Problems and Promise of Smart Cards in Taxation

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Revised July 2008

Abstract

The potential impact of smart cards is examined in the context of a standard model of direct and indirect taxation. The distinction between the two types of tax is made in terms of the information required to implement them. Electronic cards in general are understood as devices for enriching and certifying information related to individuals and transactions. Smart cards are a subclass of these that may perform additional functions including dynamic updating and linking of disparate datasets.

1 Introduction

Administrative issues do not usually make for exciting economics. They usually fall into the forgotten footnotes of scholarly articles that are primarily concerned with grander visions of economic mechanisms. A discussion of the possible impact of developments in information technology for the implementation of government policy might seem to fall into that category. However, it is also possible to identify key innovations in recent history that have become, not just background items in a more interesting economic story but, indeed, the story themselves.

So, within the context of tax policy, is the "smart card" a convenience in doing something a little more effectively than we already do it, or is it potentially a dramatic new opportunity? In this paper we examine some of the economic arguments that bear on these questions drawing on the standard analysis of direct and indirect taxation. The principal focus is on some fundamental informational constraints in the implementation of optimal tax systems – do smart cards hold the promise of alleviating any of these constraints? However, although, the argument is simply from a conventional economics perspective I do not wish to underestimate the potential contribution to the discussion from related fields such as accountancy and law.

2 Cards: Smart and not-so-smart

At the outset it is as well to try to develop a taxonomy of the kinds of cards that we are talking about. What should we assume that they can do?

Let us say a word about non-smart cards first . In their certification role dumb cards may have considerable promise and may assist in overcoming a class of information problems that we shall review in section 5. However we should acknowledge that their contribution could be achieved in other ways – paper documents such as identity cards or passports, biometric records, tattoos. We may leave open a number of questions that could be relevant to economists, lawyers and administrators, such as the visibility of the information and the degree of compulsion in use of the card. Effective certification clearly could make a major contribution in terms of tax administration and possibly in terms of enforcement but, in one sense, it is nothing new.

If we want to discuss *smart* cards, then what do we mean by "smart" and what more might smart cards do? The focus presumably ought to be on "smartness" in the encoding of information that is potentially useful in tax design. Let us distinguish three ways in which the encoding can be said to be smart:

- *Quantity of information.* In a snapshot sense it can appear to offer considerable precision. It is clearly a lot more convenient than having something tattooed on your forehead. But in essence it is not really doing anything different from a dumb card, just doing it more intensively and comprehensively.

- *Automatic updating.* A natural extension to the basic idea of the first smart-card role. It can work in either or both of two principal ways. The first of these takes account of the potential changeability of exogenous information: what makes the smart card smart is its adaptation to new circumstances. The second way it can update itself is in recording the bearer's decisions and choices. Here the card acts as a small computer database. Again the role is foreshadowed in old-fashioned paper records: as an example think of endorsements to a driving licence triggered by a traffic offence.[1]

- *Information linking.* The third smart role for a card is as an electronic master key. The card itself does not carry the data-base but is a conduit of approach to official confidential databases. We will return to this issue in section 5.

I suggest that the key distinction is not whether cards are dumb or smart but whether cards are static or dynamic. In the static case the role of the card is summarised in an electronic statement: "this certifies my characteristics:" it is just the electronic tattoo and it may be convenient for both individuals and officials. However dynamic cards could perhaps achieve something more subtle. Their mission statement is something like: "this certifies the history of my transactions" or "this certifies the history of my characteristics," or perhaps both statements combined.

As we will see, all three versions of smartness are of potential interest in questions of tax design. Some of them appear to present a considerable challenge.

3   Questions about taxation

In order to examine the potential of smart cards let us briefly review how taxes work.

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[1]There is even a "tattoo" analogy. Consider the ink stamp that is sometimes used to certify entrance to a night club or the fact that you have voted.

3.1 Taxation: necessity and objectives

Let us begin with two basic questions, the answers to which may seem rather obvious.

First, why do we have taxes? There are, broadly speaking three principal reasons advanced in the literature.

1. There are socially desirable goods that cannot be charged for and the funds to provide these have to come from somewhere. The classic example of this is the provision of national defence.

2. There are cases where price manipulation is in the public interest, to correct market "distortions."[2] Examples of this are the use of taxes to achieve environmental objectives or to offset other effects of consumption and production externalities.

3. It may be considered appropriate to use fiscal measures to implement other forms of social engineering; this often involves manipulating the distribution of income or of spending power.

Second, what economic principles should guide the design of taxes? The conventional list of criteria consists of allocative efficiency, distributional equity, effective administration.

These two questions are relevant for understanding the potential for smart cards. Cards could, in principle, have a role in all three taxation roles cited in the response to the first question. However while it is clear that technological improvements embodied in cards could potentially improve the effectiveness of tax administration the case remains to be made as to whether there is a similar advantage in respect of the efficiency and equity objectives.

3.2 Tax types and information

Now a less obvious question, also relevant for cards. Why is there a separation between direct and indirect taxation and what is the nature of the separation?

This is not just a matter of labelling nor of administrative convenience.[3] A more fundamental reason lies in the structure of information associated

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[2]These are usually characterised as Pigovian taxes.(Sandmo 1975)

[3]In some jurisdictions it may be the case that different government departments or agenciues are responsible for direct and indirect taxation. This used to be the situation in the UK, with the Inland Revenue largely responsible for direct taxes (income tax, capital gains tax) and Her Majesty's Customs and Excise responsible for indirect taxation (value added tax, excise duties). From 18 April 2005 they were combined in Her Majesty's Revenue and Customs.

with each broad type of tax and the scope for the shaping economic incentives. Put simply: what is a government agency allowed to know, or what should a tax-modeller assume that it be allowed to know? In the case of direct taxes the appropriate assumption is that the tax agency is well informed about the attributes and circumstances of individual persons, including their income; but there is severely limited detail as to the disposition of personal income across alternative expenditure categories. In the case of indirect taxes the agency is well informed about broad classes of transactions, by commodity group, by industry sector, perhaps by firm; but detail on purchases by individuals may be restricted.

This discussion leads to a crucial further question: are both types of tax necessary? As we will see below (section 4.2) if we follow the standard economic theory of taxation there is strikingly direct answer to this question. One issue that we need to examine is whether the presence of the smart card is likely to modify the answer to the question.

3.3 Taxes in practice

Before we develop this analysis using a proper model let us also review the way that taxes work in practice Let us take an illustrative example from the UK, focusing on the broad categories direct and indirect taxes. The UK case is not particularly special but the data happen to be easily obtainable and interpretable.

Figure 1[4] demonstrates the principal stylised facts about the effective incidence of taxes. The method underlying the figure ranks households by equivalised disposable income and uses this ranking to form ten decile groups; direct taxes[5] can be added back into the disposable income for households in each group in order to derive gross income of each group; indirect taxes[6] can be imputed on the basis of actual expenditures and deducted from disposable income in order to derive post-tax income. The Lorenz curves for the three distributions (gross, disposable and post-tax income respectively) can used

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[4]Source: UK Office for National Statistics – see Jones (2007). This is a continuation of a series that used to be published annually in *Economic Trends* (see, for example Jones 2006) but is now available only on line. The primary data source is the UK's annual Expenditure and Food Survey covering about 7,000 households,

[5]Covers personal income tax income tax, employees' National Insurance contributions and Council tax and Northern Ireland rates

[6]VAT, excise duties (on alcoholic drinks, tobacco, petrol, oil, betting), customs (import) duties, motor vehicle duties, air passenger duty, insurance premium tax, driving licenses, Television licenses, Stamp duties, fossil fuel levy, payments to National Lottery Distribution Fund.
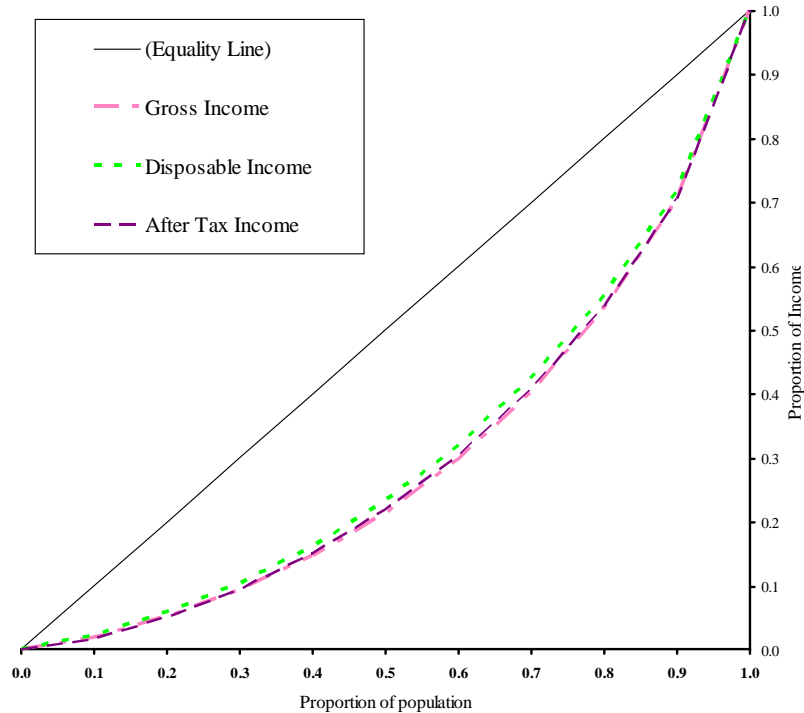
Figure 1: Effects of tax on income distribution: UK 2005/6

to give a snapshot of the impact of the two types of taxes.[7] It is clear that the Lorenz curves for gross income and after-tax income almost coincide while the Lorenz curves for disposable income lies "inside" the other two, although not a long way inside.[8]   The interpretation is that (1) direct taxes have a moderately egalitarian effect that is (2) almost wholly offset by indirect taxes.   Direct taxes are mildly progressive in practice; indirect taxes mildly regressive.[9]

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[7]Clearly the method involves some rather crude incidence assumptions and neg;ects the role of taxes on intermediate goods – see Dilnot et al. (1990).

[8]The relevant Gini coefficients are as follows:

Gross income	0.407
Disposable income	0.379
Post-tax income	0.403

[9]In the example here indirect taxes are principally in the form of VAT; but the result on regressivity in practice applies to other types of indirect tax (Keen 2007)

Figure 2 presents the implied average tax rates in terms of actual income reductions by direct (respectively indirect) taxes at different positions in the income distribution; the direct tax rate is computed by taking the direct taxes paid by those in a particular decile group and dividing by the gross income attributable to that group; likewise the indirect tax rate is computed by taking the indirect taxes payable on the expenditures incurred by those in a particular income slice and dividing by the group's gross income. It is clear that the average tax rate for indirect taxes (broadly) increases with income, which follows from the Lorenz-curve evidence; it is also clear that there has been very little change in the pattern of effective tax rates over recent years.[10]
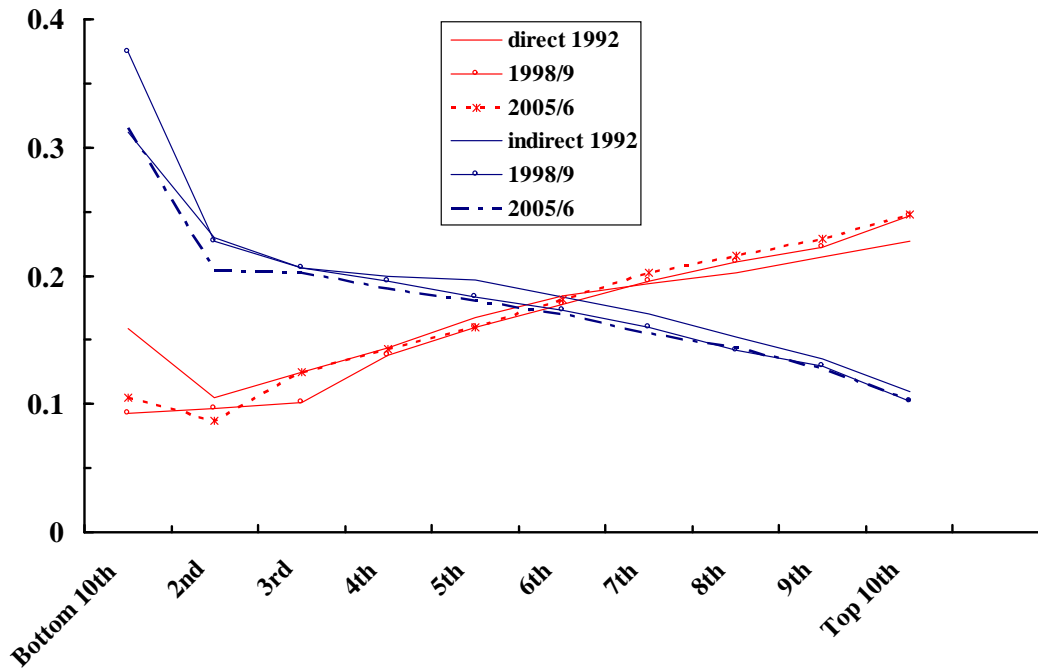

Figure 2: Implied Tax Rates at different positions in the income distribution. Direct and indirect taxes UK 1992-2005/6

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[10]If one were to present the average tax rate calculations with respect to disposable income (rather than gross income) a similar story would emerge but of course the tax rates would be higher.

4 Taxation: an approach

To set out the framework for discussion let us examine a very simple economic model of the personal income taxes and commodity taxes. We will use this to review some of the received wisdom on taxation and to construct a framework for an economic discussion of smart card innovation.

4.1 Model outline

We imagine an atemporal world where there are exactly n separate commodities all of which are supplied through the market and all of which could be taxed; the term "commodities" includes not only physical goods but also services. The assumption that one can sharply distinguish different types of commodities is itself a strong one: innovation and product diversity usually mean that the boundaries between commodities is rather blurred; so it may be quite tricky introducing and enforcing indirect taxes that, say, have different rates on different commodities. However, making made that assumption, the tax-inclusive consumer prices of commodities $1, 2, ..., n$ are the publicly known values $p_1, p_2, ..., p_n$. Individual i has a single income source and is endowed with a given amount of income y_i; he buys quantities $x_{1i}, x_{2i}, ..., x_{ni}$ of the commodities at the given prices. In the standard version of the story individual i's decision is made in such a way as to maximise his utility – a function of the quantities bought – subject to the budget constraint

$$p_1 x_{1i} + p_2 x_{2i} + ... + x_{ni} \leq y_i \tag{1}$$

Taxation works in this model by altering the budget constraint of each individual i. In the standard story it does so in one of two ways:

- *Direct taxation.* Use information about personal circumstances to reduce the individual's income y_i below its value in the absence of income tax, y_i^*. Neglecting possible income-reducing behavioural responses on the part of the taxpayer that would modify y_i^*, this yields a tax revenue $y_i^* - y_i$.

- *Indirect taxation.* Use information about commodity types to push up the price of some of the commodities from their free-market values $p_1^*, p_2^*, ...p_n^*$. Neglecting possible market responses in the background that might adjust these free-market values as the tax is altered, this yields for example a tax revenue $[p_1 - p_1^*] x_{1i}$ from individual i's purchases of commodity 1. If tax policy changes individuals will modify their choices of the amounts of goods in response to the changed price signals.

Let us use this as a basis for discussion of different types of taxation and the ways in which smart cards might work.

4.2   How it works

The literature on the economics of taxation provides a number of clear-cut results within this framework. The particular attraction of the approach is that it is parsimonious in its informational requirements: in the main it does not require detailed information concerning the transactions of Irene (person i) and Janet (person j) for commodities 1, 2, 3,..., rather one uses information about the total transactions in each commodity. However, as a preliminary point let us note that this version of the model is seriously oversimplified, in that, if it is pushed too hard, it will yield nonsense results. The oversimplification is in at least two respects.

First, the description of income tax will not do. This version makes no allowance for behavioural response on the income-generating side. Because of this the income tax in the model has become, in effect, that Philosopher's Stone of taxation policy, a poll tax. Taking this at face value it means that the objectives of the tax system can be achieved with a very simple personal levy on each individual. This does not seem to accord with common sense and is, perhaps, a blind alley in terms of economic insights.

Second, the commodity-tax system itself is in some sense overdetermined. Suppose, for the moment, we rule out direct taxation and allow only commodity taxes. The story has (so far) not imposed any restrictions on the range of commodities that are taxable: what if we assume that all commodity groups are taxable? Then we have reinvented the problem of the previous paragraph: for any given amounts of the commodities if all the prices in equation (1) were doubled the effect on the problem would be exactly equivalent to halving income (Atkinson and Stiglitz 1972). We are back to the Philosopher's Stone.

In public economics there are standard routes for avoiding these modelling traps. First one needs to assume that there is at least one commodity that, because of legal restrictions, administrative cost or informational problems is not taxable. Then if one is just concerned to examine the structure of commodity taxes, the required get-out device is to assume that income is not taxable. If one wants to analyse the structure of both income and commodity taxes simultaneously then it is conventional to assume that income can be modelled as a function of labour, so that one replaces a fixed y_i^* in the basic model with something like

$$y_i^* = f_i\left(L_i\right);\tag{2}$$

in this modification i chooses labour L_i in the light of personal preferences for leisure and objective circumstances, but that leisure itself cannot be treated as a taxable good (Atkinson and Stiglitz 1976). The "objective circumstances" cover the labour-market opportunities that i faces, taxes that affect the price of leisure and taxes that affect the price of other commodities. So, both direct and indirect taxes will have an effect on taxable income through the relationship between income and labour supply f_i. What do we know about the way taxes should be set? Let us suppose for the moment that we are not concerned with taxes in their role of offsetting price distortions (motive 2 mentioned above on page 3). Then we have the following rather clear-cut results for the different variants of the standard model.
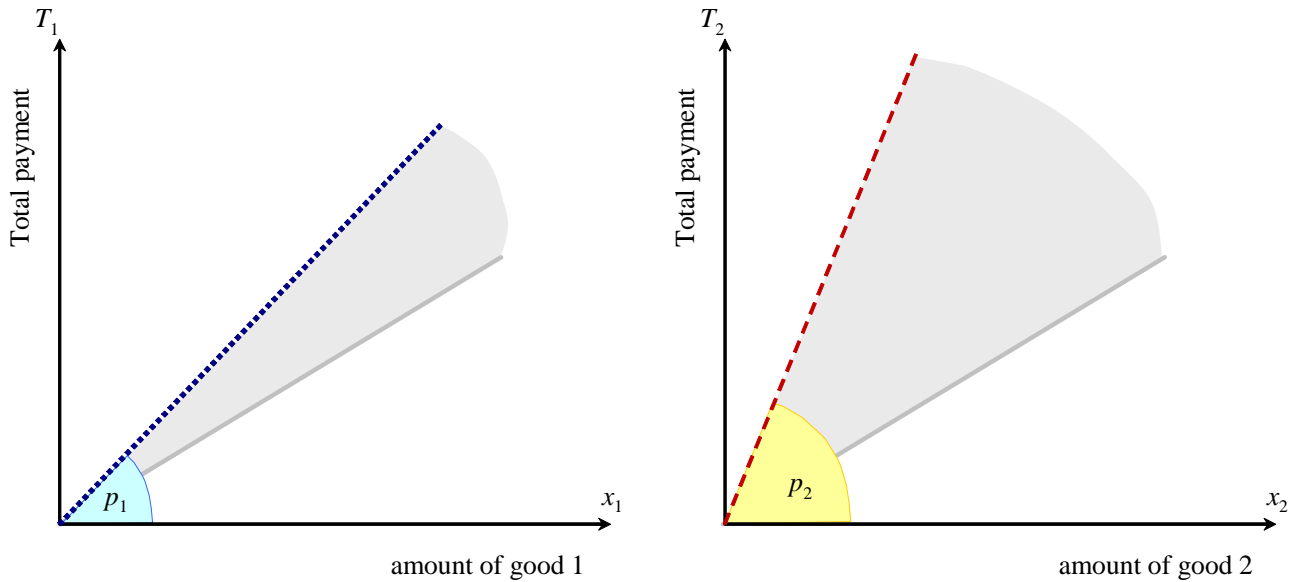

Figure 3: Consumer prices differing across goods

Indirect taxes in isolation. In the commodity-tax-only problem the issue becomes one of how great a "wedge" should be forced between the market price and the consumer price: there will be different regimes for different classes of consumption goods. Figure 3 illustrates the idea: the horizontal axis in each panel measures the quantities of good 1 and good 2 respectively and the vertical axis represents the total amount that the consumer has to pay; the solid line in each panel represents the free-market situation and the broken line is the situation facing the consumer once the commodity taxes are introduced; the vertical distance represents the revenue raised by the tax

wedge. If the objective is solely to raise revenue in the least distortionary way[11] then the standard result is that one should have higher tax rates on commodities for which the demand is, in some sense, less responsive to price – the so-called "Ramsey rule" (Coady and Drèze 2002).

One effect of this rule is that, because necessities are typically less price-elastic and necessities are consumed disproportionately by the poor, the "optimal" tax rates across different commodity groups will accentuate the regressive nature of indirect taxation. Of course the setting of the tax-optimisation problem can be modified (at the cost of some considerable complexity) to incorporate concern for distributional equity but the resulting tax rules are not particularly transparent.

Direct and indirect taxes together. In the problem with both types of tax a remarkable result can be established. Suppose that individuals differ in terms of their objective circumstances but not in terms of their tastes[12] and also that tastes for commodities are "separable" from tastes for leisure (roughly speaking, your marginal willingness to trade apples for bananas is independent of whether you work a lot or a little). Then whatever, the government's equity objectives and revenue requirements, the optimal direct-cum-indirect tax problem puts all commodity taxes to zero and raises everything through income tax (Atkinson and Stiglitz 1976). Actually the result is even stronger than that: there appears to be no role for taxes on commodities, even if the income tax structure were not optimally designed (Laroque 2005, Kaplow 2006).

In the light of this why do we not just dump everything on to the income tax? It would certainly make the tax-administration issue more straightforward in that one or more major databases need no longer be maintained, far fewer items of time-sensitive information need to be updated and the number of employees in tax agencies could be slashed. As a consequence the coding of taxation smart cards could be a lot more straightforward. An effective tax system need just have information on people's circumstances and incomes, not on their market transactions. The theoretical result has been around in

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[11]This is a loaded expression. The minimum-distortion problem is set in the context of a single representative consumer. The commodity taxes are adjusted in such a way as to maximise the consumer's utility subject to raising enough revenue to cover an exogenous revenue requirement and the quantities of goods are selected by the consumer in response to the tax-inclusive prices. It is the adoption of the representative-consumer model that leads to the striking outcome of a regressive tax structure.

[12]This means that the income function f_i in (2) will differ between Irene and Janet (persons i and j) on account of Irene and Janet commanding different wage rates in the labour market, not on account of Irene being laid back and Janet a workaholic.

the economics literature for more than thirty years but there is little sign that governments are in a hurry to do away with indirect taxes. Why should this be and what are the implications for technological innovation in tax administration? There are several possible reasons:

- *Divergence between model and reality.* As in nearly all economic theorising the model introduces some sharp restrictions in order to get sharp results. If one were to assume that preferences for commodities are not separable from leisure, or that they are heterogeneous across the population then, of course, the result does not hold (Cremer et al. 2001, Mirrlees 1976, Saez 2002). However, this does not seem to me to be a very strong point: relying on the fact that the real world is complicated is not necessarily a good argument for making the tax administration complicated.

- *Efficiency arguments for price manipulation.* If we bring motive 2 for taxation into the argument then clearly there is a role for commodity taxes. An economic case can be made that everyday consumption activities such as drinking, smoking, driving create negative externalities that require correction through regulation or through fiscal mechanisms. Even though these points are sometimes taken very seriously by citizens and governments – consider popular discussion of "green" taxes in connection with environmental issues– they are clearly not the whole answer.

- *Political-economy reasons.* It may well be in the interest of powerful interest groups to prevent a substantial shift from indirect to direct taxation, but that is beyond the scope of the present discussion.

- *Paternalism.* It is sometimes the case that governments want to influence individuals' consumption patterns for paternalistic reasons – the case of merit (or demerit) goods. Indirect taxes are a convenient way of doing this.

- *Administrative reasons.* This may be connected with the previous class of reasons. Governments are always likely to be strongly attracted to the power of indirect tax as a mechanism for raising revenue and it would probably require something much stronger than abstract economic reasoning to provide a countervailing force to this attraction. At a deeper level one may suspect that there is some unease about the adequacy of the information content of direct-tax databases. Reporting problems including wilful noncompliance and legal loopholes may undermine the effectiveness of income tax and other similar instruments.

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A cautious government could be expected to retain both direct and indirect taxation as a kind of belt-and-braces policy.

In the light of these considerations, particularly the last one, we might reasonably pose the question whether improvements in information technology could help resolve the issue.

5   Smart cards: Modifying the model

The standard model set out in section 4 uses a very rigid informational setting. The direct-tax component assumes that reported income is a reliable signal of personal taxable capacity. The information content of basic commodity tax scheme illustrated in Figure 3 is limited just to product standards – no personal data are required. Let us consider some ways in which the model might be modified to take account of technological innovation in handling information.

5.1   Tagging

Let us begin with the direct-tax part of the model. One of the reasons why we rely on income taxation is the near infeasibility of sensible lump-sum taxes. There is an incentive-compatibility constraint that is central to the design of direct taxes: one would like to be able to impose taxes that correspond to some given, innate taxable capacity such as earnings capability; if you cannot do that you link the tax to an observable quantity such as income but, to be effective, you must do this in such a way that high-ability Irene does not have an incentive to masquerade as a low-ability person like Janet in making her choice of labour supply L_i (equation 2). This incentive to masquerade could be weakened – the incentive-compatibility constraint could be loosened – if it is possible to "tag" people according to whether their observable characteristics place them in some relevant group or groups (Akerlof 1978, Slemrod 2006) – a form of electronic tattoo corresponding to group membership. To be useful for tax design the group characteristic should be related to taxable capacity. However, it is not immediately clear that there is much role for a smart card – it appears that the role could be performed quite well by dumb cards, albeit dumb cards with lots of stuff on them.

5.2 Personalised prices

Now consider the way in which the basic model might be modified in terms of indirect taxation.

First, let us relax the assumption that every consumer of a particular commodity has to pay the same price for it. Dropping this assumption raises some questions of procedural equity – should men pay more for hairdressing services than women? should the elderly pay less for bus travel than the non-elderly? – but here we want to consider the desirability of "personalised pricing"[13] as a practical instrument of tax policy and the scope for implementing it.
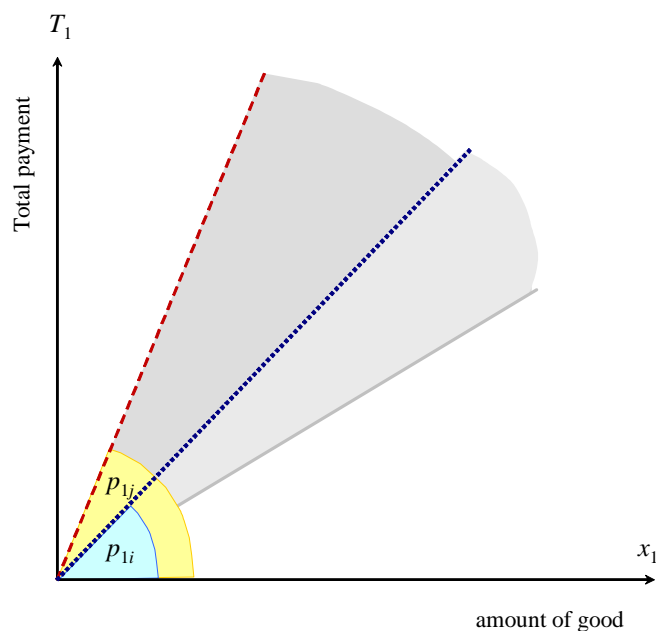

Figure 4: Personalised prices

Figure 4 illustrates the idea and although, at first glance it looks rather like the two panels of Figure 3 sandwiched together, the economic issues are fundamentally different. In Figure 3 there were price differences across categories of goods 1, 2, 3,...; by contrast in Figure 4 Irene and Janet are each potential purchasers of the same commodity (good 1) but they are confronted by different price schedules – see the broken lines with slopes p_{1i} and p_{1j}; of course the free-market price of the commodity is the same whoever consumes

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[13]I use "personalised pricing" as a convenient label even though the prices may just differ across groups of persons rather than across individuals.

it (see the solid line in Figure 4) so the tax rate on commodity 1 is higher for Janet than for Irene. We now have systematic variation in price-distortions across individuals rather than across commodity groups. What would be the economic case for considering this kind of arrangement?

Clearly there are cases where the may be an argument for personalised pricing on *efficiency* grounds alone. For example, it may be that young people like Janet create more negative externalities through drinking alcohol than do middle-aged women like Irene, so perhaps the tax on alcohol ought to be higher for them. The efficiency argument will work rather like the standard practice of insurance companies that sort people into risk classes and charge higher rates to those in higher risk classes: young Janet will likely pay higher motor-insurance premia than older Irene for example.

But if, for reasons of political expediency or administrative convenience, the indirect taxes must be maintained in a pure revenue-raising role, could a system of personalised pricing also achieve taxation objectives other then efficiency? Could it be tweaked so as to deliver distributional *equity*? Clearly if equity objectives are interpreted in terms of well-defined, observable and certifiable personal characteristics then only a small modification to the risk-class story is required (Ainsworth 2006b, 2006c). High-needs Irene pays a lower price (is charged a lower tax) then does low-needs Janet. As with the direct-taxation argument for tagging we could use an electronic card to provide lower prices for persons in need than for others. But, again they only need to be appropriately coded dumb cards.[14]

However, if it were desirable to capture distributional equity in terms of income, or income-related information, then there could be a role for truly smart cards. The "smartness" feature here is that of information linking: it appears that the prospect arises of the commodity-tax designer having access to the same rich information sources as the income-tax administrator.

5.3 Quantity-sensitive prices

Truly smart cards could potentially do more than just encode lots of information about personal characteristics; but should they? For example there may be a case on grounds of economic efficiency for implementing nonlinear payment schedules for certain types of goods and services[15] and the ques-

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[14]Of course we could also use the same device to achieve a tax objective other than equity such as the paternalistic motive mentioned in Section 4.2. This might, for example, be the real reason for charging young Janet a higher price for alcohol.

[15]The classic example of this is where the production conditions of a public utility are such that it is effectively a natural monopoly (there is a substantial fixed-cost component). An efficient charging scheme or tariff can be designed that involves a flat fee – an entry fee

tion arises whether they may also be a case to be made on the grounds of distributional equity.
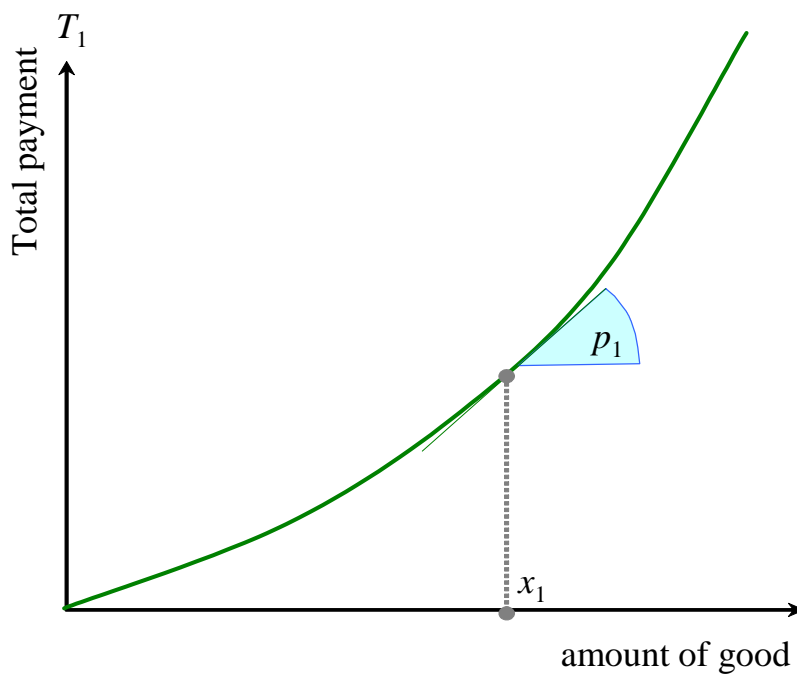

Figure 5: A non-linear payment scheme

In the design of commodity taxation one could consider the possibility of having "progressive" payment schemes such as that illustrated in Figure 5: here the average payment per unit of good 1 and the marginal payment (p_1) rise continuously with the amount bought, x_1. In contrast to the situation in section 5.2 we have price variation by quantity bought rather than by person. An electronic payment card that is smart in the sense of being self-updating would, in principle, enable you to do this   because previous transactions during a specified charging period could be recorded on the card. But would it be worth while doing this?

On pure efficiency grounds the marginal payment should be equal to the marginal cost of production, whoever is doing the consuming. So in this

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to the market – and a charge per unit actually used. The unit usage charge is set to the marginal cost of providing the service by the public utility, so as to fulfil the conditions for allocate efficiency; the sum of the fixed fees charged to customers is sufficient to ensure that the firm can cover its costs. The schedule is considered nonlinear because of the combination of the flat-fee and unit-charge components of the tariff: high-usage consumers will pay a lower average price than low-usage consumers.

respect the complex non-linear scheme depicted in Figure 5 is not really very clever.
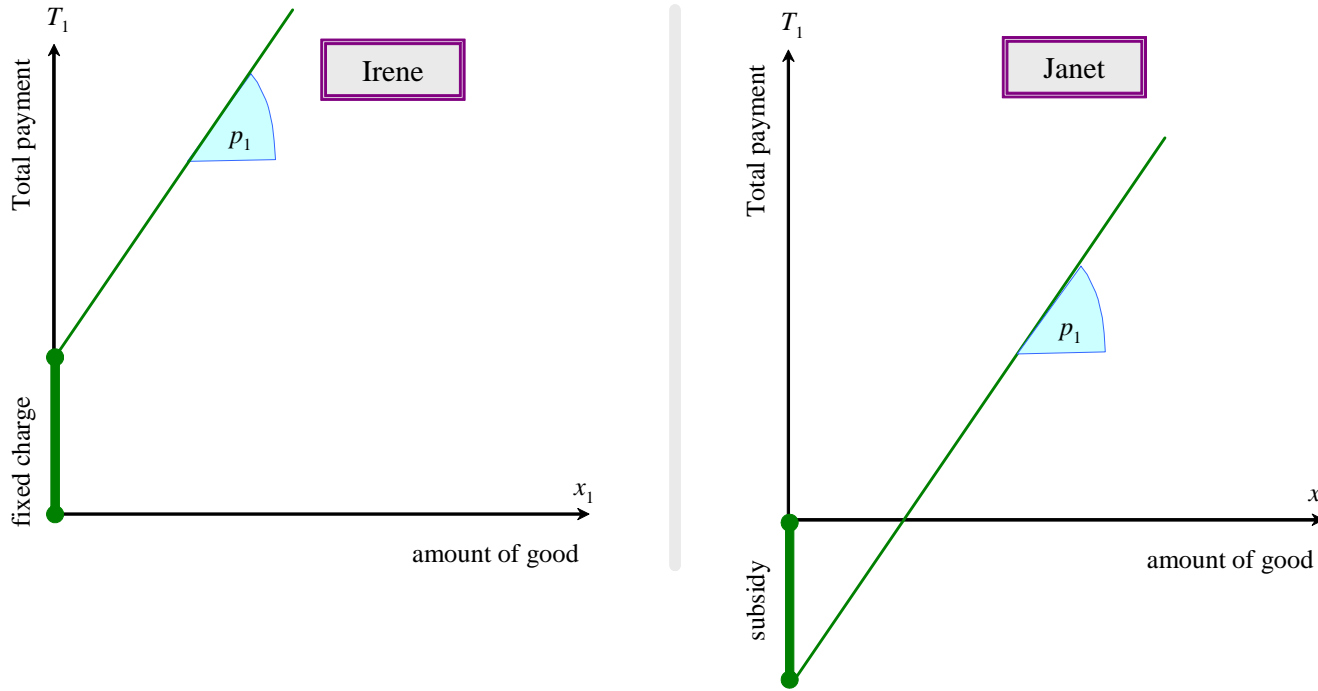

Figure 6: A simpler (and smarter?) non-linear payment scheme

However, the point about efficient pricing does not preclude there being a "flat" component of payment which may be tailored to the characteristics of the purchaser. Consider the alternative non-linear payment scheme depicted in the two panels of Figure 6. In both panels the marginal charge per unit of the commodity is constant at p_1. In the left-hand panel Irene also has to incur a fixed charge before being allowed to buy units of commodity 1 in the market and the fixed charge could differ from one consumer to another. Indeed there is no reason why this flat component should be positive: the right-hand panel of Figure 6 depicts the case where Janet actually receives a subsidy on entry into the market for commodity 1. Presumably a smart card that is updated for each transaction could keep track of payments for and purchases of commodity 1 for any given consumer.

6   Implementation

Some aspects of the argument about implementation appear to work overwhelmingly in favour of personalised cards, whether or not they are smart. In my opinion the potential implementation advantages lie principally in three areas.

First, if implementation of some part of the tax code essentially requires little more than a verification of personal identity then card technology offers a tremendous opportunity in terms of administrative cost. The administrative cost advantage over older technologies with centralised records may appear to be maintained even when slightly more is required from the card than a simple identity check. For example, one could have a government identity card with very little on it used that is used as a guarantor for a number of proxy cards with specialised functions, including taxation. However, once one moves to more sophisticated uses of information, the opportunity may not be fully realised in practice, unless there a substantial investment in personal and corporate software development that permits true interoperability and networking.[16] The potential cost advantage may be lost by simple function creep.

Second, smart-card technology can permit an important shift of power regarding the use of personal information. Because an electronic card, even if not truly "smart," permits the relocation of part of the database from a central computer to something that is in a person's possession, the control of the information remains with the individual who has rights over the information – at least in principle. The potential for greater privacy and more effective security of information presents an opportunity to the tax administration for enhancing taxpayer satisfaction. Implementing this level of taxpayer privacy would be virtually impossible without a technology that did not incorporate personalised cards in some form.

Third, the feasibility of distributed information may have potential advantages in reducing the possibility of the evasion of taxes on consumption. In many countries the switch to the chip-and-pin system for regular credit card transactions has seriously reduced the problem of credit-card fraud by retailers. A similar case can be made for combating tax fraud. [17]

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[16]For example Italy can be considered as leading Europe in the adoption of electronic cards for personal identification (Ainsworth 2006a, p. 19). However, there has been limited success in terms of reducing corporate and state bureacracy for reasons such as software incompatibility, so that the hoped-for "electronic revolution" has not really happened. See *Corriere della Sera*, 10 March 2008: "Stato digitale, rivoluzione a metà. Burocrazia, fisco, sanità: Vantaggi e occasioni mancate" – http://archiviostorico.corriere.it/2008/marzo/10/Stato_digitale_rivoluzione_meta_co_9_080310070.shtml

[17]As an example see Ainsworth (2008)'s discussion of the use in Germany of card tech-

However, these potential advantages might not be fully realisable in the light of the economic mechanisms discussed in section 5. The possible problems are dealt with in sections 6.1, which deals principally with questions relating to the implementation of smart cards in commodity taxation, and 6.2, which deals with broader issues of personal identification.

6.1 Voluntarism and participation

Even with truly smart cards, can smart schemes really be implemented across a broad range of commodity taxes as well as personal taxes? There is obviously a raft of issues in social policy, law and public administration that bear on this question, but let us focus primarily on economic issues. Taxation smart cards need not, perhaps should not, be things that are imposed on unwilling subjects of an authoritarian state. Rather they should be considered as part of a service provision that is subject to normal economic incentives. If one were to assume, explicitly or implicitly, that citizens are compelled to use a particular payment medium then one would be falling into the same kind of intellectual trap as assuming that a new tax would be exempt from compliance problems.

In some respect the problem is similar to the familiar problem of take-up of social benefits.[18] A primary component of the take-up problem is the phenomenon of social stigma[19] and it is unclear whether a smart-card would prevent or present this: on the one hand the widespread use of a uniform-format plastic card prevents your being easily identified as needy by your fellow citizens; on the other, the personally coded transactions details presents your needy status automatically at every checkout till. A second component of the take-up problem, commonly characterised as financial exclusion, may be less tractable. Some of the low-income population and the needy – the elderly, those who are not literate – are not at ease with technology. They live from week to week; they budget for the rent, the electricity and the phone by putting money in jam-jars.[20] If the voluntarism principle is to be applied to the "smart" implementation of indirect taxes, then it has to respect how people choose to do their trading and to take account of the

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nology rather than minicomputers in cash registers (p. 30).

[18] See for example Currie and Grogger (2001) who discuss the use of Electronic Benefit Transfer cards in the Food Stamp Program in the U.S.

[19] In the UK context this has manifested itself in terms of poor take up of the provision of welfare milk, free school meals, vouchers for asylum-seekers.

[20] As an example, the UK government's desire to pay welfare benefits into bank accounts rather than in cash via post offices ran into a fundamental difficulty: not everyone has a bank account.

true transactions costs that may apply to those individuals who are being targeted (Currie 2004).

If there is self-selection of the payment medium would there be a voluntary take-up of smart-card technology? The perceived benefits of using a smart card clearly include convenience and privacy; the card is convenient because it eliminates the need to visit the office of a government agency to get a discount voucher; it preserves privacy because the details required for implementing the tax rule can, in the main, be coded on the card rather than residing on a centralised database. Clearly, a standardised transactions methodology could exploit these perceived benefits and could be built on the same lines as the voluntarily adopted electronic payment schemes used for public transport and mobile phones. The challenge presented by this design issue should not be underestimated, but there is evidence that the take-up issue of can be resolved through making services associated with this type of card attractive: an example is the widespread acceptance of a card providing age-verification for tobacco-vending in Japan (Ainsworth 2006a, p. 24).

Voluntarism in trading is also present in a further problem of implementation of commodity-tax cards that is already well known from the problem of public-utility pricing.[21] Not all commodities are well suited for non-linear payment schemes. If it is possible to resell the commodity easily then the voluntary migration to a secondary or parallel market conducted in cash will undermine the sophisticated non-linear scheme, even if mediated by the use of smart cards. Similar arguments apply to schemes that attempt to introduce personalised prices. Here again free-market forces may erode the effectiveness of an otherwise cleverly designed scheme: whether this is likely to happen depends on the characteristics of the commodity in question. Low erosion commodities where taxation smart-cards could be implemented include personal services such as legal advice and medical care (Ainsworth 2006a, p. 12). By contrast high-erosion commodities are never going to be suitable for smart-card commodity taxation; these consist of simple non-branded goods that would lose little of their value on resale (as an example think of , like office consumables). However, it would not be appropriate just to think of the problem as one of classifying goods and services into low-erosion and high-erosion classes and to use this static classification as a basis for personalised prices implemented through smart-cards. The overall erosion problem is likely to be exacerbated by consumers' substitution of lower-erosion for higher erosion commodities to achieve the same or similar outcomes for themselves: as an example computer hardware and software

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[21]See note 15 above.

might be substituted for accountancy services.[22]

6.2 Tags and time

The use of smart cards in either direct or indirect tax schemes relies on there being reliable and usable personal data as indicators of needs or desert in the context of tax design. Whether it is reasonable to assume that this is the case evidently depends on the type of personal indicator or tag.

For some dimensions of personal attributes – male versus female, old versus young – this appears uncontroversial; in this case the qualification condition is easily verified and is stable. It is not surprising that some of the less contentious indicator-based schemes involve just this type of attribute, such as the age-verification scheme noted in section 6.1.

For other attribute dimensions the indicator is works only fairly well because the tagging requires authentication that may be ambiguous or open to challenge. Take as an example chronic medical conditions that may qualify a person for some type of needs-related benefit. The verification of the condition requires the intervention of a medical expert who may be capable of being swayed by human emotions concerning the client's wider economic circumstances. The person's eligibility status then becomes malleable which will to some extent act like the erosion problem that we mentioned in the context of parallel markets. If one tries to control benefit or eligibility in another dimension – for example in respect of unemployment benefit – more individuals may be reclassified in respect of their qualification for sickness benefit. A further difficulty with attributes falling into this category is that individuals' status can change – something that is almost no problem in the case of the attributes discussed in the preceding paragraph. We return to this below.

For a third category of personal attributes the tagging approach could be highly problematic. These are the characteristics that are most closely related to the precise economic conditions that are perhaps most relevant to policy-makers who are concerned with issues of distributional equity – those that are closely associated with a family's or household's low-income status.

Finally consider an implementation issue that is crucial to truly smart cards: time. Time is introduced into the argument in a very limited way in that we do not need to consider strategic behaviour on the part of consumers or others or the possibility of savings. We have already had a glimpse

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[22]This problem is not entirely confined to the personalised prices or quantity-sensitive prices discussed in sections 5.2 and 5.3. Commodity boundaries in the conventional model of section 4 can be also be eroded as a result of economic motivation to invent new products.

of the time aspect in the discussion of quantity-sensitive prices: the smart card keeps track of the individual's history of certain specific actions. As it happens, sophisticated tracking may not be all that helpful for reasons discussed in section 5.3. However the history may be useful for providing a more intelligent tag that can be used by the tax authorities to classify, rather like the credit rating systems used by financial organisations.

Where time may present a fundamental problem concerns situations in which individuals' attributes may themselves change. Of course it should not be hard to take into account predictable alterations in circumstances: if we all know that a benefit or allowance comes into operation at age 65 this can even be hardwired into a smart card. But if a person's income-status is subject to short term variability, albeit that the variability is entirely outside the person's control, it may be difficult for a mechanism that is well suited to a longer time period to keep up with the changing situation in a transparent and intelligible way; this could be particularly problematic given the short planning horizons of the most needy (see section 6.1 above). Even if the database system to which the cards are connected is particularly responsive reliance on an automatic mechanism mediated through a smart card could cause severe difficulties for those who need the most help.[23]

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[23]Recently in the UK someone had the bright idea of using HMRC to distribute cash benefits. This has proved to be an administrative disaster because of the volatile nature of individuals' needs status and the fact that HMRC works on a longer time period (the tax year) than is relevant for some people's budgeting.

"There were calls [...] for the sacking of the government minister responsible for the tax credits system after an admission from the Treasury that almost £2bn had been overpaid for the second year running.

"According to the latest figures, £1.8bn of tax credits was overpaid in the 2004/05 financial year, forcing families to face large repayment bills for the second year running The number of families facing tax credit repayments has risen despite a fall in the total sum being claimed back by the government, the new figures showed. More than 1.9m claims were overpaid last year, up 120,000 from the previous year, when charities warned some families were being forced into poverty by the debt. Some £2.2bn was overpaid in 2003-04, resulting in £1bn of debt being written off by HM Revenue and Customs (HMRC).

"The government insisted today that people will not be forced to reimburse the state if the overpayment is the system's fault, rather than a change in people's circumstances, as it admitted further overpayments would continue in the future

"Overpayments are a part of the system which is designed to be flexible to take into account changes in income of families during the course of a year. But the scale has been much higher than expected, forcing the Treasury to introduce changes, first outlined in the 2005 pre-budget report. But the reforms were introduced too late to affect today's figures. For some families, it could be the second year in a row that they are forced to pay money back to the government." – *The Guardian* : Wednesday May 31, 2006 http://politics.guardian.co.uk/homeaffairs/story/0,,1786777,00.html?gusrc=rss

7 Conclusion

Electronic cards hold out the promise of making tax administration slicker. Smart cards hold out the promise of even more. Bearing in mind that the fundamental difference between direct and indirect taxes is not to be found in their legal incidence but in terms of the information associated with them, a device that could link disparate databases and update information in real time has the potential for changing some of the fundamentals of the economics of taxation. Improvements and possible innovations in economic mechanisms could be attainable.

The key question is whether the tax system is capable of implementing these innovative mechanisms in ways that are consistent with individuals' economic rationality and normal modes of life. Where there are problems they will probably not be because of failings in the IT innovation – because the smart cards are not smart enough – but because human economic behaviour will still follow the same rules that we have become accustomed to under the old technology.

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