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Optimal monetary policy in open economies revisited☆

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ABSTRACT

This paper revisits optimal monetary policy in open economies, in particular, focusing on the noncooperative policy game under local currency pricing in a two-country dynamic stochastic general equilibrium model. We first derive the quadratic loss functions which noncooperative policy makers aim to minimize. Then, we show that noncooperative policy makers face extra trade-offs regarding stabilizing real marginal costs induced by deviations from the law of one price under local currency pricing, and that optimal monetary policy seeks to stabilize CPI inflation rates and more so under noncooperation than it does under cooperation. As a result of the increased number of stabilizing objectives, welfare gains from cooperation emerge even when two countries face only technology shocks. Still, gains from cooperation are not large, implying that frictions other than nominal rigidities are necessary to strongly recommend cooperation as an important policy framework to increase global welfare.

1. Introduction

In a world of integrated trade in goods and assets, sovereign nations become more and more interdependent. The prolonged recession after the Global Financial Crisis again reminds policy makers in major economies of the depth and scope of such interrelations. Understanding the nature of cross-country spillovers of shocks and policy impacts comes back to center stage in policy discussions. Should central banks cooperate in order to internalize the possible externality from policy reactions? Is there any gain from such cooperation? And if so, how large might it be?

The desirability of policy cooperation, namely whether there exist gains from cooperation, has been one of the central issues in macroeconomics. The root of the discussion can be traced way back to Hume (1752), who first noticed possible policy spillovers among countries. Since then, there have been a vast number of studies investigating the nature of policy games in open economies. Recently, many have studied optimal monetary policy in open economies using micro-founded, open-economy sticky-price models based on the so-called New Open Economy Macroeconomics (hereafter, NOEM) initiated by Obstfeld and Rogoff (1995) and Svensson and van Wijnbergen (1989). Contrary to traditional studies using the Mundell-Fleming model, correct welfare can be computed with the NOEM models. Thus, comparison of different policies becomes possible without resort to *ad hoc* criteria.

This paper revisits optimal monetary policy in open economies in a new direction, which is a noncooperative game under local currency pricing (hereafter, LCP). The motivations behind seeking optimal noncooperative monetary policy under LCP are twofold: one is *positive* and the other is *normative*. The former arises because exchange rate pass-through is imperfect. There are numerous empirical studies which point out significant deviation from the law of one price. To name a few, Isard (1977), among early studies on this issue, presents evidence that "the law of one price is flagrantly and systematically violated." Knetter (1993) reports that "Japanese and German exporters use destination-specific markup adjustment to stabilize local-currency prices of exports." Goldberg and Knetter (1997) offer a comprehensive survey of early literature on empirical evidence that "the local currency prices of foreign products do not respond fully to exchange rates." Engel (1999) shows that "relative prices of nontraded goods appear to account for almost none of the movement

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Table 1
Taxonomy of optimal monetary policy in open economies.

	Pricing			
Games	PCP		LCP	
Cooperation	One-period ahead	OR (1995), OR (2002)	One-period ahead	DE (2003), CP (2005a)
	Staggered	CGG (2002), BB (2003), BB (2006)	Staggered	Engel (2011)
Noncooperation	One-period ahead	CP (2001), OR (2002)	One-period ahead	DE (2003), CP (2005a)
	Staggered	CGG (2002), BB (2003), BB (2006)	Staggered	*This paper* (2017)

Note: OR denotes Obstfeld and Rogoff, CP denotes Corsetti and Pesenti, CGG denotes Clarida, Galí and Gertler, BB denotes Benigno and Benigno, and DE denotes Devereux and Engel.

of U.S. real exchange rates," implying that there are significant fluctuations in the relative prices of traded goods. A recent study by Atkeson and Burstein (2008) provides new evidence using individual prices: "the terms of trade for manufactured goods are significantly less volatile than the manufacturing PPI-based real exchange rate; and that the CPI-based real exchange rate for goods has roughly the same volatility as the manufacturing PPI-based real exchange rate." These two findings support their modeling strategy to put emphasis on "the decisions of individual firms to price-to-market."

The latter motivation will be discussed in detail in the next subsection, and is illustrated diagrammatically in Table 1. Optimal monetary policy in open economies has been investigated under many different settings in the NOEM, such as under cooperation or noncooperation, producer currency pricing (hereafter, PCP) or LCP, and with or without home bias. Consequently, our understanding of how monetary policy should be conducted in an interconnected world is deepened. There is, however, one last missing piece, which has not yet been analyzed in a theoretical dynamic stochastic general equilibrium (hereafter, DSGE) model. That is, how optimal noncooperative monetary policy under LCP should be conducted, or whether there are any gains from cooperation under LCP. These are the questions to which we aim to give answers in this paper.

For this purpose, we first solve the equilibrium conditions under monopolistic competition, sticky prices and LCP in a two-country model. The Ramsey (deterministic) steady states under both cooperative and noncooperative regimes are at globally efficient levels and identical to those under the flexible-price equilibrium. Thus, the exact welfare comparison between cooperation and noncooperation becomes possible. Then, we approximate welfare around this deterministic steady state up to the second order. In a noncooperative regime, even if the steady state is efficient thanks to the optimal subsidy, linear terms cannot be eliminated. Following Sutherland (2002), Benigno and Woodford (2005) and Benigno and Benigno (2006), we take a second-order approximation to the structural equations to substitute out the linear terms with only second-order terms. Correct welfare metrics up to the second-order approximation are thus obtained.

Our loss functions under LCP show that noncooperative policy makers naturally aim to stabilize variables whose fluctuations are to be minimized by cooperative policy makers as analyzed in Engel (2011), including output, producer price index (hereafter, PPI) inflation rates, import price inflation rates, and deviations from the law of one price.[1] In addition, they also seek to stabilize fluctuations in real marginal costs that firms face when setting prices in both domestic and export markets. These additional objectives are unique to the noncooperative game and therefore the sources for potential gains from cooperation, which are absent in previous studies on optimal monetary policy in open economies.[2]

Then, in order to clarify the nature of optimal monetary policy in open economies, we compare impulse responses under optimal monetary policies among three cases: (1) PCP; (2) cooperative regime and LCP; (3) noncooperative regime and LCP. Note that in our setting with only technology shocks, optimal cooperative as well as noncooperative policies result in identical allocations and prices under PCP.

Fluctuations in consumer price index (hereafter, CPI) inflation rates become smaller under LCP than under PCP. This is because the violation of the law of one price induces inefficient price dispersions within producer as well as export prices, as emphasized by Engel (2011). As a result, the "inward-looking" policy that focuses on stabilization of PPI inflation rates is no more optimal under LCP. In addition, under LCP, noncooperative policy makers stabilize CPI inflation rates more than cooperative central banks do. This larger stabilization motive arises from the unique objectives in the loss functions under noncooperation. Inability to cooperate constrains the dynamics toward more efficient outcomes. Reactions of domestic output to a domestic technology shock become smaller under noncooperation. Without any frictions, global welfare increases when production in the country with favorable efficiency shocks increases. This difference in the responses of output creates room for cooperative policies to improve global welfare.

We also compute the welfare gain from cooperation under LCP by solving the nonlinear Ramsey problem. Welfare gains from cooperation are largest with log utility even though both countries become insular in structural equations under PCP. Still, welfare gains computed from nonlinear Ramsey problems are not sizable with only technology shocks. Within the reasonable range of parameter calibration, the welfare cost stemming from the inability to cooperate can only be, at most, 0.04% in consumption units, in response to one standard deviation of technology shocks. Corsetti (2008) remarks that in early leading studies, the quantitative assessment of welfare gains from cooperation is found far from sufficient to justify cooperation, and whether this result still holds in richer models is a critical research question. Our paper finds that given only price rigidities, sizable welfare gains may not arise from cooperation.

1.1. Literature review

First, we classify previous studies of optimal monetary policy in open economies by three dimensions.[3] The first dimension regards assumptions about nominal rigidities, that is, either one-period ahead price setting or staggered price setting à la Calvo (1983). In early studies using one-period ahead price setting, analytical solutions can be obtained with money supply as the control variable of monetary policy. With staggered price setting, central banks maximize correctly approximated social welfare up to the second order subject to the linearly approximated structural equations. The second dimension is about export price setting, namely PCP or LCP. In the former, export prices fully reflect exchange rate fluctuations, while not at all in the latter. The third dimension is whether monetary policy in open economies is conducted in a cooperative or noncooperative manner.

Table 1 offers a taxonomy of previous studies on optimal monetary policy in open economies. Regarded as the beginning of the

[1] Note that last terms are not considered under PCP, since the law of one price holds.

[2] Technically, these additional objectives arise from the linear terms in the second-order approximated welfare, that are eventually substituted by second-order approximated aggregate supply conditions.

[3] Corsetti et al. (2010) offer a comprehensive survey of optimal monetary policy in open economies including other aspects such as financial market imperfections.