The State-Contingent Debt Premium: Evidence from French Public Bonds

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Abstract

State-contingent debt (SCD) instruments have been proposed as a potential improvement in sovereign debt markets; however, their cost of issuance relative to traditional bonds is not yet well understood. We provide a direct estimate for the SCD premium using a unique quasi-twin bond strategy. We employ two similar bonds issued by France in 1956 that differed in that one had coupon payments linked to national industrial production and find that, at issuance, the expected yield for the state-contingent bond was 112 basis points higher relative to the conventional bond. Realized spreads were even greater, 181 basis points, due to higher than expected economic growth. However, this led to an increase in the price of the SCD bond relative to the conventional bond in secondary markets, reducing the realized and expected state-contingent bond premium to zero by 1964. Estimated SCD spreads rose again to 150 basis points following an exogenous negative shock to industrial production in May 1968. We use these findings to explore alternative explanations for state-contingent debt premia.

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1 Introduction

State-contingent debt instruments (SCDIs) have been proposed as a potential improvement on traditional public borrowing (Shiller 1993; Obstfeld and Peri 1998; Haldane 1999; Borensztein and Mauro 2004; Blanchard, Mauro, and Acalin 2016; Benford, Ostry, and Shiller 2018; Cohen et al. 2020; Dvorkin et al. 2022; Volz 2022), and have received renewed attention by policy makers and economists in the wake of the Global Financial Crisis and the Covid19 pandemic (Blanchard, Mauro, and Acalin 2016; Cohen et al. 2020; Brooke et al. 2013; United Nations 2021). These instruments are designed such that sovereigns repay more in good times and less in bad times, potentially offering debt relief and reducing the likelihood of default during economic downturns. However, linking debt payments to a state variable shifts risk to lenders who therefore require a premium to hold this debt. This raises the issuance costs for state-contingent debt and reduces its potential benefits.

Are SCDIs too costly to be useful? Unfortunately, the cost of issuing SCDIs is not yet well understood in large part because there are few examples of widespread issuance of SCDIs. Thus, existing estimates of their premia have been based on calibrated theoretical models (Benford, Best, et al. 2016; Eguren-Martin, Meldrum, and Yan 2021; Roch and Roldán 2023; Mouabbi, Renne, and Sahuc 2024), generated from hypothetical assets (Eguren-Martin, Meldrum, and Yan 2021), or empirically using bond issuances that are relatively small or associated with sovereign debt restructurings (Chamon and Mauro 2006; Igan, Kim, and Levy 2021). However, theoretical models rely on simplifying assumptions that may be difficult to validate with few real world experiences. Premia estimated using bond data following debt restructurings may not be useful for understanding how SCDIs would be priced in normal times as they could also include debt-restructuring premia, which may be loaded onto the state-contingent warrant that is typically added as a sweetener for investors accepting the restructuring. Furthermore, these investors may have concentrated

purchases in distressed assets and may not be informative about widespread market measures of risk premia in normal times. The ideal empirical experiment to measure state-contingent debt premia would be a setting where a well-developed public debt market issued two similar bonds in normal times, one traditional and one state-contingent.

In this paper, we take advantage of a unique historical experiment stateion that allows us to estimate empirically the state-contingent debt premium using a quasi "twin-bond" analysis: the simultaneous issuance of traditional and state-contingent bonds in France in 1956. We analyze two bonds issued between April and May 1956 by the Fourth French Republic. The "Bons PTT" issued by the state agency Postes, Télégraphes et Téléphone (henceforth, BPTT) in April 1956, was a conventional non-contingent or "plain vanilla" bond that was guaranteed by the French state (Le Roux and Oger 1999). The "Bons d'équipement industriel et agricole" (henceforth, BEIA), issued by the French Treasury in May 1956, was a state-contingent bond with coupons tied to the level of industrial production of the French economy.[1] To the best of our knowledge, this was the first example in history of an output-linked sovereign bond.[2]

These two bonds were identical in terms of place of subscription, face value, redemption value, and tax treatment. Both had a 15-year maturity, the same lottery provision determining their redemption, and were actively traded in secondary markets. They represented a significant share of borrowing by the French state in 1956. The BPTT accounted for 5% of total public borrowing while the BEIA represented 19% of French public borrowing (Daage

[1]Industrial production is highly positively correlated with real GDP. For example, Monnet and Puy (2021) use the same industrial production index to construct synthetic quarterly GDP series for France in the 1950s. Borensztein and Mauro (2004) suggest that an industrial-production linked bond may have an additional advantage in that it is potentially harder for a government to manipulate than GDP statistics. The industrial production index was published by the Institut national de la statistique et des études économiques (INSEE), which was created in 1947. Tavernier (2018) dicusses the de facto independence of INSEE since it's establishment.

[2]At the time, state-contingent debt was a common form of borrowing in France, used not only by the government (public debt) but also by publicly held companies (semi-public debt) and private companies. In fact, about half of all debt issued by the state, by companies owned by the state, and by private companies in 1956 in France had state-contingent properties (Rozental 1959).

1957).

The key difference was in the payment of coupons. The BPTT had a fixed 5.5% coupon, while the BEIA had a minimum coupon equal to 5% plus a bonus that depended on the performance of the French industrial production index as published by the official statistics office. In other words, other than the computation of the coupon, the terms of the two bonds were identical, including parts of the actual text published in the official legal publication of the government of France, allowing for a quasi-twin bond research strategy to estimate the state-contingent debt premium.

We estimate realized and expected state-contingent premia at issuance and at different points in time after issuance. Realized state-contingent debt premia is computed using secondary market prices and the realized future value for industrial production to compute realized cash flows and yields to maturity. The expected state-contingent debt premia uses expectations based on publicly available forecasts for industrial production to compute expected cash flows and expected yields to maturity. Our baseline state-contingent premia is obtained by taking the difference between the yield of the state-contingent bond and the traditional bond. This computation assumes that default risk is similar for the two bonds. In a robustness check, we show that the liquidity premia are similar for the two bonds. State-contingent debt premia that take into account liquidity are very similar to our baseline estimates.[3]

A crucial element for our analysis is the expected level of industrial production over time, which determines expected coupon payments for the state-contingent bond. We use

[3]Note that the the BEIA issuance is four times larger than the BPTT, so there could be liquidity differences in the two markets. Unfortunately, there is no available data on volume traded or bid-ask spreads for these bonds. We we show that implicit bid-ask spreads based on Roll (1984) were small and similar for the two bonds. One potential remaining issue is that the traditional bond, BPTT, had been issued multiple times before 1956. The state-contingent bond, BEIA, was issued for the first time in 1956. However, other state-contingent bonds had been issued in the past. If novelty risk plays a role, the computed state-contingent debt premia we compute may be be overestimated. It is hard to model these premia but as Consiglio and Zenios (2018) notes, novelty premia should be transitory.

official public forecasts for industrial production to compute these expected coupons. This is particularly suitable for our time period because the French economy followed an "indicative planning" approach, regularly publishing its targets for industrial production in its plans (Kindleberger 1967). Multiple plans were published during our sample periods which, when combined with secondary market prices, allow for the estimation of time-varying expected state-contingent debt premia.[4]

Our empirical estimates show that the expected state-contingent debt premium at issuance was 112 basis points. Due to robust economic growth of the French economy, ex-post, the realized state-contingent debt premium at issuance was 181 basis points. We also show that bond prices of the state-contingent debt increased with the continued strong performance of the French economy, which lowered the realized premia for most of the sample period. The premia fell to zero by the end of 1963 before increasing temporarily to 150 basis points in May 1968 following unexpected widespread strikes and protests that signfiicantly reduced French industrial production. By 1970 this premia decreased again to values close to zero. Expected premia ranged between -30 and 30 basis points over a three year horizon between 1958 and 1965.

Unlike traditional sovereign debt instruments, which have well-established markets and can be valued using standard methods, SCDIs are relatively rare and not necessarily well-understood by market participants. This lack of familiarity and liquidity (arising from their novelty and potential for complexity), together with lender risk aversion, can make it difficult for sovereigns to issue these instruments at a fair price, potentially reducing the use of contingent public debt. Unsurprisingly, most recent issuances of SCDIs have been part of debt restructurings, where they can help resolve disagreements between borrowers and lenders over expected future growth and repayment capabilities. Recent examples include Argentina, Greece, and Ukraine. Outside of debt restructurings, the issuance of SCDIs has

[4]The literature traditionally performs Monte Carlo simulations to obtain estimates of expected coupons.

occurred in small, illiquid markets, for example, in Portugal and Italy, and has been perceived as being too niche to attract a significant amount of interest from investors. Therefore, we do not currently have reliable empirical estimates of the state-contingent debt premium issued in a well-developed debt market and advanced economy during normal times (i.e., outside of debt restructurings and in an environment where statistical reporting is reliable).[5] The main contribution of our paper is to provide credible estimates for this premia in an environment where state-contingent debt was regularly used.

The premia we estimate are considerably lower than what has been found in the existing literature. For example, for SCDI used in debt restructurings, Igan, Kim, and Levy (2021) estimate an average realized premia for the five-year period after issuance equal to 1250, 425 and 665 basis points for Argentina, Greece, and Ukraine, respectively. For the first five-year period after issuance in our sample (between 1956 and 1961), we estimate a realized premia of 178 basis points and 52 basis points for the next five-year period. The average for our full sample period is 93 basis points, considerably lower than bonds that are part of restructurings. Our estimates of expected premia are even lower. The average expected premia we estimate is equal to 34 basis points. Benford, Ostry, and Shiller (2018) report a range of premia from theoretical models between 35 to 150 basis points.

Several reasons have been identified for the existence of a state-contingent debt premia. Borensztein, Jeanne, et al. (2005) collected investors' opinions on growth-indexed bonds and identified potential challenges in pricing these bonds, including issues with novelty and liquidity premia as well as concerns about the "theoretical" price. Chamon and Mauro (2006) show that the process of computing the theoretical price for growth-indexed bonds is similar to that of "plain-vanilla" bonds. In addition, they calculated the reduction in default probabilities on all debt following the issuance of growth-indexed bonds, calling it a "pleasant by-product." Chamon, Costa, and Ricci (2008) document novelty premia for Argentinian

[5]See Pina (2022) for a review of SCDIs issued and their characteristics.

GDP-linked warrants. However, as Igan, Kim, and Levy (2021) show, this premia for the Argentinian GDP-linked warrants was not transitory and therefore it is unlikely to represent novelty premia. Instead, Roch and Roldán (2023) and Igan, Kim, and Levy (2021) interpret state-contingent debt premia as uncertainty premia. They show high and persistent risk-premia in SCDIs that is pro-cyclical, i.e., lower when the economy is doing poorly. In these papers, the size and the pro-cyclicality of risk-premia are inconsistent with risk aversion but are consistent with ambiguity aversion.

Our paper contributes to existing literature on state-contingent debt by directly measuring the state-contingent debt premia using a quasi-twin bond strategy that requires fewer assumptions relative to approaches based on theoretical models or synthetic assets. We find smaller state-contingent debt premia at issuance, which even decrease over time until the French economy was hit by a large negative shock – the general strike of May-June 1968. Following a temporary increase in 1968 and 1969, the debt premia then decreases through 1970. We also show that realized state-contingent debt spreads are positively correlated with industrial production gaps; however, they increased dramatically following a large negative shock, a general strike, in May 1968. These findings are consistent with the view that state-contingent debt premia are a combination of risk-aversion and ambiguity aversion. When uncertainty is large and economic conditions are poor, as in 1968, risk-aversion dominates and is the main driver in elevated state-contingent debt spreads. However, when risk-aversion is relatively low, the state-contingent debt premia is actually pro-cyclical relative to industrial production, and is larger when industrial production is above trend. This view is consistent with Roch and Roldán (2023) and Igan, Kim, and Levy (2021), but it highlights that the level of the state-contingent debt premia may itself be state-dependent depending on which effect dominates.

The paper proceeds as follows. Section 2 presents the historical context and discusses state-contingent debt in France at the time. Section 3 discusses the data used in this paper as

well as the method used to compute the state-contingent debt premium. Section 4 presents the results for realized and expected risk premia. Section 5 discusses potential sources for the state-contingent debt premia that are consistent with our empirical findings, and Section 6 concludes.

2 Historical Context

2.1 The French Postwar Economy

Despite political instability (21 national governments) and decolonization wars in North Africa and Indochina that increased military expenditures and disrupted trade, the Fourth Republic of France (October 1946 - October 1958) experienced rapid economic growth (Lynch 2006). It began the era that would later be known as "Les Trente Glorieuses" or the "Glorious Thirty," the period of high French growth rates that lasted until 1975.

The governments of the French Fourth Republic implemented several key domestic economic policies, including the nationalization of major industries, such as banks, insurance companies, coal mines, and significant transportation and manufacturing enterprises, like the French automotive company Groupe Renault as well as the national railroads. This was complemented by the emergence of French economic planning, beginning in 1947 and led by Jean Monnet. It focused on increasing production in industries like coal and steel and upgrading the country's infrastructure.

Nationalization meant that debt issued by some of these companies was now guaranteed by the government. This debt was referred to as semi-public debt and included companies for which the majority of the capital was held by the State as well as semi-public institution,s such as Crédit Foncier or Crédit National (Daage 1957). These nationalized industries were among the first ones to issue large-scale bonds that were linked to state-variables that were relevant for each company, such as their product prices. The bonds of state companies (e.g., electric companies, railroads, and mining) introduced French investors to the concept

of state-contingent debt, reducing investor uncertainty regarding indexed debt and how to value it – two factors highlighted in the literature as potential impediments to SCDI issuance (Borensztein and Mauro 2004). The main state-contingent bond used in our analysis was issued by the government a few years after these later these bonds, and was traditional public debt with the exception of one novel feature – its coupon was linked to movements in France's industrial production index.

During our sample period, the governments of the French Fourth Republic relied on indicative planning, a form of economic planning that focused on setting targets for economic growth and used these targets to guide its policies and allocate resources. This is of particular interest to us since it provides a contemporaneous source of economic forecasts for industrial production, which are a crucial input into our computation of expected returns for the French state-contingent bond. The indicative planning approach used in postwar France provides government-sanctioned targets for the industrial production index that were public and time-varying (Massé 1965). The First Plan (Monnet Plan) was implemented in 1946 and designed to cover 1947-50. This plan was later extended to 1952 and was aimed at providing an orderly reconstruction of productive capacity in the wake of war destruction and promoted expansion of basic sectors, such as coal, electricity, steel, and machinery (Kindleberger 1967). Indicative planning continued well after reconstruction had been achieved during this period. The Second Plan (Hirsch Plan) ran from 1954 to 1957 and broadened the focus of investment activities beyond basic industries and into other types of manufacturing and housing. The Third Plan covered 1958-61 and, in addition to growth, aimed to address balance-of-payments problems. It was interrupted by the fall of the Fourth Republic in May 1958. An interim plan was adopted in 1960 for 1960-61, and a Fourth Plan was developed for 1962-65. The Fifth Plan was designed for 1966-70. The next plan covering 1971-75 falls out of the sample period for the bonds considered in this paper. The targets included in each plan will be used as forecasts to compute expected bond yields.

In the years just prior to the issuance of the BEIA bond (1954-55), the French Fourth Republic experienced rapid economic growth with little inflationary pressure as unused resources after the war were absorbed into production. However, after 1955, it was unable to sustain rapid growth without triggering higher inflation, stoked by fiscal deficits (including costs arising from financing its empire and colonial wars, particularly in Algeria), rapid credit expansion, and a tight labor market (unemployment was less than 1%). The inflation rate eventually rose to 15% in the last year of the French Fourth Republic. The central bank responded by raising the discount rate by 2 percentage points and the finance minister raised taxes in the second half of the year. Shortly after the establishment of the French Fifth Republic on October 4, 1958 and a second devaluation of the French currency, the De Gaulle government implemented additional measures to stabilize inflation and promote economic growth, including restrictions on credit to industry as well as raising taxes and cutting government spending to address structural budget deficits.[6] The stabilization measures included a ban on new issuance of indexed debt, including the type of state contingent debt we used for our analysis (Hauser 1964). At that time, policy makers believed that forbidding indexed debt would help to stabilize prices and reduce inflationary expectations (Deacon, Derry, and Mirfendereski 2004). This ban was lifted in 1968, but no new indexed government bonds were issued until 1973 when two gold-linked bonds were issued. The next section describes the state-contingent bonds issued in France during our sample period.

2.2 State-Contingent Bond Issuance in France

This sub-section provides additional historical context as to why state-contingent bonds were issued by the government in the 1950s, highlighting some aspects that are particularly

[6]The government ran budget deficits amounting to 20% of expenditures in 1956 and 1957 during a period when bank credit also expanded rapidly, by 22% in 1956 and 15% in 1957 (Szymczak 1959; International Settlements 1958). France financed these deficits through a combination of new public borrowing and advances from the Bank of France. France lost half its official reserves during this period and was forced to devalue twice by roughly 30%.

relevant for the main bond used in this paper, the BEIA, which itself is described in more detail in the next section. To do so we first describe the earliest innovators in France – public and private companies that issued corporate bonds in the 1950s indexed to the price of products they sold or to company revenues.

As briefly mentioned, state-contingent bonds were common in France during the Fourth Republic. Indexation of debt (usually with respect to prices) became more common after World War II (it was adopted in Finland, France and Israel) and was viewed as the logical outcome of a high inflationary environment (Seligman 1963). Most indexed contracts were linked to nominal variables. The French industrial production bond we consider stands out in that it was linked to a real variable. While the contemporaneous academic and policy literature discuss indexation with respect to protecting purchasing power, we have found no clear explanation as to why the French issued their IP bond. However, using primary and secondary sources, we are able to place the issuance of the BEIA bond into the French financial and political context of the period we study.

A. Monod Enterprises was among the first French firms to issue state-contingent bonds, linking their 1952 issuance to labor and material costs (Rozental 1959). That same year, the public electric company issued bonds tying interest payments and principal returns to the average selling price of electricity (Finch 1956). The following year, another bond linked to the price of electricity had 1/10 of bonds retired each year through a lottery, a similar mechanism that was later implemented in the BEIA and BPTT issues. In the Somua issue in 1953, the return was given by $157 + (I_k - I_0)/I_0$, where I_k corresponds to the ratio of the value of total sales to the number of hours of direct labor, one year before the payment of the bond, and I_0, the same ratio for the base year of 1952 (Rozental 1959). As will be shown later in the paper, this formula was similar to how the coupons for the BEIA bond were computed.

By 1956, variable-return bonds constituted 53% of all private corporate bonds, with con-

vertible bonds adding another 12% (Rozental 1959). Major companies like Pechiney, Sidelor, Michelin, Renault, SAVIEM, and GICEL issued bonds linked to financial performance indicators such as earnings, dividends, turnover, or commodity prices. These examples illustrate how variable-return bonds were a common feature in French financial market at the time, and that the structure of the state-contingent public bond that we study in this paper, both indexation and redemption mechanisms, was not necessarily novel.

Between 1956 and 1957, the French government issued three state-contingent bonds.[7] The first, BEIA, was issued in 1956 and was indexed to industrial production. It accounted for about 10% of the public and semi-public debt issued in 1956, and 19% of public debt issued in 1956. The second bond, the Emprunt, or national loan of 1956, was indexed to the average of the variable-income securities index (containing 295 French stocks) and the fixed-income securities index (consisting of 62 securities). The Emprunt accounted for about 56% of the public and semi-public debt issued in 1956 and 75% of public debt issued in 1956. The third bond was the Indexées or 5% bond of 1957. It was indexed to the annual index of variable-income securities (a stock market index). This bond accounted for about 24% of the public and semi-public debt and 76% of public debt issued in 1957. These numbers show the prevalence of state-contingent public debt in France at the time.

Despite its importance in financing public borrowing in France, the BEIA state-contingent bond has been largely forgotten by the literature on SCDIs. For example, in discussing the nonexistence of financial instruments tied to national income or output, Shiller (1993) states:

> *The closest I have been able to find in any published source to the national income markets proposed in this book is an article advocating swaps and options on business cycle variables, particularly indices of consumer confidence.*

Contrast this with the statement from Paul Ramadier, the French Minister of Finance, in 1956 to *Le Monde* about these bonds:

[7]The 3.5% Gold Loan (Pinay Bonds), issued in 1952, was indexed to the price of gold, offering investors a safeguard against currency devaluation, but not against the state of the French economy.

> *The purpose of this loan was clearly defined by Mr. Ramadier: to associate savings with the equipment of the nation by making it finance part of the public investments which condition economic expansion. In return, subscribers receive progressive interest, proportional to the increase in production. They are, according to the formula of the Minister, "shareholders whose dividend varies according to the national income.*"

A similar quote appeared in the *New York Times* (Heffernan 1956), where Paul Ramadier refers to the interest payment for this bond as a "dividend" that "is subject to revision annually in line with any changes in the gross national product of France as measured by a new index of industrial production."[8]

3 Data and Bond Terms

3.1 Data sources

This section describes the data sources used in this paper as well as the terms and pricing for the two bonds that are used in our quasi-twin analysis: the BEIA and the BPTT.

Data on bond terms and bond payments are available from France's official legal publication: the *Journal Officiel de la République*. This source also provides information on the official index values used to compute the variable coupons. The industrial production index was produced by the Institut National de la Statistique et des Etudes Economiques (INSEE). Forecasts for industrial production indexes are obtained from French government indicative plans (Commissariat général du Plan 1959; Commissariat général du Plan 1962; Commissariat général du Plan 1965). Bond prices are available from DFIH - Data for Financial History Database (Hautcœur and Riva 2018) at roughly the monthly frequency, with a maximum of three observations for any given month, and a few months without any quotes. The data are available between April 1956, when the BPTT bond was issued, and June 1971, when the BEIA bond matured. We also hand-collected daily prices for a subsample of our

[8] See also Nevin (1962) for a suggestion to link GNP measured at constant prices, and Day (1964) for linking public debt to GNP measured at current prices

period for the two bonds using *Cote Desfossés*, which is available at the French National Library. Unfortunately not all issues are currently available. Our analysis also uses an aforementioned article from the *New York Times* about the BEIA bonds to obtain a forecast for industrial production at issuance (Heffernan 1956).

With the exception of how the coupons are computed, the terms of the BEIA and the BPTT bonds are the essentially same. Their common terms are described in the official legal publication of the French government and parliament. The interest earned on both bonds was not taxable, and both traded actively in secondary markets. Both bonds were issued in 1956 with maturity equal to 15 years (last payment in 1971). They were issued with face values of either 10,000, 100,000 or 1 million Francs; in 1960, these issuance amounts were re-denominated to new Francs (simply by dividing by 100). They paid an annual coupon and 105% of the face value upon redemption. They had an equivalent "redemption" provision, which started in 1957. Each bond had a serial number. Draws happened every year, two months before the payment of coupons. Between 1957 and 1961, five lottery draws took place, featuring tickets with numbers ranging from 00 to 99. Bonds with serial numbers whose last two digits matched the lottery numbers were redeemed in that year. The number of lottery tickets drawn increased to seven between 1962 and 1970. According to the legal text of the bonds, both the BPTT and BEIA bonds could not be redeemed earlier or strategically by the government.

The BPTT was first issued 9th of April 1956, and paid coupons on May 1st of each year (Décret n°56-084 1956). The funds raised through the BPTT were dedicated to national infrastructure expansion, including the airmail network and telephones (Le Monde 1956a). The BPTT bond had a fixed interest rate equal to 5.5% and was therefore a conventional bond. BPTT issuance amounted to 5% of public debt in 1956.

The BEIA was issued on May 22nd and subscription was closed on June 21st 1956. It paid coupons on June 1st of each year (Décret n°56-476 1956). It had a fixed interest

rate of 5% and a bonus in any given year equal to 5% of the difference between industrial production of the previous year and the level in 1955 (the index used 1952 as its base year, and equaled 119 in 1955). The industrial production index was published by the National Institute of Statistics and is a weighted average of French industries. The terms of the BEIA were explained in the press with examples of their computation, mentioning that a minimum interest of 5% was guaranteed for subscribers, even if production declined. In a statement to *Le Monde*, Mr. Ramadier, Minister of Economic Affairs, highlighted the likely return of the bond given the recent performance of France's industrial production index (Le Monde 1956c). The funds would be used to invest in agricultural and industrial infrastructure. BEIA issuance represented 19% of the public debt in 1956.[9]

The bond was well received in the financial press. For example, the *Journal de Finances* on June 1st, 1956, writes "From every point of view, the formula for the Industrial and Agricultural Equipment Bonds appears well designed; it bears the mark of ingenuity developed over many years by the Treasury to offer savers investments that meet their aspirations. The information published on the initial results of the operation confirms this opinion since, four days after its opening, subscriptions already exceeded 20 billion francs."

3.2 Bond Coupons and Prices

Given the bond's terms, the cash flow from owning a 100 new French francs BPTT bond in year t is:[10]

$$C_{t,BPTT} = \begin{cases} 5.5, & \text{if the bond is not redeemed in year } t \\ 5.5 + 105, & \text{if the bond is redeemed in year } t \end{cases} \tag{1}$$

[9] To put this figure in modern perspective, inflation-indexed bonds represent roughly 10% of total marketable current U.S. or French debt.

[10] In the computations of spreads, we forward the cash flows of the BPTT bond one month using the monthly yield for a French perpetual government bond in order to match the payment dates between the BPTT and the BEIA bonds.

while the cash flow in French new francs for the BEIA bond was given by:

$$C_{t,BEIA} = \begin{cases} 5 + 0.05 \times (\max(IP_{t-1} - IP_{1955}, 0)), & \text{if bond is not redeemed in year } t \\ 105 + 5 + 0.05 \times (\max(IP_{t-1} - IP_{1955}, 0)), & \text{if bond is redeemed in year } t \end{cases} \tag{2}$$

where IP is the industrial production index.

For any year t, expected cash flows can be computed by taking into account the probability of a bond being redeemed as well as the expected coupons for the state-contingent debt. Figure 1 shows the probability of a bond being drawn for redeemed for any t. Bonds were identified by their serial numbers. A particular bond was drawn in the first year with 6% probability. In the second year, this probability was $\approx 6.4\%$, and so on and so forth. In the penultimate year, the bond was redeemed with 50% probability, and in the last year this probability was 100%. To illustrate how the lottery affects expected bond payments, consider a holder of a bond in January 1970, before the lottery draw. The expected cash flows for the holder of this bond are computed as:

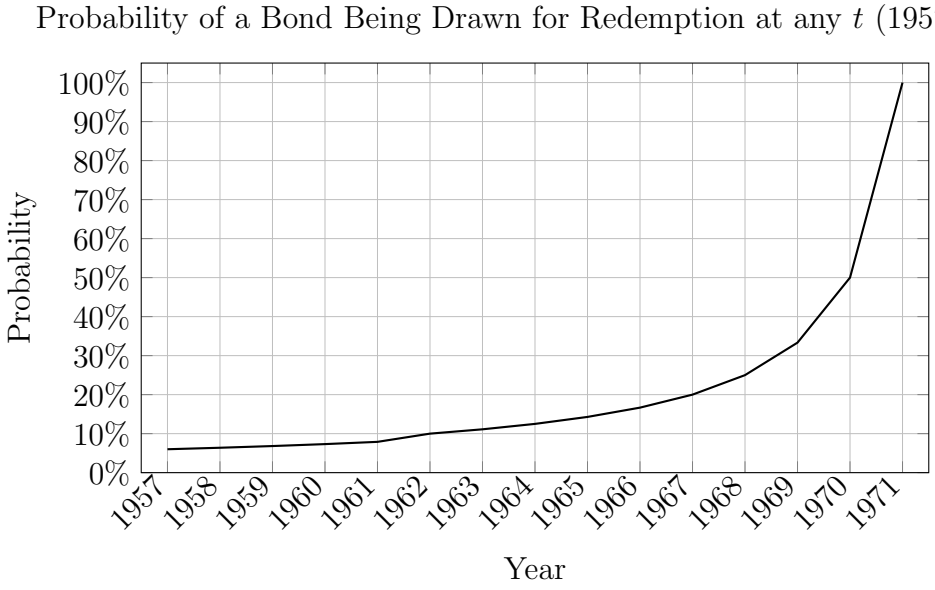
$$C^e_{1970} = 50\% \left(105 + \text{Coupon}^e_{1970}\right) + 50\% \left(\text{Coupon}^e_{1970}\right), \tag{3}$$

$$C^e_{1971} = 50\% \left(105 + \text{Coupon}^e_{1971}\right. \tag{4}$$

In January 1969, there would be three expected coupons, c^e_{1969}, c^e_{1970}, and c^e_{1971}, and so on and so forth for other years.

Figure 2 shows bond prices for the the BPTT and BEIA bonds in the secondary market, plotting the average monthly price between April 1956 and June 1971. Prices for both bonds decrease after a coupon payment, as expected. The figure shows that until 1958 the

Figure 1: Probability of a bond being redeemed from 1957 to 1971. Probabilities increase sharply in later years as fewer undrawn bonds remain.



two bonds had similar prices. However, beginning in that year, the prices of the bonds diverged, with the price of the state-contingent bond (BEIA) increasing, peaking in 1964 and remaining above the price of the conventional bond (BPTT) until maturity. The figure also shows how a negative output shock affects bond prices differentially. For example, the slowdown of the French economy in 1968, when France was hit unexpectedly by a general strike, reduced the price of the state-contingent bond but not the price of the traditional bond.

3.3 Realized and Expected Values for the Industrial Production Index

One crucial input for computing the expected state-contingent debt premium is the expectations for future values of industrial production at different points in time. Unfortunately, there are no private or financial market forecasts available for this period. Instead, we rely on public statements by government officials to newspapers or on publicly available targets published by the public planning commission, as furdiscussed in this section.

Figure 2: Bond prices for the "Bons d'équipement industriel et agricole" (BEIA), a state-contingent bond linked to industrial production, and for the Bons PTTT (BPTTT), a conventional bond. Prices are defined as the average traded price within a month. Source: Authors' calculations using data from Hautcœur and Riva (2018).

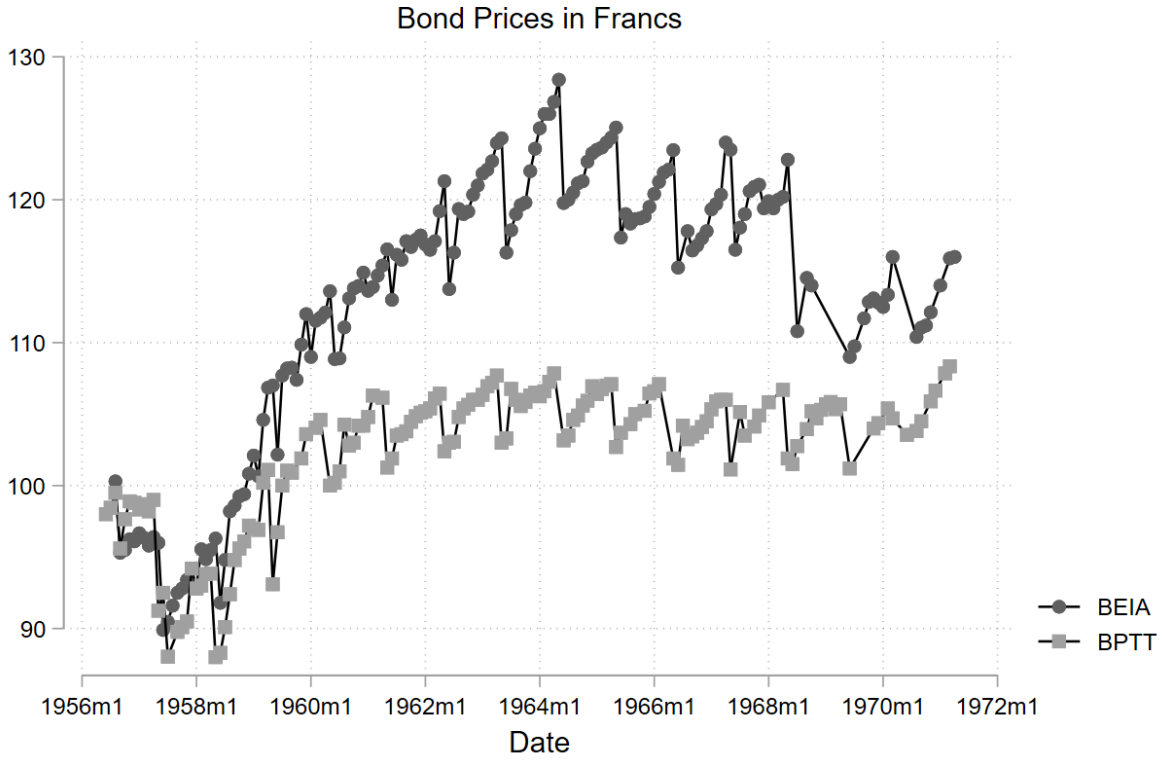
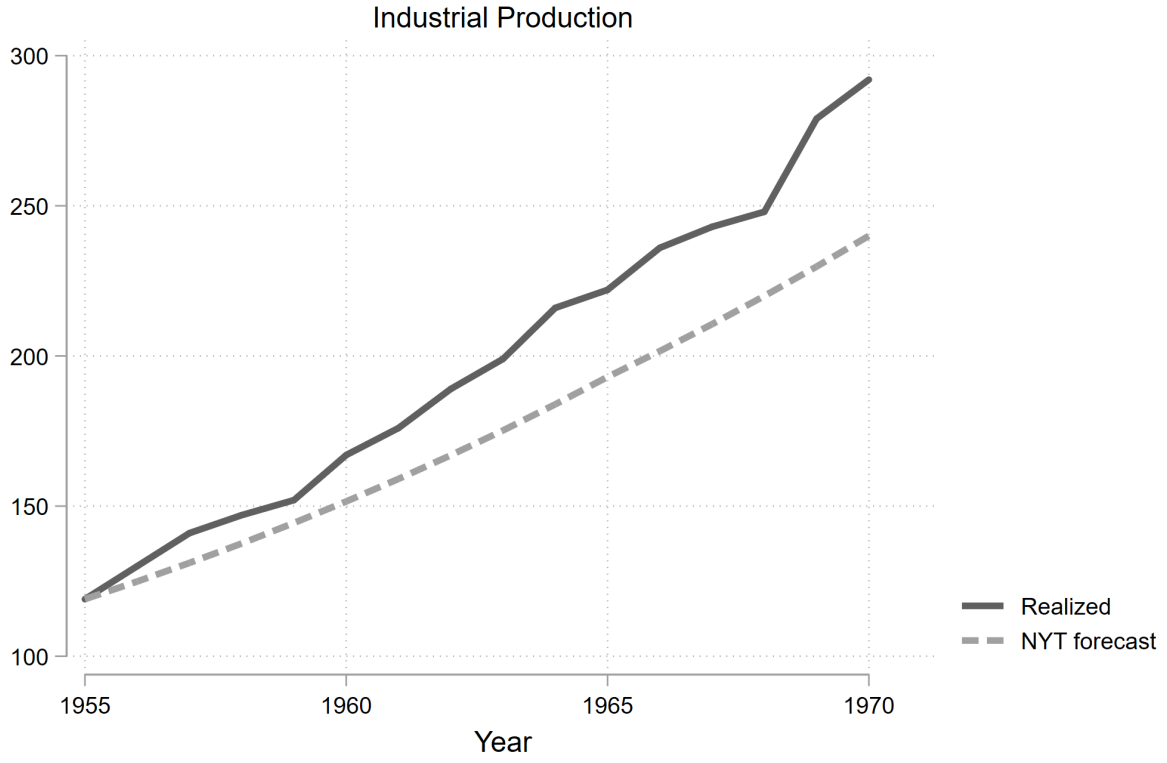


Figure 3 plots the realized level of the Industrial Production Index (full line) as well as the implicit forecast for Industrial Production at issuance (dashed line), based on this quote to the *New York Times* in 1956 by Paul Ramadier, the French Minister of Finance:

> *If the French economy keeps growing at the rate expected by official economic thinking, the new bond (...) a return of 8.65% in the tenth year and about 11% in their fifteenth year.*

Figure 3: Realized Level of the Industrial Production Index (solid line) and Forecast for Industrial Production at Issuance (dashed line) Source for Forecast: *The New York Times*, as described in the text.



From these returns, it is possible to extract the expected value of the industrial production index. A return of 8.65% in the tenth year implies a forecast for the Industrial Production index equal to 193 in 1965 and 240 in 1970.[11] It is possible to see that realized industrial

[11]Note that the provisional value for the value of industrial production in 1955 as reported in *Le Monde*

production greatly exceeded the expected level at the time of issuance. These data are thus consistent with an increase in the price of the bond as shown in Figure 2.

How good were these forecasts? Cited in the *Journal de Finances* on June 1st, 1956, the Ministry of Finance and Economic Affairs refers to a growth in the volume of production equal to 8% in 1965, such that the index with base 1952 would reach around 130, which turned out to be the actual realized number.

In addition to this forecast at the time of issuance, we also use data on the targets for industrial production published in official production plans as part of the government's indicative planning. The index published in the Second to Fifth Plans is slightly different from the one used to compute the coupons for the BEIA bond as it does not include construction or public works. However, it is still highly correlated with the overall production index since construction and public works represented a relatively small share of GDP (5.64% of GDP in 1960). The correlation coefficient of the percentage change in the two indices between 1952 and 1970 is equal to 0.97. Accordingly, to compute the industrial production forecasts, we assume that construction and public works had the same forecast for the growth rate as the forecast in the plan to compute the relevant industrial production index. Note also that these forecasts are reported as values for industrial production for a specific year. To determine yearly values, we assume a constant growth rate between the forecast date and the forecast's final year, which is the number provided in the plans.[12]

Using these forecasts, we obtain four waves of expectations for industrial production. First, the forecast published in the *New York Times* is shown in Figure 3. Then, we use the three forecasts published in each indicative plan. The Second Plan predicted that the industrial production index without public works and construction would be equal to 124 in

was 120 (Le Monde 1956b), later revised to 119. To compute these forecasts for the industrial production index, the value of 120 is used.

[12]Wickham (1963) shows that the deviations from the forecast IP between the first and fourth plans shrunk, indicating improved forecasting.

1957. The realized index value of IP turned out to be 146. Note that bond payments were based on an industrial production index including public works and construction. Following our assumption that construction and public works have the same growth rate as the forecast in the plan, we obtain an expected value for the relevant industrial production index equal to 123 and a realized value equal to 141.

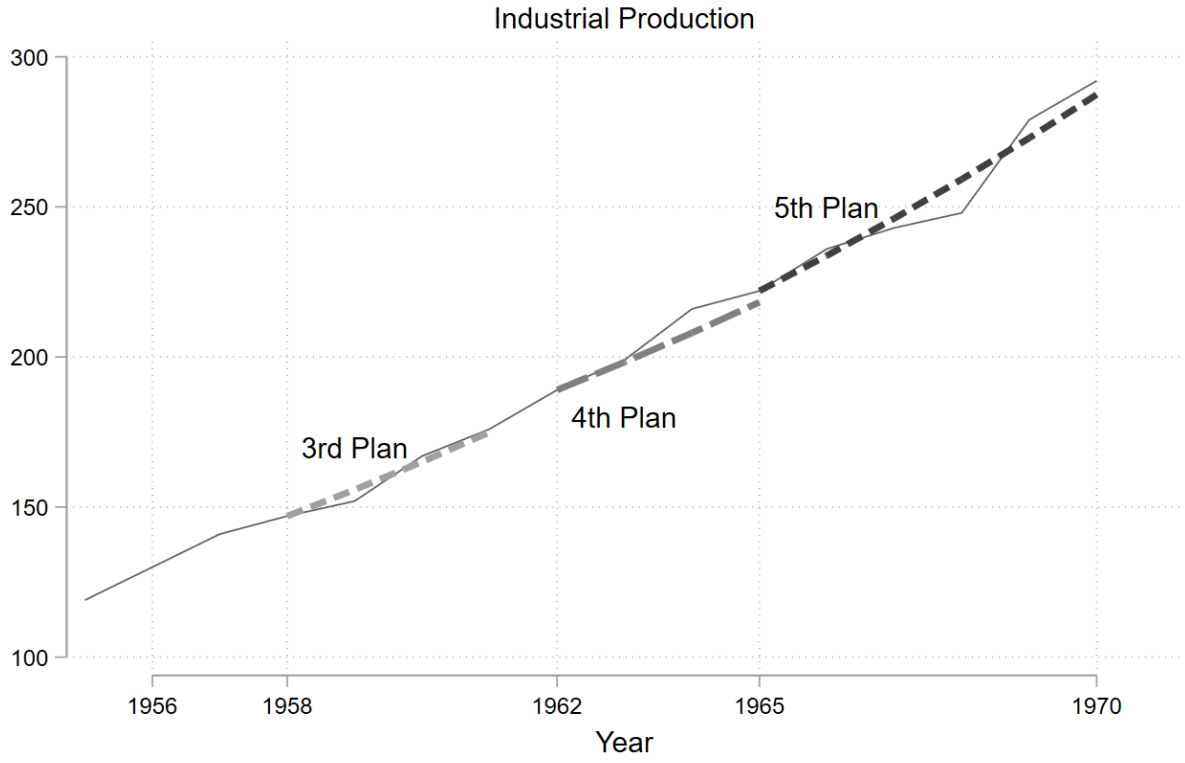
Industrial production in the Third Plan for 1961 was expected to be 175, while the realized value of the index turned out to be 176.[13] The Fourth Plan predicted IP to be 218 in 1965, while the realized value turned out to be 222. Finally, for the Fifth Plan, the forecast was 259 for 1968 and 287 for 1970; realized values of IP turned out to be 248 in 1968 and 292 in 1970 (Commissariat général du Plan 1959; Commissariat général du Plan 1962; Commissariat général du Plan 1965).

Figure 4 compares the objectives for industrial production as published in the French government plans. Looking at these time-varying forecasts, it is possible to see that there are some instances when realized industrial production was below expected. For example, in 1959, realized industrial production was lower than what was forecast by the Third Plan. The opposite happened in 1964, when the Fourth Plan's forecast ended up lower than realized industrial production. Finally, in the summer of 1968, industrial production fell significantly below the forecast made in the Fifth Plan. (Between May and June 1968, France experienced civil unrest and labor strikes. About 9 million workers, two-thirds of the French workforce and 18% of the French population, were involved in the general strike (Ross 2008).)[14] These short-run deviations from the expected path for industrial production allow us to observe how the estimated risk premia, in expectation, responds to previous realizations that were lower than expected. In other words, they provide short-horizon experiments to investigate how

[13]These values are all re-based for the base year 1952 even though they are published in the Plans with different base years. They are also transformed to match the overall industrial production index including public works and construction as explained above.

[14]Monnet (2018) argues that the widespread labor strikes beginning in May 1968 and their effect on industrial production were unanticipated.

Figure 4: The full line shows realized values for industrial production. The dashed lines represent forecasts at different points in time.



the compensation demanded by investors depends on actual uses of the state-contingency. We turn to the calculation of risk premia next.

4 The State-Contingent Bond Premia

In this section, our primary goal is to measure total state-contingent debt premia. A state-contingent debt premium may be the consequence of investor risk-aversion, which makes fluctuations in payments less attractive for investors and who therefore need to be compensated with higher expected returns (Pina 2024). Alternatively, it can be the consequence of novelty premia (Chamon, Costa, and Ricci 2008), ambiguity, or liquidity premia (Igan, Kim, and Levy 2021; Roch and Roldán 2023). In this section, we describe the strategy to identify the compensation required by investors to hold state-contingent debt, and in the

next section, we explore which explanations are consistent with our empirical findings.

The price of both bonds at issuance are equal to $p_0 = 100$. The strategy is to compute for each t the expected cash flows from a bond purchased at time t for p_t, and obtain internal rates of return (IRR), or the yield to maturity. This approach assumes that bond holders purchase the bond at t and hold the bond until maturity or until it is redeemed through a lottery provision.[15] The state-contingent debt premia is then given by the difference between yields of the state-contingent bond and the traditional bond.

Although the quasi-twin bond strategy has many advantages, a few challenges remain. The first is the redemption lottery, which impacts both bonds and makes any particular bond's maturity date unpredictable. Thus, even for the benchmark BPTT bond, which has a fixed coupon, it is necessary to compute expected cash flows at each period in time. To compute the expected coupon and the yield to maturity, consider a BPTT bond that was bought in month m and year y, where $m = 5$ and $y = 1$ represents May 1956. Let n represent the number of months until the next coupon payment, which for a BPTT bond occurs annually on May 1, between 1957 and 1971. At $m = 5$ and $y = 1$, or May 1956, n is equal to 12. At $m = 6$ and $y = 1$, n is equal to 11, and decreases once per month until $n = 12$ again at $m = 5$ and $y = 2$. This can be represented by the following expression:

$$n(m) = \begin{cases} 5 - m & \text{if } 1 \leq m \leq 4 \\ 17 - m & \text{if } 5 \leq m \leq 12, \end{cases} \tag{5}$$

where $n\,(m)$ represents the number of months until the next coupon payment. Then, for

[15] An alternative method would be to compute a price-based return, where the total bond return is given by the monthly percentage change in the price of the bond plus the coupon divided by the price of the bond in the previous month. This is the method used in Meyer, Reinhart, and Trebesch (2022) to average across bond returns. However, the data on French state-contingent bonds will sometimes yield negative values for a monthly total return. Therefore, our analysis focuses on using the internal rate of return method. Another option would be to compute the theoretical price using a discount rate as the present value of expected cash flows and compare it to the empirical price. Given that there is a quasi-twin bond, the yield to maturity approach relies on fewer assumptions, for example, on the relevant discount rate.

each m, y, we compute the expected yield to maturity, YTM using the following expression:

$$p_{m,y} = \sum_{i=1}^{15-y} \frac{C^e_{y+i}}{(1+YTM)^{\frac{(i-1)\times 12+n(m)}{12}}} \tag{6}$$

where $y = \{0, 1, 2, 3, \ldots, 14\}$, $p_{m,y}$ is the price of the bond at month m and year y, and C^e_{y+i} represents the expected payments from the bond. For the final year, $y = 15$ and $m = \{1, 2, 3, 4\}$,

$$p_{m,15} = \frac{C^e_{15}}{(1+YTM)^{\frac{5-m}{12}}}. \tag{7}$$

The second issue is how to estimate expected coupons for the state-contingent debt. We use the projections of industrial production published by the French government in their indicative plans (and discussed in the data section) to compute expectations for industrial production. Indicative planning provides an alternative source to compute the expected coupons, and one that was freely available to investors. However, given that these IP forecasts are for three to five years, it is crucial to match the maturity of the bond coupons with the forecast provided in the plans. That is, if the forecast is for the next three years, we compute coupons only over three years; we assume that the bond is bought immediately after paying a coupon and redeemed at the end of the forecast.

A third potential issue concerns differences in the amount of issuance of the two bonds used in the quasi-twin experiment. In 1956, the total issuance of BPTT was 217.24 million new Francs while the total issuance of BEIA was 813 million new Francs. Given both bond issues represented a significant share of outstanding public debt, as a baseline, we assumed that there was ample liquidity in the secondary market such that the liquidity premia is zero. However, if we instead assume a positive liquidity premia, given the conventional bond (BPTT) was one quarter the size of the issuance of the SCDI bond (BEIA), this would imply that our estimates of a state-contingent debt premia represent a lower bound. Note

that there were other public bonds trading at this time, including BPTT bonds with similar structure issued in 1950, 1953, 1954, 1955, 1957, and 1958. These issuances had coupon rates between 5.5% and 6% and had similar structures to the 1956 bond. The 1955 and the 1957 BPTT bonds amounted to 240 million new Francs each (Daage 1957). The repeated issuance of BPTT bonds creates a sort of 'series' effect where the market may perceive a continuous and stable supply of these PTT bonds, perhaps reducing its liquidity premium. In a robustness check, we show that there were no significant liquidity differences between the two bonds considered here.

4.1 Realized State-Contingent Premia

Figure 5 plots the expected cash flows from holding the BPTT bond (solid line), the expected cash flows from holding the state-contingent BEIA bond using the forecast for industrial production at the time of issuance (and obtained from the *New York Times*) (dottend line), and the realized cash flows from holding the BEIA (dashed line).

Figure 6 plots realized yields to maturity between May 1956 and 1971. Each dot represents an estimated yield to maturity. Missing observations occur because, for some months, there is no secondary market price for one of the bonds. Figure 7 computes the realized spread as the difference between the two yields to maturity. Again, each point represents an observation for which it was possible to compute the yields of both bonds. The average realized spread was 114 basis points. These plots show that initially the state-contingent risk premia was falling. This is consistent with the performance of the French economy, which moved the state-contingent bond well beyond the threshold at which the bonus would not be paid. In fact, at the end of 1963 and the start of 1964, the realized spread was negative. In 1964, growth in industrial production fell and the estimated risk premia increased. However, by the start of 1968 it was once again negative as the French economy continued its rapid expansion. In May-June 1968, the French economy entered a period of unanticipated

Figure 5: Expected coupon payments in francs on a 100 franc bond for the BPTT (solid line), expected cash flows for the BEIA using the forecasts for industrial production at issuance (dotted line), and cash flows with realized industrial production for the BEIA (dashed line).

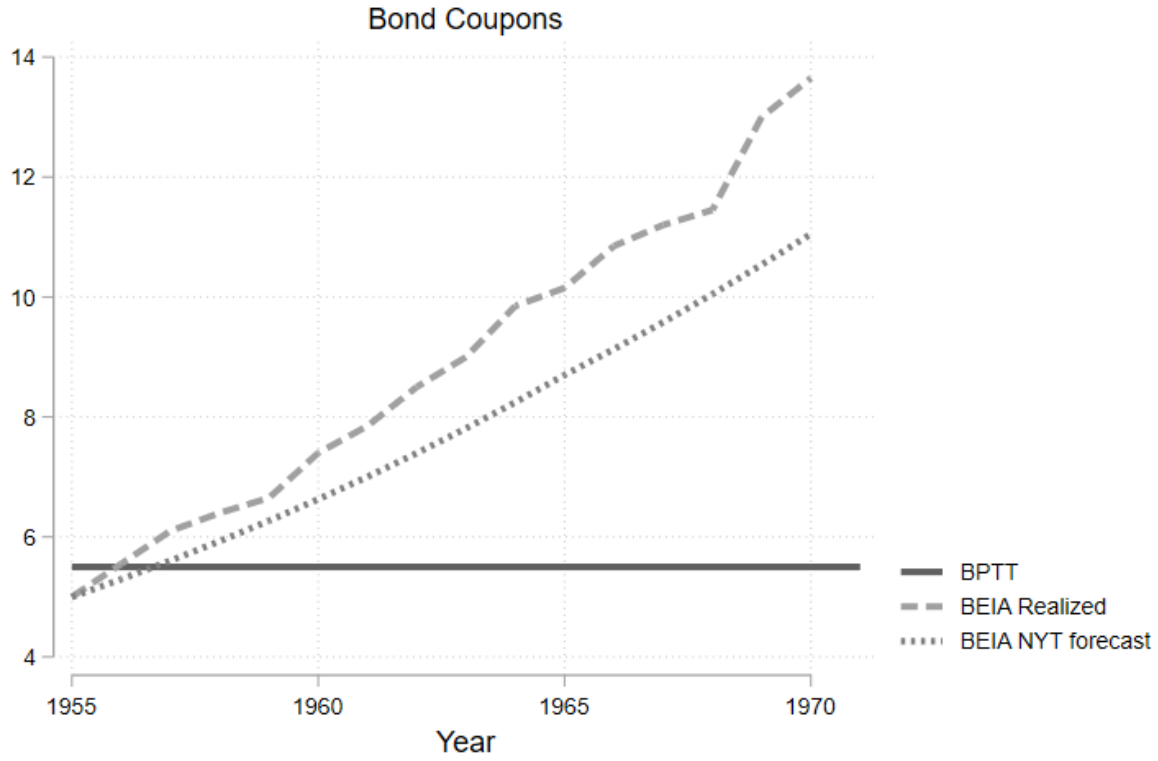
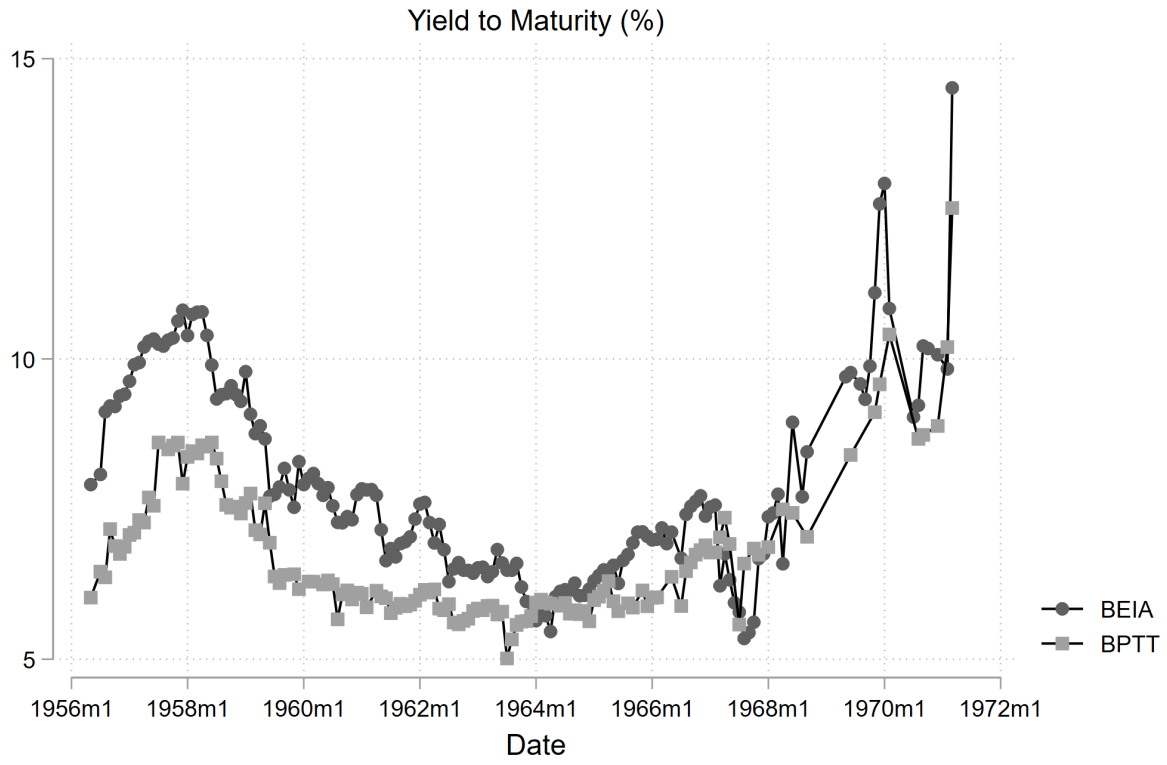


Figure 6: Realized Yields to Maturity.

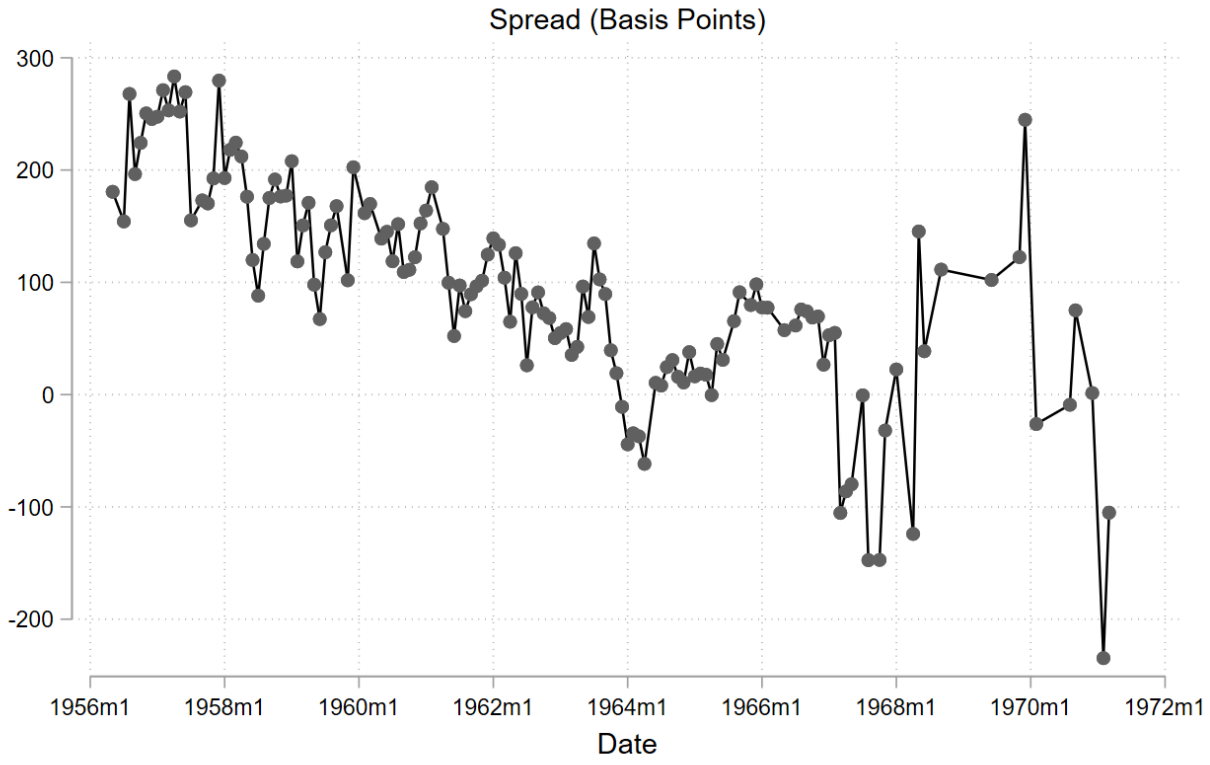


significant turmoil and the estimated risk premia increased substantially. Student protests broadened into a widespread general strike that unexpectedly reduced production in the summer of 1968, with the IMF estimating at that time that GDP falling by 2% in response (IMF, 1969, p.78). Towards the end of our sample period, spreads fluctuate more, in part due to some missing observations, but remain at an elevated level.

4.2 Expected State-Contingent Premia

Using the date of issuance forecast mentioned in the *New York Times*, we obtain an expected spread at issuance equal to 112 basis points, a value that is lower than the realized premium at issuance (181 basis points). It is also possible to compute three additional expected spreads using the forecasts provided by the indicative plans from the French gov-

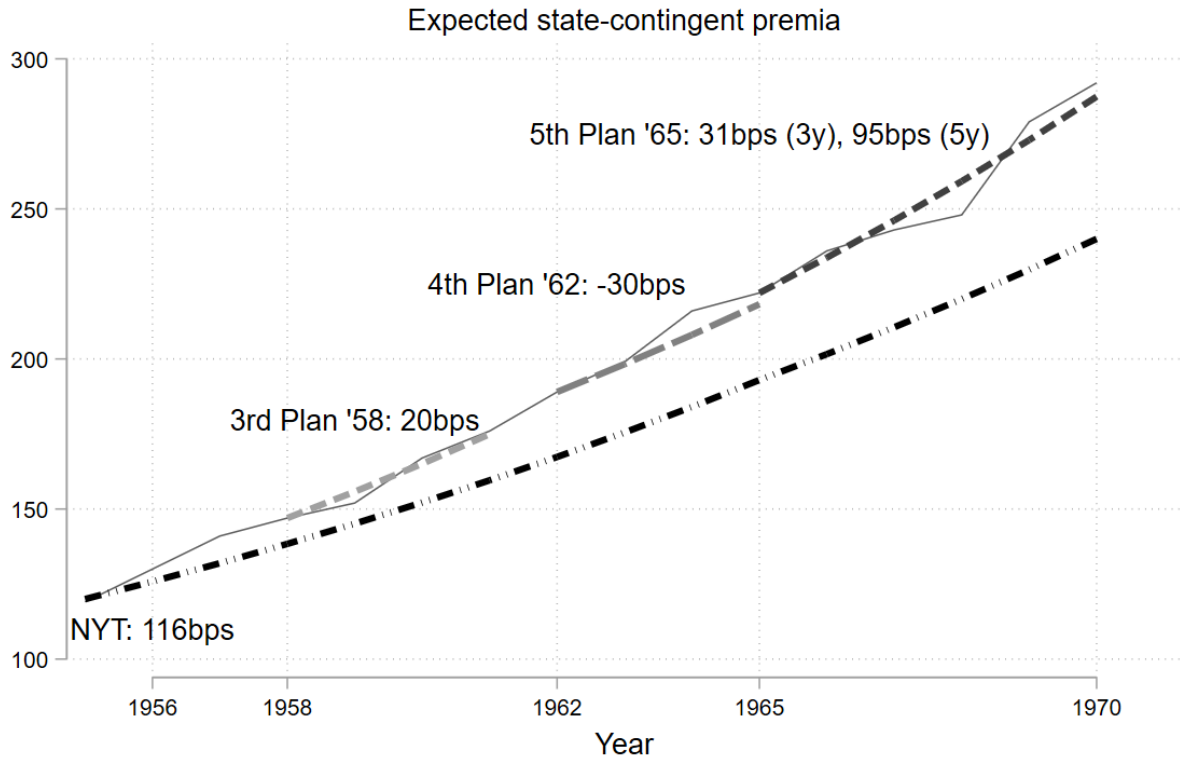
Figure 7: Realized State-Contingent Spread.



ernment. As mentioned earlier, these plans had horizons of three to five years. To simplify, we assume that the two bonds are redeemed at the end of each forecast, and that each bond is bought right after paying a coupon. For example, the Third Plan was completed during 1958 and provided forecasts for industrial production for 1959, 1960, and 1961. Computing the internal rate of return under the assumption that both bonds are redeemed in 1961 yields an expected state-contingent debt premia equal to 20 basis points in 1958. Doing the same exercise for the Fourth Plan in 1962, one obtains an expected state-contingent debt premia equal to -30 basis points in 1962. Finally, for the Fifth Plan, we run two exercises – one with a three-year maturity (to match the other forecasts) and one with a five-year maturity – as in the indicative plan itself. For the three-year maturity exercise, we assume that the bond was bought in 1965 and redeemed in 1968. For the five-year exercise, we assume the bond was redeemed only in 1970. The three-year maturity exercise has an estimated expected state-contingent debt spread of 31 basis points in 1965. Figure 8 summarizes the results for the expected state-contingent debt premia.

Taking the average of the three estimates for the three-year maturity expected state-contingent debt spreads, one obtains a state-contingent debt premia equal to 8 basis points. The five-year exercise shows an estimated expected state-contingent debt spread of 95 basis points in 1965. These findings highlight how maturity may play a role in the determination of expected state-contingent debt premia. They also suggest that when the economy is performing relatively well, the state-contingent debt premia is decreasing. However, a negative shock, as was the case in 1968, quickly increases it. Referring back to Figure 2, we can see that following May 1968, bond prices for the state-contingent bond significantly declined while those for the traditional bond did not. In other words, following the unexpected negative shock to industrial production, the spread between the two bonds went from about zero to about 150 basis points, and remained elevated until 1970. These findings appear to be consistent with an asymmetric response of premia to shocks.

Figure 8: Expected State-Contingent Spread at issuance in 1956, and in 1958, 1962, and 1965. The dashed lines show different waves of expected levels of industrial production, while the full line shows realized industrial production.



Finally, how much insurance was provided by the state-contingent bond in May-June 1968? To answer this question, we can compare the coupon payment on the BEIA bond in 1969, which reflects the realization of industrial production in 1968, with the expected coupon at the start of 1968, before the massive labor strike. Given the structure of the bond, the expected coupon in 1969 was 7.01 francs. The realized coupon was 6.45 francs, which corresponds to 92% of the expected value. We can also compute the maximum reduction implied by the structure of this bond. If the industrial production index had collapsed to the 1955 level, the coupon would be 5 francs, 71% of the expected payment on this bond.

5 Unpacking State Contingent Debt Premia

5.1 Liquidity Premia

One assumption in the calculation of the state-contingent debt premia was that liquidity premia was the same between the two bonds, such that any remaining differences in yields corresponded to the state-contingent debt premia. However, the state-contingent bond is larger in volume issued than the traditional bond, and liquidity could potentially play a role. Unfortunately, direct measures of liquidity, like volume traded or bid-ask spreads are not available for these bonds. To account for potential differences in liquidity premia between the two bonds, we estimate the implicit bid-ask spread using the simple Roll test Roll (1984), which allows us to estimate the effective bid-ask spread using only price data and which has been shown to effectively capture liquidity spreads (Goyenko, Holden, and Trzcinka 2009).

The main assumption in the Roll model is that in the absence of new information, and under efficient market conditions, price changes (or returns) are primarily driven by the bid-ask bounce—a phenomenon where transaction prices oscillate between the bid and ask prices. This bid-ask bounce introduces a negative serial correlation in returns. By quantifying this negative serial covariance, we can estimate the effective bid-ask spread, which serves as a proxy for liquidity. By assumption, the bid-ask spread is constant over the period analyzed.

Let P_t denote the price of the bond at time t. The Roll model can be used to estimate the effective bid-ask spread S (expressed in francs) based on price changes as follows:

$$\delta_t = P_t - P_{t-1},$$

where δ_t represents the change in price from $t-1$ to t. The implicit bid-ask spread is then given by:

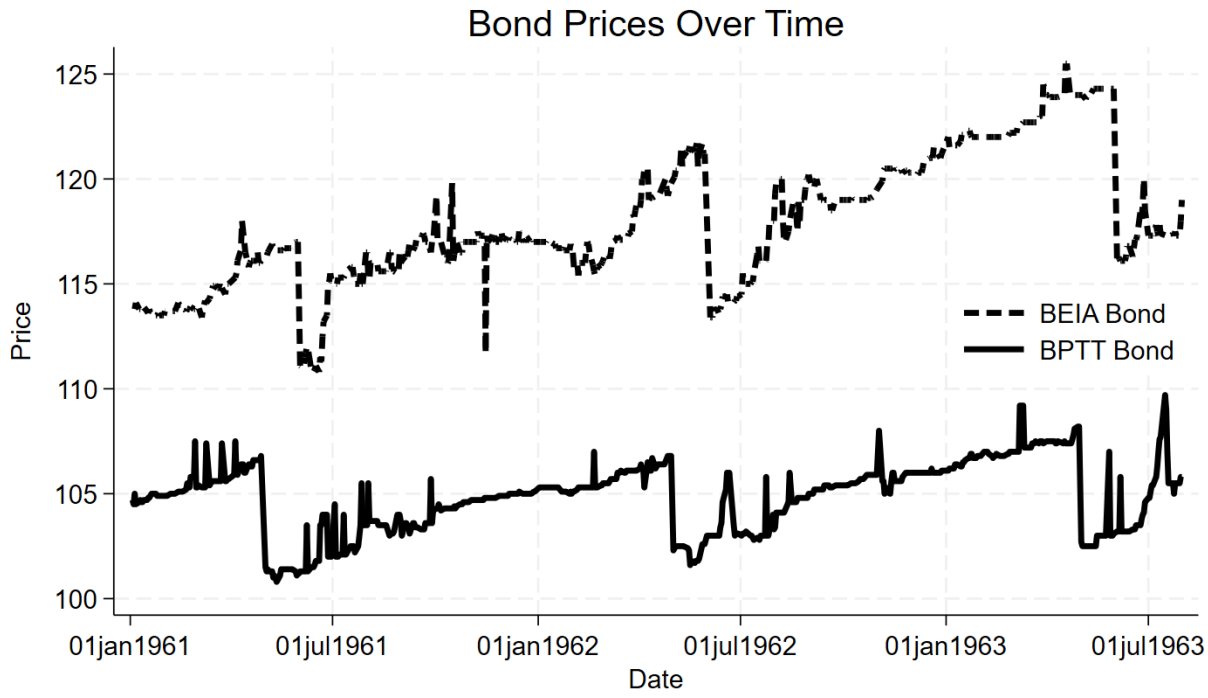
$$S = 2\sqrt{-\operatorname{Cov}(\delta_t, \delta_{t-1})},$$

provided that $\operatorname{Cov}(\delta_t, \delta_{t-1}) < 0$. The factor of 2 accounts for the round-trip cost of transacting at both the bid and ask prices. A negative serial covariance $\operatorname{Cov}(\delta_t, \delta_{t-1})$ indicates the presence of the bid-ask bounce effect, allowing for the estimation of S. A larger estimated spread implies lower liquidity as it suggests higher transaction costs due to a wider bid-ask spread.

To implement the Roll test, we hand- collected daily price data for the two bonds published in the *Cote Desfossés* from the French National Library. Unfortunately, editions prior to 1961 are currently reserved for digitization, and not accessible while other volumes have been deemed by the archivists as too fragile to be consulted and are also being safeguarded for digitization. Therefore, to date, we have thus collected a consistent daily sample between January 5th 1961 and July 31st 1963. The August 1963 volume was not authorized to be released. Although this covers only a subsample of our data, it still provides us with 562 daily observations, which are sufficient to run the Roll test.

That said, there are at least two advantages to using data from 1961 to 1963 for this exercise. First, this is after the period of instability that saw the end of the Fourth Republic and the start of the Fifth Republic in 1958. Second, these years correspond to a period when most of the original bond issuance is still being traded. Recall that each year a portion

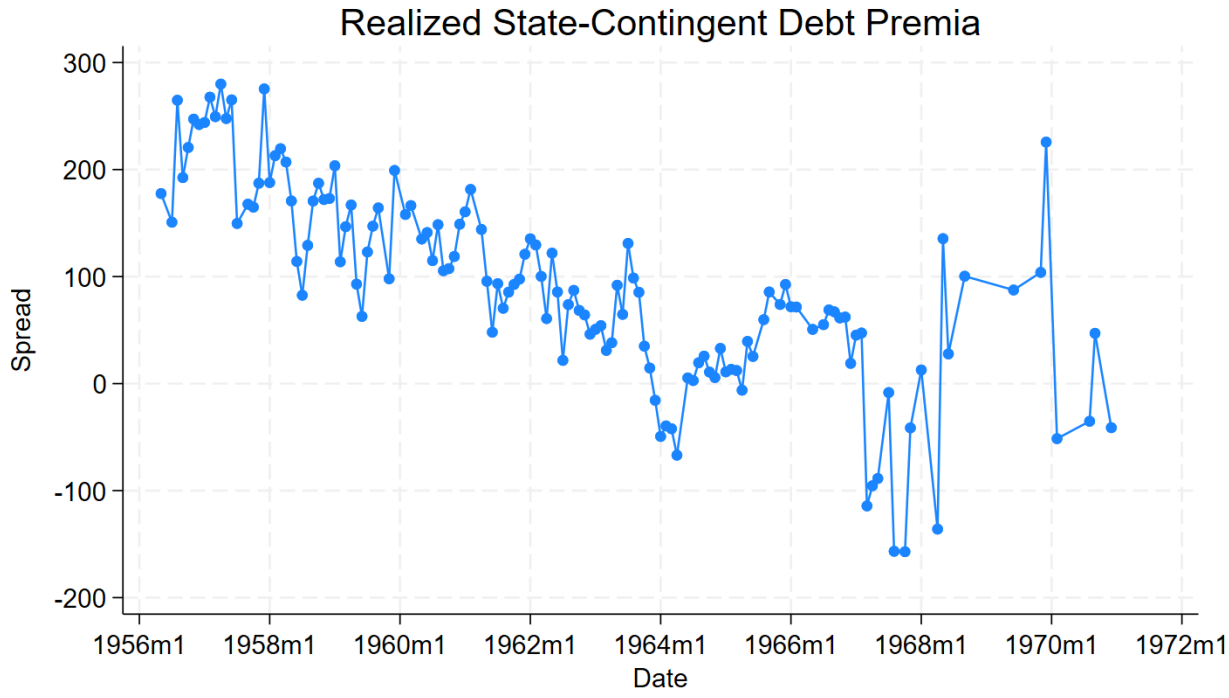
Figure 9: This figure displays the daily prices of the BEIA and BPTT bonds over the study period. The BEIA bond is represented by a dashed line, while the BPTT bond is depicted with a solid line.



of both the BPTT and BEIA bonds were redeemed through a lottery, which changes the outstanding volume of both bonds. Combined with the general strike of May 1968, it is not surprising that estimates for the state-contingent debt premium are noisier towards the end of the sample.

Figure 9 plots daily prices for the two bonds. We use end-of-day prices for the two bonds. Both bonds during this sample period display negative serial covariance in price. Therefore, we can apply the Roll test. One issue when computing returns is that the bond price naturally drops after the coupon is paid. This is not an issue for the BPTT as the coupon payment occurs on May 1st, a date where the market is closed due to a national holiday. For the BEIA we omit observations that use June 1st to avoid bias in the estimation of returns.

Figure 10: This figure displays the estimated state-contingent debt premia after controlling for liquidity premia using the implicit bid-ask spread computed with the Roll method.



Using the formulas above, we obtain a bid-ask spread equal to 0.71 new francs for the BPTT and 0.59 new francs for the BEIA (0.68% for the BPTT and 0.51% for the BEIA if expressed in rates of return). We can adjust the bond prices using this bid-ask spread and compute the liquidity-corrected state-contingent debt premia. Figure 10 shows the estimated state-contingent debt spread after correcting for estimated liquidity premia. The results are very similar to the estimates without adjusting for the bid-ask spread, suggesting that differential liquidity premia did not likely play a role in these markets.

5.2 Novelty Premia and Maturity

As Chamon, Costa, and Ricci (2008) argue, novelty premia should yield decreasing spreads over time. Our findings for realized premia show initially a negative trend. However, this trend is interrupted in 1963 and then again in 1968. To test for a novelty premia more

Table 1: The table presents results from a regression of spreads (in basis points) on a linear time trend. The constant term represents the estimated spread at the beginning of the period, and the time trend coefficient indicates the average change in spreads over time. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

	(1)
	Realized Spread (basis points)
Linear Time Trend	-1.515***
	(0.160)
Constant	209.9***
	(10.10)
Observations	139
R-squared	0.559

systematically, we run a simple regression of spreads on a linear time trend using monthly data, where the time trend takes on the value of 0 for the first observation of the realized spread. Table 1 shows that the coefficient for the linear trend is negative, which would be consistent with a novelty premia. Although state-contingent debt was common at the time, this was the first public bond issued relative to real variables. However, one issue with this type of test is that it is difficult to disentangle the effect of novelty and maturity. Bonds bought in the secondary market after issuance have, by construction, lower maturities. An alternative hypothesis is that state-contingent bonds with higher maturity are more costly for borrowers. Furthermore, estimates for the expected state-contingent debt premia with three-year maturity do not show a clear decreasing state-contingent debt premia, and they are lower than expected state-contingent debt premia estimates over longer maturities.

5.3 Cyclicality, Risk and Ambiguity Aversion

We use monthly data on business cycle variables from Monnet (2014) to investigate the cyclical properties of our measured realized state-contingent debt premia. Figure 11 plots the estimated state-contingent debt premia together with the Industrial Production Gap

estimated using the HP-filter with smoothing parameter equal to 14,400. In Table 2 we show the results of a regression of realized state-contingent spreads on a linear time trend and on the industrial production gap. Given that the coupon payment is computed with respect to the value of industrial production in the previous year, we include specifications with contemporaneous values of the industrial production gap as well as lagged values. Columns (1) to (4) show that the relevant industrial production gap lag occurs at six months. We further construct a relevant lag for the industrial production gap that incorporates the timing of coupon payments. Given that the BEIA June coupon payment is based on the level of industrial production in December, we construct a variable, Relevant Gap lag, that takes on the five-month lag for spreads estimated in May, four months for April, and one month for January. For the observations between June and December, we use the current industrial production gap since this is the best forecast for the coupon payment on June 1st of the subsequent year.

The results displayed in Table 2 show a positive relationship between the lag in industrial production and the realized spread at the monthly frequency. In other words, the spread is pro-cyclical relative to the business cycle, which is inconsistent with risk aversion, but may be consistent with ambiguity aversion, as shown in Roch and Roldán (2023) and Igan, Kim, and Levy (2021).

Relative to these articles, we find significantly smaller state-contingent debt premia, no differential liquidity premia, and a role for novelty premia. We also find large fluctuations in the state-contingent debt premia that may be difficult to reconcile with ambiguity aversion. For example, in May 1968 the realized spread increased immediately following a significant drop in industrial production due to a general strike, and remained elevated throughout 1969, before decreasing again in 1970. According to ambiguity aversion, the spread should decrease in bad times. However, we observe the opposite.

Figure 11: This figure displays the estimated state-contingent debt premia (left axis) together with the Industrial Production Gap (Gap, right axis) estimated using the HP-filter with smoothing parameter 14,400.

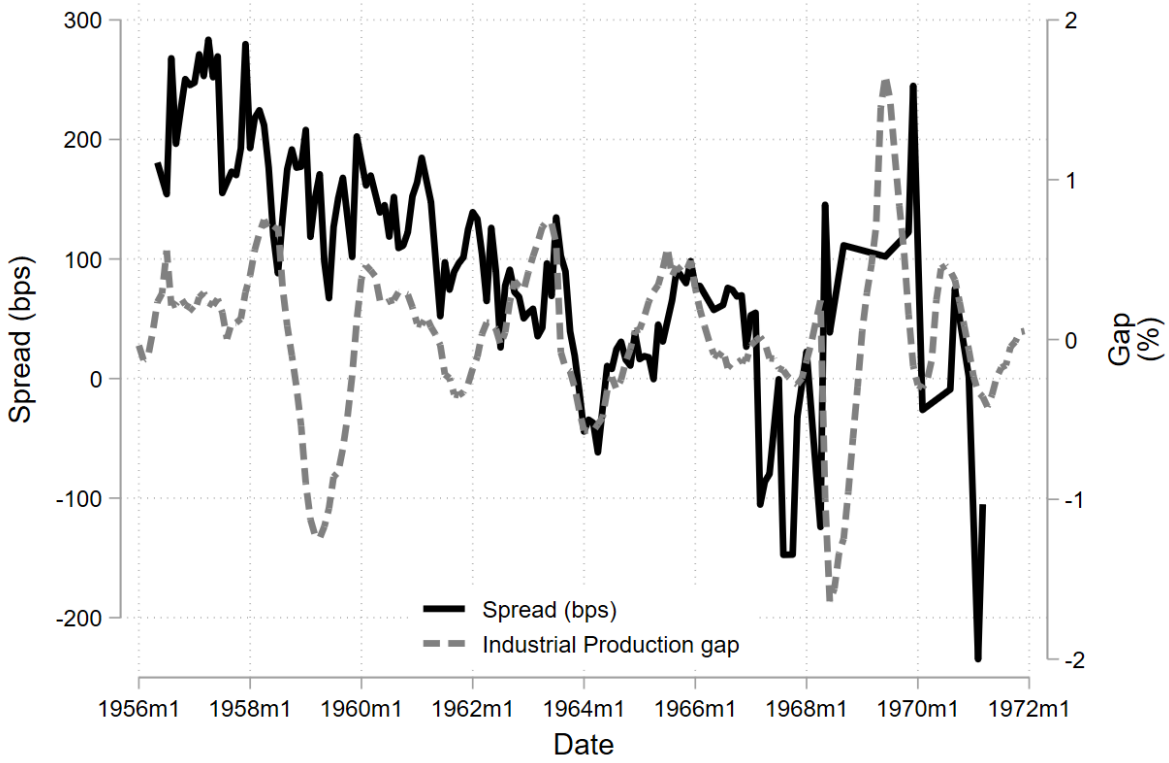


Table 2: This table presents the results from multiple regressions examining the relationship between bond spreads and a time trend variable, as well as the industrial production gap (gap). Models include various lags of the industrial production gap to capture both immediate and delayed effects on bond spreads. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	Realized Spread (basis points)				
	(1)	(2)	(3)	(4)	(5)
Linear time trend	-1.491***	-1.529***	-1.526***	-1.525***	-1.486***
	(0.157)	(0.151)	(0.158)	(0.144)	(0.155)
IP gap at t	20.22			10.66	
	(12.88)			(16.57)	
IP gap at t-6		34.77**		34.03*	
		(17.57)		(18.62)	
IP gap at t-12			-15.30	-12.90	
			(12.61)	(16.24)	
Relevant Gap lag					32.40**
					(15.90)
Constant	207.9***	208.6***	211.1***	208.7***	207.8***
	(9.878)	(10.03)	(9.874)	(9.537)	(9.831)
Observations	139	139	139	139	139
R-squared	0.569	0.585	0.564	0.594	0.577

6 Conclusion

We estimate premia on state-contingent debt instruments (SCDIs) relative to conventional bonds using a quasi-twin bond strategy and unique bond data from postwar France. Our empirical approach is novel in that this state-contingent bond was issued in a developed economy, outside of a debt restructuring, and in a context where indexed bonds were relatively common. And, given that we have a natural control bond, our methodology relies on a limited number of assumptions and therefore provides direct computations of risk premia.

The analysis of bonds issued in France in 1956 shows that the initial expected yield for the state-contingent bond was 112 basis points higher than its conventional counterpart. The realized yields were even larger, 181 basis points. However, by 1964, the premia had fallen to zero. It then increased after the shock of the labor strike in the summer of 1968. These results suggest that the state-contingent debt premium may be relatively low in good times, when the bonds are paying well above the minimum threshold, but may actually be large at issuance or in bad times. Crucially, these may be the periods when this debt is most useful for borrowers. Our findings are consistent with the existence of a novelty premia in state contingent debt, pro-cyclical risk premia outside of extreme events, but counter-cyclical risk premia during large shocks. However, contrary to previous research, our results suggest that state-contingent debt may not be prohibitively expensive, preserving the potential benefits of state contingency.

Future research could extend our analysis to other state-contingent public bonds in France or to private bonds with state-contingent features. Although it may be difficult to implement a twin-bond strategy for these bonds, other approaches may be employed to explore this unique laboratory from history. Additionally, a structural analysis could complement the approach taken in this paper. Finally, investigating the long-term performance of SCDIs, particularly their impact on debt sustainability, is another area calling for additional research.

Our findings contribute to the understanding of state-contingent debt markets and highlight the costs of issuing these types of debt; however, a full account of costs and benefits is necessary to inform policy makers and market participants.

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