Macroprudential Policies and Financial Stability[1]

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Abstract

The paper attempts to assess to what extent the central bank or the government should respond to developments that can cause *financial instability*, such as housing or asset bubbles, overextended budgetary policies, or excessive public and household debt. To analyze this question we set up a simple reduced-form model in which monetary and fiscal policy interact, and imbalances (bubbles) can occur in the medium-run. Considering several scenarios with both benevolent and idiosyncratic policymakers, the analysis shows that the answer depends on a number of characteristics of the economy, as well as on the monetary and fiscal policy preferences with respect to inflation and output stabilization. We show that socially optimal financial instability *prevention* should be carried out by: (i) both monetary and fiscal policy ('*sharing region*') under some circumstances, and (ii) fiscal policy only ('*specialization region*') under others. There is however a moral hazard problem: both policymakers have an incentive to be insufficiently pro-active in safeguarding financial stability, and shift the responsibility to the other policy. Specifically, under a range of circumstances we obtain a situation in which neither policy mitigates instability threats ('*indifference region*'). These results can be related to the build-up of the current global financial crisis, and have strong implications for the optimal design of the delegation process.

Keywords: financial instability, bubbles, fiscal-monetary policy interaction, asset prices, public debt, deficit. **JEL classification:** G01, E61

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[1]We would like to thank Nicholas Groshenny, Viv Hall, and the participants of several conferences for their comments and suggestions. We gratefully acknowledge the support by the Australian Research Council (DP0879638), and the Ministry of Education, Youth and Sports of the Czech Republic (MSM 4977751301). An earlier version of the paper was circulated titled 'Financial Instability Prevention'.

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1. Introduction

Policymakers have long been concerned with the issue of whether fluctuations of various classes of asset prices, as an indicator of inflation, or of financial fragility, should be taken into account when setting monetary or fiscal policies. And if so, how?

The current global financial crisis has highlighted the importance of re-examining these questions. The main objective of the paper is therefore to formally model them, and assess to what extent, if at all, the central bank and the government should take into account potentially destabilizing developments such as bubbles in the asset and housing markets, or excessive public and household debt.

In doing so our focus is ex-ante rather than ex-post. We attempt to derive the optimal degrees of 'financial instability (pro)activism' of monetary and fiscal policies that avoid macroeconomic imbalances and a potential crisis. Our analysis will *not* provide insights into how to deal with the current situation, or previous episodes such as the 1930s slump or the Japanese depression of the 1990s.

Whether policymakers should respond to asset prices has been examined a number of times in the academic literature, and the consensus view has been remarkably clear. Movements in asset prices should not be included in monetary policy rules since, if inflation is being targeted and predicted correctly, the additional welfare benefits of doing so are minimal. Indeed to include them could have damaging side effects. Perhaps the most definitive statement of this view comes from Bernanke and Gertler (2001) who argue that: *'Once the predictive content of asset prices for inflation has been accounted for, there should be no additional response of monetary policy to asset price fluctuations'.* Many other papers reach the same view: for example Vickers (2000), Filardo (2000) who tests the ideas put forward in Goodhart (1995), Mishkin (2001), Gilchrist and Leahy (2002), Faia and Monacelli (2007).

Based on the findings of this stream of literature, and perhaps also due to the moral hazard problem we identify below, financial instability has been given little role institutionally as far as real world policymakers are concerned.[5] Nevertheless, as Bernanke and Gertler (2001) themselves note, there are various qualifications to this standard view. Some authors have stressed that these qualifiers could prove important under certain circumstances; and that having policies react to asset price changes, misalignments or bubbles is likely to be helpful for that reason. Cecchetti et al (2002) for example argue that central banks need to react differently to asset price misalignments than to changes that are driven by fundamentals ('normal' times). Since central banks can presumably detect fundamentals, this should be possible without imposing target values for asset prices.

[5]There exists some evidence that European Central Bank had reacted to asset prices even prior to the current crisis (Silklos and Bohl (2009)), but such behaviour was neither strong enough nor wide-spread enough to have much real effect.

Similarly Bordo and Jeanne (2002), in investigating the circumstances in which asset price reversals can have a serious effect on real activity, find that whether including asset prices in the policy rule is helpful or not depends on the prevailing economic conditions in a complex, non-linear way. Implicitly Bean (2003) comes to a similar conclusion when he argues that monetary policy needs only adequate inflation forecasts, but comments that a credit crunch or financial imbalances might affect policy in subtle ways since price stability does not in itself ensure financial stability or a low impact on activity levels. Bean therefore recommends a closer look at cases where credit expansion and asset price movements signal financial imbalances rather than a response to changes in the fundamentals.[6]

Given these qualifiers, and in the light of the unusual financial instability of 2007-2009, it is important to look again at the desirability of giving various asset price movements a role in the setting of macroeconomic policies. To do so we use a simple theoretical model, as the above cited papers do, although for reasons of transparency and simplicity we use a reduced-form model rather than the structural models of those references. This is motivated by what we know from existing research showing that if there is a role for financial instability activism, it is likely to be complex and nonlinear. Hence the ability to generate analytic insights from our results will be at a premium. In addition, we adopt a general instability measure that could be interpreted broadly as a monetary aggregate, asset prices, house prices, excessive public or private debt etc.

While the details of the model will be given later, let us note that there will be no additional policy instrument to achieve the financial stability goal (in the spirit of Tinbergen (1952)). Nevertheless, the analysis shows that under some (but not all) circumstances social welfare can still be improved using existing instruments of monetary and fiscal policies. The improvement is achieved by a change in the optimal responses of the two policies to the main macroeconomic variables.

Our analysis emphasizes four key points. First, the need for policies designed to safeguard financial stability is generated by the government's (society's) 'ambition' for outcomes in the real economy that cannot be sustained over the long-term.[7] In a reduced-form analysis, these can be modelled as society's and/or government's output target above the potential level. In the absence of excessive ambition no extra instability activism is needed, as in the standard view.

Second, financial instability affects the policymakers' utility both directly and indirectly. In terms of the indirect effect, a policy of 'leaning against the wind' alters macroeconomic outcomes, and hence the utility of the policymakers. In terms of the direct effect, if policymakers admit that financial stability is important by attending to it pro-actively, then a given deviation from it will cause great

[6] As does Wolf (2009) in his review of inflation targeting's track record.

[7] Examples of such ambition include persistent budget deficits driven be political considerations or unsustainable welfare/health/pension settings, excessively leveraged financial institutions, households opting for excessive morgages etc.

disutility to them; as we can see in the present crisis. This is how we incorporate financial instability activism in the model - it enters as a parameter in the policy objective function, and hence expresses both the degree of *activism* and *aversion* to financial instability.

Third, we show that, from the social welfare point of view, financial instability should be mitigated by fiscal policy alone under some circumstances (fiscal specialization region), and jointly by both policies under others (sharing region). Under some parameter values of the latter region monetary policy should be more active than fiscal policy, under some the policies should be equally active, and under others fiscal policy should be the more active policy. Furthermore, under some parameter values of the former region we find that the optimal fiscal policy is 'ultra-active', and should respond to nothing but potential financial instability determinants. In both cases the magnitude of optimal policy activism to financial instability is shown to be a function of a number of variables describing the economy and the policymakers' (society's) preferences. Most importantly, it is determined by the relative potencies (effectiveness) of the policies - in line with the principle of comparative advantage.

Fourth, we show that the implementation of such optimal 'macroprudential' policy setting may be 'problematic'. By problematic we mean that the natural aversion to further interventions (a combination of the cost of an additional use of the existing instruments, and the diversion of policy effort from the core targets of inflation and output) may lead both the government and central bank to be insufficiently pro-active in avoiding financial instability, and to try to shift the responsibility to the other policy. In particular, an 'indifference region' may occur in which both policies fully disregard financial instability. As an implication, due to the inherent moral hazard problem, it is often socially suboptimal if the monetary or fiscal policymakers are allowed to select the degree of their financial instability pro-activism freely.

To examine the institutional implications of this problem we consider two alternatives for the delegation process from the perspective of social welfare. In our *Dependence scenario*, the government selects the degree of pro-activism for itself as well as for the central banker. In our *Independence scenario* the central banker chooses its own degree of financial instability pro-activism.

It is shown that while each scenario can Pareto-dominate the other in terms of social welfare under certain circumstances, only the Independence scenario can achieve the first best outcomes (under some parameter values). Intuitively, this is because in the Independence scenario the central bank can 'force' the government to become more pro-active in preserving financial stability by reducing various fiscal excesses.

The rest of the paper is structured as follows. Section 2 presents the model. Section 3 describes the delegation scenarios and their timing. Section 4 reports the results, separately for the various scenarios, and provides their comparison from the social welfare point of view. Section 5 summarizes and concludes.

2. Model

Our aim is to provide some basic insights into the policymakers' activism towards financial instability (*f-instability* for short) - both from the normative and positive perspective. The former perspective refers to the socially optimal levels of activism, whereas the latter refers to the levels that are likely to obtain in the real world under existing delegation procedures.

2.1. **The Gist of the Policy Interaction.** The intuition of our policy interaction follows Nordhaus (1994) which can be summarized in general terms as follows. There are two independent policymakers: fiscal (the government) denoted by F, and monetary (the central bank) denoted by M. Their policy instruments are f and m respectively. Each policy has three objectives related to the stabilization of the level of inflation, π, the output gap, x, and *asset growth gap*, g, where the latter two gaps are the difference between the actual levels and some (correctly defined) natural levels. As discussed above, g can be interpreted broadly as the deviation of asset prices, property prices, public or private debt from some optimal levels. Formally, the period utility of both policymakers u_i, $\forall i \in \{F, M\}$, can be written as

$$u_i(\pi, x, g). \tag{1}$$

Woodford (2003) showed that the first two elements can be derived from micro-foundations. Further, both policies can affect, at least under some circumstances, all the targeted variables

$$x(f, m), \qquad g(f, m), \qquad \pi(f, m). \tag{2}$$

This policy effect is either direct (through the constraints of the economy), or indirect (influencing, due to policy spillovers, the optimal choice of the other policymaker - denoted by *). As Nordhaus (1994) shows, the above implies policy inter-dependence

$$m^*(f) \qquad \text{and} \qquad f^*(m). \tag{3}$$

In order to be able to derive clear analytical results, we will use the simplest reduced-form macroeconomic framework that can capture these properties rather than a general equilibrium model. This is a deliberate choice, and follows Blanchard (2008) who calls for '*the re-legalization of shortcuts and of simple models.*' Nevertheless, in the Appendix we show how our simple description of the economy can be derived from a conventional New Keynesian model. This is because the New Keynesian model has well-known micro foundations, and its parameters can be derived from (and are functions of) the deep parameters of the underlying microeconomic relations. Put differently, there exists a mapping between the micro-founded and reduced-form models.[8]

2.2. **Preferences.** The policymakers' and society's period utility functions feature three 'stabilization' components of the following form[9]

$$u_{i,t} = -\beta_i \left(x_t - x_i^T\right)^2 - \left(\pi_t - \pi_i^T\right)^2 - \lambda_i \left(g_t - g_i^T\right)^2, \tag{4}$$

where $i \in \{F, M, S\}$ and S is the social planner (society). The non-negative parameters π^T, x^T, g^T denote the respective targets. The $\beta > 0$ and $\lambda \geq 0$ express the relative weights between the three stabilization objectives. The β parameter is (the reciprocal of) the degree of *conservatism.* The $\lambda \geq 0$ weight expresses two things: the degree of *f-instability activism* as well as the extent of *f-instability aversion.*

The fact that the policymakers are averse to f-instability can also be interpreted as *future* considerations about the former two objectives - an attempt to avoid potential imbalances. Specifically, excessively volatile or rapid growth in some financial and real variables is likely to cause more volatile inflation and output further down the track, and hence is already a reason for concern in the present. We will refer to the cases $\lambda = 0$, $\lambda \in (0, \infty)$, and $\lambda = \infty$ as the policymaker being *passive*, *active*, and *ultra-active* (in regards to f-instability prevention) respectively.[10]

In order to reduce the number of free parameters and the degree of heterogeneity, and better identify the main driving forces, let us assume that the latter two targets are common across players, and normalize them to zero

$$\forall i, \; \pi_i^T = 0 = g_i^T.$$

The main source of heterogeneity in the model will be the remaining target, x^T. We will refer to it as the degree of *ambition*, and distinguish two types of players: *responsible* with $x^T = 0$, and *ambitious* with $x^T > 0$. To further streamline the analysis we will focus on the scenario typically of most concern, in which the central bank is responsible, but the government is ambitious, see for example Faust and Svensson (2002). Society may be responsible or ambitious, but no more than the government

$$0 < x_F^T \geq x_S^T \geq x_M^T = 0. \tag{5}$$

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[8]While there are limitations of a reduced-form approach (which we fully acknowledge), it will nevertheless be apparent that our main findings are *independent* of the structure of the macroeconomic setting. Therefore, in the interest of simplicity, and to maximize the insights that can be derived, nothing is lost by the use of a reduced-form model in this case.

[9]The players can be thought of as discounting the future in a multiperiod criterion, but it will become apparent that this does not affect the nature of our medium-run results.

[10]Note that our meaning is different from the active/passive labels used by Leeper (1991).

The government's ambition either reflects society's ambition, $x_F^T = x_S^T > 0$, in which case the government is *benevolent*, or is driven by other (short-term political) factors, $x_F^T > x_S^T \geq 0$, in which case the government is *idiosyncratic*. The main reason given in the literature for allowing $x_T^F > x_T^S$ has been the presence of various political economy features, or to overcome the effects of distortionary taxation or monopolistic competition which prevent markets clearing at full employment. We exclude the case of $x_F^T < x_S^T$ - which was included in the working paper version of this article - as relatively unlikely to occur. This is because the society has a longer optimizing horizon, and hence commonly incorporates the future cost of ambition driven imbalances to a greater extent than does the government. Allowing for $x_S^T > 0$ expresses that society may however not do so fully: ie there may still be some underlying myopia on society's part.

2.3. **Economy.** Our interest lies in examining the *medium-run* forces behind financial instability, which can be thought of as a period of somewhere between 3-10 years. The model will reflect this in three respects. First, we will examine the values that obtain on average (over the business cycle), and are hence unaffected by (zero mean) shocks. Second, and because of that, each policymaker will have perfect control over their instrument. Third, we will not include the long-term budget constraint of the government (incorporating only a less restrictive medium-run constraint) in order to capture the excessive behaviour of some real world governments, and its consequences in terms of financial stability.[11]

We summarize the properties of (2) in the following Lucas type supply curve

$$x_t = \mu(\pi_t - \pi_t^e) + \rho\,(G_t - \pi_t)\,. \tag{6}$$

The π^e variable denotes inflation expectations for the coming period that are formed rationally (ie in a forward looking fashion) by private agents. Since our focus is on the medium-run outcomes, neither the exact details of expectations formation nor shocks would affect our conclusions. The reader can however think of the standard $E_t\pi_{t+1}$ formulation.

The G variable is the instrument of F policy, which should be interpreted broadly as the *medium-run stance* of F policy. It can be thought of as all the F settings that affect *present* or *future* revenues and expenditures. The present component could be summarized by the average size of the budget deficit, or the growth rate of nominal debt as a percentage of GDP. The future component may also include demographic factors that affect future welfare, medicare and pension expenditures,

[11]Many countries, including a number of industrial ones, have been running an excessive fiscal policy for decades. While such behaviour is obviously not sustainable forever, it suggests that the long-term budget constraint may be non-binding for significant periods of time (consistent with out medium run horizon of 3-10 years). We therefore believe that a model focusing on financial stability should be able to capture such behaviour. Nevertheless, the excessive use of fiscal policies will be penalised by the third term of F's objective function.

as well as the expected value of potential government guarantees for private firms etc).

The specification in (6) postulates that the real economy is affected by F policy in real terms, which is due to the medium-run focus. Intuitively, inflation reduces the purchasing power of the government's handout, lowering its income effect, and hence the stimulus made to consumption and investment. The specification also implicitly assumes that the economy exhibits some non-Ricardian features (eg naïve voters or borrowing constraints).

In terms of M policy, we assume the central bank to directly use π as its instrument, which is reasonable due to our focus on the medium-run outcomes. The parameters $\mu > 0$ and $\rho > 0$ will hence be referred to as the *potency of* M and F policy respectively. Excessively expansionary, excessively contractionary, and balanced policies can therefore be described by $G > 0$, $G < 0$, and $G = 0$ respectively for F policy, and $\pi > 0$, $\pi < 0$, and $\pi = 0$ respectively for M policy.

The final relationship needed is a linkage between the policies and f-instability. This is provided by assuming that asset growth is directly fuelled by excessive F policy in real terms, or by low inflation and hence (by implication) low interest rates in the medium-run (so that we capture the asset effects on consumption and investment spending that have been such a feature in the current crisis): ie

$$g_t = G_t - \pi_t. \tag{7}$$

Let us sum up the influence of the policies on the three targeted variables. Both M and F policies affect x through (6), and g through (7). Because of these two effects, the policies also indirectly (through their reaction functions) influence each other's optimal instrument setting, π^* and G^*, as will become evident in Section 4.1.[12]

In terms of the government's intertemporal budget constraint, in the long-run it obviously has to hold (on average) that $G \leq 0$. This is because rational agents would refuse to hold government debt.[13] It can however be argued that the constraints placed on the government in the medium-run (say 5-10 years) are less tight. We can think of a medium-run budget constraint such that, on average, the deficit is below a certain threshold $\bar{G} > 0$. In the interest of clarity, we will below make it non-binding in our equilibrium, ie $\bar{G} \geq G^*$.[14]

[12]In our setup, depending on the relative potencies of the policies, a low inflation policy may stimulate the economy better than a high inflation policy - by increasing the value of real debt and hence magnifying the expansionary effect of F policy better than any inflation surprise could. This is similar to the intuition of Sargent and Wallace's (1981) unpleasant arithmetic result, or the analysis of Leeper (1991), as well as the Fiscal theory of the price level, see eg Cochrane (2009).

[13]Alternatively, one would have to explicitly allow for the probability of default.

[14]If it is somewhat binding the equilibrium outcomes will change quantitatively with G^* reduced to satisfy the constraint, but the qualitative nature of our results is unchanged.

This will allow for the possibility that the government is running structural deficits over the medium term, and for imbalances to build up over that time horizon. Based on F outcomes in the real world, in which many countries have run structural deficits for significant periods of time (even in the expansionary part of the business cycle and despite deteriorating demographic factors), we believe such specification should not be ruled out a priori and deserves an investigation.

3. Scenarios and Timing

We assume that the central bank has *full instrument-independence* from the government, ie it can choose π optimally given its own objectives. In terms of either player's f-instability activism, λ_M and λ_F, we assume that those parameters are chosen simultaneously at the beginning of the game and then apply throughout the whole game. We will consider three different scenarios in terms of which player chooses these values, which can be interpreted as varying degrees of *goal-independence* of the government and central bank.
(1) *Welfare scenario*, W: Both λ_M and λ_F are chosen by S;
(2) *Independence scenario*, I: λ_M is chosen by M and λ_F is chosen by F;
(3) *Dependence scenario*, D: Both λ_M and λ_F are chosen by F.

In all scenarios, observing the λ choices, the players then set their instruments each period in a discretionary fashion, with the remaining policy parameters, ambition and conservatism, as given. This again happens under imperfect information, ie simultaneously, and gets repeated every period.[15]

The Welfare scenario provides the *normative* benchmark case. This is because the social planner optimally chooses to delegate the degree of f-instability activism to M and F in the proportion that maximizes social welfare. Put differently, these are the values that would win an election (Demertzis et al. (2004)).

The I and D scenarios present the *positive* view, ie provide two alternatives of how f-instability activism can and has been implemented institutionally in the real world. The former seems more likely to be the case in industrial countries, whereas the latter in developing countries.[16]

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[15]Let us mention that our companion work considers, in different settings/contexts, various alternative macroeconomic and game theoretic specifications. In Hughes Hallett, Libich and Stehlík (2009a) we endogenize the x_i^T and β_i parameters and examine the case for M and F policy coordination. In Libich and Stehlík (2008) we allow for a more general timing of moves whereby the policy actions may feature some rigidity and/or commitment, ie they do not necessarily happen simultaneously every period. In Hallett, Libich and Stehlík (2009b) short-run considerations, incomplete information, and the stabilization of shocks are also investigated. None of these papers however incorporates f-instability activism. In order to separate its impact from that of those extensions we do not pursue them here.

[16]Let us acknowledge that letting the players choose their preference parameter is not a common practice. But as discussed in the introduction, this is a modelling shortcut to express the fact that if a policymaker *chooses* to respond to financial instability threats, it implicitly admits that financial stability is important to him, and hence a given deviation from it will cause

We will see below that the socially optimal values derived in the W scenario often do *not* obtain in the I and D scenarios due to a *moral hazard* problem on the part of the policymakers. This is because they do not only take into account the effect of their λ on macroeconomic outcomes (and hence *indirectly* on their utility), but also how much their utility will be *directly* affected by their choice of λ - for a given set of macroeconomic outcomes. Therefore, a higher λ may lead to an improvement in social welfare, but still lower the utility of the respective policymaker who therefore has an incentive to choose a socially suboptimal (too low) value of λ.

This can happen in two ways. A higher λ may produce higher social welfare but affect the distribution of gains in utility to the disadvantage of some players. Or a higher λ may decrease the spillovers between players, but not by enough to compensate for the loss in their private objectives.

4. Results

In presenting the results of our analysis, Section 4.1 will first derive the optimal setting of the policy instruments and the resulting macroeconomic outcomes - treating λ_M and λ_F as exogenous. Sections 4.2-4.4 then endogenize them and report their equilibrium values - separately for the three considered scenarios. These will be denoted as λ_i^j where $i \in \{F, M\}$ and $j \in \{W, I, D\}$. In doing so we will use the following terminology:

Definition 1. *Let us define the following regions based on the values of* λ_i^j*:*

(1) ***sharing****: both policies are active,* $\min\left\{\lambda_M^j, \lambda_F^j\right\} > 0$*;*
(2) ***specialization****: one policy is passive and the other active or ultra-active,*
  (a) M***-specialization****:* M *policy is the active one,* $\lambda_M^j > \lambda_F^j = 0$*;*
  (b) F***-specialization****:* F *policy is the active one,* $\lambda_F^j > \lambda_M^j = 0$;
(3) ***indifference****: both policies are passive,* $\lambda_M^j = \lambda_F^j = 0$.

4.1. Instrument Setting and Macroeconomic Outcomes.

In order to derive the macroeconomic outcomes we adopt a two stage solution. First we solve backwards, treating λ_M and λ_F as exogenous to determine the optimal instrument values. Then we determine the optimal λ values for each scenario. Using the players' preferences, (4)-(5), together with the supply constraints, (6)-(7), we get the following policy reaction functions under rational expectations

$$\pi_t = \frac{G_t\left[\rho\beta_M\left(\rho-\mu\right)+\lambda_M\right]}{1+\rho\beta_M\left(\rho-\mu\right)+\lambda_M} \quad \text{and} \quad G_t = \frac{\pi_t(\lambda_F+\rho^2\beta_F)+\rho\beta_F x_F^T}{\lambda_F+\rho^2\beta_F}. \tag{8}$$

Note that even if the policies are formally instrument-independent as we assume, they are still inter-dependent - through spillovers in the economic outcomes. Put

him great disutility. So by letting him choose his f-instability activism, we are effectively letting him choose his f-instability aversion. Nevertheless, our focus below is on the Welfare scenario that is immune to this issue since it is the social planner that chooses λ_M and λ_F.

differently, the optimal setting of each policy is, for almost all parameter values, a function of the other policy's choice. Solving the reaction functions jointly we obtain the equilibrium macroeconomic outcomes as follows (we drop the time subscript for these medium-term outcomes)

(9)
$$\pi^* = [\beta_M \rho(\rho - \mu) + \lambda_M] \frac{x_F^T \beta_F \rho}{\beta_F \rho^2 + \lambda_F} \quad \text{and} \quad G^* = [\beta_M \rho(\rho - \mu) + 1 + \lambda_M] \frac{x_F^T \beta_F \rho}{\beta_F \rho^2 + \lambda_F},$$

(10)
$$g^* = \frac{x_F^T \beta_F \rho}{\beta_F \rho^2 + \lambda_F} \quad \text{and} \quad x^* = \frac{x_F^T \beta_F \rho^2}{\beta_F \rho^2 + \lambda_F},$$

As assumed above, the medium-run budget constraint will not bind, ie it is chosen such that $G^* \leq \bar{G}$. Note that if $x_F^T = 0$ all variables are at their optimal medium-run values, and there exist no imbalances. Since the driving force of financial instability disappears in such cases, there is no need for policy activism. In contrast, if $x_F^T > 0$ - which is assumed throughout - then imbalances build up over the medium term.

We can think of the $g^* > 0$ situation as a *bubble*. It can be seen in (10) that the size of the bubble is increasing in F ambition x_F^T but decreasing in F f-instability activism λ_F. This is naturally going to affect the socially optimal value of λ_F. Furthermore, while M f-instability activism λ_M does not directly determine the size of the bubble in the model, it does affect the incentives of the government, and hence the equilibrium medium-run stance of F policy. The rest of the paper examines these effects in more detail under three different delegation scenarios.

4.2. **Welfare Scenario,** S**.** To derive the equilibrium outcomes of this benchmark case, move backwards and substitute all equilibrium values from (9)-(10) into u_S. Then take derivatives with respect to both λ_M and λ_F, set them equal to zero, and solve them jointly. Doing so yields the following socially optimal degrees of M and F f-instability activism

(11)
$$\lambda_M^W = \begin{cases} 0 & \text{if} \quad \rho \geq \mu, \\ \rho(\mu - \rho)\beta_M & \text{if} \quad \rho \leq \mu, \end{cases}$$

(12)
$$\lambda_F^W = \begin{cases} \frac{\beta_F \left[x_F^T \lambda_S + \beta_S \rho^2 \left(x_F^T - x_S^T \right) \right]}{x_S^T \beta_S} > 0 & \text{if} \quad x_S^T > 0, \\ \infty & \text{if} \quad x_S^T = 0. \end{cases}$$

Let us start by noting two intuitive results. First, if the government is benevolent and its preferences are fully in line with society's we naturally obtain $\lambda_F^W = \lambda_S$. Second, under $x_F^T = 0$ the social planner would be indifferent to the value of λ_F^W, since in the absence of imbalances there is no need for f-instability activism (in either policy) to counter-act them.

Our first proposition summarizes the possible types of outcomes, and suggests that it is by no means obvious which policy *should* mitigate f-instability forces or

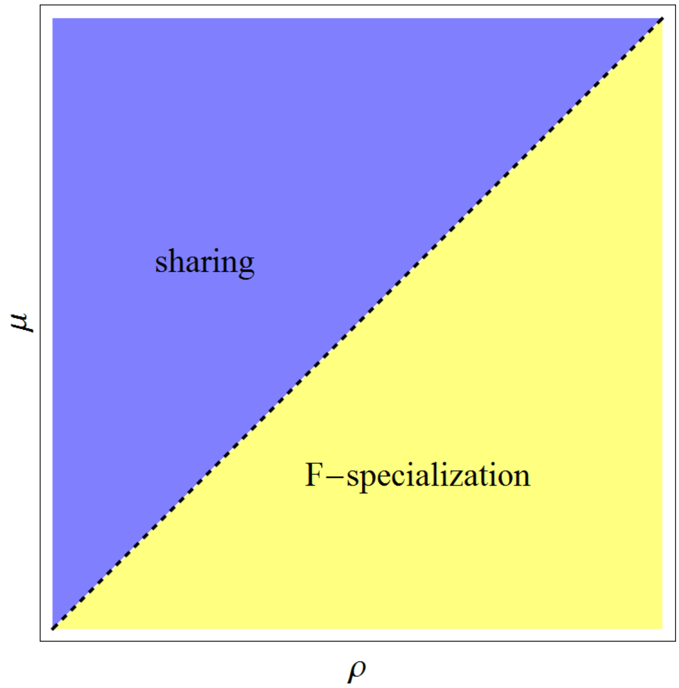

FIGURE 1. The possible regions in the Welfare scenario in the ρ vs μ space (with the 45 degree line indicated).

how strongly so.[17] It demonstrates that the answer depends on several variables describing the economy and the preferences of the players (that are functions of the deep parameters of the underlying micro-founded setup).

Proposition 1. *In the Welfare scenario, we obtain either the **sharing** or the F-**specialization** regions. The M-specialization or indifference regions however do not occur in equilibrium.*

Proof. The proposition claims that we have either $\min\left\{\lambda_M^W, \lambda_F^W\right\} > 0$ or $\lambda_F^W > \lambda_M^W = 0$, but never $\lambda_M^W \geq \lambda_F^W = 0$. It is straightforward to derive these from (11)-(12), setting up the relevant inequalities.

Specifically, the sharing region obtains if $\rho < \mu$, and the F-specialization region occurs if $\rho \geq \mu$. The fact that the M-specialization and indifference regions cannot obtain can be seen in (5) since $\lambda_F^W = 0$ does not result for any of the available parameter values in (5). □

The regions are shown in Figure 1. Intuitively, under all circumstances it is, due to $x_F^T > 0$, socially optimal that at least one policymaker is active in mitigating

[17]This is the normative finding. The next two sections present the Independence and Dependence scenarios and show that the positive results are analogous. They demonstrates that it is far from obvious which policy, if any, *will* react to potential f-instability forces.

f-instability determinants.[18] Note that this can be the case even under $\lambda_S = 0$, ie even if the society disregards f-instability. In these cases society delegates active policymaker(s) because the government's ambition not only impairs financial stability, but also makes inflation deviate from the target and output from its potential. More active policymakers tend to reduce these deviations, which will be discussed below in more detail.

Whether we obtain the sharing or the F-specialization region, and how active each policy should be relative to the other depends on the potencies of the policies. Specifically, we have the following result which follows from the principle of comparative advantage:

Proposition 2. ***(Comparative Advantage).*** *If F policy is more potent that M policy then it should be the only active policy, and under some circumstances it should even be ultra-active. If the potencies are reversed then both policies should be active. In particular, if M policy is* ***sufficiently*** *more potent it should be the more active of the two policies.*

Proof. The fact that F-specialization region occurs if $\rho \geq \mu$ was shown in the previous proof and the existence of $\lambda_F^W = \infty$ under $x_S^T = 0$ can be seen in (12). Similarly, the sharing region was shown to occur under $\rho < \mu$. To derive the circumstances under which $\lambda_M^W > \lambda_F^W > 0$ use (11)-(12) and rearrange to obtain

$$\mu > \rho + \frac{\beta_F \left[x_F^T \lambda_S + \beta_S \rho^2 \left(x_F^T - x_S^T\right)\right]}{\rho x_S^T \beta_S \beta_M} > \rho,$$

which completes the proof. □

Intuitively, if F policy is more potent it should carry out the prevention task on its own because the imbalances are of its own making, and can hence better be addressed. In fact, if society is responsible it finds it optimal to appoint an ultra-active government in terms of f-instability. In such case F f-instability activism fully offsets F ambition, and achieves both real asset growth and inflation on target.

If M policy is more potent than F policy, then it should share the task and do so in proportion to its relative potency. These results are consistent with the standard notion of comparative advantage. In order to enhance our understanding of the macroeconomic role and effects of f-instability activism, the following remark reports its relationships to other variables in the model.

[18] This is true for all the parameter values considered in (5). The working paper version of this article allows for $x_F^T < x_S^T$ and shows that the indifference and F-specialization regions may also occur. For example, it is straightforward to see from (11)-(12) that the former obtains if and only if both $\rho \geq \mu$ and $x_S^T > x_F^T \left(1 + \frac{\lambda_S}{\rho^2 \beta_S}\right) > x_F^T$ hold. This implies that not only x_S^T has to be greater than x_F^T, it has to be *sufficiently* greater. As this is an unlikely case, we have excluded it from our analysis.

Remark 1. *(i) From the social welfare point of view f-instability activism is a* ***substitute*** *for policy conservatism, but only within each policy, not across policies. (ii) The socially optimal degree of F f-instability activism is, in addition to* β_F, *weakly increasing in* ρ, λ_S *and* $\frac{x_F^T}{x_S^T}$.

It is claimed that for each policy i, λ_i^W is (weakly) increasing in β_i, hence decreasing in the degree of own conservatism, but it is not a function of the degree of conservatism of the other policy. These claims, as well as those of part (ii), follow by inspection of (11) and (12).

Intuitively, λ_M is a substitute for M policy conservatism as it brings inflation closer to the inflation target, see (9). Both F policy activism and conservatism have the same effect, and in addition they deliver a budget outcome closer to a balanced one, which implies their substitutability. Note that since all three elements of the utilities are quadratic, it is optimal to 'spread the load' between the three stabilization objectives.

In terms of claim (ii), the greater the potency and ambition of F policy, and the lower the government's conservatism, the greater degree of F f-instability activism λ_F^W that will be delegated. This is because such government tends to run a more expansionary F policy, ceteris paribus, and only a higher λ_F^W will tame the government's expansionary (and financially destabilizing) efforts. The optimal λ_F^W is further increased if the society is more averse to f-instability and/or less ambitious - for the same reasons.

In contrast, a more ambitious society tends to appoint a less pro-active F policymaker. Put differently, society's preferences may hinder financial stability not only by electing an ambitious government, but also by making the government insufficiently pro-active in the face of f-instability. As our analysis shows this then leads to a bubble and real imbalances in the medium-run.

The build up of the current global financial crisis seems to have some resonance with these findings. Excessive behaviour was typical not only of the government policies, but also of various private sector agents: eg some financial institutions taking on excessive leverage or some households going into excessive debt. Such factors translate into a higher value of x_S^T, and hence a lower λ_F^W.

In summary, the socially optimal degrees of f-instability activism are a function of a number of (inter-connected) variables. The fact that these may change over time implies that society may find it difficult to 'institutionalize' them. In other words, it may be impossible to legislate certain λ_F and λ_M values, let alone the socially optimal ones. Therefore, in the real world the degrees of M and F activism are typically at the discretion of the government in power (the Dependence scenario), or chosen by the central bank and the government respectively (the Independence scenario). We examine these two cases in the following two sections.

4.3. **Independence Scenario, I.** In this scenario each policymaker chooses independently (and simultaneously) their own λ value.[19] Analogously to the welfare case, to do this substitute all equilibrium outcomes from (9)-(10) into u_M and u_F, differentiate with respect to λ_M and λ_F respectively, and set equal to zero to obtain the reaction functions (we only report the F policy reaction function that will be used below)

$$(13)\qquad \lambda_F = 2\lambda_M^2 + 4\beta_M\lambda_M\rho(\rho-\mu) + k \quad \text{where} \quad k = \rho^2\left[2\beta_M^2(\mu-\rho)^2 - \beta_F\right].$$

Solving the reaction functions jointly yields

$$(14)\qquad \lambda_M^I = \begin{cases} 0 & \text{if} \quad \mu \le \bar{\mu}(\rho), \\ \rho(\mu-\rho)\beta_M - \frac{1}{2} & \text{if} \quad \mu \ge \bar{\mu}(\rho), \end{cases}$$

$$(15)\qquad \lambda_F^I = \begin{cases} 0 & \text{if} \quad \rho \ge \bar{\rho}, \\ \frac{1}{2} - \beta_F\rho^2 & \text{if} \quad \rho \le \bar{\rho}, \end{cases}$$

where

$$(16)\qquad \bar{\mu}(\rho) = \rho + \frac{1}{2\rho\beta_M} \quad \text{and} \quad \bar{\rho} = \sqrt{\frac{1}{2\beta_F}}.$$

The following result is the analog of Proposition 1 for the I scenario.

Proposition 3. *In the Independence scenario we can obtain all the regions of Definition 1:* ***sharing****,* M***-specialization****,* F***-specialization****, as well as* ***indifference****. There however exist no circumstances under which a policy is ultra-active.*

Proof. These existence claims are proven by inspection of (14) and (15). In particular, the sharing region obtains iff $\mu > \bar{\mu}$ and $\rho < \bar{\rho}$, the M-specialization region obtains iff $\mu > \bar{\mu}$ and $\rho \ge \bar{\rho}$, the F-specialization region obtains iff $\mu \le \bar{\mu}$ and $\rho < \bar{\rho}$, and the indifference region obtains iff $\mu \le \bar{\mu}$ and $\rho \ge \bar{\rho}$. The expressions also show that $\max\left\{\lambda_M^I, \lambda_F^I\right\} < \infty$ for all parameter values. □

These regions are plotted in Figure 2, which shows how they depend on the potencies of the two policies, as well as the degrees of conservatism that determine the threshold levels $\bar{\mu}$ and $\bar{\rho}$ from (16). Intuitively, the more potent and/or less conservative F policy is, the more likely it is that the socially suboptimal indifference and M-specialization regions occur. Interestingly, the presence of a more conservative central bank makes the indifference region more likely of the two (by increasing $\bar{\mu}$), since such banker makes the government even more likely to be passive towards f-instability forces.

In order to better understand the intuition of these results, which are in stark contrast to those of the Welfare scenario in Proposition 1, let us examine the

[19] In an early version of this paper we have considered commitment (Stackelberg leadership) of one policy in setting policy activism. As this has not generated additional insights, we do not pursue this avenue here, except for the result in Remark 2.

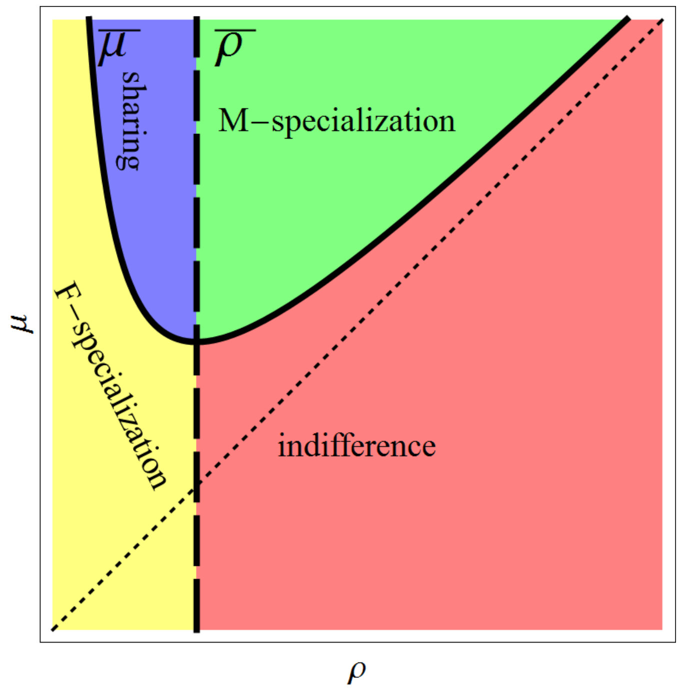

FIGURE 2. The possible regions in the Independence scenario in the ρ vs μ space (an example under $\beta_M = \beta_F = 1$). The lines indicate the thresholds $\bar{\mu}$ and $\bar{\rho}$ from (16), and the 45 degree line.

incentives of the government in setting λ_F^I in more detail - focusing on its reaction function in (13). We can also think of the following exercise as the case in which the government knows that the central bank may choose λ_M in some arbitrarily fashion potentially different from (14).[20]

The reaction function (13) shows that the optimal λ_F^I is a quadratic function of λ_M. It implies that under some parameter values λ_F^I is monotonically increasing in λ_M implying complementarity, whereas under others the relationship is *non-monotone*.[21] Specifically, in the case of $\rho < \mu$ and $k > 0$ (which can obtain for any combination of β_M and β_F), the quadratic equation has two positive roots, meaning that λ_F^I is: (i) decreasing in λ_M for values below a certain threshold, (ii) increasing in λ_M for values above a certain threshold, and (iii) unrelated to λ_M for values between the thresholds. An example is plotted in Figure 3.

[20]This has arguably been the case in the real world up until the current financial crisis, whereby central banks have typically chosen to be passive and disregard financial instability.

[21]The fact that there may be such non-monotone relationships even in a simple reduced-form model like ours highlights the importance of accounting for the interaction of the policies and multiple overlapping policy goals.

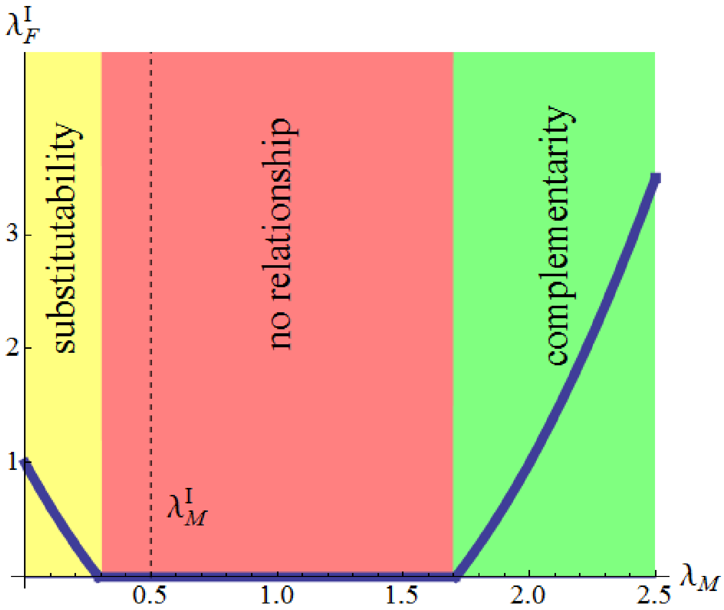

FIGURE 3. An example of λ_F^I as a function of λ_M for values $\beta_M = \beta_F = \rho = 1$, and $\mu = 2$. The optimal $\lambda_M^I = 0.5$ is indicated by the dashed line.

It is instructive to discuss the intuition behind the λ_F^I vs λ_M relationship by using the π_t^*, x_t^* and g_t^* values derived in (9)-(10). Each change in λ_F generally impacts the government's utility in four respects - three indirect and one direct.

In terms of the indirect effects, λ_F determines π_t^*, x_t^* and g_t^* and hence the gaps of these variables from their targets. In terms of the direct effect λ_F is the magnitude with which the latter gap is felt by the government. Whether λ_F^I is positive or zero, and whether it is increasing or decreasing in λ_M, depends on the relative strengths of these four effects.

1) Complementarity: λ_F^I is increasing in λ_M. In this case (which obtains for a large part of the parameter space), λ_M is sufficiently high that it tends to increase π_t^*: see (9). The central bank cannot stop the government increasing debt so all it can do is allow π_t^* to rise to deflate it, similarly to the intuition of the fiscal theory of the price level: Cochrane (2009). The government suffers disutility from that but faces a tradeoff. By increasing λ_F the government counter-acts this and reduces π_t^* closer to its target value. Another positive side-effect of such action is that a higher λ_F reduces real asset growth, and hence brings it closer to its target value g_F^T. But by raising λ_F, a unit deviation from this target now causes a higher disutility. Furthermore, a higher λ_F reduces x_t^* and moves it further away from the output target x_F^T (it can be easily shown that $x_t^* \leq x_F^T$ for all $\lambda_F \geq 0$). We can therefore conclude that in this region the former two effects dominate the latter two, and hence a higher λ_M induces F to be more instability pro-active and help achieve the inflation target.

2) Substitutability: λ_F^I *is decreasing in* λ_M*.* The advantage of a lower λ_F to the government in this case, in addition to the fact that a unit f-instability is less painful, is the fact that a lower λ_F moves x_t^* closer to its target. But the disadvantage of a lower λ_F is the fact that it takes π_t^* further away from the target (the parameters of this case generate deflation, and a lower λ_F makes the deflation even stronger). Another downside is that g_t^* will move further away from its target. In this case however the former two effects dominate, and F therefore makes it harder for M to achieve the inflation target.

3) No relationship: λ_F^I *is not a function of* λ_M*.* This case is a combination of the other two, in which the best thing the government can do for itself is to be passive and disregard f-instability altogether.

The above discussion and Figure 3 imply the following:

Remark 2. *In the Independence scenario, M can indirectly induce F policy to be active.*

Note that this inducement can not only come through a high enough value of λ_M, but for some parameter values by selecting a low enough value of λ_M. The intuition behind this result follows from the above discussion: both players wish to avoid the direct costs of f-instability prevention.

4.4. **Dependence Scenario,** D**.** In this scenario, the government is choosing its own λ_F, while delegating λ_M to the central bank. Analogously to the welfare case, substitute all equilibrium outcomes from (9)-(10) into u_F, differentiate with respect to λ_M and λ_F, set equal to zero, and solve jointly to obtain

$$\lambda_M^D = \lambda_M^W, \tag{17}$$

$$\lambda_F^D = 0. \tag{18}$$

The following Proposition summarizes the possible outcomes for the D scenario.

Proposition 4. *In the Dependence scenario, we obtain either the **indifference** or M-**specialization** regions. There exist no parameter values yielding the F-specialization or sharing regions, or an ultra-active policy.*

Proof. These existence claims are proven by inspection of (14) and (15). In particular, the indifference and M-specialization regions obtain iff $\rho \geq \mu$ and $\rho < \mu$ respectively. The fact that the F-specialization and sharing regions cannot obtain can be seen in (18) whereby $\lambda_F^D = 0$ results for all parameter values. The expressions also show that $\max\left\{\lambda_M^I, \lambda_F^I\right\} < \infty$ for all parameter values. □

The regions are shown in Figure 4. Intuitively, the government will always choose to *fully* pass on the responsibility for f-instability to the central bank, and hence the sharing and F-specialization regions do not obtain.

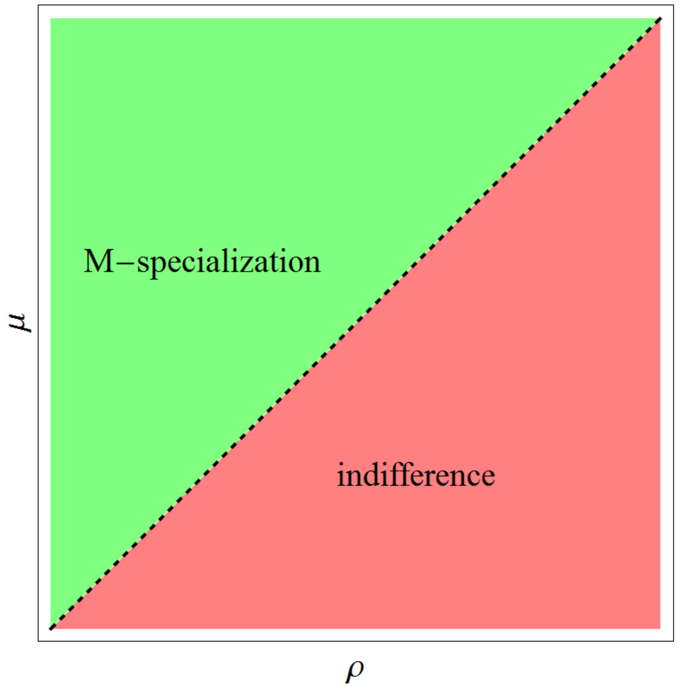

FIGURE 4. The possible regions in the Dependence scenario in the ρ vs μ space (with the 45 degree line indicated).

4.5. **Comparison of the Scenarios.** The preceding three sections reported the f-instability activism regions for the W, D and I scenarios respectively. They implied that equilibrium policy activism in the latter two scenarios may differ from one another, as well as from the socially optimal setting. For example, note that neither policy's equilibrium activism, in either the I or the D scenario, is a function of λ_S - unlike λ_F^W.

To complement the above discussion of the intuition for the various outcomes and influences, this section will compare and contrast the three scenarios and offer explanations for the differences between them. As reported in Propositions 1, 3, and 4, summarized in Figures 1, 2, and 4 respectively, the W scenario yields the sharing and the F-specialization regions, the D scenario yields the M-specialization and indifference regions, and the I yields all of these four regions under some circumstances. The following two propositions compare the equilibrium λ_i^j values across policies and scenarios, and point to a moral hazard on the part of the policymakers.

Proposition 5. ***(F moral hazard).*** *In the Dependence scenario, the government will choose F activism to be* ***less than*** *or equal to the value that: (i) it delegates to the central bank, $\lambda_F^D \leq \lambda_M^D$, and that (ii) it chooses for itself in the Independence scenario, $\lambda_F^D \leq \lambda_F^I$.*

Proof. All claims are implied by inspection of (11), (15), and (17)-(18). □

The claims demonstrate that the government has an incentive to 'pass the buck', and leave it up to the central bank to deal with the consequences of its excessively ambitious actions. Put differently, the government realizes that it will be necessary to reduce any excessive asset growth of its own making, but refuses to bear the real costs of doing so.

As λ_F affects F's utility not only indirectly (through macroeconomic outcomes), but also directly (via the magnitude with which a given outcome is 'felt' by the government), ambitious F policymakers may choose a low λ_F to 'avoid responsibility' for these outcomes. This constitutes a moral hazard type problem.

Proposition 6. ***(M moral hazard).*** *In the Independence scenario, the central bank will choose M activism to be* ***less than*** *or equal to: (i) the socially optimal value,* $\lambda_M^I \leq \lambda_M^W$, *and (ii) the value delegated to the bank by the government under in the Dependence scenario,* $\lambda_M^I \leq \lambda_M^D$.

Proof. By inspection of (11), (14), and (17). □

It should however be recognised that real world central banks with explicit inflation targets are constrained in terms of f-instability activism. As our analytical solutions imply, the price to pay for preventing instability of the financial system is the need to deviate from the inflation target. The fact that central banks are accountable for achieving the target in most countries arguably justifies and explains a potentially suboptimal f-instability activism.

It is also worth noting that while these results obtain in our one-shot game, the moral hazard problem may be alleviated in a repeated game setting. This is because, as is well known, (infinite) repetition allows players to better coordinate their actions, using various punishment strategies or building reputations under incomplete information.

The proposition further implies that in the Independence scenario the government's influence over the central bank is limited. Since an independent bank is inclined to be less active than it should, the government sometimes needs to step in and make up for it, ie compensate for the suboptimally low λ_M^I. Interestingly, we have the following:

Remark 3. *In the Independence scenario the government* ***may*** *choose its activism that is* ***more than*** *the value assigned to it in the Welfare scenario,* $\lambda_F^I > \lambda_F^W$.

Using (12) and (15) reveal that $\lambda_F^I > \lambda_F^W$ obtains iff

$$\frac{x_S^T}{x_F^T} \in \left(\frac{2\beta_F \left(\lambda_S + \rho^2\right)}{\beta_S}, 1 \right] \tag{19}$$

In words, the $\frac{x_S^T}{x_F^T}$ value has to be sufficiently high relative to λ_S, $\frac{\beta_F}{\beta_S}$ and ρ for this 'compensation' to happen, ie such situation is more likely if the government is less ambitious and/or more conservative. For all other parameter values, including those of responsible and/or highly f-instability averse society, the government's f-instability activism will be below (or equal to) the socially desirable level.

The following remark contrasts the way F policy activism is perceived by the government on one hand and society on the other, and sheds further light on the intuition of the previous results.

Remark 4. *From the government's point of view F f-instability activism is: (i) a* ***complement*** *to F policy conservatism in the Independence scenario, and (ii)* ***unrelated*** *to F policy conservatism in the Dependence scenario. Both of these are in contrast to society's perspective of Proposition 1 whereby F f-instability activism is a* ***substitute*** *to F policy conservatism.*

Equation (15) shows that λ_F^I is non-increasing in β_F, the inverse of F-conservatism, whereas (12) shows that λ_F^W is non-decreasing in β_F. Further, (18) shows that λ_F^D is not a function of β_F.

Also note that in terms of M policy there is no change from the Welfare scenario in either the I or D scenarios, ie M policy f-instability activism is, from the central bank's as well as from society's perspective, a substitute to M policy conservatism. As a matter of practical policy making, the central banker may utilize this substitutability and find it politically more convenient to select (the rhetoric of) a higher λ_M rather than a lower β_M if having the option. This is especially true in turbulent situations such as the current financial crisis in which the society's f-instability aversion, λ_S, is high.

The following remark compares the relative activism of the policies prescribed by the various scenarios.

Remark 5. *In the Independence scenario, unlike in the Welfare and Dependence scenarios, M policy may end up being the more (or the only) active policy despite being less potent.*

The condition for $\lambda_M^I > \lambda_F^I$ from (14)-(15) can be simplified into $\beta_M < \beta_F - \frac{1}{\rho^2}$, and this holds even for some $\mu < \rho$ values. The result is seen graphically in Figure 2. It implies that the outcomes may be in contradiction with the principle of comparative advantage reported in Proposition 2, and provides a further indication of the shortcomings of the delegation process. The next section examines the implications for the socially desirable design.

4.6. **Optimal Institutional Design.** The following proposition reports the welfare consequences of the two regimes in terms of f-instability assignments.

Proposition 7. ***(Welfare comparison).*** *(i) The socially optimal (first best) outcomes can never be achieved in the Dependence scenario, whereas they can be achieved in the Independence scenario under some parameter values. Under those circumstances, the Independence scenario Pareto-dominates the Dependence* *scenario. (ii) Nevertheless, there exist a range of parameter values under which the welfare ranking of the scenarios is reversed, or where the scenarios yield identical welfare outcomes.*

Proof. In terms of claim (i), for the macroeconomic outcomes of a scenario $j \in \{D, I\}$ to be socially optimal, $u_S^j = u_S^W$, it is required that the values of λ_M^j and λ_F^j are the same as λ_M^W and λ_F^W respectively as they affect all the variables in (9)-(10). In terms of the D scenario, inspecting (12) and (18) shows that while λ_F^W is always positive, λ_F^D is always zero, and hence they never equal.

In terms of the I scenario, comparing the regions of Propositions 1 and 3 implies that the only possibility for identical activism values for both policies is the F-specialization region, that obtains for values $\rho \in (\mu, \bar{\rho})$ where $\bar{\rho} = \sqrt{\frac{1}{2\beta_F}}$ from (16). Specifically, setting $\lambda_F^I = \lambda_F^W$ and rearranging yields

$$\rho = \sqrt{\frac{x_S^T}{2\beta_F x_F^T} - \frac{\lambda_S}{\beta_S}}, \tag{20}$$

under which $u_S^I = u_S^W > u_S^D$.

In terms of claim (ii), it is straightforward to verify that if $\rho < \bar{\rho}$ then there exists, under some (but not all circumstances), a positive threshold $\bar{\lambda}_S$ such that if $\lambda_S < \bar{\lambda}_S$ then the Dependence scenario Pareto-dominates the Independence scenario, if $\lambda_S > \bar{\lambda}_S$ the reverse is true, and if $\lambda_S = \bar{\lambda}_S$ then the two scenarios yield identical social welfare.

The threshold $\bar{\lambda}_S$ is a function of a number of parameters. To derive it substitute all the equilibrium outcomes including λ_i^j into u_S^I and u_S^D respectively, and impose $u_S^I = u_S^D$. For example for the values $\mu > \bar{\mu}$ this yields, after rearranging

$$\bar{\lambda}_S = \frac{\rho^2 \left[\beta_S \left(x_F^T - 2x_S^T + 4x_S^T \beta_F \rho^2\right) - x_F^T \beta_F^2 \rho^2 \left(1 + 4\beta_S \rho^2\right)\right]}{\left(4\beta_F^2 \rho^4 - 1\right) x_F^T}, \tag{21}$$

which completes the proof. □

This proposition demonstrates two points. First, it exposes the shortcomings of letting one or both policymakers select their degree of activism. The first best outcomes are delivered under no circumstances in the D scenario, and only very special circumstances in the I scenario. For illustration, Figure 5 reports social welfare from the two scenarios for selected parameter values. It shows that society suffers disutility from both scenarios, whereas the Welfare scenario would deliver zero disutility (the top plain in the figure) for all λ_S and x_S^T.

Second, the proposition shows that the superiority of a particular delegation scenario depends on the circumstances. It is instructive to consider two of the possible cases.

Case 1: If F policy is sufficiently potent, both in absolute terms and relative to M policy, ie if $\rho \geq \max\{\mu, \bar{\rho}\}$, then identical outcomes across scenarios will be

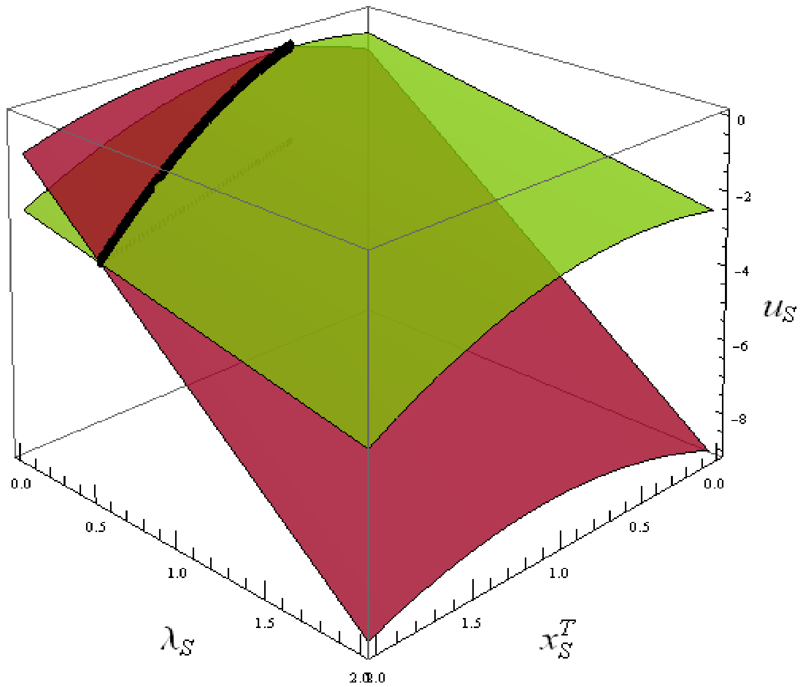

FIGURE 5. An example of social welfare in the D (red/dark) and I (green/light) scenarios under $\rho = \frac{1}{2}$ and all other parameter values set to one. The threshold $\bar{\lambda}_S$ is indicated by the thick line.

achieved, and this is true for any λ_S. This is because in such case the indifference region obtains in both scenarios, $\lambda_F^I = \lambda_F^D = \lambda_M^I = \lambda_M^D = 0$, and hence the same macroeconomic outcomes will be achieved. Therefore, the choice of the delegation scenario is irrelevant in such case. The fact that these are socially suboptimal outcomes can be readily seen in Propositions 1 showing that the indifference region never obtains in the W scenario.

Case 2: In contrast to Case 1, if F policy's potency is less than a certain threshold level, $\rho < \bar{\rho}$ (which can however be greater than, equal to, or less than μ), then the two scenarios yield identical welfare only for a specific value of λ_S, namely $\lambda_S = \bar{\lambda}_S$. An example of such a threshold, specifically the one from (21), can be seen in Figure 5.

Intuitively, at least one of the policies' activism in each scenario is strictly positive in such case, but it is too low (below its assigned values in the Welfare scenario λ_M^W and λ_F^W). When λ_S is large enough, then the fact that λ_F^D is lower (further away from λ_F^W) than λ_F^I is relatively more important than the fact that λ_M^I is lower (further away from λ_M^W) than λ_M^D. Therefore, the Independence scenario generates higher social welfare than the Dependence scenario. For values of $\lambda_S < \bar{\lambda}_S$ this is however reversed.

The following remark summarizes the policy implication of the above discussion.

Remark 6. ***(Optimal delegation).*** *A two-tier delegation delivers socially optimal outcomes. Society first imposes λ_F onto the government, and the government then imposes λ_M onto the central bank. If either player is allowed to choose their own degree of activism λ_i, which is the case in both the Independence and Dependence scenarios, inferior outcomes will typically result.*

5. Summary and Conclusions

The paper examines how strongly, if at all, monetary and fiscal policymakers should pre-emptively respond to phenomena that can cause imbalances, financial instability, or asset price bubbles. In our reduced-form framework it is shown that the answer depends on a number of variables describing the economy and society's (or policymakers') preferences.

We however find that if the government and the central bank have discretion over the degree of their financial instability activism, socially inferior outcomes often result due to a moral hazard problem on their part. Therefore, the precise structure of the delegation process - that determines the incentives of the policymakers to be prudent - plays an important role in the preservation of financial stability.

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7. Appendix

This section motivates the above setup by showing that a supply constraint such as (6) can be derived from a fairly standard New Keynesian model under reasonable circumstances. Let us assume the following IS curve, Phillips curve and a simple interest rate rule

$$x = x^e - \sigma\left(i - \pi^e\right) + \chi G + \varepsilon, \tag{22}$$

$$\pi = \beta\pi^e + \kappa x + \varphi G + v, \tag{23}$$

$$i = \bar{\imath} + \gamma\pi, \tag{24}$$

where $\sigma, \chi, \beta, \kappa, \varphi, \gamma$ are positive parameters, we will normalize the neutral interest rate $\bar{\imath}$ to zero similarly to the inflation target, ε and υ are demand and supply shocks respectively, and the e superscript denotes expected variables (where again the exact timing is not essential for our purposes as long as expectations are formed in a forward looking fashion). Note that F policy enters the usual way: it boosts output and this leads to inflationary pressures.

Substituting (23) and (24) into (22) and rearranging to get the same form as (6) yields

(25)

$$x^e = \left(\frac{\beta}{\kappa} + \sigma\right)(\pi - \pi^e) + \left(\frac{\beta - 1}{\kappa} - \sigma\gamma\right)(G - \pi) + \left(\frac{1 - \beta - \varphi}{\kappa} + \sigma(\gamma - 1) - \chi\right) G - \frac{\nu}{\kappa} - \varepsilon.$$

Taking expectations we obtain the desired equation (6), where

$$\mu = \left(\frac{\beta}{\kappa} + \sigma\right) \quad \text{and} \quad \rho = \left(\mu - \sigma\gamma - \frac{1}{\kappa}\right),$$

and where we disregarded the shocks (due to our medium-run focus), and normalized the remaining G elements to zero

$$\frac{1 - \beta - \varphi}{\kappa} + \sigma(\gamma - 1) - \chi = 0. \quad (26)$$

Two issues are worth noting. First, in line with the assumption made in the main text μ and ρ are positive (the former for all parameter values and the latter for a large range). Second, under the normalization in (26) we always have $\mu > \rho$ which is the case we focused on in Figures 3 and 5 But if the normalization is not imposed and $\frac{1-\beta-\varphi}{\kappa} + \sigma(\gamma - 1) - \chi > 0$ we have an additional boost of output through F policy, which increases the policy's potency possibly above that of M policy. Therefore, in the main text we have also reported results for the $\mu < \rho$ case.[22]

[22] In an earlier draft of the paper we (i) did not impose the normalization in (26), and (ii) allowed for $\rho < 0$. But as this more general setup did not offer any additional insights we streamlined the analysis to report our key insights more clearly.