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## **Electronic Money and the Monetary Transmission Process**

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# Chapter 1

## Introduction

One of the most influential developments within the 20th century has been the electrification of computation, communication and data processing. The associated technologies have transformed most areas of public and private life by speeding up traditional processes, reallocating time resources and fundamentally changing the resource constraints of most technical, social and economic systems. Within economics especially one development is of special interest for macroeconomic analysis: the tremendous reduction of all types of transaction costs: physical costs of transportation, the costs of disseminating information, costs for processing and analyzing information, etc. If one narrows the focus further to monetary economics, reductions in transaction costs have primarily affected the payments system, transforming it from a paper-based communication and exchange system with delays of days or more to a nearly real-time electronic, fully integrated communication network. One of the most recent developments in this field has been the implementation of payment media which are purely electronic and neither rely on any physical manifestation of the underlying value nor on a direct assignment to a liable side, either as an actual person or a legal entity. These payment media are often denoted as electronic money.

This thesis is dedicated to the attempt to analyze the consequences of these new forms of payment media for the links between a very special economic player, the central bank, and the macroeconomic developments of the entire economy. In general these links are discussed under the term transmission of monetary policy. Hence the central interest of the thesis can be refined as an analysis of the consequences of electronic money on the monetary transmission mechanism. In order to comply with this task there are generally two major steps within the analysis. First the phenomenon of electronic money is inspected and its most important economic characteristics are identified and analyzed. Secondly, the results of this analysis are used to study their effects on the transmission of monetary policy and the underlying reactions of economic agents using different economic frameworks.

In order to set the basis for the first step chapter 2 introduces the phenomenon of electronic money by describing its history, giving a concise definition, classifying it into differ-

ent subtypes, subsuming it into the broader payments system and differentiating it from the market for financial products, which evolved simultaneously, but satisfy different, even if related, needs and desires. In chapter 3 the knowledge attained thus far is used to identify relatively low transaction costs as the most important economic characteristic of electronic money. This is done by an extensive comparative cost analysis of the most common payment instruments and a brief examination of their regulation. Turning to the second step of the analysis chapter 4 uses microeconomic and partial equilibrium frameworks for studying the effects of transactions costs, or changes of those, on issues such as the demand for payment instruments, the strategic interdependence between consumers and merchants, the price setting behaviour of issuers and the complete market for payment media. Finally transactions costs and their variations are integrated into a general equilibrium setup in order to introduce in the main framework of the remaining analysis. Chapter 5 acts as an intermediate excursus, which provides a general overview over the actual state of the theoretical models and constructs of the monetary transmission mechanism and starts with a preliminary examination of the effects of sinking transaction costs on these constructs. Chapter 6 provides the basis and heart of the formal analysis. Therein transaction costs are integrated into a microfounded dynamic general equilibrium model of an economy, which is at least partially in line with the currently dominating New Keynesian model of a monetary economy. After exposing the structure of the model, the impact of decreasing transaction costs on the monetary transmission process is studied by comparing and analyzing the impulse responses of the model on several shocks in two different scenarios: before and after the cost variation. Additionally the effects in the transitional period are analyzed with the help of an appropriate shock experiment. Chapter 7 summarizes and discusses the results obtained from the analysis in the context of the related literature. Additionally it reflects on the consequences for the conduct of monetary policy. Finally chapter 8 concludes the main results, reflects on the limits of the analysis presented and gives an outlook for possible future research designs.

Before going on to dig deeper into the presented topic, it should be remarked that within the analysis several serious restrictions have to be made. In chapter 3 neither all types nor all brands of payment instruments could be presented and analyzed. Therefore the study is restricted to the most common payment instruments and the information with respect to new brands of electronic payment instruments is chosen from the best documented examples. A similar argument holds for the analysis of the regulatory environment for payment instruments. Herein the study examines the two greatest economic areas with a more or less unified regulatory framework: the Unites States (US) and the European Union (EU). And finally while presenting the current state of the theory of monetary transmission the study is again limited to the most widely acknowledged and most promising models and theoretical constructs. In order to explore more specialized topics the reader is recommended to use the frequent references to the literature as a starting point to related, but not fully discussed questions and topics.

# Chapter 2

## Electronic Money

### 2.1 The History of Electronic Money

The genesis of electronic money is closely related to the evolution of products and services within the financial and payment sectors of modern economies. In the last few decades this process has been driven by two particular developments: technological progress both with respect to processor and memory capacities and with respect to telecommunications. Both fields contributed to reduce the production costs of financial products and the costs corresponding to the asymmetric distribution of information within financial markets. Thus there were the deepening of the financial markets since the early nineteensixties, the electronization of payments in the nineteenseventies and the strong growth of the markets for financial derivatives since the middle of the nineteeneighties.<sup>1</sup> The second development in particular formed the environment for the rise of electronic money. Principally electronic transfers of money, or the right of disposal of money, were possible since the invention of the telegraph as the first electronic device for transmitting communication signals. But using data processing and telecommunication facilities for down-market payments had not been established before the mid-seventies, because the necessary computing capacities and telecommunication networks were not previously available.<sup>2</sup> In the aftermath electronic settlement systems were developed first for the interbank market, then for commercial clients and finally for consumers. The most important steps were the introduction of credit cards, debit cards and ATM's (automatic teller machines). In recent years services such as telephone and PC banking were added.<sup>3</sup>

Despite the development of the chip card in the early nineteenseventies,<sup>4</sup> electronic money as a payment instrument was introduced for the first time at the end of this decade. In 1978 the first stored-value card with a magnetic stripe was developed in Belgium. In the

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<sup>1</sup>Cf. Mishkin et al. (1999), p. 6ff.

<sup>2</sup>Cf. Sietmann (1997), p. 9f.

<sup>3</sup>Cf. Mishkin et al. (1999), p. 11.

<sup>4</sup>Cf. Good (1997), p. 6f.

early nineteeneighties a card with an integrated chip followed and at the same time the idea of a virtual substitute for cash, which was promoted especially by David Chaum, was born. In the last years of this decade the electronic payment by remote data transmission or the electronic cash procedure, for which operations started in 1990, became a reality in Germany.<sup>5</sup>

Since the mid-nineties an array of pilot projects testing multifunctional smart cards and net money were implemented and run by various syndicates and joint ventures. Examples in Germany include the GeldKarte of the Zentraler Kreditausschuss (association of German financial institutions - ZKA), the Pay Card of Deutsche Bahn AG, e-cash (Deutsche Bank) and CyberCoin (Dresdner Bank and Landesbank Sachsen). While the project GeldKarte was extended into the national standard, most of the other systems disappeared soon.<sup>6</sup> Similar experiences can be found in many European and non-European countries. Thus in all countries belonging to G10 there are smart-card systems in operation and in the majority<sup>7</sup> there are also internet payment services available. Recently smart-card projects were also found in the most important economies in Eastern Europe (Russia), Asia (China, India, Korea), Latin America (Brazil, Mexico) and Africa (South Africa, Nigeria). On the contrary, there are only in a few countries pilot projects for using virtual tokens as digital money within the internet.<sup>8</sup>

## 2.2 Electronic Money

In the discussion the terms electronic, virtual and digital money are used for relatively heterogenous bundles of products and services, which are used in order to satisfy the demand for payment services. In order to avoid an arduous and systematic classification of the term electronic money, which has already been achieved by others, we will use this term within the present study according to a modified version of the definitions given by the Bank for International Settlement (BIS) and the European Central Bank (ECB).

The BIS defines electronic money as a set of payment instruments, which are characterized by the facts that prepaid values are stored on an electronic device, that these instruments are accepted by a number of potential market participants, and that the stored values can be transported and/or transferred by means of mobile storing devices or through electronic telecommunication networks.<sup>9</sup> In principal the ECB defines electronic money in the same manner,<sup>10</sup> but adds explicitly that electronic money is a prepaid bearer instrument.<sup>11</sup> Both institutions emphasize the characteristics of electronic money as a technological innovation and a liability of private agents. They therefore distinguish

<sup>5</sup>Cf. Boehle et al. (1998), pp. 105ff., 120ff., Table 10.

<sup>6</sup>Cf. Committee on Payment and Settlement System (2000), p. 33f.

<sup>7</sup>More precisely those are Germany, France, UK, Japan, Netherlands, Switzerland and USA.

<sup>8</sup>Cf. Committee on Payment and Settlement System (2000).

<sup>9</sup>Cf. BIS (1996), p. 1.

<sup>10</sup>Cf. ECB (1998), p. 6.

<sup>11</sup>A bearer instrument represents a payment instrument, which is characterized by its capability to circulate anonymously.

between electronic money and the two payment media central bank money and deposits as well as alternative means of exchange such as credit, commodities, services or other wealth items. Additionally electronic or paper-based payment instruments such as credit and debit cards, cheques or electronic transfers of funds constitute a further category. Likewise excluded from the definition are private monies used within closed systems such as private barter rings, internal exchange schemes and customer loyalty schemes (e.g. Air Miles (Loyalty Management Group Canada) or Miles & More (Lufthansa)).

The emphasis on the character of electronic money as a prepaid value refers to two important facets: from the issuer's perspective electronic money constitutes a liability and in order to purchase electronic money one needs to surrender generally accepted liquidity in the form of another payment medium. Since electronic money is not issued by central banks, it joins deposits as a liability within the private sector and hence, belongs to the inside money of the economy.<sup>12</sup> This interpretation corresponds to the widely shared perception that electronic money constitutes a new form of deposits belonging to private banks within a two-tier banking system. According to the directive 2000/46/EC in Europe these deposits are covered by the duty for redeemability at par value into either central bank money or deposits.<sup>13</sup> Hence, electronic money gains the status of final liquidity, since it constitutes a legal claim on central bank money.

## 2.3 Electronic Money and its Components

In order to distinguish between different types of electronic money defined according to above various criteria may be employed.

Using the question, whether access to the electronic payment instrument is either based on software or hardware devices, net money can be distinguished from smart-cards.<sup>14</sup> While net money provides transactions via internet or other electronic networks, smart cards serve mostly as devices for physical use at the point of purchase. By using card reading devices and PCs they can be also used as a payment instrument in the internet. Thus the difference between these two types of electronic money is likely to diminish in future.<sup>15</sup> Turning to the form of the payment circuit, electronic money can be divided into implementation as a closed circuit, and as an open circuit.<sup>16</sup> While the first type refers to account-based net money and smart-cards with an obligatory clearing after each transaction, token-based net money and smart cards with the possibility to use the stored values for additional transactions without the mediation of a clearing instance, can be put into the second category.<sup>17</sup> According to this criterion exclusively electronic payment instruments or media belonging to the second type can circulate in terms of payment

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<sup>12</sup>Cf. Berentsen (1998a), p. 2.

<sup>13</sup>N.N. (2000b), p. 64. The full title of the directive is given in the bibliography.

<sup>14</sup>Cf. Stolpmann (1997), p. 25f. or ECB (1999), p. 14.

<sup>15</sup>Cf. Boehle et al. (1998), p. 142.

<sup>16</sup>Cf. Pauli et al. (1997), p. 9.

<sup>17</sup>Cf. Schmitt (1999), p. 9.

media.<sup>18</sup> Hence the openness of the circuit is a necessary characteristic of a money form. Thus substantial parts of the set of payment instruments currently discussed under the terms smart cards and net money are actually not included in the interpretation of the definition of electronic money given above.

Nonwithstanding its internal consistency this narrow definition of electronic money seems to be somewhat problematic, since it excludes a broad range of non-circulating, but pre-paid exchange media. This is despite the fact that these media constitute liabilities, which at least temporarily provide the possibility of financial intermediation characterized by very low costs. The resulting possibility for skimming away profits is a strong incentive for financial intermediaries to migrate within this business field. It seems quite unrealistic that the effects of monetary policy on the financial sector should not be influenced by this phenomenon. Due to this argument the current study subscribes to the view of Piffaretti (1998) that electronic money does not only comprise payment instruments within open circuits but also within closed circuits, for whose existence circulating payment media are not necessary. The last variant of electronic money is characterized by the exclusive issue for a distinct transaction and by its destruction within the clearing process. Hence it does not constitute a circulating payment instrument.<sup>19</sup>

Very closely related to the topic of an immediate clearance per transaction is the classification criterion of anonymity. Anonymity is severely obstructed by the exchange of information within the clearing process. The continuous nature of this criterion does not allow us to distinguish between different categories of payment instruments, but it does provide an interval to which different product variants can be assigned. Furthermore there is a trade-off between the reliability and the anonymity of a payment instrument,<sup>20</sup> because the reliability of the systems can be increased, with respect to both fraud and counterfeit, by the documentation of all transactions in so-called shadow accounts.<sup>21</sup> Indeed blinding techniques<sup>22</sup> offer some possibilities to reduce the effects of this trade-off, but in general the problem remains unsolved.

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<sup>18</sup>Cf. Boehle et al. (1998), p. 145. Deposits can circulate inasmuch as cheques are valid claims and can circulate as bearer instruments.

<sup>19</sup>Cf. Piffaretti (1998), p. 8f.

<sup>20</sup>Cf. Prinz (1999), p. 17.

<sup>21</sup>Boehle et al. (1998), p. 159.

<sup>22</sup>Blinding denotes a procedure in which electronic units of value are generated by the customer's PC, are attached with a randomly generated serial number, are encrypted by the use of some cryptographic techniques and sent to the issuer, which adds his digital signature and returns it to its client. This one removes his encryption and uses the value unit, which is now characterized by its serial number and the signature of its issuer, for transactions. As long as the user of the unit, i.e. the purchaser, does not reveal his identity, anonymity is secured by this method. Cf. Chaum (1997), p. 97.