Available online at www.sciencedirect.com
ScienceDirect
Journal of Economic Theory 142 (2008) 233–246
JOURNAL OF Economic Theory
www.elsevier.com/locate/jet

A dynamic model of settlement

Thorsten Koeppl[a], Cyril Monnet[b], Ted Temzelides[c,*]

[a] *Department of Economics, Queen's University, Kingston K7L 3N6, Canada*
[b] *European Central Bank, DG Research, D-60311 Frankfurt/Main, Germany*
[c] *Department of Economics, University of Pittsburgh, Pittsburgh, PA 15260, USA*

Received 28 February 2006; final version received 18 October 2006
Available online 4 December 2006

Abstract

We investigate the role of settlement in a dynamic model of a payment system where the ability of participants to perform certain welfare-improving transactions is subject to random and unobservable shocks. In the absence of settlement, the full information first-best allocation cannot be supported due to incentive constraints. In contrast, this allocation can be supported if settlement is introduced, provided that it takes place with a sufficiently high frequency.

JEL classification: C72; D82; E40; G20

Keywords: Settlement; Payment systems; Random matching; Private information; Mechanism design

1. Introduction

A distinguishing feature of payment systems (PSs) is *settlement*, or the discharge of past obligations through the transfer of an asset. [1] Actual settlement has three defining properties. First, it is not a welfare-improving activity by itself. Rather, settlement involves a mere transfer of an asset between participants in order to fulfill the obligations created by previous transactions. Second, it takes place periodically. For instance, debit card transactions are generally settled on a monthly basis, while settlement of interbank transactions generally takes place daily. Finally, settlement gives the opportunity to all participants in the system to start afresh since, after settling their obligations, they are no longer liable to the system.

* Corresponding author.
E-mail addresses: thor@econ.queensu.ca (T. Koeppl), cyril.monnet@ecb.int (C. Monnet), tedt@pitt.edu (T. Temzelides).

[1] For references to different notions of settlement, we refer the reader to BIS [4].

0022-0531/$ - see front matter © 2006 Elsevier Inc. All rights reserved.
doi:10.1016/j.jet.2006.10.005

In this paper we employ the dynamic model of a PS developed in Koeppl et al. [16] and use it in order to study the role of settlement. Our main finding is that settlement is an essential part of an optimal PS as it enables agents to engage in beneficial transactions that would otherwise not be realized. We employ a version of the model of exchange developed by Kiyotaki and Wright [12,13]. Our model, however, departs from monetary economics and, instead, emphasizes the role of private information in a way related to the dynamic contracting literature.[2] The use of a dynamic framework is essential since some of the questions that optimal PS design poses are inherently dynamic and, therefore, very hard or impossible to study within the existing literature, which is almost exclusively static.[3]

The environment in our model assumes a periodic pattern in which each *transaction stage* consisting of a finite number of bilateral trades is followed by a *centralized round*, in which a general good can be produced using a linear technology. The transaction stage is assumed to be subject to a private information friction. Thus, incentives are needed in order to induce truthful revelation. This implies that, in the absence of settlement, it is impossible to support the full information first-best allocation. In contrast, we demonstrate that, if settlement is introduced in the centralized stage, the full information first-best allocation is attainable in this setup.

We decentralize the efficient allocation via a PS. This involves assigning balances to individual agents during the transaction stage and optimally adjusting these balances given the agents' histories of transactions. Agents can trade these balances against the general good in the centralized round which we model as a competitive market.[4] Having settlement of balances in the centralized round is essential since the first-best allocation cannot be supported in its absence.

Our model displays the following properties. First, periodic settlement in centralized rounds does not increase welfare by itself. The increase in welfare is accomplished indirectly through the interplay between settlement and intertemporal incentives. Second, the first-best is supportable only if settlement takes place with a sufficiently high frequency. Finally, PS participants exit the settlement stage with identical balances. In this sense, agents start afresh as their history does not affect their future transactions.

The reason for settlement being essential in achieving the first-best can be summarized as follows. In the presence of private information, in order for any transactions to take place, the PS must provide intertemporal incentives. This is costly and, in the absence of settlement, these costs can only be borne directly, creating a distortion during the bilateral transactions stage. Settlement allows accumulating and shifting these costs to the centralized stage. This is efficient since incentives in bilateral transactions can then be set properly. More precisely, under a linearity assumption, balance adjustments in the settlement round do not create direct welfare gains or losses on average. In addition, periodic settlement limits the obligations an agent can accumulate over time. Hence, when settlement occurs frequently enough, and the net value of future transactions is high enough, agents will choose to participate in the system.

---

[2] See, for example, Green [6]. Other classic references include Spear and Srivastava [22] and Atkeson and Lucas [2].

[3] See Kahn and Roberds [10,11] for two papers in this literature. Kahn [9] provides an excellent summary of the current literature and outlines some of the main open questions in PSs research. Temzelides and Williamson [23] contains a dynamic model of payments under private information. Their work is complementary to ours since it concentrates on the role of credit limits and insurance against the inability to settle transactions. See Berentsen et al. [3] for another recent dynamic model that involves banking and credit. Finally, Andolfatto [1] considers the role of record-keeping and of monetary exchange in an environment related to ours. None of these models, however, address issues related to settlement.

[4] A novelty of this approach is that it involves non-cooperative implementation together with a Walrasian equilibrium aspect.