign interest rates, as well as consumption and investment decisions. If private agents do not expect the government to be able to deliver its fiscal promises, they might be afraid of future fiscal consolidation episodes, and respond by increasing precautionary savings (as they do under Ricardian equivalence, but for a radically different rationale).

I find a strong confirmation that credibility affects market perceptions and risk prices. Better credibility is significantly associated with better market indicators of sovereign risk. This confirms that governments should strive to build and maintain credibility, by means of better institutions, more prudent forecasts, and regular communication about progress towards targets.

The fiscal literature usually adopts a more positive approach. Many papers delve into whether the fiscal stance is sustainable and whether there are some normative thresholds (*e.g.*, Collard et al., 2013). They thus seem to consider governments as credible whenever they are within such thresholds. By contrast, I posit that governments should actively seek to convince agents, as credibility helps anchor expectations and deliver better macro-fiscal outcomes (Leeper, 2009). As noticed by Baker et al. (2016), fiscal policy is the largest source of policy uncertainty; anchoring expectations would thus make fiscal measures more predictable and more effective. As such, my approach has some contiguity with articles on fiscal forward guidance (Fujiwara and Waki, 2017), although the latter concept remains heterodox.

There are some similarities between the indicators built in this chapter and other fiscal measures commonly used in the literature. First, research on budget forecasts and fiscal slippage looks at the gap between forecasts and outturns, while I consider the gap between private and official forecasts. It uses this as a measure of forecasting errors; a bad track record of forecasting

performance can certainly be expected to undermine the credibility of government announcements, but it is not the only component of credibility. Second, similarly to the fiscal foresight literature (Forni and Gambetti, 2010; Leeper et al., 2013; Forni and Gambetti, 2016), I measure how fiscal shocks deform expectations and to what extent they come as surprises. Yet, my main channel is confidence, while the empirical fiscal foresight literature utilizes the lag between a policy decision and its legislative and effective implementation, which means that private agents receive clear advance signals about the tax rates and transfers they will face in the (near-term) future. Third, I look at the dispersion of market forecasters like papers on forecast disagreement (Lahiri and Sheng, 2010; Dovern et al., 2012; Ricco et al., 2016), but I use this dispersion as a proxy for confidence rather than intrinsic forecast uncertainty. Fourth, there is an obvious analogy between this chapter and the monetary policy literature, since I try like them to capture how well official targets and announcements help anchor private expectations.

The concept of fiscal credibility relates also to a broad stream of macroeconomic fiscal policy literature. For instance, the debate on expansionary versus recessive fiscal contractions is premised on whether Ricardian effects transit through the expectation formation process. The Ricardian equivalence is based on strong assumptions, for instance that private savings and government debt yield the same interest rate (Buchanan, 1976). Credibility considerations could on the contrary invalidate this assumption. If agents do not trust the government to achieve its fiscal commitments, then their response in terms of savings could be different from what Ricardian equivalence would anticipate. The empirical literature on fiscal multipliers is generally based either on observed fiscal outcomes, or on policy announcements; both fail to capture what agents expectations truly are. Likewise, recent mutations in fiscal policymaking, such as the implementation of fiscal councils, fiscal rules, and medium-term budgeting, have all been advocated by the need for governments to constrain their discretion and restore or improve their fiscal credibility. The literature on fiscal dominance is a warning to central banks that monetary credibility can easily be jettisoned by irresponsible—incredible—governments.

The next section develops the intuition and methodology underpinning the credibility indicators developed in this chapter. Section 3.3 then describes credibility inequalities between countries, before section 3.4 examines the dynamics of credibility and its correlation with other indicators. Building upon these stylized facts, section 3.5 conducts the empirical identification of credibility factors and impacts. Section 3.6 concludes with some political economy implications, especially in the current CoViD-19 context.

3.2 An indirect measure of fiscal credibility

This chapter proposes a novel proxy for fiscal credibility (or rather for the lack thereof): the gap between market forecasts and official plans for the fiscal balance. The intuition is that

a credible government should succeed in anchoring expectations through the release of official forecasts. This approach mimics that of the monetary policy literature, which shows that the extent of anchoring is intimately related to the credibility of the monetary strategy (Cukierman and Meltzer, 1986; King, 1995; International Monetary Fund, 2018).[2] Similarly, if a government is credible enough, private expectations about fiscal outcomes should be centered around the government's targets.

I focus on the fiscal balance (as a percent of GDP), which is the main headline, high-level summary of fiscal stance that everyone comments and monitors (media, watchdogs, and supranational institutions alike). Because of the close link between the fiscal deficit (*i.e.*, the government's financing need) and public debt, governments usually communicate on their annual deficit targets and justify slippages with respect to these targets. In other words, the fiscal balance corresponds to the natural headline target of fiscal policy—its main anchor. Importantly, it is also an aggregate indicator, which reflects myriad factors that act in concert (even more so than inflation in the case of monetary policy analysis) and a decentralized decision-making process (within and between several administrative levels of governments).[3]

Thus, the main measure of credibility developed in this chapter is holistic, in the sense that it captures any difference in forecasts between the government and private agents. Implicitly, I assume that, as long as the government and the market observe the same information, they should produce similar forecasts.[4] My credibility indicator includes a *pure credibility* factor—agents' trust in the government's willingness and ability to achieve the targets it sets forth—, but also the fact that they may have a different time horizon from the authorities, diverging views on the macroeconomic context, access to other sets of information, and a different balance of risks (governments tend to be more optimistic).

I choose to look mainly at the overall balance rather than a cyclically-adjusted or structural measure, as I consider that a government's counting on implausible macroeconomic assumptions lacks as much credibility as a government inflating its revenue projections. I consider that a credible government should be able to convince that it will reach its target, independently of news, transitory shocks, or cyclical developments. If need be, a government can in theory always adjust its spending to meet its overall balance target, were its revenues to exceed or come short of expectations. However, this is not always optimal. There may be reasons not to fol-

[2]Admittedly, monetary policy context is simpler, in the sense that there is in general one priority objective, which is inflation. By contrast, fiscal policy takes on many more goals.

[3]Outturns sometimes reflect the behavior of a particularly trouble-making subnational government (*e.g.*, Catalonia in Spain) or agency (*e.g.*, an ill-governed state-owned enterprise). My credibility indicator misses all forms of off-budget items, such as contingent liabilities.

[4]In practice, though, governments probably have a more forward-looking time horizon than private agents, thus factor in more long-term information and react less to temporary shocks.

low too strictly the initial budget target—typically, to avoid procyclicality when the economic environment abruptly changes. This is only possible when governments already enjoy a certain credibility, as for sizable shocks, they should trigger revised budgets.[5]

To check the implications of these methodological choices, I develop a cyclically-adjusted indicator of credibility. As explained in Appendix 3.C, I can decompose the overall credibility into two components: the credibility of the macroeconomic forecasts underpinning official budget targets (as proxied by growth projections) and the credibility of the budget targets themselves.

For each country i and monthly date t in my sample, I compute the discrepancy between private (superscript p) and official (superscript o) expectations ($\mathbb{E}$) regarding the overall fiscal balance in h years ahead, expressed in percent of GDP and denoted $b_{i,t+h}$.[6] By convention, the indicator is positive when the government expects a lower fiscal balance (*i.e.*, a larger deficit) than observers.

Definition 2 (Relative, instantaneous credibility)**.** The $(t+h)$-credibility of country i at time t is:

$$Cred_{i,t}^{(h)} \equiv \mathbb{E}_t^p b_{i,t+h} - \mathbb{E}_t^o b_{i,t+h} \tag{3.1}$$

For government expectations, I collect official plans, as detailed in stability and convergence plans (SCPs) and draft budgetary plans (DBPs). SCPs are the main tool for the European Union to coordinate national fiscal policies since the 1997 Stability and Growth Pact (SGP). Euro area countries submit a stability programs to the European Commission every year, while others submit a convergence program. Since the 2012 "two-pack" SGP reform, euro members additionally need to submit DBPs to the Commission when they send draft budgets to their own parliaments.

These various budgetary plans provide objectives rather than forecasts, akin to a central bank's inflation objective (except that they are more frequently redefined). They rely on certain macroeconomic forecasts; they incorporate some policy buffers so that governments can in theory adjust to shocks without missing their budgetary targets. I rely mainly on these plans and programs prepared for European institutions rather than national budget documents, for they have to follow an imposed format (in English), making them more comparable and more widely commented by European markets. During financial assistance programs ("programs" in the rest

[5]Similarly, central banks should in theory not respond to supply-side shocks (*e.g.*, temporary bursts of imported inflation or one-off changes in indirect tax rates), but may have to if their credibility is not solidly established yet and inflation expectations would respond too forcefully.

[6]This notation is slightly abusive, for t is a monthly date. The subscript $t+h$ is to be understood as a simplification for year $\lfloor t/12 \rfloor + h$. Besides, in this chapter, I use the convention that year y stands for the fiscal year $y/y+1$. This is only relevant for the U.K., whose fiscal year starts in April, whereas the budget year of EU countries coincides with calendar years.

of this chapter), countries file program and review documents rather than SCPs. Therefore, I incorporate program targets into my dataset.[7]

For private forecasts, the Consensus Economics publications constitute my main data source. Each month since 1989, this economic survey organization polls the macroeconomic forecasts of more than 700 economists worldwide, mostly within investment banks and economic research institutes. The published Consensus forecast is the unweighted, arithmetic average of each respondent's forecast:

$$\mathbb{E}_t^p b_{i,t+h} = \frac{1}{N_{i,t}^{(h)}} \sum_{forecaster\ f=1}^{N_{i,t}^{(h)}} \mathbb{E}_t^f b_{i,t+h} \tag{3.2}$$

It thus measures the central forecast of the market and private agents in general. While European governments provide official fiscal forecasts with a medium-term horizon, the Consensus forecasts mainly cover the current and upcoming years, so in this chapter I focus on $h \in \{0, 1\}$.[8] For some countries, the Consensus provides fiscal balance forecasts in nominal terms rather than a ratio of GDP; in such instances, as the Consensus does not comprise a nominal GDP forecast, I approximate the latter by assuming that: (1) the government and the market always share a common estimate of what nominal GDP was in the preceding year—given by the contemporaneous IMF's World Economic Outlook (WEO) forecast; (2) and private forecasters consider that GDP deflators grow at the same rate as consumer price indices.[9] I also complement the Consensus Economics data with market forecast data that are compiled by Bloomberg.[10]

While some papers about forecast interference highlight that forecasters might have strategic reasons to produce biased revenue forecasts or other forecasts where they have a cost-minimizing preference (Danninger et al., 2005; Christoffersen and Diebold, 1997), this is unlikely the case with the fiscal balance. I thus consider the Consensus' fiscal balance forecast to reflect the market's best prediction of fiscal outcomes, summarizing its views on current revenue and budget

[7] I limit this exercise to fiscal programs (those with Portugal, Ireland, Cyprus, and Greece), excluding the banking sector support program in Spain and the balance of payment assistance programs in Hungary, Latvia, and Romania.

[8] The idea of anchoring, especially in the monetary policy literature, is meant as more medium-term concept, but as far as I know, private agents rarely disclose their medium-term fiscal expectations. One could nevertheless argue that, given typical implementation lags for fiscal policy, fiscal credibility already materializes in one-year-ahead forecasts.

[9] In other words, I infer recursively the Consensus' nominal GDP forecast, starting with $\mathbb{E}_t^p Y_{i,t-1} = Y_{i,t-1}|_{\text{WEO}_t}$ and chaining:

$$\mathbb{E}_t^p Y_{i,t+h} = (1 + \mathbb{E}_t^p g_{i,t+h})(1 + \mathbb{E}_t^p \pi_{i,t+h})\mathbb{E}_t^p Y_{i,t+h-1}$$

Then, I linearly interpolate fiscal year GDP, as necessary.

[10] With Bloomberg, I extend the coverage to Austria, Belgium, Cyprus, Denmark, Finland, Greece, Ireland, and Portugal, as well as the time coverage for the Netherlands, Spain, and Sweden. As a data compilation rule, I give precedence to Consensus Economics, which generally polls more forecasters than Bloomberg.

policies, past government's performance, and exogenous factors.[11] Both the Consensus and Bloomberg provide mean forecasts across a pool of forecasters, but the latter do not necessarily update their projections every month. This admittedly generates persistence in the mean forecast, which might take a few months to respond to news shocks, such as the release of a new official fiscal plan. Such latency does not necessarily signal a lack of fiscal credibility, but it prevents the mean forecast to jump too fast in response to receiving new information (*e.g.*, high-frequency data). This is preferable, as government forecasts are updated even less frequently than private forecasts, usually once or twice a year. Importantly, I conjecture that credible fiscal targets and anchored expectations should weather news shocks steadily, trusting the government to take the necessary action to achieve its objectives.

I compute the fiscal credibility of 27 European countries, covering 1995 to 2019 and totaling 4,250+ data points. The sample includes the United Kingdom and all European Union (EU) countries, except for Luxembourg and Malta (Appendix 3.A). While equation (3.1) provides an instantaneous measure of fiscal credibility, I derive various complementary metrics aimed at capturing the intrinsic degree of fiscal credibility of a government.

First, as in the forecasting bias literature (*e.g.*, Frankel and Schreger, 2013), the average credibility over a period of time $\mathcal{T}$ is a proxy for a systematic bias between official announcements and market players' beliefs.

$$Cred_{i,\mathcal{T}}^{(h)} \equiv \left\langle Cred_{i,t}^{(h)} \right\rangle_{t\in\mathcal{T}} = \frac{1}{\|\mathcal{T}\|} \sum_{t\in\mathcal{T}} Cred_{i,t}^{(h)} \tag{3.3}$$

Second, the average absolute value of credibility is a measure of how far private forecasts are from official plans—it captures symmetrically the extent of the disbelief, irrespective of whether markets are more or less optimistic. In the forecasting error literature, such an indicator measures accuracy, rather than bias. Yet, I depart slightly from the literature (*e.g.*, Demertzis et al., 2012; Kumar et al., 2015), which commonly relies root-mean squared error (RMSE) statistics, in order to penalize more larger errors. I rather refrain from weighting more larger deviations, to remain neutral.

$$ACred_{i,\mathcal{T}}^{(h)} \equiv \frac{1}{\|\mathcal{T}\|} \sum_{t\in\mathcal{T}} \left| Cred_{i,t}^{(h)} \right| \tag{3.4}$$

The higher this absolute indicator, the less anchored are private expectations, the less credible the government (somewhat counter-intuitively). Moreover, this measure of credibility is symmetrical: it is agnostic as to whether it is better for governments to be more or less opti-

[11] By contrast, there is a clear case for governments to adopt strategic forecasts: this is exactly what I want to capture.

mistic than the private sector.[12] While markets are often and on average more pessimistic than governments (*i.e.*, they expect a larger fiscal deficit), cases where markets forecasts of the fiscal balance are above official targets still represent about one fourth of my sample. Therefore, compared with the *relative* credibility, which proxies perceptions that the government is overly optimistic, *absolute* credibility measures the (un)anchoring of expectations.

Third, since credibility is the ability to anchor expectations, credible governments should foster sufficient certainty to prevent markets from flickering whenever there is a shock or unexpected news. Therefore, another dimension of credibility is the volatility of market forecasts. Since Consensus forecasts are updated more often than official projections, credibility should mean that markets take exogenous shocks or economic news placidly. The more credible a government, the stickier market anticipations. We measure this by looking at the standard deviation of $Cred_{i,t}^{(\cdot)}$:

$$Vol_{i,\mathcal{T}}^{(h)} \equiv \left[\frac{1}{\|\mathcal{T}\| - 1} \sum_{t \in \mathcal{T}} \left(Cred_{i,t}^{(h)} - Cred_{i,\mathcal{T}}^{(h)} \right)^2 \right]^{1/2} \tag{3.5}$$

One can note that for a period of time $\mathcal{T}$ when the government keeps its fiscal target unchanged, $Vol_{i,\mathcal{T}}^{(h)}$ is also the standard deviation of mean private forecasts. I will use later a rolling version of this definition to proxy the recently-observed volatility: $Vol_{i,t}^{(h)} \equiv Vol_{i,\{t-12,\ldots,t-1\}}^{(h)}$.

Last, by virtue of anchoring expectations, credibility should also be associated with less dispersion in private forecasts (Capistrán and Ramos-Francia, 2010; Dovern et al., 2012). Forecast disagreement can be seen as the result of a Bayesian learning process in the midst of noisy information(Lahiri and Sheng, 2010; Ricco et al., 2016). Agents aggregate governments' communication and other sources sources of information, including some macroeconomic data; they weigh more the former when they trust the government's ability and willingness to carry out its official plan. In other words, the more credible the government, the more market anticipations should converge. Hence, I examine the dispersion $SdCred_{i,\mathcal{T}}^{(h)}$ of the various private forecasts that compose the Consensus.[13]

[12] Instead, I could have used a normative measure, such as

$$\exp^{\lambda\left(\mathbb{E}_t^o b_{i,t+h} - \mathbb{E}_t^p b_{i,t+h}\right)} - 1 - \lambda\left(\mathbb{E}_t^o b_{i,t+h} - \mathbb{E}_t^p b_{i,t+h}\right)$$

to weight more situations where governments are seen as too optimistic.

[13] The Bessel-corrected standard deviation of the consensus is reported routinely by Consensus Economics:

$$\sigma_{i,t}^{(h)} \equiv \sqrt{\frac{1}{N_{i,t}^{(h)} - 1} \sum_{f=1}^{N_{i,t}^{(h)}} \left(\mathbb{E}_t^f b_{i,t+h} - \mathbb{E}_t^p b_{i,t+h} \right)^2} \tag{3.6}$$

This statistic is unfortunately unavailable for countries covered only by Bloomberg data, which reduces my sample to 18 countries. Then I can average it over time:

$$SdCred_{i,\mathcal{T}}^{(h)} \equiv \left\langle \sigma_{i,t}^{(h)} \right\rangle_{t \in \mathcal{T}} \tag{3.7}$$

3.3 Who is credible?

Market forecasts are more conservative (or pessimistic) than governments (as already found by Frankel and Schreger, 2016). On average over the sample, private forecasts of the fiscal balance are smaller than governments' targets, with a country-average credibility that is mostly negative and ranging between -1.1 and +0.1 percent of GDP (Figure 3.1). This bias is stronger the longer the forecast horizon; public forecasts are on average 0.3 percentage point higher than private anticipations for the current year deficit, and 0.5 percentage point higher for next year. This relates to the optimistic bias described in the forecast literature: actual outcomes tend to come short of governments' forecasts, especially GDP growth and fiscal policy costings. The authorities often justify their voluntarist forecasts by referring to self-fulfilling confidence effects—a theory that seems to fail, as agents seem to endogenize such an optimistic bias. Interestingly, though, markets are not *always* more bearish than governments: they expect a better fiscal balance than governments in as much as 32 percent of the observations for the current year, and 23 percent for one-year-ahead forecasts.

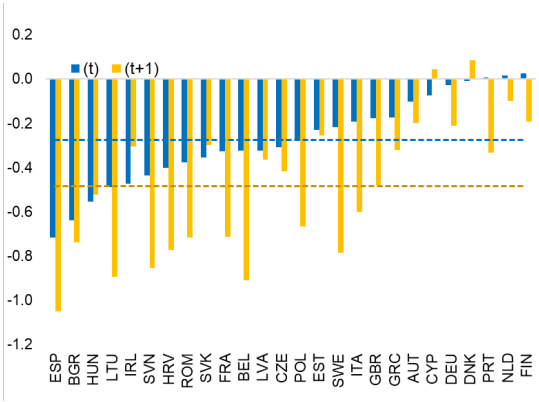
Absolute credibility is, on average in my sample, as high as 0.6–0.7 percent of GDP (Figure 3.1b). This is quite a large number, given that most of the overall balance outcomes lie within -6 and +3 percent of GDP. This result is not solely explained by a divergence of views on growth and inflation: levelling off the role of macroeconomic forecasts reduces the forecast spread by only 0.1 percent of GDP, so that the absolute cyclically-adjusted credibility is still an average of 0.5–0.6 percent of GDP (Figure 3.1d). This result is not driven by outliers either. There are a number of countries whose above-average score could be explained by repeated crises, political instability, and exchange rate uncertainty. Interestingly, some countries that fare well in terms of relative credibility indicator, such as Cyprus or Italy, do not necessarily perform as well in terms of absolute credibility, which indicates that private expectations are not well-anchored on government targets.

Credibility for in-year execution (t-credibility) and credibility for next year plan ($(t+1)$-credibility) are highly correlated, although not always aligned (Figure 3.2a). More precisely, government targets for a farther forecast horizon h are on average seen as less credible. Yet, the better countries anchor which private expectations about for the current year budget balance, the better they anchor expectations about outer years as well.

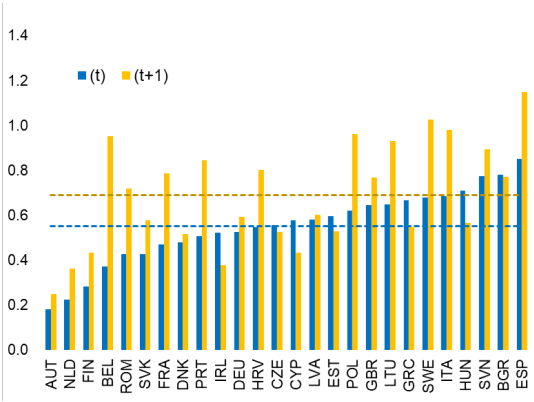
Intuitively, the forecast horizon can influence the forecast spread in two ways. On the one hand, forecasts for outer years are inherently more uncertain, so that one could expect a larger divergence of views, the longer the horizon. Implementing a voted budget is also relatively straightforward for the economies in my sample, which all have relatively robust budgetary

Figure 3.1. *Cross-country comparisons (country averages, in percentage points of* GDP*)*

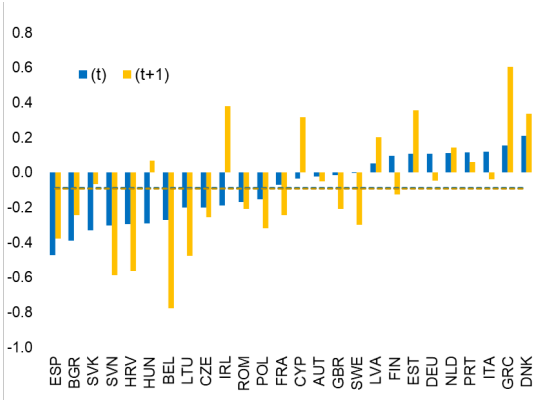
(a) Average (relative) credibility



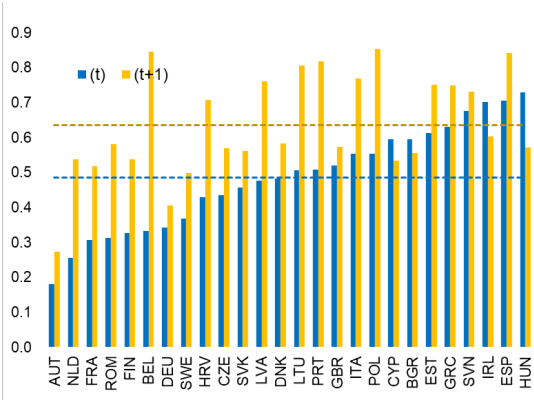
(b) Average absolute credibility



(c) Average (relative) cyclically-adjusted credibility



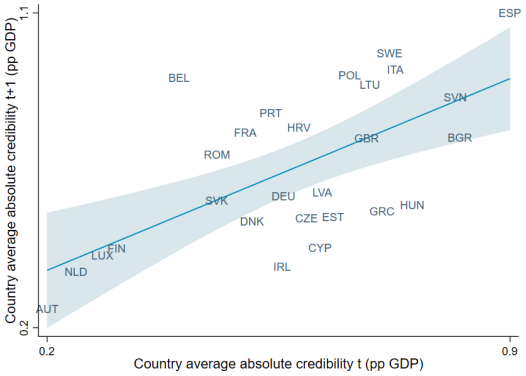
(d) Average absolute cyclically-adjusted credibility



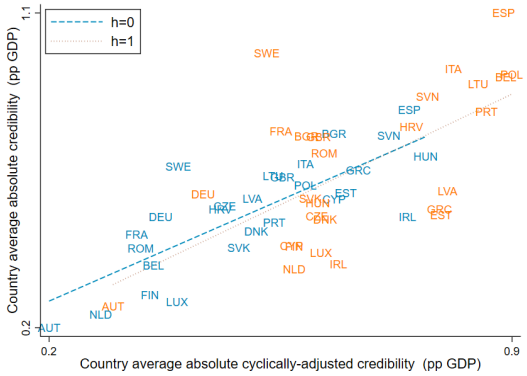
Notes: These charts (and most of those that follow) plot credibility for the current ("t" for $h = 0$) and upcoming ("$t + 1$" for $h = 1$) years. Dashed lines are the sample unweighted means. Country codes are per appendix 3.A.

Figure 3.2. *Correlations between absolute credibility indicators (country averages, in percentage points of* GDP*)*

(a) Role of forecast horizon



(b) Role of cyclical component



Note: The dotted lines are simple linear regressions.

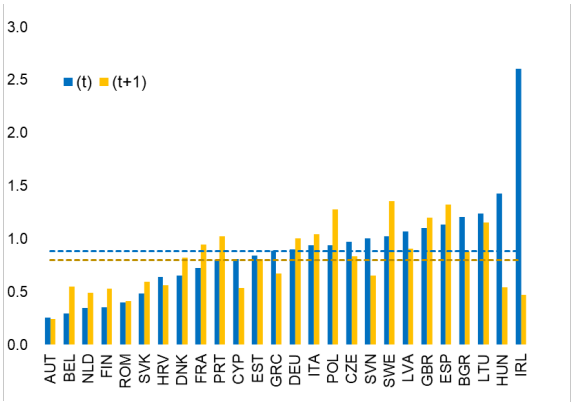
institutions and public financial management practices. Substantial deviations should thus not happen except when the government passes a revised budget or faces unforeseen exogenous shocks (*e.g.*, swings in its financing conditions, materialization of a contingent liability). By comparison, multiyear budgetary targets are less biding, so that they should anchor expectations less than annual budgets. This is particularly the case when there is political instability—which could explain for instance why Belgium, Croatia, or Portugal appear more credible for $h = 1$ than $h = 0$. On the other hand, private forecasters have less information to justify a strong, divergent opinion on future deficits. And they might also factor in weaknesses and recurrent slippages in budget execution (*e.g.*, in Greece or Ireland).

All in all, $Cred^{(1)}$ is thus likely to be a better indicator of policy credibility, while $Cred^{(0)}$ may rather reflect implementation credibility and high-frequency news. This is why I will henceforth focus my analysis on $Cred^{(1)}$.

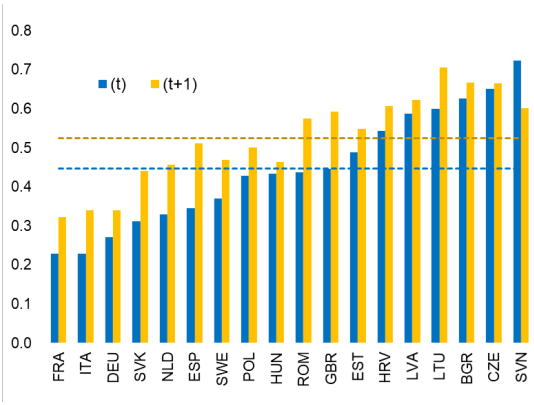
Correcting for the cyclical component of credibility reduces the bias observed in terms of relative credibility (Figures 3.1a–3.1c). The systematic optimistic bias governments have compared with private forecasters thus proves to relate to a large extent to underlying macroeconomic projections; the share of observations where markets expect a better fiscal balance in the following year than governments jumps from 23 to 42 percent when filtering out disagreements about future economic growth. By contrast, the cyclical component plays a minor role on absolute credibility, which indicates that average absolute credibility is a reflection of the credibility of the budget rather than the perceived capacity to produce growth forecasts.

Figure 3.3. *Credibility and volatility (country averages)*

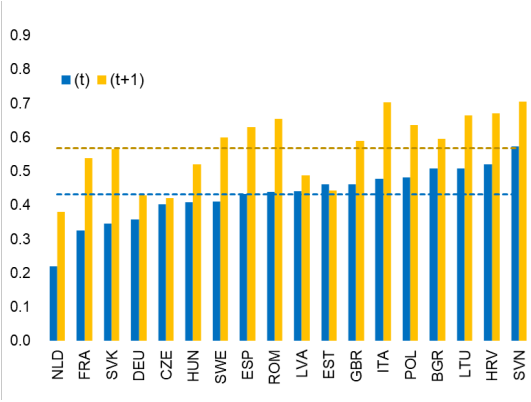
(a) Volatility across time (in percentage points of GDP)



(b) Dispersion of forecasts (in percentage points of GDP)



(c) Probability of private forecast divergence



Notes: Sample for *SdCred* is restricted by Consensus data availability. Dashed lines are the sample unweighted means. The probability on panel (c) is the probability that private forecasts be more than $\varepsilon = 0.5$ percent of GDP away from the government's target, assuming a normal distribution for private forecasts.

For some countries in the sample, private forecast volatility is high, which also points to a credibility deficiency. The standard deviation of my main credibility indicator can be sizable, at 0.8–0.9 percent of GDP on average for the whole sample, with some countries reaching an average of 2.6 percent of GDP (Figure 3.3a). Volatility seems especially high for countries that have not adopted the euro or have experienced severe crises during the sample period. This finding indicates a possible link with exchange rate or monetary policy stability and an impact of the frequency and size of exogenous shocks. It is intuitive that government capacity to anchor expectations decrease with instability, as shocks prevent it from building a good track record and it is much more difficult to forecast in choppy times. As Figure 3.3a shows, volatility is on average lower for one-year-ahead forecasts, confirming that shorter-term forecasts are mostly updated along the news cycle.

The dispersion of private forecasts is as high as 0.5 percent of GDP on average (Figure 3.3b). Seemingly, private forecasts are more consensual for large euro countries, compared with non-euro countries and beneficiaries of financial assistance programs.[14] This could be because, for larger countries such as France, Italy, or Germany, economic news are wider-spread and forecasts are updated on a more regular basis.

Ultimately, a credible government should be able to anchor *all expectations* in a narrow corridor around its target. Thus, I combine the average anchoring $Cred$ and the dispersion of forecasters around the average forecast $SdCred$ into a summary measure—namely, the likelihood for a private forecast to be outside a confidence interval around the official target. Assuming that the Consensus is a representative enough sample and that private forecasts follow a normal distribution, I compute the probability that forecasts lie further away from the official target than ε percentage point of GDP as follows:[15]

$$\begin{aligned} P_{i,t}^{(h)}(\varepsilon) &\equiv \mathbb{P}_f\left(\left|\mathbb{E}_t^f b_{i,t+h} - \mathbb{E}_t^o b_{i,t+h}\right| \geq \varepsilon\right) \\ &= 1 + \Phi\left(\frac{-\varepsilon - Cred_{i,t}^{(h)}}{\sigma_{i,t}^{(h)}}\right) - \Phi\left(\frac{\varepsilon - Cred_{i,t}^{(h)}}{\sigma_{i,t}^{(h)}}\right) \end{aligned} \tag{3.8}$$

Figure 3.3c reports the results for $\varepsilon = 0.5$ percent of GDP—a relatively liberal margin, given that 0.5 percent of GDP is typically the order of magnitude of an annual fiscal adjustment. More than 40 percent professional forecasters are likely to think the government target for the current year will be missed by a larger margin than ± 0.5 percent of GDP, and this proportion reaches almost 60 percent when it comes to next year targets.

[14] Spain is an exception, since the program supported the banking sector resolution rather than the budget.

[15] I let Φ denote the cumulative density function of the standard normal distribution.

Overall, all country ratings presented in this section seem strongly related. Absolute credibility, volatility, and dispersion are highly correlated, thus capture different aspects of the same concept of credibility. Appendix Figure 3.10 illustrates how these various country-level indicators relate to each other.[16]

3.4 Rise and fall of credibility

Beyond country averages, my credibility indicator sheds light on how well governments anchor expectations over time. Several regularities emerge from a visual analysis of credibility over time (Figures 3.15–3.16 in appendix 3.G). First, credibility for current year and next evolve generally in parallel, even though there can be some stress for current year that does not translate to next year anchoring.

Credibility seems to oscillate around a country-specific *steady state*, with (sometimes large) jumps in both directions that take more or less time to fade away. Augmented Dickey-Fuller (ADF) tests are used to check whether these times series are realizations of mean-reverting processes. For some countries, the null hypothesis that credibility is not stationary cannot be rejected, while, for others, the test concludes to a mean-reverting process (Table 3.6). For all, I derive from the ADF regressions a characteristic half-life time, that is the number of months it takes for a shock to be halfway corrected.[17] I find significant persistence in the lack of credibility—it takes up to 9 months for a confidence shock to be brought down halfway (Figure 3.4). in the same vein, I find a negative correlation between $ACred_{i,t}$ and $Vol_{i,t}$, suggesting that past volatility could hinder credibility.

Credibility behaves as a *capital of trust* that changes slowly. To investigate whether the traditional wisdom that it takes more time to build trust than lose it, I introduce a non-linearity in the ADF regressions.[18] For many countries in the sample, the credibility times series exhibit an asymmetric behavior. This indicates that once private forecasters anticipate an under-performance of the government (*i.e.*, a larger deficit than planned), it is harder to convince them otherwise than when they anticipate an over-performance.

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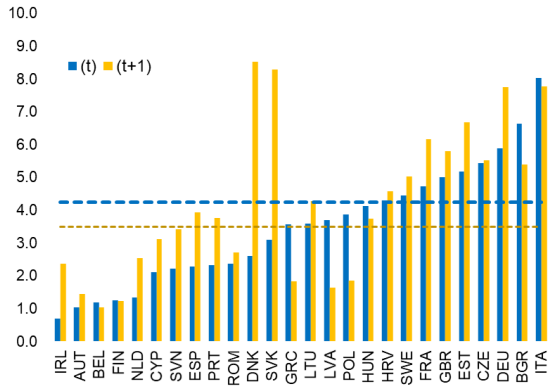
[16] Appendix Table 3.5 reports pairwise Pearson's correlations between these indicators, as well as Spearman (1904)'s rank correlations (which are less sensitive to outliers than Pearson's correlations).

[17] ADF tests are based on the following regression: $\Delta Y_t = \alpha + \beta Y_{t-1} + lags(\Delta Y) + \epsilon_t$. The process Y is stationary when β is significantly lower than zero. I compute the half-life of the process as $\tau_{1/2} = \frac{-\ln 2}{\ln(1+\beta)}$.

[18] I estimate the following: $\Delta Cred_t = \alpha + \beta Cred_{t-1} + \gamma Cred_{t-1}\mathbb{I}_{Cred_{t-1}<0} + lags(\Delta Cred) + \epsilon_t$ where $\mathbb{I}_X$ is a dummy that equals 1 when X, 0 otherwise. Appendix Table 3.7 reports the estimated coefficients β, γ for each country. When $\gamma > 0$, credibility is restored more slowly after a negative shock than a positive shock.

Figure 3.4. *Half-Life time of credibility (in months)*



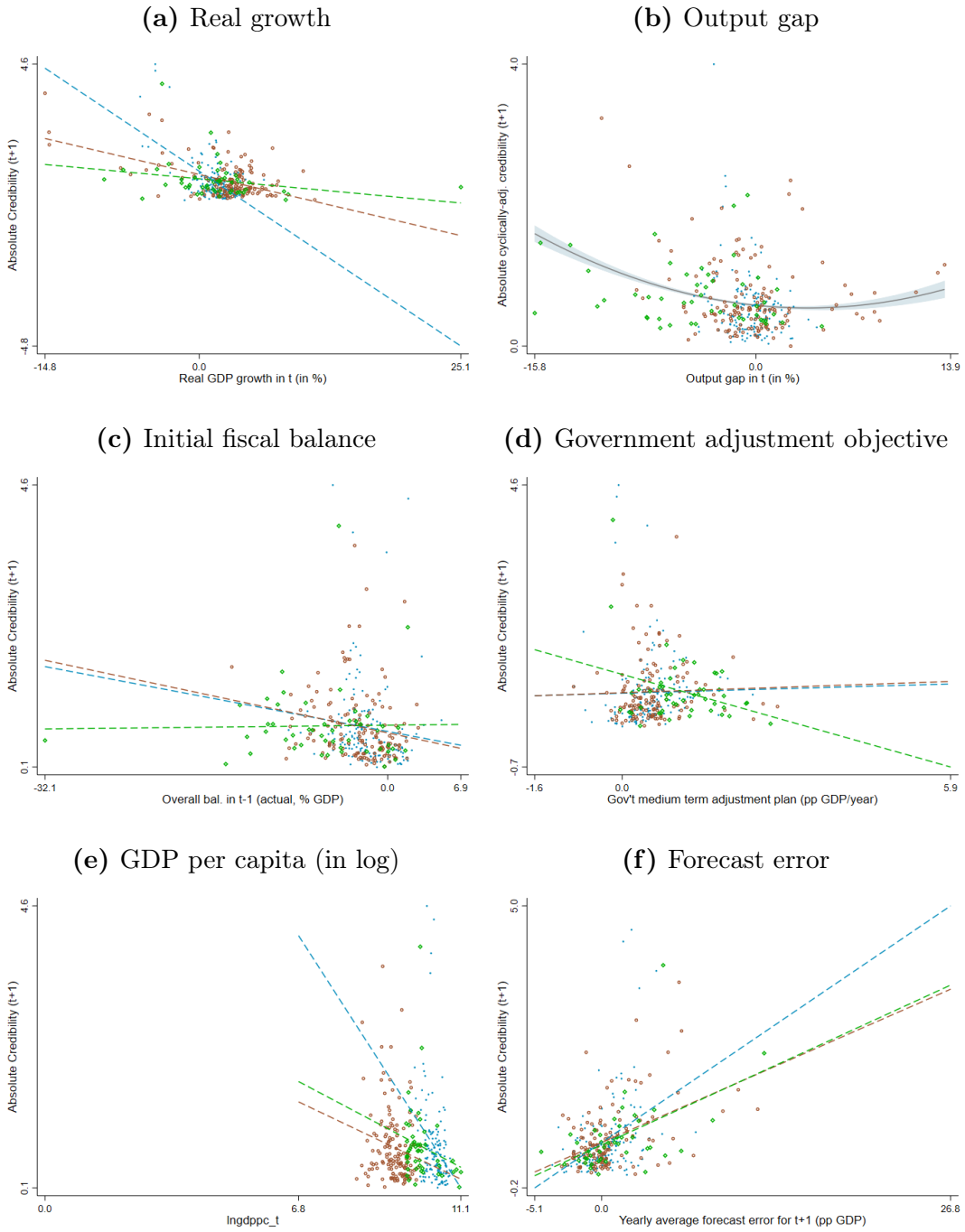
Note: The half-life is the estimated time for a mean-reverting process to correct half of a deviation relative to the mean after a shock. Dashed lines are the sample unweighted means.

Recognizing credibility as a stock of trust has profound implications. It means that when Mario Draghi takes over the Prime Minister office in Italy, it may take him several budgets to assert the credibility of his cabinet. A prolonged delay in (re)establishing trust comes at a cost, as it prevents flexibility without necessarily reaping the benefits of being credible (see section 3.5). With asymmetrical persistence, things can be even worse: it takes more time for good governments to rebuild trust than it takes bad governments to destroy it. To illustrate this point, I have run a rudimentary event study analysis around the appointment of new governments (Figure 3.14 in appendix). If anything, the installation of new policymakers seem to worsen credibility, which seems to confirm that observers judge on actions rather than simply on reputation.

What can help explain these country differences, and more importantly, these sizable variations over time? The remaining of this section examines the role of potential factors. Some of the charts distinguish core EU economies, program countries, and Eastern Europe (as per appendix 3.A), to check whether country heterogeneity may have an effect.

First, initial conditions, including the position in the business cycle and the fiscal stance, can impact credibility—even though these factors do not intrinsically change whether the government is virtuous or not. Governments seem to be more easily credible when growth is higher: on Figure 3.5a, the slope of the interpolation line between credibility and growth is negative, especially for most advanced economies. Even after taking out the cyclical component, expectations seem better anchored when the output gap is positive (Figure 3.5b). This might be because governments tend to underestimate fiscal multipliers when the output gap is negative or because private agents expect a countercyclical fiscal response. Furthermore, private forecasters seem to give a credibility premium to governments with an already sound fiscal stance, while they seem

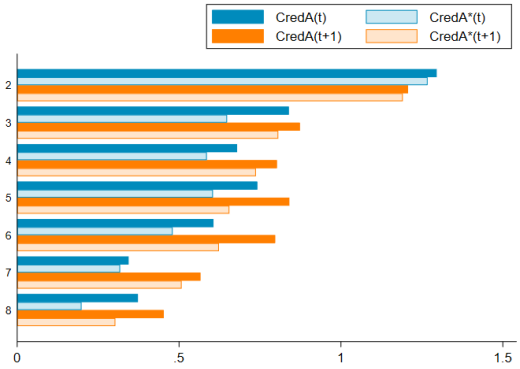
Figure 3.5. *Absolute $(t+1)$-credibility and macroeconomic indicators (annual averages)*



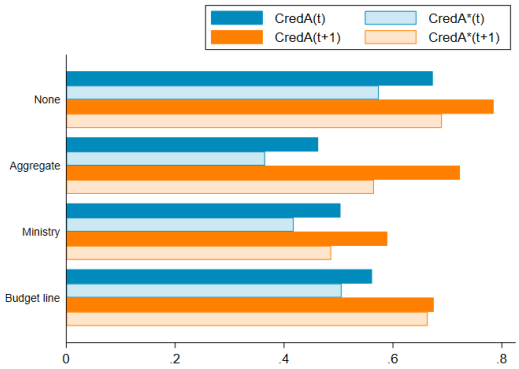
Notes: Blue dots for "core" economies, red circles for IMF programs, and green diamonds for Eastern European countries—these country groups are per appendix 3.A. Dashed lines are linear regressions (per country type) and the shaded area in panel (b) is a quadratic interpolation with 95-percent confidence bands. Medium-term adjustments are taken from SCPs and annualized for comparability. Precisely, Medium-term adjustments are computed as $\Delta^{MT} \equiv (\mathbb{E}^o_t b_{i,t+h} - \mathbb{E}^o_t b_{i,t-1})/(h+1)$ with the largest h available. I also looked at fiscal adjustments planned for year $t+h$: $\Delta^{(h)}_{i,t} \equiv \mathbb{E}^o_t b_{i,t+h} - \mathbb{E}^o_t b_{i,t-1}$.

Figure 3.6. *Absolute credibility and institutional design*

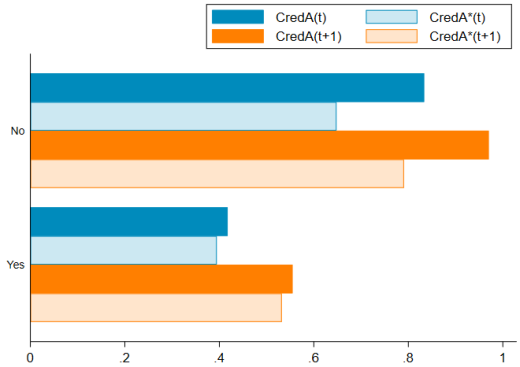
(a) How many fiscal rules are there?



(b) At what level are budget medium-term ceilings?



(c) Is there a fiscal council?



(d) Scope of independent fiscal institution's mandate

Notes: Blue and orange bars are respectively the average absolute t-credibility and $(t+1)$-credibility. Lighter-shaded bars are for cyclically-adjusted averages. The number of fiscal rules on panel (a) is taken from Lledó et al. (2017); it includes both domestic and supranational rules. The index on panel (d) is computed by the European Commission's Scope Index of Fiscal Institutions (SIFI), available for 2015-18.

to penalize those that start off from a large deficit (Figure 3.5c).[19] The same can be observed with the initial public debt-to-GDP ratio or the sovereign yield, with the exception of program countries for which absolute credibility decreases with public debt and improves with interest rates. This could be because, in the case of programs, the larger the fiscal problems, the stricter program monitoring is likely to be.

[19]Visually, Maastricht 3-percent deficit threshold does not appear to play any remarkable role.

Second, institutions certainly matter, especially budgetary institutions. For instance, having a fully-staffed, qualified administration is a likely precondition for producing reliable forecasts that agents can trust. The development level, as measured by GDP per capita, is negatively associated with $ACred$; in particular in Eastern European countries, governments of less developed economies seem to struggle more to anchor expectations (downward interpolation line on Figure 3.5e).[20]

More specifically, strong budgetary institutions should support the expectation-formation process, for they improve transparency and accountability. Among such institutions, fiscal rules and councils have been created to enhance the government's credibility (Debrun et al., 2013; Lledó et al., 2017; Beetsma et al., 2019).[21] Seen from the prism of a principal-agent relationship between voters and elected politicians, they are attempts to reduce to the government's informational advantage and fiscal discretion and thereby improve macrofiscal outcomes (Hameed, 2005; Dabla-Norris et al., 2010). I verify in Figure 3.6 that expectations are better anchored when (preferably several) fiscal rules, a fiscal council, and some multiyear budget ceilings are in place. For the latter, an aggregate multiyear budget target seems to work better than item-level ceilings—which presumably few observers expect to hold the test of time. Unexpectedly, having core fiscal tasks performed by independent institutions is not clearly associated with stronger credibility. This is what Figure 3.6d shows, using the European Commission's Scope Index of Fiscal Institutions that measures the breadth of tasks discharged by independent agencies.[22]

Third, fiscal policy is inevitably at the core of fiscal credibility, in at least two respects (beyond the soundness of the current fiscal stance): past fiscal slippages and the assessed quality or feasibility of fiscal plans. Governments almost systematically come short of promised fiscal adjustments (Beetsma et al., 2009). And private forecasters seem to trust less governments that have had large slippages (Figure 3.5f). Appendix 3.D provides further analysis of the role of past fiscal performance, based on several possible "real time" measures.

The content of fiscal plans seems to impact credibility: more ambitious annual and medium-term adjustments are associated with more suspecting private expectations, except in program

[20]Today, except for Bulgaria, all countries in my sample are classified as high-income economies by the World Bank. However, some only graduated in the last 15 years, and there remain some variation in institutional capacity. Anecdotally, there is substantial cross-country variation in the SCPs prepared by each country. This is why I use in the empirical analysis per capita GDP as a control variable to capture all institutional aspects for which I do not have an explicit indicator.

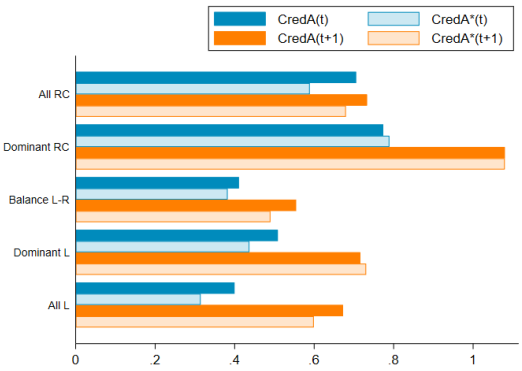
[21]A fiscal rule is defined in this chapter as a numerical limit set *de jure* on some budgetary aggregate and meant to impose a long-lasting constraint on fiscal policy (Schaechter et al., 2012). Fiscal councils are independent, apolitical, technical bodies entrusted with a public finance watchdog role (Kopits, 2013).

[22]The tasks covered by the index are (a) monitoring of compliance with fiscal rules; (b) macroeconomic forecasting; (c) budgetary forecasting and policy costing; (d) sustainability assessment; (e) promotion of fiscal transparency; and (f) normative recommendations on fiscal policy.

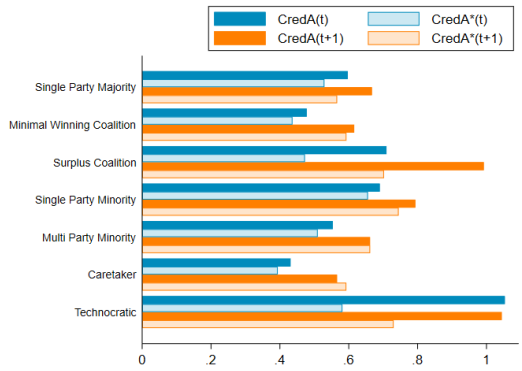
cases (Figure 3.5d). This result suggests that credibility is not only about sticking to one's commitments, it includes setting reasonable and realistic targets.

Figure 3.7. *Absolute credibility and political cycle*

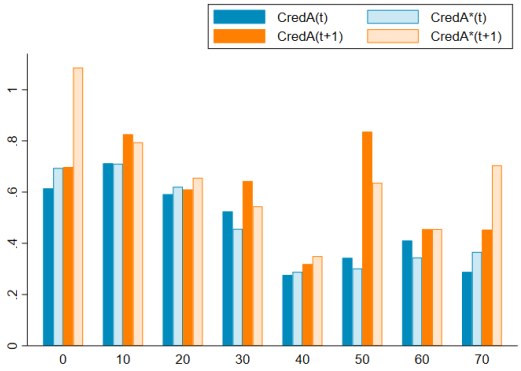
(a) Government's political orientation



(b) Type of government



(c) Share of people who trust politicians?



Notes: Blue and orange bars are respectively the average absolute t-credibility and $(t+1)$-credibility. Lighter-shaded bars are for cyclically-adjusted averages. L and R stand for left and right parties. Panel (c) relies on the shares of respondents to the European Social Survey who declare they rather trust their political representatives (not less than 5 on a scale from 0 to 10); the x-axis groups observations by deciles (*e.g.*, the label "40" stands for a share between 40 and 50).

Last, I explore how fiscal credibility may be influenced by political cycles.[23] As plotted in Appendix Figure 3.13, elections do not necessarily de-anchor expectations, even though they are associated with somewhat higher levels of volatility in credibility. However, somewhat confirming the literature about the political economy of fiscal policy (*e.g.*, Alesina et al., 1998), I

[23]With the so-called European semester and the budget cycle, my indicators can follow seasonal patterns, too. This is what Appendix Figure 3.11 examines. I find that within the year credibility is the weakest at the beginning of the year (when end-year forecasts are the most difficult because the furthest in the future) and during budget preparation.

find some associations between credibility and political variables (Figure 3.7). Unsurprisingly, credibility improves with trust in politicians; yet, too much trust also seems to be associated with lesser credibility, indicating that some level of distrust might be conducive of fiscal discipline. Governments that are more tilted towards left-wing parties also seem to inspire more credibility, although the optimal for credibility appears to be a government formed by a balanced mix of right- and left-wing representatives.

3.5 Empirical analysis

The determinants of fiscal credibility

Drawing from the bi-variate analysis conducted in the previous section, this section explores the relative role of the various factors that appear associated with fiscal credibility—as well as some further variables used tentatively as controls. Specifically, the multivariate empirical analysis presented in this section is based on panel estimations of the following equation:

$$ACred_{i,t}^{(h)} = \phi_{year(t)} + \psi_{month(t)} + \chi_i + \rho ACred_{i,t-1}^{(h)} + \beta X_{i,t} + u_{i,t} \tag{3.9}$$

where i and t index respectively countries and monthly dates.

On the left-hand side, I focus on absolute credibility at horizon $h = 1$ as my main measure of fiscal credibility, reckoning with several considerations. First, as the concept of credibility involves the anchoring of expectations, which means private agents should be neither more bullish nor more bearish than their governments. Second, while governments may prefer to have private expectations above their fiscal balance target when undertaking fiscal consolidation, there are cases when the opposite is true. For instance, in the context of a fiscal stimulus, governments may want agents to people to believe that the money will actually be spent as planned, so as to maximize Keynesian effects. This is for instance typical of less advanced economies, whose public financial management systems are not always flexible enough to deploy large emergency spending and non-recurrent budget items tend to be under-executed (*e.g.*, the CoViD-19-related spending in 2020). Third, as the average absolute credibility is less sensitive to cyclical adjustment (section 3.3); regressions based on absolute rather than relative credibility are less likely be driven by the credibility of growth forecasts.

On the right-hand side, I assume absolute $(t + 1)$-credibility can be explained by seasonal patterns, persistence, and a vector of determinants (X). Namely, the latter capture various dimensions: (1) initial macroeconomic conditions (public debt and deficit ratios, output gap, inflation) and the existence of an IMF program; (2) institutional setting, such as the level of economic development (captured by the per-capita GDP) and the existence of virtuous fiscal institutions; (3) plans and track record of fiscal policy; and (4) political variables (political affiliation, electoral dummies—as Merola and Pérez (2012) does for forecast errors). In addition, to ascertain

that $ACred$ does not simply capture economic uncertainty or a broader sentiment of confidence in the economy, I add to this list a country-specific uncertainty indicator (Ahir et al., 2018) and structural features, such as export quality and diversification (Henn et al., 2013), the composition of the deficit (tax burden, quality of spending), and the composition of public debt (share held by residents or the central bank, share in foreign currency, to capture possible home bias or original sin).[24]

The specification in equation (3.9) is designed to identify determinants of fiscal credibility, that is, the main signals that motivate professional forecasters to consider official targets will or not be achieved. However, the specification can hardly be exhaustive, nor represent a comprehensive, structural model of the formation of their forecasts. For this reason, I include a lavish number of fixed effects: country and year fixed effects to account for unobserved common factors, and monthly fixed effects to account for seasonality (alike Aaronson 2001). I check whether country fixed effects need to be included with a Hausman (1978) test; the null hypothesis that the difference in coefficients is not systematic is strongly rejected with a higher than 99 percent confidence for most regressions, confirming that fixed effects should be included for a consistent estimation. Likewise, year and seasonal fixed effects are in most cases called for by Wald tests that reject the null hypothesis that the corresponding estimated coefficients are jointly nil. In addition, all my regressions include binary variables for elections, IMF program reviews, and the release of new official targets, which appeared to impact credibility in section 3.4.

I allow for a relatively generic distribution of residuals. It is likely that residuals behave differently for each country—fiscal credibility being more volatile in some countries than others, in relation to past performance, type of economy, distribution of economic shocks, and strength of institutions. Hence, I test for the presence of heteroskedasticity, drawing from Greene (2012). Modified Wald tests show that the assumption of homoskedasticity is generally rejected. Furthermore, I test for autocorrelation, following the procedure suggested by Wooldridge (2010). Depending on the results, I address heteroskedasticity and serial correlation issues by running a feasible generalized least squares (FGLS) procedure and allowing first-order autoregressive (AR(1)) disturbances (Greene, 2012). In other words, I allow $u_{i,t} = \eta_i u_{i,t-1} + \epsilon_{i,t}$ where $\epsilon_{i,t} \sim \mathcal{N}(0; \sigma_i)$ are independent. I also investigate the existence of cross-sectional dependence. With Breusch-Pagan LM tests (intended for panels with a long time dimension like mine), the null that contemporaneous residuals are independent is sometimes rejected. Yet, this test is hardly informative, as my panel is unbalanced; plus, intuitively, it would be hard to justify that expectations spill from one country to another.[25]

[24] All these structural variables are included to check whether the credibility indicator could capture a broader sentiment of confidence in the economy than simply in the policymaker.

[25] In any case, I cannot control explicitly for panel dependence, as my dataset is not balanced enough.

Section 3.4 found credibility to be somewhat persistent. However, all feasible variants of panel unit root tests (*i.e.*, Im et al.'s (2003) test or Fischer-type tests, given my panel is unbalanced) strongly reject the hypothesis that all panels are stationary. Autocorrelation and partial autocorrelation functions do not exhibit any significant value beyond a lag of one year, and the KPSS test's failure to reject stationarity confirms that even fractional integration is unlikely (Lee and Schmidt, 1996). The hypothesis of long memory is further rejected by the GPH test based on log-periodogram regressions, as was first proposed by Geweke and Porter-Hudak (1983) and later upgraded by Phillips (2007). Therefore, there is only weak serial dependence, which the inclusion of AR(1) residuals should be sufficient to handle.[26]

The main findings are presented in Table 3.1. The first column is a baseline specification; it confirms that credibility is persistent and that the release of new targets helps anchor expectations, but it shows that elections do not play a significant role. More surprisingly, the conclusion of an IMF program review is associated with less confidence in the government, possibly indicating that IMF -imposed targets are not necessarily credible.

Columns (2)–(9) introduce variables describing the macroeconomic environment. They confirm that credibility is harmed when the government runs a higher public debt or a larger deficit, but also when inflation is high, the growth rate is low, the economy runs below potential (*i.e.*, with a negative output gap), and monetary policy is accommodative (as signaled by a lower policy rate, in nominal or real terms).

Next, I turn to structural economic variables—to assert whether the fiscal credibility indicator might be driven by confidence in the economy rather than trust in the government. I find that credibility is only marginally influenced by the structure of public debt (column (10)). In particular, credibility improves slightly when public debt is owned to a larger extent by resident—the *home bias*, which for instance makes Japanese government bonds look safer than fundamentals would otherwise support. By contrast, I do not find any significant correlation between my credibility indicator and the structure of the economy, which proves that the former truly reflects the confidence in the government's announcements rather than the strength of the economy.[27]

As suspected from the literature and the stylized facts of sections 3.3–3.4, institutions can contribute to improve credibility; in particular, columns (12)–(13) show that having an independent fiscal council that sets macroeconomic assumptions for the budget and monitors budget implementation is associated with more credibility. These regressions also confirm that past policy performance and current policy plans have an impact on credibility (columns (14)–(18)).

[26]The observed persistence could stem from level shifts associated with successive governments, rather than long memory (*cf.* the discussion in Smith, 2005).

[27]I just find a weak, negative correlation between credibility and export quality (column (11)), which looks spurious.

Table 3.1. *Main results: determinants of fiscal credibility*

	Base	Initial Conditions							Economic		Institutions		Policy					Combined
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
Credibility (lagged)	0.749***	0.746***	0.745***	0.748***	0.748***	0.774***	0.777***	0.771***	0.746***	0.751***	0.765***	0.711***	0.706***	0.746***	0.747***	0.764***	0.748***	0.739***	0.749***
	[0.010]	[0.010]	[0.010]	[0.010]	[0.010]	[0.009]	[0.009]	[0.009]	[0.010]	[0.010]	[0.012]	[0.014]	[0.014]	[0.010]	[0.010]	[0.010]	[0.010]	[0.011]	[0.011]
Release of new target (dummy)	-0.361***	-0.371***	-0.371***	-0.373***	-0.372***	-0.379***	-0.380***	-0.366***	-0.373***	-0.385***	-0.603***	-0.505***	-0.437***	-0.360***	-0.361***	-0.391***	-0.407***	-0.397***	-0.410***
	[0.021]	[0.021]	[0.021]	[0.021]	[0.021]	[0.022]	[0.022]	[0.021]	[0.021]	[0.023]	[0.029]	[0.032]	[0.030]	[0.021]	[0.021]	[0.022]	[0.023]	[0.025]	[0.024]
= 1 when election occurs	-0.019	-0.023	-0.023	-0.020	-0.021	-0.023	-0.023	-0.020	-0.019	-0.026	-0.033	-0.064	-0.049	-0.020	-0.019	-0.027	-0.022	-0.034	-0.030
	[0.026]	[0.026]	[0.026]	[0.026]	[0.026]	[0.027]	[0.027]	[0.027]	[0.026]	[0.028]	[0.038]	[0.047]	[0.045]	[0.026]	[0.026]	[0.028]	[0.030]	[0.032]	[0.030]
= 1 for IMF program approval/review	0.095**	0.083*	0.094**	0.088**	0.090**	0.087**	0.110**	0.104**	0.087**	0.093*	0.119**	-0.006	0.018	0.082*	0.082*	0.108**	0.111**	0.084*	0.083
	[0.044]	[0.045]	[0.044]	[0.044]	[0.044]	[0.043]	[0.043]	[0.043]	[0.044]	[0.052]	[0.060]	[0.069]	[0.053]	[0.045]	[0.045]	[0.044]	[0.048]	[0.044]	[0.052]
Public debt ratio in t-1 (in % GDP)		0.002***																	
		[0.001]																	
Primary balance in t-1 (% GDP; WEO)			-0.015***																0.012**
			[0.004]																[0.005]
Inflation in t (average yoy; %)				0.018***															
				[0.005]															
Inflation if higher than 4%					0.008**														
					[0.004]														
Output gap in t-1 (in %)						-0.010***													-0.006*
						[0.003]													[0.004]
Real GDP growth in t-1 (in %)							-0.007***												
							[0.003]												
ECB i-rate; main refinancing operation								-0.106***											-0.127***
								[0.029]											[0.031]
Real policy rate									-0.022***										
									[0.005]										
Resid share of public debt (percent)										-0.002**									0.001**
										[0.001]									[0.001]
Export quality index											4.388**								
											[2.178]								
Nation: Independent body sets budget assumptions												-0.127**							
												[0.054]							
Nation: Independent body monitors implementation													-0.067*						
													[0.035]						
Adjustment planned in t+1 (pp GDP)														0.011***					
														[0.004]					
Gov't medium term adjustment plan (pp GDP/year)															0.030**				0.054***
															[0.013]				[0.016]
Yearly average forecast error for t+1 (pp GDP)																0.026***			0.034***
																[0.004]			[0.005]
2yr-rolling for. error with first t+1 estimate (pp GDP)																		0.012***	
																		[0.004]	
Number of numerical fiscal rules																			0.013**
																			[0.007]
Constant	0.280***	0.150**	0.269***	0.251***	0.285***	0.276***	0.285***	0.271***	0.246***	0.428***	-4.122*	0.355***	0.353***	0.275***	0.272***	0.265***	0.258***	0.272***	0.146**
	[0.036]	[0.063]	[0.036]	[0.037]	[0.036]	[0.026]	[0.026]	[0.025]	[0.037]	[0.065]	[2.162]	[0.054]	[0.056]	[0.036]	[0.036]	[0.026]	[0.039]	[0.043]	[0.058]
Observations	3,895	3,831	3,831	3,831	3,831	3,831	3,831	3,895	3,831	3,331	2,275	1,833	2,019	3,895	3,895	3,571	3,223	2,938	3,055
Number of ccode	27	26	26	26	26	26	26	27	26	23	27	21	25	27	27	27	27	27	23
Fixed effects	CYM	CYM	CYM	CYM	CYM	YM	YM	YM	CYM	CYM	CYM	CYM	CYM	CYM	CYM	YM	CYM	CYM	YM
Heterosked	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Autocorr	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hausman	0.000	0.000	0.001	0.000	0.001	1.000	0.110	1.000	0.000	0.000	0.000	0.071	0.030	0.000	0.000	0.246	0.041	0.014	0.809
Wald Y	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Wald M	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000
Modif. Wald	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Breusch-Pagan	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-1.000	-1.000	-1.000	0.000	0.000	0.000	0.000	-1.000	0.000
Serial	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Standard errors in brackets. ***, **, and * stand for significance at the 99, 95, and 90 percent confidence levels, respectively. Fixed effects `C`, `Y`, and `M` stand for country, year, and month. At the bottom of the table, `Hausman`, `Wald Y/M`, `Modif.Wald`, `Breusch-Pagan`, and `Serial` provide the p-values for the Hausman test of including country fixed effects, the Wald tests of including year (`Y`) and month (`M`) fixed effects, the modified Wald test of heteroskedasticity, the Breusch-Pagan test of cross-sectional dependence, and the test of serial correlation.

Governments having failed to perform according to plan in previous years are seen as less credible, as well as governments targeting ambitious fiscal adjustments.

In a second stage, I combine these various factors into a single regression, so as to be able to compare the relative influence of each. The choice of predictors stems from the following selection procedure: within each category of variables (economic, political, institutional, *etc*.), I discard those for which there are less observations; I skim those providing redundant information by examining pairwise correlations; and I double check with an analysis of variance inflation factors, aiming for factors that do not exceed the common cutoff value of 10.[28] Results in column (19) confirm that credibility is influenced simultaneously by the macroeconomic environment, policy decisions, and the institutional setup. The most impacting factors seem to be policy variables (including monetary policy). This tends to prove two things: (1) the credibility indicator developed in this chapter truly captures the agents' responses to policy announcements and track record (rather than a broader sentiment of confidence); and (2) institutions, such as fiscal rules and fiscal councils, do not *per se* have a sizable impact and are rather likely to operate through their role in changing policymaking practices (hence, through their impact on track record and quality of budget plans and implementation).[29]

In a third stage, recognizing that model selection may impact the statistical properties of my results so far, I run a Bayesian model averaging estimation (Magnus and Durbin, 1999; Danilov and Magnus, 2004). Namely, instead of estimating selected forms of equation (3.9), I compute a weighted average of all conditional estimates obtained by varying X over the possible combinations of explanatory variables, because each of these variants may contain information about the true data-generating process.[30] Since my dataset and the number of candidate variables are large, I rely on the weighted-average least-square estimator developed by Magnus et al. (2010). Such a Bayesian model-averaging technique accounts for the uncertainty of both estimation and model selection.

Results can be found in Table 3.2, with two alternative prior distributions; they are broadly in line with non-Bayesian estimations. Further, Bayesian estimates show that fiscal rules have a stronger impact when they are softer—national rather than supranational, and political rather than constitutional—, which probably explains why credibility did not seem to improve after

[28] Even though multicollinearity is usually not considered a major issue for panel analysis.

[29] The combined regression in Table 3.1 even suggests that having too many fiscal rules could be counterproductive.

[30] I actually impose the lagged endogenous variable, fixed effects, and dummies for IMF program, elections, and new target release dates to be always included in the model. All other regressors are deemed auxiliary, because I am not sure about whether they need be included. Hoeting et al. (1999) provides a more detailed discussion of model-averaging estimation.

the global financial crisis (GFC), despite the various reforms of the SGP.[31] As an exception, expenditure ceilings seem to work better when they are defined at a more disaggregated level. To explain this, I postulate that credibility-enhancing institutional features, such as fiscal rules or fiscal agencies, could result from a self-selection bias: only already ill-behaved governments may be led to establishing such constraining counter-powers.

The interaction between various variables is interesting. For instance, inflation comes out as having a non-linear effect, in the sense that some inflation is good for credibility, but not too much. Likewise, private agents seem to trust more governments who have an ambitious multiyear adjustment objective, but not when it is front-loaded. They are deterred by downside revisions and forecast errors. Political variables, such as the political orientation of the ruling party or the parliamentarian support of the government, and macroeconomic uncertainty and structural parameters seem to matter as little with Bayesian estimation as with traditional estimators.[32]

Several robustness checks vouch for these findings. First, when I use the t-credibility indicator (with a shorter horizon $h = 0$), results remain similar, confirming that what I capture is somewhat independent of the forecast horizon (Table 3.8 in appendix 3.H). The main noticeable difference is that the composition of public debt and the economic structure play an even lesser role for short-term credibility; but fiscal rules contribute more to short-term credibility. Second, adding another lag to the baseline regression helps verify that allowing the residuals to be autocorrelated and including time fixed effects are sufficient to control of serial correlation, as it does not alter results substantially (Table 3.9). Third, as some of the exogenous variables are produced only annually, I run the same regressions on a yearly basis (Table 3.11).[33] As expected, slow-moving factors, such as fiscal institutions or average past errors or revisions, turn out as more significantly associated with credibility than in the baseline monthly regression.

Last, methodological choices in the definition of fiscal credibility do not seem to drive the findings of this section. In particular, I run the same regressions with cyclically-adjusted credibility, to check that results are not driven by pro-cyclical fluctuations of market sentiment. As can be seen on Table 3.10, they are not, except at the margin for the impact of an IMF program

[31] In parallel, the GFC and the subsequent European debt crisis might have whetted markets' scrutiny over fiscal policy.

[32] I consider an auxiliary regressor to be significantly correlated with credibility when its t-ratio is greater than one in absolute value, *i.e.* when the one-standard error confidence band does not cover zero.

[33] Namely, the specification is: $ACred_{i,y}^{(h)} = \phi_y + \chi_i + \rho ACred_{i,y-1}^{(h)} + \beta X_{i,y} + \epsilon_{i,y}$, where i, y index countries and years, and $ACred_{i,y}^{(h)} \equiv \left\langle ACred_{i,t}^{(h)} \right\rangle_{t \in y}$ is the annual average of fiscal credibility. The sample is then much reduced on its time dimension (which is now broadly similar to the cross-section dimension), and unbalanced. Hence, I follow the same estimation procedure based on an FGLS as in the previous section.

Table 3.2. *Bayesian estimations*

	Neutral Laplace prior			Neutral Subbotin prior		
	Coef.	Std.Err.		Coef.	Std.Err.	
Credibility in t-1	0.645	0.0233	**	0.645	0.0234	**
Release of new target for t+1 (dummy)	-0.603	0.0729	**	-0.602	0.0730	**
= 1 when election occurs	-0.0371	0.0912		-0.0375	0.0911	
(mean) IMF prog. review	0.257	0.199	**	0.260	0.199	**
Public debt ratio in t-1 (in % GDP)	-0.00107	0.00669		-0.00105	0.00705	
Primary balance in t-1 (% GDP, WEO)	0.189	0.0619	**	0.193	0.0666	**
Inflation in t (average yoy, %)	-0.122	0.0576	**	-0.138	0.0596	**
Inflation if higher than 4%	0.0480	0.0377	**	0.0523	0.0392	**
Output gap in t-1 (in %)	0.00556	0.0345		0.00196	0.0340	
Real GDP growth in t-1 (in %)	0.0294	0.0287	**	0.0265	0.0285	
Sovereign yield (10 yr, Bloomberg)	0.0353	0.0326	**	0.0382	0.0327	**
ECB i-rate, main refinancing operation	-0.119	0.0734	**	-0.110	0.0745	**
IMFprog	0.0619	0.122		0.0518	0.123	
FCU share of public debt (percent)	-0.0133	0.00894	**	-0.0144	0.00898	**
CB share of public debt (percent)	-0.255	0.140	**	-0.266	0.146	**
Resid share of public debt (percent)	-0.00156	0.00976		-0.00295	0.00984	
Export diversification index	-0.241	0.324		-0.205	0.323	
Export quality index	1.921	12.91		1.259	12.83	
Log GDP per capita	-2.075	1.436	**	-2.369	1.515	**
Number of numerical fiscal rules	0.163	0.136	**	0.147	0.139	**
Expenditure rule at the national level (1), supranational level (2), or both (3)	-0.0822	0.141		-0.0742	0.142	
Revenue rule at the national level (1), supranational level (2), or both (3)	0.356	0.245	**	0.429	0.248	**
Budget balance rule at the national level (1), supranational level (2), or both	-0.175	0.187		-0.176	0.187	
Multiyear expenditure ceiling (1= aggregate, 2= ministry, 3=budget item)	-0.197	0.0911	**	-0.211	0.0923	**
FR: legal basis	1.070	0.285	**	1.152	0.293	**
Uncertainty index	0.483	0.531		0.442	0.524	
Political color of government (Schmidt index; R, C, L for right, center, left)	-0.0145	0.138		-0.00890	0.124	
Type of government	0.0160	0.0293		0.0184	0.0288	
Share of gov't from Left party	0.00124	0.00564		0.00115	0.00507	
Adjustment planned in t+1 (pp GDP)	0.0900	0.0372	**	0.0966	0.0388	**
Gov't medium term adjustment plan (pp GDP/year)	-0.394	0.152	**	-0.422	0.158	**
Yearly average gov't latest revision for t+1 estimate (pp GDP)	-0.110	0.0594	**	-0.112	0.0633	**
2yr-rolling gov't latest revision for t+1 estimate (pp GDP)	-0.00401	0.0540		-0.00686	0.0571	
24m-rolling gov't latest revision for t+1 estimate (pp GDP)	-0.160	0.0445	**	-0.163	0.0467	**
Yearly average forecast error for t+1 (pp GDP)	0.222	0.0688	**	0.229	0.0745	**
Yearly average for. error with first t+1 estimate (pp GDP)	-0.0243	0.0267		-0.0282	0.0271	**
2yr-rolling for. error with first t+1 estimate (pp GDP)	0.0503	0.0345	**	0.0518	0.0347	**
Constant	12.80	17.53		15.88	17.93	
Observations	850			850		

Notes: The dependent variable is $ACred_{i,t}^{(1)}$; month, country, and year fixed-effects are included. ** stands for a t-ratio greater than one in absolute value.

(which becomes significant) and that of economic resilience (export quality and debt composition lose significance). This is possibly because IMF programs usually intervene when an economy goes beyond the *normal* cyclical downturn. Besides, replacing absolute credibility with relative (cyclically-adjusted) credibility yields very similar results (Tables 3.13–3.12).

The role of fiscal policy communication

In the complex process of expectation formation, private forecasters face many informational imperfections and asymmetries—that is why there is disagreement among them, as evidenced by my $SdCred$ indicator of forecast dispersion (Andrade and Le Bihan, 2013; Coibion and

Gorodnichenko, 2012). Among the noisy and imperfect information they face, private agents must decide how much to weigh government signals, knowing that they are engaged with the latter in a principal-agent relationship and that authorities might have incentives to disclose only partial, biased information.

A credible government succeeds in anchoring private beliefs around official targets when its communications dominate other potential sources of information. The literature on policy communication, starting from the seminal article by Morris and Shin (2002), hints at how clear fiscal policy communication can help private expectations converge (Ricco et al., 2016). In that context, the credibility indicators developed in this chapter potentially capture different things, depending on how much time has elapsed since the last official announcement.[34]

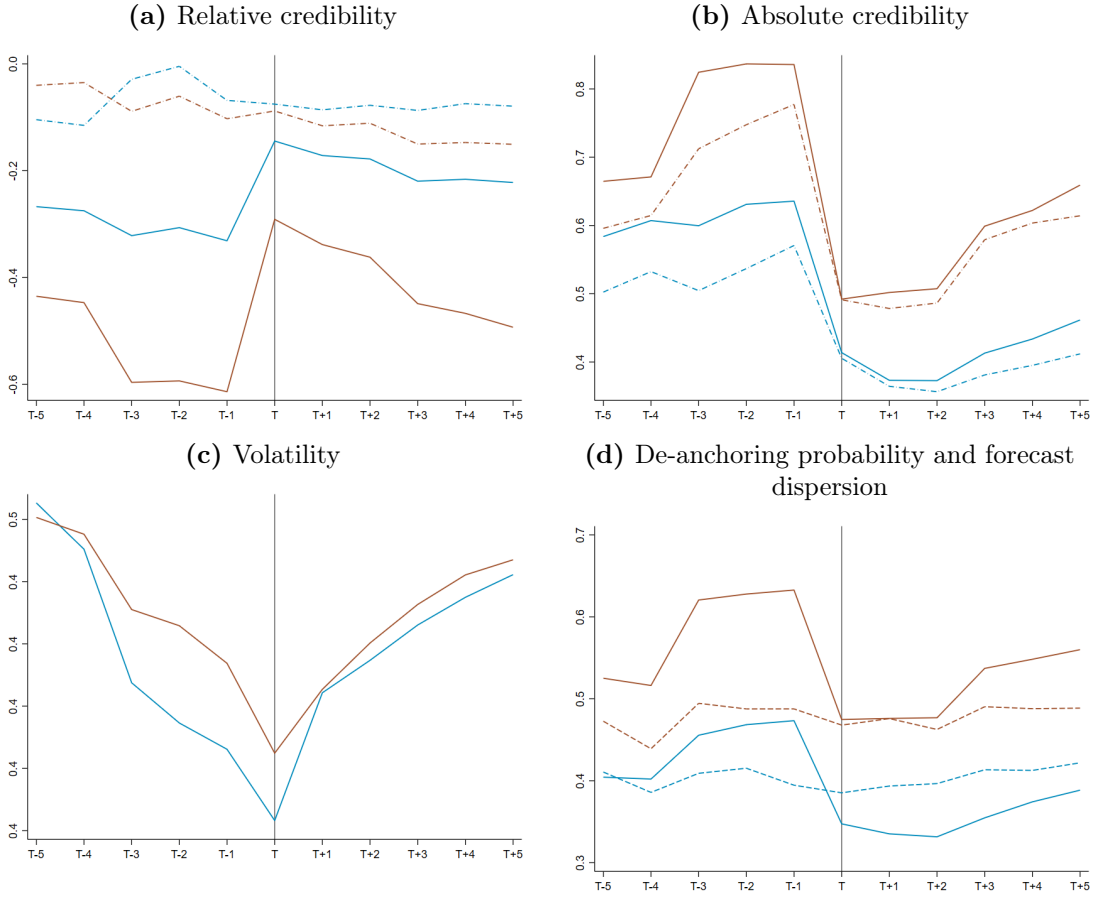
This subsection investigates how the government's releasing new official targets catalyzes the convergence of private and public projections and improves instantaneous credibility. Announcements of new fiscal targets should in themselves be a shock on market perceptions. The release of new fiscal plans clearly constitute statistical innovations for the credibility time series, whose impact is *a priori* ambiguous. One the one hand, the release of new official plans, updated to account for the latest developments, could help re-anchor private expectations. On the other hand, the disclosure of new official targets could also add confusion if communication is poor or the new targets are panglossian.[35]

Figure 3.8 illustrates, with an event study, how the publication of new targets is conducive of a convergence between private views and targets. Credibility improves dramatically upon the release of new official plans and then slowly worsens (Figures 3.8a–3.8b). On average, on impact, both relative and absolute credibility improve by 0.2 percentage point of GDP for current year forecasts and 0.4 percentage point of GDP for next year forecasts. The larger effect for one-year ahead expectations is not surprising: the longer the time horizon, the less proprietary information private forecasters own (from their clients or their own investments, *e.g.*), the more preponderant government communication is in the forecast updating process. The volatility of credibility tends to decrease already a few months announcements, which could be because of political discussions and public debates help crystallize private forecasters' opinions (Figure 3.8c). Official announcements thus help anchor expectations, even though they have no impact on the dispersion of private forecasts—the latter could then reflect an intrinsic assessment of government's ability to achieve targets (Figure 3.8d).

[34]That being said, the findings of section 3.5 are not driven by such announcements. In addition to including a dummy in all regression, I have run the same regressions as in Table 3.1, but excluding observations corresponding to the release of new policy targets. Results are essentially unchanged (see Table 3.14).

[35]This should be less likely in my sample, because the authorities are subject to the European commission oversight.

Figure 3.8. *Evolution around release of new official forecasts*



Notes: On the monthly x-axis, T labels the month when the government publishes new budgetary objectives. Blue and orange lines are respectively for $h = 0$ and $h = 1$. Dashed lines represent cyclically-adjusted credibility on panels (a)-(b), and private forecast dispersion on panel (d).

The credibility bonus that come with policy announcements is short-lived, especially for next year forecasts. After a few months, credibility tends to be eroded. As the literature on forecasts underlines, disagreement can be sourced in several factors: disagreements about macroeconomic outlook, about policy intentions, or about the government's capacity to reach its targets. Thus, communication through the regular update of fiscal targets likely help alleviate some of the prevalent uncertainty.

To study how the determinants of credibility contribute to the success of new announcements in re-anchoring expectations, I run the following regression:

$$\Delta ACred^{(h)}_{i,T+k} = \phi_{year(T)} + \chi_i + \rho ACred^{(h)}_{i,T-1} + \beta X_{i,T+k} + u_{i,T+k} \tag{3.10}$$

where T indexes all the country-specific dates when governments updated their fiscal targets and all other notations are similar to equation (3.9). Since the professional forecasters enlisted in the Consensus do not always update their projections immediately, I look at several months $T + k$, with $k = 0, \ldots, 5$, after the release; this basic local projection method *à la* Jordà (2005) allows me to see how the contribution of each determinant varies over time.

Table 3.3. *Credibility on the month of release of new official targets*

	Variable of interest	T	$T+1$	$T+2$	$T+3$	$T+4$	$T+5$
Macro conditions	Public debt ratio in previous year	0.001*	0.001*	0.001***	0.002	0.004*	0.005*
	Inflation	0.000	0.001	-0.006	0.016	0.032	0.054***
	Inflation if higher than 4%	-0.002	0.012	-0.004	0.015	0.018	0.032*
	Output gap (previous year)	-0.021***	-0.010	-0.010*	-0.011	-0.027**	-0.019
	Sovereign yield	0.019	-0.007	-0.005	-0.005	0.019	0.073***
	Policy interest rate	0.206*	-0.063	0.363***	0.194	0.492	0.181
Institutions	Log GDP per capita	-0.077***	0.483**	-0.120***	0.030	-0.003	0.145
	Number of numerical fiscal rules	0.017	0.020	-0.005	0.107**	0.046**	0.092**
	Budget balance rule	-0.112***	-0.099**	-0.059	0.016	0.224***	0.173**
	Debt rule	0.063*	0.054	0.060*	0.133	0.202	0.073
	Multiyear expenditure ceiling	0.001	0.019	-0.066**	-0.005	-0.075*	-0.036
	Independent body sets budget assumptions	-0.055	-0.115**	-0.153***	-0.225*	-0.159	-0.272***
	Index of independent fiscal institutions	-0.002*	-0.002	0.001	0.002	0.003	0.002
Policy	Adjustment objective for t+1	0.017*	0.004	0.024**	0.014	0.028**	0.012
	Medium term adjustment objective	-0.028	0.065**	0.091***	0.056	0.108**	0.070
	t+1 target change	0.121***	0.126***	0.080***	-0.016	-0.010	-0.011
	Past forecast error (2 years)	0.026**	0.016	0.030***	0.005	0.028**	0.032**
Misc.	Uncertainty index	-0.622*	-0.644*	-0.752**	0.886**	0.977**	0.914*
	Government democratic strength†	-0.001	0.002	-0.025*	-0.035*	-0.046**	-0.026

Notes: For simplicity, this table summarizes in a compact form several separate regressions where the explanatory variables of interest are introduced one by one, as in Table 3.1. A positive coefficient means that the variable contributes to increase $ACred$, that is to worsen credibility. All regressions include fixed effects and some control variables, which have been omitted here; so have the standard errors and various statistics and tests.
***, **, and * stand for significance at the 99, 95, and 90 percent confidence levels, respectively.
† This categorical variable captures how much of a majority the government enjoys in parliament; it goes from 1 for a single party majority government and goes up to 7 for a technocratic government (Armingeon et al., 2019).

Several factors contribute to emphasize or undercut the credibility gain of releasing new fiscal targets, as shown in Table 3.3 for $h = 1$. First, macroeconomic conditions; the new announcement bonus appears to be somewhat offset when markets have concerns about the macroeconomic conditions and liquidity risks (proxied by the price of sovereign financing or the size of public debt). Second, having robust budgetary institutions as well as safeguards in the budget-making process, in the form of numerical fiscal rules and independent expertise, makes the release of new targets more effective. The effect is remarkably stronger than what I found in the previous subsection for the level of credibility. And the effect of institutions also contributes to maintain the announcement bonus for longer; for several of them, the estimated coefficient even increases for several months after the release date.

Third, policy itself matters. Policy statements that set ambitious objectives are met with circumspection, in absolute terms and also relative to the previous target. A track record of past fiscal errors tends to undermine the positive impact of new announcements. I find that powerful governments, which are backed by a democratic majority, get less of this credibility dividend, which I assume is related to the fact that announcements by less stable governments are more broadly scrutinized, hence more cautious and realistic. Last, the regression involving the uncertainty index by Ahir et al. (2018) sheds light on the forecasting process and confirms how new announcements initially crystallize expectations more when uncertainty is high (forecasters are desperate for seemingly reliable information), but this effect dissipates rapidly and uncertainty takes over again after a few months.

The benefits of credibility

Fiscal credibility can be expected to have several beneficial macroeconomic effects. First, a credible government, by convincing markets about its fiscal policy, should be able to access better financing conditions. Second, fiscal credibility should foster a virtuous sentiment of confidence, which in turn should stimulate demand through higher investment and higher consumption. Under more trust and certainty, agents need to accrue less precautionary savings. Therefore, credibility should contribute to higher GDP growth. This growth should translate into more robust tax revenues, which, together with better financing terms, should help to improve fiscal outturns. By contraposition, when agents mistrust the government, they might delay consumption and investment in favor of precautionary savings, and possibly resort to informality.[36] This might erode tax bases and tax morale, making it more likely for governments to miss their fiscal targets, and fuel mistrust further.

This subsection empirically examines how credibility impacts fiscal performance. It runs the following fixed-effect panel regressions, where credibility C, as measured by one of the indicators introduced in this chapter, is now on the right-hand side of the equation, with a lag:

$$Z_{i,t} = \phi_{year(t)} + \psi_{month(t)} + \chi_i + \beta C^{(h)}_{i,t-1} + \rho Z_{i,t-1} + \eta_{i,t} \tag{3.11}$$

Several endogenous variables Z can be considered; I focus here on market indicators of sovereign risk.[37] The empirical approach follows closely that of the previous subsection—

[36] The literature on informality finds a clear link between lack of trust in governments and institutions and the extent of informal activity.

[37] I have also run these regressions with growth components as the explained variable, on a quarterly and annual basis. While more work is needed to fully address potential endogeneity issues, preliminary results indicate that high credibility (as measured by several different indicators) may be associated with better macroeconomic performance, thanks to higher investment and to a lesser extent to private consumption. This would be aligned with Ricco et al. (2016)'s finding that public spending shocks have a more effective impact on growth when the government's communication anchors expectations more strongly.

Table 3.4. *Fiscal credibility and outcomes*

	Sov. CDS								Sov. yield (2 years)								Sov. yield (10 years)			Rating			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
Lag endogenous	0.836***	0.894***	0.883***	0.894***	0.882***	0.875***	0.862***	0.880***	0.960***	0.962***	0.962***	0.960***	0.968***	0.961***	0.960***	0.961***	0.970***	0.970***	0.971***	0.988***	0.988***	0.993***	0.999***
	[0.015]	[0.007]	[0.011]	[0.008]	[0.011]	[0.010]	[0.014]	[0.014]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]	[0.004]	[0.004]	[0.004]	[0.002]	[0.002]	[0.002]	[0.000]
Lagged credA_t	2.382**								0.019**														
	[1.103]								[0.008]														
Lagged change in credA_t		1.344**								0.019**							0.019**			-0.004**			
		[0.535]								[0.009]							[0.009]			[0.002]			
Lagged credA_t1			0.858**																				
			[0.421]																				
Lagged change in credA_t1				1.420***							0.016**												
				[0.466]							[0.007]												
Lagged credA_ca_t					1.454*																		
					[0.746]																		
Lagged change in credA_ca_t						1.286**															-0.005**		
						[0.566]															[0.002]		
Lagged credA_ca_t1												0.013*											
												[0.007]											
Lagged credV_t							6.423***																
							[2.243]																
Lagged credV_t1								3.916**															
								[1.945]															
Lagged change in credV_t1													-0.072**										
													[0.033]										
Lagged priv_sd_t1																						-0.010*	
																						[0.006]	
Lagged credR_t														0.042***				0.032**					
														[0.015]				[0.014]					
Lagged credR_t if < 0														-0.056***				-0.033*					
														[0.019]				[0.018]					
Lagged change in credR_t																			-0.024**				-0.000
																			[0.011]				[0.003]
Lagged change in credR_t if < 0																			0.027*				0.006*
																			[0.016]				[0.003]
Lagged credR_t1															0.032**								
															[0.013]								
Lagged credR_t1 if < 0															-0.036**								
															[0.015]								
Lagged change in credR_t1																0.013							
																[0.010]							
Lagged change in credR_t1 if < 0																-0.032***							
																[0.013]							
Constant	4.498	4.078***	3.656**	4.048***	3.622*	4.754***	1.498	1.963	-0.009	-0.004	-0.005	-0.011	-0.017*	-0.010	-0.010	-0.005	-0.030*	-0.034*	-0.031*	0.192***	0.190***	0.110***	0.018**
	[4.767]	[1.297]	[1.633]	[1.267]	[1.991]	[1.517]	[4.497]	[3.759]	[0.015]	[0.015]	[0.015]	[0.016]	[0.010]	[0.015]	[0.015]	[0.015]	[0.018]	[0.018]	[0.018]	[0.040]	[0.040]	[0.036]	[0.008]
Observations	3,337	3,319	3,323	3,303	3,337	3,319	3,121	3,083	2,451	2,442	2,427	2,421	2,295	2,451	2,438	2,427	2,855	2,866	2,855	3,883	3,883	3,450	3,883
Number of ccode	25	25	25	25	25	25	25	25	17	17	17	17	17	17	17	17	21	21	21	27	27	18	27
Fixed effects	C	C	C	C	C	C	C	C	YM	YM	YM	YM	Y	YM	YM	YM	YM	YM	YM	CY	CY	CYM	Y
Heterosked	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Autocorr	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hausman	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.947	0.947	0.967	0.964	0.603	0.932	0.927	0.927	0.971	0.906	0.906	0.000	0.000	0.021	0.695
Wald Y	0.439	0.439	0.374	0.374	0.345	0.345	0.399	0.334	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Wald M	0.493	0.493	0.476	0.476	0.476	0.476	0.477	0.470	0.052	0.052	0.044	0.045	0.117	0.050	0.042	0.042	0.000	0.000	0.000	0.599	0.677	0.022	0.452
Modif. Wald	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Breusch-Pagan	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Serial	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Same conventions for the statistical tests as in Table 3.1. Beyond, `credA` is the absolute credibility *ACred*, `credR` the relative credibility *Cred*, `credV` the volatility of credibility over time *Vol*, and `priv_sd` the dispersion of private forecasts *SdCred*. `ca` denotes cyclically-adjusted credibility indicators, while `t` and `t1` are for $h = 0$ and $h = 0$, respectively. `X if < 0` is the variable X interacted with the dummy $\mathbb{I}_{X<0}$.

except that here there are less variables of interest on the right-hand side. Admittedly, this specification may omit some determinants, but the abundant fixed effects and the AR(1) residuals should mostly capture. It provides insights, in terms of correlations rather than causality, on how the various credibility indicators I have developed in this chapter (or the variation thereof) relate to macro-fiscal performance. Relative credibility $Cred$ is also included in some regressions, to see whether there could be some non-linear effects between situations where markets are more pessimistic than governments, and (rarer) cases where they are more optimistic.

I find a strong confirmation that credibility affects market perception and price of sovereign risk. Better credibility, as proxied by many of the indicators developed in this chapter, is significantly associated with lower sovereign CDS spreads, as can be seen in columns (1)–(8) of Table 3.4. The impact of credibility stands between 5 and 27 bps, depending on the indicator considered.[38] Credibility is also strongly correlated to lower sovereign yields, representing an impact of around 0.4 percentage point for short maturities (columns (9)–(16)) and 0.3 for longer tenors (regressions (17)–(19)). It seems to also come with somewhat better ratings (20)–(23).[39] As evidenced by regressions where I introduce a non-linear term, these effects are stronger when $Cred$ is negative; in other words, markets penalize more strongly governments that are too optimistic than those who are too pessimistic, compared with the markets' own expectations.

3.6 Conclusion

This chapter fills a gap in the literature by providing an explicit measure of fiscal credibility. The quantitative indicators of fiscal credibility it develops cover 27 European countries and the 1995–2019 period on a monthly frequency. Moreover, the methodology can be easily replicated to other countries. Other complementary sources of data could be leveraged, for instance Frankel's (2011) dataset of official macro-fiscal forecast for 33 countries over 1985–2011. Alternatively, such forecasts can be found in national budget documents. For private expectations, it should be possible to extract forecasts from the publications of research institutes, think tanks, and ratings agencies, using text mining techniques. Other indicators of market sentiment towards the government could also be envisaged, for example by parsing tweets or the specialized press and media—yet, this would likely lead to a qualitative, rather than quantitative indicator of perceptions.

[38] This is calculated as $\beta \left\langle C^{(h)}_{i,t-1} \right\rangle / (1-\rho)$, using the sample-wide mean of credibility.

[39] As an indicator of sovereign credit ratings, I follow Afonso et al. (2012)'s methodology and transform ratings by the main credit agencies (DBRS, Fitch, Moody's, and S&P) into a discrete numerical variable, AAA being the highest value. My only innovation is to add (subtract) 0.5 when the outlook is positive (negative).

This chapter provides stylized facts about the average credibility of European countries and the dynamics of fiscal credibility. Private agents are more wary about some countries than others, and such sentiment tends to persist over time. I find that credibility is influenced simultaneously by the macroeconomic environment, policy decisions, the government's past record, and the institutional setup. Among all these factors, the most influential ones relate to policy: credibility is lesser the higher public debt and deficit, the larger slippages in the past, and the more ambitious the targeted fiscal adjustment. Fiscal rules and fiscal councils can contribute to improving credibility, but more as a catalyst of reasonable policy than by themselves.

I find that my indicator of fiscal credibility is correlated with the market valuation of sovereign risk. Therefore, governments should strive to build and maintain credibility, by means of better institutions, more prudent forecasts, and regular communication about progress towards targets. A credible government might even trigger a virtuous circle, if its credibility is conducive of more investment and less precautionary savings, thereby boosting growth and placing the government in a better position to meet its fiscal targets.

For policy and law makers, these findings have deep implications. First, it means that their track record are crucial to build a precious sentiment of confidence in their fiscal decisions. Most officials consider the budget a mere political vehicle, where packaging and broad policy intentions are more important than content. They should be more careful in drafting and implementing budget laws. A systematically optimistic bias can for instance cost valuable credibility. Second, credibility-enhancing institutions can contribute, but not replace such a careful approach. Ideally, such fiscal institutions should be designed in such a way that forces governments to account for the long-term consequences of their fiscal choices in terms of fiscal credibility and medium-term fiscal performance. Third, strong communication and a clear accountability framework could provide better results than setting up *ad hoc* institutions (especially when the latter are essentially formal).[40]

These policy implications are even more stringent in times of crisis, as it is crucial to prevent credibility from eroding in the face of adverse shocks. For instance, in response to the CoViD-19 shock, most countries suspended their normal macroeconomic policy frameworks, such as their fiscal rules or restrictions on monetary financing. While extreme circumstances called for unorthodox policies, most governments have not publicly addressed the heightening medium-term risks they may represent for public debt sustainability. For the sake of limiting the damage on fiscal credibility, even after market risk pricing normalizes, authorities should rapidly devise and communicate an exit strategy out of these extraordinary policies. They could also rely more on state-contingent policy instruments, alike countercyclical macroprudential policy tools;

[40]The IMF three pillars of good monetary policymaking are independence, accountability, and transparency. Clearly, devolving fiscal responsibilities to an independent, non-elected agency is unthinkable.

for instance, by issuing indexed debt or by having budget rules to mechanically change some budget or tax items depending on cyclical developments. When the time will come for countries to reduce their debts, being (seen as) credible could be the long-sought-after key to expansionary fiscal contractions.

Appendices

3.A Data coverage

Country	Code	First available		Forecast directly in % of GDP	# of obs.	Group
		Official forecast	Consensus forecast			
Austria	AUT	1998M11	2012M05	Yes*	92	Core
Belgium	BEL	1998M12	2012M05	Yes*	92	Core
Bulgaria	BGR	2007M12	2007M05	Yes	145	Eastern
Croatia	HRV	2013M04	2007M05	Yes	81	Eastern
Cyprus	CYP	2004M05	2014M01	Yes*	72	Program
Czech Republic	CZE	2004M05	1998M05	Yes	188	Eastern
Denmark	DNK	1998M12	2008M02	Yes*	143	Core
Estonia	EST	2004M05	2007M05	Yes	152	Eastern
Finland	FIN	1998M09	2012M08	Yes*	89	Core
France	FRA	1998M12	1995M01	No	253	Core
Germany	DEU	1999M01	1995M01	No	252	Core
Greece	GRC	1998M12	2010M05	Yes*	116	Program
Hungary	HUN	2004M12	1998M05	Yes	181	Eastern
Ireland	IRL	1998M12	2010M05	Yes*	116	Program
Italy	ITA	1998M12	1995M01	No	253	Core
Latvia	LVA	2004M12	2007M05	Yes	152	Eastern
Lithuania	LTU	2004M05	2007M05	Yes	152	Eastern
Luxembourg	LUX	1999M02	2014M08	Yes	65	Core
Netherlands	NLD	1998M11	2010M03	No	118	Core
Poland	POL	2004M12	1998M05	Yes	181	Eastern
Portugal	PRT	2000M02	2010M05	Yes*	116	Program
Romania	ROM	2007M11	2010M05	Yes*	116	Eastern
Slovak Republic	SVK	2004M11	2010M03	Yes	118	Eastern
Slovenia	SVN	2004M05	2007M05	Yes	152	Eastern
Spain	ESP	1998M12	2008M03	No	142	Program
Sweden	SWE	1998M12	2007M10	No	147	Core
United Kingdom†	GBR	1998M12	1995M01	No	253	Core

* Available *via* Bloomberg

† Relies on fiscal years that start in April.

3.B Data sources and definitions

	Definition	Unit	Source
$\mathbb{E}_t^p b$	Private forecast of general government's overall balance	percent of GDP	Monthly Consensus Economics publications, Bloomberg surveys
$\mathbb{E}_t^o b$	Official forecast of general government's overall balance	percent of GDP	Stability and Convergence Programs, Draft budgetary plans, and program reviews
ζ	Output gap	percent of potential GDP	WEO
g	Real GDP growth	percent of GDP	WEO
D	Public debt	percent of GDP	WEO
b	General government's overall balance (net borrowing)	percent of GDP	Eurostat
pb	Non-interest balance	percent of GDP	WEO
i	Long-term yield (10-year T-bond)	percent	WEO
	GDP per capita	€ and US$	WEO
	Fiscal rule design	indices	IMF fiscal rule database (Lledó et al., 2017)
	Fiscal councils	indices	IMF Fiscal council dataset (Debrun et al., 2013; Beetsma et al., 2019)
	Independent fiscal institution	index	European Commission, 2018 vintage
	Sovereign CDS spreads and currency asset swap spreads	last price	Bloomberg
	Sovereign credit ratings	index	DBRS Morningstar, Moody's, Fitch, S&P
	Sovereign yields	percent	Eurostat (Maastricht definition), Bloomberg
	Headline and core inflation	percent, year-over-year	Eurostat (HCPI)
	IMF programs and program reviews	dummy	IMF's Monitoring of Fund Arrangements (MONA) database
	Political data	index	Comparative Political dataset (CPDS) (Armingeon et al., 2019), which I completed over 2018–19
	Trust in politicians	percent	European Social Survey (ESS)
	Election	dummy	Election Guide by International Foundation for Electoral Systems (IFES) [here]
	Export quality/diversification	indices[†]	IMF (based on Cadot et al., 2011; Henn et al., 2013)
	Uncertainty	index	Ahir et al. (2018)

[†] Export diversification is a Theil index: a lower value corresponds to more diversified exports.

3.C Cyclical adjustment

To assess to what extent my credibility indicator $Cred$ is driven by the credibility of the underlying macroeconomic assumptions, I would need to compare the private and official forecasts of cyclically-adjusted balances rather than those of overall balances. Yet, this is not feasible, as private forecasters publish neither cyclically-adjusted balance forecasts, nor the output gap estimates that underlie their calculations. Even governments started only lately to publish such forecasts on a systematic basis. This appendix describes a workaround.

Cyclically-adjusted balances are fiscal balances filtered from the effects of the business cycle. Since the latter are difficult to estimate with precision, analysts usually rely on estimates of the elasticity to output of the various items that compose the fiscal balance. Namely, if $b_t = \sum_k r_{kt} - \sum_k g_{kt}$ is a breakdown of the fiscal balance (as a ratio of GDP) between revenue and spending items and Y and Y^* stand for the actual and potential GDP, then the cyclically-adjusted balance as a share of potential GDP can be computed as follows (Bornhorst et al., 2011):

$$b_t^* \equiv \sum_k r_{kt} \left(\frac{Y_t^*}{Y_t}\right)^{\varepsilon_k - 1} - \sum_k g_{kt} \left(\frac{Y_t^*}{Y_t}\right)^{-\eta_k - 1}$$

The elasticity coefficients $(\varepsilon_k)_k$ and $(\eta_k)_k$ are all non-negative; they are close to 1 for tax revenues, and close to nil for spending (except for automatic stabilizers, such as unemployment benefits).[41] Hence the following first order of approximation when the output gap $\zeta_t = Y_t/Y_t^* - 1$ is small:

$$b_t^* \approx b_t + \zeta_t \left[\sum_k r_{kt}(1-\varepsilon_k) - \sum_k g_{kt}(1+\eta_k)\right] \approx b_t - \zeta_t \sum_k g_{kt}$$

It is thus commonly assumed that the cyclical component of the fiscal balance is $\varepsilon\zeta_t$, with the overall elasticity ε roughly constant and equal to the government's size (*i.e.*, in most advanced economy cases, around 0.3–0.5). Assuming that the government and private forecasters share the same methodology to compute cyclically-adjusted balances and that they both have similar estimates of the elasticity coefficients (ε), I can define a cyclically-adjusted indicator of credibility which filters out potential differences of views about macroeconomic forecasts:

$$Cred_{i,t}^{*(h)} \equiv Cred_{i,t}^{(h)} - \varepsilon_i \left[\mathbb{E}_t^p \zeta_{i,t+h} - \mathbb{E}_t^o \zeta_{i,t+h}\right] \tag{3.12}$$

where $\mathbb{E}_t^p \zeta_{i,t+h}$ (resp. $\mathbb{E}_t^o \zeta_{i,t+h}$) is the h-year-ahead output gap forecast made at time t by private agents (resp. the government) about country i.

[41] The two "-1" in the exponents appear when one looks at (potential) GDP ratios. The elasticities themselves are defined as $\ln R_k = \alpha_k + \varepsilon_k \ln Y$ for revenues and $\ln G_k = \beta_k - \eta_k \ln Y$ for expenditure, with the uppercase standing for nominal variables.

The problem here is that the bracket is unknown, unless another—less benign—assumption is made: that official and private forecasts share the same estimates of potential growth and $t-1$ output gap, in which case the bracket becomes a simple function of their respective growth forecasts:[42]

$$Cred^{*(h)}_{i,t} \approx Cred^{(h)}_{i,t} - \varepsilon_i \sum_{\ell=0}^{h} \mathbb{E}^p_t \gamma_{i,t+\ell} - \mathbb{E}^o_t \gamma_{i,t+\ell}$$

This cyclical adjustment allows to break down the credibility indicator $Cred^{(h)}$ in two components: credibility of macroeconomic forecasts ($\mathbb{E}^p_t \gamma - \mathbb{E}^o_t \gamma$) and credibility of budget targets given macroeconomic forecasts ($Cred^{*(h)}$). The latter is a proxy of what the difference in views about fiscal outcomes would be, were everyone to agree on the macroeconomic parameters.

Data sources are similar to what I present in section 3.2. Government growth forecasts $\mathbb{E}^o_t \gamma_{i,t+h}$ are taken from SCPs, DBPs, and program documents; private forecasts $\mathbb{E}^p_t \gamma_{i,t+h}$ come from data published by Bloomberg and Consensus Economics. Last, I use country-specific elasticities ε_i that Mourre et al. (2019) estimated and the European commission uses when computing cyclically-adjusted balances for surveillance purposes.

[42] Indeed, in first approximation, $\Delta\zeta_t = \gamma_t - \gamma^*_t$ with γ and γ^* denoting respectively the rates of actual and potential growth.

3.D Indicators of past fiscal performance

A nice feature of my dataset is that I can compute revisions in fiscal plans, as well as real time forecast errors, as they could have been observed by contemporaneous forecasters. The forecast error the government makes at time t about its year $t+h$ deficit is simply the slippage between official plans and actual outcomes:

$$e_t^{(h)} \equiv \mathbb{E}_t^o b_{i,t+h} - b_{i,t+h} \; \forall h, \tag{3.13}$$

The latter forecast error is somewhat of an anachronism, in the sense that it is measured from today's perspective——after several rounds of national accounts revisions and sometimes changes in the basis year or accounting rules. As an alternative, I can look at the error as observed from the first outturn estimate, which is probably the slippage private forecasters eventually remember:[43]

$$\hat{e}_{i,t}^{(h)} \equiv \mathbb{E}_t^o b_{i,t+h} - \mathbb{E}_{\tilde{t}+h+1}^o b_{i,t+h} \tag{3.14}$$

Another possible source of concern for private agents is the government' changing markedly their fiscal targets—let us just imagine what would happen to inflation forecasts if central banks changed their objectives every six months. I compute target revisions as the latest change in official forecasts:

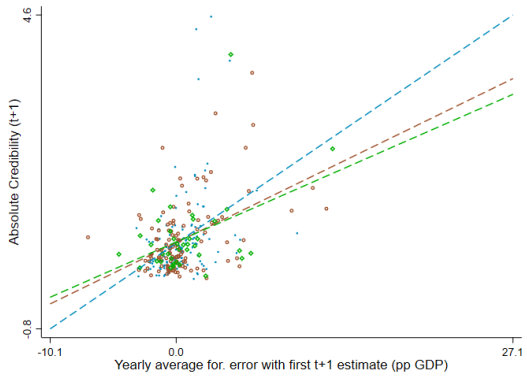
$$\delta_t^{(h)} = \begin{cases} \mathbb{E}_t^o b_{i,t+h} - \mathbb{E}_{t-1}^o b_{i,t+h} & \text{if there is a new release in } t \\ \delta_{t-1}^{(h)} & \text{otherwise} \end{cases} \tag{3.15}$$

Since markets likely keep track of the history of fiscal revisions and slippages, I examine in this chapter two rolling averages of forecast errors and revisions: namely, if $x \in \{e, \hat{e}, \delta\}$, a moving average over the 24 months $x_{i,t|24m}^{(h)} \equiv \left\langle x_{i,s}^{(h)} \right\rangle_{t-24 \leq s \leq t-1}$; and an average of the last two full calendar years $x_{i,t|2yr}^{(h)} \equiv \left\langle x_{i,s}^{(h)} \right\rangle_{\lfloor t/12 \rfloor - 24 \leq s \leq \lfloor t/12 \rfloor - 1}$. Some results are plotted on Figure 3.9. The main findings are that credibility seems to erode when observed forecasts errors increase, or when the government has revised often its fiscal balance downwards (*i.e.*, to a larger deficit).

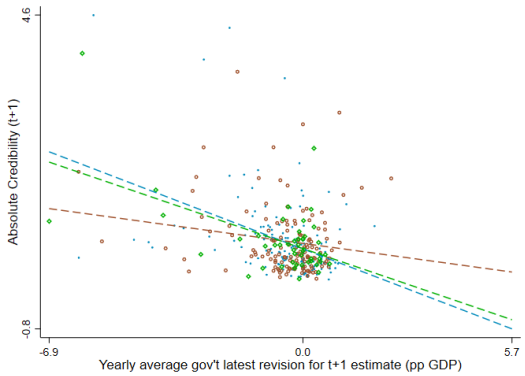
[43] $\tilde{t}$ is the first month of year $t+h+1$ in which governments release an outturn estimate for year $t+h$ (usually between March and June).

Figure 3.9. *Credibility and past fiscal performance*

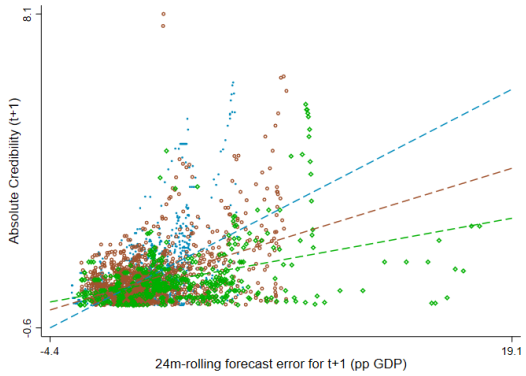
(a) Impact of past errors (as observed at first)



(b) Revisions for year $t+1$



(c) Rolling average of forecast errors

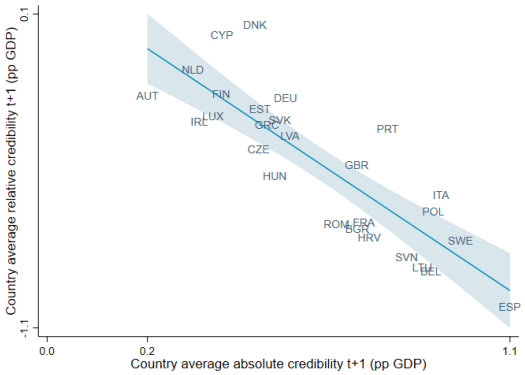


Notes: Blue dots are for "core" economies, red circles for IMF programs, and green diamonds for Eastern European countries—these country groups are defined in appendix 3.A. Dashed lines are linear regressions (per country type).

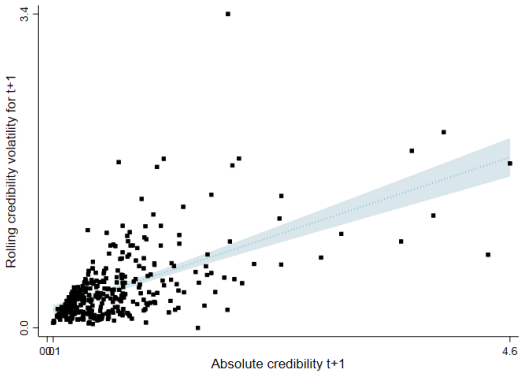
3.E Correlations between credibility indicators

Figure 3.10. *Correlations between absolute credibility and other indicators (for $h = 1$)*

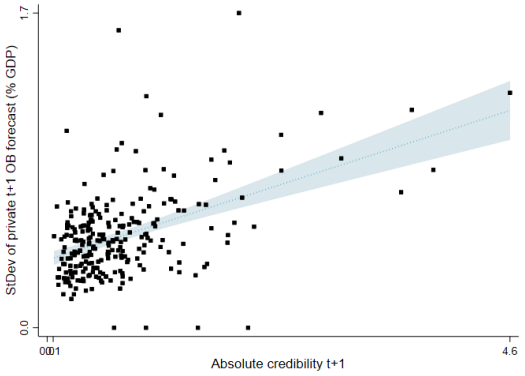
(a) Relative versus absolute credibility (country averages)



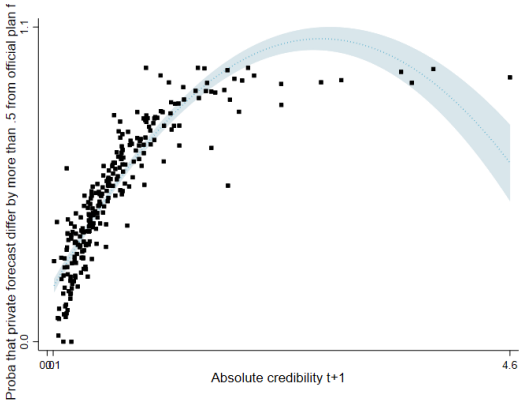
(b) Volatility versus absolute credibility (country-year averages)



(c) Relative versus absolute credibility (country-year averages)



(d) Probability of divergent expectation (country-year averages)



Note: Dotted lines represent a plain linear regression and shaded areas the associated 95-percent confidence bands. On panel (a), the negative correlation reflects simply the fact that relative credibility is more often negative than not, which translates into a larger (positive) absolute credibility. The larger absolute credibility, the less credible the government.

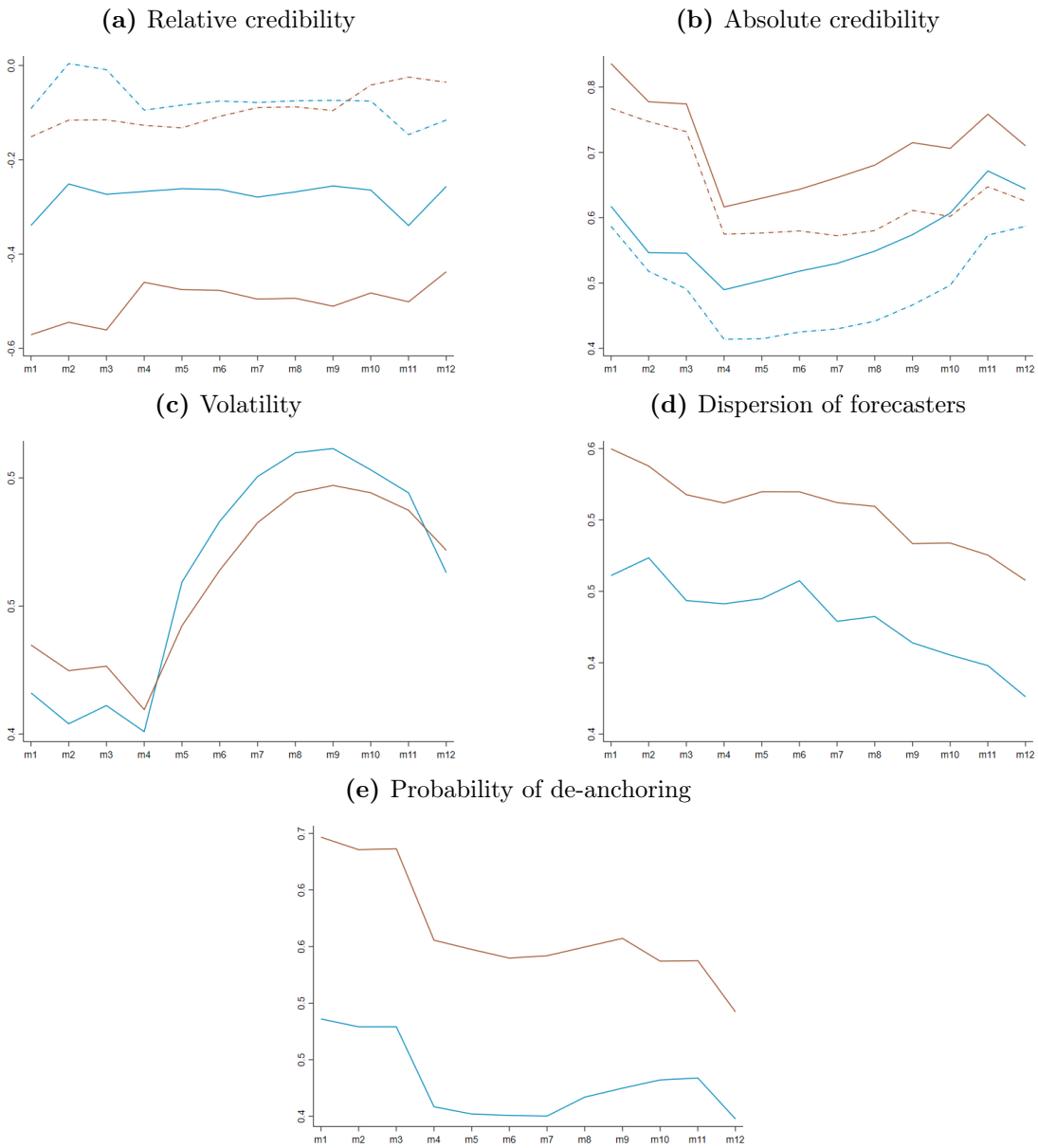
Table 3.5. *Pearson's correlation and Spearman's rank correlation (in percent)*

		$Cred$		$ACred$		$ACred^*$		$SdCred$		Vol		$\tau_{1/2}$		P	
		(t)	(t+1)	(t)	(t+1)	(t)	(t+1)	(t)	(t+1)	(t)	(t+1)	(t)	(t+1)	(t)	(t+1)
$Cred$	(t)		73‡	-64‡	-45†	-56‡	-35*	-38	-40	-51‡	-18	-15	-2	-47†	-44*
	(t+1)	73‡		-51‡	-84‡	-18	-47†	-25	-28	-15	-40†	-19	11	-60‡	-80‡
$ACred$	(t)	-48†	-50‡		59‡	82‡	48†	33	24	59‡	62‡	51‡	28	67‡	46*
	(t+1)	-44†	-86‡	52‡		24	61‡	-2	3	9	70‡	31	10	54†	80‡
$ACred^*$	(t)	-42†	-18	78‡	20		53‡	32	21	71‡	29	18	14	54†	29
	(t+1)	-32	-44†	34*	54‡	50‡		30	32	19	37*	4	-17	56†	46*
$SdCred$	(t)	-42*	-31	34	-3	33	28		91‡	32	-17	-10	-41*	66‡	16
	(t+1)	-45*	-41*	31	8	25	34	93‡		24	-9	-16	-45*	59‡	19
Vol	(t)	-54‡	-39†	82‡	33	72‡	25	40*	42*		29	15	8	45*	15
	(t+1)	-11	-44†	63‡	70‡	30	31	-16	-5	58‡		54‡	35*	17	17
$\tau_{1/2}$	(t)	-11	-19	49†	30	12	-4	-5	-5	38*	61‡		64‡	19	-6
	(t+1)	-7	5	26	10	14	-19	-36	-41*	21	41†	69‡		-18	-16
P	(t)	-40*	-51†	53†	47†	52†	60‡	66‡	67‡	39	11	5	-26		70‡
	(t+1)	-43*	-72‡	38	78‡	28	47†	16	22	14	13	-17	-17	69‡	

Notes: The upper right half of the matrix reports pairwise correlations between the various credibility indicators (average country indicators, while the lower right side shows their Spearman's rank correlations—that is, the correlation between country rankings according these various statistics. ‡, †, and * stand for rejection of the hypothesis that there is no linear/monotonic relationship at the 1, 5, and 10 percent confidence levels.

3.F Event studies

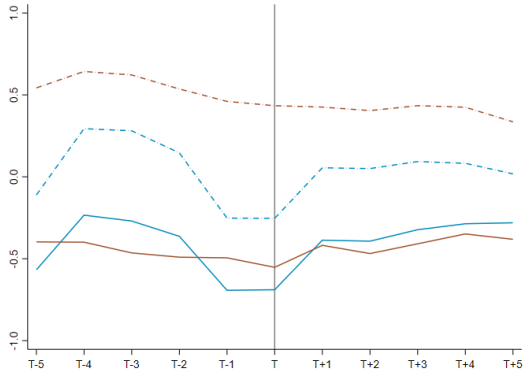
Figure 3.11. *Seasonal patterns (averages per month, in percent of* GDP*)*



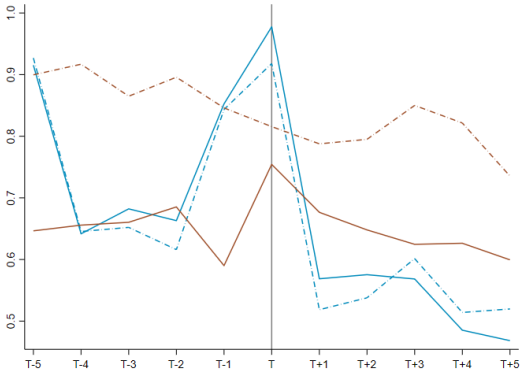
Note: Blue and red lines are respectively for $h = 0$ and $h = 1$; dashed lines include cyclical adjustment. The U.K., whose fiscal year starts in April, is excluded.

Figure 3.12. *Evolution around* IMF *program reviews*

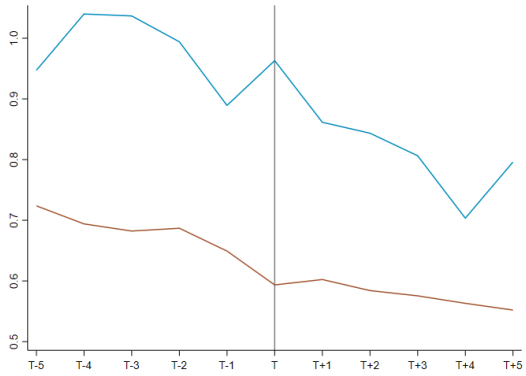
(a) Relative credibility



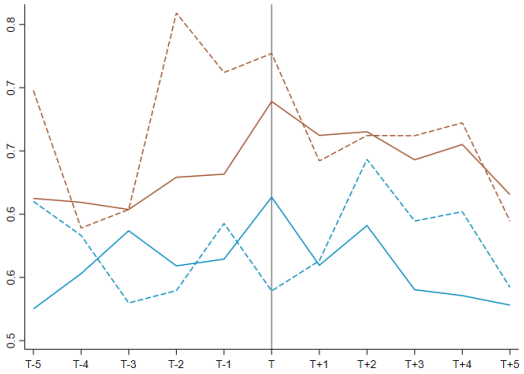
(b) Absolute credibility



(c) Volatility

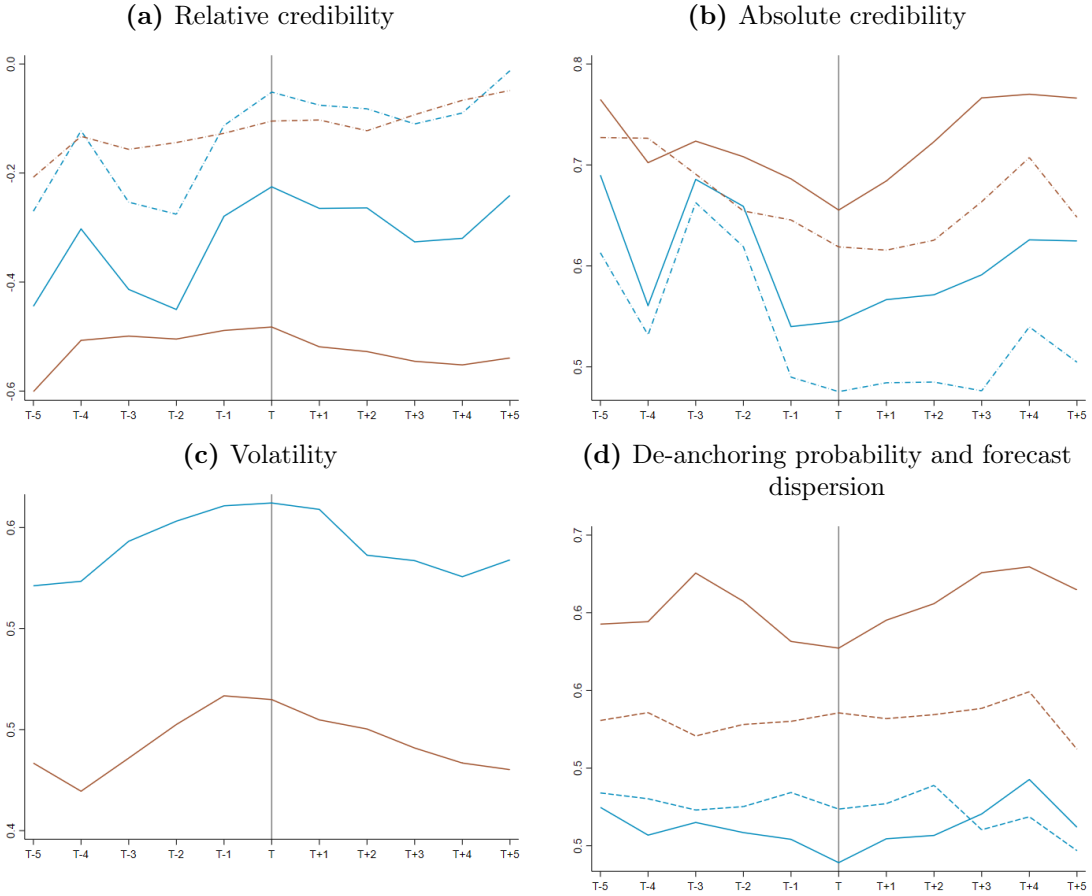


(d) De-anchoring probability and forecast dispersion



Notes: The horizontal axis is in months; T is the date when the review is officially approved by the IMF Board. Blue and red lines are respectively for $h = 0$ and $h = 1$. Dashed lines represent cyclically-adjusted credibility on panels (a)-(b), and private forecast dispersion on panel (d).

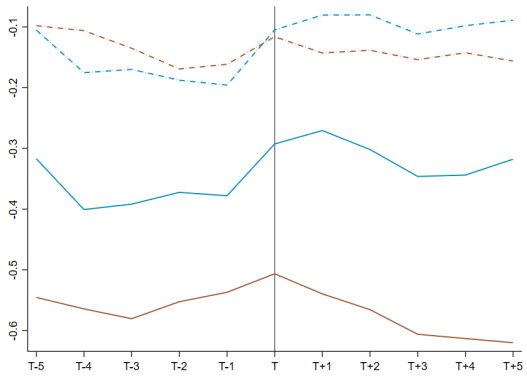
Figure 3.13. *Evolution around elections*



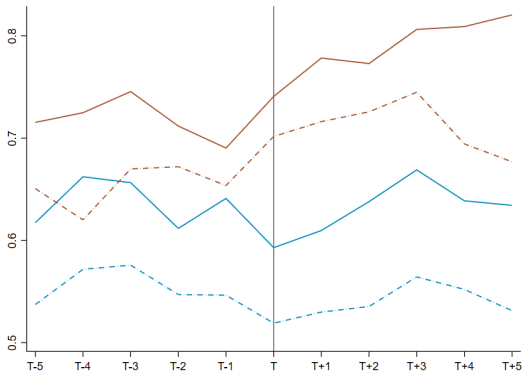
Notes: The horizontal axis is in months; T is the time of a general election for the central government (presidential or parliamentary). Blue and red lines are respectively for $h = 0$ and $h = 1$. Dashed lines represent cyclically-adjusted credibility on panels (a)-(b), and private forecast dispersion on panel (d).

Figure 3.14. *Evolution when government changes*

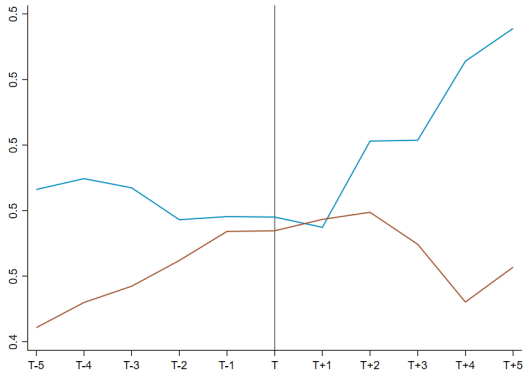
(a) Relative credibility



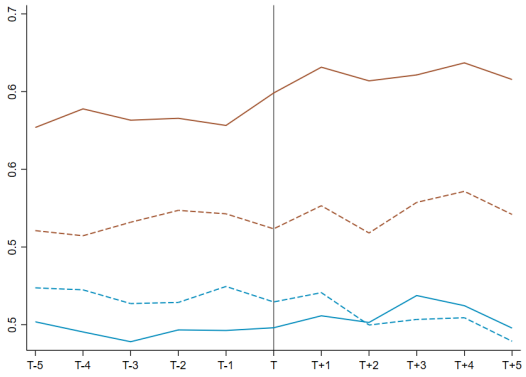
(b) Absolute credibility



(c) Volatility



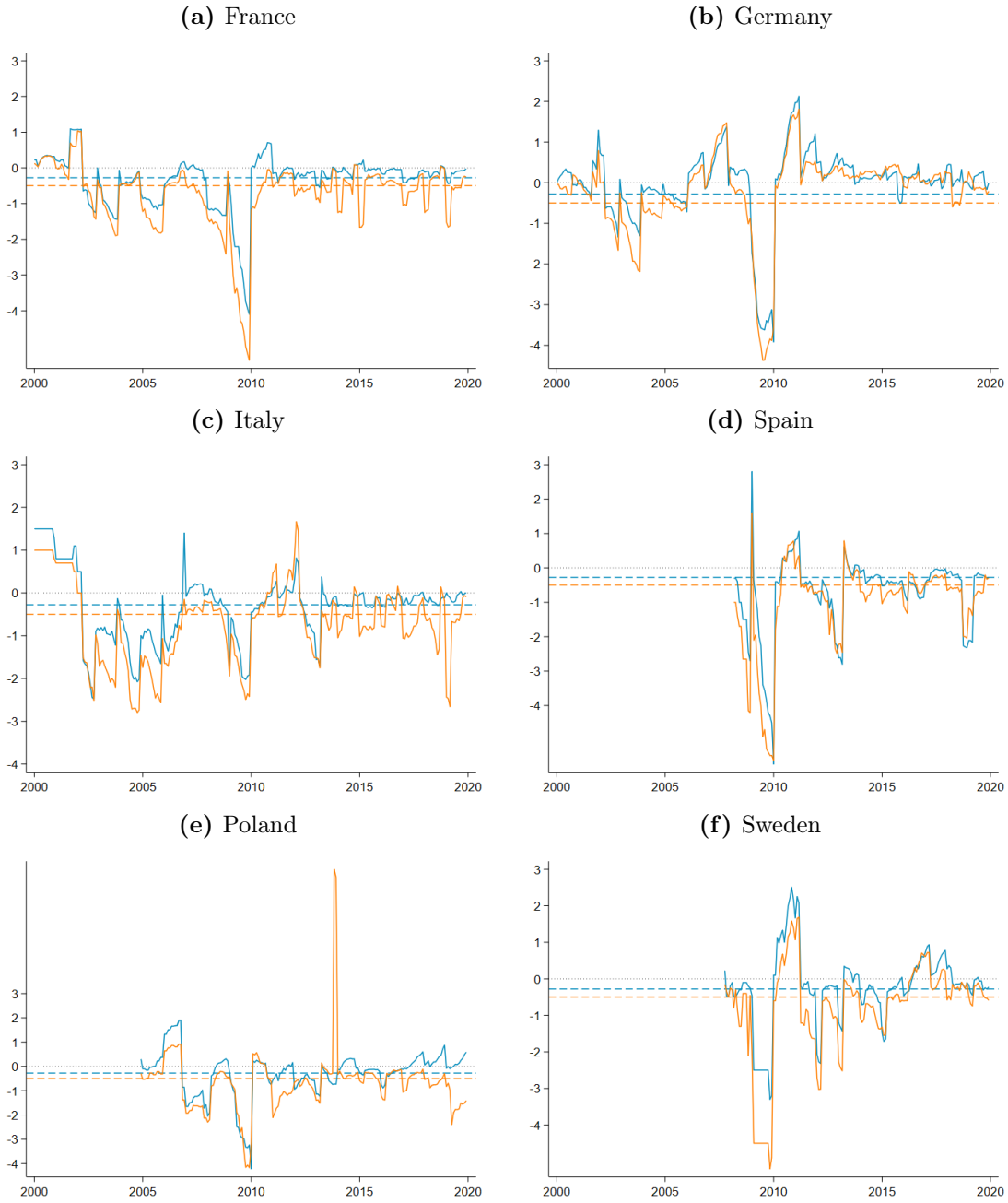
(d) De-anchoring probability and forecast dispersion



Notes: The horizontal axis is in months; T is the time of a change in government (using data from Armingeon et al., 2019, which I complete for recent years). Blue and red lines are respectively for $h = 0$ and $h = 1$. Dashed lines represent cyclically-adjusted credibility on panels (a)-(b), and private forecast dispersion on panel (d).

3.G Time series

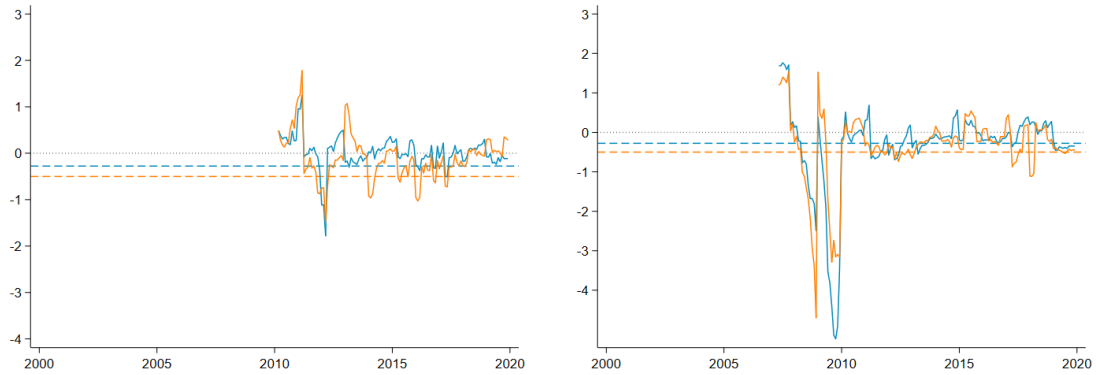
Figure 3.15. *Relative Credibility over Time (in percentage point of* GDP*)*



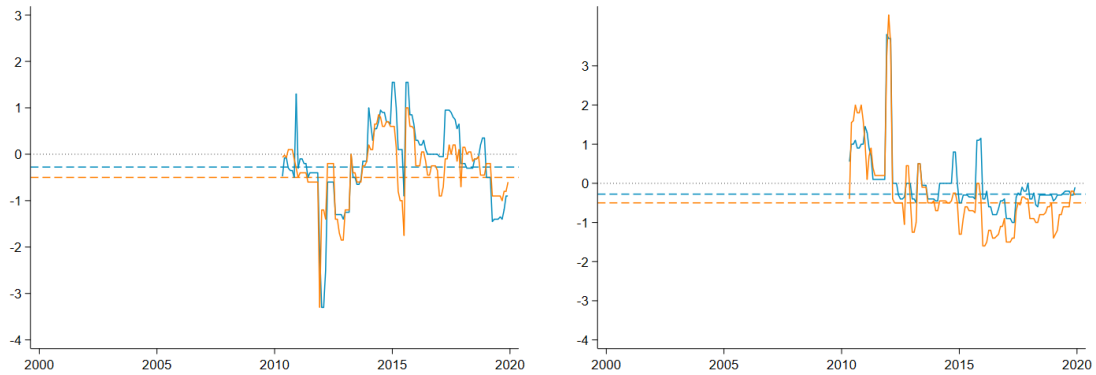
Note: Dotted lines are the sample averages. Blue for $h = 0$; orange for $h = 1$.

Figure 3.15. *Relative Credibility over Time (continued)*

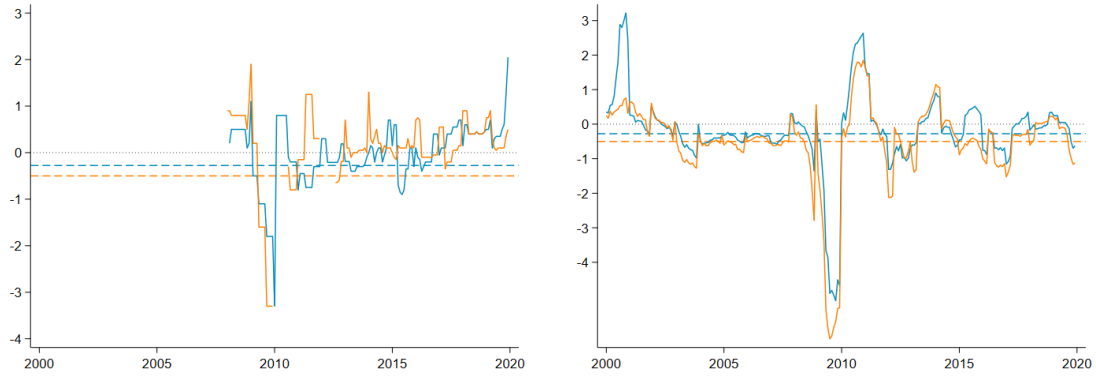
(g) Netherlands **(h)** Latvia



(i) Greece **(j)** Portugal

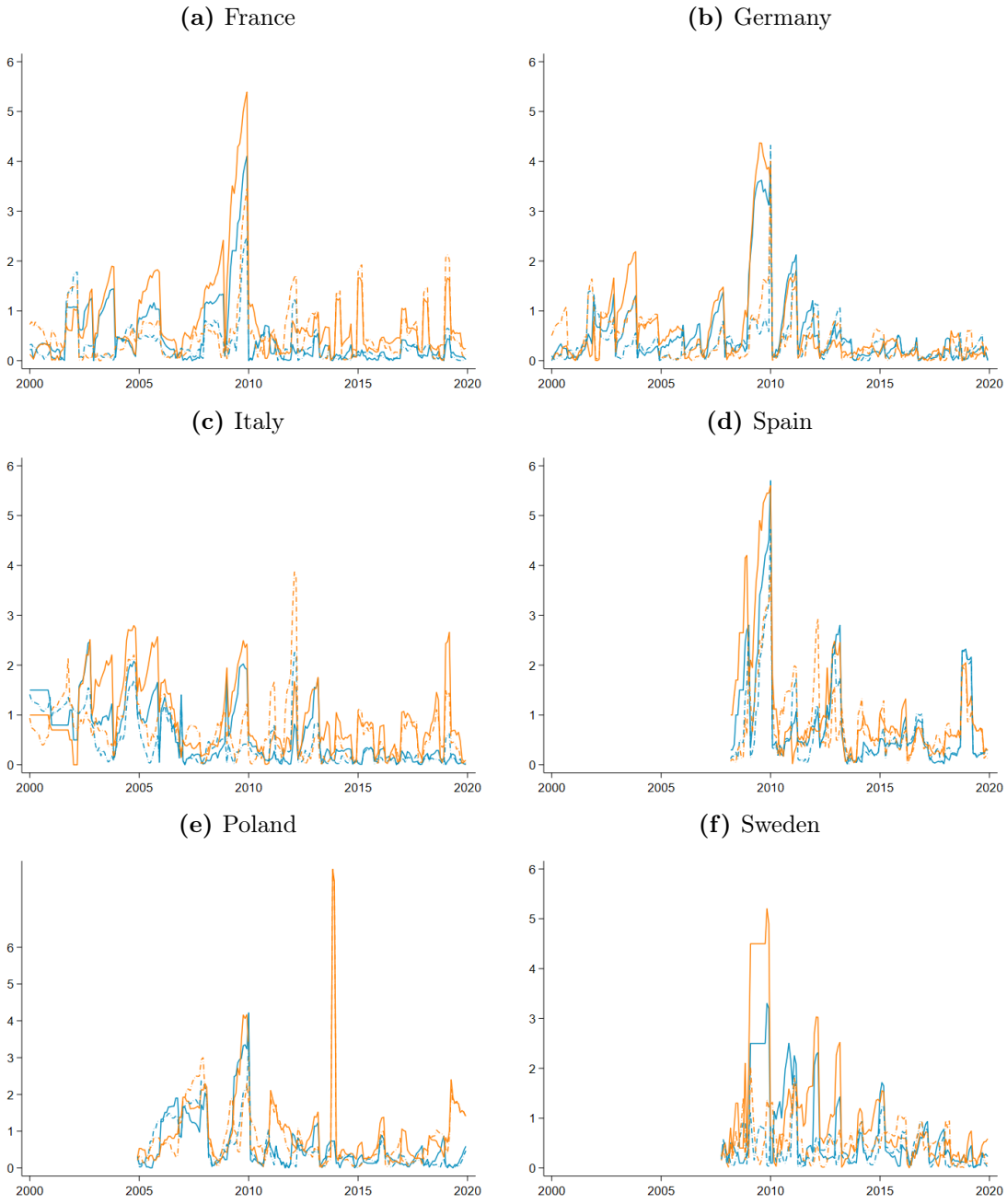


(k) Denmark **(l)** U.K.



Note: Dotted lines are the sample averages. Blue for $h = 0$; orange for $h = 1$.

Figure 3.16. *Absolute credibility over time (in percentage point of* GDP*)*



Note: Dotted lines are the cyclically adjusted series. Blue for $h = t$; orange for $h = t + 1$.

3.H Further empirical analysis

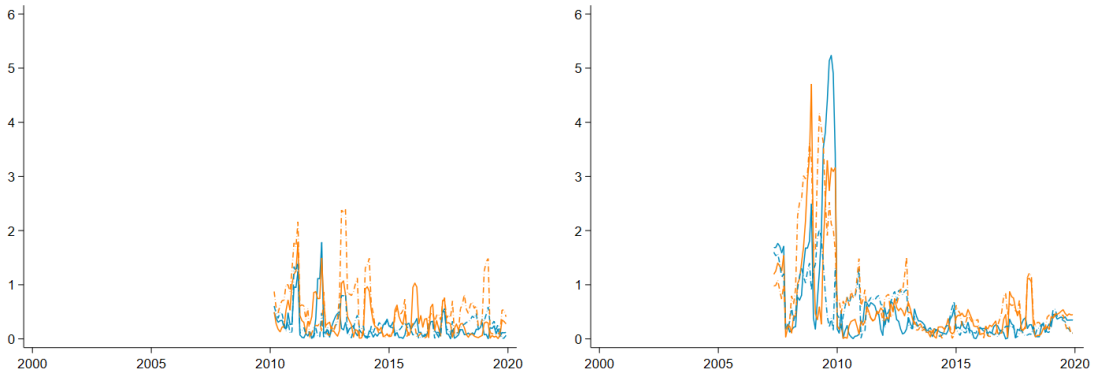
Table 3.6. *Results of Augmented Dickey-Fuller tests and half-life times*

	Horizon $h = t$			Horizon $h = t + 1$		
	Lag coeff	Z stat	p-val*	Lag coeff	Z stat	p-val*
Austria	-0.489	-3.846	0.002	-0.379	-3.398	0.011
Belgium	-0.440	-3.656	0.005	-0.488	-3.738	0.004
Bulgaria	-0.099	-2.835	0.053	-0.120	-2.781	0.061
Croatia	-0.149	-2.379	0.148	-0.141	-2.503	0.115
Cyprus	-0.280	-3.249	0.017	-0.200	-1.925	0.320
Czech Rep.	-0.120	-3.668	0.005	-0.118	-3.434	0.010
Denmark	-0.233	-3.161	0.022	-0.078	-1.129	0.703
Estonia	-0.125	-2.922	0.043	-0.099	-2.648	0.083
Finland	-0.428	-3.575	0.006	-0.431	-3.511	0.008
France	-0.136	-4.015	0.001	-0.106	-3.235	0.018
Germany	-0.111	-3.750	0.003	-0.085	-3.558	0.007
Greece	-0.177	-2.793	0.059	-0.315	-3.874	0.002
Hungary	-0.155	-3.615	0.005	-0.169	-3.159	0.022
Ireland	-0.631	-5.294	0.000	-0.254	-2.313	0.168
Italy	-0.083	-3.241	0.018	-0.085	-3.119	0.025
Latvia	-0.171	-4.250	0.001	-0.344	-4.959	0.000
Lithuania	-0.176	-3.699	0.004	-0.149	-3.363	0.012
Luxembourg	-0.442	-3.321	0.014	-0.153	-2.026	0.275
Netherlands	-0.407	-4.207	0.001	-0.239	-3.152	0.023
Poland	-0.164	-3.910	0.002	-0.313	-4.799	0.000
Portugal	-0.258	-3.343	0.013	-0.169	-2.874	0.048
Romania	-0.254	-3.271	0.016	-0.225	-3.333	0.013
Slovak Rep.	-0.201	-3.195	0.020	-0.080	-2.076	0.254
Slovenia	-0.268	-3.994	0.001	-0.183	-3.108	0.026
Spain	-0.263	-3.766	0.003	-0.161	-2.945	0.040
Sweden	-0.144	-3.052	0.030	-0.129	-2.885	0.047
U.K.	-0.129	-4.657	0.000	-0.113	-3.843	0.002

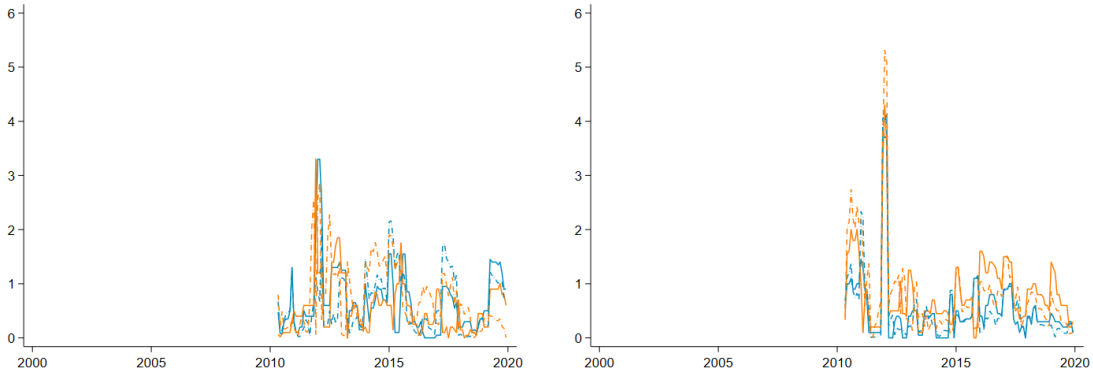
* MacKinnon (1994)'s approximation

Figure 3.16. *Absolute credibility over time (continued)*

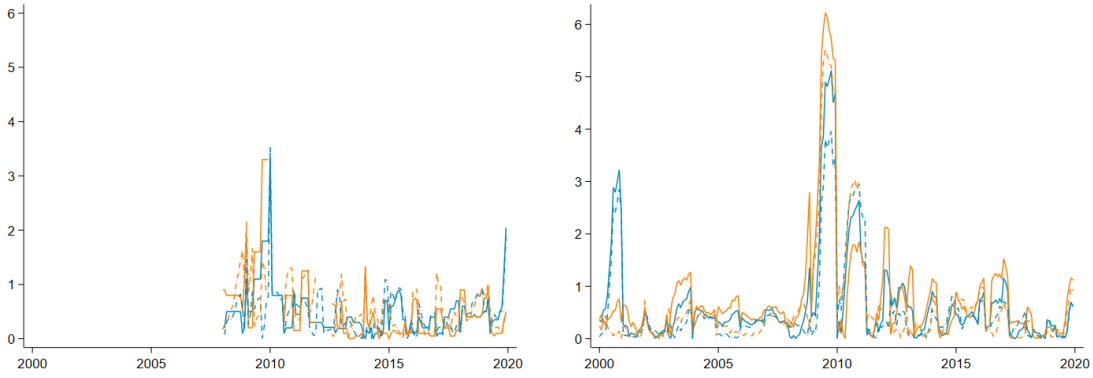
(g) Netherlands **(h)** Latvia



(i) Greece **(j)** Portugal



(k) Denmark **(l)** U.K.



Note: Dotted lines are the cyclically-adjusted series. Blue for $h = t$; orange for $h = t + 1$.

Table 3.7. *Asymmetric persistence test*

	Horizon $h = t$		Horizon $h = t + 1$	
	Lag coeff.	Lag < 0	Lag coeff.	Lag < 0
Austria	-0.939***	0.657***	-0.624**	0.459*
Belgium	-0.577*	0.447	-0.132	0.069
Bulgaria	-0.711***	0.641***	-0.520	0.455
Croatia	-0.190	0.085	-0.533	0.491
Cyprus	-0.284***	0.010	-0.178	-0.070
Czech Rep.	-0.256**	0.158	-0.520**	0.430**
Denmark	-0.135	-0.134	-0.251***	0.290***
Estonia	-0.354***	0.276**	-0.265**	0.198*
Finland	-0.345**	-0.200	-0.347	0.021
France	-0.219**	0.117	-0.250	0.190
Germany	-0.149***	0.051	-0.147**	0.076
Greece	-0.246**	0.106	-0.170	-0.070
Hungary	-0.960***	0.835***	-0.760**	0.669*
Ireland	-1.429	0.827	0.125	-0.260
Italy	-0.075*	0.000	-0.086	0.035
Latvia	-0.450***	0.323**	-0.497**	0.243
Lithuania	-0.476	0.337	-0.927	0.846
Luxembourg	-0.619**	0.383	-0.421	0.353
Netherlands	-0.389***	-0.036	-0.282***	0.099
Poland	-0.189**	0.049	-0.617***	0.506***
Portugal	-0.295***	0.139	-0.227***	0.157
Romania	-0.806**	0.696*	3.916	-3.964
Slovak Rep.	-0.573***	0.468***	-0.065	-0.004
Slovenia	-0.443***	0.276**	-0.481	0.431
Spain	-0.808***	0.639**	-1.112***	1.011**
Sweden	-0.107	-0.042	-0.259	0.177
U.K.	-0.120***	-0.008	-0.137	0.046

Table 3.8. Determinants of short-term credibility ($h = 0$)

	Base	Initial Conditions						Institutions				Policy					Political	Combined
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
Credibility in t-1	0.740***	0.740***	0.739***	0.739***	0.736***	0.740***	0.763***	0.739***	0.738***	0.738***	0.737***	0.738***	0.738***	0.720***	0.732***	0.734***	0.648***	0.738***	0.783***
	[0.010]	[0.010]	[0.010]	[0.010]	[0.010]	[0.010]	[0.011]	[0.010]	[0.010]	[0.010]	[0.010]	[0.010]	[0.010]	[0.011]	[0.011]	[0.011]	[0.013]	[0.010]	[0.010]
Release of new target for t+1 (dummy)	-0.255***	-0.272***	-0.270***	-0.271***	-0.272***	-0.274***	-0.224***	-0.272***	-0.269***	-0.255***	-0.253***	-0.255***	-0.254***	-0.260***	-0.265***	-0.284***	-0.270***	-0.255***	-0.316***
	[0.021]	[0.021]	[0.021]	[0.021]	[0.021]	[0.021]	[0.023]	[0.021]	[0.021]	[0.021]	[0.021]	[0.021]	[0.021]	[0.022]	[0.022]	[0.023]	[0.025]	[0.021]	[0.023]
= 1 when election occurs	0.002	-0.006	-0.008	-0.005	-0.007	-0.005	-0.008	-0.004	-0.007	0.002	0.002	0.002	0.001	0.003	0.008	0.001	0.002	0.001	-0.011
	[0.027]	[0.027]	[0.027]	[0.027]	[0.027]	[0.027]	[0.027]	[0.027]	[0.027]	[0.027]	[0.027]	[0.027]	[0.027]	[0.028]	[0.029]	[0.032]	[0.034]	[0.027]	[0.030]
(mean) IMFprog_review	0.178***	0.175***	0.176***	0.172***	0.155***	0.178***	0.180**	0.171***	0.168***	0.181***	0.171***	0.176***	0.166***	0.193***	0.167***	0.167***	0.151***	0.179***	0.108**
	[0.048]	[0.048]	[0.048]	[0.049]	[0.049]	[0.048]	[0.082]	[0.049]	[0.049]	[0.048]	[0.049]	[0.048]	[0.049]	[0.053]	[0.049]	[0.052]	[0.052]	[0.049]	[0.053]
Public debt ratio in t-1 (in % GDP)		0.000*																	
		[0.000]																	
Primary balance in t-1 (% GDP, WEO)			-0.007*																0.003
			[0.004]																[0.004]
Inflation in t (average yoy, %)				0.009**															
				[0.005]															
Output gap in t-1 (in %)					-0.011***														-0.011***
					[0.003]														[0.003]
Real GDP growth in t-1 (in %)						-0.008***													
						[0.003]													
Sovereign yield (10 yr, Bloomberg)							0.011***												
							[0.003]												
Real policy rate								-0.011**											
								[0.005]											
Log GDP per capita									-0.022**										
									[0.010]										
Expenditure rule at the national level (1), supranational level (2), or both (3)										-0.021*									
										[0.011]									
Revenue rule at the national level (1), supranational level (2), or both (3)											-0.047***								
											[0.017]								
fr_legal_any												-0.022*							
												[0.013]							
Adjustment planned in t+1 (pp GDP)													0.012***						
													[0.005]						
24m-rolling gov't latest revision for t+1 estimate (pp GDP)														-0.024**					
														[0.010]					
Yearly average forecast error for t+1 (pp GDP)															0.021***				0.022***
															[0.004]				[0.005]
Yearly average for. error with first t+1 estimate (pp GDP)																0.021***			
																[0.005]			
2yr-rolling for. error with first t+1 estimate (pp GDP)																	0.017**		
																	[0.007]		
Share of gov't from Left party																		-0.000**	
																		[0.000]	
ECB i-rate, main refinancing operation																			-0.029
																			[0.029]
Resid share of public debt (percent)																			0.001
																			[0.000]
Number of numerical fiscal rules																			-0.003
																			[0.006]
Gov't medium term adjustment plan (pp GDP/year)																			-0.028*
																			[0.016]
Constant	0.160***	0.145***	0.166***	0.146***	0.170***	0.181***	0.160***	0.145***	0.390***	0.213***	0.166***	0.253***	0.154***	0.171***	0.147***	0.175***	0.179***	0.169***	0.162***
	[0.025]	[0.028]	[0.026]	[0.027]	[0.026]	[0.027]	[0.024]	[0.027]	[0.110]	[0.038]	[0.025]	[0.060]	[0.025]	[0.025]	[0.026]	[0.028]	[0.046]	[0.025]	[0.054]
Observations	3,910	3,846	3,846	3,846	3,846	3,846	2,876	3,846	3,846	3,910	3,910	3,910	3,910	3,564	3,586	3,238	2,953	3,910	3,070
Number of ccode	27	26	26	26	26	26	21	26	26	27	27	27	27	27	27	27	27	27	23
Fixed effects	YM	YM	YM	YM	YM	YM	YM	YM	YM	YM	YM	YM	YM	YM	YM	YM	CYM	YM	YM
Heterosked	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Autocorr	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hausman	0.997	0.979	0.949	0.998	1.000	0.993	0.977	0.997	0.999	0.996	1.000	1.000	0.997	1.000	1.000	1.000	0.000	0.985	1.000
Wald Y	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Modif. Wald	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Breusch-Pagan	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-1.000	0.000	0.000
Serial	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Same conventions as Table 3.1.

Table 3.9. *Determinants of credibility with lags*

	Base	InitialConditions							Economic	Institutions		Policy						Political			Combined
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
Credibility in t-1	0.818***	0.817***	0.816***	0.816***	0.817***	0.817***	0.818***	0.807***	0.836***	0.804***	0.801***	0.805***	0.815***	0.817***	0.812***	0.808***	0.813***	0.817***	0.825***	0.816***	0.816***	0.814***
	[0.015]	[0.015]	[0.015]	[0.015]	[0.015]	[0.015]	[0.015]	[0.015]	[0.015]	[0.019]	[0.021]	[0.020]	[0.015]	[0.015]	[0.016]	[0.016]	[0.017]	[0.018]	[0.016]	[0.015]	[0.015]	[0.017]
Credibility in t-2	-0.059***	-0.061***	-0.060***	-0.058***	-0.058***	-0.059***	-0.059***	-0.055***	-0.039***	-0.029	-0.078***	-0.091***	-0.058***	-0.059***	-0.058***	-0.051***	-0.055***	-0.063***	-0.061***	-0.058***	-0.058***	-0.051***
	[0.015]	[0.015]	[0.015]	[0.015]	[0.015]	[0.015]	[0.015]	[0.015]	[0.015]	[0.018]	[0.020]	[0.020]	[0.015]	[0.015]	[0.016]	[0.015]	[0.016]	[0.017]	[0.015]	[0.015]	[0.015]	[0.016]
Release of new target for t+1 (dummy)	-0.373***	-0.382***	-0.382***	-0.384***	-0.384***	-0.382***	-0.383***	-0.371***	-0.389***	-0.616***	-0.522***	-0.452***	-0.372***	-0.372***	-0.374***	-0.397***	-0.418***	-0.415***	-0.413***	-0.373***	-0.373***	-0.422***
	[0.022]	[0.022]	[0.022]	[0.022]	[0.022]	[0.022]	[0.022]	[0.022]	[0.022]	[0.029]	[0.033]	[0.030]	[0.021]	[0.022]	[0.024]	[0.022]	[0.024]	[0.026]	[0.023]	[0.022]	[0.022]	[0.024]
= 1 when election occurs	-0.015	-0.019	-0.019	-0.015	-0.017	-0.017	-0.018	-0.015	-0.017	-0.026	-0.054	-0.041	-0.016	-0.015	-0.015	-0.019	-0.018	-0.029	-0.014	-0.014	-0.015	-0.026
	[0.026]	[0.026]	[0.026]	[0.026]	[0.026]	[0.026]	[0.026]	[0.026]	[0.027]	[0.038]	[0.047]	[0.045]	[0.026]	[0.026]	[0.028]	[0.028]	[0.030]	[0.032]	[0.028]	[0.026]	[0.026]	[0.030]
(mean) IMFprog_review	0.101**	0.090**	0.100**	0.094**	0.097**	0.090**	0.097**	0.096**	0.106**	0.129**	0.004	0.028	0.087*	0.088**	0.125***	0.116**	0.120**	0.087*	0.223***	0.101**	0.103**	0.086*
	[0.044]	[0.045]	[0.044]	[0.044]	[0.045]	[0.045]	[0.045]	[0.044]	[0.043]	[0.060]	[0.070]	[0.053]	[0.045]	[0.045]	[0.047]	[0.046]	[0.049]	[0.045]	[0.060]	[0.044]	[0.045]	[0.052]
Public debt ratio in t-1 (in % GDP)		0.002**																				
		[0.001]																				
Primary balance in t-1 (% GDP, WEO)			-0.014***																			0.011**
			[0.004]																			[0.004]
Inflation in t (average yoy, %)				0.017**																		
				[0.005]																		
Inflation if higher than 4%					0.007*																	
					[0.004]																	
Output gap in t-1 (in %)						-0.008**																-0.006
						[0.003]																[0.004]
Real GDP growth in t-1 (in %)							-0.005*															
							[0.003]															
ECB i-rate, main refinancing operation								-0.112***														-0.116***
								[0.028]														[0.030]
Real policy rate									-0.009**													
									[0.005]													
Export quality index										4.271**												
										[2.097]												
Nation: Independent body sets budget assumptions											-0.111**											
											[0.051]											
Nation: Independent body monitors implementation												-0.066**										
												[0.033]										
Adjustment planned in t+1 (pp GDP)													0.010***									
													[0.003]									
Gov't medium term adjustment plan (pp GDP/year)														0.028**								0.051***
														[0.012]								[0.016]
2yr-rolling gov't latest revision for t+1 estimate (pp GDP)															0.014*							
															[0.008]							
Yearly average forecast error for t+1 (pp GDP)																0.022***						0.033***
																[0.004]						[0.005]
Yearly average for. error with first t+1 estimate (pp GDP)																	0.020***					
																	[0.004]					
2yr-rolling for. error with first t+1 estimate (pp GDP)																		0.011***				
																		[0.004]				
Uncertainty index																			0.291**			
																			[0.130]			
Political color of government (Schmidt index; R, C, L for right, center, left)																				-0.007*		
																				[0.004]		
Share of gov't from Left party																					-0.000*	
																					[0.000]	
Resid share of public debt (percent)																						0.001**
																						[0.000]
Number of numerical fiscal rules																						0.012**
																						[0.006]
Constant	0.281***	0.164***	0.271***	0.255***	0.286***	0.292***	0.294***	0.287***	0.253***	-4.008*	0.353***	0.361***	0.276***	0.274***	0.304***	0.266***	0.260***	0.270***	0.256***	0.299***	0.292***	0.157***
	[0.034]	[0.060]	[0.035]	[0.036]	[0.035]	[0.035]	[0.035]	[0.035]	[0.027]	[2.082]	[0.052]	[0.054]	[0.034]	[0.035]	[0.038]	[0.036]	[0.038]	[0.041]	[0.042]	[0.036]	[0.035]	[0.056]
Observations	3,866	3,803	3,803	3,803	3,803	3,803	3,803	3,866	3,803	2,246	1,814	1,998	3,866	3,866	3,495	3,542	3,194	2,919	3,469	3,866	3,866	3,031
Number of ccode	27	26	26	26	26	26	26	27	26	27	21	25	27	27	27	27	27	27	23	27	27	23
Fixed effects	CYM	CYM	CYM	CYM	CYM	CYM	CYM	CYM	YM	CYM	CYM	CYM	CYM	CYM	CYM	CYM	CYM	CYM	CYM	CYM	CYM	YM
Heterosked	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Autocorr	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hausman	0.011	0.048	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.002	0.029	0.002	0.004	0.001	0.000	0.000	0.829
Wald Y	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Modif. Wald	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Breusch-Pagan	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-1.000	-1.000	-1.000	0.000	0.000	0.000	0.000	0.000	-1.000	0.000	0.000	0.000	0.000
Serial	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Same conventions as Table 3.1.

Table 3.10. *Determinants of cyclically-adjusted credibility*

	Base	InitialConditions							Institutions		Policy							Combined
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
Credibility in t-1	0.793***	0.790***	0.790***	0.792***	0.766***	0.789***	0.731***	0.791***	0.789***	0.791***	0.772***	0.790***	0.786***	0.763***	0.761***	0.795***	0.798***	0.771***	0.753***
	[0.010]	[0.010]	[0.010]	[0.010]	[0.010]	[0.010]	[0.013]	[0.010]	[0.010]	[0.010]	[0.010]	[0.010]	[0.010]	[0.011]	[0.011]	[0.010]	[0.011]	[0.012]	[0.012]
Release of new target for t+1 (dummy)	-0.307***	-0.308***	-0.303***	-0.306***	-0.302***	-0.307***	-0.268***	-0.306***	-0.306***	-0.305***	-0.305***	-0.307***	-0.307***	-0.284***	-0.276***	-0.337***	-0.364***	-0.347***	-0.329***
	[0.022]	[0.022]	[0.022]	[0.022]	[0.022]	[0.022]	[0.025]	[0.022]	[0.022]	[0.022]	[0.022]	[0.022]	[0.022]	[0.024]	[0.024]	[0.023]	[0.025]	[0.027]	[0.025]
= 1 when election occurs	-0.002	-0.002	-0.002	-0.000	0.003	-0.001	-0.019	-0.000	-0.001	-0.002	0.002	-0.002	-0.001	0.001	-0.010	-0.004	-0.004	-0.024	-0.010
	[0.027]	[0.027]	[0.027]	[0.027]	[0.027]	[0.027]	[0.030]	[0.027]	[0.027]	[0.027]	[0.027]	[0.027]	[0.027]	[0.029]	[0.028]	[0.029]	[0.031]	[0.033]	[0.030]
(mean) IMFprog_review	0.004	-0.005	0.006	0.000	-0.034	0.007	0.019	0.000	-0.024	-0.002	-0.024	-0.012	0.011	0.064	0.050	0.001	0.005	-0.014	0.020
	[0.046]	[0.046]	[0.046]	[0.046]	[0.048]	[0.046]	[0.086]	[0.046]	[0.048]	[0.046]	[0.048]	[0.047]	[0.047]	[0.050]	[0.048]	[0.047]	[0.049]	[0.048]	[0.058]
Public debt ratio in t-1 (in % GDP)		0.000***																	
		[0.000]																	
Primary balance in t-1 (% GDP, WEO)			-0.009***																-0.006
			[0.003]																[0.005]
Inflation in t (average yoy, %)				0.008*															
				[0.004]															
Output gap in t-1 (in %)					-0.017***														-0.017***
					[0.004]														[0.004]
Real GDP growth in t-1 (in %)						-0.008***													
						[0.003]													
Sovereign yield (10 yr, Bloomberg)							0.020***												
							[0.006]												
Real policy rate								-0.008*											
								[0.005]											
IMFprog									0.037**										
									[0.016]										
Budget balance rule at the national level (1), supranational level (2), or both										-0.022*									
										[0.013]									
Debt rule at the national level (1), supranational level (2), or both (3)											-0.107***								
											[0.033]								
Gov't medium term adjustment plan (pp GDP/year)												0.022**							0.004
												[0.011]							[0.017]
Yearly average gov't latest revision for t+1 estimate (pp GDP)													-0.025***						
													[0.007]						
2yr-rolling gov't latest revision for t+1 estimate (pp GDP)														-0.018**					
														[0.008]					
24m-rolling gov't latest revision for t+1 estimate (pp GDP)															-0.033***				
															[0.008]				
Yearly average forecast error for t+1 (pp GDP)																0.009***			0.001
																[0.004]			[0.005]
Yearly average for. error with first t+1 estimate (pp GDP)																	0.009**		
																	[0.004]		
2yr-rolling for. error with first t+1 estimate (pp GDP)																		0.019***	
																		[0.004]	
ECB i-rate, main refinancing operation																			-0.038
																			[0.032]
Resid share of public debt (percent)																			0.000
																			[0.000]
Number of numerical fiscal rules																			-0.002
																			[0.006]
Constant	0.263***	0.234***	0.267***	0.248***	0.266***	0.280***	0.338***	0.248***	0.259***	0.326***	0.578***	0.259***	0.263***	0.282***	0.282***	0.273***	0.290***	0.326***	0.299***
	[0.026]	[0.028]	[0.026]	[0.027]	[0.036]	[0.027]	[0.040]	[0.027]	[0.026]	[0.045]	[0.107]	[0.026]	[0.026]	[0.026]	[0.026]	[0.027]	[0.029]	[0.030]	[0.056]
Observations	3,875	3,811	3,811	3,811	3,811	3,811	2,841	3,811	3,875	3,875	3,875	3,875	3,843	3,490	3,529	3,551	3,203	2,918	3,055
Number of ccode	27	26	26	26	26	26	21	26	27	27	27	27	27	27	27	27	27	27	23
Fixed effects	YM	YM	YM	YM	CYM	YM	CYM	YM	YM	YM	CYM	YM	YM	YM	YM	YM	YM	YM	YM
Heterosked	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Autocorr	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hausman	1.000	0.189	0.119	0.214	0.024	0.246	0.065	0.197	0.429	0.260	0.080	0.649	0.383	0.437	0.553	0.711	0.501	0.846	0.925
Wald Y	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Modif. Wald	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Breusch-Pagan	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-1.000	0.000
Serial	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Same conventions as Table 3.1.

Table 3.11. *Determinants (annual frequency)*

	Base	Initial Conditions					Economic		Institutions			Policy				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Credibility in t-1	0.215***	0.201***	0.209***	0.208***	0.146**	0.211***	0.255***	0.486***	0.213***	0.199***	-0.269***	0.197***	0.201***	0.377***	0.389***	0.267***
	[0.051]	[0.052]	[0.051]	[0.051]	[0.060]	[0.051]	[0.055]	[0.058]	[0.052]	[0.052]	[0.080]	[0.051]	[0.054]	[0.047]	[0.050]	[0.059]
(mean) new_t1	-0.624	-0.591	-0.663	-0.532	-1.517***	-0.676	-1.331**	0.110	-0.848*	-0.565	-0.780*	-0.916*	-0.841*	-0.837**	-0.414	-0.105
	[0.470]	[0.475]	[0.457]	[0.468]	[0.550]	[0.458]	[0.562]	[0.469]	[0.481]	[0.470]	[0.418]	[0.483]	[0.474]	[0.399]	[0.442]	[0.460]
(mean) election	0.211	0.142	0.263	0.167	-0.154	0.261	-0.013	0.261	0.133	0.218	-0.255	0.105	0.068	0.164	0.406	0.436
	[0.274]	[0.278]	[0.273]	[0.273]	[0.269]	[0.273]	[0.305]	[0.517]	[0.275]	[0.273]	[0.491]	[0.264]	[0.264]	[0.310]	[0.349]	[0.342]
(mean) pb_1t		-0.031**														
		[0.015]														
(mean) cpi_t			0.059***													
			[0.016]													
(mean) cpi_high_t				0.033**												
				[0.014]												
(mean) yd_10y					0.039***											
					[0.014]											
(mean) i_real_t						-0.061***										
						[0.017]										
(mean) debtResid							-0.005*									
							[0.003]									
(mean) Xdiversification								-0.101*								
								[0.060]								
(mean) lngdppc_t									0.414**							
									[0.203]							
(mean) fr_ER										-0.164*						
										[0.098]						
(mean) fc_indptAssmpt											-0.513**					
											[0.240]					
(mean) rev_2y_t1												0.048**				
												[0.021]				
(mean) rev_24m_t1													0.046*			
													[0.025]			
(mean) err_yr_t1														0.077***		
														[0.012]		
(mean) err_1st_yr_t1															0.073***	
															[0.013]	
(mean) err_1st_2y_t1																0.060***
																[0.014]
Constant	0.497***	0.460***	0.394***	0.496***	0.614***	0.391***	0.875***	0.377**	-3.916*	0.831***	0.352	0.570***	0.537***	0.373***	0.345***	0.367***
	[0.124]	[0.122]	[0.126]	[0.125]	[0.130]	[0.126]	[0.198]	[0.171]	[2.164]	[0.234]	[0.340]	[0.133]	[0.132]	[0.084]	[0.088]	[0.096]
Observations	313	308	308	308	236	308	269	177	308	313	145	286	295	286	257	236
Number of ccode	27	26	26	26	21	26	23	24	26	27	19	27	27	27	27	27
Fixed effects	CY	CY	CY	CY	CY	CY	CY	Y	CY	CY	Y	CY	CY	Y	Y	Y
Heterosked	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Autocorr	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hausman	0.019	0.014	0.003	0.010	0.000	0.003	0.022	0.577	0.016	0.028	0.129	0.001	0.003	0.832	0.580	0.322
Wald Y	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Modif. Wald	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Breusch-Pagan	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000
Serial	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Same conventions as Table 3.1.

Table 3.12. *Determinants with relative credibility*

	Base	Initial Conditions							Economic	Institutions				Policy				Political
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Credibility in t-1	0.774***	0.803***	0.772***	0.774***	0.773***	0.803***	0.773***	0.774***	0.801***	0.773***	0.742***	0.731***	0.759***	0.766***	0.788***	0.791***	0.763***	0.778***
	[0.009]	[0.009]	[0.009]	[0.009]	[0.009]	[0.009]	[0.009]	[0.009]	[0.009]	[0.009]	[0.013]	[0.013]	[0.009]	[0.009]	[0.009]	[0.009]	[0.011]	[0.009]
Release of new target for t+1 (dummy)	0.367***	0.396***	0.382***	0.384***	0.382***	0.395***	0.383***	0.384***	0.388***	0.365***	0.516***	0.355***	0.359***	0.363***	0.383***	0.405***	0.409***	0.410***
	[0.024]	[0.025]	[0.025]	[0.025]	[0.025]	[0.025]	[0.025]	[0.025]	[0.025]	[0.024]	[0.036]	[0.028]	[0.024]	[0.024]	[0.025]	[0.027]	[0.029]	[0.026]
= 1 when election occurs	-0.002	0.000	0.002	-0.001	-0.000	-0.000	0.000	-0.001	-0.000	-0.002	0.011	0.001	0.000	-0.002	0.003	-0.002	0.011	-0.004
	[0.030]	[0.031]	[0.030]	[0.030]	[0.030]	[0.031]	[0.030]	[0.030]	[0.031]	[0.030]	[0.053]	[0.052]	[0.030]	[0.030]	[0.032]	[0.034]	[0.037]	[0.032]
= 1 for IMF program approval/review completion	-0.039	-0.060	-0.040	-0.030	-0.030	-0.049	-0.030	-0.029	-0.057	-0.020	-0.006	0.009	0.005	-0.003	-0.067	-0.076	-0.022	-0.112
	[0.050]	[0.049]	[0.050]	[0.050]	[0.050]	[0.049]	[0.050]	[0.050]	[0.048]	[0.050]	[0.069]	[0.058]	[0.050]	[0.050]	[0.049]	[0.052]	[0.050]	[0.071]
Public debt ratio in t-1 (in % GDP)		-0.000**																
		[0.000]																
Primary balance in t-1 (% GDP; WEO)			0.017***															
			[0.005]															
Inflation in t (average yoy; %)				-0.015**														
				[0.006]														
Inflation if higher than 4%					-0.013***													
					[0.005]													
Output gap in t-1 (in %)						0.009***												
						[0.003]												
Real GDP growth in t-1 (in %)							0.010***											
							[0.003]											
Real policy rate								0.016***										
								[0.006]										
FCU share of public debt (percent)									-0.001**									
									[0.000]									
Debt rule at the national level (1); supranational level (2); or both (3)										0.115***								
										[0.037]								
Nation: Independent body sets budget assumptions											0.160***							
											[0.059]							
Nation: Independent body monitors implementation												0.121***						
												[0.040]						
Adjustment planned in t+1 (pp GDP)													-0.039***					
													[0.004]					
Gov't medium term adjustment plan (pp GDP/year)														-0.098***				
														[0.015]				
Yearly average forecast error for t+1 (pp GDP)															-0.036***			
															[0.004]			
Yearly average for. error with first t+1 estimate (pp GDP)																-0.034***		
																[0.004]		
2yr-rolling for. error with first t+1 estimate (pp GDP)																	-0.011**	
																	[0.005]	
Uncertainty index																		-0.309**
																		[0.153]
Constant	-0.207***	-0.191***	-0.189***	-0.181***	-0.211***	-0.225***	-0.229***	-0.180***	-0.211***	-0.557***	-0.334***	-0.237***	-0.189***	-0.181***	-0.239***	-0.246***	-0.212***	-0.166***
	[0.040]	[0.031]	[0.041]	[0.042]	[0.041]	[0.029]	[0.041]	[0.042]	[0.029]	[0.120]	[0.058]	[0.055]	[0.040]	[0.040]	[0.029]	[0.031]	[0.047]	[0.049]
Observations	3,895	3,831	3,831	3,831	3,831	3,831	3,831	3,831	3,831	3,895	1,833	2,019	3,895	3,895	3,571	3,223	2,938	3,494
Number of ccode	27	26	26	26	26	26	26	26	26	27	21	25	27	27	27	27	27	23
Fixed effects	CYM	YM	CYM	CYM	CYM	YM	CYM	CYM	YM	CYM	CYM	CY	CYM	CYM	YM	YM	CYM	CYM
Heterosked	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Autocorr	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hausman	0.000	1.000	0.000	0.000	0.000	0.980	0.062	0.000	1.000	0.000	0.015	0.001	0.000	0.000	0.452	0.374	0.042	0.000
Wald Y	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Wald M	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.146	0.000	0.000	0.000	0.000	0.000	0.000
Modif. Wald	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Breusch-Pagan	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-1.000	-1.000	0.000	0.000	0.000	0.000	-1.000	0.000
Serial	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Same conventions as Table 3.1.

Table 3.13. *Determinants with relative cyclically-adjusted credibility*

	Base		Initial Conditions			Institutions			Policy			Political
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Credibility in t-1	0.812***	0.809***	0.832***	0.808***	0.810***	0.836***	0.808***	0.816***	0.805***	0.809***	0.840***	0.810***
	[0.009]	[0.009]	[0.009]	[0.009]	[0.009]	[0.009]	[0.009]	[0.013]	[0.009]	[0.009]	[0.009]	[0.009]
Release of new target for t+1 (dummy)	0.059**	0.071**	0.074***	0.070**	0.071**	0.075***	0.059**	0.191***	0.057**	0.058**	0.072**	0.059**
	[0.028]	[0.028]	[0.028]	[0.028]	[0.028]	[0.028]	[0.028]	[0.041]	[0.028]	[0.028]	[0.029]	[0.028]
= 1 when election occurs	0.022	0.030	0.024	0.028	0.030	0.026	0.023	0.040	0.025	0.023	0.017	0.019
	[0.034]	[0.034]	[0.034]	[0.034]	[0.034]	[0.034]	[0.034]	[0.060]	[0.034]	[0.034]	[0.036]	[0.034]
= 1 for IMF program approval/review completion	0.033	0.026	0.051	0.023	0.027	0.080	0.057	-0.001	0.068	0.058	0.068	0.030
	[0.062]	[0.062]	[0.061]	[0.062]	[0.062]	[0.060]	[0.062]	[0.077]	[0.062]	[0.062]	[0.063]	[0.062]
Inflation in t (average yoy; %)		0.016**										
		[0.006]										
Output gap in t-1 (in %)			-0.009**									
			[0.004]									
Real GDP growth in t-1 (in %)				-0.014***								
				[0.004]								
Real policy rate					-0.015**							
					[0.007]							
Log GDP per capita						0.025**						
						[0.011]						
Debt rule at the national level (1); supranational level (2); or both (3)							0.156***					
							[0.040]					
Nation: Independent body sets budget assumptions								0.081**				
								[0.035]				
Adjustment planned in t+1 (pp GDP)									-0.025***			
									[0.005]			
Gov't medium term adjustment plan (pp GDP/year)										-0.057***		
										[0.017]		
Yearly average forecast error for t+1 (pp GDP)											-0.009**	
											[0.004]	
Type of government												0.011*
												[0.006]
Constant	-0.146***	-0.180***	-0.140***	-0.125***	-0.177***	-0.394***	-0.620***	-0.297***	-0.134***	-0.130***	-0.105***	-0.168***
	[0.045]	[0.047]	[0.033]	[0.046]	[0.047]	[0.116]	[0.130]	[0.043]	[0.045]	[0.046]	[0.034]	[0.047]
Observations	3,875	3,811	3,811	3,811	3,811	3,811	3,875	1,813	3,875	3,875	3,551	3,875
Number of ccode	27	26	26	26	26	26	27	21	27	27	27	27
Fixed effects	CYM	CYM	YM	CYM	CYM	YM	CYM	YM	CYM	CYM	YM	CYM
Heterosked	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Autocorr	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hausman	0.038	0.058	0.116	0.036	0.064	0.109	0.001	0.879	0.031	0.047	0.889	0.026
Wald Y	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000
Wald M	0.039	0.018	0.017	0.018	0.018	0.017	0.038	0.027	0.059	0.048	0.076	0.039
Modif. Wald	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Breusch-Pagan	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-1.000	0.000	0.000	0.000	0.000
Serial	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Same conventions as Table 3.1.

Table 3.14. *Determinants when excluding official release months*

	Base	Initial Conditions							Institutions		Policy						Political
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Credibility in t-1	0.918***	0.930***	0.916***	0.917***	0.918***	0.917***	0.918***	0.913***	0.916***	0.917***	0.911***	0.916***	0.917***	0.917***	0.925***	0.926***	0.917***	0.918***
	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]	[0.008]	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]	[0.008]	[0.007]
= 1 when election occurs	-0.022	-0.026	-0.023	-0.020	-0.021	-0.021	-0.021	-0.021	-0.020	-0.021	-0.037*	-0.022	-0.022	-0.021	-0.030	-0.027	-0.024	-0.019
	[0.018]	[0.018]	[0.018]	[0.018]	[0.018]	[0.018]	[0.018]	[0.018]	[0.018]	[0.018]	[0.022]	[0.018]	[0.018]	[0.018]	[0.019]	[0.020]	[0.021]	[0.019]
Public debt ratio in t-1 (in % GDP)		0.001***																
		[0.000]																
Primary balance in t-1 (% GDP; WEO)			-0.015***															
			[0.003]															
Inflation in t (average yoy; %)				0.011***														
				[0.004]														
Inflation if higher than 4%					0.005*													
					[0.003]													
Output gap in t-1 (in %)						-0.005**												
						[0.003]												
Real GDP growth in t-1 (in %)							-0.006**											
							[0.002]											
ECB i-rate; main refinancing operation								-0.056***										
								[0.021]										
Real policy rate									-0.014***									
									[0.004]									
Expenditure rule at the national level (1); supranational level (2); or both (3)										-0.075***								
										[0.020]								
Fiscal Responsibility Law (transparancy and accountability)											-0.057*							
											[0.031]							
Adjustment planned in t+1 (pp GDP)												0.010***						
												[0.003]						
Gov't medium term adjustment plan (pp GDP/year)													0.034***					
													[0.011]					
Yearly average gov't latest revision for t+1 estimate (pp GDP)														-0.014***				
														[0.005]				
Yearly average forecast error for t+1 (pp GDP)															0.019***			
															[0.003]			
Yearly average for. error with first t+1 estimate (pp GDP)																0.021***		
																[0.003]		
2yr-rolling for. error with first t+1 estimate (pp GDP)																	0.013***	
																	[0.003]	
Uncertainty index																		0.188*
																		[0.100]
Constant	0.282***	0.207***	0.270***	0.263***	0.286***	0.288***	0.297***	0.286***	0.260***	0.433***	0.370***	0.278***	0.273***	0.276***	0.214***	0.209***	0.276***	0.269***
	[0.024]	[0.020]	[0.025]	[0.025]	[0.025]	[0.025]	[0.025]	[0.025]	[0.026]	[0.047]	[0.043]	[0.024]	[0.024]	[0.024]	[0.018]	[0.019]	[0.028]	[0.030]
Observations	3,452	3,399	3,399	3,399	3,399	3,399	3,399	3,452	3,399	3,452	2,681	3,452	3,452	3,420	3,174	2,874	2,608	3,103
Number of ccode	27	26	26	26	26	26	26	27	26	27	22	27	27	27	27	27	27	23
Fixed effects	CYM	YM	CYM	CYM	CYM	CYM	CYM	CYM	CYM	CYM	CYM	CYM	CYM	CYM	YM	YM	CYM	CYM
Heterosked	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Autocorr	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hausman	0.002	1.000	0.000	0.000	0.000	0.000	0.032	0.001	0.000	0.000	0.036	0.000	0.001	0.002	0.152	0.377	0.033	0.024
Wald Y	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Wald M	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Modif. Wald	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Breusch-Pagan	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-1.000	-1.000	0.000
Serial	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Same conventions as Table 3.1.

Chapter 4

The Prince and Me
A model of Fiscal Credibility

"To be persuasive, we must be believable; to be believable, we must be credible; to be credible, we must be truthful."

— Edward R. Murrow (1963) *Congressional Committee Hearing*

Government fiscal actions influence forward-looking private agents' current and future decisions, which, in turn, impact fiscal performance. This chapter highlights this expectation channel with a Barro-type endogenous growth model where an impatient government finances growth-enhancing spending through income taxes and public debt. Fiscal and macroeconomic outcomes emerge from the interplay of households and policymakers' preferences for public expenditure and private consumption. I find that the government's maximizing its own utility and facing an endogenous interest spread are sufficient ingredients to yield multiple equilibria, independently of the government's policy intentions. The economy almost always heads to the high public spending equilibrium, emphasizing the importance of fiscal institutions to tame government impatience and bolster fiscal credibility.

Contents

4.1 Introduction

In the wake of 2008–09 the Great Financial Crisis (GFC), recovery in many advanced economies remained subdued for almost a decade. One commonly cited reason for this sub-par performance is excessive public indebtedness. Perhaps more harmful than large public debt ratios, governments' inability to provide private agents with a stable and credible fiscal outlook (and convincing path to curb public debt) hampered private growth prospects, undermined investment and consumption, and fueled precautionary savings. Uncertainty about public finances is regularly associated throughout economic history (be it post-war periods or the 1980s–90s for developing economies) with low growth and volatile macroeconomic environment, at times culminating in full-fledged sovereign crises. A similar situation is bound to occur again once the world is done waging its war against CoViD-19.[1]

The empirical relationship between fiscal policy, economic agents' expectations, and macroeconomic instability is not to be proven. Starting from the seminal work by Blanchard and Perotti (2002), the literature has repeatedly emphasized the sizable impact fiscal decisions have on economic output, as well as the difficulty to conclusively estimate it—especially as it depends on many factors, such as the position in the business cycle, the openness to trade and capital flows, the monetary stance, and the nature of the fiscal decision itself. The Keynesian effects of fiscal policy are offset by various crowding out channels (see Blanchard, 1991, for a comprehensive exposition).

Several of these links between fiscal and macroeconomic performance operate through expectations. For instance, the fiscal foresight literature shows how private agents anticipate fiscal decisions and adjust their forecasts and plans depending on government announcements (Leeper et al., 2012; Blanchard and Leigh, 2013). However, the theoretical underpinnings of such expectation channels remain elusive, apart from the Ricardian equivalence, which posits that rational agents expect a tax hike following a fiscal stimulus. In particular, the possibility of a feedback loop between fiscal foresight and fiscal outcomes, and, more importantly, the possibility that such a loop leads to a multiplicity of equilibria have, to the best of my knowledge, never been studied theoretically.

This chapter explores these issues, laying down the foundations of a theoretical model that allows for such a feedback loop to operate. It explains how government fiscal actions influence forward-looking private agents' current and future decisions, which, in turn, impact fiscal performance. Eventually, it could contribute to justify the importance of fiscal credibility, a concept on which implicitly rely current practices of imposing fiscal accountability frameworks and

[1] Already, the IMF is calling on governments to clarify their post-CoViD-19 fiscal frameworks (International Monetary Fund, 2021).

medium-term fiscal frameworks—meant to enhance communication around, and oversight of fiscal policy and objectives. Indeed, once established, the feedback loop between government's observed preferences and macroeconomic outcomes could make it possible to model how government's reputation may lead to instability.

The monetary policy literature sets a useful example: it derives from the *ex ante* indeterminacy between the high and low inflation steady states important lessons about the risk of reputational effects, coordination issues between authorities and agents, and expectation-driven fluctuations.[2] The literature has come up with various ways to model these credibility effects. For instance, under game theory approaches, reputation emerges from repeated games, while reputation-building and learning processes can ensue from setups with imperfect or asymmetric information setups (see, for instance, Blackburn and Christensen, 1989; Cukierman, 1992, and references therein). Another strand of papers introduces Markov-switching mechanisms, where the monetary regime varies stochastically and is unknown to agents (Laxton et al., 1994; Cukierman and Meltzer, 1986; Jeanne, 1997). But most of these models build upon (a) the seminal contribution by Kydland and Prescott (1977), who showed that outcome under discretion might be sub-optimal because the output cost of disinflation is smaller if the policy is credible (the so-called credibility hypothesis); and (b) the New Keynesian model, which proves under sticky prices and rational expectations that monetary policy transmits through intertemporal allocations (owing to the forward-looking Phillips curve).

Most of the theoretical literature on fiscal policy and macroeconomic stability has so far focused on the stabilizing role of fiscal policy in the face of cyclical fluctuations, usually by means of counter-cyclical tax instruments. Typically, instability is obtained from exogenous shocks on fundamentals (Kletzer, 2006; Moldovan, 2010) or volatile expectations (the so-called sunspots; Guo and Lansing, 1998; Dromel and Pintus, 2008). Besides, most papers rely on the strong assumption that the production technology exhibits increasing returns to scale (Christiano and Harrison, 1999; Farmer and Benhabib, 1994). To generate multiplicity and indeterminacy, other papers rely on labor market imperfections [3] or some form of segmentation: between consumers (Carli and Modesto, forthcoming), sectors (Brito and Venditti, 2010; Mulligan and Sala-i Martin, 1993), or countries (Corsetti et al., 2014). More recent papers have also envisaged rigidities in fiscal policy or specific tax functions as destabilizing and potentially pro-cyclical (Abad et al., 2020; Nishimura et al., 2015; Lloyd-Braga and Modesto, 2017).[4]

[2] This is not a normative mechanism; it happens independently of whether the policymaker is virtuous and aims at lowering inflation.

[3] A few examples include Dufourt et al. (2008); Schmitt-Grohé and Uribe (1997); Farmer and Benhabib (1994).

[4] There is also a substantial amount of research on regime-switching sunspot shocks regarding inflation and monetary policy (starting with Benhabib et al., 2001), but the government is usually absent of these models.

By contrast, this chapter focuses on the destabilizing role of the government, thus providing a novel source of instability. It aims at designing a relatively parsimonious setup, so that mechanisms remain relatively intuitive—this ruled out dynamic stochastic general equilibrium models—, based on macroeconomic relations rather than *ad hoc* elements—this eliminated game theory presentations. The framework introduced here is somewhat lean in terms of assumptions: it simply adds a government's optimization program to a standard framework. And the fiscal policy function is captured by a proportional income tax and the aggregate level of public outlays.[5] Yet, it allows some flexibility in modeling government tastes in terms of growth composition and preference for the present. Incidentally, I refrain from introducing explicitly the 'type' of government, as would a Markov-switching model, in order to show that even in an economy where the government is elected forever and whose preferences are manifest can there be steady state multiplicity.

What matters here is that forward-looking, rational investors and consumers anticipate fiscal policy decisions and adapt their behaviors accordingly. For instance, if households observe that the government is eager to spend and run high public debt in the future, they increase savings and postpone consumption. In turns, such a behavior, bound to yield lesser tax revenues, heightens the need for future tax hikes. By contrast to the classical crowding-out effect that transits through the availability and cost of credit, crowding-out occurs here because households know governments are more impatient and it becomes better for them, in terms of welfare, to smooth out consumption inter-temporally. To get this dynamic and forward-looking perspective, I rely on a growth model *à la* Barro (1990) where the endogenous growth engine is productive government spending, echoing the rich literature on fiscal policy, growth and fluctuations, which often yield multiple equilibria.[6]

Namely, in this chapter, two key ingredients are added to an endogenous growth model. First, the government is explicitly modelled as a separate agent—contrary to most of the literature on endogenous growth, for which the government (when modelled explicitly) usually follows a fiscal rule. As such, the government maximizes its own objectives. To represent the short-term electoral pressures it faces (the political economy of myopia), the government is supposed to be more impatient than households. While the government mostly derives utility from its own spending (which positively impacts productivity), it also gets an externality from private consumption. Indeed, any government—whether benevolent or selfish—has reasons to care for public spending and private consumption. Benevolent governments want public spending for the enhancing effect it has on growth, while less virtuous governments like public spending and

[5] My results can also be obtained with a standard logarithmic utility function for the consumer, in which the elasticity of intertemporal substitution in consumption is unitary.

[6] See for instance Cazzavillan (1996); Turnovsky (1997); Greiner and Semmler (1999); Futagami et al. (2008); Minea and Villieu (2012); Nishimura et al. (2016); to cite only a few papers.

private consumption for more selfish, electoral motives. By comparison, most of the literature on the impact of fiscal policy on growth either relies on some sort of debt target or debt ceiling (Barro, 1990; Barro and Sala-i Martin, 1992, 1995) or assumes a benevolent government to derive some normative conclusions about optimal taxation or the optimal financing of public spending (*e.g.*, Lucas Jr, 1990; Judd, 1985, 1999).

The interactions and frictions between households and the government, seen as two competing, forward-looking agents with different degrees of impatience, are intended to reflect more closely the political economy reality. Moreover, the government is constrained, in the sense that it cannot accumulate assets, and the only financial market it can tap is the sovereign bond market (where it is necessarily a net seller). By comparison, households are more patient and keen to accumulate productive capital.

This alone is not enough to generate instability.[7] I find that there can be only one stationary path—despite the various feedback loops, which are usually found to foster multiple equilibria (Card et al., 2008). A key engine of growth is the difference of discount rates between the government and households; however, if that difference is too important, the economy is left without any balanced growth path. Additionally, having heterogeneous preferences is necessary to endogenous growth. In fact, the government's marginal utility should be higher than that of households, and the externality from private consumption in the government's utility function hinders growth. This suggests that worse than an impatient, selfish government is an impatient government that cares a little for the welfare of its electorate.

Second, an imperfection in asset allocation is introduced in the form of an endogenous interest rate spread between private capital and Treasury bonds. This spread exacerbates the tension in the economy between consumption, investment, and public expenditure, in a context where only households can accumulate assets. Government choices affect households through (a) the impact of public spending on productivity; and (b) the quantity of sovereign bonds it issues. Similarly, the consumer's choices feed back into the government utility because of the explicit externality from private consumption, but also because investment decisions change growth prospects, thus tax income. Yet, another channel seems determinant: all these decisions impact the financing costs of the government. The spread makes productive assets and sovereign bonds imperfect substitutes, in the absence of other financial instruments and with the government's inability to invest in physical assets. It thereby prevents agents from fully smoothing out demand over time—in other words, it prevents them from hedging against each other's choices and preferences. Consequently, growth is necessarily lower with than without the spread.

[7] This finding confirms and generalizes previous literature, such as Minea and Villieu (2013).

With this second ingredient, I get a second steady state that is less intensive in public spending. Households can trade off consumption against investment; but these two decisions are not equivalent inter-temporally and impact the government differently. In parallel, the government can either spend or let households consume more. A side finding is that the externality from private consumption in the government's utility function is not necessary, but it makes the occurrence of multiplicity more likely. This seems to suggest that the more governments care about private welfare, the more instability it generates in the economy: a ruthlessly selfish government is more predictable than a somewhat benevolent one.

The steady state that is less intensive in public expenditure is unstable, while the balanced growth path with high public spending (and low consumption) is a saddle point and attracts the only converging dynamic trajectories under rational expectations. This happens as follows: as private agents expect the government to be thrifty and generate (overall) deficits, they increase capital accumulation and reduce their consumption, thereby enticing the government to spend more. The low equilibrium is not attainable except when the economy starts there or if agents are able to credibly coordinate onto it (*i.e.*, changing what each expects about the other's future decisions).

These findings have several policy implications. First, the fact that a multiplicity of stationary trajectories can result from the interplay of a government and citizens optimizing two different goals highlights that macro-fiscal outcomes do not only depend on the government's ability or willingness to implement what is best for the country. Against this risk, the government would need to credibly anchor expectations—like the central banker who commits to a nominal anchor. Fiscal policy, like monetary policy, needs to be clearly and transparently communicated for agents to coordinate towards the preferred equilibrium. Second, even if this is admittedly beyond the framework developed here, which is presented in a context of rational expectations and perfect knowledge about model parameters, similar mechanisms could produce, in situations marred with uncertainty and irrational expectations, swings in private expectations about the government's behavior and preferences can generate fluctuations. This relates to the confidence agents have in their government. Third, a key element of the model is that households and governments have different discount rates. The impatience of a government can be seen as a proxy for its credibility: too impatient a government fails to represent well its citizens and to serve their best interest; it leads households to save more, which is eventually beneficial in terms of capital accumulation but lowers the welfare of private agents. Fiscal rules or a fiscal watchdog can help curb the government's impatience and force it to account for the intertemporal consequences of its actions.

Beyond its contribution to the endogenous growth and instability models, this chapter proposes a new facet of the time-consistency issues that face a government, beyond risks of default-

ing or deviating from fiscal objectives. In this chapter, I highlight that the interactions between sovereign and private decisions may lead to a multiplicity of equilibria. The literature often relies on *ad hoc* costs of default or deviation from prior commitments—either in the form of sanctions from the international community, exclusion from financial markets, or higher risk premia (Eaton and Gersovitz, 1981) or because of reputational implications *à la* Bulow and Rogoff (1989). Even without allowing for default, the endogenous growth model developed here involves endogenous macroeconomic channels and costs, and underscores feedback loops between fiscal credibility, macroeconomic performance, and fiscal outcomes. Thus, this chapter also relates to the vast literature on the two-way linkages between fiscal and macroeconomic performance. Last, since the model developed here includes an endogenous cost of public debt that responds to how agents perceive the government, it relates to the literature on interest spreads and nonlinear effects of debt accumulation. Last, this model contributes to the strand of literature that studies the interactions between public debt dynamics and fiscal policy, even though I abstract from debt constraints, limits in government ability to tax, strategic default, or sustainability concerns(as in Arellano and Bai, 2017; Nishimura et al., 2015; Collard et al., 2015).

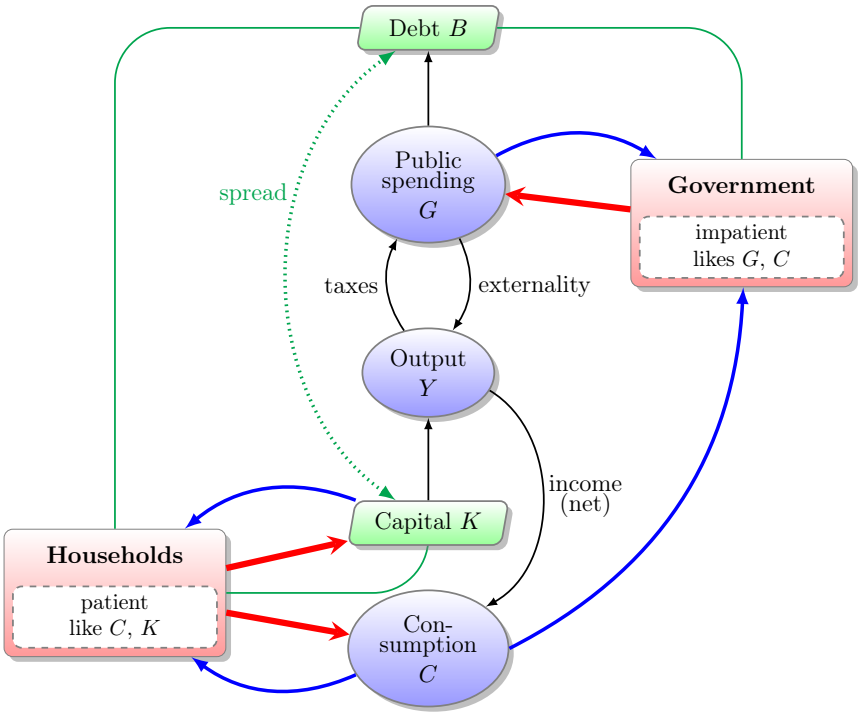
This chapter is organized as follows. In section 4.2, I present the various constitutive elements of the model. Section 4.3 highlights some properties of the balanced growth paths and explains the mechanisms at play. I discuss the existence of multiple equilibria and the interplay of preferences between the two agents, without (Section 4.4) and with (Section 4.5) an endogenous interest rate spread between private capital and sovereign bonds. I examine the stability of the stationary paths in Section 4.6, and conclude with some potential extensions in section 4.7.

4.2 The model

I consider an economy in continuous time $t \in \mathbb{R}^+$ that comprised three types of agents: a constant, homogeneous population of households, a large number of identical, competitive firms, and a government. The labor supply is considered fully inelastic. Assuming the economy to be large and developed enough, with deep capital markets, I abstract from modelling international markets.

Since I am interested in how government preferences (and households' response to these preferences) impact macro-fiscal outcomes, I introduce in an endogenous growth model *à la* Barro (1990) a government that is distinct from aggregate households (whence, non-benevolent) and carries out its own maximization program. To represent the short-term electoral pressures it faces, the government is supposed to be more impatient than households; moreover, it cannot accumulate assets, and the only financial market it can tap is the sovereign bond market (where it is a net seller). By comparison, households are more patient and keen to accumulate productive capital.

Figure 4.1. *A model with two utility-optimizing agents*



Note: The color of arrows work as follows: red represents the two agent's decisions in terms of their respective control variables, as part of their optimization program; blue indicates the agent's deriving utility; green shows what financial instruments each has access to; and black stands for economic impacts.

The model allows for externalities between the private agent's and the government's decisions (Figure 4.1). Households get direct utility from consumption and equity, the latter for capitalistic reasons. In addition, they indirectly derive utility from capital, through the disposable revenue it generates and that finances future consumption and investment. Sovereign debt, on the other hand provides additional utility and income through the productive public services it contributes to finance. As for the government, it cares for both private consumption and its own spending.

Firms

The representative firm relies on a Cobb-Douglas technology to produce the final good. As in Barro (1990), the government contributes to the production function by providing public services and infrastructure:

$$Y_t = AK_t^a(G_tL_t)^{1-a} \tag{4.1}$$

where Y, $A > 0$, K, L, and G denote the firm's output, total factor productivity (TFP), private capital, labor input, and public spending. $0 < a < 1$ is the capital share of income.

Public spending such as infrastructure, education, health and social insurance, and public services that preserve the rule of law and foster a better business environment (police, effective courts) contribute to make labor more productive. Note that the entire amount of public spending enters the production function in (4.1), even though some of it might not necessarily enhance growth. For instance, Barro (1990) and Barro and Sala-i Martin (1992) distinguish between public expenditures that produce a positive externality and non-defense, non-education consumption services. Deficiencies in public financial management systems, as well as political incentives to choose unproductive projects, can also make public spending less efficient. These considerations are implicitly embedded in the TFP factor.[8]

The population size is normalized to one, which is equivalent to considering all variables in a per capita form (*e.g.*, $Y_t = \mathcal{Y}_t/L_t$). The final good is the numeraire; its price is omitted. Therefore, if w and r^k stand for the wage rate and the rental rate of physical capital, profit maximization gives at each time t the usual equality between each factor's marginal cost and return:[9]

$$w_t = (1-a)Y_t/L_t \quad \text{and} \quad r_t^k = aY_t/K_t \tag{4.2}$$

Households

The infinite-lived representative consumer supplies at each period an inelastic quantity of labor $L_t = 1$. Starting with initial endowments $K_0 > 0, B_0 \geq 0$, consumers maintain a portfolio of assets composed of productive capital K_t and sovereign bonds B_t. Physical capital depreciates at a constant rate $\delta \in \,]0\,;\,1[$.

Consumer preferences are separable over time; instantaneous utility $\mathcal{U}_{ct}(C, K)$ stems from both consumption and capital. Namely, the utility from private consumption is a standard isoelastic function, $\frac{C_t^{1-\theta}-1}{1-\theta}$, with $0 < 1-\theta \leq 1$ the inverse intertemporal elasticity of substitution (IIES) in consumption, which indicates how much households wish to smooth consumption over time. Additionally, I assume that individuals accumulate capital not only to defer consumption, but also for its own sake—the Weberian idea of *capitalism spirit*. As in Kurz (1968a) Zou (1995), and Kamihigashi (2008), owning capital provides an instantaneous utility $v(K) = \kappa\frac{K^{1-\theta}}{1-\theta}$, with $\kappa > 0$, which I assume to be separable from consumption utility.

[8] To account explicitly for this dichotomy in the model, I could introduce a public spending efficiency parameter $\eta \in]0, 1]$ and replace G_t in equation (4.1) by the share ηG_t that is valuable to firms and households. Such an efficiency parameter is implicitly captured by the TFP; resolving the model with η is strictly equivalent to replacing A with $A\eta^{1-a}$ everywhere.

[9] And the usual corollary: $Y_t = r_t^k K_t + w_t$.

Under perfect foresight and denoting $\phi > 0$ the discount rate (*i.e.*, the household's degree of impatience), the consumer's intertemporal utility function is:

$$\mathcal{U}_c \equiv \mathbb{E}_0 \int_0^\infty e^{-\phi t} \mathcal{U}_{ct}(C_t, K_t) dt \equiv \mathbb{E}_0 \int_0^\infty e^{-\phi t} \left\{ \frac{C_t^{1-\theta} - 1}{1-\theta} + \kappa \frac{K^{1-\theta}}{1-\theta} \right\} dt \tag{4.3}$$

Households are mostly interested in their own consumption—by contrast to the government, which I allow in the next subsection to be more or less selfish. However, since they trade off current consumption against investment that will let them consume more in the future (thanks to higher income), the IIES should be at least as high as the share of capital in the economy. Empirically, a is found in the 0.3–0.5 range and θ at around 0.7 (when agents have access to capital markets and with significant heterogeneity; Havranek et al., 2015; Gruber, 2013), so that it is not outrageous to assume the following:

Assumption 1 (Consumer's preference)**.** The IIES in consumption is larger than capital intensity: $\theta > a$.

Each household derives income from wage, capital, and sovereign debt. While production and profits are not taxed, all types of income are, with no deduction for depreciation. Hence the budget constraint:

$$C_t + \dot{K}_t + \dot{B}_t \leq R_t^k K_t + R_t^\ell + R_t^b B_t \tag{4.4}$$

where $R_t^k \equiv (1-\tau) r_t^k - \delta$, $R_t^b \equiv (1-\tau^b) r_t^b$, and $R_t^\ell \equiv (1-\tau) w_t$ stand for the after-tax rates of return on equity, sovereign bonds, and labor—with $0 < \tau < 1$ the *ad valorem* tax rate on income from capital and labor and $0 < \tau^b < 1$ the tax on sovereign bond returns.

Households maximize their utility (4.3) by choosing a path for C_t, B_t, and K_t, under the budget constraint (4.4). Under rational expectations and perfect information, it is equivalent to drop the expectation sign $\mathbb{E}$. The resulting optimization problem can be solved with the calculus of variations method.[10] For any continuous-time Lagrange multiplier λ_t that is chosen such that $\lambda_t \neq 0$ if and only if the budget constraint (4.4) is saturated, the consumer's utility can be written and transformed with an integration by parts as follows:

$$\begin{aligned} \mathcal{U}_c =& \int_0^\infty e^{-\phi t} \mathcal{U}_{ct}(C_t, K_t) dt - \int_0^\infty e^{-\phi t} \lambda_t \left[C_t + \dot{K}_t + \dot{B}_t - R_t^k K_t - R_t^\ell - R_t^b B_t \right] dt \\ =& (K_0 + B_0)\lambda_0 - \lim_{t \to +\infty} e^{-\phi t} \lambda_t (K_t + B_t) + \int_0^\infty e^{-\phi t} \mathcal{L}_c dt \end{aligned} \tag{4.5}$$

[10] For another way to reach the same results, one can assume the budget constraint (4.4) is saturated, replace C_t by $K_t + R_t^\ell + R_t^b B_t - \dot{B}_t$ in the utility function, call $u(B, K, \dot{B}, \dot{K}, t)$ the resulting entity under the integral sign, and develop the Euler equations:

$$\forall X \in \{B, K\}, \ \frac{\partial u}{\partial X} = \frac{\partial}{\partial t} \frac{\partial u}{\partial \dot{X}}$$

where the last integrant is $\mathcal{L}_c \equiv \mathcal{U}_{ct}(C_t, K_t) - \lambda_t \left[C_t - R_t^k K_t - R_t^\ell - R_t^b B_t\right] + (\dot{\lambda}_t - \phi\lambda_t)(K_t + B_t)$

The first order conditions can then be derived directly from the equivalent optimization program that maximizes $\mathcal{L}_c$ with no other constraint than non-negativity ones:[11]

$$\frac{\partial \mathcal{L}_c}{\partial C} = C_t^{-\theta} - \lambda_t = 0 \tag{4.6a}$$

$$\frac{\partial \mathcal{L}_c}{\partial K} = \kappa K^{-\theta} + \lambda_t R_t^k + \dot{\lambda}_t - \phi\lambda_t = 0 \tag{4.6b}$$

$$\frac{\partial \mathcal{L}_c}{\partial B} = \lambda_t R_t^b + \dot{\lambda}_t - \phi\lambda_t = 0 \tag{4.6c}$$

as well as the transversality conditions:

$$\lim_{t\to+\infty} e^{-\phi t}\lambda_t(K_t + B_t) = \lim_{t\to+\infty} e^{-\phi t} C_t^{-\theta}(K_t + B_t) = 0 \tag{4.6d}$$

For optimality, the budget constraint is necessarily saturated and λ admits no zero. Thus, the last one of Kuhn-Tucker conditions is $\forall t,\ \lambda_t > 0$ and equations (4.6a)–(4.6b) can be combined as follows:

$$\frac{\dot{\lambda}_t}{\lambda_t} = \phi - R_t^k - \frac{\kappa K^{-\theta}}{\lambda_t} = -\theta\frac{\dot{C}_t}{C_t} \tag{4.7}$$

A no-arbitrage condition stems from equations (4.6b)–(4.6c) and the Kuhn-Tucker condition; it takes the form of an endogenous spread χ_t between the rental rate of capital and sovereign yields:

$$\chi_t \equiv R_t^k - R_t^b = -\kappa\left(\frac{C_t}{K_t}\right)^\theta \tag{4.8}$$

This spread is always negative, indicating that public debt is more expensive than private capital. This is plausible for three reasons. First, χ_t is the after-tax spread; even though sovereign interest rates are usually lower, nominally, than corporate bond yields (for comparable instruments), they can be higher after accounting for effective taxation.[12] Typically, governments grant preferential tax treatments to income from sovereign bonds; moreover, capital is subject to corporate income tax in addition to personal income tax on non-sovereign investment. Second, sovereign bonds are often used in monetary policy operations and enjoy lower risk weights for the purpose of prudential regulations, which reduces their opportunity cost. Third, χ_t is the weighted effective spread and reflects composition effects, while the maturity structure is bound to differ between

[11] I rule out corner solutions *ab initio*; if one of the control variables C, K, or B is nil, then the corresponding first order condition is an inequality.

[12] Except when sovereign credit risk rises substantially, sovereign yields are often found to be a floor for corporate bond yields, because for sovereign securities are usually seen as the risk-less asset of an economy—especially in emerging economies where financial markets are more shallow (Bevilaqua et al., 2020; Corsetti et al., 2014).

the two assets. As government debt generally has a lengthier average maturity than corporate securities, the associated risk premium is likely higher, overall.

The model thus allows for spread fluctuations: at a given level and cost of capital, the higher consumption, the more public debt is crowded out in the household's budget constraint (4.4) and the cheaper it is (*i.e.*, the higher sovereign yields). Compared with the existing theoretical literature, introducing this spread between households' and the government's respective costs of borrowing aims at modelling confidence effects in the government's and its bonds. It also plays a determinant role in fostering multiple equilibria, as sections 4.4 and 4.5 will demonstrate.

Government

The government is not a social planner in this chapter (as in Acharya and Rajan, 2013). It values the consumption of its electorate, but also cares for its own spending. Therefore, the government has its own optimization program, contrary to most of the literature on endogenous growth, for which the government (when modelled explicitly) follows a fiscal rule. Private consumption C_t acts as a positive externality for the government. By contrast with households, the government has no direct utility from the accumulation of capital stock and a different discount factor $\varphi > 0$. I posit the following utility function:[13]

$$\mathcal{U}_g = \int_0^\infty e^{-\varphi t} \frac{G_t^{1-\varsigma} - 1}{1-\varsigma} C_t^\vartheta dt \tag{4.9}$$

The two parameters $0 \leq \varsigma \leq 1$ and $\vartheta \geq 0$ relate to the government's relative preferences for public spending and private consumption, respectively. The inverse intertemporal elasticity of substitution (IIES) in public spending ς indicates how much governments wish to smooth their expenditure over time, while the degree of externality ϑ indicates how much the government's spending decisions are influenced by households' aggregate behavior in terms of consumption. Hence, ϑ represents a perturbing element in public expenditure intertemporal decisions; the marginal utility of public expenditure in the balanced growth path state (that is, the degree of homogeneity of marginal utility) is $\vartheta - \varsigma$ instead of $-\varsigma$, intuitively making convergence more sluggish and fluctuations more likely.

The government finances its spending from two sources: (a) by levying an income tax on wages and interest earnings and (b) by selling bonds to households. Notably, I refrain from as-

[13] In an attempt to make notations a bit easier to remember, I use the same Greek letters for the various parameters of the government's and the consumer's utility functions, but written differently. Namely:

	Household	Government	Mnemonic
C_t	$1-\theta$	ϑ	'th' for thrift (or lack thereof)
G_t	...	$1-\varsigma$	's' for spending
Discount rate	ϕ	φ	'f' for future

suming that the government is bound by a debt limit. I depart in this from most of the theoretical literature. Blanchard (1984) for instance assumes that there is a limit on the ability to borrow that stems from the government's ability to generate and sustain large surpluses in the future, while Futagami et al. (2008); Minea and Villieu (2013); Nishimura et al. (2016) rely on explicit debt targets or fiscal rules. Thus, the government can run budget deficits but must comply with the intertemporal budget constraint:

$$G_t + r_t^b B_t \leq \dot{B}_t + \tau r_t^k K_t + \tau w_t + \tau^b r_t^b B_t \tag{4.10}$$

Incidentally, the government's and consumer's budget constraints (4.4) and (4.10) can be combined to yield the product market clearing condition:

$$\dot{K}_t \leq Y_t - \delta K_t - G_t - C_t \tag{4.11}$$

To solve the government's optimization problem, let me call μ_t the continuous-time Lagrange multiplier associated with the constraint (4.10) and write out the current-value Hamiltonian:

$$\mathcal{H}_g(B_t, G_t, \mu_t) = \frac{G_t^{1-\varsigma} - 1}{1-\varsigma} C_t^{\vartheta} + \mu_t \left[G_t + R_t^b B_t - \tau r_t^k K_t - \tau w_t \right] \tag{4.12}$$

under the following transversality condition:

$$\lim_{t \to \infty} e^{-\varphi t} G_t^{-\varsigma} C_t^{\vartheta} B_t = 0 \tag{4.13}$$

Whenever the budget constraint is saturated, $\mu_t < 0$ and the two first order conditions yield:

$$\frac{\dot{\mu}_t}{\mu_t} = \varphi - R_t^b = \vartheta \frac{\dot{C}_t}{C_t} - \varsigma \frac{\dot{G}_t}{G_t} \tag{4.14}$$

This equation is key to the government's tradeoff between letting households consume more or spending more itself, while such a decision in turns impact the relative price of assets.

The government in this model implicitly maximizes spending (and debt, too), which is meant to represent realistically the behavior of actual governments. Unlike other papers, my model do not impose a debt ceiling or a debt target; however, the government's preference for spending is still limited by three things: (a) the externality in the government's utility function, to the extent that public spending crowds out private consumption; (b) the cost of sovereign borrowing, which increases if households decide to consume rather than invest; and (c) the transversality constraint (*i.e.*, the sustainability of the government's behavior). The fact that the government pursues its own objectives can be interpreted from a political economy angle: for electoral reasons, governments usually enjoy spending (in ostentatious infrastructure projects or social programs, or simply to "*buy votes*"), while they also care enough about the well-being of their constituencies (which in such a model goes through utility) to be re-elected. Yet, even a benevolent government might have also good reasons to seek public spending. A good social planner should be

conscious of the impact of public expenditure on production in equation (4.1), the social return of public spending being higher than its private return (Barro and Sala-i Martin, 1992).

In this chapter, private agents do not necessarily trust the government, partly because it follows its own maximization program and does not act as a benevolent planner. But another credibility issue arises from the government's having a reputedly different discount rate than households. More precisely, I will suppose that government has a stronger preference for the present; because of electoral cycles, it has a shorter time horizon than the infinite-lived households (or successive generations who value the heirs' consumption as their own).[14] Similarly, Aguiar et al. (2019) and Acharya and Rajan (2013) argue that governments are more impatient than private agents, as they are motivated by political economy incentives, thereby generating welfare losses. The following assumption establishes the government's relative shortsightedness, which can also be interpreted as a *proxy* for successive governments with a finite time horizon.

Assumption 2 (Impatient sovereign)**.** The government is less patient than households: $\varphi > \phi$.

Intertemporal equilibrium

The resulting dynamic system is the set of equations (4.7), (4.10), (4.11), and (4.14). The state variables K_t and B_t are predetermined, their values being inherited at each time t from the past history $s < t$. On the other hand, the control variables C_t and G_t are forward-looking. Relying on the non-arbitrage equation (4.8) and the expressions (4.2) of the wage and return on investment, I reach the following differential equations for the various variables.

$$\vartheta \frac{\dot{C}_t}{C_t} - \varsigma \frac{\dot{G}_t}{G_t} = \varphi - (1-\tau) a \frac{Y_t}{K_t} + \delta + \chi_t \tag{4.15a}$$

$$\theta \frac{\dot{C}_t}{C_t} = (1-\tau) a \frac{Y_t}{K_t} - \delta - \phi \tag{4.15b}$$

$$\dot{B}_t = G_t - \tau Y_t + \left[(1-\tau) a \frac{Y_t}{K_t} - \delta - \chi_t \right] B_t \tag{4.15c}$$

$$\dot{K}_t = Y_t - \delta K_t - G_t - C_t \tag{4.15d}$$

Definition 3. With Y_t and χ_t given respectively in (4.1) and (4.8), an intertemporal perfect foresight equilibrium is a path $\{C_t, G_t, B_t, K_t\}_{t \in \mathbb{R}_+}$ satisfying the laws of motion (4.15) for given (K_0, B_0), as well as the transversality conditions (4.6d) and (4.13) and the following sign restrictions: $\forall t$, $(C_t,\ G_t,\ B_t,\ K_t) \in \mathbb{R}_+^4$.

[14] The literature on default often assumes also that governments have limited horizons (*e.g.*, Collard et al., 2015).

Combining equations (4.15a)–(4.15c) offers some insights on how the preference parameters impact the pace of debt accumulation: $\frac{\dot{B}_t}{B_t} = \frac{G_t - \tau Y_t}{B_t} + \varphi - \vartheta \frac{\dot{C}_t}{C_t} + \varsigma \frac{\dot{G}_t}{G_t} = \frac{G_t - \tau Y_t}{B_t} + \phi + \theta \frac{\dot{C}_t}{C_t} - \chi_t$. For a given primary surplus, the government tends to accumulate more debt, the higher its preference for the present, the higher its self-interest in growing its own spending, and the less it cares about private consumption. Conversely, debt grows more slowly when households have a higher utility from consumption and a lower direct utility from capital accumulation (which means they are all the more eager to consume rather than save, hence demand higher interest rates on the government's borrowing). It might seem surprising that public debt grows faster when households are more impatient; it is because of the externality of public spending in production: more public spending today provides households with a higher disposable revenue in the future, even though it will need to be financed through taxes later in the future.

As common in the literature, I normalize all variables by the stock of capital. Namely, I let $x_t \equiv \frac{X_t}{K_t}$ denote the shares of total private capital, for $X = C, G, B$, and $\gamma_t \equiv \frac{\dot{K}_t}{K_t}$ the growth rate. With these notations, the spread between private and sovereign yields is $\chi_t = -\kappa c_t^\theta$, and I get:

$$\vartheta \frac{\dot{c}_t}{c_t} - \varsigma \frac{\dot{g}_t}{g_t} = \varphi - (1-\tau) a A g_t^{1-a} + \delta + \gamma_t(\varsigma - \vartheta) - \kappa c_t^\theta \tag{4.16a}$$

$$\theta \frac{\dot{c}_t}{c_t} = (1-\tau) a A g_t^{1-a} - \delta - \phi - \theta \gamma_t \tag{4.16b}$$

$$\dot{b}_t = g_t - \tau A g_t^{1-a} + \left[(1-\tau) a A g_t^{1-a} - \delta + \kappa c_t^\theta - \gamma_t \right] b_t \tag{4.16c}$$

$$\gamma_t = A g_t^{1-a} - \delta - g_t - c_t \tag{4.16d}$$

The growth rate γ can be negative without implying that the economy altogether is in recession. The output growth is $\hat{y}_t = a\gamma_t + (1-a)\frac{\dot{G}_t}{G_t} = \gamma_t + (1-a)\frac{\dot{g}_t}{g_t}$. The model allows for situation where government spending is the main driver of economic growth (as is the case in some countries where the State is over-bloated, with an overmanned public service and monopolistic state-owned enterprises).

Equation (4.16c) can be interpreted as a classic debt-accumulation equation. The first two terms form the primary deficit.[15] The square bracket and the last term form the automatic debt dynamics—what the literature often refers to as the interest rate-growth differential.

4.3 Balanced growth paths

In this section, I examine the steady state(s) of the economy, that is the equilibrium such that c_t, g_t, and b_t are constant over time, under the assumption that taxation also remains unchanged.

[15] I call $\tau A g^{1-a} - g$ the primary balance slightly abusively, as it implicitly subtracts from the overall balance the interest bill net of income tax on sovereign yields, rather than the gross interest bill.

On such a balanced growth path, consumption, production, public debt, and public spending are proportional to the stock of capital. In other words, they all grow at the same rate, $\gamma^\star$, so that $\forall X \in \{G, C, B, K\},\ \forall t \in \mathbb{R}_+,\ X_t = x^\star K_0 e^{\gamma^\star t}$ with $x^\star$ the steady state ratio X/K.[16] Replacing these in the transversality conditions (4.6d) and (4.13) yields the following constraints on the growth rate:

$$\gamma^\star < \frac{\varphi}{1-\varsigma+\vartheta} \qquad ; \qquad \gamma^\star < \frac{\phi}{1-\theta} \tag{4.17}$$

If the accumulation of capital was faster than the ratio of the discount factor and the degree of homogeneity of the utility of an agent, then that utility would diverge.

Definition 4. A balanced growth path are steady state values $(c^\star, g^\star, \gamma^\star, b^\star) \in \mathbb{R}_+^4$ satisfying the inequalities (4.17) and the following system of equations, where $\xi \equiv \vartheta - \varsigma + \theta$:

$$\xi\gamma^\star = \varphi - \phi - \kappa {c^\star}^\theta \tag{4.18a}$$

$$(1-\tau)aA{g^\star}^{1-a} = \phi + \delta + \theta\gamma^\star \tag{4.18b}$$

$$c^\star = A{g^\star}^{1-a} - \delta - g^\star - \gamma^\star \tag{4.18c}$$

$$\tau A{g^\star}^{1-a} - g^\star = b^\star\left[\varphi - \gamma^\star(1+\vartheta-\varsigma)\right] \tag{4.18d}$$

A new parameter emerges: ξ is the divergence between the government and households in terms of the total marginal utility (including the impact of the externality). It is also the gap between the preferences of the two agents and can be decomposed with the various weights involved in the two utility functions: $\xi = [\vartheta - (1-\theta)] + [1-\varsigma]$; the first bracket is the difference between the externality in the government's utility and the household's IIES in consumption, and the second is the government's IIES in public spending (from which households do not derive any utility).

This parameter ξ plays a crucial role. If the government's and households' utility functions had the same degree of homogeneity ($\xi = 0$), then either $\phi = \varphi + \chi^\star$ and any growth rate $\gamma^\star$ could be solution, or the dynamic system would diverge without any steady state (which is a consequence of the absence of an exogenous debt limit in my model). For the remainder of chapter, I will avoid such a situation and assume agents are *heterogeneous enough*. Furthermore, provided that $\xi \neq 0$, the consumption in the steady state is $c^\star = \left[\varphi - \phi - \xi\frac{(1-\tau)aA{g^\star}^{1-a} - \phi - \delta}{\theta}\right]^{1/\theta}\frac{1}{\kappa^{1/\theta}}$, which imposes a threshold $\varpi \equiv \frac{(\vartheta-\varsigma)(\phi+\delta)+\theta(\varphi+\delta)}{\xi aA(1-\tau)}$ on the admissible values of public spending for a steady state to be exist. Depending on the sign of ξ, this threshold will act either as an upper or a lower bound on $g^\star$. The discriminating condition $\xi \lessgtr 0$ thus implies very different steady

[16] For convenience, I use the same notation for capital as for other variables, but obviously $k^\star = 1$.

states. As having an upper bound on public spending is more realistic, I will assume that ξ is non-negative. Appendix 4.B provides the proof that the case $\xi < 0$ is anyway less interesting, as it does not yield multiple equilibria.

Assumption 3. The utility functions of the government and households are distinct, and that of the government has a higher degree of homogeneity: $\xi = \theta + \vartheta - \varsigma > 0$.

The steady-state growth rate of the economy, $\gamma^\star$, is determined by the interplay between the government's and the private agent's respective preferences. However, the government is the only one to influence the productivity of the economy—the output per unit of private capital being $y_t = Ag_t^{1-a}$. Contrary to the standard endogenous growth literature where growth results from savings, technology, and capital decay (*e.g.*, AK models *à la* Romer, 1986), it is in this chapter's model a function of the deep parameters describing the agents' preferences: $\gamma^\star = (\varphi - \phi + \chi^\star)/\xi$. It can be read as the ratio of preference heterogeneity between the sovereign and households in terms of: (1) their discount factors (adjusted for the relative cost of financing $\chi^\star$) and (2) their propensity to enjoy more spending in the economy (whether theirs or others), as it increases marginally their utility. For growth to be positive, the most impatient agent needs to also have the highest marginal utility.

To better understand how state variables B and K interlink the respective preferences of households and the sovereign, it is useful to extract from equation (4.18a) a non-arbitrage condition between households and the government in terms of discounted marginal utility:

$$R^b + \gamma^\star(\vartheta - \varsigma) - \varphi = R^k - \theta\gamma^\star - \phi \tag{4.19}$$

Since $\xi > 0$, the growth rate decreases with the interest rate spread. As a matter of fact, the growth rate is always smaller than in the case without spread $\kappa = 0$, which I will treat specifically in the next section: $\gamma^\star < \frac{\varphi-\phi}{\xi}$; in a sense, the spread thus distorts resource allocation to debt-financed, growth-enhancing public spending. Growth is positive only when the government is sufficiently impatient to compensate the spread it faces.

Preferences interplay through two channels. First, a spread between capital and public debt stems from the households' portfolio decisions, based on private agents' interest in owning capital. Since public debt crowds out consumption and capital accumulation, the larger marginal utility $(-\theta)$ households derive from consumption, the more they can afford to finance private capital at a high cost. Second, there is a tradeoff between agents *via* the level of public debt. When the government is more impatient than households (*i.e.*, $\varphi > \phi$), households need to have a higher marginal utility than the government for growth to be positive. Otherwise, the government takes on more debt, which leads to an unwelcome outcome (namely, an attrition of the capital stock). Only when households have strong views and preferences can they impose

some discipline on governments, by rationing its capacity to borrow. Indeed, for a household, the bigger its marginal utility, the lower the price of private capital relative to sovereign yields.

In this model, higher public spending is unconditionally associated with higher growth, thanks to its externality on the production function, but it can crowd out private consumption. Considering $g^\star$ as a variable for a moment, it is straightforward from (4.18b) that $\gamma^\star$ grows with $g^\star$. By contrast, private consumption benefits from public services only up to a certain point: namely, up to $g^\star = ((1-a)A)^{1/a}$, which is also the level of public expenditure that households would choose if they could (appendix 4.A). Intuitively, public services provide an externality that enhances labor productivity, but their financing weighs on the consumer's purchasing power and crowds private investment out. Beyond a certain level, the cost of public expenditure outweighs its benefits, which is reminiscent of the "*Armey curve*" —the inverted U-shape relation between the government's size and GDP growth first described by Armey (1995). The tipping point beyond which marginal public spending is counterproductive is higher, the larger the labor intensity in the production function and the higher overall productivity.

The government faces adverse debt dynamics in the steady state. The right-hand side of equation (4.18d) is always positive, as per the transversality condition (4.17). As the public debt ratio $b^\star$ cannot be negative, the government ought to generate a primary surplus in the steady state: $\tau A g^{\star 1-a} - g^\star > 0$. Therefore, at the steady state, government spending $g^\star$ will have to be lower than $(\tau A)^{1/a}$.[17] This is not necessarily orthogonal to papers that introduce persistent deficits in growth models (*e.g.*, Minea and Villieu, 2012), as these focus on overall (not primary) deficit.

Turning to the household's optimization problem, consuming more is not necessarily a Pareto-improvement. Supposing the economy starts at $t = 0$, and stays on its balanced growth path forever thereafter, the welfare of the representative household, as defined by the utility they get from steady-state consumption and investment, is:[18]

$$\mathcal{U}_c^\star = \frac{K_0^{1-\theta}}{(1-\theta)(\phi - \gamma^\star(1-\theta))}\left[c^{\star 1-\theta} + \kappa\right] - \frac{1}{(1-\theta)\phi} \tag{4.20}$$

Since the growth rate of capital $\gamma^\star$ decreases with $c^\star$ (equation (4.18a)), welfare is not necessarily an increasing function of private consumption. I notice that $\frac{\partial \mathcal{U}_c^\star}{\partial c^\star}$ is proportional to $-(2\theta-1)\kappa - \theta\kappa^2 c^{\star\theta-1} - \left[(1-\varsigma+\vartheta)\phi - (1-\theta)\varphi\right] c^{\star-\theta}$ is not always positive. In particular, when the appetite for capital accumulation κ is large, the first terms dominate the square bracket, making welfare higher with a lower level of consumption (which allows for more investment).

[17] This condition rules out the level of public spending households would choose in absence of a government, $\tilde{g} = ((1-a)A)^{1/a}$ (see appendix 4.A), as in general $1-a$ is larger than τ.

[18] Similarly, the government's welfare is $\mathcal{U}_g^\star = \frac{K_0^{1-\varsigma+\vartheta} g^{\star 1-\varsigma} c^{\star\vartheta}}{(1-\varsigma)(\varphi - \gamma^\star(1-\varsigma+\vartheta))} - \frac{K_0^\vartheta c^{\star\vartheta}}{(1-\varsigma)(\varphi-\gamma^\star\vartheta)}$.

Similarly, when the government is sufficiently impatient ($(1-\theta)\varphi > (1-\varsigma+\vartheta)\phi$), households are always better off with less consumption; instead, they save and derive utility from building capital.

4.4 Role of heterogeneous preferences in the absence of wealth utility

This section examines the role played by the various intra- and inter-temporal preference parameters in the model. To characterize the steady state solution when households derive no utility from capital—at least, not directly—, I temporarily assume away the spread:

Assumption 4 (No spread)**.** Agents do not value the holding of productive assets *per se*: $\kappa = 0$. Therefore, the spread χ_t is nil.

The following system describes the balanced growth path:

$$\gamma^\star = \frac{\varphi - \phi}{\xi} \tag{4.21a}$$

$$g^\star = \left(\frac{\phi + \delta + \xi^{-1}(\varphi - \phi)\theta}{(1-\tau)aA} \right)^{\frac{1}{1-a}} \tag{4.21b}$$

$$c^\star = Ag^{\star 1-a} - \delta - g^\star - \xi^{-1}(\varphi - \phi) \tag{4.21c}$$

$$b^\star = \frac{\tau A g^{\star 1-a} - g^\star}{\varphi - \xi^{-1}(\varphi - \phi)(1 + \vartheta - \varsigma)} \tag{4.21d}$$

Growth sustainability stems for the relative preferences of the heterogeneous agents and their relative level of impatience, as can be observed in equation (4.21a). In particular, the growth rate $\gamma^\star$ would not be positive without Assumptions 2 and 3. Whomever has the higher discount rate shall benefit spend more, while others shall save.[19] It is actually this very discrepancy in preferences that generates endogenous growth; yet, the smaller the differences in marginal utility (when $\xi \to 0^+$), the higher growth. The tax rate does not impact the growth rate at all.

Public spending is higher the larger the fiscal space, but also the more crucial its role in the production function. As appears from equation (4.21b), a higher the tax rate gives the government more space to spend (formally: $\partial g^\star / \partial \tau = \frac{g^\star}{(1-\tau)(1-a)} > 0$). Besides, when capital (through capital intensity a or the depreciation rate δ) or the TFP A contribute more to growth, the

[19] This finding somehow reminiscent of Ramsey (1928)'s "*division of society into two classes, the thrifty enjoying bliss and the improvident at the subsistence level,*" although in an admittedly very different setup where only private agents interact and can accumulate assets.

government spends less. At a given level of capital accumulation $\gamma^\star$, the government's spending decision is also determined by consumers' preferences: it is higher the more patient households are, and the less marginal utility they derive from consumption. Equation (4.21c) is mostly an accounting identity; households consume whatever is left once a share of output ($y^\star = Ag^{\star 1-a}$) has been used for government's spending and for gross investment (including depreciation).

Proposition 1 (Unicity without spread)**.** *Under assumptions 1–4, there exists a unique balanced growth path with positive growth and public spending provided that the government is not too impatient:*

$$1-\theta < (1-\varsigma+\vartheta)\frac{\phi}{\varphi} < 1-\varsigma+\vartheta \tag{4.22}$$

Moreover, there exist $0 < \Phi_b < \Phi_c$ *such that:*

(a) $\forall \varphi - \phi < \xi\Phi_b$*, public debt is positive in the steady state;*

(b) $\forall \varphi - \phi < \xi\Phi_c$*, private consumption is positive in the steady state.*

This unique equilibrium is locally unstable.

■ *Proof of Proposition 1.* Uniqueness of the steady state comes immediately from system (4.21). Moreover, since $\xi > 0$ and $\varphi > \phi$, all variables are defined; and $g^\star$ and $c^\star$ are positive as soon as they exist. Condition (4.22) stems from factoring equation (4.18a) in the transversality conditions; it imposes a ceiling on the degree of homogeneity of the consumer's utility that is slightly stricter than that of Assumption 3. Provided this ceiling is respected, $g^\star > \tau A g^{\star 1-a}$ is enough to ensure that $b^\star > 0$; the *sine qua non* condition is:

$$g^\star = \left(\frac{\phi+\delta+\xi^{-1}(\varphi-\phi)\theta)}{(1-\tau)aA}\right)^{\frac{1}{1-a}} < (\tau A)^{1/a}$$

which leads me to define $\Phi_b \equiv \frac{(1-\tau)aA(\tau A)^{\frac{1-a}{a}}-\phi-\delta}{\theta}$.

For $c^\star = Ag^{\star 1-a} - g^\star - \delta - \xi^{-1}(\varphi-\phi)$ to be positive, I need:

$$g^\star = \left(\frac{\phi+\delta+\xi^{-1}(\varphi-\phi)\theta)}{(1-\tau)aA}\right)^{\frac{1}{1-a}} < \frac{\phi+\delta(1-(1-\tau)a)+\xi^{-1}(\varphi-\phi)(\theta-(1-\tau)a)}{(1-\tau)a}$$

The function $f:\ x \mapsto \frac{\phi+\delta(1-(1-\tau)a)+x(\theta-(1-\tau)a)}{(1-\tau)a} - \left(\frac{\phi+\delta+x\theta)}{(1-\tau)aA}\right)^{\frac{1}{1-a}}$ is concave, with $f(0) > 0$ and $\lim_{x\to+\infty} f(x) = -\infty$, so there exists a unique Φ_c such that $\forall x \in \mathbb{R}_+,\ f(x) > 0 \Leftrightarrow x < \Phi_c$. The fact that $f(\Phi_b) = \frac{\phi+\delta(1-\theta)}{\theta} + (\tau A)^{1/a}\frac{1-\tau}{\tau} > 0$ proves that Φ_b is smaller than Φ_c. The proof of instability is provided in appendix 4.D. ■

Proposition 1 shows that there is an upper limit on how much more impatient the government can be relatively to households, however this impatience may generate growth. The upper limit

Table 4.1. *Sensitivity of growth and public spending to preference parameters in the absence of spread*

	Sensitivity to x	
Parameter x	$g^\star$	$\gamma^\star$
Household's IIES θ	$\vartheta - \varsigma$	-1
Externality ϑ in $\mathcal{U}_g$	$-\theta$	-1
Government's IIES ς	θ	1

Note: The two columns provide respectively $\frac{\partial g^{\star 1-a}}{\partial x}$ (abstracting from the positive factor $\frac{\varphi-\phi}{\xi^2(1-\tau)aA}$) and $\frac{\partial \gamma^\star}{\partial x}$ (abstracting from the positive factor $\frac{\varphi-\phi}{\xi^2}$).

is higher when the two agents' preferences are more divergent (*i.e.*, ξ larger), confirming my earlier interpretation that only heterogeneous agents can afford to have different discount rates. Yet, if the government grew too impatient, then it would eventually suppress private consumption altogether.

Apart from discount rates, what role do the various preference parameters play in the model? Table 4.1 summarizes the sensitivity of growth and public spending to the various preference parameters. The economy grows faster the more the government wants to spend, and the less both agents enjoy private consumption. In particular, instead of contributing to a better outcome, the fact that the government cares for private consumption by the prism of the externality ϑ is detrimental to growth. Public spending, like growth, increases when the government values less private consumption and more its own. The impact of the household's preference on public spending depends on the sign of the government's marginal utility, $\vartheta - \varsigma$; if $\varsigma > \vartheta$, public spending (at the steady state) is a decreasing function of the household's IIES in consumption. Last, private consumption rises with growth only when the government is not too impatient.[20]

In the absence of the externality from private consumption onto public spending decisions (the source of inefficiency in the model), the economy grows only when the impatient government has stronger preferences than households, meaning that the government's IIES in public spending is higher than the household's IIES in private consumption. If $\vartheta = 0$, the government derives no utility from private consumption—at least *not directly*: there is still, by design, a feedback loop through investment and taxation. This incidentally replicates the standard models found in the literature, although one major difference between this chapter and most of the existing literature is the optimizing behavior for the government. By contrast, for instance, Futagami et al. (2008) only have a debt ceiling rule, but I can still obtain a very similar setup to theirs by

[20]The derivative $\frac{\partial c^\star}{\partial \gamma^\star} = \frac{[\theta-(1-\tau)a](1-a)A-\theta g^{\star a}}{(1-\tau)(1-a)aA}$ is positive if and only if $\left(\frac{\phi+\delta+\xi^{-1}(\varphi-\phi)\theta}{(1-\tau)aA}\right)^{\frac{a}{1-a}} < \frac{\theta-(1-\tau)a}{\theta}(1-a)A$.

imposing that the government has the same discount factor as private agents (*i.e.*, $\phi = \varphi$).[21] In this case, I find like them that $b^\star = \frac{\tau A g^{\star 1-a} - g^\star}{\phi}$; but since $\gamma^\star(\theta - \varsigma) = 0$, I would need to impose also $\theta = \varsigma$ to ensure that the economy is growing. In a more general case, when the two agents have different preferences for the present, I get $\gamma^\star = \frac{\phi - \varphi}{\varsigma - \theta}$. The most impatient of the two agents needs a larger utility from her own consumption for growth to be positive. And, indeed, public spending $g^\star = \left(\frac{\phi + \delta + \theta\gamma^\star}{(1-\tau)aA}\right)^{\frac{1}{1-a}}$ is larger the larger θ.

4.5 Role of the endogenous spread

In this section, I return to the general formulation where households derive utility from owning private capital, dropping Assumption 4 (but maintaining Assumptions 1–3). Consequently, they are more willing to smooth out consumption over time to undertake investment, and make spendthrift governments pay more interests.[22] To solve the system, I first use (4.18b) to express growth as a function of public spending:

$$\gamma^\star = \frac{(1-\tau)aAg^{\star 1-a} - \phi - \delta}{\theta} \tag{4.23a}$$

I denote $\varpi \equiv \frac{(\vartheta - \varsigma)(\phi + \delta) + \theta(\varphi + \delta)}{\xi a A (1-\tau)}$ and derive from equations (4.18a)–(4.18c) two expressions for consumption as a function of $g^\star$:

$$c^\star = c_1(g^\star) \equiv \left(\frac{(1-\tau)aA}{\kappa\theta}\right)^{1/\theta} \left[\xi\varpi - \xi g^{\star 1-a}\right]^{1/\theta} \tag{4.23b}$$

$$= c_2(g^\star) \equiv \frac{A\left(\theta - (1-\tau)a\right)}{\theta} g^{\star 1-a} - g^\star + \frac{\phi + \delta(1-\theta)}{\theta} \tag{4.23c}$$

$\varpi^{1/1-a}$ thus appears as the *maximum* admissible value for $g^\star$.[23] Looking at the previous equations, it may seem like the government's preference parameters play but a minor role compared with the consumer's. Yet, they are embedded in ϖ and ξ—in particular, $aA(1-\tau)\varpi = \frac{(\vartheta - \varsigma)(\phi + \delta) + \theta(\varphi + \delta)}{\xi}$ is a centroid of $\phi + \delta$ and $\varphi + \delta$, with weights corresponding to the marginal utilities of the government and the household. In other words, ϖ represents the overall selfishness of the two agents. Once the control variables $c^\star,\ g^\star$ are chosen, public debt stems easily:

$$b^\star = \frac{\tau A g^{\star 1-a} - g^\star}{\varphi - \gamma^\star(1 + \vartheta - \varsigma)} = \frac{\tau A g^{\star 1-a} - g^\star}{\varphi - \frac{(1-\tau)aAg^{\star 1-a} - \phi - \delta}{\theta}(1 + \vartheta - \varsigma)} \tag{4.23d}$$

---

[21] Futagami et al. (2008) use a logarithmic utility function for households: $\mathcal{U}_c = \int_0^\infty \ln C_t e^{-\phi t} dt$, which I can exactly reproduce by doing $\theta \to 1$. Appendix 4.C examines the logarithmic case in further details.

[22] At the steady state, the spread $\chi^\star = \phi - \varphi + \xi\frac{(1-\tau)aAg^{\star 1-a} - \phi - \delta}{\theta}$ is growing with the level of public spending.

[23] One can recognize that $\varpi^{1/1-a}$ is the steady state I found in the previous section, in absence of the spread κ.

The necessary condition for the economy to grow in the steady state is that $g^{\star 1-a}$ be larger than $h_0 \equiv \frac{\phi+\delta}{(1-\tau)aA} < \varpi$. This means that not only the government cannot be atrophied ($g^\star = 0$ generally failing to satisfy equations (4.23b) and (4.23c) simultaneously), but also it ought to play a significant enough role in the economy. This comes directly from the fact that public spending contributes to factor productivity in equation (4.1).

Proposition 2 (Multiplicity)**.** *Let* $\varpi = \frac{(\vartheta-\varsigma)(\phi+\delta)+\theta(\varphi+\delta)}{\xi aA(1-\tau)}$. *Under Assumptions 1–3, the system* (4.23) *admits at most two solutions. Furthermore, there exist critical values* $\underline{\varpi} > 0$, $0 < \underline{\kappa} < \overline{\kappa}$, *and* $\hat{\varphi} > \phi$ *such that the following is true:*

(a) If $\kappa > \overline{\kappa}$ *and* $\varpi < \underline{\varpi}$, *there is no stationary solution (Figure 4.2b).*

(b) If $\kappa > \overline{\kappa}$ *and* $\varpi > \underline{\varpi}$, *there is one stationary solution,* $\overline{g}^\star$, *such that* $c_2'(\overline{g}^\star) < c_1'(\overline{g}^\star)$, *which is associated with positive growth* $\overline{\gamma}^\star$ *provided that* $\varphi < \hat{\varphi}$ *(Figure 4.2d).*

(c) If $\kappa < \overline{\kappa}$ *and* $\varpi < \underline{\varpi}$, *there is one stationary solution,* $\underline{g}^\star$, *such that* $c_2'(\underline{g}^\star) > c_1'(\underline{g}^\star)$, *which is associated with positive growth* $\overline{\gamma}^\star$ *provided that* $\varphi > \hat{\varphi}$ *(Figure 4.2c).*

(d) When $\kappa < \overline{\kappa}$ *and* $\varpi > \underline{\varpi}$, *there are either no (Figure 4.2a) or two solutions (Figure 4.2e). A necessary and sufficient condition for two steady states to co-exist is that* $\kappa > \underline{\kappa}$. *In such as case, I denote* $0 < \underline{g}^\star < \overline{g}^\star < \varpi^{\frac{1}{1-a}}$ *the two steady states and* $\forall x \in \{c, b, \gamma, \chi\}$, $\underline{x}^\star$, $\overline{x}^\star$ *the associated variables. Imposing* $\varphi > \hat{\varphi}$ *ensures that the economy grows in both steady states. The lower (*i.e., *less intensive in public spending) steady state is richer in private consumption than the higher one (*$\underline{c}^\star > \overline{c}^\star$*) but grows more slowly (*$\underline{\gamma}^\star < \overline{\gamma}^\star$*) and carries more debt (*$\underline{b}^\star > \overline{b}^\star$*).*

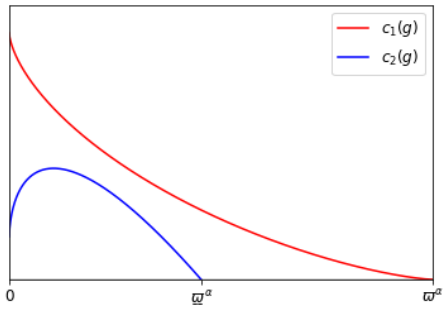
Last, if $\varpi < (\tau A)^{1/a}$, *the government runs a primary surplus in all existing steady states.*

■ *Proof of Proposition 2.* To simplify the calculus, I define $C_1(h) \equiv S\left[\varpi - h\right]^{1/\theta}$; $C_2(h) \equiv \frac{AW}{\theta}h - h^{\frac{1}{1-a}} + V$; $V \equiv \frac{\phi+\delta(1-\theta)}{\theta}$; $W \equiv \theta - (1-\tau)a$; and $S \equiv \left(\frac{(1-\tau)aA\xi}{\kappa\theta}\right)^{1/\theta}$. The system (4.23b–4.23c) is then equivalent to $c^\star = C_1(g^{\star 1-a}) = C_2(g^{\star 1-a})$. Since $g \mapsto g^{1-a}$ is a one-to-one transformation of $\mathbb{R}_+$, the number of balanced growth paths equals that of intersections between $C_1(\cdot)$ and $C_2(\cdot)$.

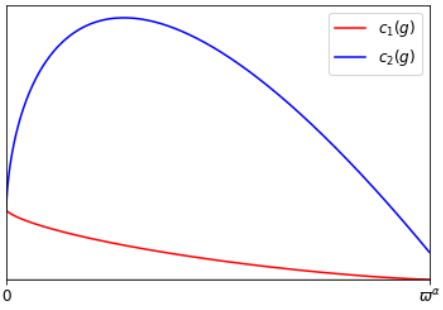
The function C_1 is defined, positive, decreasing, convex, and C^∞ on $]0\,;\,\varpi[$, with $C_1(0) > 0$ and $C_1(\varpi) = 0$ (Figure 4.2). Besides, since $W > 0$ under Assumption 1, C_2 is concave, increasing on the interval $[0\,;\,h_2']$, with $h_2' \equiv \left(\frac{AW(1-a)}{\theta}\right)^{\frac{1-a}{a}}$, and decreasing thereafter, thereby admitting $C_2(h_2') = \frac{a}{1-a}\left(\frac{AW(1-a)}{\theta}\right)^{\frac{1}{a}} + V$ as its global *maximum*. Because $C_2(0) = V > 0$ and $\lim_{+\infty} C_2 = -\infty$, C_2 admits a unique zero $\underline{\varpi} > h_2'$, which constitutes an upper bound to the set of acceptable solutions, since negative levels of private consumption are of no interest to this chapter.

Figure 4.2. *Possible configurations for the two characteristic functions*

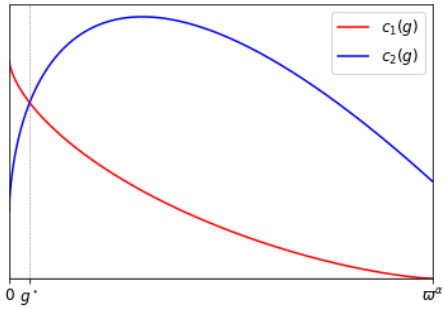
(a) c_1 above c_2



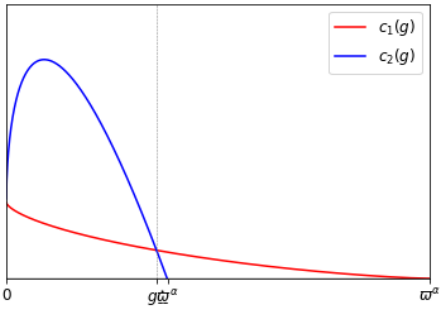
(b) c_2 above c_1



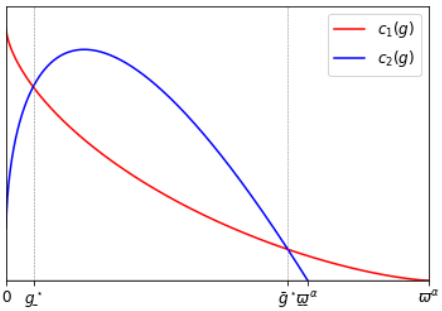
(c) Unique steady state with $c_2'(g^\star) > c_1'(g^\star)$



(d) Unique steady state with $c_2'(g^\star) < c_1'(g^\star)$



(e) Dual steady states



Note: The exponent α is defined as $\alpha \equiv \frac{1}{1-a}$.

Existence of steady states. The difference $C_1 - C_2$ is a strictly convex function. This in itself proves that there cannot be more than two stationary solutions. If $C_1(0) < C_2(0)$ and $C_1(\varpi) = 0 < C_2(\varpi)$, there is none. Posing:

$$\overline{\kappa} \equiv \frac{(\vartheta - \varsigma)(\phi + \delta) + \theta(\varphi + \delta)}{\theta} \left[\frac{\theta}{\phi + \delta(1-\theta)}\right]^{\theta} \tag{4.24}$$

the former is equivalent to $\kappa > \overline{\kappa}$, and the latter to $\varpi < \underline{\varpi}$. If $\kappa < \overline{\kappa}$ and $\varpi < \underline{\varpi}$, or else if $\kappa > \overline{\kappa}$ and $\varpi > \underline{\varpi}$, $C_1(\cdot)$ and $C_2(\cdot)$ cross each other only once, and there is a unique solution.

Let me assume now that $\kappa < \overline{\kappa}$ and $\varpi > \underline{\varpi}$. Either C_1 remains above C_2 $\forall h \in [0\,;\,\varpi]$, or they cross twice.[24] Since $C_1'(0) < C_2'(0)$ (from Assumption 1) and $C_1'(\varpi) = 0 > C_2'(\varpi)$ (from $\varpi > \underline{\varpi} > h_2'$), $C_1 - C_2$ is continuous, decreases between 0 and a certain $\tilde{h} > h_2'$, and increases on $\left[\tilde{h}\,;\,\varpi\right]$. Hence, there are exactly two solutions to $C_1(h) = C_2(h)$ if and only if $C_1(\tilde{h}) < C_2(\tilde{h})$. At this stage, I need to step back and explicit the dependence of all these entities on the parameter κ: $\tilde{h}(\kappa)$ is the unique h such that $C_1'(\tilde{h}(\kappa), \kappa) = C_2'(\tilde{h}(\kappa))$ and I am looking for a discriminating criterion for $\nu(\kappa) = C_1(\tilde{h}(\kappa), \kappa) - C_2(\tilde{h}(\kappa)) \lessgtr 0$. Because $\forall 0 < \kappa < \overline{\kappa}$, $\nu'(\kappa) = \frac{\partial C_1}{\partial \kappa}(\tilde{h}(\kappa)) + \frac{\partial \tilde{h}}{\partial \kappa}\left[C_1'(\tilde{h}(\kappa)) - C_2'(\tilde{h}(\kappa))\right] = \frac{\partial C_1}{\partial \kappa}(\tilde{h}(\kappa)) < 0$, there is a unique $\underline{\kappa} \in]0\,;\,\overline{\kappa}[$ such that $\forall \kappa \in]0\,;\,\overline{\kappa}[\,,\ \nu(\kappa) < 0 \iff \kappa > \underline{\kappa}$.

Positive growth. Owing to equation (4.23a), I want to make sure that any steady state be such that $g^{\star 1-a} < h_0 = \frac{\phi+\delta}{(1-\tau)aA} < \varpi$. I first study cases such that there is a *low* steady state such that $c_1'(\underline{g}^\star) < c_2'(\underline{g}^\star)$ (this happens when $\kappa < \overline{\kappa}$ and $\varpi < \underline{\varpi}$, or else when $\underline{\kappa} < \kappa < \overline{\kappa}$ and $\varpi > \underline{\varpi}$). That low steady state is higher than $h_0^{\frac{1}{1-a}}$ if and only if $C_1(h_0) > C_2(h_0)$ and $C_1'(h_0) < C_2'(h_0)$, the second condition being superfluous in the case of a single steady state—it might help to refer to Figure 4.2 to better visualize. Given that $C_1(h_0) = \left(\frac{\varphi-\phi}{\kappa}\right)^{1/\theta}$ and $C_2(h_0) = \frac{\phi+\delta}{(1-\tau)a} - \delta - h_0^{\frac{1}{1-a}}$, the inequality $C_1(h_0) > C_2(h_0)$ is equivalent to $\varphi > \hat{\varphi}$, with:

$$\hat{\varphi} \equiv \phi + \kappa \left[\frac{\phi+\delta}{(1-\tau)a} - \delta - \left(\frac{\phi+\delta}{(1-\tau)aA}\right)^{\frac{1}{1-a}}\right]^{\theta}$$

Meanwhile, under Assumption 2, $C_1'(h_0) < C_2'(h_0)$ is equivalent to $\varphi > \underline{\varphi}$, with:

$$\underline{\varphi} \equiv \phi + \kappa^{\frac{1}{1-\theta}} \left[\frac{\max\left\{0;\ \theta^2\left(\frac{\phi+\delta}{(1-\tau)aA}\right)^{\frac{a}{1-a}} - A(1-a)\theta^2 + (1-\tau)(1-a)a\theta\right\}}{(1-\tau)(1-a)aA\xi}\right]^{\frac{\theta}{1-\theta}}$$

However, this second condition is superfluous as $\hat{\varphi} > \underline{\varphi}$. Indeed, when $\underline{\varphi}$ is strictly larger than ϕ, it is such that if $\varphi = \underline{\varphi}$, $C_1'(h_0) = C_2'(h_0)$, so $\underline{g}^{\star 1-a} < h_0$ ($< \overline{g}^{\star 1-a}$ when the latter is defined); consequently, $C_1(h_0) < C_2(h_0)$, which proves that $\underline{\varphi} < \hat{\varphi}$. Now, when there is only a *high* steady state $\overline{g}^\star$(*i.e.*, when $\kappa < \overline{\kappa}$ and $\varpi < \underline{\varpi}$), $C_1(h_0) - C_2(h_0)$ has to be negative for h_0 to be lower than $\overline{g}^{\star 1-a}$, or equivalently, $\varphi < \hat{\varphi}$.

[24] Technically, there is a rare, tangent case, too, with the two functions touching only once without crossing.

Compatibility of the various conditions. One can notice that $\varphi > \hat{\varphi} \iff \kappa > \hat{\kappa}$ with $\hat{\kappa} \equiv (\varphi - \phi)\left[\frac{\phi+\delta}{(1-\tau)a} - \delta - \left(\frac{\phi+\delta}{(1-\tau)aA}\right)^{\frac{1}{1-a}}\right]^{-\theta}$. Assume $\kappa = \hat{\kappa}$, meaning that $C_1(h_0) = C_2(h_0)$—in other words, $h_0^{1/(1-a)} \in \left\{\underline{g}^\star, \overline{g}^\star\right\}$. If h_0 corresponds to the low steady state, then necessarily $C_1(0) < C_2(0)$—meaning that $\kappa = \hat{\kappa} < \overline{\kappa}$ (since $\overline{\kappa}$ is the lowest κ such that $C_1(0) \geq C_2(0)$). Plus, h_0 has to be smaller than $\tilde{h}$, hence $C_1(\tilde{h}) < C_2(\tilde{h})$ by Rolle's theorem—meaning that $\hat{\kappa} > \underline{\kappa}$ (since $\underline{\kappa}$ is the biggest κ such that $C_1(\tilde{h}) \geq C_2(\tilde{h})$). On the other, hand, if h_0 is the high steady state, $C_1(\tilde{h}) < C_2(\tilde{h})$—meaning $\hat{\kappa} > \underline{\kappa}$ as well.

Characteristics of the steady states. In all cases, the primary balance $\tau A g^{1-a} - g$ is a surplus at the steady state as soon as $g^\star < (\tau A)^{1/a}$; since $g^\star < \varpi^{1/1-a}$, $\varpi < (\tau A)^{1/a-1}$ is a sufficient condition. Since $c_1(\cdot)$ is decreasing, it comes immediately that, when there are two steady states, $\underline{c}^\star = c_1(\underline{g}^\star) > c_1(\overline{g}^\star) = \overline{c}^\star$. Besides, $\frac{\partial \gamma^\star}{\partial g^\star} > 0$ from equation (4.23a), so the high steady state is associated with more growth. Last, equation (4.23d) yields that the sign of $\frac{\partial b^\star}{\partial g^\star}$ is the same as $(\theta\varphi + (\phi+\delta)(1+\vartheta-\varsigma))[\tau A(1-a)g^{\star -a} - 1] + (1-\tau)a^2 A(1+\vartheta-\varsigma)g^{\star 1-a}$, which is positive under realistic choices of parameters.[25] *QED.* ■

The multiplicity of equilibria stems from the interference of the concurrent maximization programs of two uncooperative agents. First, agents have direct and indirect externalities on each other. On top of the explicit externality from household's consumption decisions in the government's utility function (quantified by ϑ), public spending and investment contribute to growth, with a feedback effect on the satisfaction of both agents—through disposable income and tax revenue. Second, the spirit of capitalism distorts the allocation of savings between sovereign bonds and investment—households do not have access to loans and only have those two assets at their disposal to smooth out their consumption. Because of the household's preference for capital, these two assets are imperfect substitutes, giving rise to an interest rate spread.

More precisely, multiplicity comes mostly from the tradeoff in the consumer's maximization program between consuming and accruing capital, while only the latter has a positive impact on production and tax revenues. Schematically, since both consumption and capital appear in their utility function, households can at each period trade off consumption against investment (especially when κ is sufficiently large). But these two decisions have different intertemporal implications: consumption crowds out productive public spending, while investment fosters more taxable income in the future and lowers sovereign yields. In parallel, at a given time t, the government can accept to spend less if households consume sufficiently more; but here again, this is not equivalent on an intertemporal basis (as consumption is less useful for future growth).

[25] Indeed, $\frac{\partial b^\star}{\partial g^\star}$ is a U-shaped function of $g^\star$; it suffices that it be positive at its minimum, which leads to the following condition: $\theta\varphi + (\phi+\delta)(1+\vartheta-\varsigma) < A^{\frac{1}{a}}(1+\vartheta-\varsigma)(1-\tau)a\tau^{\frac{1-a}{a}}$, which is in general true.

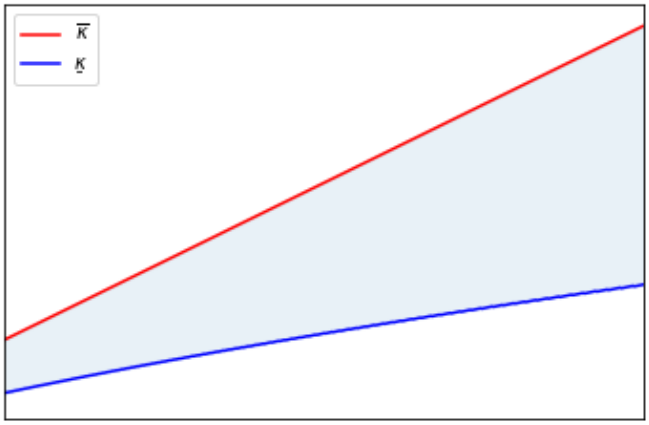
This multiplicity of stationary states could lead to indeterminacy, as each agent may expect the other to settle on either balanced growth path. Starting close to the *low* equilibrium (*i.e.*, with lower public expenditure), assume for instance that households expect an increase in public spending, thus an increase in output growth. Because of their financing constraint, they need to decide whether to cut consumption or investment. Since they not only expect the return on their investment to allow them to consume more in the future, but also get a direct satisfaction from owning capital, they are then more inclined to save and invest, rather than consume—fueling future growth further, as well as prospects for tax revenue. As a result, the larger public spending can be sustained.

I find that the multiplicity of balanced growth paths in the model hinges on three main elements. First, Proposition 2 highlights the primordial role of the sensitivity κ of the spread $\chi^\star$ to households' choices (deriving from their appetite for capital), If κ is too small, the multiplicity is not ensured; neither is it when it is too large. If households get a strong utility from owning capital, they charge a prohibitive interest rate on sovereign bonds; yet, in parallel, the economy grows faster, and, because households value consumption relatively less, the government ends up in the high public spending equilibrium. Conversely, if they do not attach so much direct value to capital, they generate less growth, and the competition between the government's and household's preferences prevents the existence of any steady state (provided that $\varpi < \underline{\varpi}$). This is what happened in Section 4.4. The spread is thus an artefact enabling households to make their voices heard, which leads to the emergence of a low public spending steady state.

Second, the steady state growth rate depends on how much more impatient the government is relative to households, similarly to section 4.4. More precisely, for the economy to admit a stationary path with positive growth, the government needs to be sufficiently impatient (especially when the spirit of capitalism κ is strong), but not excessively.

The third condition on ϖ, is subtler; it requires ϖ to be larger than a certain threshold, which means that the government's preference for the present and for its spending should be relatively strong compared with consumers' inclination. Note that $\underline{\varpi}$ is implicitly defined by the function $c_2(\cdot)$; therefore, it depends only on the household's IIES and discount rate and the broad structure of the economy (a, A, δ) and the tax rate. As a result, the condition $\varpi > \underline{\varpi}$ is one about the government's parameters—for instance, it can be seen as a lower bound on its discount rate φ: the government needs to be sufficiently more impatient than households. Surprisingly, the externality ϑ from private consumption on the government's utility does not play such a determinant role—it intervenes only through the government's marginal utility $\vartheta - \varsigma$. As a matter of fact, it is not indispensable to the multiplicity of equilibria, as the following corollary proves.

Figure 4.3. *Wealth utility factors κ that ensure multiplicity when varies the private consumption externality ϑ on the government's utility*



Note: The shaded area represents the possible values of κ, delimited by $\overline{\kappa}$ and $\underline{\kappa}$ from Proposition 2.

Corollary 1. *Even absent the externality ($\vartheta = 0$), there can be multiple equilibria, even though in rarer cases. Namely, the interval of admissible κ is narrower the smaller ϑ, as illustrated on Figure 4.3. Appendix 4.F provides some calibration examples.*

■ *Proof of Corollary 1.* As ϑ decreases, ϖ becomes higher—this is intuitive as the latter quantifies the total degree of selfishness in the economy; thus, it is easier to satisfy $\varpi > \underline{\varpi}$ in Proposition 2, since the threshold does not depend on ϑ. From equation (4.24), the smaller ϑ, the lower $\overline{\kappa}$. More precisely (owing to the fact that $C_1(0)|_{\underline{\kappa}} = C_2(0)|_{\underline{\kappa}} = \frac{\phi+\delta(1-\theta)}{\theta}$, by the very definition of $\underline{\kappa}$):

$$\frac{\partial \overline{\kappa}}{\partial \vartheta} = \frac{\phi+\delta}{\theta}\, C_1^{-\theta}(0)\big|_{\underline{\kappa}} > 0$$

Similarly, using the implicit definitions of $\tilde{h}$ and $\underline{\kappa}$ given in the proof of Proposition 2 and the implicit function theorem, I find that $\frac{\partial \underline{\kappa}}{\partial \vartheta} = \frac{-\partial \nu/\partial \vartheta|_{\kappa=\underline{\kappa}}}{\nu'(\underline{\kappa})} = \frac{-\partial C_1/\partial \vartheta|_{h=\tilde{h}(\underline{\kappa})}}{\nu'(\underline{\kappa})} > 0$; in other words, $\underline{\kappa}$ is also lower, the smaller the externality. After replacing ν The exact derivative is as follows:

$$\frac{\partial \underline{\kappa}}{\partial \vartheta} = \frac{\phi+\delta-a(1-\tau)A\tilde{h}(\overline{\kappa})}{\theta}\, C_1^{-\theta}(\tilde{h}(\kappa))\Big|_{\overline{\kappa}} > 0$$

The size of the band in which κ needs to reside for the model to admit two solutions reduces, too. More precisely, the partial derivative of the ratio $\overline{\kappa}/\underline{\kappa}$ with respect to ϑ is positive. Indeed, for the difference of growth rates to be positive:

$$\frac{1}{\overline{\kappa}}\frac{\partial \overline{\kappa}}{\partial \vartheta} > \frac{1}{\underline{\kappa}}\frac{\partial \underline{\kappa}}{\partial \vartheta} \iff \frac{\phi+\delta-a(1-\tau)A\tilde{h}(\overline{\kappa})}{\varpi-\tilde{h}(\overline{\kappa})} > \frac{\phi+\delta}{\varpi}$$

it suffices that $\phi+\delta$ be greater than $a(1-\tau)A\varpi$, which can comes immediate, as $a(1-\tau)A\varpi$ is a centroid of $\phi+\delta$ and $\varphi+\delta$. *QED.* ■

Even though the externality ϑ is not essential, it makes multiplicity more likely. It is because the externality makes the government more ambivalent in its choices than when it only pursues its own spending. Eventually, what underpins the existence of multiple equilibria in this model is the interplay between the two agents through the spread χ and their distinct goals, and their relative impatience. Incidentally, I could also choose a logarithmic utility from consumption (*i.e.*, set $\theta \to 1$) and still get multiple equilibria (a proof is provided in appendix 4.C.

The remainder of this section investigates how changes in preference parameters move the steady state(s), with an illustration on Figure 4.5.

Proposition 3 (Comparative statics)**.** *Under the same assumptions as Proposition 2, the following results hold:*

(a) The balanced growth path the more intensive in public spending contains even more public spending:

- *when the government's impatience φ or its* IIES *ς decrease;*
- *when the externality ϑ, the households' impatience ϕ, their taste for capital ownership κ, the tax rate τ, or the total factor productivity A increase.*

(b) The lower balanced growth path $\underline{g}^\star$ behaves symmetrically; factors that increase the high balanced growth path also push the two stationary paths further apart.

(c) Growth in the high steady state $\overline{\gamma}^\star$ increases when ϑ or κ increase or when ς or φ decrease; but this makes consumption $\overline{c}^\star$ shrink.

(d) Growth in the high steady state $\underline{\gamma}^\star$ increases when ϑ, κ, τ, or ϕ decrease or when ς or φ increase; the impact on $\underline{c}^\star$ depends on whether $c_2'(\underline{g}^\star) \lessgtr 0$.

■ *Proof of Proposition 3.* Since all the functions involved are sufficiently smooth, I can invoke the implicit function theorem to assess how the balanced growth paths $g^\star$, defined by $c_1(g^\star) = c_2(g^\star)$, respond to a change in a given parameter x: $\frac{\partial g^\star}{\partial x} = \frac{-\partial(c_1-c_2)/\partial x}{\partial(c_1-c_2)/\partial g}\Big|_{g=g^\star}$. Since Proposition 2 proved the denominator is positive for the high balanced growth path, and negative for the low balanced growth path, a factor that pushes one up drives the other one down. All the partial derivatives involved are computed in Table 4.2; this is enough to prove the assertions (a) and (b) in the proposition. Regarding the influence of a change in parameters on $c^\star$ and $\gamma^\star$, I rely on equations (4.23a) and (4.23c), respectively (see Table 4.3). The issue is that, while $c_2'(\overline{g}^\star)$ is necessarily negative, the sign of $c_2'(\underline{g}^\star)$ is unknown *a priori*. ■

While distinct government preferences are at the foundation of multiplicity, I find that stronger preferences—when the government is more impatient (relative to households) or has a stronger

IIES—tend to make the two steady state converge towards each other. Eventually, when there is too much tension between the two maximization programs, the multiplicity is rescinded.

This shows that putting in place fiscal institutions to dull government's impatience and steer the economy to the preferred steady state might have the opposite effect. What Proposition 3 shows is that a less impatient government might spend even more, unless its impatience changes enough to get the economy out of the situation of multiplicity. The same goes for institutions intended to increase policymakers' preference for private over public consumption.

4.6 Dynamics

In this section, I examine the dynamic stability of the steady states found with Proposition 2. The dynamic system of equations (4.16) can be reduced to a three-dimensional autonomous system with respect to c_t, g_t, and b_t, the latter being predetermined:

$$\dot{c}_t = L(c_t, g_t)c_t \tag{4.25a}$$
$$\dot{g}_t = M(c_t, g_t)g_t \tag{4.25b}$$
$$\dot{b}_t = g_t - \tau A g_t^{1-a} + N(c_t, g_t)b_t \tag{4.25c}$$

where $L(\cdot), M(\cdot), N(\cdot)$ are defined as follows:

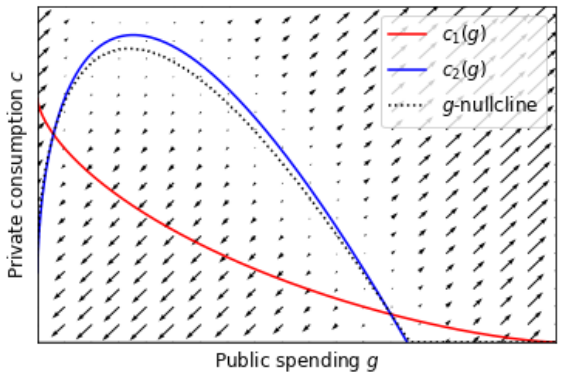
$$L(c,g) \equiv g + c + \left[\frac{(1-\tau)a}{\theta} - 1\right] Ag^{1-a} - \frac{\phi + (1-\theta)\delta}{\theta}$$
$$M(c,g) \equiv L(c,g) + \frac{1}{\varsigma}\left[\kappa c^{\theta} + \frac{\xi(1-\tau)Ag^{1-a}}{\theta} - \varphi + \phi - \frac{\xi(\delta+\phi)}{\theta}\right] Ag^{1-a}$$
$$N(c,g) \equiv g + c + \kappa c^{\theta} - (1 - a + a\tau)Ag^{1-a}$$

The three equations (4.25) formulate an autonomous dynamic system with respect to the two forward-looking, control variables c_t and g_t and the predetermined state variable b_t. The evolution over time of these three variables determine the entire paths of all endogenous variables, for a given size and composition of balance sheets (K_0, B_0). For reference, the growth rate of the economy is simply $\gamma_t = Ag_t^{1-a} - \delta - g_t - c_t$.

The dynamic adjustment of b_t is always unstable. By contrast, papers relying on some sort of debt anchor (either a cap on indebtedness or a debt objective) find that debt is associated with stable local dynamics Futagami et al. (2008). As a matter of fact, the very nature of debt dynamics generates divergent paths, unless the economy starts at the debt-stabilizing primary balance.

What drives the dynamics for private consumption and public expenditure is the spread and the market clearance condition on the product market. The first equation in system (4.25) says

Figure 4.4. *Phase diagram in the two steady state case*



Note: The arrows indicate the dynamics in the various regions of the (g, c) plan. The dotted line is the g-nullcline where $\dot{g} = 0$, while the c-nullcline is the blue line $c = c_2(g)$.

that $\frac{\dot{c}}{c} = c - c_2(g)$.[26] It means that consumption grows whenever it is above $c_2(g)$, which comes from the market clearance condition once public spending and investment have been determined. Besides, $\frac{\dot{g}}{g} = \frac{\dot{c}}{c} + \frac{\kappa}{\varsigma}(c^\theta - c_1^\theta(g))$; public spending grows when consumption is higher than both $c_1(g)$ and $c_2(g)$ and shrinks whenever consumption is smaller than both $c_1(g)$ and $c_2(g)$. The g-nullcline is the locus defined by $c + \frac{\kappa}{\varsigma}c^\theta = c_2(g) + \frac{\kappa}{\varsigma}(c^\theta - c_1^\theta(g))$, which is located between the c_1 and c_2 curves (closer to one or the other depending on the strength of household's appetite for investment and the government's IIES in spending), as illustrated on Figure 4.4. The function $c_1(\cdot)$ comes from the endogenous spread functional form $\chi = -\kappa c^\theta$, so $c > c_1(g)$ signifies that the spread is too small compared with fundamentals; intuitively, public spending tends to grow more than consumption when the spread is small. The fact that $c - c_2(g)$ boosts both control variables shows how the government and households compete for any slack in the product market.

Proposition 4. *In the context of Proposition 2, all possible steady states are hyperbolic. Moreover:*

(a) If $\kappa > \overline{\kappa}$ and $\varpi > \underline{\varpi}$, the unique stationary path $\overline{g}^\star$ is a locally determinate saddle-point.

(b) If $\kappa < \overline{\kappa}$ and $\varpi < \underline{\varpi}$, the unique stationary path $\underline{g}^\star$ is an unstable node (a source).

[26] As a reminder, $c_1(\cdot), c_2(\cdot)$ have been defined in equations (4.23b) and (4.23c).

(c) If $\kappa \in]\underline{\kappa}\,;\,\overline{\kappa}[$ and $\varpi > \underline{\varpi}$ the two stationary paths have distinct local dynamic properties: the lower steady state $\underline{g}^\star$ is unstable and the higher $\overline{g}^\star$ is a saddle.

■ *Proof of Proposition 4.* Classically, the local stability properties of a given steady state are determined looking at the sign of the (real parts of the) eigenvalues associated to the Jacobian matrix of system (4.25), which is:

$$\mathcal{J}(g) = \begin{pmatrix} \frac{\partial L}{\partial c}c + L & \frac{\partial L}{\partial g}c & 0 \\ \frac{\partial M}{\partial c}g & \frac{\partial M}{\partial g}g + M & 0 \\ \frac{\partial N}{\partial c}b & 1 - \tau(1-a)Ag^{-a} + \frac{\partial N}{\partial g}b & N \end{pmatrix} \tag{4.26}$$

There is an obvious eigenvalue associated with the debt ratio. At the steady state, it can be expressed thanks to equation (4.18d) as: $N(c^\star, g^\star) = \frac{\tau A {g^\star}^{1-a} - g^\star}{b^\star} = N^\star \equiv \varphi - (1 + \vartheta - \varsigma)\gamma^\star$. It has to be positive for the transversality condition (4.17) to hold.

For the other two eigenvalues, I focus on the upper-left 2×2 sub-matrix of $\mathcal{J}(g)$, which I call $\tilde{\mathcal{J}}(g)$. I notice that $L(c,g) = c - c_2(g)$ and $M(c,g) = c - c_2(g) + \frac{\kappa}{\varsigma}\left(c^\theta - (c_1(g))^\theta\right)$ and remember the balanced growth path equations (4.18), in order to express the sub-Jacobian evaluated at a steady state as follows:[27]:

$$\tilde{\mathcal{J}}(g^\star) = \begin{pmatrix} c^\star & -c_2'(g^\star)c^\star \\ g^\star + \frac{\kappa\theta}{\varsigma}g^\star {c^\star}^{\theta-1} & -c_2'(g^\star)g^\star - \frac{\kappa\theta}{\varsigma}c_1'(g^\star)g^\star {c^\star}^{\theta-1} \end{pmatrix} \tag{4.27}$$

The characteristic polynomial is: $\tilde{p}(X) \equiv \det(X\mathbb{I}_2 - \tilde{\mathcal{J}}) = X^2 - \operatorname{Tr}\tilde{\mathcal{J}}X + \det\tilde{\mathcal{J}}$. The trace of the sub-Jacobian matrix equates the sum of its two eigenvalues, which appears to always be positive, indicating that at least one of the eigenvalues is positive:

$$\operatorname{Tr}\tilde{\mathcal{J}}(g^\star) = c^\star - c_2'(g^\star)g^\star - \frac{\kappa\theta}{\varsigma}c_1'(g^\star)g^\star {c^\star}^{\theta-1} \tag{4.28}$$

$$= \frac{\phi + (1-\theta)\delta}{\theta} + \frac{aA{g^\star}^{1-a}}{\theta}\left[\theta - (1-\tau)a + \frac{(1-\tau)(1-a)\xi}{\varsigma}\right] > 0 \tag{4.29}$$

And the product of the two eigenvalues is:

$$\det\tilde{\mathcal{J}}(g^\star) = \frac{\kappa\theta}{\varsigma}g^\star {c^\star}^\theta \left\{c_2'(g^\star) - c_1'(g^\star)\right\} \tag{4.30}$$

Recall now the topology of the two curves C_1 and C_2 in the proof of Proposition 2 (and on Figure 4.2). It comes immediately that $\det\tilde{\mathcal{J}}(\underline{g}^\star) > 0$ while $\det\tilde{\mathcal{J}}(\overline{g}^\star) < 0$.

In sum, none of the three eigenvalues of $\mathcal{J}$ has a zero real part at the steady state. At the lower steady state $\underline{g}^\star$, the Jacobian matrix has one positive eigenvalue and two eigenvalues whose real parts are positive; therefore, the lower steady state is unstable.[28] By contrast, at the higher

[27] Since all other steady state variables are function of $g^\star$ in system (4.18), I simply call $g^\star$ the corresponding steady state.

[28] It is an unstable node or focus-node, depending on whether the roots are all real or not.

steady state $\overline{g}^\star$, all three eigenvalues are real and two out of three are positive—this is a saddle point.[29] ■

The local dynamics of this model are locally determinate. Proposition 4 shows that there is no sink: no steady state is able to attract all trajectories that come into its neighborhood in the (c, g) plane—which would be necessary for local indeterminacy, given that public debt dynamics are locally unstable. Instead, the steady state with low public spending is a repeller, while the high steady state is a saddle-point (with a stable manifold of dimension 1). Therefore, While the steady state multiplicity found in last section opened the door to indeterminacy, dynamic trajectories that respect the positivity and transversality constraints (under rational expectations) necessarily follow the same path that leads to the high steady state $\overline{g}^\star$. Starting points outside of this trajectory would generate divergent trajectories.

This is somewhat similar to a poverty trap mechanism *à la* Kurz (1968b): no matter the initial intentions of the government, the economy is more likely to move away from the low public spending and high consumption steady state, and fall into a steady state with a large government size. Luckily, this also ensures that the economy grows faster, because large public spending forces consumers to save (hence invest) more.

Why should the government and households fail to coordinate on the high consumption steady state? Starting on the low balanced growth path, assume private agents expect a future increase in public spending or that a shock puts the economy off the steady state. Since public expenditure crowds out household's spending, households decide to smooth out their consumption plan over time, which has two effects: (a) it lowers the sovereign bond spread and (b) it brings out more savings which households invest in productive capital—promise of growth (and future tax revenue). Both of these effects in turn opens up more fiscal space: the government can indeed spend more. This is sustainable, owing to the multiplier effect of government spending on growth, which makes it possible to finance a larger level of public debt. From the government's perspective, if policymakers expect households to cut consumption to finance more investment, they will be able to bank on the associated stream of future tax revenues to increase immediately public expenditure (any debt sustainability analysis is based on medium-term macro-fiscal projections). This is even more true than the cut in consumption would otherwise mean a slight decrease in government utility, due to the externality.

[29] To know whether the dynamical properties of the lower steady state are an unstable node or an unstable focus-node with oscillations, I compute the discriminant:

$$\Delta = \left[c^\star - c_2'(g^\star)g^\star - \frac{\kappa\theta}{\varsigma}c_1'(g^\star)g^\star c^{\star\theta-1}\right]^2 - 4\frac{\kappa\theta}{\varsigma}g^\star c^{\star\theta}\left\{c_2'(g^\star) - c_1'(g^\star)\right\} \tag{4.31}$$

From simulations, it appears this discriminant is always positive.

By contrast, at the higher balanced growth path, while the mechanisms are identical, their respective strengths are not. A marginal change in consumption when consumption is initially lower translates into a larger impact on household's utility, for which households make the government pays more. Moreover, the production technology gets decreasing returns from government spending, so a marginal change public expenditure when starting from an already high level does not impact much expected tax revenues. In sum, sovereign financing costs change more radically than around the lower steady state, with lesser prospects to pay them with future growth, thereby impacting more forcefully the government's debt servicing capacity. The economy likely goes back to the high steady state.

The economy gets trapped in an equilibrium with more public spending and lower private consumption. This happens in the model even in the absence of information asymmetry, strategic decisions, or uncertainty. Incidentally, in this model, reaching the high public spending steady state is not necessarily bad for households: provided they have a sufficient appetite for capital accumulation, their welfare can improve when consuming less (section 4.3). However, this is not necessarily the case, and there might be social preferences for less government expenditure (for instance because public debt overhang is seen as risky). Typically, such situations would call for commitment mechanisms: clarity, transparency, and accountability on the objectives of the government, and possibly some correction mechanisms to handle deviations. But this chapter highlights how such mechanisms are bound to fail.

4.7 Conclusion

I have considered a Barro-like economy where endogenous growth is due to the impact of government spending on productivity. I depart from the previous literature by allowing the government to maximize its own utility function, with a distinct set of preferences and a higher level of impatience compared with households. The interplay between the household's and the government's respective decisions, in a context where these two agents do not have the same access to financial instruments and the only two available assets are imperfect substitutes, implies several feedback loops between the two and contributes to the emergence of multiple stationary paths.

With a relatively simple setup, this model thus illustrates how accounting explicitly for a government's preferences and level of myopia can lead to multiplicity of stationary paths. Using a relatively parsimonious setup, the model yields two balanced growth paths, one being unstable, and the other being a saddle point. The unstable one produces low public spending and high private consumption, but is unlikely to be reached. The saddle point is characterized by large public spending, and puts households in a situation where they have to save and invest more.

This could potentially be extended and proven to be a novel mechanism of instability, while with further assumptions equilibria multiplicity could lead to expectation-driven shocks.

In this chapter's model, agents are all rational and they all perfectly know each other's preference parameters. However, a natural interpretation of my findings is the following. If at the beginning of time $t = 0$, households were clueless about their government's preferences, had to make a guess, and adjust theirs accordingly to ensure that the economy nonetheless grew, failing to do so correctly could generate an even more sub-optimal outcome. Going one step further, these priors about government's preferences could be governed by the observation of past performances and the announcement of intentions (*e.g.*, an *electoral program*), with a learning process. In such a setup, the outcome would thus be influenced by the credibility of the government and its past performance—this is what I find empirically in chapter 3—and vulnerable to sunspot disturbances. Were the government unable to anchor expectations, the existence of multiple equilibria associated with different expectations could easily lead to a Markov-switching rational expectation path. This is especially likely under adaptive learning: Grandmont (1998) shows that uncertainty about the local stability of the economy leads agents to wrongly extrapolate past observed deviations from equilibrium, thereby making the learning dynamics (locally) diverge.

The model developed here could be extended in several ways to yield indeterminacy and even more than two balanced growth paths. First, paralleling the externality in the government's utility function and considering public spending and private consumption partial substitutes (Ni, 1995; Balducci, 2006), households could derive a direct utility from public expenditure. For instance, with an instantaneous utility that looks like $\frac{C_t^{1-\theta}-1}{1-\theta} G_t^{\sigma}$, the model could yield up to three stationary solutions. Second, increasing returns to scale (possibly through a stronger productive externality from public spending) or an IIES in consumption larger than unity are often associated with indeterminacy and poverty traps (Brito and Venditti, 2010)—such cases could be interesting extensions. Third, a (possibly endogenous) Laffer curve in tax revenue or state-contingent tax rates (which could depend on the position in the business cycle or on the debt ratio) could be added. Fourth, the spread could be made dependent on the level of debt, by assuming households value the holding of sovereign securities, as a different class of assets (as in Modesto et al., 2020).[30]

The fact that instability may emerge from the government's maximizing its own, myopic goals, carries policy implications. First, a too impatient government may fail to represent well its citizens and doesn't have their best interests at heart. Therefore, it might deliver a sub-optimal

[30]They could derive an instantaneous utility from their stock of sovereign bonds, for the same capitalism spirit reason as private capital, but also for a rational diversification purpose. As a matter of fact, aggregate portfolios are even empirically found to favor government paper over productive capital compared with what a classical Capital Asset Pricing Model (CAPM) would prescribe.

outcome (multiple equilibria). Curbing the government's relative impatience and forcing it to pay more attention to the intertemporal consequences of its actions thus appear as sufficient reasons to put in place fiscal rules or a fiscal watchdog. Second, under indeterminacy, public policies are insufficient to drive the economy to high growth solutions during the transition to long-term equilibrium. Agents decisions (private and government) will place the economy towards one or another converging path, independently of initial conditions or other fundamentals. Against this, the government needs to credibly anchor expectations for the economy to reach the best equilibrium—similar the central banker who commits to a nominal anchor in order to alleviate indeterminacy. This happens independently of actual type of the government and only involves how view it (credible or not). This chapter therefore provides a theoretical justification to the importance of fiscal credibility, on which implicitly rely current practices of imposing fiscal accountability frameworks and medium-term fiscal frameworks—meant to enhance communication around fiscal policy and objectives.

Appendices

4.A Benevolent government

As a benchmark, it is interesting the consider an economy from which the government as a separate agent with its own preferences is absent—or equivalently an economy in which the government chooses public spending and debt so as to maximize household utility. In this appendix, the production technology is assumed similar to that of section 4.2, with an externality from public spending. Household choose at once how much they intend to consume, how much they want to invest in capital, and how much public spending they mandate their government to undertake.

The maximization program for households is only subject to the market clearing condition (4.11) and writes:

$$\max_{C_t,K_t,G_t} \mathcal{U}_c \qquad \text{such that} \dot{K}_t + \delta K_t + G_t + C_t \leq Y_t \tag{4.32}$$

As in section 4.2, this optimization problem can be solved with the calculus of variations method. Any continuous-time Lagrange multiplier such that $\forall t \lambda_t \neq 0 \iff$ the constraint is saturated verifies:

$$\mathcal{U}_c = K_0\lambda_0 - \lim_{t\to+\infty} e^{-\phi t}\lambda_t K_t + \int_0^\infty e^{-\phi t}\left\{\frac{C_t^{1-\theta}-1}{1-\theta} + \kappa\frac{K^{1-\theta}}{1-\theta} + \lambda_t[Y_t - \delta K_t - G_t - C_t] + (\dot{\lambda}_t - \phi\lambda_t)K_t\right\} \tag{4.33}$$

which leads to the following Kuhn-Tucker conditions (after normalizing as in section 4.2):

$$\lambda_t = C_t^{-\theta} > 0 \tag{4.34a}$$

$$g_t = (A(1-a))^{1/a} \tag{4.34b}$$

$$\theta\frac{\dot{c}_t}{c_t} = Aag_t^{1-a} + \kappa c_t^\theta - \phi - \delta - \theta\gamma_t \tag{4.34c}$$

$$\lim_{t\to+\infty} e^{-\phi t}\lambda_t K_t = 0 \tag{4.34d}$$

4.B Negative ξ case

Proposition 5. *If $\xi < 0$, and under Assumptions 1–2, there is a $\overline{\varpi}$ such that there exists a balanced growth path if and only if $\varpi = \frac{(\vartheta-\varsigma)(\phi+\delta)+\theta(\varphi+\delta)}{\xi a A(1-\tau)} \leq \overline{\varpi}$, in which case that solution is unique.*

■ *Proof of Proposition 5.* I use similar simplifying notations than in the proof of Proposition 2: $c^\star = C_1(g^{\star 1-a}) = C_2(g^{\star 1-a})$ with $C_1(h) \equiv S\left[\xi\varpi - \xi h\right]^{1/\theta}$; $C_2(h) \equiv \frac{A(\theta-(1-\tau)a)}{\theta}h - h^{\frac{1}{1-a}} +$

$\frac{\phi+\delta(1-\theta)}{\theta}$; and $S \equiv \left(\frac{(1-\tau)aA}{\kappa\theta}\right)^{1/\theta}$. ξ plays no role in C_2, so the analysis in the proof of Proposition 2 is still valid; in particular, I can define $\overline{\varpi}$ as I defined $\underline{\varpi}$ before, that is as the only $h > 0$ such that $C_2(h) = 0$. What changes with $\xi < 0$ is that now, $C_1(\cdot)$ exists and is positive and non-decreasing on $[\varpi\,;+\infty[$, with $C_1(\varpi) = 0$ and $C_1(+\infty) = +\infty$.[31]

There cannot be a solution if $\varpi > \overline{\varpi}$, so I assume that $\varpi \leq \overline{\varpi}$ and focus the analysis on $[\varpi\,;\overline{\varpi}]$. Since $C_1(\varpi) = 0 < C_2(\varpi)$ and $C_2(\overline{\varpi}) = 0 < C_1(\overline{\varpi})$, the two functions necessarily interact an odd number of times. Given that $\forall h$, $C_1''(h) = \frac{\xi^2 S(1-\theta)}{\theta^2}\left[\xi\varpi - \xi h\right]^{1/\theta-2} > 0$, C_1 is convex on $[\varpi\,;+\infty[$, while C_2 is concave; so there cannot be more than a unique solution. *QED.* ■

4.C Logarithmic utility from consumption

Proposition 6. *If $\theta \to 1$, the utility derived from consumption by the household in* (4.3) *becomes logarithmic and the direct utility from capital ownership becomes constant $v(K) = \kappa$. Then, under Assumptions 1–3, one can find $\underline{\kappa}$, $\overline{\kappa}$, and $\underline{\varpi} > 0$ such that two steady states coexist if and only if $\underline{\kappa} < \kappa < \overline{\kappa}$ and $\varpi > \underline{\varpi}$.*

■ *Proof of Proposition 6.* According to Assumption 1, and going back to the notations introduced in the proof of Proposition 2, then C_1 becomes linear ($\forall h$, $C_1(h) = S\left[\varpi - h\right]$), while C_2 is still concave. Thus, there is exactly one point $\tilde{h} > 0$ in which the two functions have the same slopes—namely, $\tilde{h} = ((AW + S)(1-a))^{\frac{1-a}{a}}$ (with $W = (1-(1-\tau)a)$).

By convexity of $C_1 - C_2$, there are at most two stationary solutions; there are exactly two of them if and only if the three following conditions are verified:

- $C_2(0) = V < C_1(0) = S\varpi$, which is equivalent to $\kappa < \overline{\kappa}$ with $\overline{\kappa} \equiv \frac{\varphi+\delta+(\vartheta-\varsigma)(\phi+\delta)}{\phi}$;
- $C_2(\varpi) < C_1(\varpi) = 0$, which is equivalent to $\varpi > \underline{\varpi}$ where $\underline{\varpi}$ is the unique zero of C_2 on $\mathbb{R}_+$.
- $C_2(\tilde{h}) > C_1(\tilde{h})$, which is equivalent to $\mu(S) > 0$, where $\mu : s \mapsto a(1-a)^{\frac{1-a}{a}}(AW+s)^{\frac{1}{a}} - s\varpi +$ is a convex function, whose minimum is reached in $s = S' \equiv \frac{\varpi^{\frac{a}{1-a}}}{1-a} - AW$. Since $\mu(0)$ is positive and $\mu(S') = C_2(\varpi)$ is negative whenever $\varpi > \underline{\varpi}$, there exist two values $S_1 < S' < S$ such that $\forall s$, $\mu(s) > 0 \iff s < S_1 or s > S_2$, or equivalently that there exist $\underline{\kappa} < \hat{\kappa}$, such that $\forall \kappa > 0$, $\mu(\frac{(1-\tau)aA\xi}{\kappa}) > 0 \iff \underline{\kappa} < \kappa < \hat{\kappa}$.

I finish by noticing that $\mu(\frac{(1-\tau)aA\xi}{\overline{\kappa}}) = a(1-a)^{\frac{1-a}{a}}\left(AW + \frac{\phi}{\varpi}\right)^{\frac{1}{a}} > 0$, thanks to $\overline{\kappa}$'s definition, which means that $\kappa < \overline{\kappa}$ is more restrictive than $\kappa < \overline{\kappa}$. *QED.* ■

[31] ϖ is potentially negative when $\xi < 0$.

4.D Local dynamics in the absence of wealth utility

Proposition 7. *Let assumptions 1–4 be verified, as well as the conditions provided in Proposition 1 for a stationary equilibrium to exist and comply with positivity constraints. This unique equilibrium is locally unstable.*

■ *Proof of Proposition 7.* This is a particular case of Proposition 4 with $\kappa = 0$, so I will draw from the notations and results of section 4.6. The eigenvalue associated with the debt ratio b is the same: $N^\star = \varphi - (1 + \vartheta - \varsigma)\gamma^\star$; it is necessarily positive given the transversality condition (4.17). For the other two dimensions, the Jacobian matrix is:

$$\tilde{\mathcal{J}} = \begin{pmatrix} c^\star & -c_2'(g^\star)c^\star \\ g^\star & -c_2'(g^\star)g^\star + \frac{(1-\tau)aA\xi(1-a)}{\varsigma\theta} g^{\star 1-a} \end{pmatrix}$$

with $c_2(\cdot)$ defined as in (4.23c). The trace and determinant of this matrix can be expressed as follows:

$$\operatorname{Tr}\tilde{\mathcal{J}} = \frac{\phi + (1-\theta)\delta}{\theta} + \frac{aAg^{\star 1-a}}{\theta}\left[\theta - (1-\tau)a + \frac{(1-\tau)(1-a)\xi}{\varsigma}\right] > 0 \tag{4.35}$$

$$\det\tilde{\mathcal{J}} = \frac{(1-\tau)aA\xi(1-a)}{\varsigma\theta} c^\star g^{\star 1-a} > 0 \tag{4.36}$$

This means that the other two eigenvalues are also positive (or their real parts are). Whence, the steady state is a source, which is strongly unstable. *QED.* ■

4.E Comparative statics

Table 4.2. *Sensitivity analysis*

x	$\left.\frac{\partial c_1}{\partial x}\right\|_{g=g^\star}$	$\left.\frac{\partial c_2}{\partial x}\right\|_{g=g^\star}$	$\left.\frac{\partial (c_1-c_2)}{\partial x}\right\|_{g=g^\star}$
g	$\frac{-\xi(1-\tau)aA(1-a)g^{-a}}{\kappa\theta^2}c^{1-\theta} < 0$	$\frac{A(\theta-(1-\tau)a)(1-a)}{\theta}g^{-a} - 1$	> 0 in $\overline{g}^\star$, < 0 in $\underline{g}^\star$
A	$\frac{-\xi(1-\tau)aAg^{1-a}}{\kappa\theta^2}c^{1-\theta} < 0$	$\frac{\theta-(1-\tau)a}{\theta}g^{1-a} > 0$	< 0
a	$\frac{\xi(1-\tau)A(a\ln g-1)g^{1-a}}{\kappa\theta^2}c^{1-\theta}$	$\frac{-(1-\tau)-A(\theta-(1-\tau)a)\ln g}{\theta}g^{1-a}$	
δ	$\frac{\xi}{\kappa\theta^2}c^{1-\theta} > 0$	$\frac{1-\theta}{\theta} > 0$	
τ	$\frac{-\xi aAg^{1-a}}{\kappa\theta^2}c^{1-\theta} > 0$	$\frac{aA}{\theta}g^{1-a} < 0$	< 0
θ	$\frac{(\vartheta-\varsigma)(1-\tau)aAg^{1-a}-(\phi+\delta)(1-\theta)}{\kappa\theta^3}c^{1-\theta} - \frac{c\ln c}{\theta}$	$\frac{\gamma}{\theta} > 0$	
ϑ	$\frac{-\gamma c^{1-\theta}}{\kappa\theta} < 0$	0	< 0
ς	$\frac{\gamma c^{1-\theta}}{\kappa\theta} > 0$	0	> 0
φ	$\frac{1}{\kappa\theta}c^{1-\theta} > 0$	0	> 0
ϕ	$\frac{\vartheta-\varsigma}{\kappa\theta^2}c^{1-\theta} < 0$	$\frac{1}{\theta} > 0$	< 0
κ	$\frac{-c}{\kappa\theta} < 0$	0	< 0

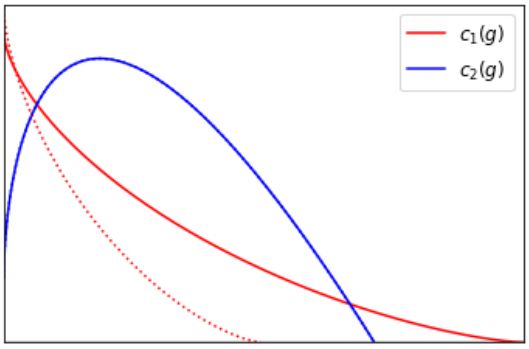
Note: All the stars that should otherwise designate the stationary variables have been removed, for the sake of readability.

Table 4.3. *Sensitivity analysis (part 2)*

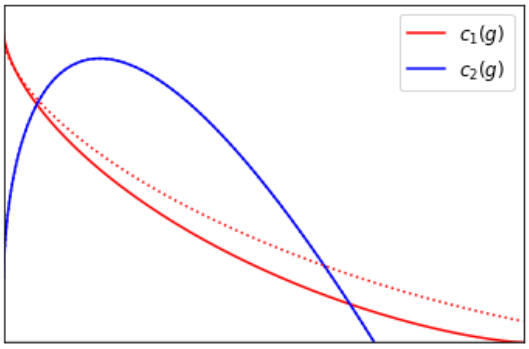
x	$\frac{\partial \gamma^\star}{\partial x}$	$\frac{\partial c^\star}{\partial x}$
A	$\frac{(1-\tau)ag^{\star 1-a}}{\theta} + \frac{(1-a)(1-\tau)aAg^{\star -a}}{\theta}\frac{\partial g^\star}{\partial A}$	$c_2'(g^\star)\frac{\partial g^\star}{\partial A} + \frac{(\theta-(1-\tau)a)}{\theta}g^{\star 1-a}$
a	$\frac{(1-a)(1-\tau)aAg^{\star -a}}{\theta}\frac{\partial g^\star}{\partial a} + \frac{(1-\tau)A(1-a\ln g^\star)g^{\star 1-a}}{\theta}$	$c_2'(g^\star)\frac{\partial g^\star}{\partial a} - \frac{A(\theta-(1-\tau)(1-a\ln g^\star))}{\theta}g^{\star 1-a}$
δ	$\frac{(1-a)(1-\tau)aAg^{\star -a}}{\theta}\frac{\partial g^\star}{\partial \delta} - \frac{1}{\theta}$	$c_2'(g^\star)\frac{\partial g^\star}{\partial \delta} + \frac{1-\theta}{\theta}$
τ	$\frac{-aAg^{\star 1-a}}{\theta} + \frac{(1-a)(1-\tau)aAg^{\star -a}}{\theta}\frac{\partial g^\star}{\partial \tau}$	$c_2'(g^\star)\frac{\partial g^\star}{\partial \tau} + \frac{Aa}{\theta}g^{\star 1-a}$
θ	$\frac{(1-a)(1-\tau)aAg^{\star -a}}{\theta}\frac{\partial g^\star}{\partial \theta} - \frac{\gamma^\star}{\theta}$	$c_2'(g^\star)\frac{\partial g^\star}{\partial \theta} + \frac{\gamma^\star}{\theta}$
ϑ	$\frac{(1-a)(1-\tau)aAg^{\star -a}}{\theta}\frac{\partial g^\star}{\partial \vartheta}$	$c_2'(g^\star)\frac{\partial g^\star}{\partial \vartheta}$
ς	$\frac{(1-a)(1-\tau)aAg^{\star -a}}{\theta}\frac{\partial g^\star}{\partial \varsigma}$	$c_2'(g^\star)\frac{\partial g^\star}{\partial \varsigma}$
φ	$\frac{(1-a)(1-\tau)aAg^{\star -a}}{\theta}\frac{\partial g^\star}{\partial \varphi}$	$c_2'(g^\star)\frac{\partial g^\star}{\partial \varphi}$
ϕ	$\frac{(1-a)(1-\tau)aAg^{\star -a}}{\theta}\frac{\partial g^\star}{\partial \phi} - \frac{1}{\theta}$	$c_2'(g^\star)\frac{\partial g^\star}{\partial \phi} + \frac{1}{\theta}$
κ	$\frac{(1-a)(1-\tau)aAg^{\star -a}}{\theta}\frac{\partial g^\star}{\partial \kappa}$	$c_2'(g^\star)\frac{\partial g^\star}{\partial \kappa}$

Figure 4.5. *Parameter sensitivity of the two characteristic functions*

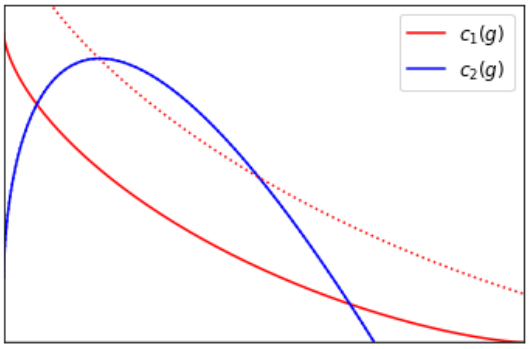
(a) Consumption externality ϑ



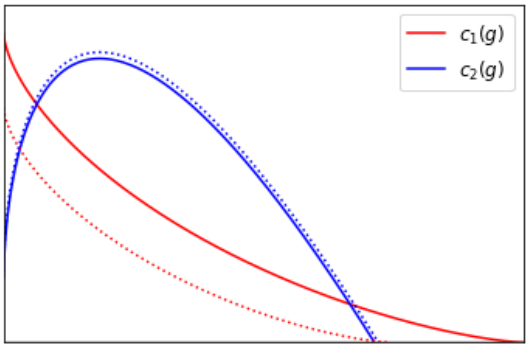
(b) Government's elasticity ς



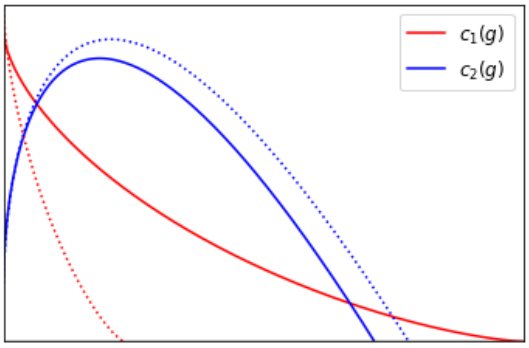
(c) Government's impatience φ



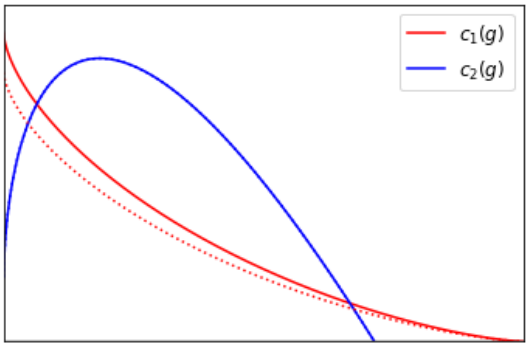
(d) Household's impatience ϕ



(e) Household's elasticity θ



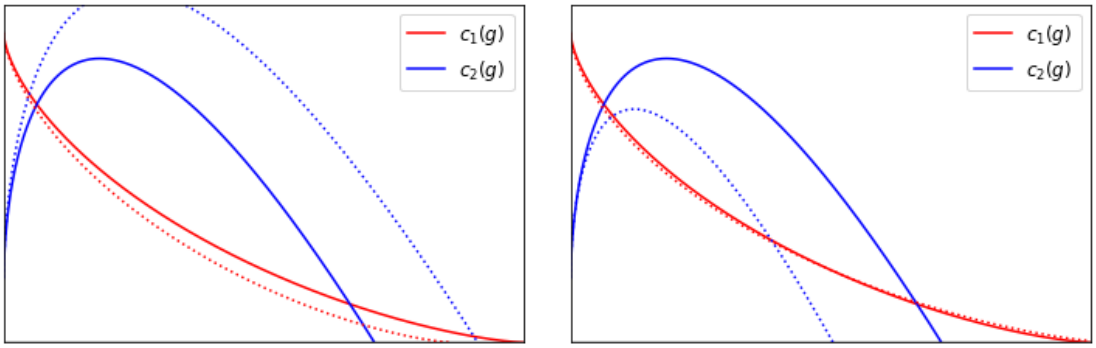
(f) Spirit of capitalism κ



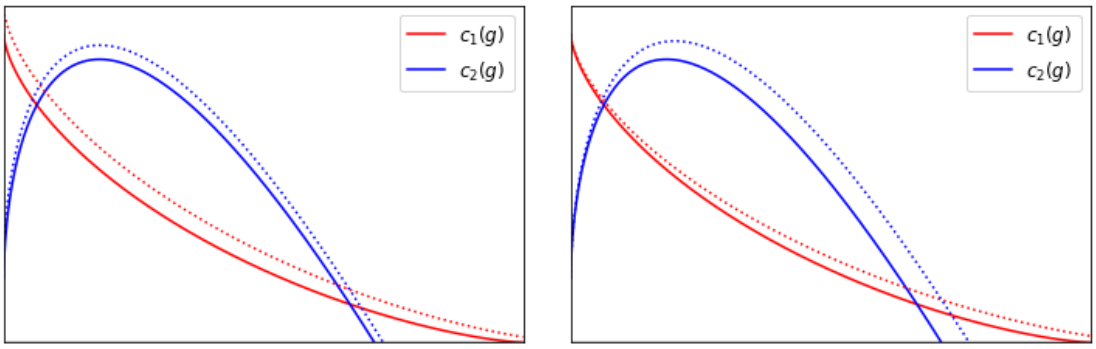
Note: The dotted lines illustrate how a 10 percent increase in the considered parameter impacts the characteristic functions $c_1(\cdot)$ and $c_2(\cdot)$.

Figure 4.5. *Parameter sensitivity (continued)*

(g) TFP A **(h)** Capital intensity a



(i) Depreciation rate δ **(j)** Tax rate τ



Note: The dotted lines illustrate how a 10 percent (50 percent for δ) increase in the considered parameter impacts the characteristic functions $c_1(\cdot)$ and $c_2(\cdot)$.

4.F Calibration

The table below provides parameters that yield one or two steady states, with and without the externality ϑ in the government's utility function.

Table 4.4. *Examples of parameters*

		Two steady states		One steady state (low)		One steady state (high)	
	Description	$\vartheta > 0$	$\vartheta = 0$	$\vartheta > 0$	$\vartheta = 0$	$\vartheta > 0$	$\vartheta = 0$
θ	Consumption weight for household	0.70	0.70	0.70	0.70	0.72	0.72
ϑ	Consumption weight for government	0.20	-	0.20	-	0.19	-
ς	Public spending weight for government	0.87	0.67	0.87	0.67	0.87	0.68
ϕ	Household's discount rate	0.60	0.60	0.70	0.70	0.60	0.60
φ	Government's discount rate	0.90	0.90	0.90	0.90	0.90	0.90
τ	Tax rate	0.40	0.40	0.40	0.40	0.40	0.40
κ	Utility from capital	0.12	0.12	0.10	0.10	0.39	0.39
δ	Depreciation rate	0.05	0.05	0.05	0.05	0.05	0.05
A	TFP	4.00	4.00	4.00	4.00	3.10	3.10
a	Capital intensity	0.35	0.35	0.35	0.35	0.35	0.35

Chapter 5

Concluding remarks

"More lucidity, therefore, is our first need. This is not easy. For all aspects of the economic problem are interconnected. Nothing can be settled in isolation."

— John Maynard Keynes (1940) *How to Pay for the War*

Clarifying a concept and its economic impacts

Fiscal policy has been and will likely remain a much potent, yet untamed animal. Economic crisis experiences seem to highlight it: we need fiscal policy as a macroeconomic stabilization tool as much as we need to be careful about the economic risks it generates. Can we entrust an elected government with such an important function? Do there exist practical means to improve the credibility of fiscal policy and policymakers?

The main motivation behind this dissertation was to unearth fiscal credibility as a concept worth considering. Fiscal credibility had been implicitly present in the fiscal landscape, as a watermark of the various flaws and imperfections that riddle fiscal policy (especially compared with monetary policy). To the best of my knowledge, this dissertation is the first attempt to define and study fiscal credibility itself. The various chapters draw intuition from the monetary policy literature, and validate the conceptual value of fiscal credibility by showing how it helps explain historical and modern experience, how it can be measured, and how it could emerge from a theoretical model.

Credibility can help explain a diversity of outcomes in broadly similar situations (as seen in chapters 2 and 3). Governments are not equals in the face of adverse shocks: credible governments are empirically associated with better outcomes. This is in part because such governments can respond more freely to shocks without generating confidence effects or fiscal stress. Estab-

lishing credibility is a virtuous circle. This is because economic agents form expectations about future budget and tax policies, which depends on their views about the government's ability to stick to its promises, and base their economic decisions on such expectations.

Beliefs about the government and anticipations of its future behaviors have deep economic implications. With low trust in the government, private agents tend to invest less, especially when high levels of public debt entice them to save. And markets tend to bill more interests to the government, weighing on the financing of growth-enhancing public services. Thus, low expectations about fiscal performance may worsen macroeconomic outcomes, which in turn translate into worse fiscal outcomes. With such a vicious circle in place, expectations could become self-fulfilling prophecies, a possibility that typically induces instability in macroeconomic models. Even though chapter 4 comes short of finding such instability, it lays some foundations by showing how the mere interplay of preferences between a non-benevolent government and the private sector may leave the economy with several stationary equilibria. Doing so, it sketches out how, with some further assumptions—for instance about the observable information, the expectation formation process, or strategic behaviors—one could find situations with local instability.

Policy implications

These considerations about fiscal credibility mean that default, illiquidity, or unsustainability are not the only concerns. Beyond the outright risk of sovereign debt crisis, there is the risk that governments, because of their bad reputations, lead ineluctably economies towards a suboptimal equilibrium. This makes external surveillance, such as that exerted by the IMF or the European commission, much harder, because it implies moving away from rigid, one-size-fits-all fiscal rules and embracing a subjective element in the assessment.

What could be ways to build or reinforce credibility? The natural way is to build credibility over time by proving a strong track record. But, as seen in chapter 3, establishing credibility takes time and may come with initial political and economic costs. Since the large stimulus packages and financial sector bailout packages most governments undertook during the GFC, governments have striven to re-establish there credibility, alternating between short-lived consolidation plans and countercyclical policies.

One lesson from the interwar period is that there are ways to make debt instruments more credible (chapter 2). Since there is no other way to enforce sovereign liabilities than international penalties and limited market access following a default, embedding commitment technologies in sovereign debt instruments could instill some further confidence. For instance, sinking funds or indexed bonds could tie the hands of policymakers in a state-contingent way, making it more difficult to deviate. Improving the maturity structure of public debt contributes to smooth out

needs associated with debt service, hence limiting rollover risks and fears of abrupt tax policy decisions.

Another lesson from past experience is that *borrowing* credibility from a third party (be it a monetary authority, debtor countries, or international entities) do not seem to hold the test of time (Sargent et al., 2019). As countries grappled in the face of unsustainable debts after WWI, they tried to use other disciplining tools that simply promising fiscal rigor. For instance, Japan in the 1920s switched on a monetary dominance regime, by which fiscal decisions had to comply with the objective of rejoining the gold standard. Exogenous discipline from the Bank of Japan and international investors curbed fiscal policy discretion. Other engaged in a vast network of foreign sovereign debts and communicated on net rather than gross debt, implicitly swapping their creditworthiness by that of other countries (the credibility spillovers described in chapter 2). However, these solutions merely bought time and eventually failed to replace fiscal sustainability. Neither has been international surveillance sufficient to prevent debt crises.

Institutions most certainly matter. Let me draw, one more time, on the good practice of monetary policymaking, which relies on three institutional pillars: accountability, independence, and transparency. Independence—founding an authority outside of electoral and political pressures—seems a utopia for the fiscal realm. The best palliatives so far are fiscal rules and fiscal councils, whose rigidity impose some constraints to government discretion. However, as shown in chapter 3, a too rigid institutional framework might be counterproductive, as fiscal needs some flexibility to respond to shocks appropriately. Mechanisms of democratic accountability are clearly in place, since in most countries fiscal policymakers are elected officials, but voters (and even parliamentarians) do not necessarily have the technical understanding, nor the long-term time horizon necessary to censor bad fiscal decisions.

This leaves us with transparency. On that front, there may be scope to do better. Chapter 3 has highlighted how new information impacts expectations, while chapter 4 has emphasized how the relative myopia of governments and the lack of coordination between government and private preferences could send the economy towards a sub-optimal equilibrium. Thus, governments could provide better, clearer information on: (a) the mandate and objectives of fiscal policy, with a clearer prioritization; (b) the tools used and the contingency plans foreseen for exceptional circumstances; (c) decisions taken by the authorities and their rationale; and (d) the quality of outcomes, reasons behind potential slippages, and corrective measures. Signalling the government's true objectives (its *type*) and building an explicit track record are important components of its building a reputation.

Credibility in the post-CoViD-19 era

It seems impossible to conclude this dissertation without a few words about CoViD-19. At the time of drafting these concluding lines, the world seems on the brink of taming the virus; after more than a year of health and economic ravages, vaccines are finally being distributed (with heterogeneous success across countries) and hopes of going back to normal seem finally within reach.

The economics of CoViD-19 are, in many regards, very similar to a situation of war—a global war against a common, invisible enemy, as many world leaders emphatically put it. This is not mere rhetoric: the stakes to battle the health and economic shock were high. The Great Lockdown was a warlike sudden stop on all economies, economically similar to what the countries I studied in chapter 2 experienced. Confinement policies to "*flatten the curve*" of viral contagion had unavoidable economic ramifications, in that they diverted production factors to nonproductive activities. Manpower was sent home (not to the battlefront!) and factories remained idle during the "*fight*" ; supply plummeted, demand collapsed. A risk of severe economic dislocation arose, even though this was a far cry from the destruction of physical and human capital that takes place during military wars.

Exceptional circumstances like CoViD-19 or wars justify unconventional economic policies that go beyond usual policy limits. The pressing need to contain the human and economic fallout from the pandemic required emergency spending on an unprecedented scale in peacetime (International Monetary Fund, 2020). It was necessary to unleash urgent healthcare spending; provide emergency assistance to workers, households, and firms as production networks and global value chains came under strain; and ensure that the (economic) damage would be short-lived. In parallel, tax revenues collapsed with the stalling of economic activity. As for the post-war recovery, the path ahead has been characterized by Knightian uncertainty—related to waves of infection and the unpredictable behavior of populations and leaders. Whence, the stop-and-go recovery will likely be will likely necessitate continued public finance involvement, as accumulated vulnerabilities are progressively unmasked.

Finding emergency sources of financing was possible, with tools and tricks somewhat similar to those described in chapter 2; debt issued during the crisis was relatively cheap, as interest rates remained low, globally (except during the initial panic of international capital market, in April–May 2020).

The challenge will be for countries to unwind these exceptional arrangements in an orderly and *credible* manner. Countries that had limited fiscal space *in principio* and economies vulnerable to capital reversals may at some point face renewed financing constraints. The interwar period shows that countries struggled, and often failed, to return to normalcy. Risks include:

(a) prolonged fiscal dominance (inflation, currency weakening); (b) protracted fiscal adjustment and solvency problems, with difficult political economy choices about who will pay. The trade-off is one between raising taxes (thus increasing the burden of households or firms, possibly with an inflation tax), borrowing in capital markets and increasing sovereign debt burdens (pushing the burden onto future generations, with the implicit promise of future tax hikes), or default and debt restructuring. A cross-border debt web will make resolution even more difficult. As during and after WWI, allied countries supported each other through loans and credit lines. This is fueling a type of financial interdependence that is not well monitored. One specificity of this current war is that it is being waged against the same enemy: there will be no defeated countries to pay for war reparations. On the upside, countries can today rely on multilateralism more so than ever in the past.

There may be several ways to rebuild credibility in the aftermath of the CoViD-19 crisis, in the light of this dissertation. Debt has already jumped by about 20 percent of GDP in advanced economies and 10 percent of GDP in emerging markets, and the question of how to roll over these new highs is arising.

First, as a significant share of pandemic-related fiscal deficits have been financed by short-term debt (Organisation for Economic Co-operation and Development, 2021), governments could engage in a conversion campaign to extend public debt maturity (while interest rates are still low). Possibly, interwar instruments such as perpetuals or sinking-fund-backed securities could help. A sinking fund could for instance help amortize CoViD-19-related debt or green recovery bonds and disencumber central bank balance sheets.

Second, dealing with CoViD-19 debts calls for vigilance about possible spillovers and hidden linkages. Domestically, both public and private sectors have taken on additional debt, whereas stress in a sector can easily spread to another through macro-financial linkages.[1]

Globally, as well, the international community should monitor the sovereign debt network that is building up, especially as advanced markets and governments have lent substantial resources to assist economies whose credibility may have been frail even before they started fighting CoViD-19 and eroded ever since. As the credibility of lenders may be affected by that of debtors, monitoring direct and indirect exposures and ensuring transparency in the reporting of debt-like liabilities seems advisable.

Third, there should be a prompt communication on exit strategies—triggers, tools, pace—to signal a commitment to normalizing policies as soon as possible. What chapter 3 showed is that

[1]For instance, bankruptcy and non-performing loan rates have so far remained uncannily low compared with *normal* crises, owing to forbearing prudential policies. However, sovereign or corporate stress could rapidly translate into hardships in the banking sector.

it takes less time to destroy credibility than rebuild it afterwards, and communication and track record are important building blocks towards such credibility. In other words, parachuting a Mario Draghi, as a *deus ex machina*, at the helm of a country under stress, might not be enough to restore at once a sufficient stock of credibility. To minimize liquidity and confidence risks and prevent further erosion of credibility, authorities should already strive to re-anchor expectations. For instance, governments should commit not to rely on capital levies or other abrupt tax measure, whose threat proved disruptive during the interwar and leads to sub-optimal allocations (Persson and Tabellini, 1999). As for voters, they should restore democratic accountability mechanisms so as to once again yoke governments to the best of their economic interests, after a year of various forms of emergency powers and budgets. Otherwise, as I sketched in chapter 4, the shortsightedness of governments might lead the economy into another equilibrium.

Countries entered the Great Lockdown with heterogeneous fiscal positions, and various levels of credibility. But they will all likely need to regain the trust of markets and investors in their public finances.

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Abstract

Fiscal policy has lately resurged as the cornerstone of economic policymaking. At the same time, even advanced economies discovered this tool was not omnipotent and could be dulled by confidence effects. A new concept of fiscal credibility emerged, without being properly defined. This dissertation explores to what extent parallels with monetary credibility can be drawn. It first explores how credibility can in practice explain a variety of outcomes, in the particularly challenging context of the interwar period. Second, it proposes a novel measure of fiscal credibility, identifies possible macroeconomic and institutional determinants, and explores the benefits of established credibility. Third, it conceptualizes the channels through which fiscal credibility might operate.

Keywords: fiscal policy, credibility, expectations, public debt

JEL *classification*: E60, H30, H11

Résumé

La politique budgétaire est revenue depuis la crise financière de 2009 sur le devant de la scène. Elle s'est révélée être tout à la fois un instrument puissant et indispensable à la disposition du gouvernement et un outil que la défiance des opérateurs pouvait rapidement émousser. Ainsi, seule la crédibilité pouvait donner à l'arme budgétaire toute sa force de frappe, à l'instar de la politique monétaire. Néanmoins, au-delà du parallèle avec la crédibilité de la banque centrale, le concept de crédibilité budgétaire reste vague et inexploré. Cette thèse permet tout d'abord d'identifier, dans une période historique défavorable, l'entre-deux-guerres, comment les gouvernements ont pu s'efforcer, avec plus ou moins de succès, de maintenir une forme de crédibilité. Elle propose une mesure novatrices de crédibilité budgétaire, qui permet d'étudier les facteurs qui y contribuent, ainsi que les bienfaits que l'on peut en retirer. Cette thèse propose enfin un cadre théorique mettant en valeur l'interaction des préférences hétérogènes entre le gouvernement et les agents privés—canaux de transmission potentiels de la crédibilité.

Mots-clés : politique bugétaire, crédibilité, anticipations, dette publique

Classification JEL : E60, H30, H11