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Monetary & Fiscal Regime Switching in the Eurozone

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To my Family

ABSTRACT

The primary purpose of this dissertation is to examine and identify regime switching of the monetary policy rule of the European Central Bank and fiscal policy rules of the state members of the Eurozone after the adoption of the single currency and the application of the Stability and Growth Pact.

The classification for the regimes originates from the debate about the Ricardian Equivalence and whether the fiscal authority backs the interest-bearing debt by committing to levy a stream of future taxes or the central bank finance new deficit with seigniorage revenues. The prevailing regime influences the private agent's expectation and could enable departures from the Equivalence.

When fiscal policy is assigned to stabilize debt, monetary policy targets inflation. Otherwise, fiscal policy determines the price level, while monetary policy prevents the debt from becoming unstable. This last regime may be necessary if an economy hit its fiscal limit and the fiscal policy cannot make the adjustment needed to stabilize the debt. In the absence of a coordinated switch of both the authorities, the inflation targeting and the debt stabilization could fail.

The empirical research carried out with Markov-switching regression method brought some evidence in favour of the monetary and fiscal policy regime changes occurred in the Eurozone.

The first chapter covers the debate on Ricardian Equivalence. The second chapter describes the interactions between the monetary and fiscal authorities and identifies the respective regimes. The third chapter illustrates the fiscal limit and the concept of debt sustainability. The fourth and conclusive chapter contains the findings of the empirical study.

CONTENTS

"Is public debt issue equivalent to taxation?
This is an age-old question in public finance theory.
David Ricardo presented the case for affirmative."
James M. Buchanan, 1976

1 THE RICARDIAN EQUIVALENCE

The Ricardian equivalence proposition was developed by the British 19th century political economist David Ricardo (1772 – 1823). The theory claims that the government decision of funding a given pattern of government spending, with either debt or tax backing, should be perceived as equivalent. Therefore, neither deficit nor debt has any effect on aggregate demand, interest rates, capital formation and, as a result, on the economic activity. For it to hold, it is required that household base their consumption choices not simply on their current income but on some notion of wealth.

A crucial part of this reasoning hinges on the *Permanent Income Hypothesis* (PIH) developed by Milton Friedman (1957), as well as on the *Life Cycle Hypothesis* (LCH) of Franco Modigliani and Richard Brumberg (1954). The theories assume that economic agents are fully informed and make their consumption decisions rationally. Moreover, the households base their consumption both on their total wealth and on currently available income. Further, they prefer pursuing a stable path of consumption aligned with their long-term average income through the *consumption smoothing*, that is a balancing act of saving and spending during their lifetime horizon. Furthermore, this theory yields other two main implications. Firstly, the consumption behavior is not affected drastically by transitory short-term events, and it is likely to respond less than one-for-one to variations in current income. Moreover, consumption path may develop even if current income does not fluctuate under foreseen future expectations.

Had this been widely acknowledged, and when the Ricardian proposition holds, *"the implied future taxes are perceived and discounted by the private sector, the current-period tax reduction will be used to increase [one-for-one] private saving to pay for future taxes, and government debt will be absorbed without any real effects on the economy."*(Kormendi, p. 994, 1983)

On the other hand, if the Ricardian equivalence shall not hold, "*a current-period tax reduction financed by issuing government debt shifts the timing of tax collection from the current period to the future. If the future taxes implied by government debt are not fully perceived and discounted by the private sector, there will be a 'net wealth effect' that increases private sector consumption, thus reducing capital accumulation and growth."* (Kormendi, p. 994, 1983).

The Ricardian equivalence has a primary role in the theoretical investigations of monetary and fiscal impacts. As Robert J. Barro remarked (1974), the premise that this argument does not hold provides a crucial point *"explicitly or implicitly, in demonstrating real effects of a shift in the stock of public debt [...], a positive effect on aggregate demand of 'expansionary' fiscal policy—which is defined here as a substitution of debt for tax finance for a given level of government expenditure."*

1.1 DAVID RICARDO "ESSAY ON THE FUNDING SYSTEM"

Ricardo submitted for the first time his economic proposition of the equivalence in the *"Essay on the Funding System"* (1820). In his work, he presented several observations about the *"Sinking Fund"*, and then shortly examined the best approaches to back the yearly government expense in both war and peacetime.

The Sinking Fund was a sovereign wealth provision fund adopted in 1716 by Great Britain under the administration of Sir Robert Walpole. In theory, the fund aimed exclusively to discharge the public debt in peacetime and to avoid overexpansion during a war.

"Ministers were accustomed to tell the House that they must have a sinking fund to meet exigencies, to second the efforts of our armies and generals, and to inspire the enemy with a salutary respect for us. But the legal and the original intention of the Sinking Fund was, to pay off the national debt."

(Ricardo, Speech 1 June 1821, 1951, V, pp. 119–20)

In theory, the Sinking Fund would have provided a plan for the periodical redemption of each contracted loan. Thus, it would have pushed awareness among the government and the private sector concerning the resulting pattern of future tax duties and required time to fully repay the debt. Nevertheless, Ricardo criticized what the fund had become—although praising its purpose—due to the opportunistic behavior of politicians who allegedly turned it into an instrument of *"mischief and delusion."*

However, it is in the second part of the speech that Ricardo laid the foundation of the famous equivalence that would then be remembered with his name.

"Suppose a country to be free from debt, and a war to take place which should involve it in an annual additional expenditure of 20 millions—there are three modes by which this expenditure may be provided; first, taxes may be raised to the amount of 20 millions per annum, from which the country would be totally freed on the return of peace; or secondly, the money might be annually borrowed and funded, in which case, if the interest agreed upon was 5 per cent., a perpetual charge of 1 million per annum taxes would be incurred for the first year's expense, from which there would be no relief during peace, or in any future war,—of an additional million for the second year's expense, and so on for every year that the war might last. At the end of twenty years, if the war lasted so long, the country would be perpetually encumbered with taxes of 20 millions per annum, and would have to repeat the same course on the recurrence of any new war. The third mode of providing for the expenses of the war would be to borrow annually the 20 millions required as before, but to provide by taxes a fund, in addition to the interest, which, accumulating at compound interest, should finally be equal to the debt. In the case supposed, if money was raised at 5 per cent., and a sum of 200,000l. per annum in addition to the million for the interests were provided, it would accumulate to 20 millions in forty-five years; and by consenting to raise 1,200,000l. per annum by taxes for every loan of 20 millions, each loan would be paid off in forty-five years from the time of its creation; and in forty-

five years from the termination of the war, if no new debt were created, the whole would be redeemed, and the whole of the taxes would be repealed. Of these three modes we are decidedly of opinion that the preference should be given to the first. [However] In the point of economy there is no real difference in either of the modes, for 20 millions in one payment, 1 million per annum for ever, or 1,200,000l. for forty-five years, are precisely of the same value."

In summary, Ricardo considered as equivalent *"in point of economy"* the three modes indicated to back the war, i.e. wholly by taxes, by annually borrowing the sum and perpetually financing only the interest due, or by borrowing the sum and providing a sinking fund to pay back the principal as well as the interest.

1.2 "ARE GOVERNMENT BONDS NET WEALTH?"

Robert J. Barro in 1974 addressed the longest-lived question in public finance: *"Are Government Bonds Net Wealth?"*

Previously, against the proposition of net wealth, J. Tobin (1971, p.91) noted in a paper published originally in 1952: *"How is it possible that society merely by the device of incurring a debt to itself can deceive itself into believing that it is wealthier? Do not the additional taxes which are necessary to carry the interest charges reduce the value of other components of private wealth?"*.

Moreover, and hence in favor of the Ricardian equivalence M. J. Bailey (1962, pp. 75-77): *"It is possible that households regard deficit financing as equivalent to taxation. The issue of a bond by the government to finance expenditures involves a liability for future interest payments and possible ultimate repayment of principal, and thus implies future taxes that would not be necessary if the expenditures were financed by current taxation. [...] If future tax liabilities implicit in deficit financing are accurately foreseen, the level at which total tax receipts are set is immaterial; the behavior of the community will be exactly the same as if the budget were continuously balanced."*

However, over the course of history, several arguments have been raised against the Ricardian equivalence, and all of them aim to defend the position of a just partial offset of future tax liabilities. Nonetheless, Barro reviews these issues and demonstrates that, under certain circumstances, the Ricardian equivalence does hold. In his dissertation, he presents, first, the argument based on finite lives and with an overlapping generation frame, then, the existence of imperfect private capital markets and government as a provider of 'nonpecuniary liquidity services.' Ultimately, the investigation shifts towards the risk characteristics associated with the government debt issue and their outcomes in the household's balance sheets.

1.2.1 The Effect of Finite Lives – A Model with Overlapping Generations

Suppose that the relevant horizon for the future taxes—corresponding to the residual average current taxpayer existence—will be shorter than that for the interest payment to bondholders; in these circumstances a stream of equal value for interest payments and taxes will have a net positive present value. The first to explicitly advance this

reasoning has been E. A. Thompson in his *"Debt Instruments in Macroeconomic and Capital Theory"* (1967, pp. 1196-1210). However, Barro demonstrates that *"current generations act effectively as though they were infinite-lived when they are connected to future generations by a chain of operative intergenerational transfer."* Moreover, that is, *"there will be no net-wealth effect and, hence, no effect on aggregate demand or on interest rates of a marginal change in government debt."* (1974, p. 1097)
In other words, it is the 'intensity of intergenerational altruism' (Seater, 1993) —here, considered as a bequest motive—to enable the Ricardian equivalence.

1.2.1.a Setup of the Model
Barro uses a variant of the Samuelson (1958) – Diamond (1965) overlapping-generations model with physical capital.

Each (representative) individual lives totally two periods, the first y and the second o (respectively 'young' and 'old'). Generations are numbered consecutively from the 1^{st} which are currently old, living their second period, followed by its descendant 2^{nd}, which are currently young. Furthermore, each person belonging to the i^{th} generation lives only with his immediate descendant $i + 1^{th}$ generation. The amount of people in each generation N is kept fixed and all of them are supposed homogeneous in utility and productivity. No technological innovation over time is taken into account. Individuals work only while young earning w as wage income for a fixed amount of time set to one unit.

An additional fundamental assumption is the perfect functioning of the private capital market. Asset holdings A take the form of equity capital. Government bonds are presented as an additional form in which assets can be owned and their real rate of return r is assumed to be paid off once per period. Expectations for both r and w for future periods are assumed to be static at the current value. The assets holding in the second period of each generation i^{th}, i.e. while old, will be transferred as a bequest to the immediate descendant, $i + 1^{th}$.

Consumption is indicated as c, and it is assumed to occur at the beginning of the period, the same applies for wage payments and receipt of interest income. The focus of the analysis is on shifts in tax liabilities and government debt for a given level of government expenditure, therefore it is assumed for convenience that the government neither demands commodities nor provides public services. Moreover, it is also assumed that the amounts of government debt and taxes are set to zero in this section.

The budget equation for the first period, that is while the agent of i^{th}generation is young is

$$w = c_i^y + (1 - r)A_i^y$$

and for the old period,

$$A_i^y + A_i^o = c_i^o + (1 - r)A_i^o$$

Barro modelled the concern of the old generation for the next one by embedding the maximum attainable utility of $i + 1^{th}$ generation U_{i+1}^*, conditional on given values of endowment and prices, into the i^{th}generation utility function; and then add its own two-periods consumption, c_i^y and c_i^o. It's crucial to explain that the attainable utility of the next generation depends on its the endowment rather than on the gross bequest A_i^o, guaranteeing the transfer of general and unrestricted purchasing power[1]. Thus, the utility function for a member of the i^{th} generation:

$$U_i = U_i(c_i^y, c_i^o, U_{i+1}^*).$$

The allocation of resources to maximize each member's utility must be subject to the past equations and to the inequality conditions, $\left(c_i^y, c_i^o, A_i^o\right) \geq 0$ for all i. The key restriction is that the bequest to the next generation's member cannot be negative, while there's no imposed condition on the asset kept while young. The general solution to the problem for the i^{th} generation will take the following form:

$$c_i^y = c_i^y(A_{i-1}^o, w, r),$$

$$A_i^y = \frac{1}{1-r}\left(w - c_i^y\right) = A_i^y(A_{i-1}^o, w, r),$$

$$c_i^o = c_i^o(A_i^y + A_{i-1}^o, w, r),$$

$$A_i^o = \frac{1}{1-r}\left(A_i^y + A_{i-1}^o - c_i^o\right) = A_i^o(A_i^y + A_{i-1}^o, w, r).$$

As in Diamond (1965), the model is closed by introducing a constant-returns-to-scale production function with capital and labor as inputs, by equating respectively the marginal products of the latter to r and w. Then the current value of r would be determined matching supply and demand of assets,

$$K(r, w) = A_{i-1}^o + A_i^y.$$

The current and future values of K would be constant in the steady state, due to the fact that N is constant and here we abstract from any technical change.
Equating the marginal product of labor to the salary and considering constant return to scale, output is given by,

$$y = rK + w$$

and the clearing condition for the commodity market,

$$c_1^o + c_2^y + \Delta K = y,$$

where ΔK is the change in capital stock between two consecutive periods, it would be nil in steady state.

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[1] *The previous results on the effect of B might not hold if parents were concerned with specific consumption components of their children ('merit good'), rather than with their children's attainable utility.* (see Barro, 1974, p. 1104).

1.2.1.b Government Debt

The model then allows for a government debt issue of a real-valued one-period bond yielding interests, rB, in the current period and repaying the principal, B, in the next. Equity and government bonds are here regarded as perfect substitutes by asset holders. The issue process is assumed to take the form of a helicopter drop to currently generation 1 (while old) households, which is assumed to occur at the beginning of the period. Equivalently, bonds could be sold on a competitive market and the proceeds assumed to be used as lump-sum transfer payment. Moreover, allowing for some portion of the proceeds to go to generation 2 (while young) households would not alter the basic results.

The future interest payments are financed by a lump-sum tax levy on the generation 2 households (while young), the principal will be paid out—bond reissuing is not an option—at the beginning of the next period thanks to an additional lump-sum tax levy on generation 2 (while old).

The generation 1 (old) budget constrain for the current period is now

$$A_1^y + A_0^o + B = c_1^o + (1-r)A_1^o.$$

For generation 2 (young), the current budget constraint, where rB represents the tax levy, is now

$$w = c_2^y + (1-r)A_2^y + rB.$$

The next period's budget constraint for generation 2 (old), where B is the principal repayment, is now

$$A_2^y + A_1^o = c_2^o + (1-r)A_2^o + B.$$

The two constraints for the generation 2 members can be combined into a single two-period budget equation, in order to derive their attainable utility U_2^*,

$$w + (1-r)A_1^o - B = c_2^y + (1-r)c_2^o + (1-r)^2 A_2^o,$$

$$U_2^* = f_2^*[(1-r)A_1^o - B, w, r],$$

The 'net bequest' $(1-r)A_1^o - B$ determines the 'endowment' for member of generation 2. From the budget constraint of the generation 1 during the first period, while old, it is displayed the inverse relation between the consumption c_1^o and the net bequest $(1-r)A_1^o - B$, for a given level of assets held $A_1^y + A_0^o$. Therefore, the generation 1 member's utility can U_1 can be derived using its budget constraint, the generation 2 member's attainable utility, and given the predetermined level of c_1^y:

$$U_1 = U_1\left(c_1^y, c_1^o, U_2^*\right) = f_1[(1-r)A_1^o - B; c_1^y, A_1^y + A_0^o, w, r]$$

The allocation problem for members of generation 1 comes down to the optimal selection of the net bequest $(1-r)A_1^o - B$, for given levels of $c_1^y, A_1^y + A_0^o, w$ and r, subject to a non-negative gross bequest, A_1^o.

$$\max_{(1-r)A_1^o - B} U_1 = f_1[(1-r)A_1^o - B; c_1^y, A_1^y + A_0^o, w, r]$$
$$s.t.\ A_1^o \geq 0, \qquad (given\ c_1^y, A_1^y + A_0^o, w, r)$$

"[…], if the solution to this problem is associated with a value of A_1^o in interior—that is, if the constraint, $A_1^o \geq 0$, is not binding— any marginal change in B would be met solely by a change in A_1^o that maintains the value of the net bequest, $(1-r)A_1^o - B$." (Barro, 1974, p. 1103).

Through the adjustment of A_1^o , a marginal change in B leaves unchanged both the consumption levels and the attained utilities of generation 1, 2 and future's ones. This outcome can also be read through the asset market equation, which defines r,

$$K(r, w) + B = A_1^o + A_2^y.$$

The government bond issue contributes to a one-to-one rise in the asset supply. On the right-hand side, the asset demand responds with a net one-to-one increase too. This result come from two separate adjustments. The quantity of asset held from generation 1 while hold A_1^o rises by $1/(1-r)$ times the change in B, in order to keep the size of the net bequest $(1-r)A_1^o - B$ unchanged. Moreover, since consumption c_2^y is fixed in the young generation 2 budget equation, the introduction of taxes, due to the interests rB, implies a decrease in the asset held A_2^y equal to $r/(1-r)$ times the change in B. Now, it follows from that, no change in r is necessary to clear the asset market as a result of a marginal change in B. Equivalently, since the bond issue doesn't affect the aggregate demand $c_1^o + c_2^y + \Delta K$, the commodity market clearing condition continues to hold together with at the same initial value of r. Then, the Barro's formulation of the Ricardian equivalence

"Essentially, a positive value of B, financed by a tax levy on the next generation, enables a member of the old generation to "go out" insolvent by leaving a debt for his descendant. However, if, prior to the government bond issue, a member of the old generation had already selected a positive bequest, it is clear that this individual already had the option of shifting resources from his descendant to himself, but he had determined that such shifting, at the margin, was non-optimal. Since the change in B does not alter the relevant opportunity set in this sense, it follows that—through the appropriate adjustment of the bequest— the values of current and future consumption and attained utility will be unaffected." (Barro, 1974, p. 1103)

The results would have changed if a generation 1 member was initially at the corner solution $A_1^o = 0$ (particularly if $A_1^o < 0$ would have been allowed and chosen). In that case, a government bond issue creates new opportunity set for a generation 1 household who would increase his consumption c_1^o along with B, as long as the corner solution for the asset held $\mathrm{A}_1^{\mathrm{o}}$ still applied. Consequently, the marginal increase in B causes an excess of asset supply over demand, even after the downward shift in A_2^y due to the interests here too. This excess would tend to raise the real interest rate r which would then induce a drop in capital formation. This process has been described by Modigliani (1961) who identified these effects as the 'excess burden' of government debt.

<u>1.2.1.c Extensions</u>

The model could be generalized in many ways and the conclusions would still hold as long as current generations are connected to all future ones by a chain of operative intergenerational transfer of unrestricted purchasing power—in either direction. Indeed, same results can be drawn if the transfer occurs oppositely, from the young to the old generation as long as a *"gift motive"* is operative.

Furthermore, the taxes which finance the government debt can be designed in order to affect generations that are not currently alive. Values of consumption and attained utility will be kept unchanged as long as the choices are interior, while shifts in the bequest fully compensate for shifts in B. If this condition doesn't hold for some generations, the impact on current behavior should be less significant the further in the future it occurs—Nevertheless, Barro made no claims proving it; he refers solely to intuition on that. A crucial assumption to add in this context is that the principal is eventually paid off, without the possibility of perpetual government finance by new debt issue.

Moreover, all the considerations developed so far can be equivalently applied to social security payments and other imposed intergenerational transfer as demonstrated by Barro. *"As in the case of changes in government debt, if the solutions for bequest are interior, the impact of a marginal change in S*—the social security transfer—*would be solely on the size of bequests and not at all on the pattern of consumption."*(1974, p. 1107)

1.2.2 Imperfect Private Capital Markets

Source of net-wealth effect could be the divergence in the discount rates of the individuals. Already R. Mundell (1971) addressed them as the cause for the partial capitalization of the taxes financing the government debt, and therefore an issue of government bonds involves a positive net-wealth effect. Barro reviews this viewpoint developing a similar model which abstracts here from the already discussed finite lives and adds costs associated with the bond issue and tax collection.

Here there are two typologies of agents: those who have a low discount rate, r_l, and those who have a high discount rate, r_h. Unlike the first category, the latter holds poor collateral, so lending to them bears significant transaction cost that results in high (net-of-default-risk) borrowing rates. The two rates are linked together by a relationship that takes into account $\lambda > 0$ as proportional transaction cost involved in the loan process

$$r_h = (1 + \lambda)r_l.$$

For the sake of simplicity, it is advantageous to modify the characteristics of the government debt, which now takes the form of perpetuity with real interest payment i per year. Low-discount-rate individuals would purchase and evaluate a new issue as $B = i/r_l$. The proceeds of the sale, B, are assumed to be heterogeneously transferred according to α in the form of a lump-sum (or equivalently as tax abatement) to both the individuals. A portion α to the r_l individuals and the remaining part $(1-\alpha)$ to the r_h individuals. The same partitioning is employed for the taxes backing the interest payments, as an addiction there is an associated proportionate cost for the bond issue and the tax collection process to the extent of γ. This results in an amount of $(1+\gamma)\alpha i$ for r_l individuals and $(1+\gamma)(1-\alpha)i$ for r_h individuals.

Regarding the net-wealth effect distinctly for each category, the low-discount-rate individuals could suffer from an adverse effect if γ is positive, differently nil. The bond purchase itself involves no wealth effect and their lump-sum transfer amounting to $\alpha B = \alpha i/r_l$ would be less than the present value of their piece of tax burdens $(1+\gamma)\,\alpha i/r_l$, discounted at rate r_l. It is necessary to emphasize that the negative effect of the bond issue and tax collection costs would arise for all the individuals if all discount rates were equal.

Concerning the other category of r_h, the lump-sum proceeds amount to $(1-\alpha)B = (1-\alpha)\,i/r_l$, while the present value of the tax $(1+\gamma)(1-\alpha)\,i/r_h$ are discounted using the high rate r_h. The net-wealth effect can be represented using the relation between the different rates

$$\frac{(1-\alpha)i}{r_l}\left(1-\frac{1+\gamma}{1+\lambda}\right)=\frac{(1-\alpha)i}{r_l(1+\lambda)}(\lambda-\gamma).$$

The net wealth effect for r_h class is positive if γ, which estimates the government transaction costs for bonds issue and tax collection, is smaller than λ, which estimates the private transaction costs implicit in the existing model of (net-of-default-risk) discount rates.

"To the extent, $1-\alpha$, that the transfer payment and tax liability involve the r_h group, the government bond issue amounts to effecting a loan from the low-discount-rate to the high-discount-rate individuals. On the other hand, this sort of transfer could already have been accomplished privately, except that the transaction costs, as measured by λ, made this transfer marginally unprofitable. Hence, the government-induced transfer implied by its bond issue can raise net wealth only if the government is more efficient than the private capital market in carrying out this sort of lending and borrowing operation." (Barro, 1974, pp. 1111-2)

Furthermore, Barro notes that a direct-loan program between the two discount rate categories of individuals could perhaps fully exploit the efficiency advantage of the government, in place of the sort of bond issue described before. Such direct program would limit the loan recipients to high-discount rate individuals. The conclusion that has been drawn is that the government efficiency—that in the first stance may presumably come from benefits of economies of scale due to information gathering—would be not enough to discriminate purchasers of the bond from loan program applicants, instead, they do it automatically among themselves before. Hence, the information requirements for this sort of program may be much greater than those needed in the first place.

Lastly, the government may be more efficient than the private market only over a specific range of B. The public choice may lead to a sufficiently large value of the government debt such that, at the margin, its net-wealth effect is zero, thought the imperfect private capital market is maintained.

1.2.3 A Government Monopoly in Liquidity Services

Assume now that the government bill provides—in addition to the direct interest, i—a form of liquidity service to the holder which is, at the margin, worth L per bond per year. Hence, if all individuals have identical discount rate, r, a further perpetual government bond would be evaluated as

$$B = (i + L)/r.$$

The taxes for financing the government debt consist of the interest costs, i, plus any other associated with the process of generating liquidity services (which may be linked to the bond issue and tax receiving), here noted as c and meant marginal and per year. Hence, at the margin, the wealth effect of a shift in government securities will be

$$\frac{1}{r}(i + L) - \frac{1}{r}(i + c) = \frac{1}{r}(L - c).$$

If the government is induced by the public to act as a competitive producer of liquidity—as it should on efficiency grounds—then $L = c$ and the marginal-wealth effect of the government bonds would be zero.

On the other hand, if the government turns out to be a monopolistic provider, so that $L > c$, then the marginal-wealth effect would be positive. The effect could potentially be even negative in case of excess supply by the government, so that $L < c$.

If the private market is competitive and private agents provide liquidity services—also perceived as close substitutes— then the government monopoly can arise only if, at the margin, the government is more efficient than the private market. However, even if the government is more efficient—over a defined range—a sufficient overextension of B would dismiss this advantage if the generation of liquidity service is, at least ultimately, subject to increasing marginal costs. Again, as in the previous case, the net-wealth effect of government debt depends on the relative efficiency, at the margin, of government against the private creation of interest bearing debt instruments.

1.2.4 Risk and Asset Substitutability

Finally, Barro considers the risk implications of the government issue and the uncertainty about the future tax liabilities concerning its financing. The government bond issue does not concern just the 'size' of the assets constituting the net wealth of individuals, there is also the 'quality' to be discussed. As J. Tobin (1971) argued: *"The calculus of total wealth is less important than the change in the composition of private* *balance sheets that the government engineers by borrowing from the public—forcing on taxpayers a long-term debt of some uncertainty while providing bond-holders highly liquid and safe assets. Since no one else can perform the same intermediation, the government's debt issues probably do, within limits, augment private wealth. Another way to make the point is to observe that future tax liabilities are likely to be capitalized at a higher discount rate than claims against the government."*

First, if there were no uncertainty about the relative burden of the (lump-sum) tax liabilities financing B, the only uncertainty in an individual's real tax burden would reflect the variability over time in the real interest payments themselves. Regarding present values, this variability would reflect the variability in prices and interest rates. In this context, the holding of government bond would be the perfect hedge against variations in tax liabilities—ignoring any considerations about the maturity structure. Hence, a concurrent expansion in government bonds and in the tax liabilities for financing these payments would not affect the risk composition of the private balance sheets.

Suppose now to include an additional variability concerning the relative applicable tax burden among individuals and this to be purely random—i.e., unrelated to variations in relative income for instance. In that case, it is clear that holding government bonds would no longer provide a perfect hedge against variations in the tax liabilities. The fractional holdings of government bonds could not match the correspondent expected fraction of tax liabilities. An individual's tax liability would undergo a source of variability beyond that of the total interest payments. Of course, it would be possible for individuals to employ private insurance markets to minimize the risks connected to fluctuations in relative tax liability. However, as long as this strategy involves transaction costs, the risk would not be entirely eliminated. In this instance, an additional government bonds issue would allow a net increase in the risk contained in the household balance sheet and as a result a wealth decline. At this point, the household typically reacts increasing desired total saving and re-balancing the portfolio from riskier towards less risky assets. The impact on capital formation—firstly, on the equity rate of return—would depend on the relative strength in these two reactions.

If a different tax system were considered, the impact on desired total saving and portfolio composition would be the opposite. An income tax whose variations follow those in income would work as a sort of public program of income insurance. The variations in relative tax liabilities can help to lessen the net variability in disposable income. Hence, a shift in government bonds could lead to a decline in the overall risk carried in household balance sheets. However, it should also be mentioned that also this income tax system, which implicitly contains a public program of income insurance, will entail transaction costs—administrative, individual reporting effort, 'moral hazard' costs associated with incentives for earning income. Therefore, a full analysis of the wealth effect would require a comparison of these public transaction costs against those associated with private insurance systems.

At the end of his analysis, Barro (1974, p. 1116) summed it up in his statement: *"The basic conclusion is that there is no persuasive theoretical case for treating government debt, at the margin, as a net component of perceived household wealth. The argument* *for a negative wealth effect seems, a priori, to be as convincing as the argument for a positive effect. […] fiscal effects involving changes in the relative amounts of tax and debt finance for a given amount of public expenditure would have no effect on aggregate demand, interest rates, and capital formation."*

1.3 MARTIN FELDSTEIN *"Perceived Wealth in Bonds and Social Security: A Comment"*

Soon after the publication of the Barro's analysis, many scholars started to question the theoretical grounds upon which his Ricardian equivalence interpretation has been drawn.

Feldstein (1976) states that the outcomes of Barro go against the modern theory of government debt presented until that time by Buchanan (1958), Modigliani (1961) and Diamond (1965). In those models, public debt was viewed as net wealth by the households so that it discouraged real capital accumulation. In particular, Feldstein challenges the central premise of a static economy with a constant population and no economic growth. However, Feldstein acknowledges the importance of the bequest motive as an extension of the conventional life-cycle model.

Feldstein then goes on analyzing an economy where the national income grows at a pace g comprising both the increase in population and the rate of technological innovation. Moreover, the rate of interest on government debt is r. In this context, the dynamics between the debt development and the GDP are the following:

$$b_t = (1 - g + r)b_{t-1} + s - t$$

Where b_t, b_{t-1} is the current and previous debt-to-GDP level, s and t the government spending and revenues ratio to GDP—here assumed immutable.

In the circumstance that the growth of the economy is higher than the interest, $r < g$, *"[...] the government can create debt and yet never have to levy a future tax to repay the debt or to pay interest on the debt. Instead, the government merely issue new debt with which to pay the interest. The debt therefore grows at the rate of interest r."* Doing that, the ratio of public debt to national income remains stable over the period. *"There is no need, therefore, to increase the previously planned bequests"*, since the current generation knows that no burden will be carried upon the future ones. *"The first generation will therefore increase its own consumption and thus reduce capital accumulation."* In short, the net wealth effect would be positive. The same result applies to social security.

Feldstein then examines the case of $r > g$ as *"the assumption that $g \geq r$ is analytically convenient but empirically false."* Bearing in mind that the government taxes the interests at the rate θ, the rate of interest paid on government bond r may *"overstate"* the net cost of debt which would, in fact, be $r_N = (1 - \theta)r$ per dollar. *"For realistic values of θ and r, the economy may be characterized by $r > g > r_N$. The property that $g > r_N$ makes this case very similar in its behavioral implications to the previous situation."* Again, the interests due would be financed by an increase in the debt at the rate r_N.

On the other hand, in the state $r_N > g$, the net wealth can be perceived positive even if some future taxes must be levied to limit the debt expansion. Nevertheless, if $r_N -$

g is considered 'small', this tax obligation would be modest and worth $1 - g/r_N$ times the future interests due. In this case, that would make the current individuals adjust their bequests only by the specified fraction $1 - g/r_N$ of the debt, meaning by less than the value of the bonds (or social security transfer received). *"The fraction g/r_N of the debt need never be financed by taxation and thus represents net-wealth creation to the infinite sequence of households. Only in the special case of a static economy ($g = 0$) is the present value of required future taxes equal to the present value of the debt itself."*

Whenever it is considerate more appropriate—on that Modigliani (1961) made similar speculations—as the net cost of debt to the government $(1 - \theta)rD$—while D is the government debt stock—the conclusion is not affected. *"If an increase in the government debt reduces private capital accumulation, the government will forgo the taxes on the income produced by that capital. If the private capital earns a marginal rate of return r, the lost tax income is θrD so that the total annual cost to the government of debt D is $(1 - \theta)rD + \theta rD = rD$. In this case, the effective net rate of interest is r, not $(1 - \theta)r$."* (Feldstein, 1976, p. 334)

Further, Feldstein briefly examines the implications due to a government debt bigger than capital stock and, hence, a great $r_N - g$ departure. That case would trigger a decline in capital accumulation over the long-run and, as a result, it will lower the wages of the future generations. In response to this, *"the first generation should anticipate this by increasing its bequests to compensate for future fall in earned income."* However, Feldstein believes that *"the complexity of these anticipations casts doubts on the empirical relevance of this entire exercise. In determining their bequest, households are required to understand [...] the general equilibrium effect of reduced saving on future wages."* Hence, Feldstein deduces that *"it may be safe to assume that households have also not made the adjustment implied by the new theory."*

In the end, he adds another element that doesn't make the theory any less questionable. *"[...] For most families the voluntary and intentional 'intergenerational transfer' are not bequest at death but support of the consumption that their heirs enjoy as children. [...] this merely changes the nature of the induced consumption and does not constitute a transfer of real capital."* (1976, p. 336)

1.4 JAMES M. BUCHANAN *"Barro on the Ricardian Equivalence Theorem"*

In 1976, Buchanan came along with his brief *"Barro on the Ricardian Equivalence Theorem"* where he admits the argument to be *'an age-old question in public finance.'*

Buchanan called for the necessity to distinguish between the full capitalization of the future tax liabilities, under the reasonable assumption made by Barro, and if this consequently implies that the fiscal policy shift causes no effect on total spending. The validity of this statement must be the result of an appropriate examination of the differential impacts of taxation and debt issue. Buchanan argues that this lack of the analysis *"may stem from the Barro's failure to specify properly the inclusive set of transactions that debt issue represents."*

Moreover, Buchanan put a question regarding the motivations behind the government resort to bonds issue—which Barro has not handled in *Are Government Bonds Net Wealth?* —and offers two explanations.

If the purpose is to finance public spending without current taxation or money creation, the government issue on the private capital market will lead the individuals, who purchase these bonds, to drawn down private investments or reduce private consumptions. Under this condition, it is unreasonable what stated by Barro that *"the increase in B implies a one-to-one increase in the asset supply."* The government bonds will replace the private ones, and the net-wealth effects of this replacement must be weighed simultaneously with that embodied in the capitalization of future tax obligations. In particular, the future burdens that are inevitable with any debt issue, public or private, may be fully capitalized—acting as Ricardian—although at the same time this behavior—the very creation of debt—may reveal the rational intention of borrowers to accelerate spending. Therefore, it seems fair to insinuate that the perceived net wealth, about the individual's consumption behavior, raises as debt increases. However, the nature of that mechanism, either public or private, contributes to the net effects.

Things change when government issue aims at increasing the aggregate demand in the economy. If that is the purpose, it might be done smoothly by explicit money creation, which does not involve future payment obligations, and such operation would underline the deflationary impact of debt sale which would generate an increase in total spending.

At this point, Buchanan interpreted the Barro's analysis suggesting that such a model has been developed with the specific intent of concentrating only on the equivalence demonstration, without aspiring to any further generalization. Hence, by doing so, Barro analyzes the upward shift in the national debt by a government which does not secure funds in at the beginning—in the sense of the 'pay-as-you-go' rule—and which does not allow its bonds to be traded again in markets. It follows that a judgment on the stimulus towards aggregate spending depends necessarily on the capitalization of both future benefits and taxes. Moreover, Buchanan moves on questioning the effectively full capitalization issue citing the Feldstein's empirical results (1974) that highlights a reduced rate of private saving, where Barro would infer no change, in the face of an operating social security system.

In the end, in regard to the U.S. social security system itself, Buchanan indicates that as the context that empirically fits more closely with the Barro's model. Nevertheless, Buchanan emphasizes the behavior of politicians—*"If the politicians are ultimately responsive to the desires of their constituents"*— and the public debt constraint at the state-local level that seem to advise indirect proof against the capitalization hypothesis and the argument that tax and debt backing should be roughly viewed as equivalent.

"*The 40-year history of social security financing yields ample evidence that politicians are extremely reluctant to adopt anything which smacks of full funding for the system. Under the Barro hypothesis, there should be roughly indifferent public reactions to a fully funded and to an unfunded pension system. […] Can anyone in the post-Keynesian world of 1975 seriously question the proclivity of politicians to expand public debt in preference to tax increases?"* (1976, p. 341)

1.5 ROBERT J. BARRO *"Perceived Wealth in Bonds and Social Security and the Ricardian Equivalence Theorem: Reply to Feldstein and Buchanan"*

1.5.1 Reply to Feldstein

The punctual reply of Barro starts reinforcing the belief that his central theory has not been affected by these criticisms.

First, he analyzes the steady-state $r > g$, that is a (real) rate of return which is constant and greater than the output growth. Further, the government debt is allowed to expand at rate g, and hence the ratio debt to income is kept fixed over time, as in Feldstein (1976)[2]. Barro argues that Feldstein's conclusions are due to an improperly calculated present value of the required future tax liabilities, set out to be the fraction $(1 - g/r)$. *"Considering an initial debt issue of amount $B(0)$ and a path of subsequent issues [...] $B(t) = B(0)e^{gt}$, and the amount of debt finance at any date $t > 0$ is $dB/dt = gB(t)$. Taxes levied at date t are the amount needed to finance interest payments net of debt finance, $rB(t) - gB(t)$. The present value of these future taxes, discounted at rate r, is*

$$\int_0^\infty (r-g)B(t)e^{-rt}dt = (r-g)B(0)\int_0^\infty e^{-(r-g)t}dt = B(0)$$

Hence, as would be expected, the present value of the future taxes coincides with the amount of the initial debt issue for any growth rate g (as long as $g < r$). Therefore, the presence of growth in the economy (at a rate below r) leaves unchanged the conclusion that government bonds are not net wealth." In other words, since the impact of the taxes that will be levied is steadily equivalent in full to the original debt issue—and not just a fraction—no positive net wealth effect occurs in the households balance sheets.

The second case where $r \leq g$ constitutes a steady state[3] it seems feasible to re-issue debt and let it *"grow forever[4] at rate r[5]"* in order to pay the interest and avoid levying any future obligations. *"In this situation [...] it appears that debt issue would be regarded as net wealth and would therefore raise aggregate demand. [...] so that the steady-state rate of return would be raised to (just) exceed the growth rate."* However, Barro notes that, in fact, the crucial issue is *"whether the economy would ever be in a steady-state where $r \leq g$."* About that, Barro cites the rejecting evidences clarifying his rhetorical question coming from models with overlapping-generations—Diamond

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[2] *"The limitation of the steady-state growth rate of the public debt to g can be rationalized by assuming that the value of the outstanding stock of debt at any point in time is bounded by the government's collateral, which I [Barro] assume can be measured by the present value of future tax capacity."*

[3] *"The situation with $r < g$ in a steady state implies inefficient capital overaccumulation, as discussed in Phelps [1966]."*

[4] *"In one respect this possibility hinges on an infinite horizon—any finite truncation [...] would restore equality between the present value of taxes and the amount of initial debt."*

[5] *"The debt could also grow at rates above r to finance a continuing flow of transfer payments. The government's collateral [...] is now infinite."*

(1965), Cass and Yaari (1967)—as well as utility-maximizing immortal family—Sidrauski (1967). In both these models, it is clear that the solution $r \leq g$ in a steady-state would be unfeasible. *"Hence, a competitive equilibrium would have to be in the (efficient) region where* $r > g$ *in a steady state."*

Moreover, Barro himself also tried to inquire this argument achieving the identical judgment with a model which includes finite-lived individuals and operative intergenerational transfer—in the form of a "gift motive", i.e. from young to old.

In the end, Barro acknowledges that the households could occur plausibly in computational difficulties during the process of estimating the general implication of a government debt issue, as suggested by Feldstein. Moreover, given that this complexity would add more uncertainty to the individuals, the model could be extended to include the uncertainty explicitly. *"However, it is much less clear that this complication would imply systematic errors in a direction such that public debt issue raises aggregate demand."*

1.5.2 Reply to Buchanan

In his response, Barro addresses the issue brought up by Buchanan dealing with the decline of either investment or consumption attributable to private agents that would follow a public debt issue. First, in the light of the individual budget constraint, the transfer payment (or a lump-sum tax cut) sum could be just employed in full by the (representative) individual for purchasing the bonds. The critical point actually is whether they are truly motivated to save the whole amount of their grown available finances.

Another issue pointed out by Buchanan was the impossibility of a one-to-one increase in the asset supply after a government debt auction and hence the replacement of private for public bonds. Barro does not deny this crowding out in the circumstance of an excess of earning asset supply that therefore would lead to an increase in interest rate. However, he added that this excess supply would only occur if the future tax liabilities were not wholly capitalized, that is when the individuals do not save the full amount of the transfer payment (equivalently the tax cut). Otherwise, if the government bonds are not perceived as net wealth, the individuals would maintain the same level of consumption and that would imply a one-to-one increase in asset demand as well as in the supply. Then, a change in interest rate would be prevented, and no private borrowers would be cut off.

In the case one also considers the substitutability among asset and liabilities, then the one-to-one increase in both government bonds and tax liabilities will only occur if they are regarded as a perfect substitute, once reckoning the different risks and liquidity features. At this point, as demonstrated by Barro, the implications depend on the efficiency, at the margin, of the government in delivering liquidity services and how closely correlated are individual's income and taxes. After his theoretical analysis, Barro claimed no hints that debt-backed transfers (or tax reduction) would spur the aggregate demand.

The empirical evidence suggested by Buchanan citing Feldstein's (1974) study infers against the full capitalization argument. Its main conclusion is that the social security system *"reduced personal saving by a half of what it otherwise would be."* However, Barro points out that the social security wealth variable happens to be statistically significant on consumption only when the sample 1947 – 71 enlarged to include 1929 – 40. Hence the variable may operate as dummy before 1937 for which it takes on a zero value. Besides, the variable loses significance when the model includes an employment variable over the entire sample. Barro concludes that *"Feldstein's finding that social security has drastically reduced saving and capital accumulation must be regarded as highly tentative."* Moreover, Barro mentions the empirical studies of consumption and saving behavior carried out by Tanner (1970), Kochin (1974), and David and Scadding (1974) as positive evidence for the future tax capitalization.

In the end, Buchanan adds what Barro reckons to be *"the weight of his own casual observation to the empirical issue"* recognizing that the politician behavior indirectly invalidates the tax capitalization hypothesis. Barro challenges this indication and affirms that the Buchanan's interpretation *"may be a bit loose to submit to empirical testing, but it is hard to reconcile it, in a general way, with the post-World War II behavior of the [U.S.] federal government."* In this respect, Barro presents U.S. data regarding the 1947 – 70 time span involving the increases in both government debt and tax receipts, with these latter rising with a higher average growth rate than the bonds. *"If federal politicians had a 'proclivity [...] to expand public debt in preference to tax increases' over this period, it was more than matched by 'declivity' of the public."* During the same period, the share of the federal spending in the GNP rose from 13% to 21%. *"Hence, the ready availability of debt finance is apparently not a necessary accompaniment to increases in the share of output absorbed by the federal government."* During 1970 – 74, the pace of growth of the government debt was 4.1% and for taxes was faster, 10.4%. Although, the *"fraction of GNP accounted for by federal spending was almost constant [...] suggesting that an acceleration of public debt is not a sufficient indicator of a rising share of government spending in total output."*

1.6 GERALD P. JR. O'DRISCOL "THE RICARDIAN NON-EQUIVALENCE THEOREM"

Following the debate between Barro, Buchanan and Feldstein, O'Driscoll granted Ricardo, 'one who cannot defend himself,' the right to reply in his *The Ricardian Non-Equivalence Theorem* (1976).

According to O'Driscoll the position in support of the equivalence attributed to Ricardo needs further examination. Actually, additional analysis of the words of 19th-century economist proves that the proposition is, in fact, a *"non-equivalence theorem."*

"[...] But the people who pay the taxes never so estimate them, and therefore do not manage their affairs accordingly. We are too apt to think, that the war is burdensome only in proportion to what we are at the moment called to pay in taxes, without reflecting on the probable duration of such taxes. It would be difficult to convince a man possessed of 20,000l., or any other sum, that a perpetual payment of 50l. per annum was equally burdensome with a single tax of 1000l." (Ricardo, 1820)

Indeed, Ricardo was the first to recognize that taxpayers suffer what we now call 'fiscal illusion' and O'Driscoll suggests that Ricardo considered taxation and debt-issuance being distinctly different, rather than equivalent.

"He [i.e., the taxpayer] would have some vague notion that 50l. per annum would be paid by posterity, and would not be paid by him; but if he leaves his fortune to his son, and leaves it charged with this perpetual tax, where is the difference whether he leaves 20,000l., with the tax, or 19,000l. without it? This argument of charging posterity with the interest of our debt, or of relieving them from a portion of such interest, is often used by otherwise well-informed people, but we confess we see no weight in it." (Ricardo, 1820)

Once again, O'Driscoll founds in this reading that Ricardo commented the two methods of financing as not equivalent in fact.

In conclusion, the attempt of O'Driscoll aimed to point out that Ricardo's position is more elaborated than the contemporary theorists have ever presented. Also, the knowledge about the question is far to be regarded as definitive.

1.7 EVIDENCES AND RESOLUTIONS ON THE RICARDIAN EQUIVALENCE

Ricardian Equivalence, despite the many questions that arose about its plausibility, has attracted the attention of plenty of scholars. The theory has many testable implications, and these have been examined in an attempt to conclude whether it is a satisfactory approximation to reality. However, the debate never ceased to endure, and the empirical studies have been far from univocally acknowledging a common ground.

In particular, Feldstein (1982) ran a regression in the context of the life-cycle hypothesis and came to a conclusion against the Ricardian equivalence: *"The evidence [...] indicates that changes in government spending, transfers and taxes can have substantial effects on aggregate demand. The estimates also indicate that the promise of future social security benefits significantly reduces private saving. Each of the basic implications of the so-called 'Ricardian equivalence theorem' is contradicted by the data."*

However, Kormendi (1983) differently concludes in favor of the equivalence through a 'consolidated approach' aimed to model private sector consumption function based on the rational evaluation of the outcomes of government fiscal policy.

Seater (1993) comprehensively surveys and assesses both the results and the methodology employed in the empirical efforts and concludes that the data strongly support Ricardian Equivalence or approximate Ricardian Equivalence. *"Two overall conclusions are now clear. The first appears uncontroversial: it seems almost impossible that Ricardian equivalence holds exactly. [...] The second conclusion is far more controversial: despite its nearly certain invalidity as a literal description of the role of public debt in the economy, Ricardian equivalence holds as a close approximation."*

The debate is continuing, but if Seater's conclusion is valid, it threatens the position that public debt is harmful to capital accumulation—specifically, high-interest rate, low saving, low rates of economic growth.

Similarly, Barro (1989) applying "The Ricardian Approach to Budget Deficits" reveals that *"this crisis scenario [the supposed harmful effects of deficits] has been hard to maintain along with the robust performance of U.S. economy since late 1982."* However, some sort of synthesis of both opinions in support and against the equivalence can be found in his concluding observations. *"Given this [government expenditures] present value, rearrangements of the timing of taxes—as implied by budget deficits—have no first-order effect on the economy. Second-order effects arise for various reasons, which include the distorting effects of taxes, the uncertainties about individual incomes and tax obligations, the imperfections of credit markets, and the finiteness of life."* (p. 51)

Moreover, Barro in tracing a parallel between two famed economic theorems wishes to recommend the further direction to be undertaken in the public finance research. *"There is a parallel between the Ricardian equivalence theorem on intertemporal government finance and the Modigliani-Miller (1958) theorem on corporate finance. Everyone knows that the Modigliani-Miller theorem is literally incorrect in saying that the structure of corporate finance does not matter. But the theorem rules out numerous sloppy reasons for why this structure might have mattered, and thereby forces theoretical and empirical analyses into a disciplined, productive mode. Similarly, I would not predict that most analysts will embrace Ricardian equivalence in the sense of concluding that fiscal policy is irrelevant. But satisfactory analyses will feature explicit modelling of elements that lead to departures from Ricardian equivalence, and the predicted consequences of fiscal policies will flow directly from these elements."* (Barro, 1989, p. 52)

1.7.1 Ricardian Equivalence and The Backing of Government Liabilities

The call made by Barro for the research guidelines was endorsed by Aiyagari and Gertler who already in 1985 has moved forward in this direction. In particular, they shaped the spectrum of circumstances that lead to a departure from the Equivalence in their attempt to test the hypothesis generally associated with Monetarism.

The debate about the Ricardian Equivalence has always been fluctuating around the way private agent's discount government bonds and their associated tax liabilities. Aiyagari and Gertler, in their "The backing of government bonds and monetarism", introduced an element of innovation to the traditional literature[6] and derived the capitalization rule as an outcome of a rational forecast based on the ruling fiscal and monetary regimes—rather than arbitrarily determine it.

They demonstrate that the way the government plans to meet their debt obligation matters for the development of expectations since a rational agent's discount future direct tax levies differently than future money creation and ultimately affect his budget constraint. Therefore, the intertemporal relationship between the current and future

[6] Traditional literature in the manner described by, e. g., Patinkin (1965), Mundell (1965)

monetary and the fiscal policy stance becomes crucial to the capitalization mechanism of future liabilities.

The fiscal authority could grant the backing for its interest-bearing debt by committing to levy a stream of future direct taxes matching its discounted present value and in a manner that adequately accommodates the central bank open market operations. Otherwise, the central bank could finance new deficit with current and future money creation, while the fiscal authority is indifferent to the monetary policy.

The current regime[7]—and the one supposed to prevail in future—matters to the behaviour of the private agents since in latter case an adjustment in the current stock of bonds signals changes in future money growth, while in the former case it implies additional future taxes that would be thus capitalized.

Aiyagari and Gertler have made use of these regime classifications to demonstrate that the conventional monetarist propositions[8] can be only satisfied in the case the fiscal authority entirely back the government liabilities. Otherwise, the price level is governed by the total supply of government liabilities—both money government bonds and money, rather than only the latter.

However, the dissertation will be limited to the identification of the ruling regimes and the on-going interaction between authorities occurred throughout the time. The next chapter will be devoted to an exhaustive analysis of the control of the fiscal and monetary stances.

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[7] Here only two 'polar' regimes are simplistically considered. In practice, it would be more appropriate to regard in which position lies the current authorities behaviours in the continuum of combination generated by the fraction of the interest-bearing debt which is backed by taxes and, in turn, by money creation.

[8] In particular the Quantity Theory of Money and the Fisherian Theory. See Aiyagari and Gertler (1985) for further demonstrations.

2 REGIMES WITH ‘ACTIVE’ AND ‘PASSIVE’ MONETARY AND FISCAL POLICIES

Eric M. Leeper in his *“Equilibria under ‘Active’ and ‘Passive’ Monetary and Fiscal Policies’* (1991) analyses two distinctive regimes of fiscal and monetary behaviour characterizing the interplay between the authorities in their attempt to guarantee a sustainable system with stable prices and a balanced government budget constraint, given the private agents’ optimization process.

In order to respect the intertemporal government budget constraint, some future government revenues must arise following a shock to the real value of government debt. That is, real government debt expansion implies higher future net-of-interest surpluses or money creation. The government relies on its monetary and fiscal authorities to levy three types of taxes employing several policy instruments.

Leeper brings forward the intuitions gathered by traditional literature from deterministic models—Sargent and Wallace (1981), McCallum (1984)—to a stochastic maximizing environment in shaping the complexity of the operations of both the monetary and fiscal authorities, in a framework where an optimizing consumer receives an endowment of goods each period. The parameters of both policy rules determine the extent of dependence on each of the authorities’ revenues sources.

The authority is established to behave as ‘active’ if it pays no attention to the current level of government debt while setting out its control variable. Otherwise, it is said to ‘passively’ behave and responds to government debt shocks in a way that its scope is restrained by both private optimization and the active authority’s decisions. And in doing so, the ‘passive’ authority is forced to use its tax to balance the budget accordingly.

The research discipline which aims to categorize equilibrium policies as representing ‘active’ or ‘passive’ behaviour pursues a useful role for interpreting macroeconomic time series. These several setups, when explicitly identified, can be used to interpret reduced-form studies on government financing.

The particular prevailing regime matters when agents with rational expectations discount future direct taxes differently than future money creation.

As T. J. Sargent (1982) pointed out, since the analyses are dynamic, the asset demand schedules—employed in dynamic models with rational expectations—are predicted to systematically change with shifts in monetary and fiscal regimes, and in the regulatory structure for the financial intermediaries. *“In particular, with a given structure of financial regulation, the demand schedule for base money depends intricately on the government's strategy for retiring the interest-bearing bonds.”* (Sargent, 1982).

Leeper (1991) furnishes the primary regime classification to interpret further studies on fiscal financing.

2.1 A STOCHASTIC MAXIMIZING FRAMEWORK

In order to analyse the interplay between the fiscal and the monetary authorities together with the private agent's behaviour, the stochastic maximizing framework proposed by Leeper (1991) will be employed.

2.1.1 Private Agents

The framework involves a representative infinitely-lived private agent endowed with y consumption units each period, while the government 'extracts' $g < y$ units for its spending which generate no utility to the consumer.

The government liabilities are allowed to be currency and government debt. Fiat currency does not yield any interest. However, real balances m_t—which are the ratio of nominal balances, M_t, and price level, p_t—provide consumers with supplementary utility separated from its consumption, noted as c_t . Individuals are also left to save one-period nominal government bond, B_t, with correlated real value $b_t = B_t/p_t$, earning a risk-free gross nominal interest rate R_t, which is supposed to hold its equilibrium level.

The consumer discounts its utility through the rate $\beta \in (0,1)$ and maximises its decision vector $\{c_t, m_t, b_t\}$ after taking into account the direct taxes τ_t payable annually in the form of the consumption good.

$$\max \mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t [\log(c_t) + \log(m_t)]$$

Subject to the consumer budget constraint:

$$c_t + \frac{M_t}{p_t} + \frac{B_t}{p_t} + \tau_t = y + \frac{M_{t-1}}{p_t} + R_{t-1}\frac{B_{t-1}}{p_t}, \qquad (1.1)$$

In the process of the maximization, individuals are expected to be able to anticipate future endowments, prices, interest rates and taxes through their probability distributions.

After imposing the necessary feasibility condition $c_t = y - g$ and introducing the gross rate of inflation $\pi_t = p_t/p_{t-1}$, the first order conditions for the consumer optimization process reduce to the constraint mentioned above (1.1) and the Fisher and money-demand relations, where c is the deterministic steady state value of consumption:

$$\frac{1}{R_t} = \beta \mathrm{E}_t \left[\frac{1}{\pi_{t+1}}\right], \qquad (1.2)$$

$$m_t = c \left[\frac{R_t}{R_t - 1}\right], \qquad (1.3)$$

The conditional expectation in (1.2) is built on an information set storing all the variables up to the current values.

2.1.2 Monetary Authority and Fiscal Authority

The monetary authority is responsible for anchoring the nominal short-term interest rate pursing a function of the current inflation rate. Thus, monetary policies yield seigniorage revenues in the form of anticipated and unanticipated inflation taxes, which only the first ones distort behaviour.

$$R_t = \alpha_0 + \alpha\pi_t + \theta_t,$$
$$\theta_t = \rho_1\theta_{t-1} + \varepsilon_{1t}, \qquad |\rho_1| \leq 1, \qquad \varepsilon_{1t} \sim \mathrm{N}(0, \sigma_1^2), \qquad (1.4)$$

The government can levy anticipated and unanticipated inflation taxes when consumer portfolios include both nominal government liabilities. The aversion to inflation of the monetary authority, whose magnitude is represented by α in eq. (1.4), determines the extent and the type of inflation financing. Anticipated inflation obtains revenues by the distortion of the private agents' money-demand behaviour, while the unanticipated inflation taxes are lump-sum and provides seigniorage resources by devaluing existing stocks of nominal liabilities.

On the other hand, the fiscal authority determines a level of direct lump-sum taxes in response to the level of real government debt outstanding, γ indexes the extent that such taxes respond to shifts of the government debt.

$$\tau_t = \gamma_0 + \gamma b_{t-1} + \psi_t,$$
$$\psi_t = \rho_2\psi_{t-1} + \varepsilon_{2t}, \qquad |\rho_2| \leq 1, \qquad \varepsilon_{2t} \sim \mathrm{N}(0, \sigma_2^2), \qquad (1.5)$$

The systematic responses $\alpha\pi_t$ and γb_{t-1} reflect fiscal financing considerations thorough the parameters α and γ which reveal the resolutions about the fiscal backing. Leeper assumes that for a given couple (α, γ), α_0 and γ_0 shall be such as to undergo positive steady-state values of real debt, real balances, and the net nominal interest rate. However, there are not any *a priori* restrictions on α and γ.

Moreover, the innovations ε_1 and ε_2 to the respective policy shocks θ and ψ are serially and mutually uncorrelated, that is:

$$\mathrm{E}(\varepsilon_{it}\varepsilon_{jt-k}) = 0 \quad \text{for all } k \quad \text{and} \quad i, j = 1,2, \quad i \neq j.$$

Leeper's approach chooses to posit random disturbances in the authorities decision-making process, while the private agents follow deterministic rules. Thus, in defining the private equilibrium, conditional on policy decisions, the usual traditional asymmetry between private agents and policy authorities is inverted.

Also, regarding disturbances, the error term in these rules might mean a twofold key to interpretation. On the one hand, θ and ψ embody features of policy behaviour derived from the technology for implementing those choices, and thus, they play the role of 'control errors'—as in Dotsey and King (1983). If this view holds, authorities can manage their instruments only up to a random error, and therefore this validates that shocks should be serially uncorrelated.

Alternatively, the error terms may describe the incentives facing policymakers in the form of replies to un-modelled or noneconomic shocks that may be transitory or permanent—as the assumptions on θ and ψ suggest. These forces might be real shocks, such as fluctuating political tensions, or demographic variations. In any case, both the treatments are consistent with the model specifications of θ and ψ. Moreover, these shocks reveal fluctuations in monetary and fiscal policy that are independent of each other.

2.1.3 Government Budget Constraint

The government annually backs the constant level of the public expenditures resorting to revenues provided by the authorities in the form of direct lump-sum taxes, money creation, and debt subject to its budget constraint:

$$\frac{B_t}{p_t}+\frac{M_t}{p_t}+\tau_t=g+\frac{M_{t-1}}{p_t}+R_{t-1}\frac{B_{t-1}}{p_t}, \tag{1.6}$$

where on the left-side there are respectively the current real government debt outstanding, the current real balance and direct taxes. While on the right-side there are the constant level of public purchases g, the inherited real balance from the past period and the debt service due on the previous bonds.

At this point, the consumer's optimal vector $\{c_t, m_t, b_t\}$ necessity to satisfy the transversality condition for real balances and real debt, in addition to the feasibility and (1.1) – (1.3) requirements. The transversality condition for government bonds demands the present value of debt to equal zero and aims at ensuring that consumers are willing to hold debt. The intertemporal budget constraint is carried out after forcing this optimality condition to the government operation:

$$\frac{B_t}{p_t}=\sum_{s=0}^{\infty}\left(\prod_{j=0}^{s}\pi_{t+j+1}R_{t+j}^{-1}\right)\left[\tau_{t+s+1}-g+\frac{M_{t+s+1}-M_{t+s}}{p_{t+s+1}}\right]. \tag{1.7}$$

2.1.4 Laws of Motion for Inflation and Real Debt

In his attempt to derive the system, Leeper characterises the equilibria in terms of deviation of the linearized model from the deterministic steady state. Although, as he pointed out the model is nearly linear since both the feasibility condition and the policy rules are linear, yet the Euler equations are linear in logarithms. However, that was enough to suggest—even though without checking the transversality condition—that the linear version may not be a bad approximation to the true nonlinear behaviour.

A recursive system in inflation and real debt is obtained from the equations characterizing the consumer optimization process (1.1) – (1.3), the policy rules (1.4) and (1.5) and the budget constraint (1.6).

Firstly, the law of motion for the inflation stems from the linearized combination of the interest-rate rule (1.4) and the Euler equation for the debt:

$$\mathrm{E}_t\tilde{\pi}_{t+1}=\alpha\beta\tilde{\pi}_t+\beta\theta_t, \tag{1.8}$$

where tilde denotes, in fact, the departure from the deterministic steady state π.

Substituting the policy rules (1.4), (1.5) and the real balance relation (1.3) into the government budget constraint, we get the low of motion for the real debt:

$$\varphi_1\tilde{\pi}_t + \tilde{b}_t + \varphi_2\tilde{\pi}_{t-1} - (\beta^{-1} - \gamma)\tilde{b}_{t-1} + \varphi_3\theta_t + \psi_t + \varphi_4\theta_{t-1} = 0, \quad (1.9)$$

where

$$\varphi_1 = \frac{c}{(R-1)}\left[\frac{1}{\beta\pi} - \frac{\alpha}{(R-1)}\right] + \frac{b}{\beta\pi}, \qquad \varphi_2 = \frac{\alpha}{\pi}\left[\frac{c}{(R-1)^2} - b\right],$$

$$\varphi_3 = -\frac{c}{(R-1)^2}, \qquad \varphi_4 = \frac{\varphi_2}{\alpha},$$

where c, R, π and b are the respectively deterministic steady state values of consumption, gross nominal interest rate, gross nominal inflation rate and the real debt.

2.2 'ACTIVE' AND 'PASSIVE' POLICIES

The definition provided by Leeper (1991) about 'active' and 'passive' policy firstly regards which constraints an authority stands when anchoring its policy. *"An active authority pays no attention to the state of government debt and is free to set its control variable as it sees fit. A passive authority responds to government debt shocks. Its behaviour is constrained by private optimization and the active authority's action."*

The second definition instead reviews the time dimension of the economic shocks to be addressed and the variable employed in the authority's rule. *"Because an active authority is not constrained by current budgetary conditions, it is free to choose a decision rule that depends on past, current, or expected future variables.[9] A passive authority is constrained by consumer optimization and the active authority's actions, so it must generate sufficient tax revenues to balance the budget. Thus, the passive authority's decision rule necessary depends on the current state of government debt, as summarized by current and past variables"* (Leeper, 1991).

The Leeper's interpretation of active policy as forward-looking, while the passive is intended to be backward-looking, is in line with the 'rules versus authorities' discussion of H. C. Simons (1936).

M. Friedman (1948) instead place the reason for his distrust in 'discretionary action in response to cyclical movements' precisely on the lack of adequate forecasting capacity of the authorities. The understanding and awareness of these processes are still inadequate to provide a proper shock response, i.e. θ and ψ. On the other hand, Friedman's proposal is not hostile to 'automatic' responses of fiscal variables to variations in economic activity. Leeper interprets this 'automatic' behaviour *"as passively setting policy instruments as a function of current and past variables, which does not require knowing the true processes generating the shocks."*

Furthermore, the works of Sargent (1982) place the emphasis of the game on the coordination scheme between the authorities. The dynamics are described by referring to a 'dominant player' which sets its policy while the passive authority accommodates.

[9] However, Leeper then argues *"that if the active authority responds only to current and past variables, the equilibrium may be undetermined."*

2.3 EQUILIBRIA UNDER 'ACTIVE' AND 'PASSIVE' MONETARY AND FISCAL POLICIES

The policy parameter area can be split into four disjoint regions on the basis of whether monetary and fiscal authorities enact active or passive policies. This interplay between policies establishes whether the solutions to the model are stable or unstable. This stability feature stems from the roots $\alpha\beta$ and $\beta^{-1}-\gamma$ of the law of motion system for inflation and real debt in (1.8) and (1.9).

"A sufficient condition for a unique saddle-path equilibrium is that one root of the system lies inside the unit circle and one root lies outside" (Blanchard and Kahn, 1980).

Hence, in the aim of dividing between stable and unstable solutions, Leeper adopts the unit circle as trigger for stability such as the equilibrium processes are jointly covariance-stationary:

Region I:	Active monetary and passive fiscal policy when $\lvert\alpha\beta\rvert > 1$ and $\lvert\beta^{-1}-\gamma\rvert < 1$.
Region II:	Passive monetary and active fiscal policy when $\lvert\alpha\beta\rvert < 1$ and $\lvert\beta^{-1}-\gamma\rvert > 1$.
Region III:	Passive monetary and passive fiscal when $\lvert\alpha\beta\rvert < 1$ and $\lvert\beta^{-1}-\gamma\rvert < 1$.
Region IV:	Active monetary and active fiscal policy when $\lvert\alpha\beta\rvert > 1$ and $\lvert\beta^{-1}-\gamma\rvert > 1$.

On the one hand, the active behaviour completely specifies policy, and furthermore, it is required that at least one authority actively sets its control variable to obtain a unique pricing function. On the other hand, the passive behaviour prevents an 'explosive' path of government debt, and at least one authority must passively set its control variable to balance the intertemporal government budget. Both these requirements are solely met in regions I and II yielding unique equilibrium path through combinations of policy parameters with one stable and one unstable root.

Differently, in region III, when both policies are passive, the system bears an incompletely specified policy and a pricing function which is indeterminate. Moreover, in region IV two active policies violate the government budget constraint when allowed for some independent departure.

2.3.1 Region I: Active Monetary and Passive Fiscal

An unconstrained monetary authority actively pursues price stability by 'strongly' reacting to inflation ($\lvert\alpha\beta\rvert > 1$). Fiscal policy passively accommodates the constraints required by private behaviour and monetary policy by adjusting direct taxes sharply when debt increases to balance the government budget ($\lvert\beta^{-1}-\gamma\rvert < 1$), then the solution for inflation originates from solving 'forward' its law of motion (1.8):

$$\tilde{\pi}_t = \left[\frac{\beta}{\rho_1-\alpha\beta}\right]\theta_t, \tag{3.1}$$

Assuming that the monetary shock $\{\theta_t\}$ follows an $AR(1)$process and substituting this into the interest rate rule to get:

$$\tilde{R}_t = \left[\frac{\rho_1}{\rho_1 - \alpha\beta}\right]\theta_t, \tag{3.2}$$

In region I equilibria, it is clear that inflation and nominal-interest-rate departures from the steady states depend entirely on the parameter of the monetary policy rule α, the discount factor β, and the monetary policy shock θ_t. Monetary policy pursues price stabilization by preventing deficit shocks from affecting inflation. For a certain path of the monetary policy shock, the solutions for $\{\tilde{\pi}_t, \tilde{R}_t\}$ determine the unique (linearized) time path of real balance shifts given by $m_t = [-c/(R-1)^2]\tilde{R}_t$.

The decision rule for the growth rate of money, defined as $h_t = M_t/M_{t-1} = m_t\pi_t/m_{t-1}$, is derived by combining this definition with the equilibrium requirement for real balances in (1.3), linearizing and then substituting the solutions for inflation and nominal interest rates to achieve:

$$\tilde{h}_t = \frac{\beta}{\rho_1 - \alpha\beta}\left[1 - \frac{\rho_1}{R-1}\right]\theta_t + \left[\frac{\beta\rho_1}{(R-1)(\rho_1 - \alpha\beta)}\right]\theta_{t-1}. \tag{3.3}$$

In equilibrium, the monetary authority by the growth rate of money $\tilde{h}_t$ responds to current and past monetary policy shocks, θ_t and θ_{t-1}, yet not to fiscal policy shocks, ψ_t.

Fiscal policy seems 'irrelevant' because its parameters and variables do not appear in the expression (3.1) and (3.3) for inflation and money growth. However, this interpretation is definitely misleading. *"Given that $|\alpha\beta| > 1$, an equilibrium exists only because fiscal behavior supports the prevailing monetary policy by raising taxes enough to prevent explosive real debt paths"* (Leeper, 1991).

Debt path develops following the stable difference equation of its law of motion in (1.9), and the 'backward' solution (if θ is serially uncorrelated) is:

$$\tilde{b}_t = \sum_{i=0}^{t}(\beta^{-1} - \gamma)^i\left[\frac{1}{\alpha\beta\pi}\left(\frac{c}{R-1} + b\right)\theta_{t-i} - \psi_{t-i}\right] + (\beta^{-1} - \gamma)^{t+1}\tilde{b}_{-1}$$

(3.4).

"Shocks to θ that induce the monetary authority to reduce current money growth (and inflation) elicit real debt expansions that, through the tax rule, raise the present value of direct taxation by enough to offset the current lump-sum negative inflation tax. Tax cuts brought forth by negative realizations of ψ reflect changes in the timing, but not the present value of direct taxation" (Leeper, 1991).

This first regime corresponds to the 'polar Ricardian' regime explained by the deterministic models proposed firstly by Sargent (1982) and subsequently by Aiyagari and Gertler (1985). The term 'polar' regime is to be intended when the backing of a marginal government shock entirely relies on the tax of a single authority, whether monetary or fiscal. That is, one authority is entirely 'dominant' vis-à-vis the other one. Nevertheless, it must make it clear that—as promptly highlighted by Aiyagari, Gertler

(1985)—in the Sargent's definition, the term 'Ricardian' concerns how the government bonds are backed, and not to whether the Ricardian equivalence holds—regarding the irrelevance of government bonds.

Moreover, under this regime, the nature of the asset demand according to Sargent (1982) should be interpreted to the extent that base money and interest-bearing government bonds are considered not so perfect substitutes. Such that, current deficits are much less inflationary than they are in other different regimes if they are associated with current tight monetary policy.

2.3.2 Region II: Passive Monetary and Active Fiscal

In the second region, the fiscal authority denies adjusting direct taxes 'strongly' with higher debt, such that $|\beta^{-1} - \gamma| > 1$, and doing so prevents deficit shocks from being wholly backed with a future tax levy. The monetary authority obeys the constraints imposed by private behaviour and fiscal policy by allowing the money stock to react to deficit shocks and tolerating inflation to the extent that $|\alpha\beta| < 1$.

The government budget constraint in (1.9) becomes an unstable difference equation in real debt with the 'forward' solution:

$$\tilde{b}_{t-1} = \sum_{i=0}^{\infty} \left(\frac{1}{\beta^{-1}-\gamma}\right)^{i+1} \mathrm{E}_{t-1}[\varphi_1 \tilde{\pi}_{t+i} + \varphi_2 \tilde{\pi}_{t+i-1} + \varphi_3 \theta_{t+i} + \varphi_4 \theta_{t+i-1} + \psi_{t+i}] \quad (3.5)$$

The expectations of future values of inflation in (3.5) can be derived from the stable difference equation of the law of motion (1.8). The three remaining expectations regarding the monetary and fiscal shocks are evaluated throughout their assumed exogenous processes. After that, the result at time t gives:

$$\tilde{b}_t = \left[\frac{\varphi_1 \alpha\beta + \varphi_2}{\beta^{-1}-\gamma-\alpha\beta}\right] \tilde{\pi}_t + \left(\left[\frac{\varphi_1 - \beta\gamma\varphi_1 + \beta\varphi_2}{(\beta^{-1}-\gamma-\alpha\beta)(\beta^{-1}-\gamma-\rho_1)}\right] + \left[\frac{\varphi_3\rho_1 + \varphi_4}{\beta^{-1}-\gamma-\rho_1}\right] \theta_t\right) + \left[\frac{\rho_2}{\beta^{-1}-\gamma-\rho_2}\right] \psi_t \quad (3.6)$$

Solving the system of the real debt and the budget constraint (3.6) and (1.9) provides the function in terms of current and past variables for the equilibrium of real debt and inflation.

2.3.2.a 'Pegged' Interest rate and Exogenous Taxes

Leeper analyses the case of 'pegged' nominal interest rates and exogenous direct taxes, that is when $\alpha = 0$, and so nominal rates are exogenous, furthermore, $\gamma = 0$ makes direct taxes exogenous. However, 'pegged' usually entails literally constant rates requiring the variance of θ to be zero ($\sigma_1^2 = 0$). Setting $\alpha = 0$ pegs the nominal rate in the sense that rates are not allowed to deviate in response to fiscal disturbances.

Holding the mutual un-correlation assumption between the policy shocks—the solutions for equilibrium prices and quantities are:

$$\tilde{R}_t = \theta_t, \tag{3.7}$$

$$\tilde{\pi}_t = -\left[\frac{1}{\varphi_1}\right]\psi_t + \beta\theta_{t-1}, \tag{3.8}$$

$$\tilde{b}_t = \left[\frac{c}{(R-1)^2}\right]\theta_t, \tag{3.9}$$

$$\tilde{m}_t = -\left[\frac{c}{(R-1)^2}\right]\theta_t, \tag{3.10}$$

The decision rule for the growth rate of money $\tilde{h}_t$ is:

$$\tilde{h}_t = -\left[\frac{1}{\varphi_1}\right]\psi_t - \left[\frac{\beta}{R-1}\right]\theta_t + \left[\frac{\beta R}{R-1}\right]\theta_{t-1}. \tag{3.11}$$

The linear expression for the growth rate of nominal debt—defined as $d_t = b_t\pi_t/b_{t-1}$ —is:

$$\tilde{d}_t = -\left[\frac{1}{\varphi_1}\right]\psi_t + \left[\frac{c\pi}{b(R-1)^2}\right]\theta_t + \left[\beta - \frac{c\pi}{b(R-1)^2}\right]\theta_{t-1}. \tag{3.12}$$

"Fiscal shocks affect only nominal values by changing the aggregate level of nominal liabilities held by the public. Monetary shocks affect real magnitudes, by altering the composition of government liabilities in consumer's portfolios[10]" (Leeper, 1991).

In this regime, the fiscal authority with its direct taxes is unresponsive to government debt, hence any marginal increase in real debt must lead to higher money growth now or in the future. In the case that a current tax cut is assumed to be financed by future money creation, nominal interest rates must rise to persuade consumers to hold the further government bonds.

When the interest rate is 'pegged' ($\alpha = 0$), the monetary authority presently extends the money supply to generate enough lump-sum inflation tax revenues capable of balancing the government budget and therefore preventing rates from growing.[11] Equations (3.8) and (3.11) relate this result.

In such coordination regime, if the monetary authority enables a policy shock that unexpectedly raises the 'pegged' interest rate it causes a pure asset exchange between the two government liabilities. Consequently, a decrease in the nominal money stock balances an equal increase in nominal debt outstanding.

In Leeper's analysis of such dynamic consumers are induced by the higher interest rates to substitute currency for debt in the offsetting ways represented by the

[10] Aiyagari and Gertler (1985) come to a similar result in the coordination scheme called 'polar non-Ricardian regime' with a fiscal authority that does not finance the debt, which in turn is implicitly backed in full by money creation.

[11] On the other hand, when monetary authority enables a policy rule with $\alpha > 0$, fiscal shocks are backed by distorting expected inflation tax revenues, and hence the monetization is spread over time. In this setting, higher deficits raise the expectations about the money creation and inflation and consequently spur current nominal interest rates.

expressions (3.9) and (3.10). Meanwhile, the total amount of government liabilities remains unaffected by this exchange, and hence also the current prices are stable.

In the next period, new money creation funds the increased debt service—since tax revenues cannot come from the exogenous taxes—and hence generates inflation, explaining the θ lagged effect on inflation and money growth respectively in equations (3.8) and (3.11).

2.3.2.b 'Pegged' Interest rate and Debt Responsive Taxes

"An active fiscal authority can determine the contemporaneous price effects of a monetary shock by choosing how future direct taxes respond to real debt" (Leeper, 1991).

When the fiscal rule implements taxes that depend on the stock of government debt outstanding ($\gamma \neq 0$), yet the nominal interest rate is still 'pegged' (so $\tilde{R}_t = \theta_t$), the equilibrium inflation equation demonstrates how the monetary shocks have a delayed effect on the price level:

$$\tilde{\pi}_t = -\frac{\gamma}{\beta^{-1}-\gamma}\left[\frac{\beta^2 c\pi}{c+b(R-1)}\right]\theta_t - \left[\frac{1}{\varphi_1}\right]\psi_t + \beta\theta_{t-1}, \quad (3.13)$$

where c, R, π and b are the respectively deterministic steady state values of consumption, gross nominal interest rate, gross nominal inflation rate and the real debt.

The fiscal authority determines through the sign of its policy parameter gamma the interference of the monetary policy on current inflation—assuming a non-negative level of real debt b in the steady state.

On the one hand, if higher real debt rises future tax levy ($0 < \gamma < \beta^{-1} - 1$), a current tight monetary behaviour temporarily reduces current inflation, yet increasing expected future inflation—by the use of positive realization of θ_t—as also concluded by Sargent and Wallace (1981).

On the other hand, if higher real debt entails lower future direct taxes ($\gamma < 0$), the aggregate stock of nominal liabilities rises, and so current inflation. Likewise, Sargent and Wallace (1981) claim this effect to be an 'unpleasant arithmetic outcome' implying that "tighter money now can mean higher inflation now."

However, it must be indicated that Leeper achieves this result altering the policy parameters and fixing the private behaviour while Sargent and Wallace intervene in the individual behaviour, with a private demand for base money that also depends on the expected rate of inflation as demonstrated by Bresciani, Turroni (1937) and Cagan (1956). Furthermore, always in this view, Sargent (1982) claims that government interest-bearing securities and base money could be perceived as very good substitutes in the setting with a 'dominant' fiscal authority.

2.3.3 Region III: Passive Monetary and Passive Fiscal

In region III, both authorities enable passive policies as though they are forced to balance the budget. There are many money growth processes—indexed by initial money stock—that are consistent with the equilibrium features when there is not an additional constraint required by the active behaviour of one authority.

Indeed, these circumstances are compatible with the price-level indeterminacy result of Sargent and Wallace (1975) derived algebraically from a system lacking unstable roots.

Furthermore, the indeterminacy result occurs even in the case when the interest-rate rule still depends on inflation, but the dependence is not ‘overly strong.’ In contrast, in region II, the initial money stock is pegged down by the budget constraint because the fiscal authority pursues a policy sufficiently unresponsive to debt shocks.

2.3.4 Region IV: Active Monetary and Active Fiscal

Finally, in region IV, each authority disregards the budget constraint and enables an active policy with the aim to determine prices. These behaviours originate two unstable roots for the system so that there is not a money-growth process that ensures the consumer willingly hold government debt unless shocks are such related to violate the mutual un-correlation assumption. There can be no independent variation in monetary and fiscal policies when both policies are active.

3 DEBT SUSTAINABILITY & FISCAL LIMIT

So far, the analysis addressed shifts in the stock of government bonds without considering its sustainability due to the underlying stream of revenues backing its level. The concept of government bonds sustainability was historically built around the solvency condition of the government intertemporal budget constraint. The financial position was deemed sustainable whenever the anticipated discounted value of the stream of future primary surpluses equals the actual valuation of the government debt.

However, every economy faces a fiscal limit where taxes and spending can no longer adjust to stabilise the debt[12].This limit originates from the economic environment as well as the current and projected policies specifications—and their perceived credibility. Furthermore, the mutable nature of the limit is also determined by several boundaries.

The first is the ceiling delimited by the Laffer curve. Such a curve is an endogenously determined upper bound at the possible level of primary surpluses resulting from the relationship between the applied tax rate and the government revenues. The Laffer curve represents the government revenues as a concave function of the tax percentage charge, through the concept of taxable income elasticity to the tax rate. Hence, it presumes a maximum for the tax revenues which is realised in parallel with a single optimal tax rate. Consequently, increases of the tax rate up to that optimal level would as well increase the tax revenues. On the other hand, increasing the tax rate beyond such value would be counter-productive given that the increased tax pressure would depress the economy and thus the taxable income.

The second bound to the limit is the floor provided by the minimum level of government spending which constitutes an additional constraint to the maximum stream of the primary surplus that a government can potentially achieve.

The third, as pointed out by Sargent and Wallace (1981), the private agents' desired level of savings imposes an upper bound to the valuation of the equilibrium debt that can be accumulated.

Once an economy hit its fiscal limit, the government debt would take an explosive trajectory, and hence no rational agent would accept to accumulate bonds that cannot be financed by any future surpluses or seigniorage. At this point, the government has no other choices but either turning the monetary policy into an accommodative behaviour that would 'inflate the debt away' or partially reneging on its promised—but 'unfunded'—liabilities.

This dynamic display another source for regime transition and can describe the development in the authorities' stances. Moreover, the likelihood of hitting the fiscal limit severely impacts the private agent's expectations.

This chapter briefly reviews the main milestones in the extensive process of seeking a satisfactory determination for the fiscal limit and the solvency condition.

[12] Several scholars argued that there might also be a Monetary Limit in a monetary economy, i.e. a ceiling on the seigniorage revenues. See Sargent and Wallace (1981).

3.1 CLASSIC INDICATORS & EMPIRICAL APPROACH

The classic public debt sustainability approach was developed in the middle of the 80's but it is still a widely used tool. This approach generally starts by formulating standard concepts of government accounting, and later build around them the arguments to create indicators able to assess the debt sustainability or tests of fiscal solvency.

The Blanchard ratio proposed in 1990 relates the level of debt to the annuity of the primary balances at a defined interest rate. It is bi-univocally employed both to assess the sustainability of the current debt-to-output ratio and the needed debt-stabilising stream of primary balances for a given debt level:

$$b^{ss} = \frac{pb^{ss}}{r} = \frac{pb^{ss}}{i^r - \gamma} \tag{3.1}$$

where b^{ss} is the steady state debt-to-GDP ratio, pb^{ss} the value of the steady-state primary balance and r a growth-adjusted interest rate—i^r the real interest rate and γ the growth rate of GDP.
Several other perfectioned ratios were developed starting from this basic formulation and progressively allowing for shocks, uncertainty and smoothing.

Bohn presented a further empirical approach (1995:2011) and employs a fiscal reaction function. Bohn (2007) deemed 'futile' to test for fiscal sustainability in the sense of the conditions allowing the intertemporal government budget constraint holds because it indeed holds under generally satisfied weak premises.

Thus, Bohn focused on the dynamics of the primary surplus and the fiscal feedback functions aiming at ensuring fiscal solvency. He believed that the fiscal reaction function (FRF) perseveres a constant-regime hence employs a regression method to estimate the fiscal policy rule:

$$pb_t = \mu_t + \rho b_{t-1} + \varepsilon_t \tag{3.2}$$

for all t, where $\rho > 0$, pb is the primary balance, μ is a set of additional determinants of pb, and ε is i.i.d.

In this specification, Bohn argued that a positive statistically significant correlation ρ between the primary surplus and the sovereign debt is enough for the intertemporal government budget to hold, and thus deem the debt sustainable.

Afterwards, Ghosh, Kim, Mendoza, Ostry and Qureshi (2013) employed the Bohn's FRF and allowed for default risk. Their estimates provided a 'fiscal space' measuring the distance separating the long-run average debt ratio and the debt limit. This latter was defined as such a level beyond which the government can no longer service its debt because the response coefficient fell sharply at high debt levels—a phenomenon which they called 'fiscal fatigue.'

3.2 DYNAMIC FISCAL LIMIT DISTRIBUTION

The classical and empirical approach maintain some flaws since they are backwards-looking estimates, grounded in past policies assumed to be immutable and with no attempt to model uncertainty and the asset market structure. Changes in policy rules specification would adjust a country's debt limit, destabilising this backward measure of 'fiscal space'.

As a consequence, the fiscal limit is not constant and will somewhat fluctuate. Several scholars like Davig, Leeper (2010b) or Bi, Leeper (2013) model the limit as a probability distribution that varies systemically with the economic environment—including the specification of budgetary stances and random disturbances—and endogenously arises from the dynamic Laffer curve defined for a given level of productivity, government purchases and transfer. Given the stochastic nature of the limit, the government could default at any point of the distribution.

The maximum debt-to-GDP levels in the upper tail of the distribution are affordable as long as the economy undergoes several positive shocks. However, given the lower probability of experiencing such good shocks, the risk that the liabilities will not be fully honoured grows if the current debt is in the upper tail. On the other hand, the default is less likely even if bad shocks undermine the economy with a moderate debt in the lower tail.

Productivity has a significant impact on the limit distribution since it affects tax revenues directly and future tax revenues indirectly, depending on the persistence of the shock. Low productivity can also generate large risk premia.

Sovereign risk premia closely follow the fiscal limit distribution: they are smooth when the default is unlikely and begin to rise, sometimes rapidly, whenever the economy is approaching the fiscal ceiling.

Moreover, private agents gradually update their beliefs and base their expectations of default on a probabilistic inference about the current fiscal regime. Lack of complete information and uncertainty about the distribution can generate risk premium paths as well.

Credible long-run reforms towards fiscal consolidation dramatically enhance the government's ability to service its debt and reduce the riskiness of its sovereign debt, regardless of the current economic health.

4 THE EMPIRICAL RESEARCH

In this last part of my dissertation, I will employ the Markov switching regression method to estimate the fiscal policy rules of the leading governments in the Eurozone and the monetary policy rule implemented by the European Central Bank after the adoption of the single currency.

This period witnesses the process of application of the Stability and Growth Pact (henceforth SGP), the governance scheme intended to pursue sound public finances and to circumscribing the fiscal stances of the members of the European Union enforcing the Treaty of Maastricht (1992)—i.e. limiting the government deficits and public debt levels to 3% and 60% of GDP respectively.

The research aims to examine the fiscal and monetary regimes in place and to address their underlying macro outcomes appropriately. The interaction between the feedback rules of both the authorities represents the primary role in the inflation stabilisation process and the debt-targeting—as we saw in the previous chapters.

At first, considerable emphasis will be placed on the event of regime shifts examining the eventual discrepancies between constant regime models and those allowing for transitions. In the case of changes in regime, the behaviour will be examined concerning three different sample periods. The first one 2000:1 – 2008:1 embraces the Euro adoption and hence inaugurates the role of the European Central Bank with the chairmanship of Wim Duisenberg pursuing its exclusive mandate of price stability. The second period encompasses both the so-called Great Recession and the Sovereign Debt Crisis. Although Ireland has started experiencing a recession in the middle of 2007 and Greece got out at the beginning of 2017, the period considered for the Eurozone as a whole narrows to 2008:2 – 2013:1. Lastly, the third period extends throughout 2013:2 – 2018:1 and outlines the Euro Area on the way to recovery.

Afterwards, the assignment will be to distinguish a characteristic behaviour amid groups of countries shifting or persisting in the same fiscal regime and the attempting to discuss the possible circumstances and aftermath.

Furthermore, each governments' policy reaction will be confronted with the aggregate fiscal response of the Eurozone—intended as if it is an indivisible body—to investigate whether exists a prevalent common behaviour or a tendency to the fiscal harmonisation.

Finally, the study will cover the extent of synchronisation and coordination between the fiscal and monetary authorities separated policies with the targets of supporting the economic cycle and controlling the price level respectively.

4.1 THE MODEL

The model represents the monetary reaction functions of the European Central Bank (ECB) and the fiscal reaction function of twelve governments of the Eurozone[13]: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, Netherlands, Portugal and Spain.

The model employs a non-constant parameter approach so that to allow for two regimes to occur in the control of both monetary and fiscal policy. In order to do so, the model estimates a stochastic Markov-switching regression method in which the likelihood of each regime can vary endogenously.

4.1.1 Fiscal Policy Rule

The fiscal rule pursued by the government employs the actual primary deficit as the policy tool. The equilibrium level of the fiscal deficit is determined by the public debt and the output gap. Following the typical Leeper feedback rule, the deficit is linked linearly to the government debt. Moreover, as in Favero and Monacelli (2005), the output gap is meant to seize the cyclical element of the fiscal policy embodied by the degree of the automatic stabilisers. All the quantities are then divided by the nominal GDP so as to obtain comparable measures as the following:

$$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \gamma_2(s_t)x_t + \upsilon_t \qquad (4.1)$$

where d_t is the primary deficit-to-GDP ratio[14], b_{t-1} is the previous period government debt-to-GDP, x_t is the ratio output gap-to-GDP and υ_t seizes the discretionary exogenous departure from the rule interpretable as a fiscal policy shock. The coefficients $\gamma_1(s_t)$, $\gamma_2(s_t)$ express the policy response to the above stated exogenous determinants debt and output gap, and hence ultimately set the traits of the underlying fiscal regime. Further, the term s_t allows those coefficients to develop stochastically over time.

It is to be noted that the employed primary deficit is, in fact, a transformation of the latter. The instrument consists of the ratio of the moving sum of the primary deficit to the moving sum of the GDP[15]. Such technical measure is established so that to ensure a clearer path which is non-severely altered by the seasonality of the fiscal dynamics.[16]

On the other hand, such transformation may account for the typical government actions' sluggishness. Indeed, the fiscal response hardly ever experiences the same degree of immediacy compared to the monetary policy one. The first reason for this peculiarity is to be found in the several checks and balances underlying the democratic and constitutional method of the political resolutions. Secondly, fiscal policy, unlike

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[13] All the members that firstly adopted the Euro in 1999 plus the Greece which followed in 2001.

[14] In this notation, positive values denote primary deficit while negative values denote primary surplus.

[15] Accordingly, the same transformation has been applied to the output gap. The stock measure of the debt is expressed in the percentage points of the moving sum of the last four quarters.

[16] Seasonally and calendar adjusted data were previously employed without satisfactory outcomes.

the monetary policy[17], consists of a scale of numerous tools capable of influencing the economy with various intensity and different deployment periods. All these facts make it unlikely an abruptly shift by the government and it calls for a measure that preserves sufficient memory.

4.1.2 Monetary Policy Rule

The monetary response function is conceived as a simple forward-looking interest rate rule targeting price stability as quantitatively intended by ECB's Governing Council in 1998, i.e. *"[...] a year-on-year increase in the Harmonised Index of Consumer Prices (HICP) for the euro area of below 2%."* Further clarified in 2003 to be *"[...] below, but close to, 2% over the medium term."*

ECB attempts the above specified sole mandate oppositely to other central banks, such as the U.S. Federal Reserve System directing its purposes to a dual mandate: stable prices and maximum sustainable employment. Hence, the model includes the reaction exclusively to inflation departures from its desired target value.

The rule adjusts the nominal interest rate on the main refinancing operations (MRO) according to the one-year-ahead inflation expectation. The monetary policy instrument settles with smoothing behaviour—see, e.g., Clarida et al., 2000—thus the short-term interest rate is supposed to develop according to the following rule:

$$i_t = \rho(s_t)i_{t-1} + \left(1 - \rho(s_t)\right)i^* \qquad (4.2)$$

Where $\rho(s_t)$ represents the persistence of the previous rate value i_{t-1} and i^* is the equilibrium value of the nominal interest rate, defined endogenously as a function of the target inflation $(\pi_t^e - 2)$:

$$i^* = \left(\alpha_0(s_t) + \alpha_1(s_t)(\pi_t^e - 2)\right) + u_t \qquad (4.3)$$

Where π_t^e is the expected inflation, $\alpha_1(s_t)$ measures the extent the ECB tolerates inflation and u_t is the monetary policy's shock.

4.1.3 Regimes definition

This estimation method aims at identifying policy regimes in a probabilistic sense.
I maintain the Leeper terminology to define the regimes; however, it must be carefully remarked that his dependent variable is the tax revenues instead here it is employed the primary deficit. Hence, the sign of the parameter that denote the specific regimes is the opposite. Consequently, a 'passive' fiscal regime is here identified with a negative and statistically different from zero $\gamma_1(s_t)$. Indeed, a passive authority reacts to government debt shocks to balance the budget. Consequently, an 'active' fiscal regime occurs, ideally, where $\gamma_1(s_t)$ is positive and statistically different from zero. However, in the context of linear regression, the event that the coefficient responsive

[17] The concept of the monetary authority deploying a single instrument policy may be historically considered accurate and still endure. However, lately, the ECB has started applying non-standard measure employing other means such as e.g. the forward guidance.

to the debt, $\gamma_1(s_t)$, is not statistically different from zero might have been even defined as something not remarkably differing from an 'active' behaviour. A fortiori, an authority is normally categorised as 'active' when entirely disregards the state of government debt and is free to set its policy instruments. Therefore, an unresponsive coefficient would plead that debt disregard behaviour, while a positive parameter bears sharp evidence of an opposite motion against budget balancing. Nonetheless, the following results will cautiously display as exclusively 'active' the primary deficit positively reacts to public debt, unless otherwise specified.

Furthermore, the fiscal stance is estimated in a way to distinguish the accountability of the fiscal reaction to the output gap x_t. Firstly, the fiscal rule will allow only the debt b_{t-1} as a determinant and, secondly, also the gap x_t will be included as a regressor in the estimation. Consequently, a positive and statistically different from zero $\gamma_2(s_t)$ identifies a 'pro-cyclical' motive, where a negative and statistically significant value implies a 'counter-cyclical' stance on the other hand.

However, when defining a regime, the results of the regression with just the debt parameter will be discuss first. In the case the inference is deemed inconclusive, some conclusions will be formulated contemplating the regression with the standalone debt responsiveness isolated from the cyclical element.

Finally, an 'active' monetary regime is identified where α_1 is positive and larger than one, i.e. the Taylor principle—more than proportionate interest rate responses to expected inflation variations—which implies stronger reaction to inflation. Conversely, a 'passive' monetary authority applies a rule where the reaction coefficient is less than one.

4.2 DATA

The estimates rely on quarterly data. The monetary authority behaviour is analysed within the sample period1999:1 – 2018:2 and data are from the ECB Statistical Data Warehouse. The short-term monetary policy instrument is the interest rate on the Main Refinancing Operations (MRO)[18]. The inflation rate is the annualised quarterly percentage rate of change of the Harmonised Index of Consumer Prices (HICP) in the Eurozone.

Fiscal rules are estimated employing different sample periods across different countries. The principal reason is that data were not collected in a way unambiguously equivalent and compatible among the state members: this would have not made them comparable over the same time span. Belgium, France, Greece, Italy, Netherlands, Portugal and Spain were analysed in 2000:1 – 2017:4; Austria in 2001:4 – 2017:4 and Germany, Ireland and Luxemburg in 2002:4 – 2017:4. The output gap x_t is constructed as the percentage difference between the Real GDP and the Potential Real GDP.[19] The latter was estimated through the Hodrick-Prescott filter in order to obtain the smoothed-curve representation of the trend GDP.

[18] Irrespective of which type of rate fixed or variable tenders.

[19] For the construction of the deficit-to-GDP d_t and debt-to-GDP b_{t-1} ratios see the previous paragraph.

All the observations reflect the European System of National and Regional Accounts (ESA 2010), i.e. the newest internationally compatible EU accounting framework.

4.3 RESULTS

4.3.1 Fiscal Authority Regime

The analysis carried out over the twelves primary Eurozone members exhibits some clear evidence of regime switching occurring in the fiscal policy pursued in the aftermath of the single currency and SGP adoption.

Significant differences were observed in the outcomes of the constant and dual regime estimations of several state members. For the complete and detailed outcomes of the estimate of each country see the Appendix.

Fiscal Regime Behaviour			
	2001:1 – 2008:1	**2008:2 – 2013:1**	**2013:2 – 2018:1**
Active	Belgium, Finland, France, Germany, Ireland, Netherlands, Spain	Belgium, Finland, France, Germany, Netherlands	Belgium, Finland, France, Germany, Ireland, Luxemburg, Netherlands, Spain
Passive	Belgium, Finland, Italy, Luxemburg, Portugal	Italy, Luxemburg, Portugal	Italy, Portugal, Greece
Only significant (p-value 0.05) regime classifications are displayed.			

Belgium & Finland

Belgium and Finland shared a compatible path for the time of switching occurrence and transition. Both the governments have been pursuing a passive rule at the dawn of the twenty-first century when shifted to an active regime from the middle of 2003 to the middle of 2006. Right after, the two states returned to the passive behaviour lasting until 2008:4 and 2009:1 for Belgium and Finland respectively, precisely one quarter before the conclusion of their first depression periods of the Great Recession. From then on, both their fiscal authorities have been persisting with the existing active regime.

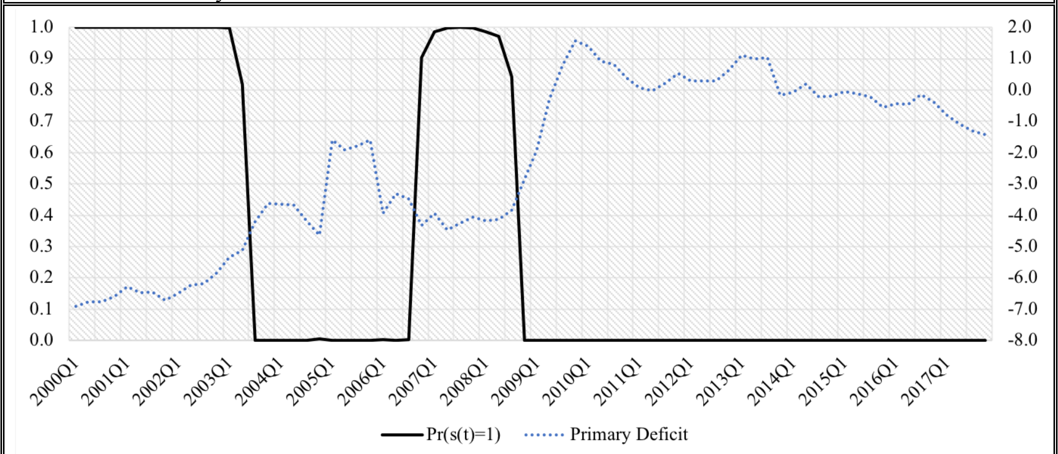
The role played by the re-established active fiscal conduct in overcoming the recession was not questioned further. Although, chasing deficits and loosening the responsibility for the budget constraint—rather than pursuing austerity—may have reasonably provided a stimulus to the economy, in its intentions at least.

Such an effort increased the sovereign debts of both countries. Finland has risen from 37.1% of GDP to 61.3% at the end of 2017, and hence in almost in full compliance with the Maastricht level. On the contrary, Belgium from a higher 92.5% to 103.4%. Nowadays, both the paths are stable and possibly undergo a sign of downwards trend.

Belgium [ESA2010 2000:1 – 2017:4]: Markov-Switching Fiscal Policy Rule									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \upsilon_t$									
	Regime 1: **PF**			*Regime 2:* **AF**			*Constant Regime*		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**5.993**	0.647	0.000	**-14.164**	4.738	0.003	**-0.678**	4.820	0.889
γ_1	**-0.111**	0.006	0.000	**0.128**	0.046	0.005	**-0.015**	0.463	0.740
σ	0.277	0.051		1.578	0.170		*S.E. resid.* = 2.668		
Regime Classification (Probability)									
Regime 1: **PF**				*Regime 2:* **AF**					
2000:1 – 2003:2				2003:3 – 2006:3					
2006:4 – 2008:3				2008:4 – 2017:4					

Belgium [ESA2010 2000:1 – 2017:4]: Probability ($s_t = 1$)

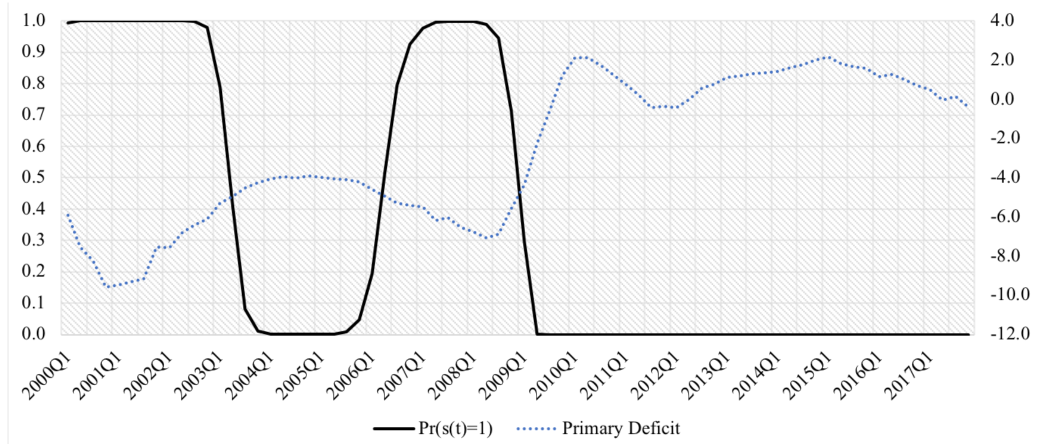
Smoothed Probability



Finland [ESA2010 2000:1 – 2017:4]: Markov-Switching Fiscal Policy Rule									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \upsilon_t$									
	Regime 1: **PF**			*Regime 2:* **AF**			*Constant Regime:* **AF**		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-0.682**	2.512	0.786	**-9.430**	1.915	0.000	**-15.015**	1.508	0.000
γ_1	**-0.160**	0.067	0.017	**0.178**	0.035	0.000	**0.268**	0.032	0.000
σ	1.246	0.262		1.782	0.199		*S.E. resid.* = 2.632		
Regime Classification (Probability)									
Regime 1: **PF**				*Regime 2:* **AF**					
2000:1 – 2003:1				2003:2 – 2006:1					
2006:2 – 2008:4				2009:1 – 2017:4					

Finland [ESA2010 2000:1 – 2017:4]: Probability ($s_t = 1$)

Smoothed Probability



Luxemburg

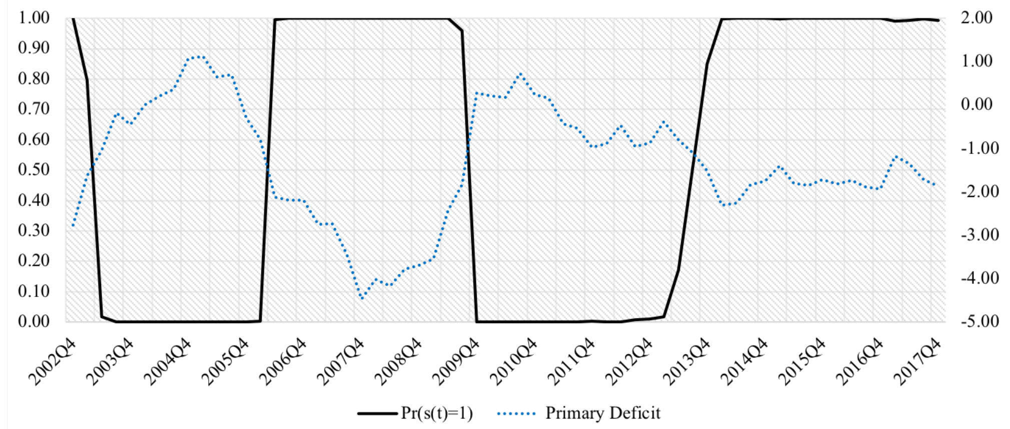
Luxemburg experienced three changes in regime in 2006:1, 2009:3 and 2013:2. The first one happening in 2006:1 set the change from a passive to an active rule which lasted until 2009:3, right after two quarters from the end of the first and only recession (2008:2 – 2009:1) the country has ever undergone over the Great Recession period. In this case, the public debt increased from 7.6% to 15.7% and continued to increase to 24% even over the passive period which ended in 2013:2. From then on, the active behaviour has been lifting the owed liabilities to a momentarily stable 23%.

Luxemburg [ESA2010 2002:4 – 2017:4]: Markov-Switching Fiscal Policy Rule									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \upsilon_t$									
	Regime 1: **AF**			*Regime 2:* **PF**			*Constant Regime*		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-3.755**	0.297	0.000	**0.402**	0.301	0.182	**-1.502**	0.417	0.001
γ_1	**0.087**	0.016	0.000	**-0.039**	0.019	0.040	**0.010**	0.024	0.675
σ	0.637	0.085		0.606	0.097		*S.E. resid.* = 1.367		

Regime Classification (Probability)		
Regime 1: **AF**	*Regime 2:* **PF**	
2002:4 – 2003:1	2003:2 – 2006:1	
2006:2 – 2009:3	2009:4 – 2013:2	
2013:3 – 2017:4		

Luxemburg [ESA2010 2002:4 – 2017:4]: Probability (s_t = 1)

Smoothed Probability



France & Netherlands

France and Netherlands have been leading a constant active fiscal regime over the entire considered period.

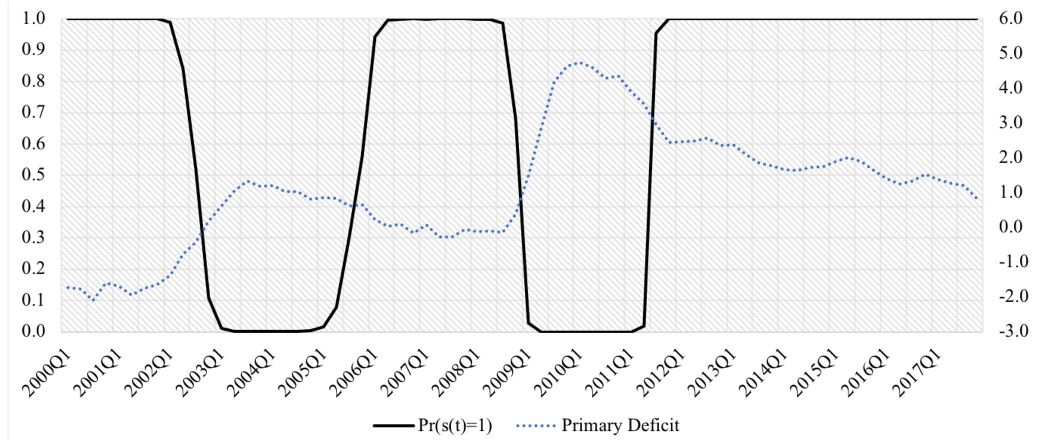
France has been fluctuating between active periods of ‘stronger’ and ‘softer’ budget balance avoidance. During the former, the debt-to-GDP ratio has increased more than during the ‘softer’ active periods where the rate was much steady. The only exception occurred during the last recession in 2011:4 – 2013:1 where a prolonged mild active behaviour expanded the debt to 96.8%. Previously, the change from a ‘softer’ to a ‘stronger’ active fiscal attitude may have made France emerge more quickly from 2008:1 – 2009:2 slowdown.

France [ESA2010 2000:1 – 2017:4]: Markov-Switching Fiscal Policy Rule									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \upsilon_t$									
	Regime 1: **AF**			*Regime 2:* **AF**			*Constant Regime:* **AF**		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-5.654**	0.541	0.000	**-9.668**	0.962	0.000	**-4.604**	0.806	0.000
γ_1	**0.079**	0.007	0.000	**0.165**	0.013	0.000	**0.074**	0.010	0.000
σ	0.700	0.074		0.535	0.093		*S.E. resid.* = 1.285		

Regime Classification (Probability)		
Regime 1: **AF**	*Regime 2:* **AF**	
2000:1 – 2002:3	2002:4 – 2005:3	
2005:4 – 2008:4	2009:1 – 2011:2	
2011:3 – 2017:4		

France [ESA2010 2000:1 – 2017:4]: Probability (s_t = 1)

Smoothed Probability



The Netherlands likewise have been undergoing an active behaviour characterised by varied shades. The first ‘stronger’ active rule held in the opening two years of the new Millenium while the second in the last five years of the sample. The latter matches both the healing stage of the Eurozone plus the reduction of the primary deficit and public debt, which stands now at 56.8% after the 68.4% peak at the start of the ‘stronger’ active phase.

Netherlands [ESA2010 2000:1 – 2017:4]: Markov-Switching Fiscal Policy Rule

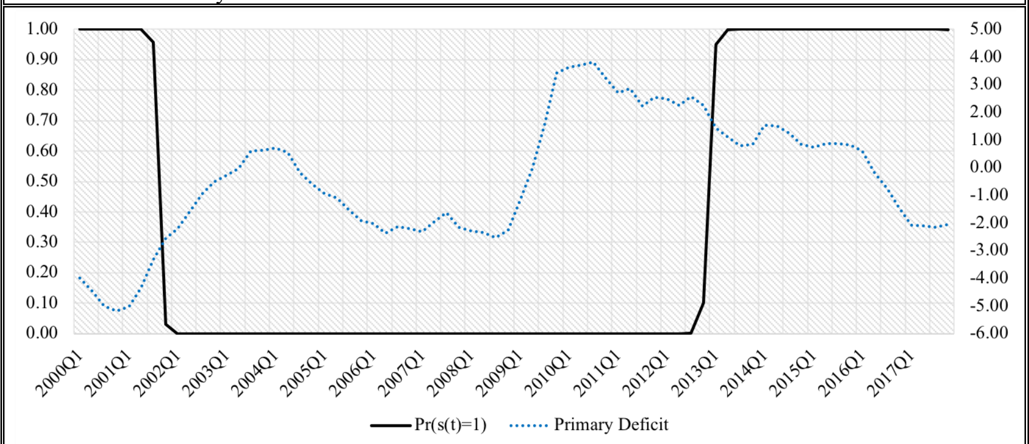
$$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \upsilon_t$$

	Regime 1: **AF**			*Regime 2:* **AF**			*Constant Regime:* **AF**		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-24.911**	2.002	0.000	**-15.496**	1.455	0.000	**-8.690**	1.698	0.000
γ_1	**0.382**	0.032	0.000	**0.297**	0.028	0.000	**0.148**	0.030	0.000
σ	0.896	0.131		1.093	0.119		*S.E. resid.* = 1.971		

Regime Classification (Probability)		
Regime 1: **AF**	*Regime 2:* **AF**	
2000:1 – 2001:3	2001:4 – 2012:4	
2013:1 – 2017:4		

Netherlands [ESA2010 2000:1 – 2017:4]: Probability (s_t = 1)

Smoothed Probability



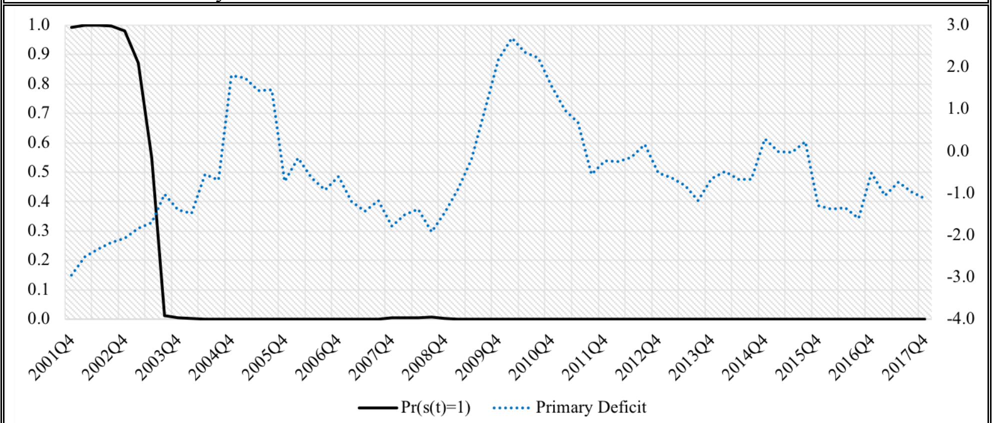
<u>Austria & Germany</u>

Austria has been sustaining an active behaviour according to the constant regime model, while the switching model was not capable of capturing any further evidence. Furthermore, the estimate of the model explicitly allowing the output gap response confirms an active fiscal rule running in 2001:4 – 2004:1 and 2015:4 – 2016:3 with a countercyclical response all over the period. The sovereign debt path has been relatively stable, excluding the leap happened through the Great Recession from an average level of 70.0% to 82.9%.

Austria [ESA2010 2001:4 – 2017:4]: Markov-Switching Fiscal Policy Rule									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \upsilon_t$									
	Regime 1			*Regime 2*			*Constant Regime:* **AF**		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-1.719**	3.623	0.635	**-2.277**	1.640	0.165	**-4.671**	1.703	0.008
γ_1	**-0.002**	0.013	0.882	**0.006**	0.005	0.228	**0.055**	0.022	0.017
σ	0.381	0.124		1.139	0.105		*S.E. resid.* = 1.209		
Regime Classification (Probability)									
Regime 1				*Regime 2*					
2001:4 – 2003:2				2003:3 – 2017:4					

Austria [ESA2010 2001:4 – 2017:4]: Probability ($s_t = 1$)

Smoothed Probability



Germany has been analysed over two data samples in order to check the robustness of the conclusions. The first one spans from 2002:4 to 2017:4 and follows ESA 2010 accounting framework—like all the other samples. The estimations of the constant regime models yield passive behaviour[20] while the switching regime model detects an active behaviour in 2007:2 – 2009:1—which also covers the German recession in 2008:2 – 2009:2—and 2011:4 – 2017:4. During the first period, the debt remained stable at around 64.8%, but instead, it contracted in the second period from 78.6% to 64.1%.

The asymmetrical signal revealed by the estimated passive rule in the constant model and the active rule identified by the switching model is worth to further investigation for a potential regime shift.

The sample 2000:1 – 2014:, following the previous ESA 1995 framework, merely confirms the enforcement of an active response in the same—slightly large—time

[20] The estimate for the debt reaction coefficient is statistically significant only if the p-value level is set to 10% for the model which does not allow for the output gap as a regressor.

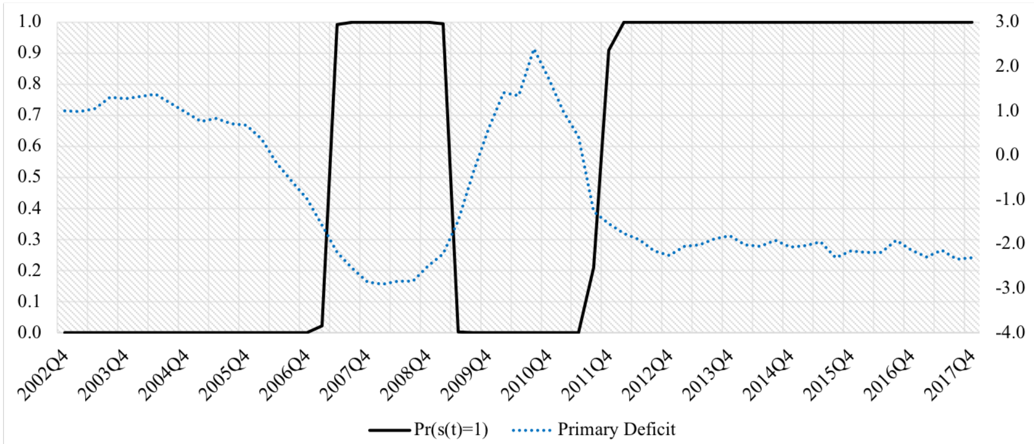
period during 2006:4 – 2009:2 and in the subperiod 2013:4 – 2014:1, together with the added 2000:1 – 2001:2.

The switching model including the output gap correction provides a passive response with a counter-cyclical element in 2000:3 – 2001:2, contradicting the previous active result, and 2009:2 – 2009:4. For these inferences, the evidence advocating a passive behaviour is not satisfactory sufficient to deem a distinct and persistent regime transformation.

Germany [ESA 2010 2002:4 – 2017:4]: Markov-Switching Fiscal Policy Rule									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + v_t$									
	Regime 1: **AF**			*Regime 2*			*Constant Regime*		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-5.192**	0.482	0.000	**1.824**	2.440	0.455	**3.408**	2.239	0.133
γ_1	**0.042**	0.007	0.000	**-0.018**	0.036	0.613	**-0.062**	0.032	0.057
σ	0.212	0.031		0.973	0.136		*S.E. resid.* = 1.528		
Regime Classification (Probability)									
Regime 1: **AF**				*Regime 2*					
2007:2 – 2009:1				2002:4 – 2007:1					
2011:4 – 2017:4				2009:2 – 2011:3					

Germany [ESA 2010 2002:4 – 2017:4]: Probability (s_t = 1)

Smoothed Probability



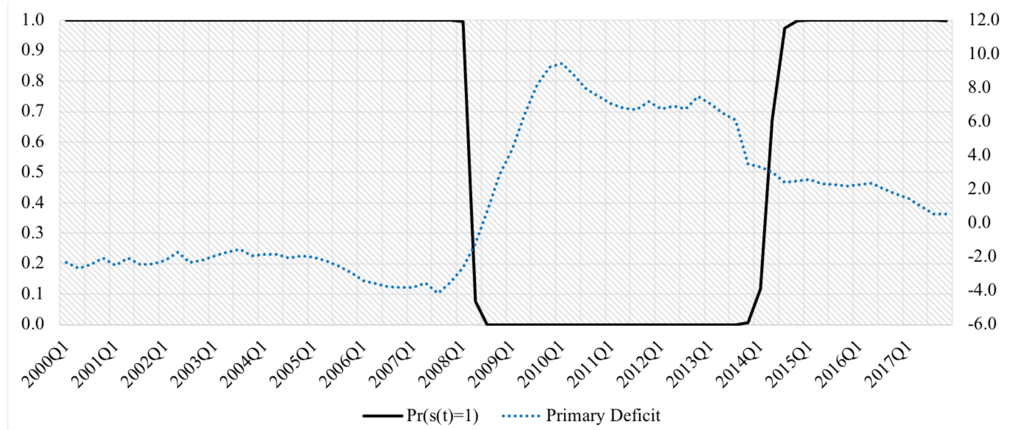
Spain, Greece, Ireland, Italy, Portugal

Spain exhibits estimates of an active behaviour considering a constant regime and such persists when allowing for changes in 2000:1 – 2008:1 and 2014:2 – 2017:4 and hence corresponding to the Eurozone economic upturn. Further analysis of the estimated rule disentangling the cyclical element produces a negative debt feedback parameter during 2008:2 – 2017:4. Hence some speculations could be conceived for a passive fiscal control over 2008:2 – 2014:2 subperiod, holding the previous inference of a subsequent active period.

Spain [ESA2010 2000:1 – 2017:4]: Markov-Switching Fiscal Policy Rule									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + v_t$									
	Regime 1: **AF**			*Regime 2*			*Constant Regime:* **AF**		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-6.649**	0.276	0.000	**4.823**	1.920	0.012	**-3.141**	1.352	0.023
γ_1	**0.085**	0.004	0.000	**0.020**	0.029	0.500	**0.069**	0.020	0.001
σ	0.644	0.079		2.494	0.382		*S.E. resid.* = 3.873		
Regime Classification (Probability)									
Regime 1: **AF**				*Regime 2*					
2000:1 – 2008:1				2008:2 – 2014:1					
2014:2 – 2017:4									

Spain [ESA2010 2000:1 – 2017:4]: Probability ($s_t = 1$)

Smoothed Probability

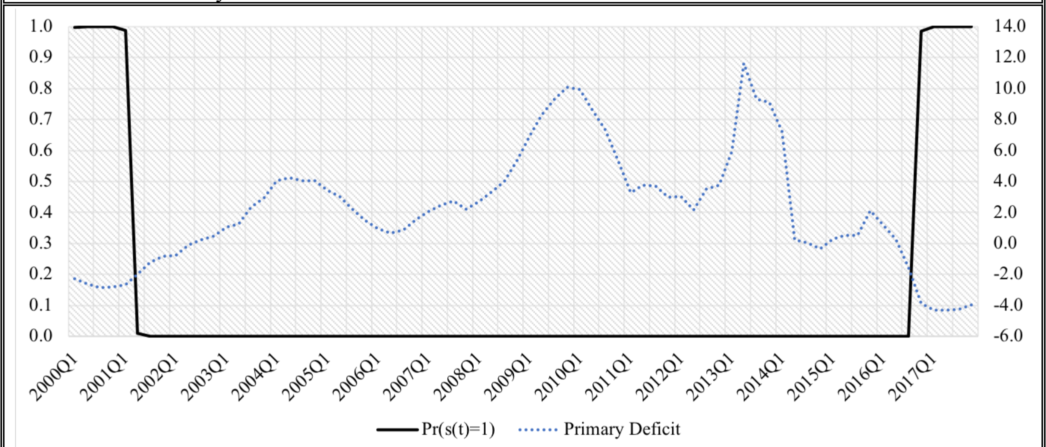


Greece acted as passive according to the estimate in 2000:1 – 2001:1 and 2016:4 – 2017:4. Moreover, this last range was launched from the first two consecutive primary surpluses since 2001 which helped to start a moderate but progressive debt decline to 178.6%. Further analysis of the fiscal stance aiming at separating the debt and cyclical response yields an active behaviour which differs in precisely this last feedback. In particular, the fiscal authority enables an active fiscal policy combined with a countercyclical effort in 2000:1 – 2002:4 and 2013:2 – 2017:4. Differently, the extensive time interval 2003:1 – 2013 is distinguished for the significant pro-cyclical reply from the government.

Greece [ESA2010 2000:1 – 2017:4]: Markov-Switching Fiscal Policy Rule									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + v_t$									
	Regime 1: **PF**			*Regime 2*			*Constant Regime*		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-0.599**	0.210	0.004	**1.940**	1.795	0.280	**2.799**	1.920	0.149
γ_1	**-0.020**	0.001	0.000	**0.010**	0.013	0.477	**-0.004**	0.014	0.778
σ	0.172	0.042		3.180	0.286		*S.E. resid.* = 3.796		
Regime Classification (Probability)									
Regime 1: **PF**				*Regime 2*					
2000:1 – 2001:1				2001:2 – 2016:3					
2016:4 – 2017:4									

Greece [ESA2010 2000:1 – 2017:4]: Probability (s_t = 1)

Smoothed Probability

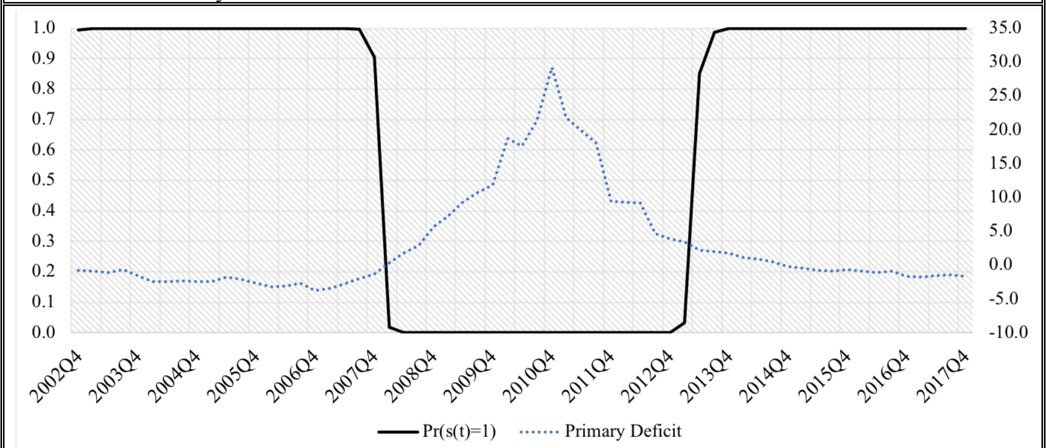


Ireland pursued an active behaviour in 2002:4 – 2007:4 and 2013:2 – 2017:4 concurrently to the closure of its final depression period through the Great Recession and in the wake of the regional economic restoration.

Ireland [ESA2010 2002:4 – 2017:4]: Markov-Switching Fiscal Policy Rule									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \upsilon_t$									
	Regime 1: **AF**			*Regime 2*			*Constant Regime:* **AF**		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-3.300**	0.241	0.000	**7.575**	4.351	0.082	**-1.580**	1.948	0.421
γ_1	**0.033**	0.004	0.000	**0.047**	0.054	0.379	**0.071**	0.026	0.009
σ	0.765	0.091		7.617	1.175		*S.E. resid.* = 7.272		
Regime Classification (Probability)									
Regime 1: **AF**				*Regime 2*					
2002:4 – 2007:4				2008:1 – 2013:1					
2013:2 – 2017:4									

Ireland [ESA2010 2002:4 – 2017:4]: Probability ($s_t = 1$)

Smoothed Probability

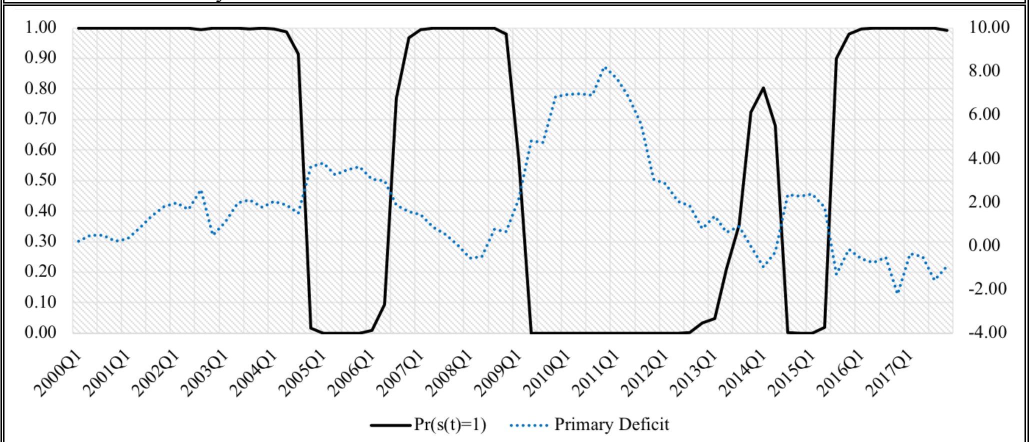


Portugal and Italy have been proving perseverance in bringing forward a passive fiscal stance throughout the entire period. However, both member states have been varying between 'stronger' and 'softer' shades of the passive regime.

Portugal [ESA2010 2000:1 – 2017:4]: Markov-Switching Fiscal Policy Rule									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + v_t$									
	Regime 1: **PF**			*Regime 2:* **PF**			*Constant Regime:* **PF**		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**2.592**	0.381	0.000	**7.661**	1.876	0.000	**3.167**	0.807	0.000
γ_1	**-0.025**	0.005	0.000	**-0.040**	0.020	0.048	**-0.015**	0.009	0.094
σ	0.786	0.105		2.034	0.274		*S.E. resid.* = 2.310		
Regime Classification (Probability)									
Regime 1: **PF**				*Regime 2:* **PF**					
2000:1 – 2004:3				2004:4 – 2006:2					
2006:3 – 2009:1				2009:2 – 2013:3					
2013:4 – 2014:2				2014:3 – 2015:2					
2015:3 – 2017:4									

Portugal [ESA2010 2000:1 – 2017:4]: Probability ($s_t = 1$)

Smoothed Probability



Italy has performed a 'stronger' passive behaviour than Portugal and has perpetually undergone primary surpluses over the entire period—with the only exception of 2009—whereas, however, those were always converted into deficits after discounting the interest payable.

Portugal has instead resorted also to primary deficits during the Great Recession also due to a lower starting level of sovereign debt of 69.0%.

The inherited higher government debt brought forward in the wake of the crisis has left Italy with no space to proceed with a fiscal stimulus that would necessarily lead to an active policy or at least mild passive ones. This lack of fiscal flexibility—which can be attached to the SGP scheme—resulted from an attempted debt-stabilisation is likely to be the peculiar feature of a country approaching its fiscal limit. Another evidence is the many sharp increases in the risk premia on the Italian sovereign debt which are in general closely related to the fiscal limit distribution.

Moreover, both countries have demonstrated in several occasions a pro-cyclical fiscal response whether the output gap was negative or positive.

Portugal and Italy—without disowning the commitment to balance the budget—loosen or strengthen the passive behaviour whether the economy outperformed or underperformed respectively.

Portugal has resorted to this specific rule feature more frequently than Italy. In particular, Italy included such pro-cyclical effort exclusively in 2000:1 – 2001:2, when outperforming output expectations.

Italy [ESA2010 2000:1 – 2017:4]: Markov-Switching Fiscal Policy Rule

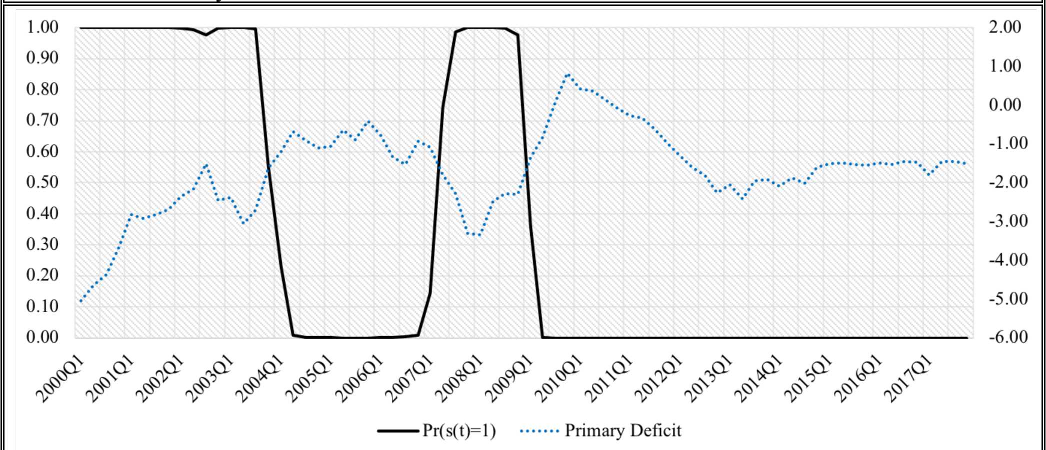
$$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \upsilon_t$$

	Regime 1: **PF**			*Regime 2:* **PF**			*Constant Regime*		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**15.829**	6.251	0.011	**2.479**	0.949	0.009	**-2.900**	1.250	0.023
γ_1	**-0.178**	0.059	0.003	**-0.031**	0.008	0.000	**0.011**	0.011	0.332
σ	0.764	0.116		0.630	0.065		*S.E. resid.* = 1.114		

Regime Classification (Probability)		
Regime 1: **PF**	*Regime 2:* **PF**	
2000:1 – 2003:4	2004:1 – 2007:1	
2007:2 – 2008:4	2009:1 – 2017:4	

Italy [ESA2010 2000:1 – 2017:4]: Probability (s_t = 1)

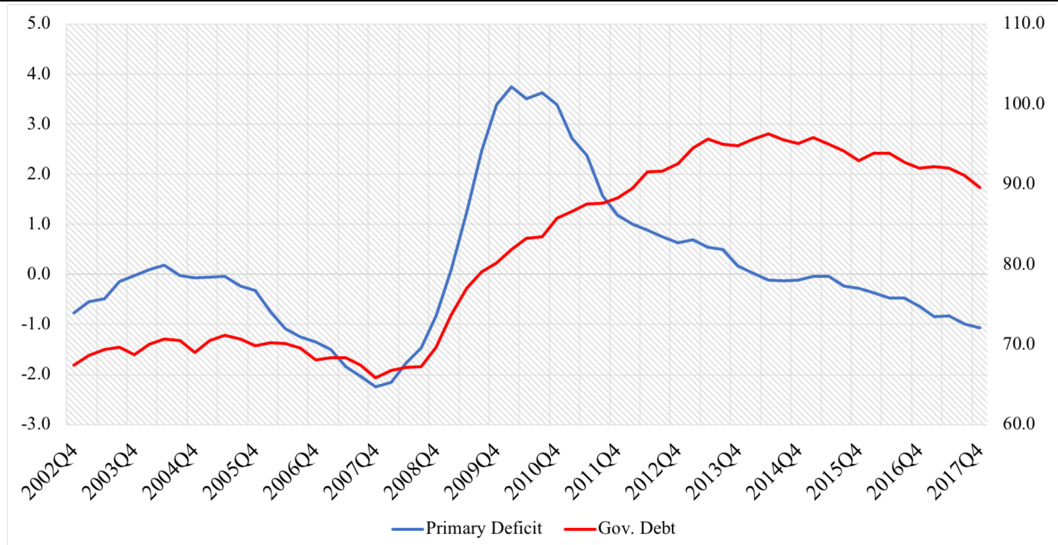
Smoothed Probability



Eurozone (12)

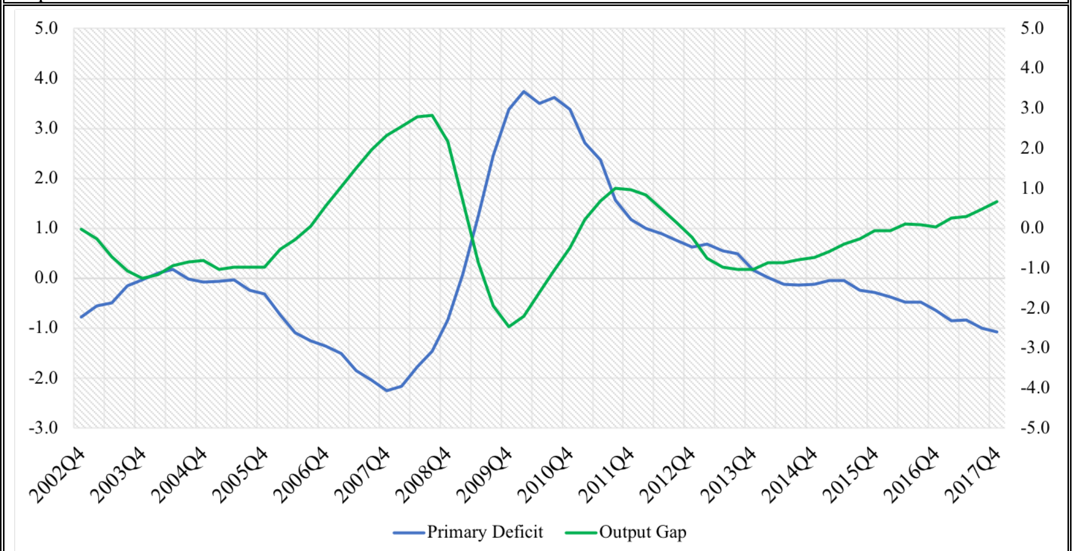
Eurozone (12) [ESA2010 2002:4 – 2017:4]: Markov-Switching Fiscal Policy Rule

% points of Gross Domestic Product



Eurozone (12) [ESA2010 2002:4 – 2017:4]: Markov-Switching Fiscal Policy Rule

% points of Gross Domestic Product



The aggregated fiscal stance of twelve governments[21] of the Eurozone is here analysed as to behave as a single fiscal authority able to pursue its own rule. Such a fiscal stance is supposed to be operating an active fiscal rule when estimated in a constant regime model.

However, the estimate of the switching rule yields a significative passive behaviour from about 2009:3 to 2015:2. Moreover, the estimate individuates a fiscal domain with

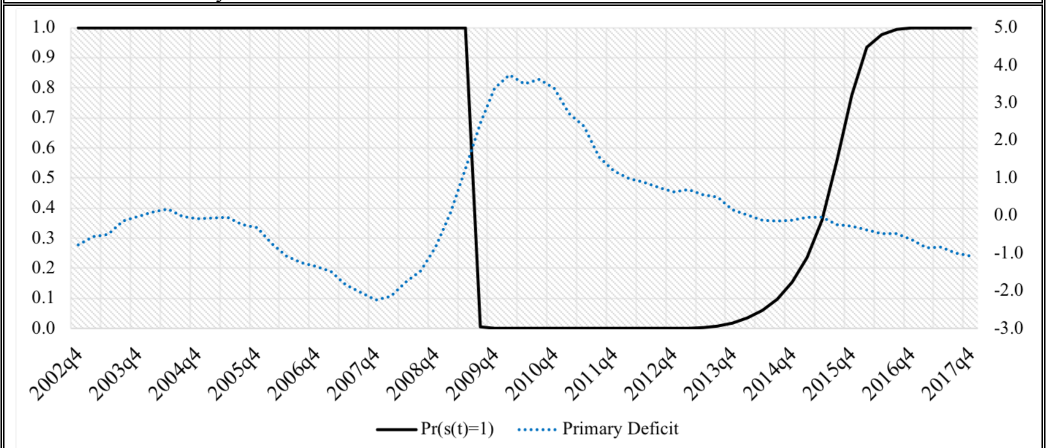
[21] Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, Netherlands, Portugal and Spain.

a debt responsive coefficient not statistically different from zero. In this case, if it is allowed a broader meaning of active regime—i.e. government disregards the debt in each direction when deciding about its policy instrument—such alleged stance occurs twice. The first happens in 2002:4 – 2009:2 and the second from approximately 2015:3 to 2017:4. This second regime shift exhibits a gradual and slow-pace development as opposed to the first one.

Eurozone (12) [ESA2010 2002:4 – 2017:4]: Markov-Switching Fiscal Policy Rule									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \upsilon_t$									
	Regime 1: **AF**			*Regime 2:* **PF**			*Constant Regime:* **AF**		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-1.617**	0.896	0.071	**20.525**	1.661	0.000	**-2.755**	1.298	0.038
γ_1	**0.012**	0.012	0.297	**-0.215**	0.019	0.000	**0.035**	0.16	0.029
σ	0.735	0.090		0.519	0.079		*S.E. resid.* = 1.405		
Regime Classification (Probability)									
Regime 1: **AF**				*Regime 2:* **PF**					
2002:4 – 2009:2				2009:3 – 2015:2					
2015:3 – 2017:4									

Eurozone (12) [ESA2010 2002:4 – 2017:4]: Markov-Switching Fiscal Policy Rule

Smoothed Probability



Not a noticeable coordination scheme amidst the individual member states and their whole behaviour has appeared from the comparative analysis throughout the period. A universal fiscal regime evolution has not happened, and many countries held their consistent behaviours. Moreover, those that have changed regime do not share the same transition direction— i.e. from active to passive—excluding Luxemburg, whose track is substantially similar to the Eurozone (12) as a whole. Nonetheless, it must be said that the aggregate Eurozone (12) and the switching fiscal authorities shared the same timing in the regime transition occurring in the wake of the Great Recession.

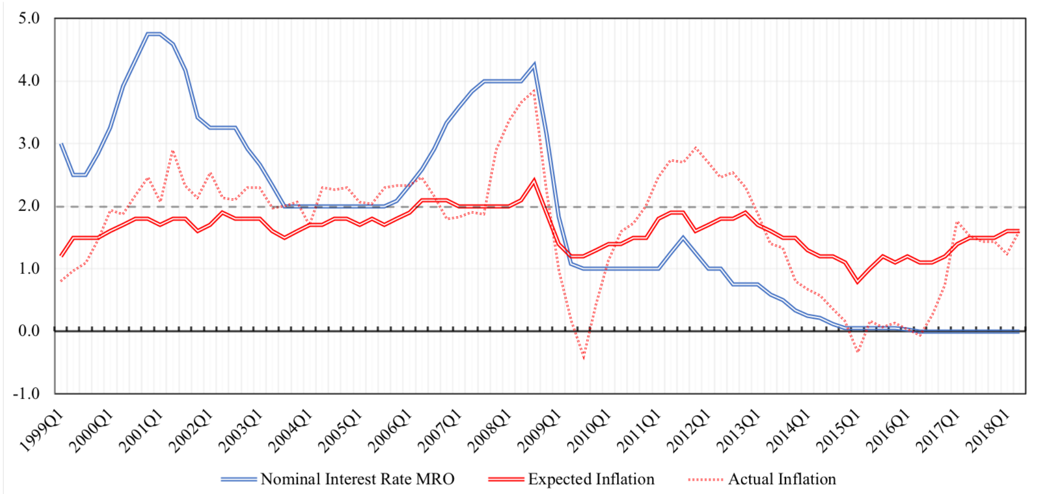
Lastly, there is more commonality of behaviour at the end of the sample than at the start of the adoption of the single currency and the ratification of the Stability and Growth Pact. In the last three years, the prevalent active fiscal behaviour among nine out of twelve members—excluding Italy, Portugal and Greece—represents a broader majority of positions than the uncoordinated system in the starting three years. This more pronounced coherence of regimes could indicate somewhat a partial result of the fiscal integration process aiming towards the broader full—both economic, monetary and fiscal—integration among the Euro.

At the same time, this Europe's work must go forward to promote sound finances according to the single speeds commanded by the particular economic circumstances of each member and the democratic validation from each constituency.

4.3.2 Monetary Authority Regime

European Central Bank [ESA2010 1999:1 – 2018:2]: Interest Rate & Inflation

% points of Gross Domestic Product

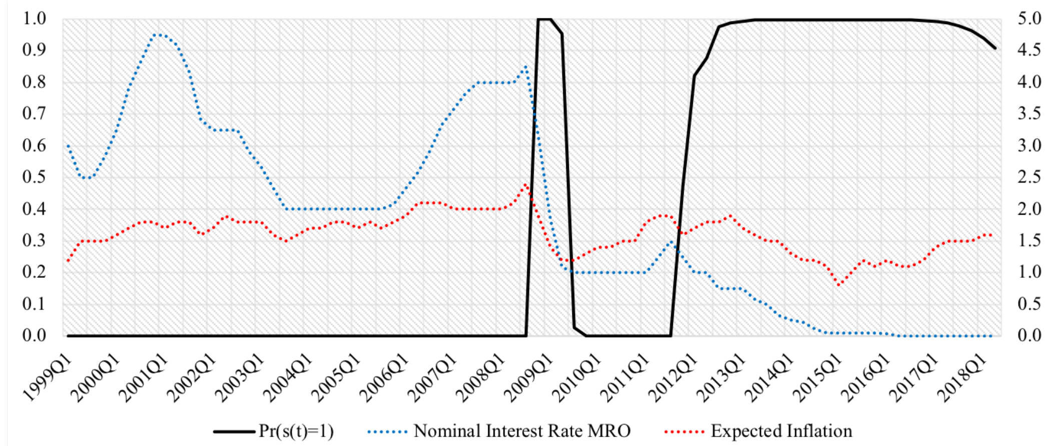


The constant regime estimate of the monetary rule yields an active behaviour throughout the whole activity of the European Central Bank. However, this inference contravenes the considerable consensus in favour of a transition to the passive monetary behaviour where the ECB is not anymore able to influence price stability. Such transition is widely advocated by the Zero Lower Bound (ZLB) of the interest rate on the Main Refinancing Operations and the implemented non-conventional measures: negative interest rates on ECB's deposits, expanded asset purchase programmes, Targeted longer-term refinancing operations (TLTRO-I, -II) and forward guidance.

European Central Bank [ESA2010 1999:1 – 2018:2]: MS Monetary Policy Rule									
$i_t = \rho(s_t)i_{t-1} + (1-\rho(s_t))(\alpha_0(s_t) + \alpha_1(s_t)(\pi_t^e - 2)) + u_t$									
	Regime 1:			*Regime 2:* **AF**			*Constant Regime:* **AF**		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
ρ	**0.656**	0.022	0.000	**0.943**	0.034	0.000	**0.925**	0.029	0.000
α_0	**0.656**	0.057	0.000	**0.306**	0.121	0.011	**3.696**	0.101	0.008
α_1	**0.840**	0.077	0.000	**8.46**	0.157	0.002	**6.037**	0.136	0.001
σ	0.099	0.013		0.236	0.024		*S.E. resid.* = 0.283		
Regime Classification (Probability)									
Regime 1: **AF**				*Regime 2:* **PF**					
1999:1 – 2008:3				2008:4 – 2009:2					
2009:3 – 2011:3				2011:4 – 2018:2					

European Central Bank [ESA2010 1999:1 – 2018:2]: MS Monetary Policy Rule

% points of Gross Domestic Product



The estimates of the model allowing regime switching provide a different snapshot of the monetary action. According to these, an active monetary stance has sought price stability until 2011:3—with a short interval in 2008:4 – 2009:2—with a strong response to inflation supporting the Taylor principle.

Then, a passive monetary regime established and it has been running since that time to nowadays, i.e. 2018:2, and presumably will remain so at least until mid-2019[22].

Whether the ECB is not able or just not willing to respond firmly to inflation, the Taylor principle has not been followed ever since.

[22] Although the ECB June 2018 announced to end the Quantitative Easing program at the end of the year, it also declared that their primary policy instrument—ECB MRO interest rate—held at 0.00% and will remain at records lows until at least mid-2019.

Moreover, the persistence of interest rate lags was more relevant in the active period with a more marked smoothing behaviour.

4.3.3 Authorities Synchronisation

Monetary and fiscal synchronisation in the timing of policy switching has been examined at the Eurozone macro aggregate level.

Before discussing presumptive policy-mix induced equilibria, it is deserving to remind that such estimating approach intended to recognise policy regimes with a probabilistic discernment. Hence, a conclusive understanding of these outcomes necessitates a relevant theory of how rational expectations equilibria are settled when policy regimes are allowed to develop over time stochastically. Such significant conclusions in this direction are beyond the purpose of this dissertation.

However, my findings have not stressed any clear evidence of monetary and fiscal policy regime switching synchronously.

To begin with, in the period 2002:4 – 2008:4 both the authorities are presumed to behave actively—i.e. both the authorities set their policy instruments disregarding the budget constraint. However, it is plausible for the economy to visit such regime temporarily. Otherwise, if the regime were permanent, the debt would explode and there would be no equilibrium. Moreover, this system should not originate a unique money-growth process and hence ensure that consumers hold the debt willingly (Leeper, 1991). That would happen unless the monetary and policy shocks are correlated to prevent it. In this view, it might be interesting to investigate further whether and how the presence of a single Central Bank and the SGP could have formed a sort of margin of manoeuvre with some intrinsic correlation capable of securing price stability

In 2008:4 – 2009:2 the passive monetary and active fiscal policy-mix would be compatible with the presence of a single rational expectations equilibrium, with the fiscal authority responsible for the price level determination in the Eurozone and the ECB preventing the debt from becoming unstable.

Next equilibrium in 2009:3 – 2011:3 is characterised by the traditional policy-mix with active monetary and passive fiscal. Such equilibria represent the conventional paradigm according to which inflation stabilisation should be an exclusive matter of monetary authority, and hence the fiscal authority is limited in setting its policy bearing the restraint of budget balancing—as well as the private agents' decisions constraint.

In 2011:4 – 2015:2 both the authorities acted passively, and that would be consistent with the price level indeterminacy effect—i.e. there are many money-growth paths compatible with the equilibrium conditions.

Finally, in 2015:3 – 2017:4 the passive monetary and active fiscal policy-mix allegedly guarantee an equilibrium where—as already explained before—is the fiscal stance that controls inflation due to its sufficiently unresponsive effort to debt shocks. Indeed, both actual and expected inflation are returning to its desired level below but close to 2% over the medium-term.

4.4 CONCLUSIONS

The estimates of the stochastically Markov-switching regression method highlight significant evidence of several regime switching occurred in the monetary policy and the fiscal policy of single governments and the Eurozone as a whole.

However, the time-varying regime phenomenon has not engaged all the fiscal authorities of the member states, and in those cases has rarely shared common transition features.

Some evidence advocates in favour of comparable fiscal stances for groups of countries and furthermore the overall level of fiscal integration within the Eurozone has improved throughout the period after the enactment of the single currency and the Stability and Growth Pact.

Monetary and fiscal authorities did not switch synchronously, and thus such interactions yielded also temporary regime settings with both the policies simultaneously function as active or passive. Such lack of timing coordination undermines inflation targeting and debt stabilisation.

Europe’s path to Unity would promote the complete integration in the ECB and fiscal behaviours. Precisely that kind of coordination that each government had experienced nationally between their former Central Banks and Treasuries until it faded away when the members mutually chose to move from single Nation-states toward an Economic and Monetary Union but not comprehensive Fiscal Union.

Hence, the conclusion of the unification process would enhance the effectiveness of the monetary and fiscal targeting policies in chasing their medium-term macro purposes due to an upgraded stage of authorities' integration.

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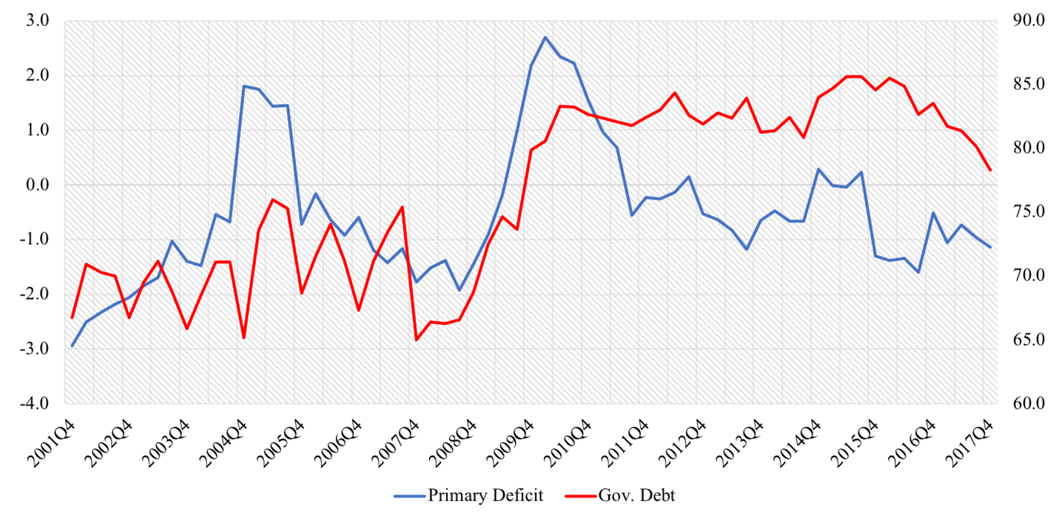
APPENDIX

AUSTRIA

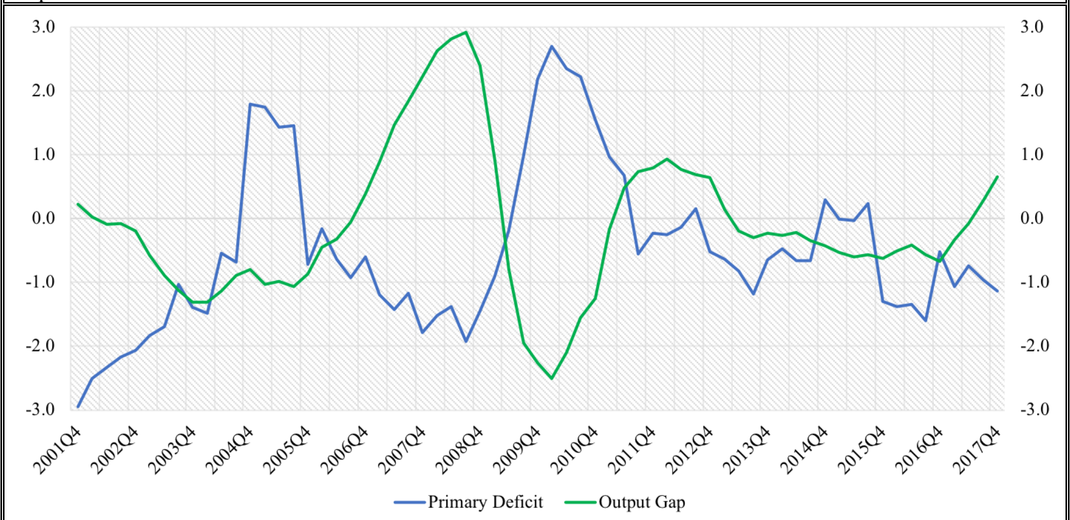
Austria [ESA2010 2001:4 – 2017:4]: Primary Deficit d_t & Public Debt b_t

% points of Gross Domestic Product



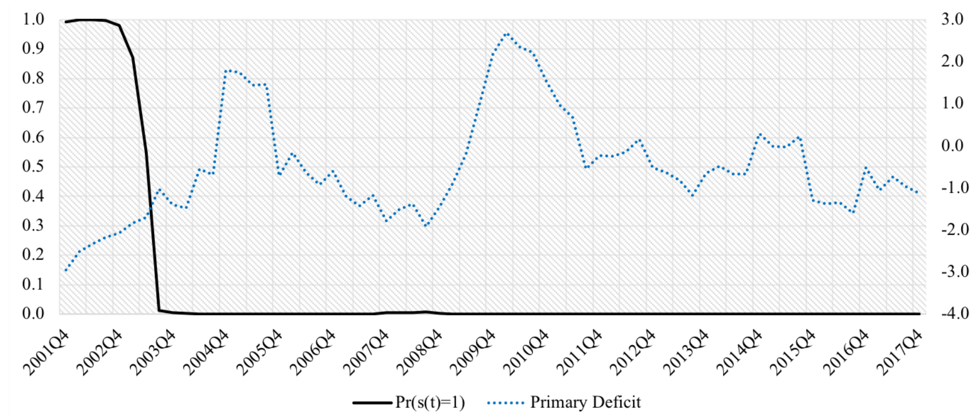
Austria [ESA2010 2001:4 – 2017:4]: Primary Deficit d_t & Output Gap x_t

% points of Gross Domestic Product

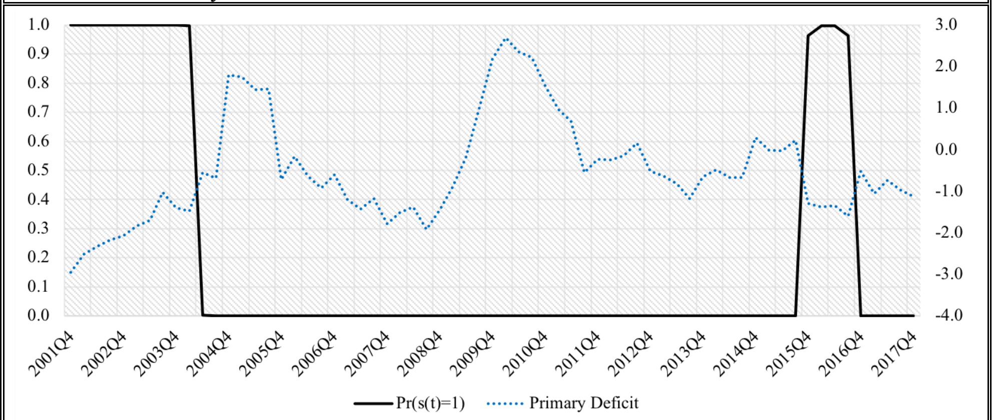


Austria [ESA2010 2001:4 – 2017:4]: Markov-Switching Fiscal Policy Rule									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \upsilon_t$									
	Regime 1			*Regime 2*			*Constant Regime:* **AF**		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-1.719**	3.623	0.635	**-2.277**	1.640	0.165	**-4.671**	1.703	0.008
γ_1	**-0.002**	0.013	0.882	**0.006**	0.005	0.228	**0.055**	0.022	0.017
σ	0.381	0.124		1.139	0.105		*S.E. resid.* = 1.209		
Regime Classification (Probability)									
Regime 1				*Regime 2*					
2001:4 – 2003:2				2003:3 – 2017:4					
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \gamma_2(s_t)x_t + \upsilon_t$									
	Regime 1: **AF**			*Regime 2*			*Constant Regime*		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-4.588**	0.480	0.000	**0.692**	1.252	0.581	**-2.869**	1.425	0.049
γ_1	**0.008**	0.001	0.000	**-0.003**	0.004	0.497	**0.008**	0.005	0.111
γ_2	**-0.942**	0.106	0.000	**-0.723**	0.089	0.000	**-0.535**	0.118	0.000
σ	0.186	0.036		0.744	0.074		*S.E. resid.* = 1.061		
Regime Classification (Probability)									
Regime 1: **AF**				*Regime 2*					
2001:4 – 2004:1				2004:2 – 2015:3					
2015:4 – 2016:3				2016:4 – 2017:4					

Austria [ESA2010 2001:4 – 2017:4]: Probability ($s_t = 1$)
Smoothed Probability



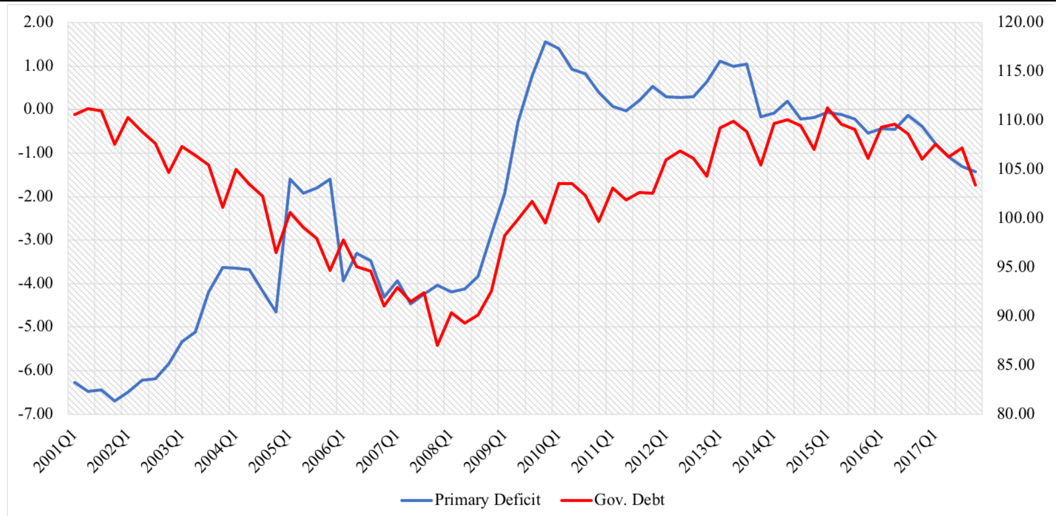
Austria [ESA2010 2001:4 – 2017:4]: Probability ($s_t = 1$), Fiscal Rule including x_t
Smoothed Probability



BELGIUM

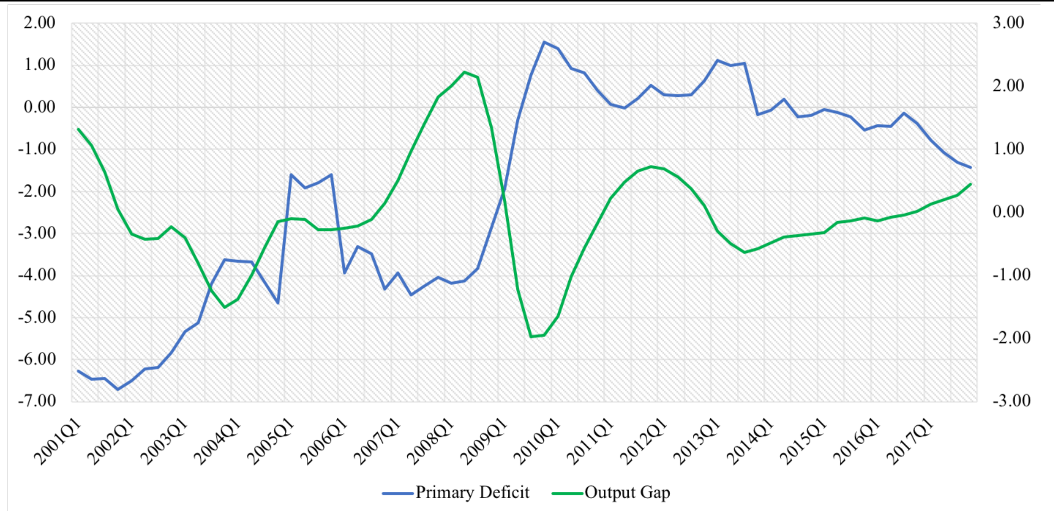
Belgium [ESA2010 2000:1 – 2017:4]: Primary Deficit d_t & Public Debt b_t

% points of Gross Domestic Product



Belgium [ESA2010 2000:1 – 2017:4]: Primary Deficit d_t & Output Gap x_t

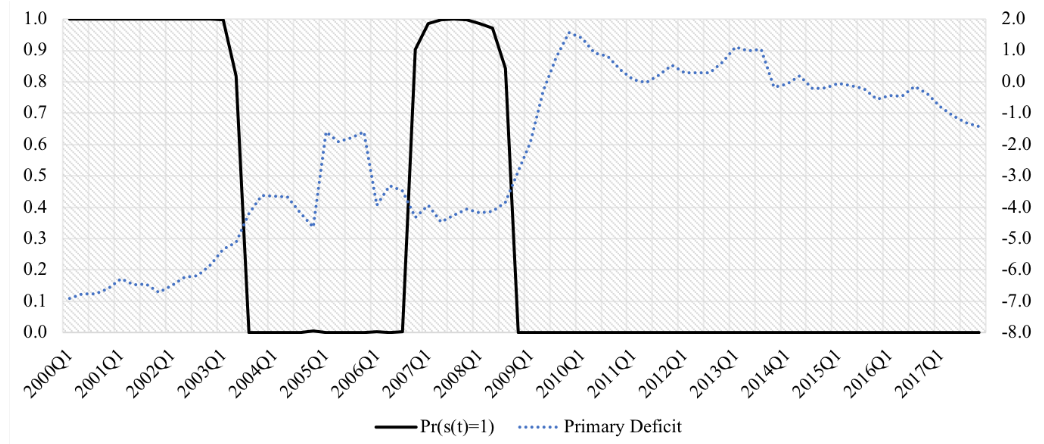
% points of Gross Domestic Product



Belgium [ESA2010 2000:1 – 2017:4]: Markov-Switching Fiscal Policy Rule									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + v_t$									
	Regime 1: **PF**			*Regime 2:* **AF**			*Constant Regime*		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**5.993**	0.647	0.000	**-14.164**	4.738	0.003	**-0.678**	4.820	0.889
γ_1	**-0.111**	0.006	0.000	**0.128**	0.046	0.005	**-0.015**	0.463	0.740
σ	0.277	0.051		1.578	0.170		*S.E. resid.* = 2.668		
Regime Classification (Probability)									
Regime 1: **PF**				*Regime 2:* **AF**					
2000:1 – 2003:2				2003:3 – 2006:3					
2006:4 – 2008:3				2008:4 – 2017:4					
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \gamma_2(s_t)x_t + v_t$									
	Regime 1: **PF**			*Regime 2:* **AF**			*Constant Regime*		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**8.840**	1.197	0.000	**-8.545**	2.733	0.002	**3.190**	4.578	0.488
γ_1	**-0.133**	0.012	0.000	**0.079**	0.026	0.003	**-0.052**	0.044	0.239
γ_2	**-0.544**	0.094	0.000	**-0.780**	0.193	0.000	**-1.214**	0.335	0.001
σ	0.503	0.065		0.778	0.085		*S.E. resid.* = 2.464		
Regime Classification (Probability)									
Regime 1: **PF**				*Regime 2:* **AF**					
2000:1 – 2004:4				2005:1 – 2005:4					
2006:1 – 2008:3				2008:4 – 2017:4					

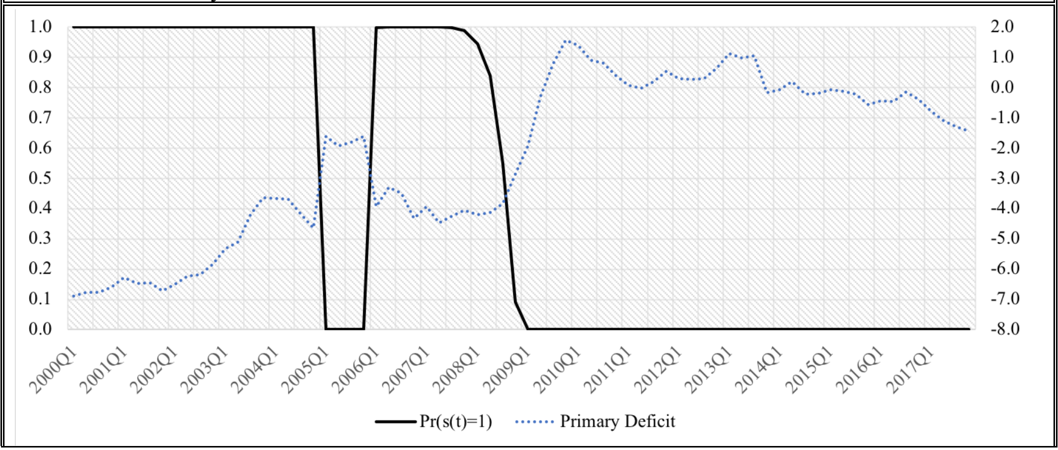
Belgium [ESA2010 2000:1 – 2017:4]: Probability ($s_t = 1$)

Smoothed Probability



Belgium [ESA2010 2000:1 – 2017:4]: Probability ($s_t = 1$), Fiscal Rule including x_t

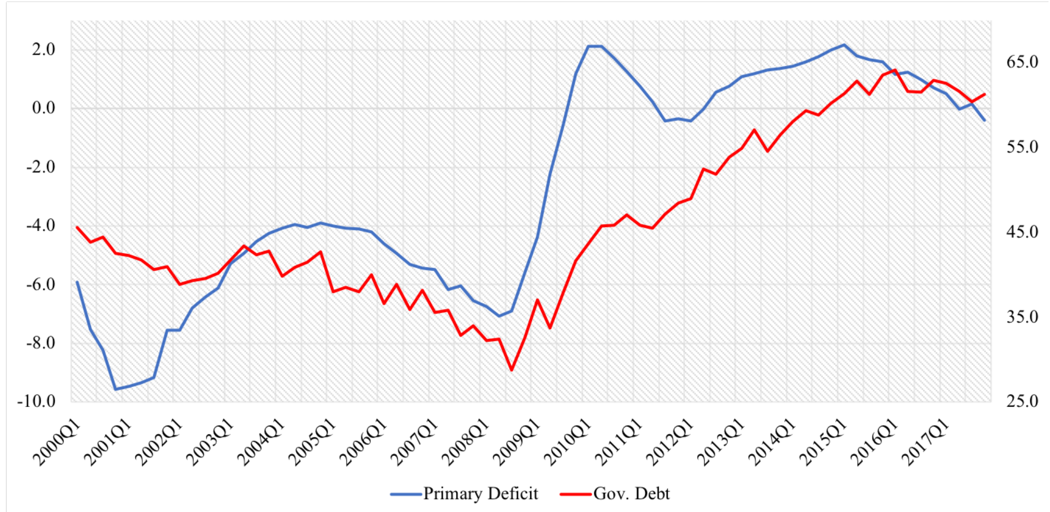
Smoothed Probability



FINLAND

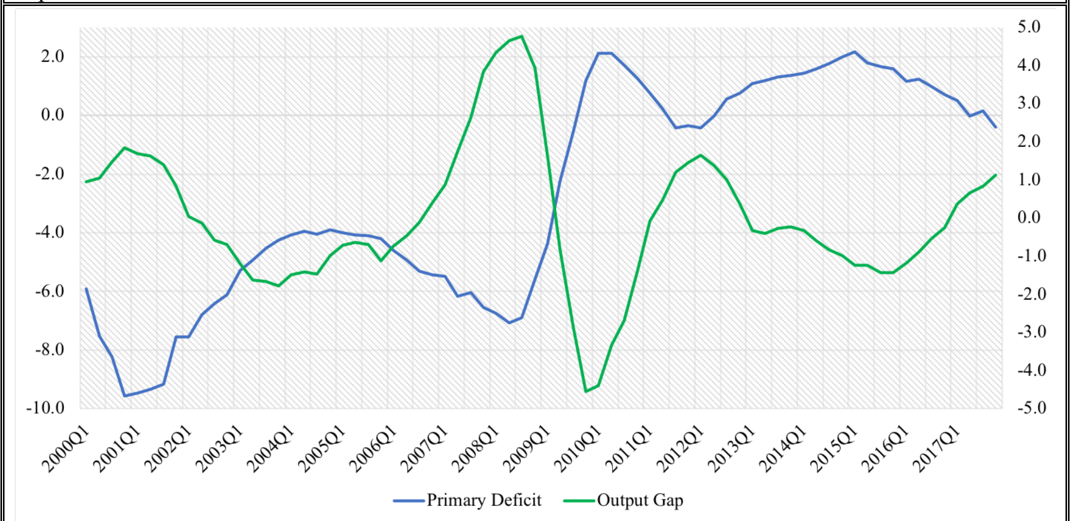
Finland [ESA2010 2000:1 – 2017:4]: Primary Deficit d_t & Public Debt b_t

% points of Gross Domestic Product



Finland [ESA2010 2000:1 – 2017:4]: Primary Deficit d_t & Output Gap x_t

% points of Gross Domestic Product



Finland [ESA2010 2000:1 – 2017:4]: Markov-Switching Fiscal Policy Rule

$$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \upsilon_t$$

	Regime 1: **PF**			*Regime 2:* **AF**			*Constant Regime:* **AF**		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-0.682**	2.512	0.786	**-9.430**	1.915	0.000	**-15.015**	1.508	0.000
γ_1	**-0.160**	0.067	0.017	**0.178**	0.035	0.000	**0.268**	0.032	0.000
σ	1.246	0.262		1.782	0.199		*S.E. resid.* = 2.632		

Regime Classification (Probability)		
Regime 1: **PF**	*Regime 2:* **AF**	
2000:1 – 2003:1	2003:2 – 2006:1	
2006:2 – 2008:4	2009:1 – 2017:4	

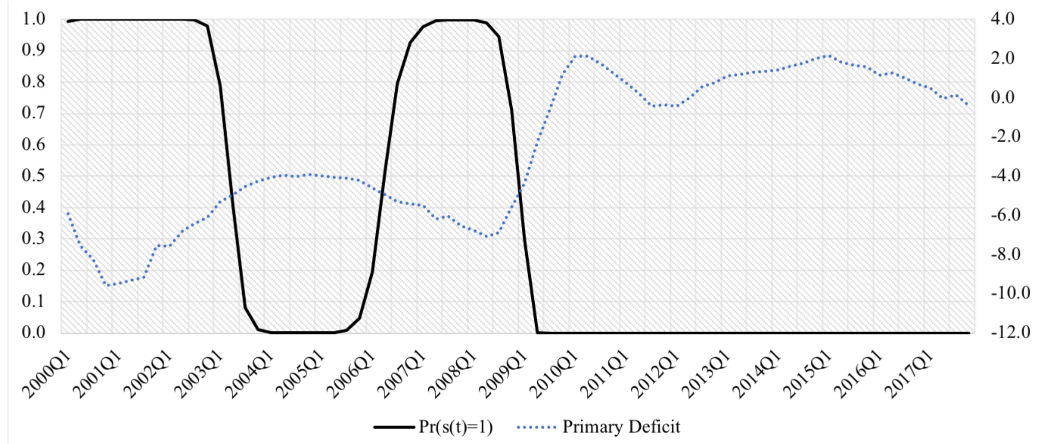
$$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \gamma_2(s_t)x_t + \upsilon_t$$

	Regime 1: **PF**			*Regime 2:* **AF**			*Constant Regime:* **AF**		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**2.512**	4.673	0.591	**-6.540**	0.779	0.000	**-13.479**	1.383	0.000
γ_1	**-0.210**	0.113	0.063	**0.127**	0.015	0.000	**0.235**	0.029	0.000
γ_2	**-1.188**	0.265	0.000	**-0.817**	0.072	0.000	**-0.696**	0 .157	0.000
σ	0.926	0.156		0.875	0.109		*S.E. resid.* = 2.338		

Regime Classification (Probability)		
Regime 1: **PF**	*Regime 2:* **AF**	
2000:1 – 2007:2	2007:3 – 2017:4	

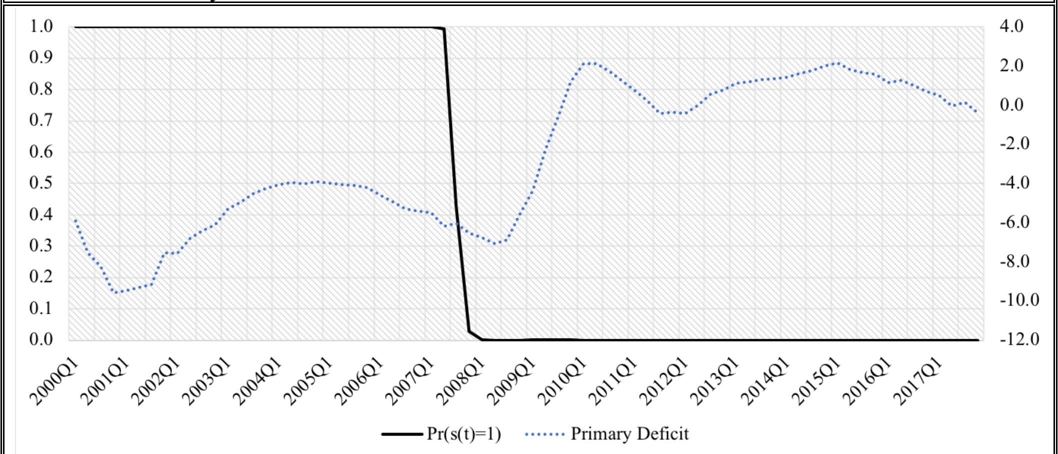
Finland [ESA2010 2000:1 – 2017:4]: Probability ($s_t = 1$)

Smoothed Probability



Finland [ESA2010 2000:1 – 2017:4]: Probability ($s_t = 1$), Fiscal Rule including x_t

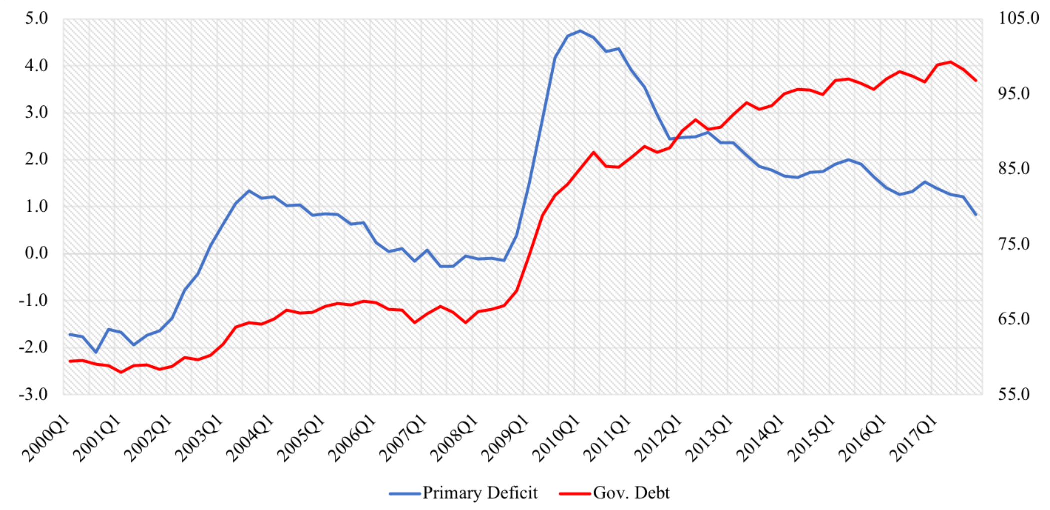
Smoothed Probability



FRANCE

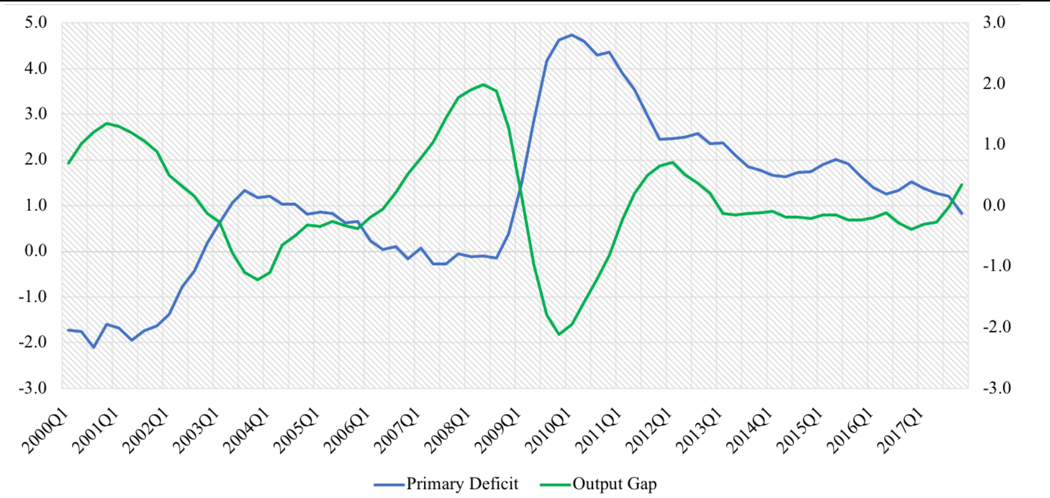
France [ESA2010 2000:1 – 2017:4]: Primary Deficit d_t & Public Debt b_t

% points of Gross Domestic Product



France [ESA2010 2000:1 – 2017:4]: Primary Deficit d_t & Output Gap x_t

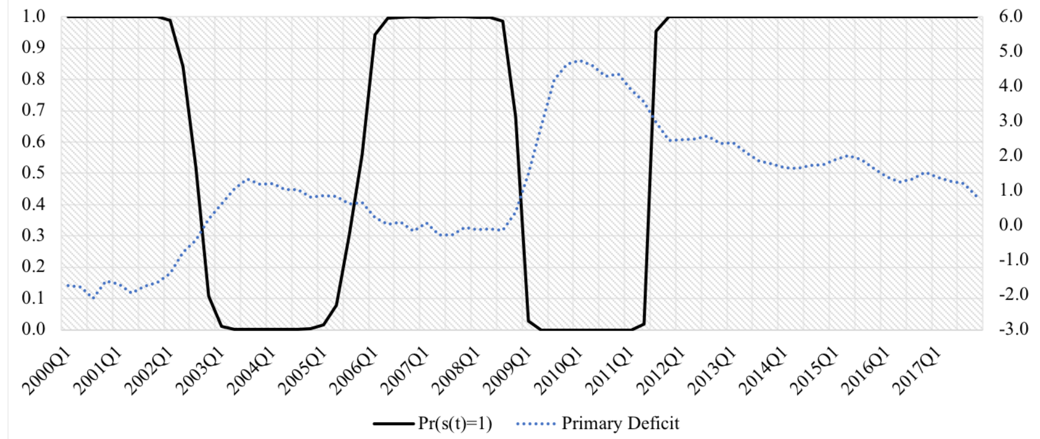
% points of Gross Domestic Product



France [ESA2010 2000:1 – 2017:4]: Markov-Switching Fiscal Policy Rule									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + v_t$									
	Regime 1: **AF**			*Regime 2:* **AF**			*Constant Regime:* **AF**		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-5.654**	0.541	0.000	**-9.668**	0.962	0.000	**-4.604**	0.806	0.000
γ_1	**0.079**	0.007	0.000	**0.165**	0.013	0.000	**0.074**	0.010	0.000
σ	0.700	0.074		0.535	0.093		*S.E. resid.* = 1.285		
Regime Classification (Probability)									
Regime 1: **AF**				*Regime 2:* **AF**					
2000:1 – 2002:3				2002:4 – 2005:3					
2005:4 – 2008:4				2009:1 – 2011:2					
2011:3 – 2017:4									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \gamma_2(s_t)x_t + v_t$									
	Regime 1: **AF**			*Regime 2:* **AF**			*Constant Regime:* **AF**		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-2.699**	0.234	0.000	**-3.325**	0.870	0.000	**-3.016**	0.638	0.000
γ_1	**0.042**	0.003	0.000	**0.073**	0.011	0.000	**0.055**	0.008	0.000
γ_2	**-1.342**	0.082	0.000	**-0.992**	0.086	0.000	**-1.025**	0.136	0.000
σ	0.324	0.036		0.447	0.069		*S.E. resid.* = 0.959		
Regime Classification (Probability)									
Regime 1: **AF**				*Regime 2:* **AF**					
2000:1 – 2002:1				2002:2 – 2013:1					
2013:2 – 2017:4									

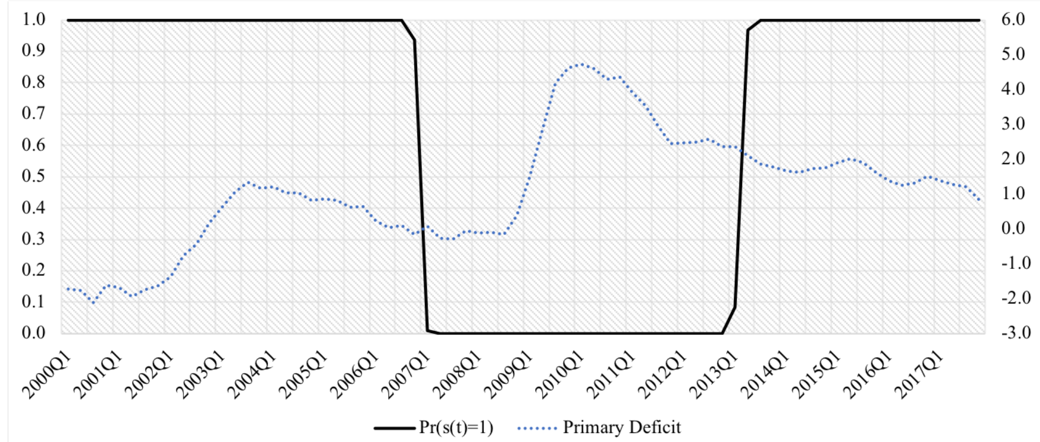
France [ESA2010 2000:1 – 2017:4]: Probability ($s_t = 1$)

Smoothed Probability



France [ESA2010 2000:1 – 2017:4]: Probability ($s_t = 1$), Fiscal Rule including x_t

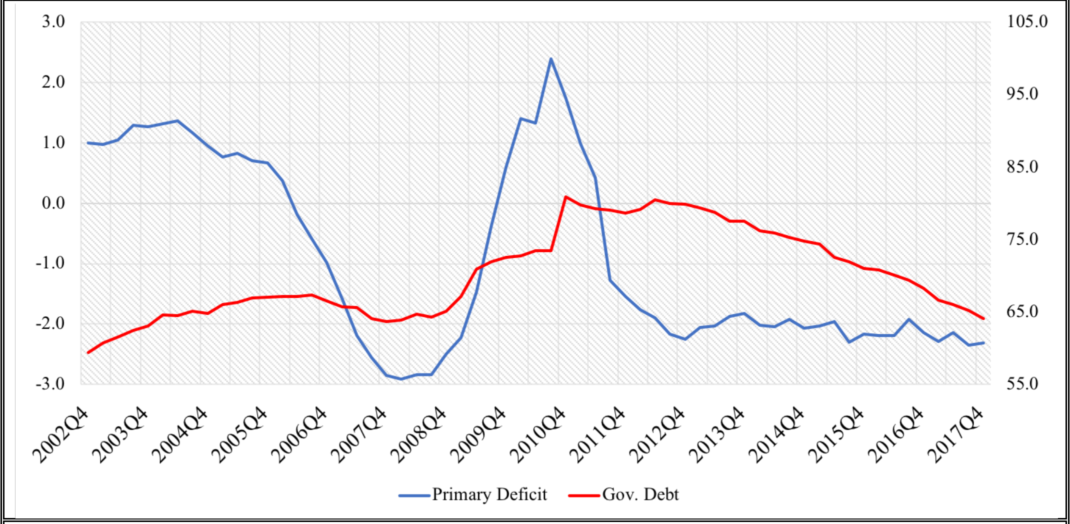
Smoothed Probability



GERMANY

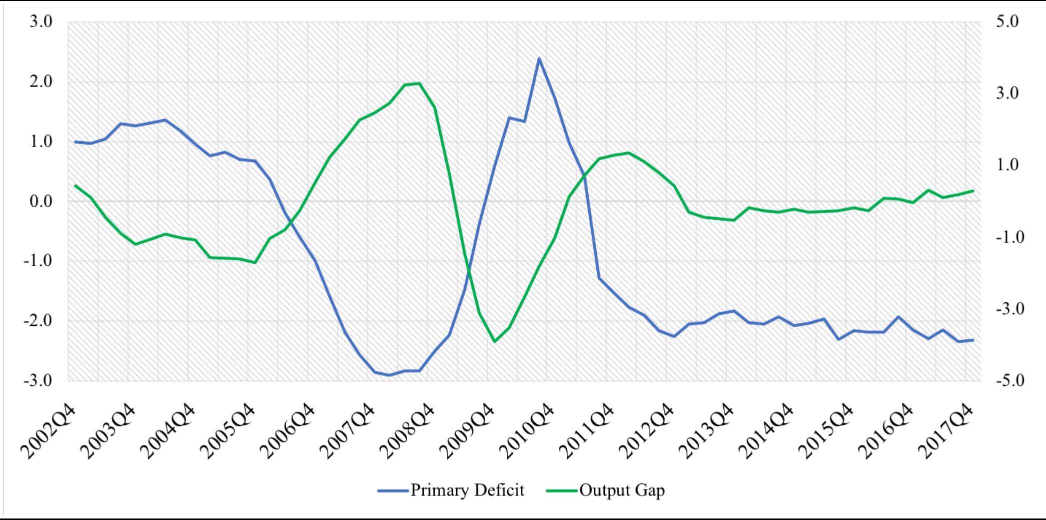
Germany [ESA 2010 2002:4 – 2017:4]: Markov-Switching Fiscal Policy Rule

% points of Gross Domestic Product



Germany [ESA 2010 2002:4 – 2017:4]: Markov-Switching Fiscal Policy Rule

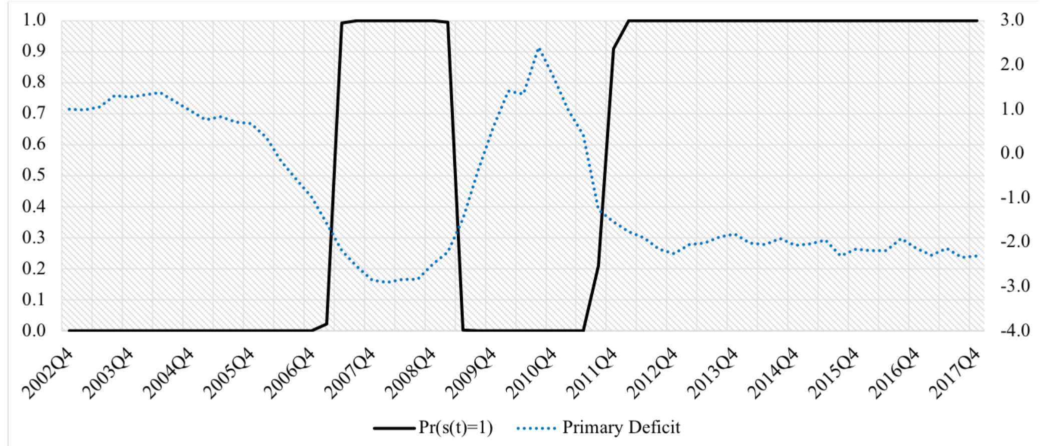
% points of Gross Domestic Product



Germany [ESA 2010 2002:4 – 2017:4]: Markov-Switching Fiscal Policy Rule									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \upsilon_t$									
	Regime 1: **AF**			*Regime 2*			*Constant Regime*		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-5.192**	0.482	0.000	**1.824**	2.440	0.455	**3.408**	2.239	0.133
γ_1	**0.042**	0.007	0.000	**-0.018**	0.036	0.613	**-0.062**	0.032	0.057
σ	0.212	0.031		0.973	0.136		*S.E. resid.* = 1.528		
Regime Classification (Probability)									
Regime 1: **AF**				*Regime 2*					
2007:2 – 2009:1				2002:4 – 2007:1					
2011:4 – 2017:4				2009:2 – 2011:3					
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \gamma_2(s_t)x_t + \upsilon_t$									
Inconclusive estimates for the switching model							*Constant Regime*		
							Coeff.	S.E.	p-value
γ_0							**4.102**	1.623	0.014
γ_1							**-0.073**	0.023	0.003
γ_2							**-0.717**	0.097	0.000
							S.E. resid. = 1.106		

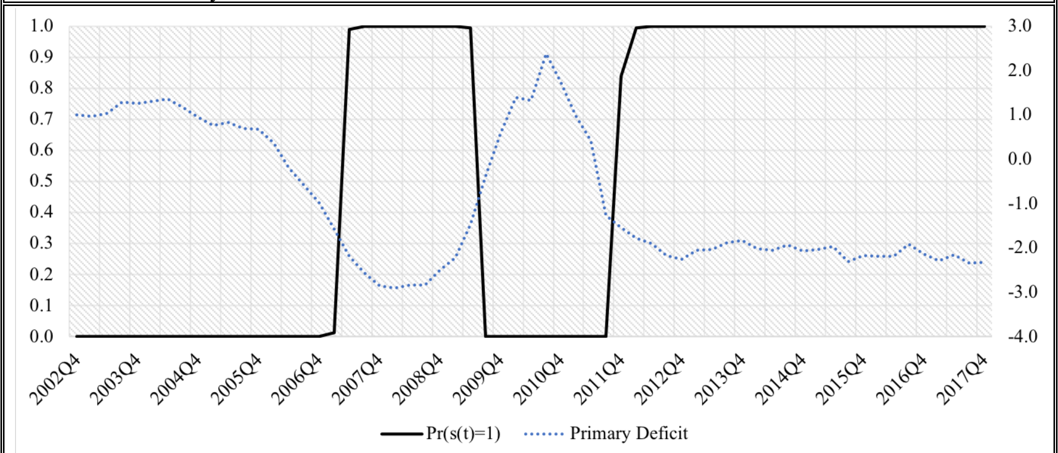
Germany [ESA 2010 2002:4 – 2017:4]: Probability ($s_t = 1$)

Smoothed Probability



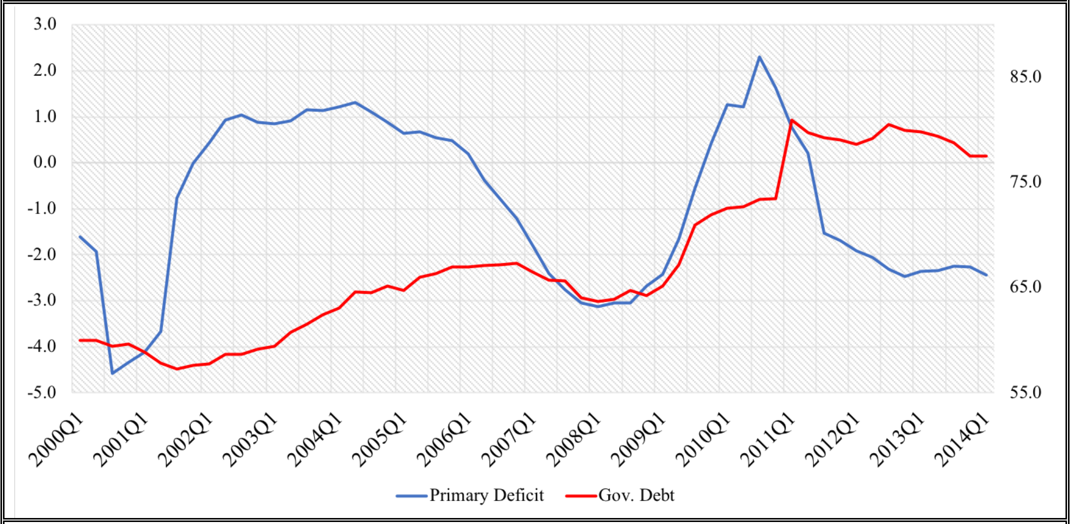
Germany [ESA 2010 2002:4 – 2017:4]: Probability ($s_t = 1$), Fiscal Rule including x_t

Smoothed Probability



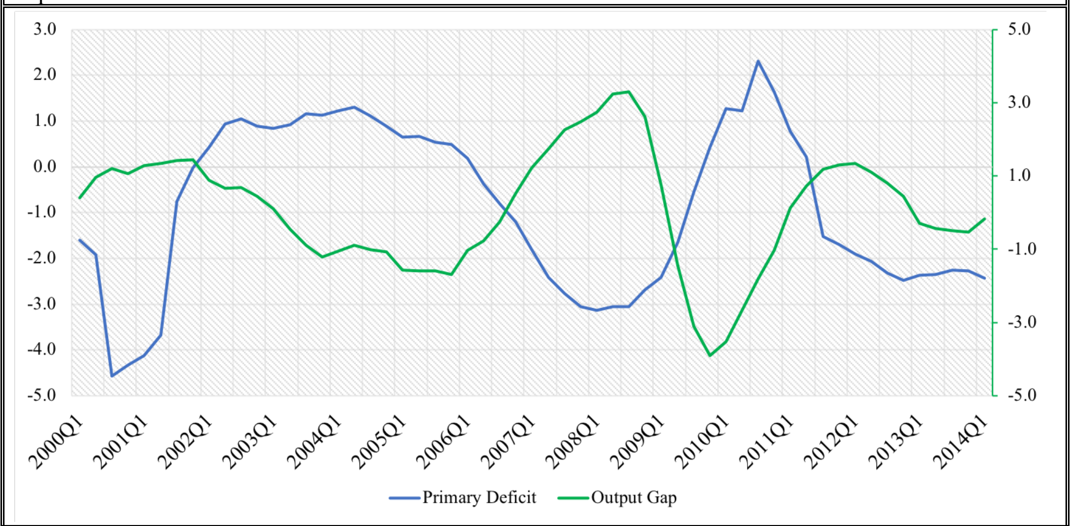
Germany [ESA 2010 2000:1 – 2014:1]: Markov-Switching Fiscal Policy Rule

% points of Gross Domestic Product



Germany [ESA 2010 2000:1 – 2014:1]: Markov-Switching Fiscal Policy Rule

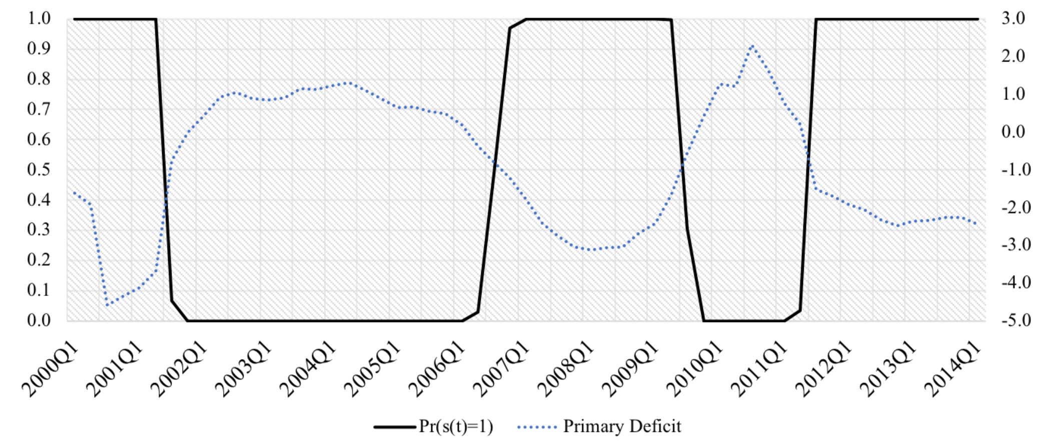
% points of Gross Domestic Product



Germany [ESA1995 2000:1 – 2014:1]: Markov-Switching Fiscal Policy Rule									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \upsilon_t$									
	Regime 1: **AF**			*Regime 2*			*Constant Regime*		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-6.115**	1.335	0.000	**-0.299**	1.312	0.820	**0.049**	2.179	0.982
γ_1	**0.052**	0.019	0.005	**0.016**	0.020	0.439	**-0.014**	0.032	0.663
σ	0.776	0.153		0.653	0.118		*S.E. resid.* = 1.811		
Regime Classification (Probability)									
Regime 1: **AF**				*Regime 2*					
2000:1 – 2001:2				2001:3 – 2006:3					
2006:4 – 2009:2				2009:3 – 2011:2					
2011:3 – 2014:1									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \gamma_2(s_t)x_t + \upsilon_t$									
	Regime 1			*Regime 2:* **PF**			*Constant Regime:* **PF**		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**13.791**	11.062	0.213	**5.182**	1.255	0.000	**-0.049**	0.024	0.050
γ_1	**-0.271**	0.178	0.127	**-0.084**	0.018	0.000	**-0.778**	0.115	0.000
γ_2	**-1.598**	0.477	0.001	**-0.839**	0.095	0.000	**2.477**	1.657	0.141
σ	0.277	0.075		0.962	0.097		*S.E. resid.* = 1.345		
Regime Classification (Probability)									
Regime 1				*Regime 2:* **PF**					
2000:1 – 2000:2				2000:3 – 2001:2					
2001:3 – 2009:1				2009:2 – 2009:4					
2010:1 – 2014:1									

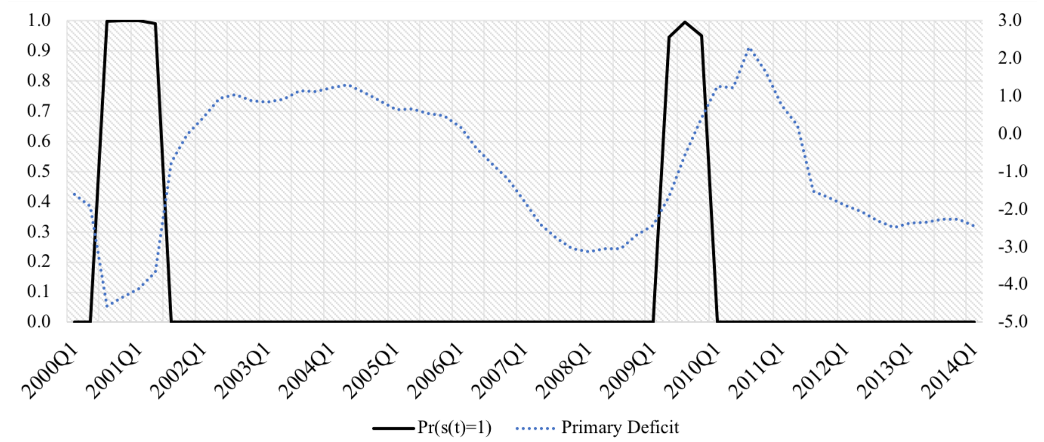
Germany [ESA1995 2000:1 – 2014:1]: Probability ($s_t = 1$)

Smoothed Probability



Germany [ESA1995 2000:1 – 2014:1]: Probability ($s_t = 1$), Fiscal Rule including x_t

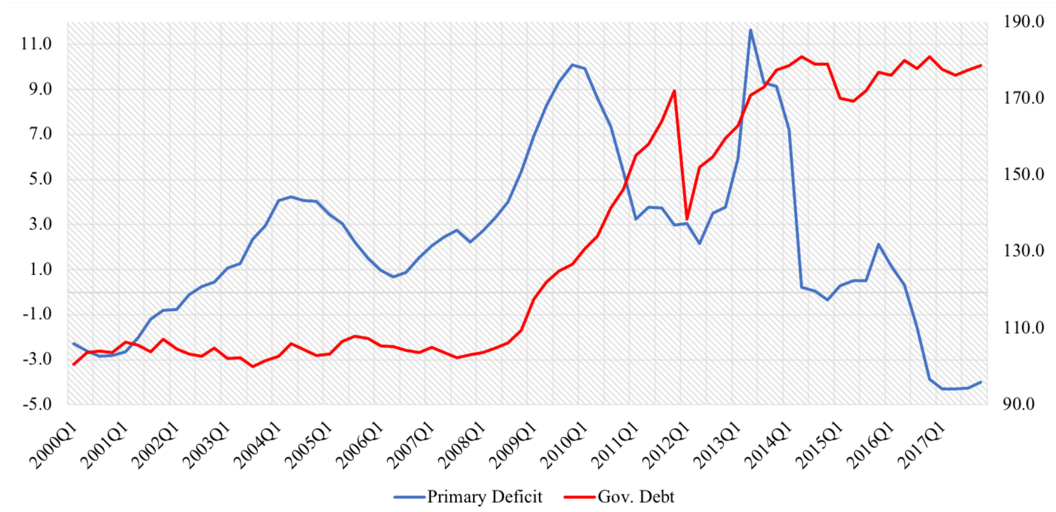
Smoothed Probability



GREECE

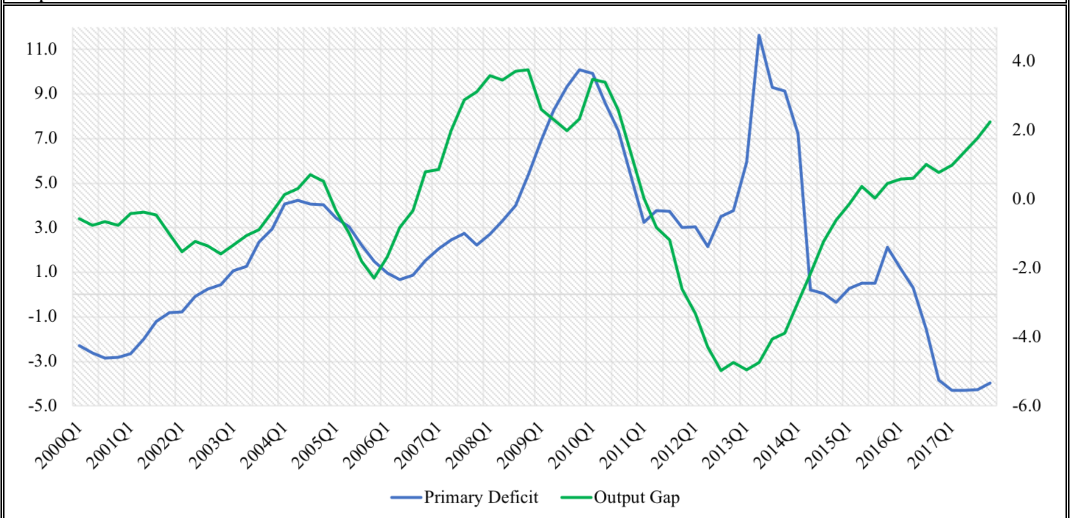
Greece [ESA2010 2000:1 – 2017:4]: Primary Deficit d_t & Public Debt b_t

% points of Gross Domestic Product



Greece [ESA2010 2000:1 – 2017:4]: Primary Deficit d_t & Output Gap x_t

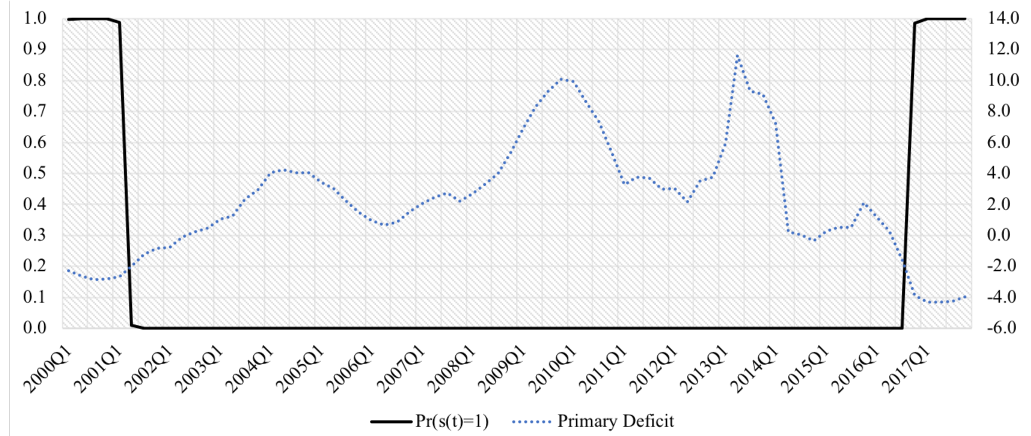
% points of Gross Domestic Product



Greece [ESA2010 2000:1 – 2017:4]: Markov-Switching Fiscal Policy Rule									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \upsilon_t$									
	Regime 1: **PF**			*Regime 2*			*Constant Regime*		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-0.599**	0.210	0.004	**1.940**	1.795	0.280	**2.799**	1.920	0.149
γ_1	**-0.020**	0.001	0.000	**0.010**	0.013	0.477	**-0.004**	0.014	0.778
σ	0.172	0.042		3.180	0.286		*S.E. resid.* = 3.796		
Regime Classification (Probability)									
Regime 1: **PF**				*Regime 2*					
2000:1 – 2001:1				2001:2 – 2016:3					
2016:4 – 2017:4									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \gamma_2(s_t)x_t + \upsilon_t$									
	Regime 1: **AF**			*Regime 2:* **AF**			*Constant Regime*		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-7.669**	1.378	0.000	**-4.603**	1.883	0.014	**2.849**	1.981	0.155
γ_1	**0.043**	0.009	0.000	**0.070**	0.015	0.000	**-0.024**	0.210	0.908
γ_2	**-2.163**	0.210	0.000	**0.732**	0.135	0.000	**-0.004**	0.015	0.765
σ	1.646	0.223		1.829	0.204		*S.E. resid.* = 3.823		
Regime Classification (Probability)									
Regime 1: **AF**				*Regime 2:* **AF**					
2000:1 – 2002:4				2003:1 – 2013:1					
2013:2 – 2017:4									

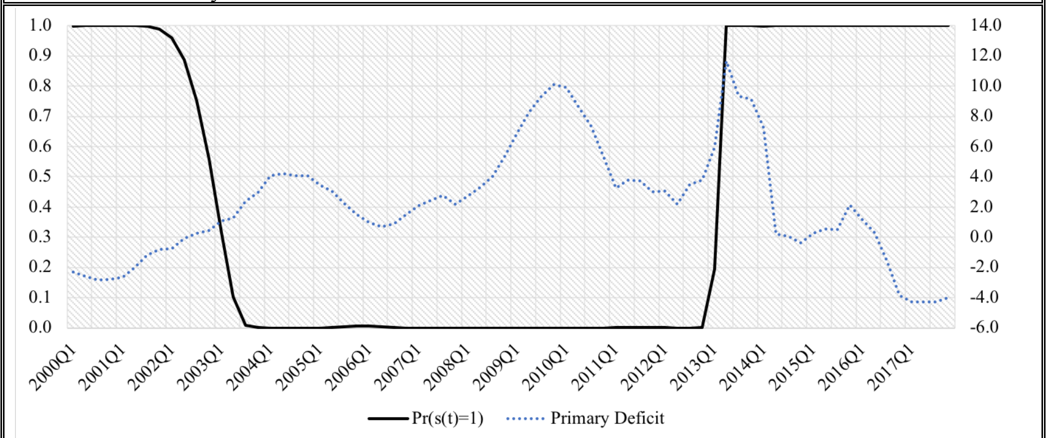
Greece [ESA2010 2000:1 – 2017:4]: Probability ($s_t = 1$)

Smoothed Probability



Greece [ESA2010 2000:1 – 2017:4]: Probability ($s_t = 1$), Fiscal Rule including x_t

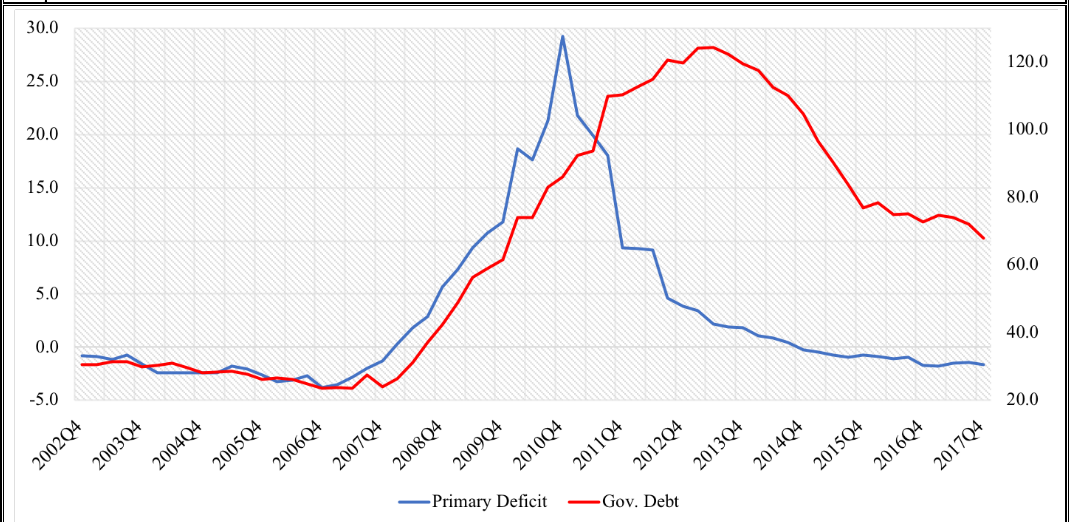
Smoothed Probability



IRELAND

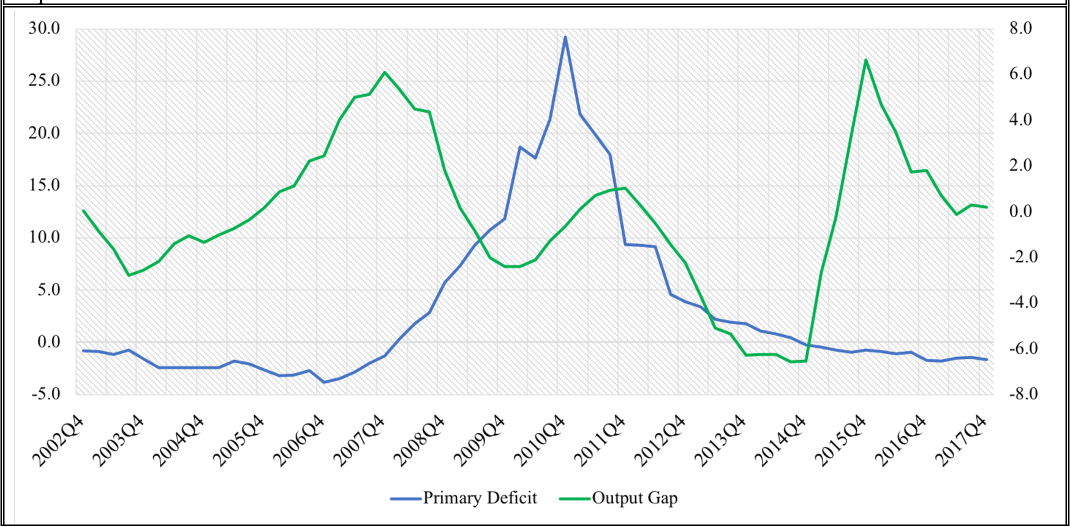
Ireland [ESA2010 2002:4 – 2017:4]: Primary Deficit d_t & Public Debt b_t

% points of Gross Domestic Product



Ireland [ESA2010 2002:4 – 2017:4]: Primary Deficit d_t & Output Gap x_t

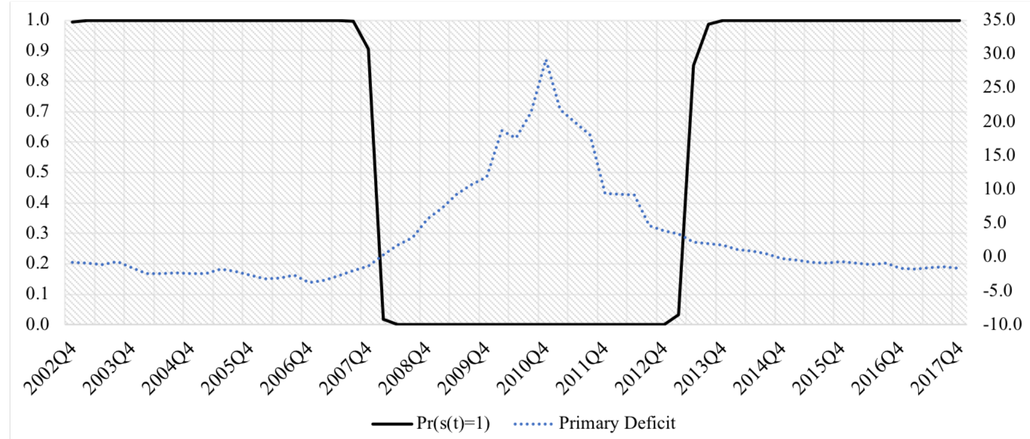
% points of Gross Domestic Product



Ireland [ESA2010 2002:4 – 2017:4]: Markov-Switching Fiscal Policy Rule									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + v_t$									
	Regime 1: **AF**			*Regime 2*			*Constant Regime:* **AF**		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-3.300**	0.241	0.000	**7.575**	4.351	0.082	**-1.580**	1.948	0.421
γ_1	**0.033**	0.004	0.000	**0.047**	0.054	0.379	**0.071**	0.026	0.009
σ	0.765	0.091		7.617	1.175		*S.E. resid.* = 7.272		
Regime Classification (Probability)									
Regime 1: **AF**				*Regime 2*					
2002:4 – 2007:4				2008:1 – 2013:1					
2013:2 – 2017:4									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \gamma_2(s_t)x_t + v_t$									
	Regime 1: **AF**			*Regime 2*			*Constant Regime:* **AF**		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-3.080**	0.236	0.000	**11.004**	4.763	0.021	**-1.763**	2.172	0.420
γ_1	**0.029**	0.004	0.000	**0.001**	0.060	0.990	**0.074**	0.031	0.019
γ_2	**-0.107**	0.039	0.006	**-1.294**	0.784	0.099	**0.067**	0.339	0.844
σ	0.689	0.084		7.192	1.103		*S.E. resid.* = 7.332		
Regime Classification (Probability)									
Regime 1: **AF**				*Regime 2*					
2002:4 – 2007:3				2007:4 – 2013:1					
2013:2 – 2017:4									

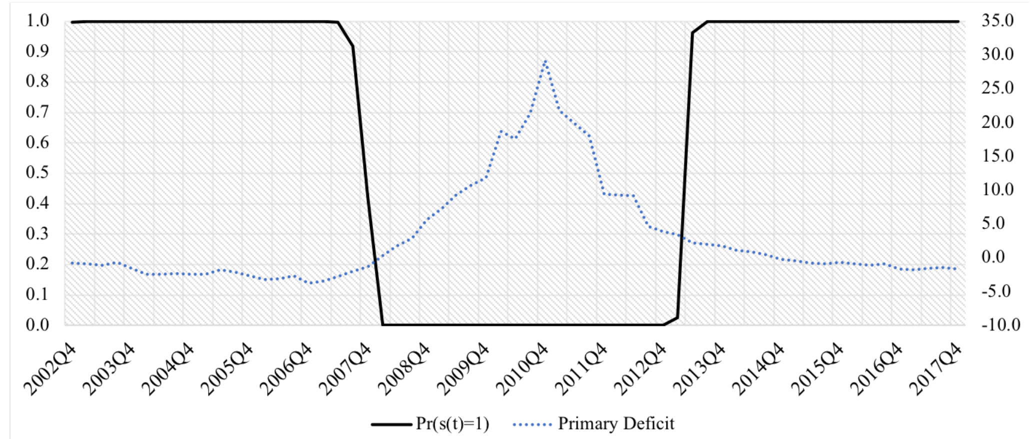
Ireland [ESA2010 2002:4 – 2017:4]: Probability ($s_t = 1$)

Smoothed Probability



Ireland [ESA2010 2002:4 – 2017:4]: Probability ($s_t = 1$), Fiscal Rule including x_t

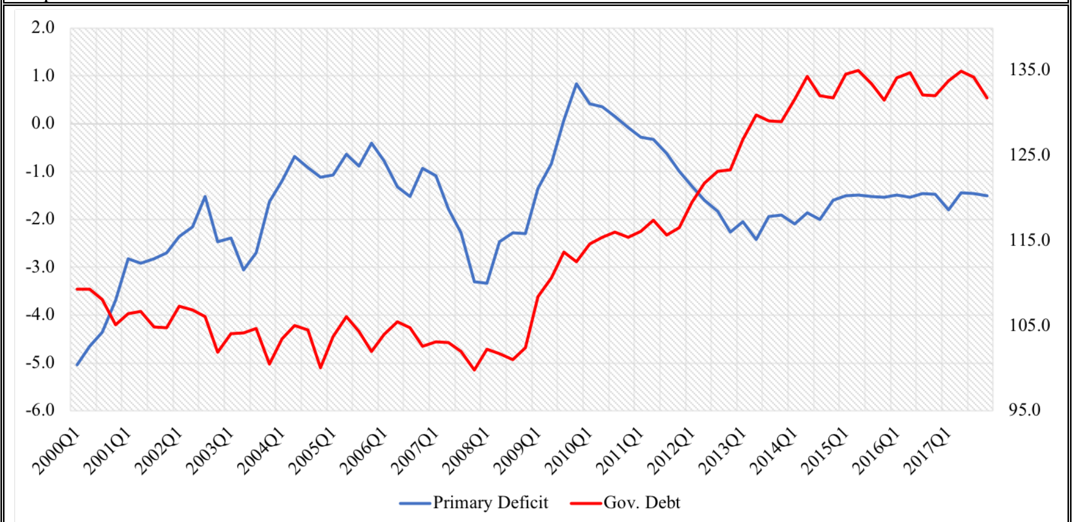
Smoothed Probability



ITALY

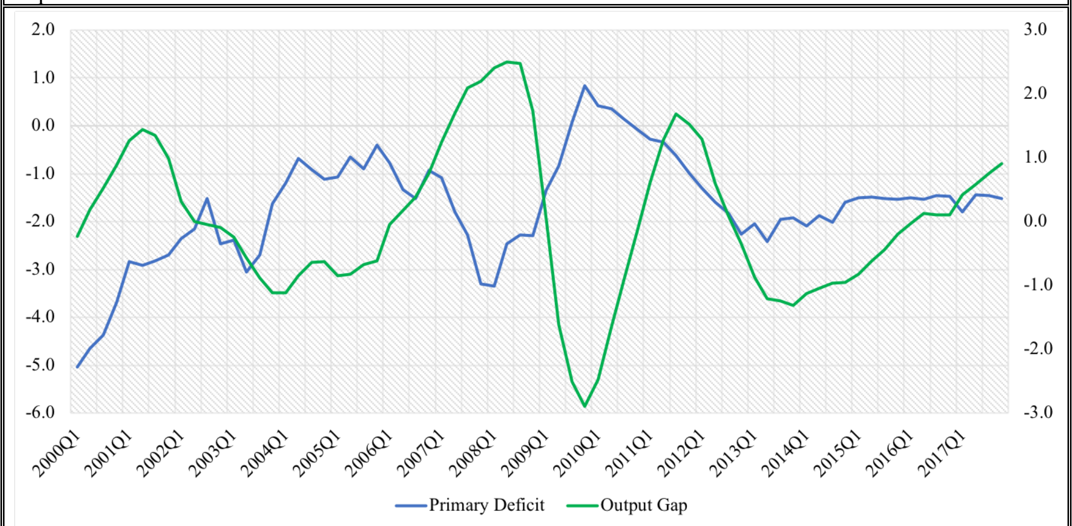
Italy [ESA2010 2000:1 – 2017:4]: Primary Deficit d_t & Public Debt b_t

% points of Gross Domestic Product



Italy [ESA2010 2000:1 – 2017:4]: Primary Deficit d_t & Output Gap x_t

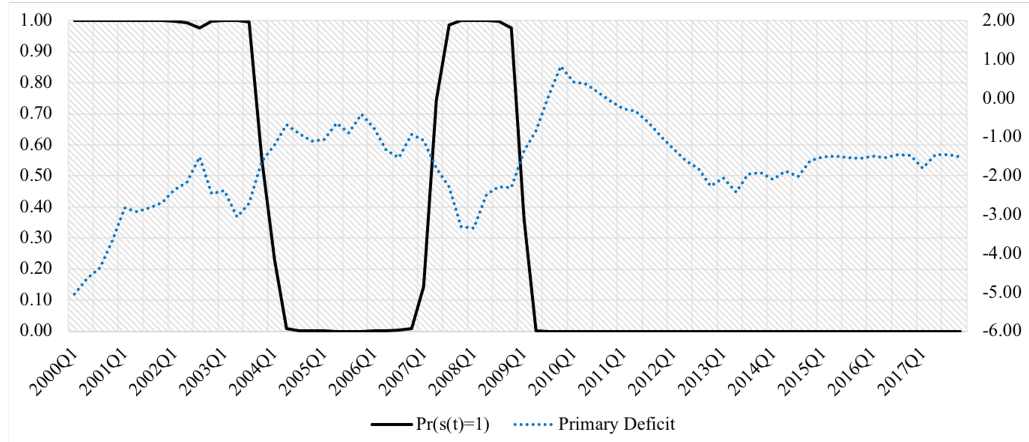
% points of Gross Domestic Product



Italy [ESA2010 2000:1 – 2017:4]: Markov-Switching Fiscal Policy Rule									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \upsilon_t$									
	Regime 1: **PF**			*Regime 2:* **PF**			*Constant Regime*		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**15.829**	6.251	0.011	**2.479**	0.949	0.009	**-2.900**	1.250	0.023
γ_1	**-0.178**	0.059	0.003	**-0.031**	0.008	0.000	**0.011**	0.011	0.332
σ	0.764	0.116		0.630	0.065		*S.E. resid.* = 1.114		
Regime Classification (Probability)									
Regime 1: **PF**				*Regime 2:* **PF**					
2000:1 – 2003:4				2004:1 – 2007:1					
2007:2 – 2008:4				2009:1 – 2017:4					
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \gamma_2(s_t)x_t + \upsilon_t$									
	Regime 1: **PF**			*Regime 2*			*Constant Regime*		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**16.736**	2.231	0.000	**-0.949**	0.916	0.300	**-1.857**	1.191	0.124
γ_1	**-0.197**	0.020	0.000	**-0.005**	0.008	0.550	**0.002**	0.010	0.878
γ_2	**0.907**	0.058	0.000	**-0.348**	0.082	0.000	**-0.383**	0.106	0.001
σ	0.039	0.011		0.783	0.068		*S.E. resid.* = 1.030		
Regime Classification (Probability)									
Regime 1: **PF**				*Regime 2*					
2000:1 – 2001:2				2001:3 – 2017:4					

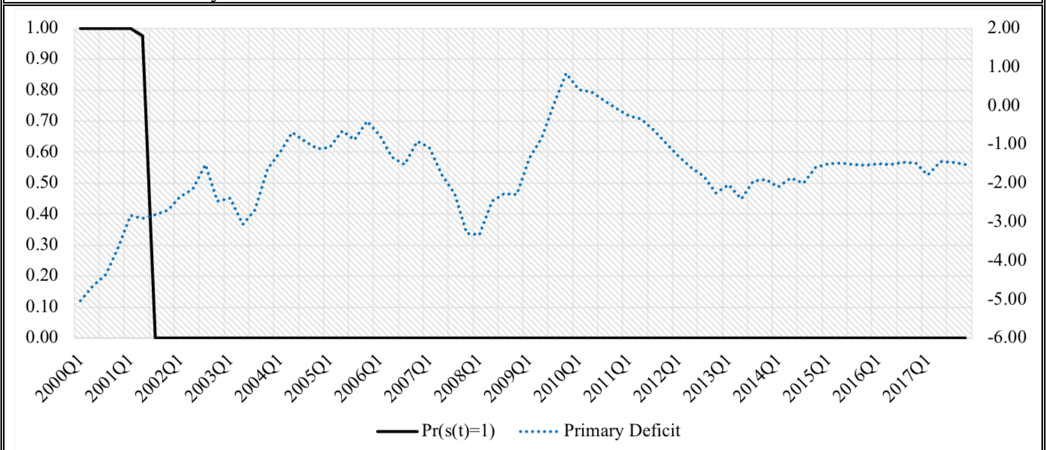
Italy [ESA2010 2000:1 – 2017:4]: Probability ($s_t = 1$)

Smoothed Probability



Italy [ESA2010 2000:1 – 2017:4]: Probability ($s_t = 1$), Fiscal Rule including x_t

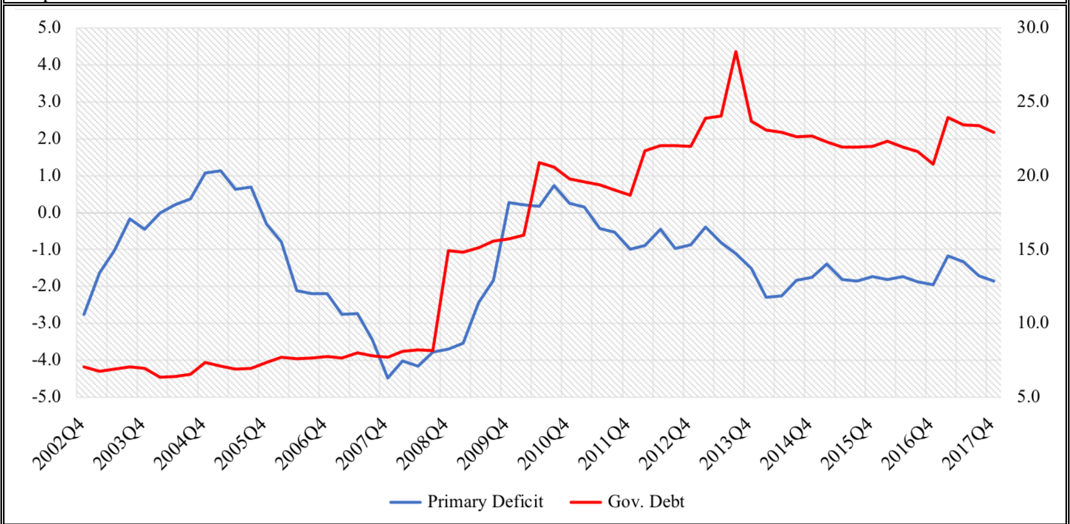
Smoothed Probability



LUXEMBURG

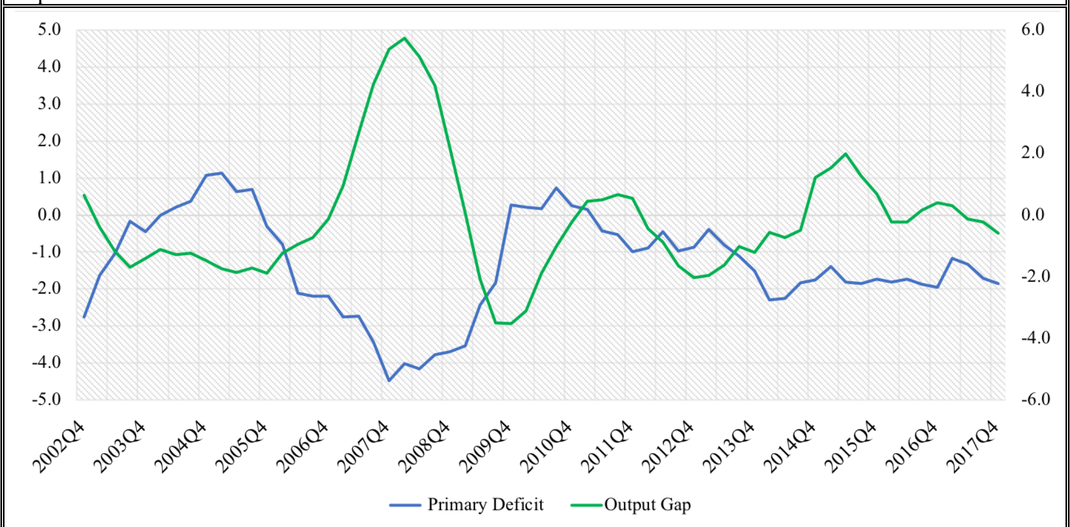
Luxemburg [ESA2010 2002:4 – 2017:4]: Primary Deficit d_t & Public Debt b_t

% points of Gross Domestic Product



Luxemburg [ESA2010 2002:4 – 2017:4]: Primary Deficit d_t & Output Gap x_t

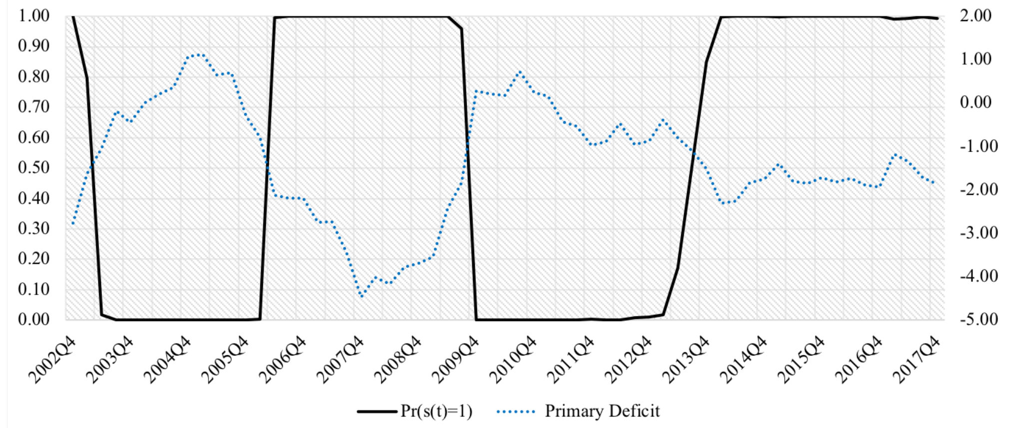
% points of Gross Domestic Product



Luxemburg [ESA2010 2002:4 – 2017:4]: Markov-Switching Fiscal Policy Rule									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + v_t$									
	Regime 1: **AF**			*Regime 2:* **PF**			*Constant Regime*		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-3.755**	0.297	0.000	**0.402**	0.301	0.182	**-1.502**	0.417	0.001
γ_1	**0.087**	0.016	0.000	**-0.039**	0.019	0.040	**0.010**	0.024	0.675
σ	0.637	0.085		0.606	0.097		*S.E. resid.* = 1.367		
Regime Classification (Probability)									
Regime 1: **AF**				*Regime 2:* **PF**					
2002:4 – 2003:1				2003:2 – 2006:1					
2006:2 – 2009:3				2009:4 – 2013:2					
2013:3 – 2017:4									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \gamma_2(s_t)x_t + v_t$									
	Regime 1: **PF**			*Regime 2:* **PF**			*Constant Regime*		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-1.043**	0.401	0.009	**0.490**	0.359	0.172	**-1.274**	0.289	0.000
γ_1	**-0.151**	0.037	0.000	**-0.080**	0.017	0.000	**-0.009**	0.017	0.602
γ_2	**-0.367**	0.040	0.000	**-0.254**	0.091	0.005	**-0.502**	0.062	0.000
σ	0.329	0.068		0.623	0.069		*S.E. resid.* = 0.942		
Regime Classification (Probability)									
Regime 1: **PF**				*Regime 2:* **PF**					
2002:4 – 2003:2				2003:3 – 2006:1					
2006:2 – 2009:3				2009:4 – 2017:4					

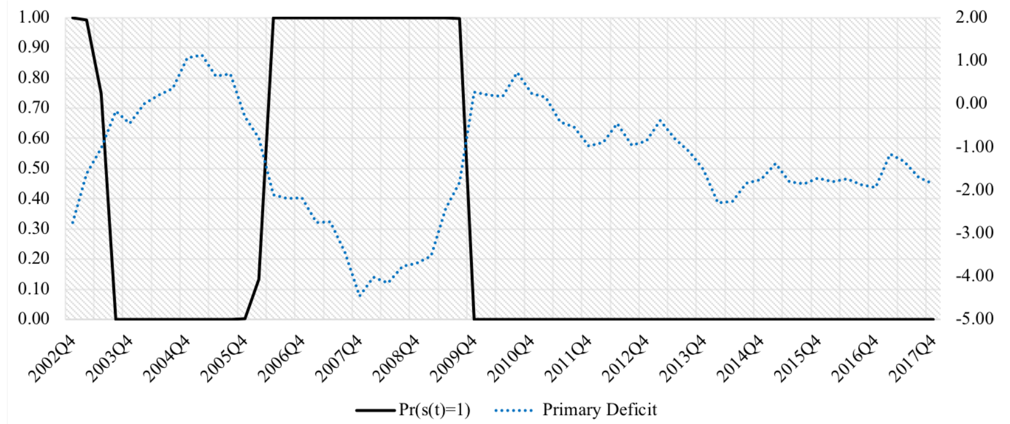
Luxemburg [ESA2010 2002:4 – 2017:4]: Probability ($s_t = 1$)

Smoothed Probability



Luxemburg [ESA2010 2002:4 – 2017:4]: Probability ($s_t = 1$), Fiscal Rule including x_t

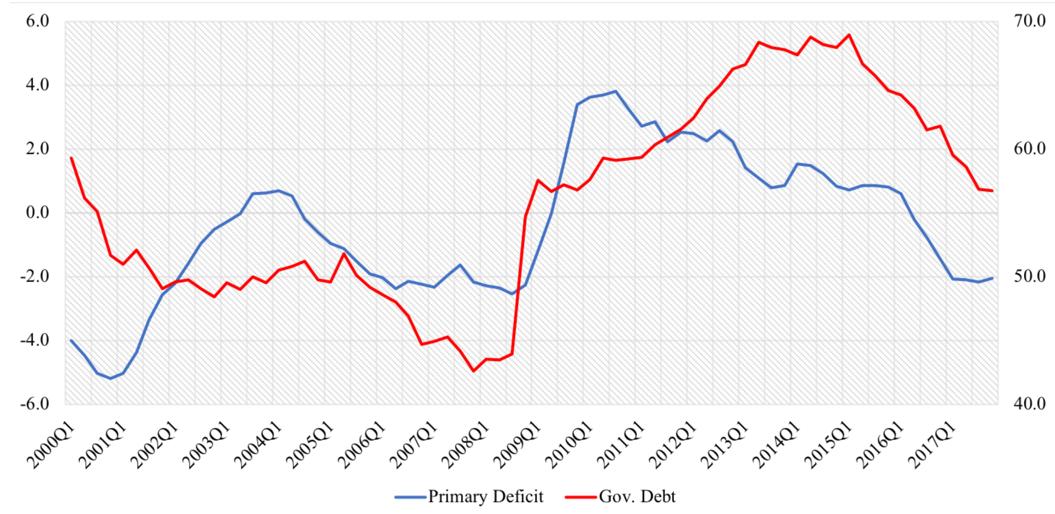
Smoothed Probability



NETHERLANDS

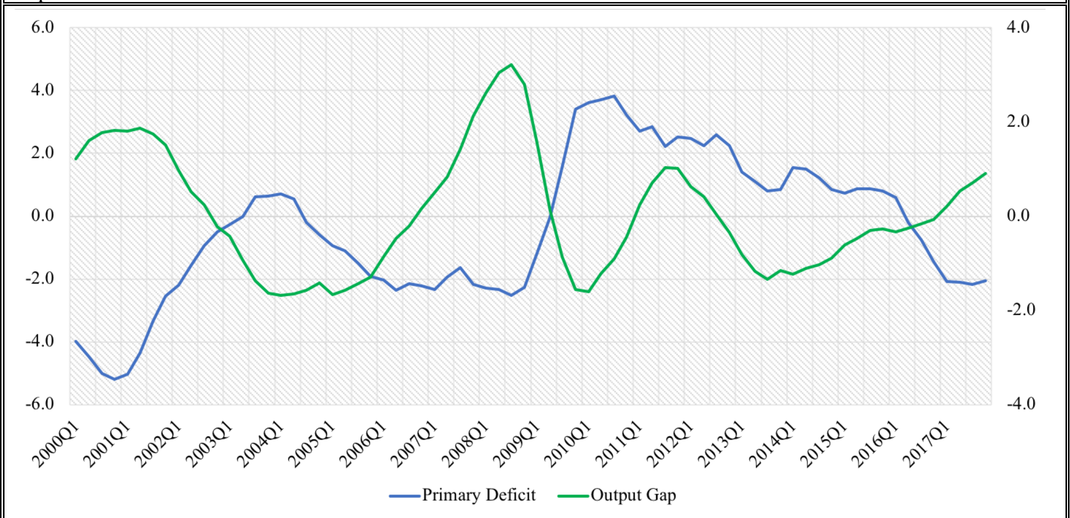
Netherlands [ESA2010 2000:1 – 2017:4]: Primary Deficit d_t & Public Debt b_t

% points of Gross Domestic Product



Netherlands [ESA2010 2000:1 – 2017:4]: Primary Deficit d_t & Output Gap x_t

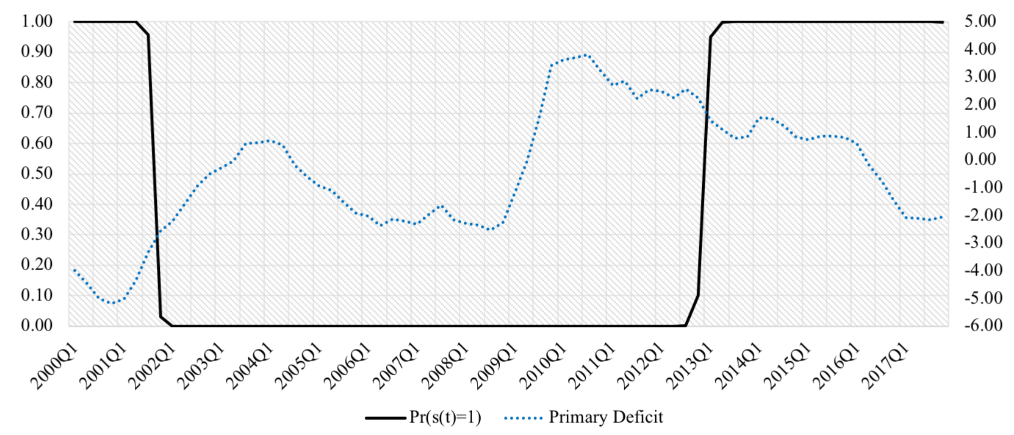
% points of Gross Domestic Product



Netherlands [ESA2010 2000:1 – 2017:4]: Markov-Switching Fiscal Policy Rule									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \upsilon_t$									
	Regime 1: **AF**			*Regime 2:* **AF**			*Constant Regime:* **AF**		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-24.911**	2.002	0.000	**-15.496**	1.455	0.000	**-8.690**	1.698	0.000
γ_1	**0.382**	0.032	0.000	**0.297**	0.028	0.000	**0.148**	0.030	0.000
σ	0.896	0.131		1.093	0.119		*S.E. resid.* = 1.971		
Regime Classification (Probability)									
Regime 1: **AF**				*Regime 2:* **AF**					
2000:1 – 2001:3				2001:4 – 2012:4					
2013:1 – 2017:4									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \gamma_2(s_t)x_t + \upsilon_t$									
	Regime 1			*Regime 2:* **AF**			*Constant Regime:* **AF**		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-4.742**	1.255	0.000	**-5.232**	1.509	0.001	**-6.100**	1.592	0.000
γ_1	**0.034**	0.024	0.155	**0.094**	0.026	0.000	**0.102**	0.028	0.001
γ_2	**-1.154**	0.060	0.000	**-0.678**	0.172	0.000	**-0.793**	0.170	0.000
σ	0.182	0.041		1.467	0.133		*S.E. resid.* = 1.732		
Regime Classification (Probability)									
Regime 1				*Regime 2:* **AF**					
2000:1 – 2001:1				2001:2 – 2004:4					
2005:1 – 2006:2				2006:3 – 2017:4					

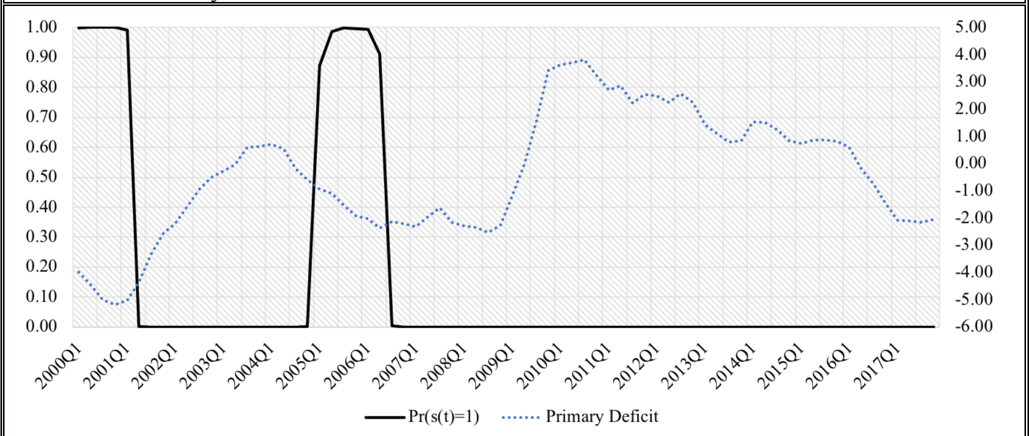
Netherlands [ESA2010 2000:1 – 2017:4]: Probability ($s_t = 1$)

Smoothed Probability



Netherlands [ESA2010 2000:1 – 2017:4]: Probability ($s_t = 1$), Fiscal Rule including x_t

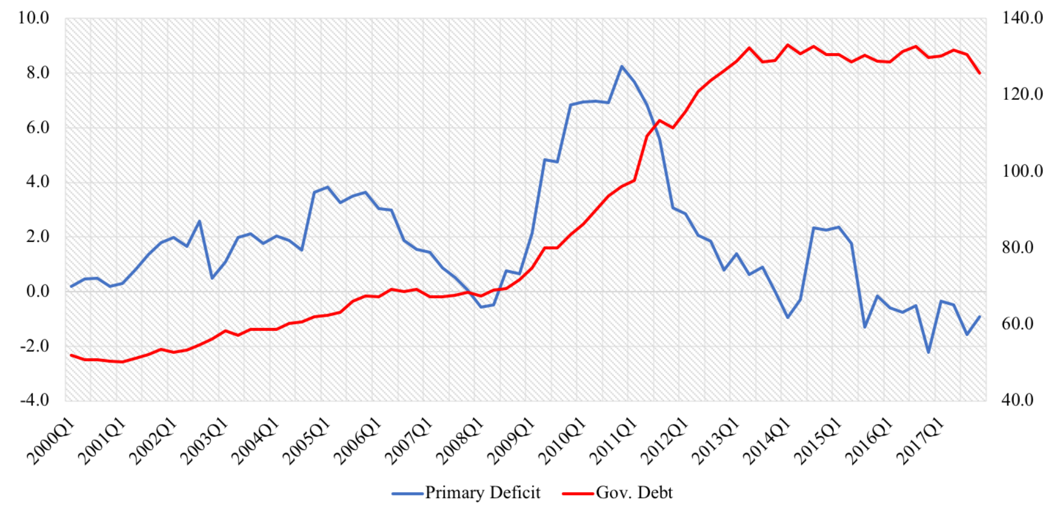
Smoothed Probability



PORTUGAL

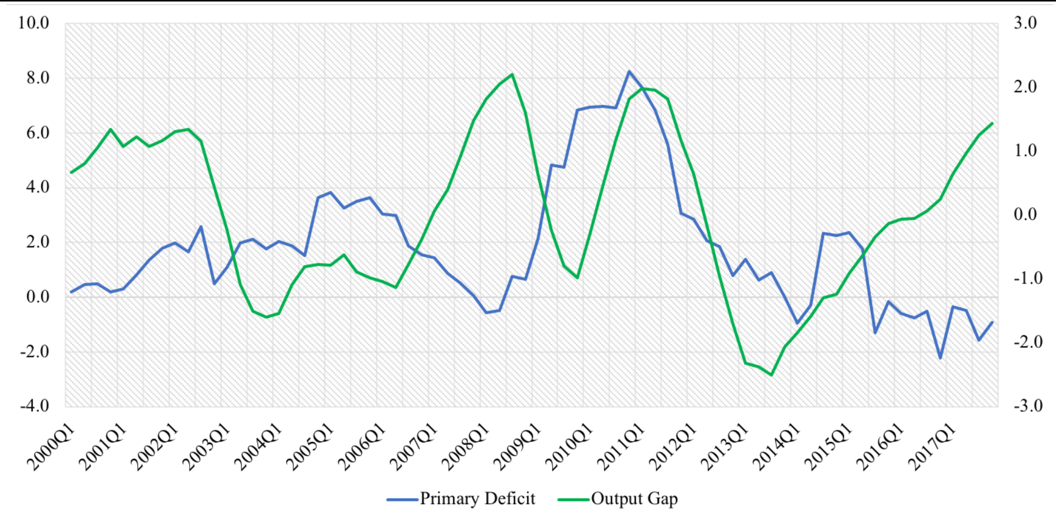
Portugal [ESA2010 2000:1 – 2017:4]: Primary Deficit d_t & Public Debt b_t

% points of Gross Domestic Product



Portugal [ESA2010 2000:1 – 2017:4]: Primary Deficit d_t & Output Gap x_t

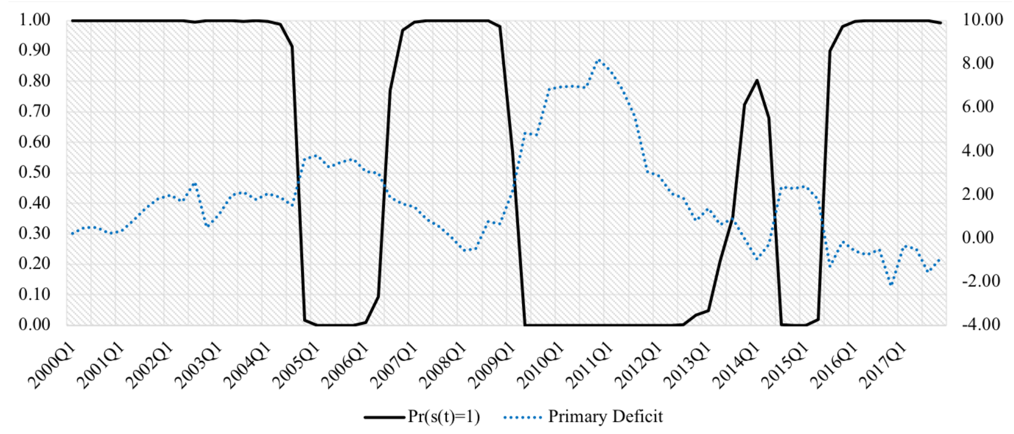
% points of Gross Domestic Product



Portugal [ESA2010 2000:1 – 2017:4]: Markov-Switching Fiscal Policy Rule									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \upsilon_t$									
	Regime 1: **PF**			*Regime 2:* **PF**			*Constant Regime:* **PF**		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**2.592**	0.381	0.000	**7.661**	1.876	0.000	**3.167**	0.807	0.000
γ_1	**-0.025**	0.005	0.000	**-0.040**	0.020	0.048	**-0.015**	0.009	0.094
σ	0.786	0.105		2.034	0.274		*S.E. resid.* = 2.310		
Regime Classification (Probability)									
Regime 1: **PF**				*Regime 2:* **PF**					
2000:1 – 2004:3				2004:4 – 2006:2					
2006:3 – 2009:1				2009:2 – 2013:3					
2013:4 – 2014:2				2014:3 – 2015:2					
2015:3 – 2017:4									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \gamma_2(s_t)x_t + \upsilon_t$									
	Regime 1: **PF**			*Regime 2:* **PF**			*Constant Regime*		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**3.011**	0.295	0.000	**7.698**	1.033	0.000	**3.161**	0.842	0.000
γ_1	**-0.028**	0.003	0.000	**-0.035**	0.010	0.001	**-0.015**	0.009	0.111
γ_2	**-0.448**	0.098	0.000	**1.313**	0.211	0.000	**0.006**	0.230	0.978
σ	0.668	0.076		1.298	0.184		*S.E. resid.* = 2.327		
Regime Classification (Probability)									
Regime 1: **PF**				*Regime 2:* **PF**					
2000:1 – 2004:3				2004:4 – 2006:2					
2006:3 – 2009:1				2009:2 – 2012:4					
2013:1 – 2014:2				2014:3 – 2015:2					
2015:3 – 2017:4									

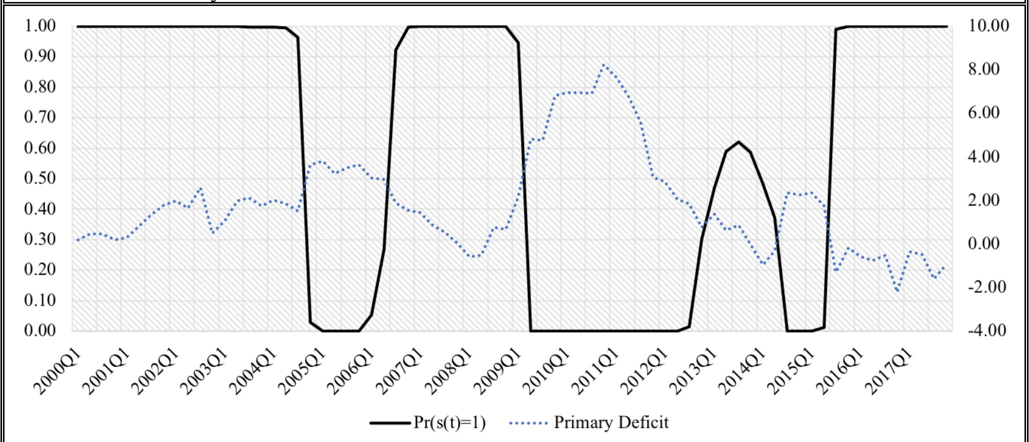
Portugal [ESA2010 2000:1 – 2017:4]: Probability ($s_t = 1$)

Smoothed Probability



Portugal [ESA2010 2000:1 – 2017:4]: Probability ($s_t = 1$), Fiscal Rule including x_t

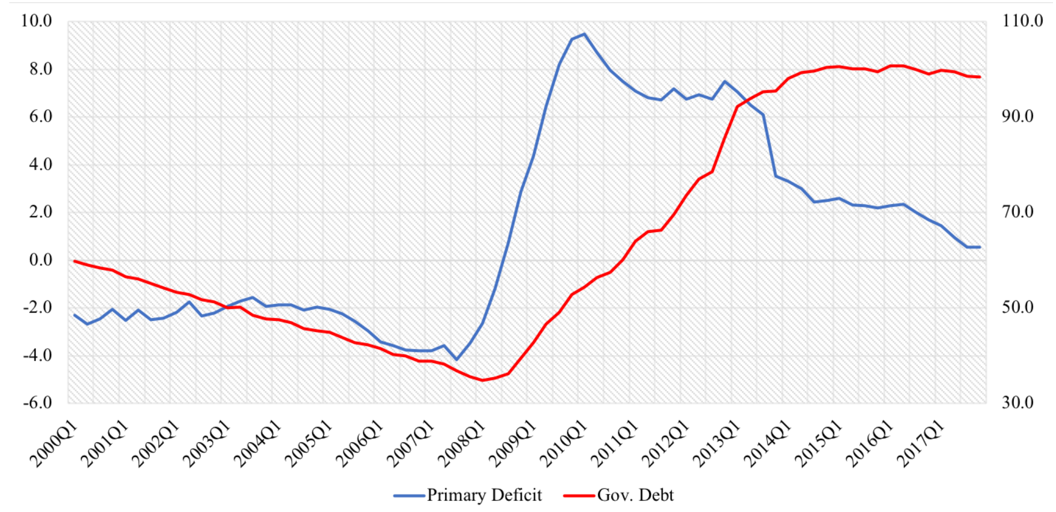
Smoothed Probability



SPAIN

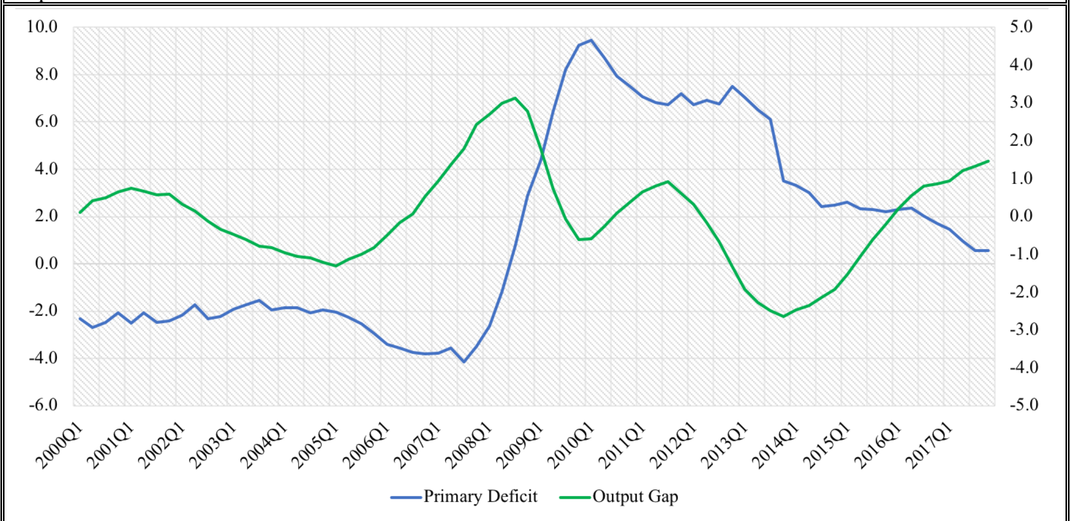
Spain [ESA2010 2000:1 – 2017:4]: Primary Deficit d_t & Public Debt b_t

% points of Gross Domestic Product



Spain [ESA2010 2000:1 – 2017:4]: Primary Deficit d_t & Output Gap x_t

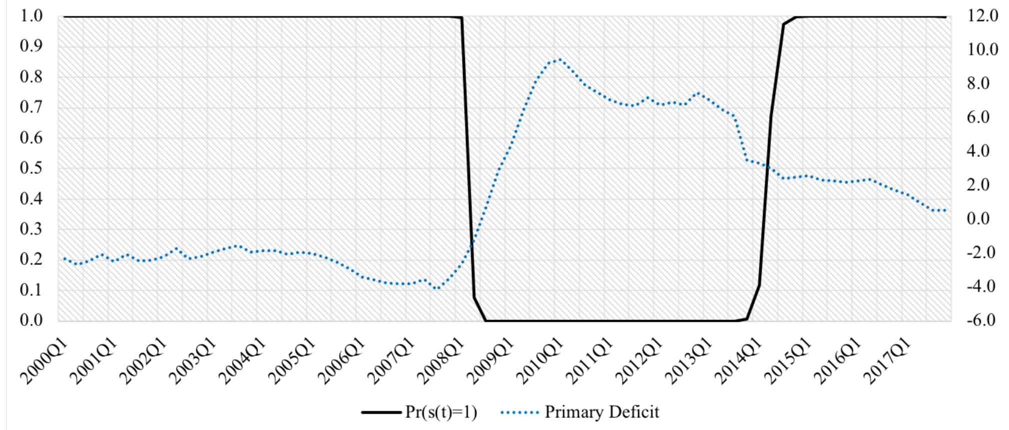
% points of Gross Domestic Product



Spain [ESA2010 2000:1 – 2017:4]: Markov-Switching Fiscal Policy Rule									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \upsilon_t$									
	Regime 1: **AF**			*Regime 2*			*Constant Regime:* **AF**		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-6.649**	0.276	0.000	**4.823**	1.920	0.012	**-3.141**	1.352	0.023
γ_1	**0.085**	0.004	0.000	**0.020**	0.029	0.500	**0.069**	0.020	0.001
σ	0.644	0.079		2.494	0.382		*S.E. resid.* = 3.873		
Regime Classification (Probability)									
Regime 1: **AF**				*Regime 2*					
2000:1 – 2008:1				2008:2 – 2014:1					
2014:2 – 2017:4									
$d_t = \gamma_0(s_t) + \gamma_1(s_t)b_{t-1} + \gamma_2(s_t)x_t + \upsilon_t$									
	Regime 1: **AF**			*Regime 2:* **PF**			*Constant Regime:* **AF**		
	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value	Coeff.	S.E.	p-value
γ_0	**-5.115**	0.754	0.000	**12.219**	1.211	0.000	**-2.854**	1.457	0.054
γ_1	**0.053**	0.016	0.001	**-0.100**	0.015	0.000	**0.064**	0.021	0.004
γ_2	**-0.305**	0.088	0.001	**-1.357**	0.234	0.000	**-0.206**	0.379	0.589
σ	0.478	0.059		1.888	0.216		*S.E. resid.* = 3.893		
Regime Classification (Probability)									
Regime 1: **AF**				*Regime 2:* **PF**					
2000:1 – 2008:1				2008:2 – 2017:4					

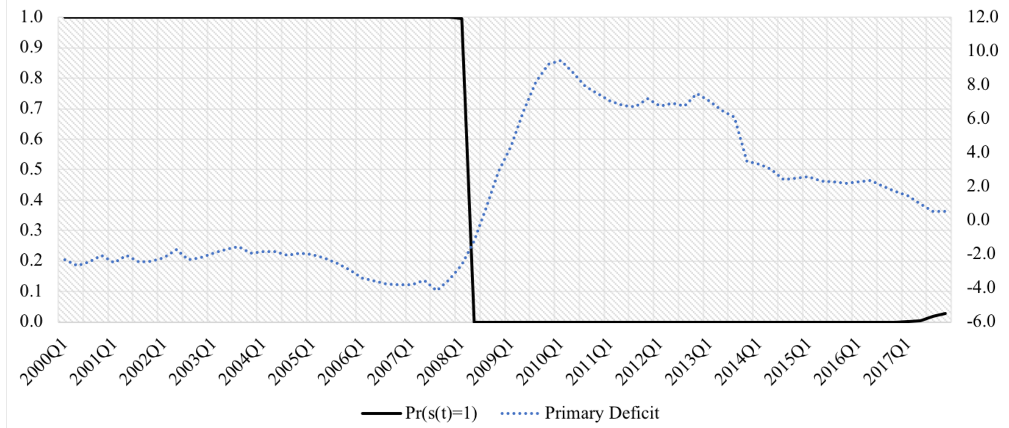
Spain [ESA2010 2000:1 – 2017:4]: Probability ($s_t = 1$)

Smoothed Probability



Spain [ESA2010 2000:1 – 2017:4]: Probability ($s_t = 1$), Fiscal Rule including x_t

Smoothed Probability



Fiscal and Monetary Policy Regime

A = Active; P = Passive; (empty) = Non significant; / = Not Available; * p-value (0.10); ** ESA1995

ESA2010

Excluding x(t)

Fiscal Policy	1999				2000				2001				2002				2003				2004				2005				2006				2007				2008				2009				2010				2011				2012				2013				2014				2015				2016				2017				2018	
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Austria	/	/	/	/	/	/	/	/	/	/	/																																																																			/	/
Belgium	/	/	/	/	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	A	A	A	A	A	A	A	A	A	A	P	P	P	P	P	P	P	P	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	/	/
Finland	/	/	/	/	P	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	A	A	A	A	A	A	A	A	A	P	P	P	P	P	P	P	P	P	P	P	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	/	/
France	/	/	/	/	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	/	/
Germany	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/																			A	A	A	A	A	A	A	A											A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	/	/
Germany**	/	/	/	/	A	A	A	A	A	A																						A	A	A	A	A	A	A	A	A	A	A															A	A	A	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Greece	/	/	/	/	P	P	P	P	P																																																															P	P	P	P	P	/	/
Ireland	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A																						A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	/	/
Italy	/	/	/	/	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	/	/
Luxemburg	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	A	A	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	A	A	A	A	A	A	A	A	A	A	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	/	/
Netherlands	/	/	/	/	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	/	/
Portugal	/	/	/	/	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	/	/
Spain	/	/	/	/	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A																										A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	/	/
Euro Area (12)	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	A	A	A	A	A	A	A	/	/

Monetary Policy	1999				2000				2001				2002				2003				2004				2005				2006				2007				2008				2009				2010				2011				2012				2013				2014				2015				2016				2017				2018	
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Euro Area	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	P	P	P	A	A	A	A	A	A	A	A	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P

ESA2010

Including x(t)

Fiscal Policy	1999				2000				2001				2002				2003				2004				2005				2006				2007				2008				2009				2010				2011				2012				2013				2014				2015				2016				2017				2018	
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Austria	/	/	/	/	/	/	/	/	/	/	/	A	A	A	A	A	A	A	A	A	A																																															A	A	A	A						/	/
Belgium	/	/	/	/	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	A	P	P	P	P	P	P	P	P	P	P	P	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	/	/
Finland	/	/	/	/	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	/	/
France	/	/	/	/	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	/	/
Germany	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/																																																																/	/
Germany**	/	/	/	/			P	P	P	P																																P	P	P																		/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Greece	/	/	/	/	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	/	/
Ireland	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A																								A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	/	/
Italy	/	/	/	/	P	P	P	P	P	P																																																																			/	/
Luxemburg	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	/	/
Netherlands	/	/	/	/						A	A	A	A	A	A	A	A	A	A	A	A	A	A	A							A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	/	/
Portugal	/	/	/	/	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	/	/
Spain	/	/	/	/	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	/	/
Euro Area (12)	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/																																																																/	/

Excluding x(t)

Fiscal Policy	Constant Regime
Austria	A
Belgium	
Finland	A
France	A
Germany	P*
Germany**	
Greece	
Ireland	A
Italy	
Luxemburg	
Netherlands	A
Portugal	P*
Spain	A
Euro Area (12)	A

Monetary Policy	Constant Regime
Euro Area	A

Including x(t)

Fiscal Policy	Constant Regime
Austria	A
Belgium	
Finland	A
France	A
Germany	P
Germany**	P
Greece	
Ireland	A
Italy	
Luxemburg	
Netherlands	A
Portugal	
Spain	A
Euro Area (12)	