Flattening Phillips curve, "passive" policy and incidence of the self-fulfilling prophecy in a standard New-Keynesian model with financial accelerator

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Abstract

Post crisis period is described by several stylized facts with a significant impact on the business cycles. Examples of such stylized facts consist in the Phillips curve flattening, very low inflation and even negative or a passive stance of the monetary policy. Thus it was contoured the so-called new-normal era which raises a series of caveats for the macroeconomic modelling. Given that, the present paper comes to address the issue on the incidence of self-fulfilling prophecy in a New-Keynesian model with financial sector. This work is normative, so further investigation have to be made on the appropriateness of a sunspot base approach in order to study the business cycle mechanic behind the underlying model.

Keywords: determinacy, financial accelerator, New-Keynesian, Phillips curve, "passive" policy
JEL Classification: JEL: E52, E58, P20

1 Introduction

Occurrence of the 2008 financial crisis brought several major changes on the macroeconomic thinking and modelling. One of the first conclusions which arised after 2008 episode was that developments within financial sector have the potential to affect seriously the economic stability, being thus necessary to consider them endogenously when concerns on the general equilibrium topic ae addressed. Therefore' a process similar to a revolution in term of models' revision was observed in post crisis period.

A lot of efforts were focused on the introduction of financial side in the workhorse approaches for business cycle analysis. On the other hand, the new stylized facts

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in the after of 2008 brought again the necessity of new changes in macroeconomic modelling. Some of these new stylized facts, which contoured the so-called new normal, consist in the sudden increase of public debt, precautionary savings, low interest rates environment (but with a strong focus of the policy makers to avoid zero and even negative rates), rapid disinflation and deflation in some cases, etc. Putting together all these mentions, several caveats have been contoured for the macroeconomic modelling activity.

Given the recent episodes of deflation or near zero inflation in several economies, sustained efforts from the policy makers to maintain positive interest rates can be observed. This means implicitly the adoption of a passive monetary policy, with potential super-inertial effects. On the other side, the Phillips curve flattening affects further the well-known macro mechanic. In this regard, under these considerations, a reexamination of the basic New-Keynesian model it is necessary. For this purpose, the underlying work aims to investigate, through the use of several indicative experiments, the effects of the so-called new normal on the New-Keynesian mechanics. More exactly we called the basic forward-looking New-Keynesian model with a standard policy rule, which was further expanded to incorporate the financial accelerator. Basically, we focused on the incidence of self-fulfilling prophecy property given the new normal environment.

Having in mind the condition for multiple multiple-rational expectations equilibria underlined by Bullard and Mitra (2002), we analyzed the emergence of a unique bounded stationary equilibrium in the current context. Therefore, the underlying approach, aims to treat the indeterminacy topic in a normative way. Background of this paper that is based on a standard New-Keynesian macroeconomic model with financial accelerator comes in lines with approaches of Cecchetti and Li (2008), Ceccheti and Kohler (2012), Poutineau and Vermandel (2014). Singh, Stone and Suda (2015) expanded a BGG model to allow for a policy response to financial developments, for which they investigated the premise for self-fulfilling prophecy.

2 Methodology

Clarida, Gali and Gertler (1999) elaborated in a seminal paper the fundamental form of New-Keynesian science that it is used today by academia as well as policy makers to form conclusion about wide economys dynamic. In fact, the underlined model became fastly the workhorse within the monetary policy management. Of course, the primitive form of the CGG (1999) model (Clarida, Gali and Gertler) suffered some changes in order to ajust to recent research findings. On the other hand, projection lines behind the CGG (1999) model have been introduced within more complex DSGE models designed for policy analysis and forecasting. Even these considerations, the original CGG (1999) model remains a benchmark reference for different topics of interest as it is the monetary policy field. Here, in the spirit of Bernanke, Gertler and Gilchrist

(1999), standard CGG model was expanded to allow for a financial accelerator. The resulting model is:

$$y_t^{gap} = E_t[y_{t+1}^{gap}] - \frac{1}{\gamma}(i_t - E_t[\pi_{t+1}]) - \alpha_t \tag{1}$$

$$\pi_t = \beta E_t[\pi_{t+1}] + (\gamma + \Psi)\frac{(1-\theta)(1-\theta\beta)}{\theta} y_t^{gap} \tag{2}$$

$$i_t = \bar{i} + \phi_y y_t^{gap} + \phi_\pi \pi_t \tag{3}$$

$$l_t = i_t - \lambda y_t^{gap} \tag{4}$$

More exactly, the core CGG (1999) approach is recognized in the literature as being the basic New-Keynesian model (BNKM). Two important mentions have to be made on the model (1) - (4) described above. Firstly, it's important to note that he difference in comparison with the BNKM doesn't consist only in relation no. (4). The other important difference is the presence of loan rate in the IS relation. This idea related to demand block is not relatively new as Bernanke and Blinder (1989) used such an IS relation. Instead, the recent financial crisis underlined the high importance of a financial sector for the business cycle fluctuations.

Secondly, the model (1) - (4) or the NK-FA model has no stochastic items, as we limited only to the study of equilibria. The four equations are presented under a log-linear form at equilibrium, being derived by optimal problems faced by representative agents that postulate a closed economy. First equation of the above model it is known as the Euler equation for output (output-gap) or the dynamic IS equation and it is used to model the aggregate demand. In fact it is derived from consumption theory as the optimal solution under rational expectation of a consumer's planing problem. This equation states that output-gap y_t^{gap} it is directly influenced by expectations of its future outcomes and it is inversely related with the real interest rate, respectively the loan rate l_t.

Furthermore, γ is the risk aversion parameter under CRRA preferences, mentioning the optimal consumption-saving problem used in the derivation of the above model supposes the separability feature of the utility function in consumption and work. The other parameter from the representative agent's utility Ψ is the inverse elasticity of work in respect with its marginal disutility, while β is the subjective discount factor. Real interest rate it is computed according to rational expectations $(i_t - E_t[\pi_t])$, represented as the real ex ante rate. α denotes the output-gap elasticity in respect to the loan rate. The second equation it is known as New-Keynesian Phillips Curve (NKPC) and links the evolution of inflation by its future expected values and the output-gap. $(\gamma + \Psi)\frac{(1-\theta)(1-\theta\beta)}{\theta}$ represents the transformed mark-up, where $(1-\theta)$ is the probability according to which the intermediate firms, within a monopolistic market, adjust their prices to new developments. This way through which firms change their prices

it is known as a la Calvo setup.

The policy action is defined through a standard Taylor reaction function without preference for smoothing interest rest fluctuations. In fact, CGG(1999) adressed several options for central bank's reaction function, but here we stop to the standard form of Taylor equation for interest rate dynamics. This equation states that central bank's reaction function changes in respect with developments in real sector ϕ_y, respectively in prices according to the coefficients ϕ_y and ϕ_π, while $\bar{i}$ is the long-run mean. Last relation shows the inversely relation between the interest rate spread and the output-gap, with the related elasticity λ.

By doing a bit algebra, the following state space representation is obtained:

$$\begin{pmatrix} y_t^{gap} \\ \pi_t \end{pmatrix} = \frac{1}{\Omega} \begin{pmatrix} \gamma & 1-\beta\phi_\pi(1+\gamma\alpha) \\ \gamma\kappa & \Gamma \end{pmatrix} E_t \begin{pmatrix} y_{t+1}^{gap} \\ \pi_{t+1} \end{pmatrix} + \Upsilon \tag{5}$$

where $\Omega = \gamma(1-\gamma\alpha)+(\phi_y+\phi_\pi\kappa)(1+\gamma\alpha)$, $\kappa = (\gamma+\Psi)\frac{(1-\theta)(1-\theta\beta)}{\theta}$ is the Phillips curve slope, $\Gamma = \Omega\beta+\kappa\left[1-\beta\phi_\pi(1+\gamma\alpha)\right]$, while Υ contains the other elements. In order to investigate the incidents of the self-fulfilling prophecy property, the Blanchard-Kahn conditions were studied. More exactly, according to Blanchard-Kahn conditions, a unique equilibrium of the model is obtained if and only if the two roots of $\frac{1}{\Omega}\begin{pmatrix} \gamma & 1-\beta\phi_\pi(1+\gamma\alpha) \\ \gamma\kappa & \Gamma \end{pmatrix}$ are inside the unit circle.

3 Calibration and results

There are several ways to put in practice the basic New-Keynesian model. Examples in that sense are the use of SVAR model on the base of rational econometrics, the use of GMM or 3SLS by calling instrumental variables or to directly call the form defined by (1) - (4). Here the last option has been chosen and the NK-FA model was calibrated for Romanian and Euro Area economies. For calibration purposes, we used posterior estimates from several benchmark paper elaborated for each economy. For Romanian economy we reffered to the papers written by Alupoaiei (2015) and Copaciu et. al. (2016)., mentioning the lack of bibliographic references in this case. Instead for Euro Area exist many references, but here we called the seminal paper of Smets and Wouters (2005).

Calibrated parameters for the NK-FA model

	β	γ	Ψ	θ	α	λ	ϕ_y	$\phi_p i$
Romania	0.992	2.5	1.5	0.7	1 /	0.3	(0,1.5)	(0,1.5)
EA	0.998	1.61	1	0.7	1 /	0.2	(0,1.5)	(0,1.5)

Table 1: Calibrated parameters for the Romanian and EA economies

Table 1 presents the parameters that we used in calibration for the two involved economies. A few observations have to be made here. First of all, it is important

to note that reported figures were chosen such to ensure as much robustness as possible, given the economies we used as reference have different structures. In that sense, we took figures in order to trade off between the model's structure, respectively the empirical observations on the business cycle. Perhaps many specialist consider that a better idea would be to directly estimate the model on empirical observation, but even that the posterior estimates depends on prior set-up. This situation it is usually met in small samples. Given that, we consider that our option it is pretty robust, if we take into account that we used the mean tendency provided by posterior estimates from different papers. The idea that we have to insert before is that we don't consider that our approach certainly endows a lower accuracy. More than that, as it is mentioned at the beginning of the paper, this work is a normative one and should be viewed accordingly.

Secondly, we have to note that some of the parameters we used in calibration were adapted a little bit given the specific context. More exactly, owing to different model structures from the reference papers, we also called another evidences from case to case (econometric exercises, considerations, etc.). Therefore, somehow our approach includes also an ad-hoc component, having in mind the idea underlined by Robert Sollow according to which he would "rather be ad-hoc than wrong". But this ad-hoc component was only marginal, given that the most part of calibration came from posterior estimated obtained in the papers we cited. For example, some parameters, such are λ or α, were not calibrated by considering only targeted estimates, being additionally taking into account the link model and real mechanics, as well as other papers or specific stylized facts. For example, the new developments in financial markets showed that a financial crisis generates a strong tightening in credit markets. This stylized fact is captured in our model (enough or not) by the increase of real costs of financing. More than that, because our model has no link with the credit policy, λ has to cover the recent developments in banking regulation and macroprudential policy. As Cecchetti and Li (2008), the elasticity of output-gap with respect to the loan rate was set to have the same importance as the real interest rate. The parameters in the policy rates were set to take values in the usual space, given the main focus is on the determinacy feature.

Incidence of multiple rational expectation equilibria was analyzed on the base of computation of relation (5). Obtained results are reported in Annex. Given the new context described by Phillips curve flattening, the problem of indeterminacy was separately analyzed for a standard calibration of the slope (case I), respectively for a second scenario (case II) where the slope was calibrated at a half value as compared with case I. Figures 1 and 2 show that for Euro-Area, determinacy region (in green) is high bigger than for the BNK model. More exactly, in the NK-FA model, a unique equilibrium it is assumed even with a passive monetary policy and implicitly out of the Taylor principle. On the other hand, for calibration related to the case II, we can observe that indeterminacy region increases a little bit for low levels of ϕ_y. A similar situation can be seen

also for Romania in the two scenarios. The difference observed in results for Romania and Euro Area consists in a slight bigger determinacy region for the former one in each of the two cases regarding the Phillips curve slope calibration.

Results presented before suggests that in NK-FA model determinacy could emerges even with a "passive" monetary policy. Therefore, second part of the analysis addresses the problem of a passive monetary policy under different stances related to the importance of financial sector. In this regard, we considered a "passive" monetary action described by the following policy parameters: $\phi_y = 0.5$ and $\phi_\pi = 0.4$. Calibration of the policy parameters under a "passive" stance were set on the base of different works with Markov switching rational expectations equilibria, mentioning here Mavromatis (2011) or Foerster (2014).

Obtained results for the two economies show that even in such a "passive" policy scenario, which fairly deviates from the determinacy condition derived by Bullard and Mitra (2002) for the basic New-Keynesian model, the emergence of an unique bounded equilibrium is still possible. Figures 5 - 8 underline that indeterminacy is inversely related to the out-gap elasticity with respect to the loan rate and directly related with the interest rate spread elasticity with respect to the output-gap. In any case, we can observe a non-linear relationship as for high levels of interest rate spread elasticity with respect to the output-gap, the self-fulfilling prophecy is met everywhere. Also under a "passive" monetary policy, flattening of the Phillips curve facilities the multiple rational expectation equilibria. Instead this time, the determinacy regions determined for Romania are significantly higher as compared with those ones obtained for the Euro Area.

4 Conclusions

Present work aimed to investigate the emergence of potential multiple rational expectations equilibria in a standard New-Keynesian model with financial sector. But it is important to note that this paper is a normative one, so the main goal was to raise attention about this topic given the so called *new normal*. Thus, rigorous analysis have to be made further for a positive outcome on this issue. The underlying subject is very important, because the self-fulfilling prophecy property, if it is identified, specific tools have to be used to solve for optimal policy in model with rational expectations. On the other hand, the emergence of self-fulfilling prophecy determines several implications for the model's mechanics.

5 References

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6 Annex

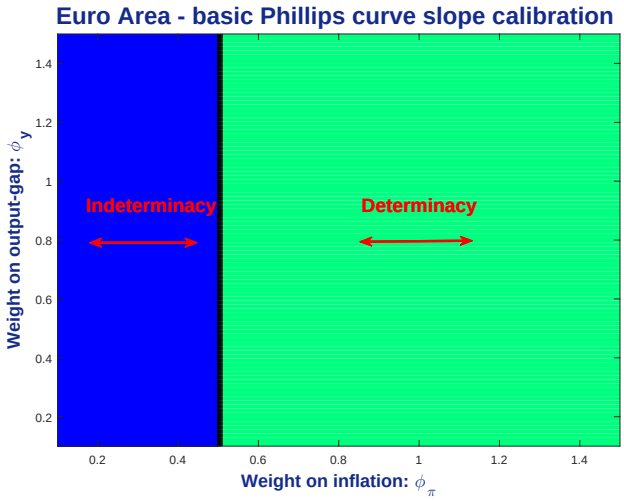

Figure 1: Determinacy region for the NK-FA model Euro Area, case I

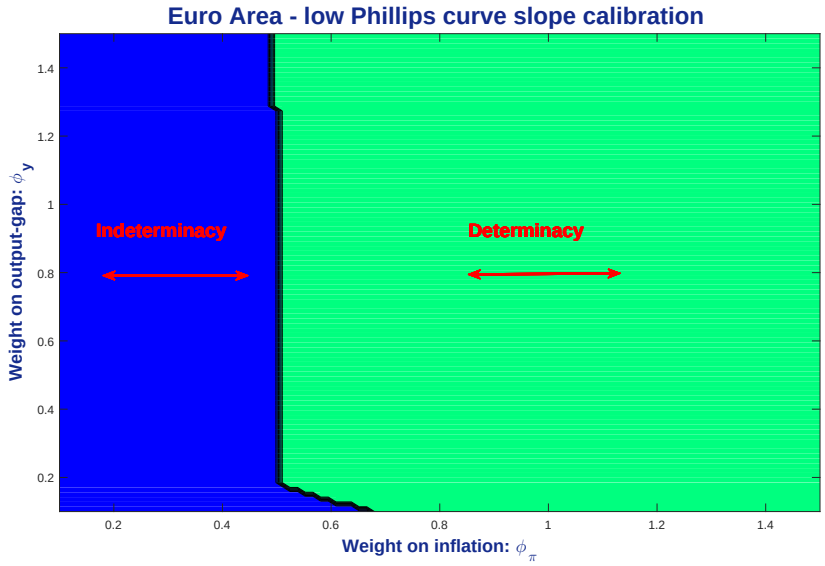

Figure 2: Determinacy region for the NK-FA model Euro Area, case II

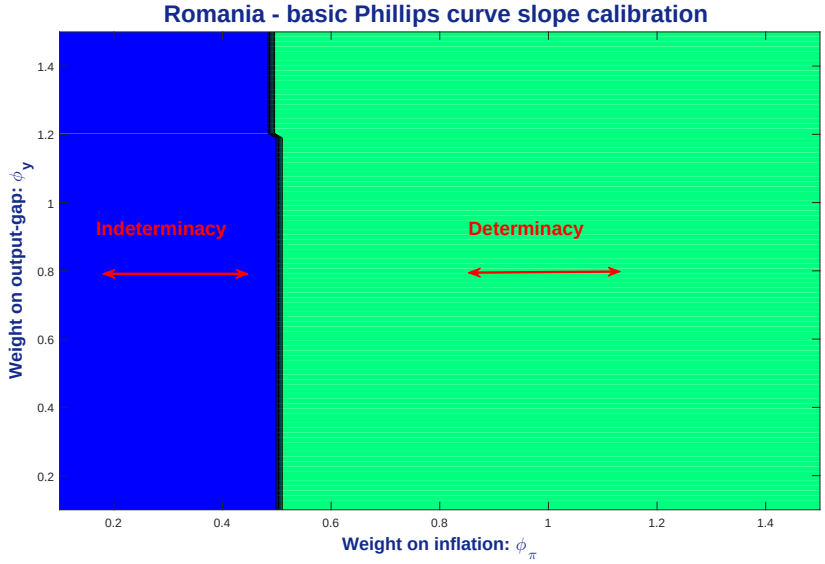

Figure 3: Determinacy region for the NK-FA model Romania, case I

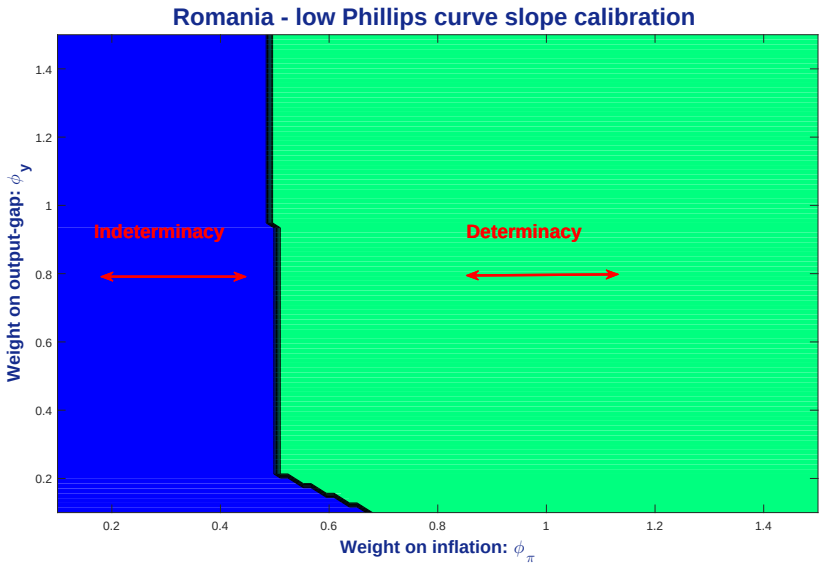

Figure 4: Determinacy region for the NK-FA model Romania, case II

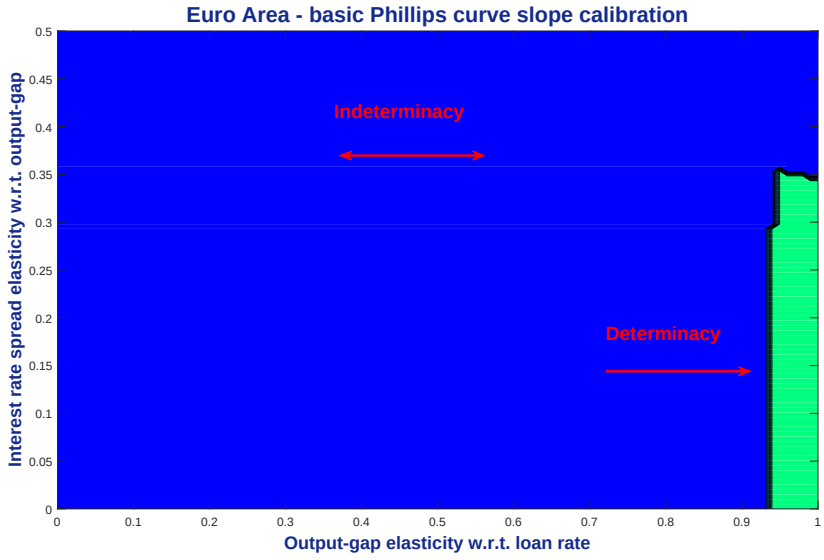

Figure 5: Determinacy region for the NK-FA model with a "passive" policy Euro Area, case I

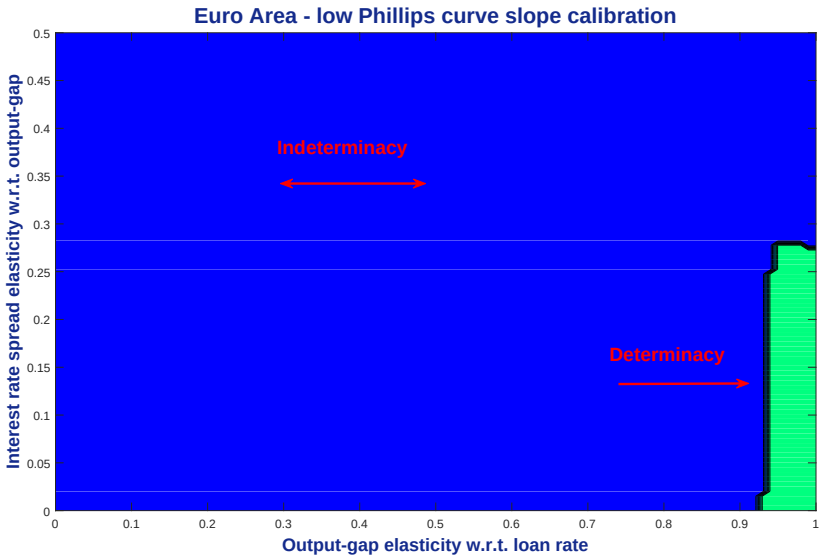

Figure 6: Determinacy region for the NK-FA model with a "passive" policy Euro Area, case II

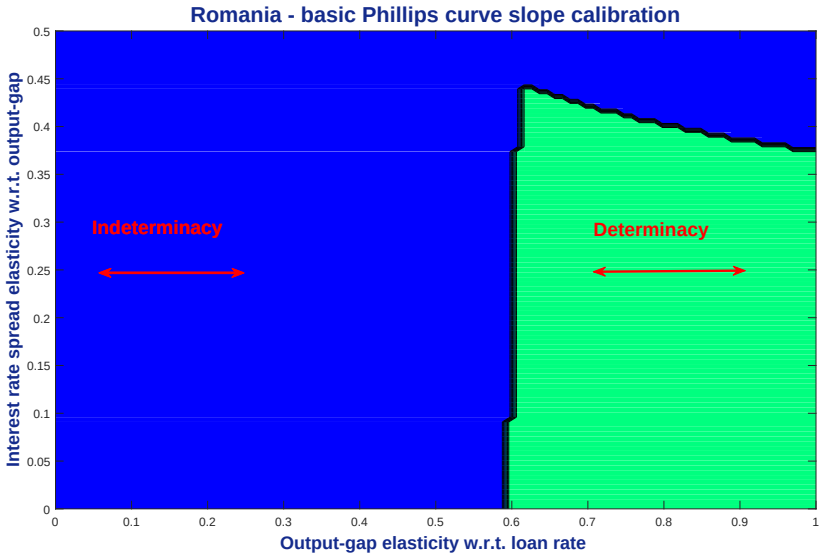

Figure 7: Determinacy region for the NK-FA model with a "passive" policy Romania, case I

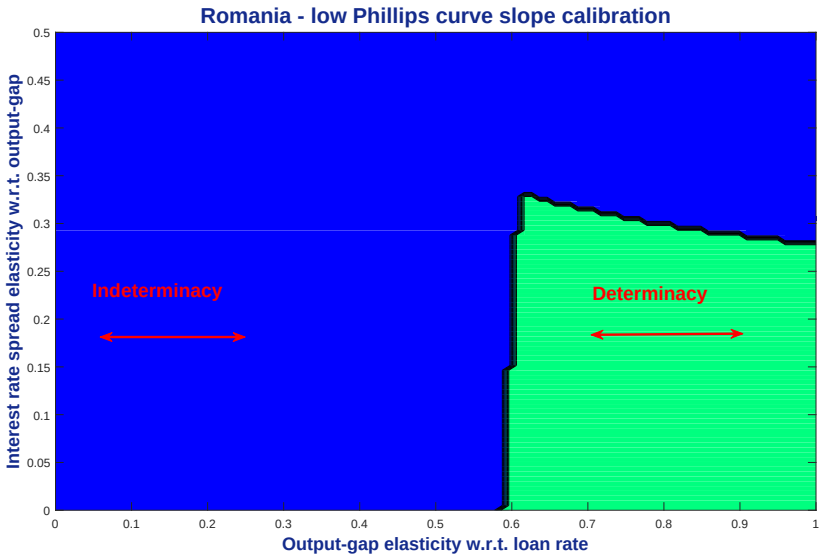

Figure 8: Determinacy region for the NK-FA model with a "passive" policy Romania, case II