

INTRODUCING EURO NOTES AND COINS TO THE PUBLIC

A preliminary scenario analysis
of retailer cash transaction data
in the early days of January 2002

by

Arnd Huchzermeier, WHU
Ludo Van der Heyden, INSEAD



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Arnd Huchzermeier, WHU
&
Ludo Van der Heyden, INSEAD

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Arnd Huchzermeier is the holder of the Chair in Production Management at the WHU, Otto-Beisheim Graduate School of Management, Burgplatz 2, 56179 Vallendar, GERMANY (email: ah@whu-koblenz.de).

Ludo Van der Heyden is the holder of the Solvay Chair of Technological Innovation and of the Wendel/CGIP Chair for the Large Family Firm, both at INSEAD, Boulevard de Constance, F-77305 Fontainebleau, Cedex, FRANCE (email: ludo.van.der.heyden@insead.fr).

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Executive Summary

The introduction of Euro bank notes and coins on January 1st 2002 is an operation of unprecedented magnitude in the financial and monetary world.

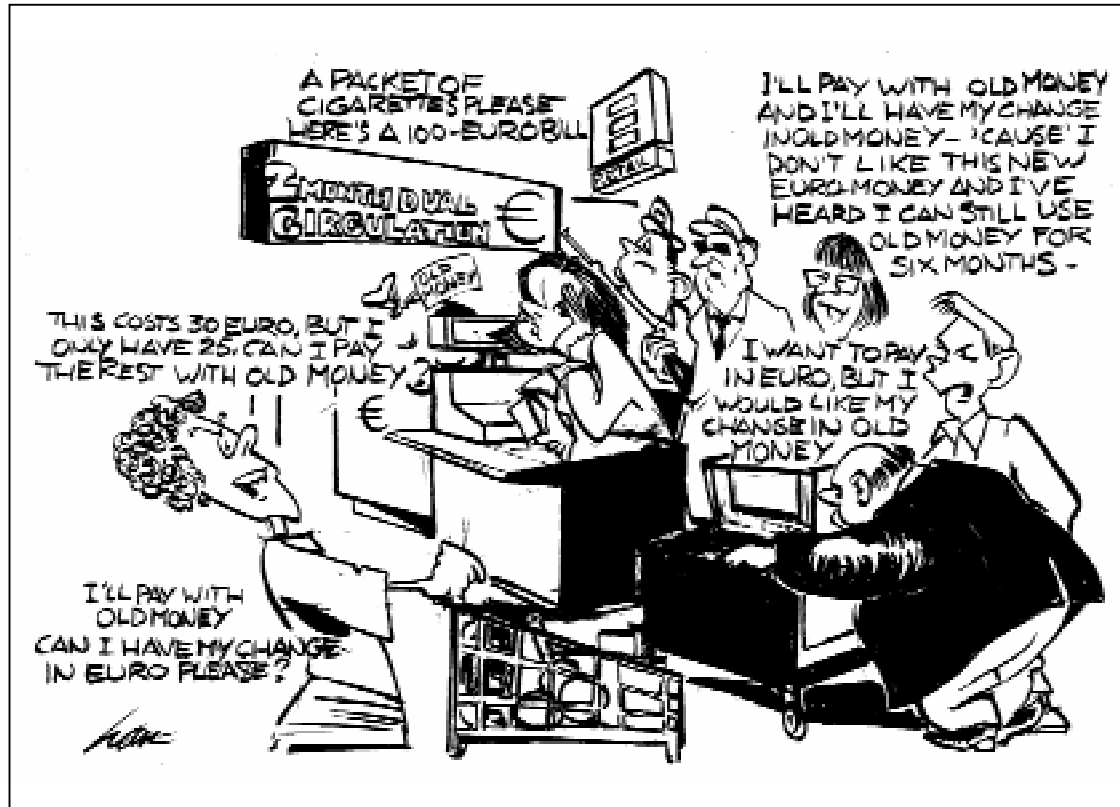
This report provides a first analysis of this operation from the viewpoint of retailer cash transactions. Interviews reveal that retailers are postponing detailed preparation of the introduction of the new currency until the legal and operational aspects of this operation have been clearly specified. In addition, though their financial and accounting systems can indeed handle two currencies (as is already the case for many), the situation is very different for the simultaneous physical handling in stores of two different currencies. This would indeed be an experiment, which is widely seen by retailers as unnecessarily difficult, unsafe and costly (for both retailers and consumers). In addition, dual currency regimes entail very different consumer behaviors as compared to single currency regimes. In some cases, consumer behavior during a dual currency regime may actually render the introduction of the new currency more difficult.

Different scenarios, based on retailer transaction data, projected forward to the early days of January 2002, allow the exploration of the amounts of coins and notes required by retailers in these early days of the new Euro currency. In particular, the policy of no-frontloading of Euro coins and notes leads to a dramatic (and underestimated) explosion in the inventory requirements for retailers of both coins and notes. It is likely that not all retailers will meet these huge cash requirements at the beginning of January 2002 (if only due to short-run cost imperatives). Shortages in the supply of the new Euro currency can therefore be expected to occur in the early days of January 2002.

These scenarios illustrate the material and immaterial costs that might be borne by retailers in the change-over operation, and the difficulties that might arise should consumers face an insufficient amount of the new currency, or go to stores with an excessive number of large notes. The costs seem, under plausible scenarios, far from negligible, and possibly of the order of yearly retailer profits. This identifies the sharing of the burden of the changeover as a key, albeit difficult policy issue to be faced.

Concerning the actual introduction of coins and notes, the study underlines the dramatic increase in the use of 5 and 10 Euro notes compared with either larger denomination notes, or coins of smaller denomination. Particular attention thus needs to be paid to the introduction of a sufficient number of small denomination notes into the economy. In that sense, the so-called 10-Euro kits are likely to prove insufficient to introduce the Euro currency to consumers. Larger Euro-kits need be considered, as well as a greater reliance on technological solutions to facilitate and complement the introduction of the new Euro coins and notes. Again, coordination of efforts amongst the different actors in the « cash » supply chain (ECB, commercial banks, retailers) is essential to mitigate against the worst case scenario where stores are

running out of cash in the first few hours of operations and are thus forced to shut down and close the shop.¹



¹ The following press articles comment on the study and may be of interest to the reader: "Wie betaalt euro?" and "Kleinhandel dreigt stil te vallen begin 2002", in: *De Standard*, November 3, 1999; "Retailers warn on Euro launch", in: *European Retail*, November 8, 1999; "Kleinhandel waarschuwt voor chaos bij invoering eurogeld", in: *Financial Economische Tijd*, November 3, 1999; "Studie: introductie euro dreigt chaos te worden", in: *Financieel Dagblad*, November 3, 1999; "Euro: Retailers call for speedier introduction of notes", in: *Financial Times*, November 2, 1999; "Handel fürchtet Chaos bei Euro-Einführung", in: *Frankfurter Allgemeine Zeitung*, November 3, 1999; "EU-Handel: Eurobargeld vor dem offiziellen Start verteilen", in: *Handelsblatt*, November 3, 1999; "Un rapport...", in: *Le Monde*, November 3, 1999; "Droht im Januar 2002 ein Chaos", in: *Neue Zürcher Zeitung*, November 3, 1999; "Nieuwe studie pleit voor euro in één klap", in: *Telegraaf*, November 3, 1999; "Poor Planning of Euro Changeover Could Create Problems for Stores", in: *The Wall Street Journal Europe*, November 3, 1999; "Eurocommerce: Chaos an Ladenkassen droht", in: *vwd - Währungsunion Spezial*, November 10, 1999.

1. Introduction

The introduction of Euro bank notes and coins on January 1st 2002 is an operation of unprecedented magnitude. It concerns the currency regimes of 11 European countries. To illustrate the magnitude of the operation, the Bundesbank estimates that in Germany, 2.8 billion DM-bank notes and 47.4 billion coins are expected to be in circulation by the end of the year 2001, on the eve of the transition to the Euro.²

For this transition into « Euro-land », it is essential that the logistical aspects of the operation be well understood, appropriately planned for, and well executed. In fact, this is critical. At this stage, the decision to invade « Euro-land » has been taken, the day has been set, and the terms (like exchange rates, denominations, ...) as well. All that is left now, is the successful execution of this massive operation.

Several key logistical and operational aspects of the operation remain to be fully planned. The planning of these aspects is essential for a proper execution of the launch of the new currency. Failure in execution could take the form, for example, of a shortage of coins at the checkout counters of big retail stores. Such occurrences would cause disturbances in these stores, with ensuing losses of sales and of consumer goodwill (i.e. future sales). More importantly, such incidents risk creating major problems for the new currency itself, which still needs to gain greater acceptance from consumers, industry, and investors. In short, the physical launch of Euro coins and notes around January 1st 2002 is an operation which neither the European Central Bank, nor the entire European Union, can afford to fail. Conversely, a successful introduction of the new currency will both strengthen the new European currency and the entire European project.

The successful introduction of the Euro bank notes and coins around January 1st 2002 is a very complex issue. Indeed this operation involves different parties, themselves guided by varied and often complex interests. In short, the question is *systemic*, and the behaviour of the system is governed by the behaviour of its *components* (essentially the European Central Bank, commercial banks, retailers, and consumers) and on the interaction amongst them. Let us illustrate the interaction amongst these components with two examples.

Commercial banks, in a desire to rapidly meet the needs of European consumers for Euro currency might decide to fill their ATMs with large denomination notes. It is precisely these large notes that will create problems for the retailers faced with the problem of having to return change on these large notes. Our second example focuses on an overlooked aspect of the Euro currency introduction, the behaviour of consumers in this change over. A well-known economic law states that in a double currency regime the weak currency chases out the strong one. Indeed, individuals faced with the choice of payment in either currency will prefer to get rid of the weak currency, and keep

² Bundesbank Report, Deutsche Bundesbank, 1999.

the strong one. Hence -- although no strong evidence can be presented on this -- it is plausible to assume that European consumers, if allowed to, will deplete their inventory of national currencies in the early days of January 2002, if a dual currency regime is permitted. A dual currency period therefore risks causing major difficulties for the "Euro cash supply chain." In such scenario, consumers will retain their Euro cash in their « pockets » and pay in national currencies, even though they could be paying in Euros. Just when the cash supply system is faced with the critical issue of introducing as many Euros into the economy to meet the demand for Euros, consumers in a dual currency period risk behaving as « contrarians » in the « supply chain » by not injecting into the economy as many Euros as fast as possible. A concerted effort to induce consumers to help alleviate the problem appears a necessity, whose precise importance is a function of the exact transition scenario.

The European Central Bank and the commercial banks seem to be preoccupied at this time only with notes. Indeed, in the change over operation, coins are the domain of the national central banks. The agents supplying coins to the economy are generally retailers. Retailers indeed return notes and coins to customers unable to present the exact quantity of cash for payment. These notes and coins are either obtained from a commercial bank, when it is not simply money collected in earlier transactions and recycled into the economy. Commercial banks represent the primary vehicle for introducing notes into the economy, increasingly through vast networks of automated teller machines (ATMs). To illustrate the role ATMs are going to play in the cash supply chain, decisions by particular banks to fill their ATMs with large Euro notes on the eve of January 1st 2002 will have immediate repercussions on the amount of coins needed by retailers presented with these large denomination bills after January 1st 2002.³ Such a situation will automatically result if ATMs are insufficiently supplied with small notes and if the ATMs supplied with small notes in the early hours of 2002 soon run out of them.⁴

Retailers thus rely also on consumers to provide them with coins, so that coins needed in one transaction actually were provided by earlier transactions on the same day. Retailers typically store 3.5% of daily transactions in coins and notes at the beginning of the day.⁵ It is clear that, in the early days of January 2002, this amount needs to be much larger, due to the fact that consumers will not be supplying retailers with a large number of Euro notes and coins at that time. This will force retailers to start the day with a much higher inventory of Euro notes and coins than will be necessary once the Euro currency will circulate as the only legal currency. Our study provides some

³ Our understanding is that, currently, 4 countries expect the ATMs in their country to be supplied with 5 and 10 Euro notes, whereas 4 others will supply them with 10 Euro notes, and 2 countries with 20 Euro notes. Only Luxembourg is currently considering supplying ATMs with 50 Euro notes.

⁴ It has been suggested by the ECB that ATM machines should be loaded with notes of the smallest denomination during the switchover period. This way, the requirements for national/Euro coins and notes will be curtailed. However, from a cash logistics perspective, this strategy is associated with the largest risk of stockouts in notes during a peak shopping season, i.e., it requires the highest frequency of replenishments of ATM machines.

⁵ Figures provided by interviews with large retailers in France and Germany. Smaller retailers would start the day with a proportionally larger inventory of coins and notes.

initial estimates of the size of these inventories. These inventories appear much higher than commonly anticipated. Such computations raise the issue not only of physically providing these inventories (and envisaging shortages of Euro currencies when the inventories provided are insufficient), but also of the cost of carrying these inventories. (As will be discussed below, retailers and service providers must also consider the costs associated with ensuring safety and security as well as managing confusion. The safety risk is an immaterial cost and is of more importance than the financial costs. The safety risk cannot be passed on to the consumer, the financial costs can -- at least in principal.) The position taken for the moment by the ECB is that these costs are to be borne by retailers, or shared between consumers and retailers. From a policy viewpoint, this is at least debatable, especially if these costs are of a high magnitude.

A final comment that might be made at this stage is to underline the fact that the Euro currency is actually of a high denomination. The smallest Euro note is 5 Euros, which amounts, in French and Belgian currencies, resp. to approximately 33 FF and 200 BF. These national currencies today have notes of 20 FF (used much more commonly than the recent 20 FF coin) and 100 BF. Hence, coins in the new currency regime will actually be in greater demand in store payments than is the case, for example, in stores in France and in Belgium. Hence, in all likelihood, Euro coins can be expected to be in greater circulation in these countries than is currently the case for the national currencies in these currencies.

In view of this fact, and recognizing the huge logistical aspects associated with the introduction of Euro coins (especially) and notes, one is left with the obvious question for technological solutions that might help alleviate a currency operation of unprecedented magnitude. For example, "e-day" might be the opportunity for launching "e-cash", not as a forced solution, but with the dual goal of managing the risks of the operation and of moving forward decisively into the new "electronic" economy. The attractiveness of "e-cash" cards, for example, is that they can be brought to the public before January 1st 2002 and programmed to automatically convert from national currencies into Euro currency at midnight on December 31st, 2001. Faced with shortages of Euro currencies, retailers might find it attractive to have the possibility of providing change to their customers using such "e-cash" cards (loaded with the appropriate currency amount).⁶

Our paper is organized as follows. In Section 2, we present the various scenarios for the introduction of the Euro currency. We also discuss issues raised by these various scenarios. Section 3 introduces our model, called NEURO, developed to analyse cash transactions in the stores. Simulations using this model are presented and discussed in Section 4. A fuller examination of retailer issues appears in Section 5. Section 6 contains our conclusions on the basis of our preliminary investigations.

⁶ Interestingly, concern about the logistics of the introduction of the Euro seems to be smaller in countries (like France) where electronic payments are more widely in use.

2. Scenarios and issues for the introduction of the Euro

The main questions to be addressed in this study are:

- 1) Should consumers be front-loaded with both Euro coins and notes?
- 2) Should a dual currency period be avoided ?

There are several scenarios for the introduction of the Euro on January 1, 2002. They evolve around the basic decisions concerning:

- ✓ *Front-loading or no front-loading* (i.e., Euros will be made available before the official introduction in January 2002) ;
- ✓ *of consumers and/or enterprises* ;
- ✓ *with coins* (this can be decided at the national level), or with *coins and notes* (the latter requires approval by the ECB) ;
- ✓ *Adoption of a dual currency period* (both national tender and Euros must be accepted for a certain period) or *no dual currency period* (only Euros are legal tender).

At this moment, German banks are considering the sale of 42 million of so-called Euro-kits containing coins up to 10 Euros. One might further question whether these kits can be dispersed quickly enough into the economy, given that waiting times at retail banks may be prohibitive in the first few days or weeks of the transition.

Another important aspect of managing the transition to Euros is that it should be accomplished in the shortest possible time to reduce costs to retailers (and retail banks). Uncertainty in the demand for cash requires the « trading » company (retailer or bank) to hold a sufficient inventory of cash each day. In case two currencies -- e.g., the DM and the Euro -- are legal tender, the cash inventory problem becomes twice as expensive, since the retailer cannot forecast the exact requirements of either currency. In fact, the retailer and the bank must both « hedge » against the worst case, if they are to continue providing good customer service during that period.

If the transition period is extended even further to maximize flexibility and convenience to consumers, or to smoothen the initial supply of Euros, then consumers are not forced or even induced to change over quickly. The cash storage problem might then greatly be amplified, and may even become unbearable -- due to the behaviour of « non-supporting » consumers. We will return to this in the discussion of our simulation results, where we will illustrate how the profitability of an entire industry might be at stake due to the changeover.

The major risks of the transition process are:

- 1) a slow adoption by consumers of the Euro (e.g. after two weeks 90% of consumers will have switched to the new currency) ;
- 2) shortages of small notes (this requires that ATMs be furnished with four chutes for 5, 10, 20 and 50 Euro notes and that they be replenished frequently).

In retailing, the main bottleneck in the cash supply chain concerns the so-called « Werttransporte » or money-in-transit service providers using mainly armoured vehicles. They assume the responsibility in the economy for the in- and outflow of cash in retail stores. Typically, no additional storage capacity is available for cash (besides for change). Moreover, retailers keep cash levels as low as possible out of security considerations. The management of the supply of Euros and the disposal of DM or FF will require far more frequent deliveries and visits by those service firms. In our interviews, it became clear that retailers currently do not intend to invest in additional safes or utilize different service companies for managing their cash logistics.⁷

In a dual currency period retailers continue to accept the national currency. The worst situation occurs when retailers are required to stockpile Euros to be returned to consumers during the day, while simultaneously collecting (for disposal to banks) the national coins and notes offered for payment by consumers during the day. Holding an inventory of cash for several business days, retailers would furthermore not be credited for this cash. This may lead to significant financing charges and opportunity costs.

The key observation then is that retailers are barely profitable, when looking at sales figures. Across the industry a profitability level of 1% of sales is common. Let us compare this to a cost of capital of 10-15%, depending on the size of the company. Overall, there will be costs that will be incurred for the following items:

- i) *cash logistics* (additional storage capacity for the old and new currency, more frequent replenishments);
- ii) *security* (safeguards, insurance, theft, hold-ups, information services to consumers) ;
- iii) *confusion* (additional cashiers and errors in handling) ;
- iv) *financing* (cost of capital and foregone rate of interest due to delayed crediting) and administrative errors due to mistakes in the change given (imbalance between turnover and received cash).

Let us consider a retailer or service provider who faces Euro requirements equal to 50% of sales for two months with total annual cash holding costs amounting to 25% (including the cost of capital). Such a retailer would face a « changeover cost to the Euro » in the order of 17.36% of annual

⁷ Money is rather bulky and heavy. Thus, large transportation capacities will be needed. (This is precisely why electronic payments and electronic cash today appear to offer a more efficient solution as compared with physical payments involving notes and coins.)

profit.⁸ In other words, the retailer would lose two months of annual profit due to the change over (not even taking into account all other business risks mentioned above). Observe that on average, retail stores are being replenished every 3 days. Thus, the costs will triple to 52% of annual profit, not accounting for the interest charges for the intake of national currency though.

Lastly, we acknowledge the fact that large retailers will be able to set up exchange booths in their facilities to smoothen the cash handling process. It is not clear whether this is feasible or even advisable. Separating the in-take from the outflow of Euros may exacerbate matters. The security and administrative costs may also outweigh any perceived benefits. In the general case, i.e., where the average transaction amount and volume is relatively small, there is a potential threat to these small businesses of having to shut down when consumers pay with large bills only. Indeed, inventory is an activity subject to considerable economies of scale. Small retailers thus risk incurring proportionally higher change over costs than bigger retailers.

⁸ To simplify calculations, assume 120 M DM of annual revenue of a retailer and an average profit level in the industry of 1%. Moreover stores are stocked up daily with Euros. Therefore, financing charges are 2 months x 10 M DM/month x 0.50 x 0.25 %/DM/year / 12 months/year = 0.2083 M DM. These costs are 17.36% (= 0.2083 M DM / 1.2 M DM) of the retailers' annual profit, or, equivalently, 2.08 months of annual profit. In case that stores are stocked up only every two (three, five) days, then these financing charges double (triple, quintuple). In this case, there apply charges for lost interest on the in-take of the old currency in the order of 10-15%. These charges need to be considered as well when calculating the financial burden of the switchover.

3. The National-to-Euro Retailer Exchange Model (NEURO)

The motivation for the NEURO model was to develop a simple and robust tool for estimating Euro note and coin requirements using current retailer transaction data. The spreadsheet models developed were shared with the participating companies. In addition, we requested feedback on the data analyses and have incorporated these ideas in the current version of the spreadsheet and in this report.⁹

For the store data analysis, we did not wish to develop a behavioural model of payment strategies by consumers for each retail store (or service outlet, like in the case of RATP...).¹⁰ However, as will be discussed below, we have accounted for many features that can be observed in payment practice at that level. In addition, we provide a *conservative* estimate: all assumptions assume the « best case » scenario. This means that we assumed that there is no artificial « inflation » in coin or note requirements following a conversion of the transaction data under the DM or FF regime into a Euro regime.¹¹ Consequently, we must state here that reality in January 2002 may in fact be worse than our results suggest.

Firms eager to provide a high level of customer service will like to hedge against running out of Euros in the first few days. These firms, rather than using a « typical » data set, must utilize a data set with a transaction volume representing « peak » or « worst-case » requirements. The likelihood of these worst-case scenarios occurring is small. However, they provide a good upper bound on the coin and notes requirements. It suffices to say that these cash requirements may lead to prohibitively large financing charges. Thus, we report only « average » requirements for retailers and service firms respectively, since we simply convert current cash transaction data in Euros.

For each retailer or service firm studied, we were presented with at least one typical cash transaction data set. The features were as follows. Projecting forward to January 2, 2002, we recognized that this day is a Wednesday (following a holiday). Therefore, transaction data of a typical Monday are more likely to occur on that first day of the new currency regime. Second, the store data should present a good proxy for the other facilities of the retail company studied. Under those conditions, the results might be used to make statements concerning cash requirements at an aggregate level.

Overall, the methodology deployed in the NEURO spreadsheet model¹² is quite simple and intuitive:

⁹ More detailed information can be found in a companion report: "E-Day: Analysis of Store Data", which can be sent upon request to the authors.

¹⁰ In case of the adoption of "psychological pricing", the requirements for Euro coins are expected to go down, e.g., when prices are rounded up or down to the nearest 9 cents level.

¹¹ The total cash payments under the Euro regime are strictly less (due to rounding down) than the total cash payments under the original currency, e.g., the DM, the FF or the NLG.

¹² Copies of the spreadsheet model can be obtained upon request from the authors.

1. A file containing an imprint of daily transaction or point-of-sales data (in DM, FF or NLG) was obtained.
2. The payments in Euros were assumed to follow current practice (as described by the obtained data files on current transactions). The purchase amounts were converted into Euro amounts using known conversion ratios, e.g., DM 1.95583/Euro. Furthermore, payment amounts converted into Euros were rounded down (rather than up) to the nearest 5 or 10 Euro note. For example, if a customer paid 40 DM, i.e., using two 20 DM notes, he/she is assumed to pay with a 20 Euro note. This implies that he/she did not pay 20.46 Euros which would have been the DM amount expressed in Euros. In this case, the cash payments in the Euro regime are « deflated » by 0.46 Euros.
3. In the early days of the transition, only few consumers are expected to pay with Euros. All others are assumed to pay with their « old » currency. Retailers do accept both currencies, but provide change in Euro only. A random sampling procedure pre-determines those customers paying in Euros. This selection is based on a pre-defined non-Euro payment factor expressed in percent of the total customer base. (We assume that this factor will go down to 10% after the first two weeks of the Euro introduction.) Given this information, the inventory positions for coins and notes are then determined for the entire sample data set, in chronological order of the recorded transactions. Change is given in an « optimal » way, i.e., minimum number of notes and coins.
4. The output of the NEURO model consists of the maximum cash requirements, expressed as a percentage of cash sales. This allows retailers to compare across stores or distribution channels (i.e., when there are multiple selling formats deployed by a retailer, e.g., at Rewe).
5. Step 4 can be repeated by retrieving from the transaction file a new set of Euro paying consumers. However, our results show that the sensitivity of cash requirements is actually quite limited. Thus, we will not report on this feature of the model.

The realism of the store data analysis leads to « reasonably grounded » estimates of coin and note requirements for each facility. This was also confirmed in our discussions with participating retailers. It became clear that using average transaction amounts would lead to severe underestimation of coin requirements. For example, if the average transaction amount in Euro is an « even » value of 13.00 Euros and all customers are assumed to pay with 50 Euro notes only, then the coin requirement is exactly one 2 Euro coin times the number of daily transactions. In this example, the requirements for small change are grossly underestimated. Moreover, this type of study neglects the fact that in almost all transactions (small or large !), there are more coins needed.

Some additional features of our model are worth mentioning. First, we converted DM purchases 1-for-1 into Euro purchases (similarly for FF and NLG purchases). This way, we omitted a systematic bias in the analysis consisting of an inflation in cash volume. Second, as mentioned before, we rounded down where possible. This way, we put an upper bound on coin requirements. Third, we assumed the same proportion of exact payments (this is tied to the respective consumers and not subject to random sampling). It is regularly argued that exact payment is given for small denominations only. However, when we convert (small denominations of) DM exact payments into Euro exact payments, then we see a larger inflow of Euro coins (than under a DM regime). Again, there is no bias in the results created. Fourth, electronic payments and vouchers are accounted for as well (in French and Dutch data sets). Fifth, a so-called « goal seek option »¹³ is utilized to achieve an inflow of 2 Euro coins. Since, the 5 Euro is a note (rather than a coin), the demand for 2 Euro coins is prohibitively large. To lower these requirements, we assumed that consumers pay (sometimes) with two 2 Euro coins and one 1 Euro coin rather than a 5 Euro note. This way, there is an inflow of 2 Euro coins generated and total coin requirements are reduced. Finally, change is returned in Euros only (which reflects the intentions about these issues of large retailers today) and split progressively into notes and coins of the next lower denomination.

In the following section, we provide an overview of the simulation results of a representative store of a large retail chain in Germany. The data set has been validated and the simulation results extensively crosschecked and analysed.

¹³ This is a standard feature in a spreadsheet program.

4. Simulation analyses using store cash transaction data

In what follows, we provide the results from our simulation studies. In particular, we consider the effect of two factors that were stated as key to the cash transactions.

The first factor is the rate of adoption of the Euro by consumers. We recall that it has been stated by the ECB that after two weeks, 90 percent of Euro-länder will have switched to the Euro currency. The second factor is the fraction of customers who present large bills for payment, e.g., 50 Euro notes and notes of larger denominations. This may in particular be the case, when capacity of ATM machines may prove to be insufficient (it is assumed that all ATM machines will be converted to four chute machines, else large notes must be stockpiled) or shortages in the supply of Euro cash will occur.

Overall, we consider the following three business scenarios for the introduction of Euro notes and coins.

1. The ideal or base case scenario: over a two-week period, more and more consumers (from 0% to 90%) adopt the Euro and there is no shortage of coins or notes.¹⁴
2. Scenario A: over a two-week period, more and more consumers adopt the Euro (as stated above), but there is a shortage of small notes (the large bill factor increases linearly from 60% on day 1 to 90% on day 3 and then decreases linearly to 0% on day 12).
3. Scenario B: over a two-week period, more and more consumers adopt the Euro (as stated above) and the shortage of small notes is reduced over time (exponential decline from 100% on day 0 – assuming that some consumers will get Euros from ATM machines the day before -- to 1% on day 12).

¹⁴ This means in practice that the ATMs supply the 5 Euro note which is normally not the case.

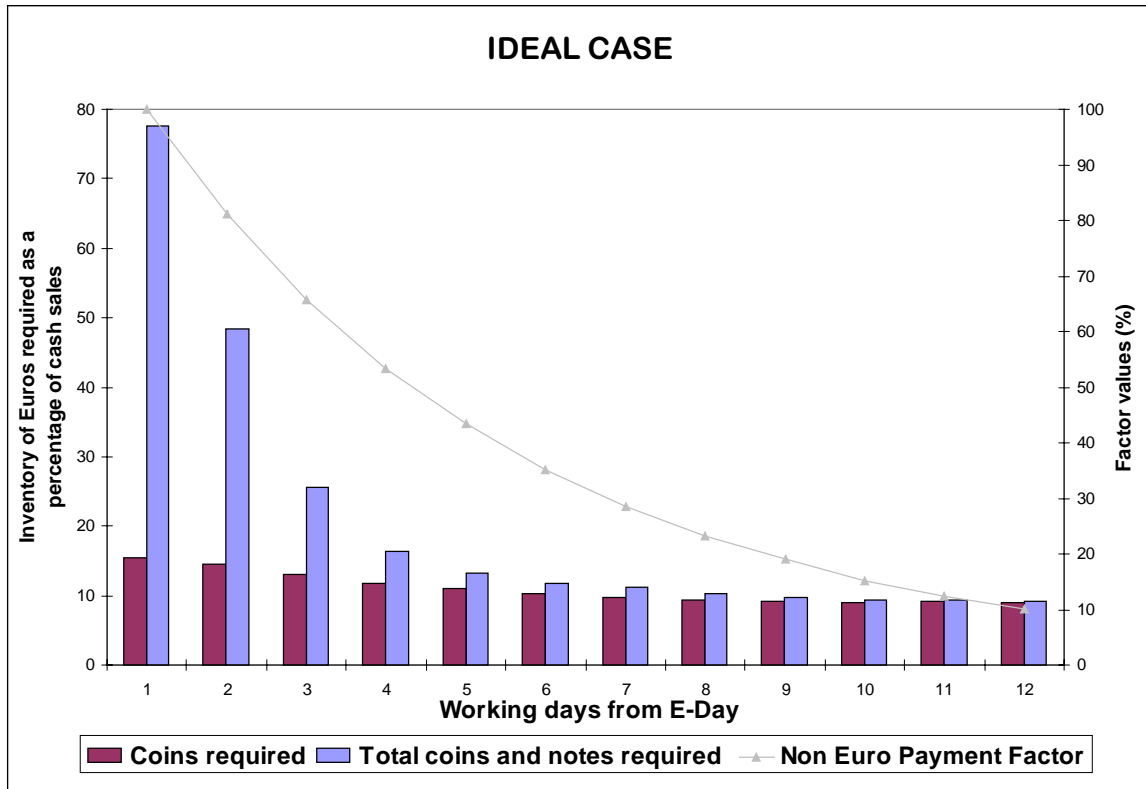


Figure 1: The Ideal or Base Case Scenario for a Retail Store

The results of the ideal or base case scenario are presented in Figure 1. Overall, the requirements for notes and coins do level off rather quickly (within the first 5 days of operations). The cash requirements for the first day are 10 times larger. Coin requirements are slightly inflated by a factor of 50% only. Observe that day 12 provides a lower bound on the minimal cash requirements of the store (most transactions are conducted in Euro notes and coins only). Over the two-week period, the average inventory of coins and notes required, expressed as a percentage of cash sales, is 20.99%. The average inventory for coins only is 10.96%.

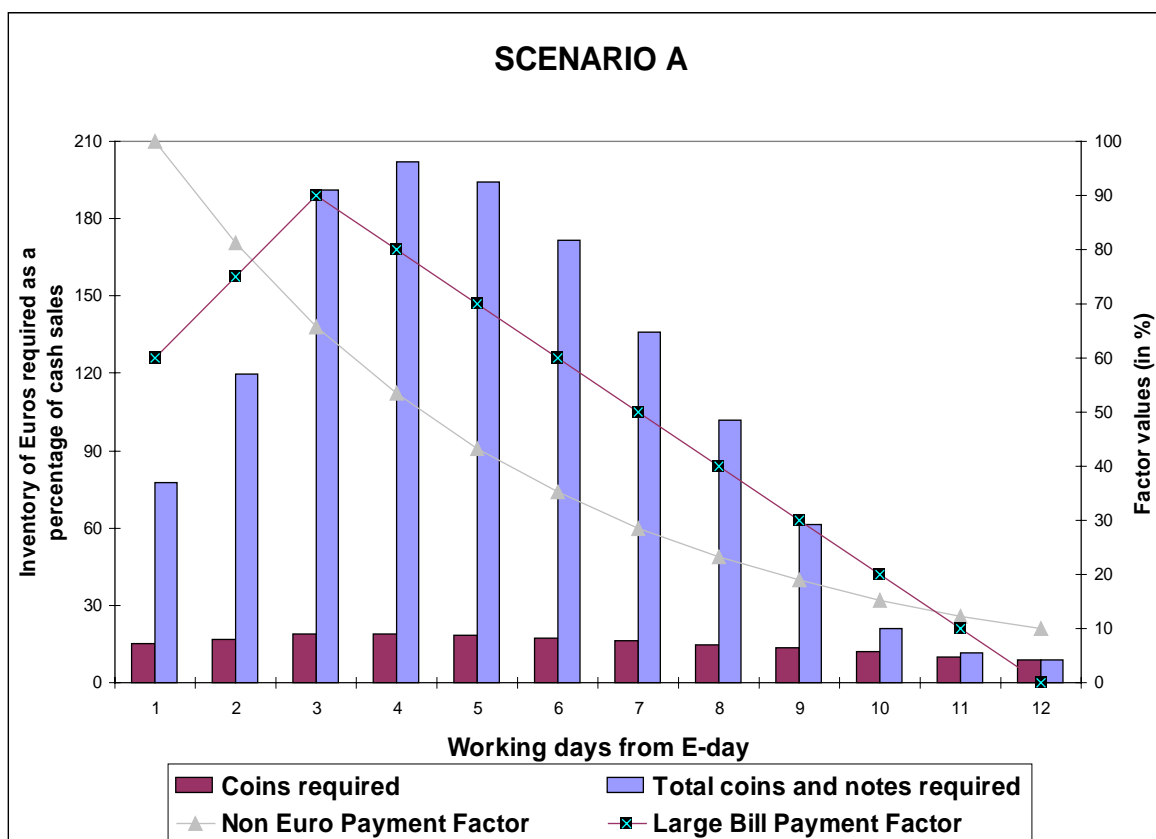


Figure 2: Scenario A for a Retail Store

Scenario A, exploits the possibility of a shortage of small notes in the first few days of the Euro introduction. In the NEURO model, we utilize 50 Euro notes only for those customers that are paying with large notes. Retailers view this assumption on large bill payments as very likely to occur. Figure 2 shows the simulation results for this scenario. Over the two-week period, average inventory of coins and notes required increases to 108.1% and average inventory of coins increases to 15.2%. Whereas the requirements for coins do not increase much, the demand for notes is greatly inflated. In fact, at times, it is 20+ times larger than on day 12 (when compared to an industry average, the peak requirements are 60+ times larger than the standard requirements of 2 to 3.5% for an average store).

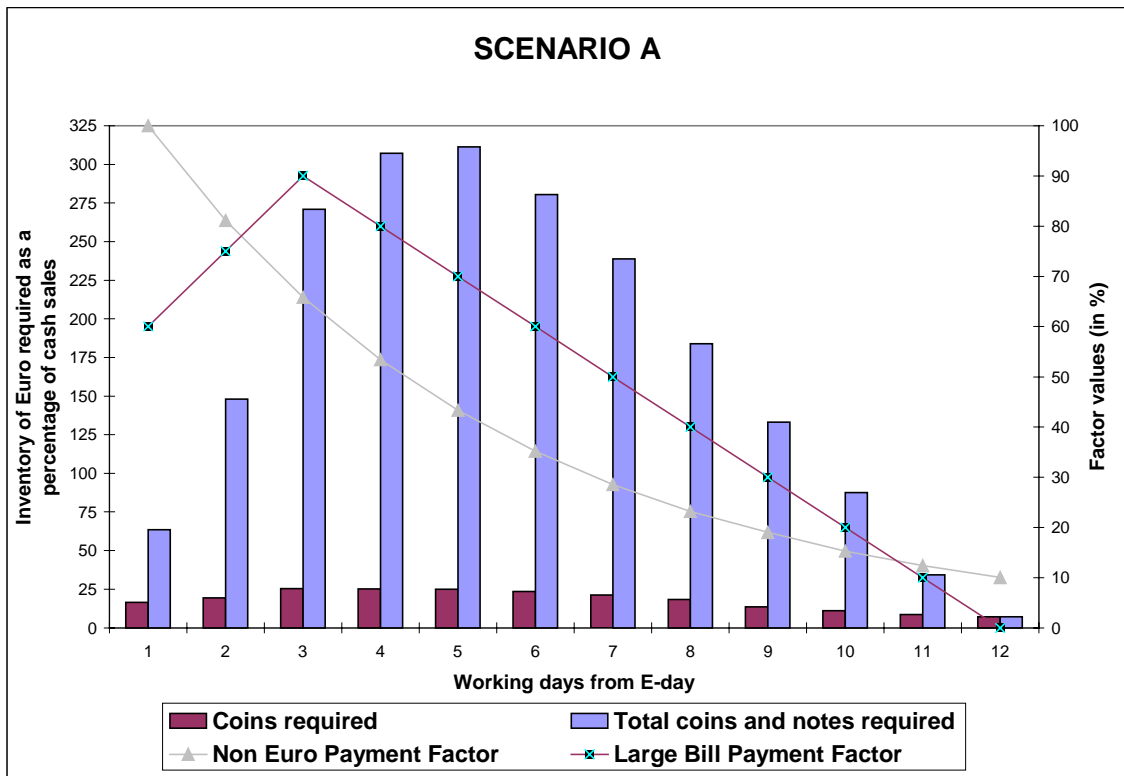


Figure 3: Scenario A for a Service Provider

Figure 3 provides an analysis of a relatively small service outlet. As can be seen from the store data analysis, requirements for Euro notes can increase dramatically (up to 300+%). Observe that coin requirements over the two-week period amount to 18% and the average cash requirements are 172.2% of cash sales. This data set exemplifies that small stores with a low transaction volume per consumer have a higher need for Euro cash than larger stores. In general, financing charges may become prohibitive i) due to higher costs of capital (financing charges) and ii) larger inventories of Euro cash required to provide an adequate level of customer service. Also, the security and safety risk may be extremely high in these cases.

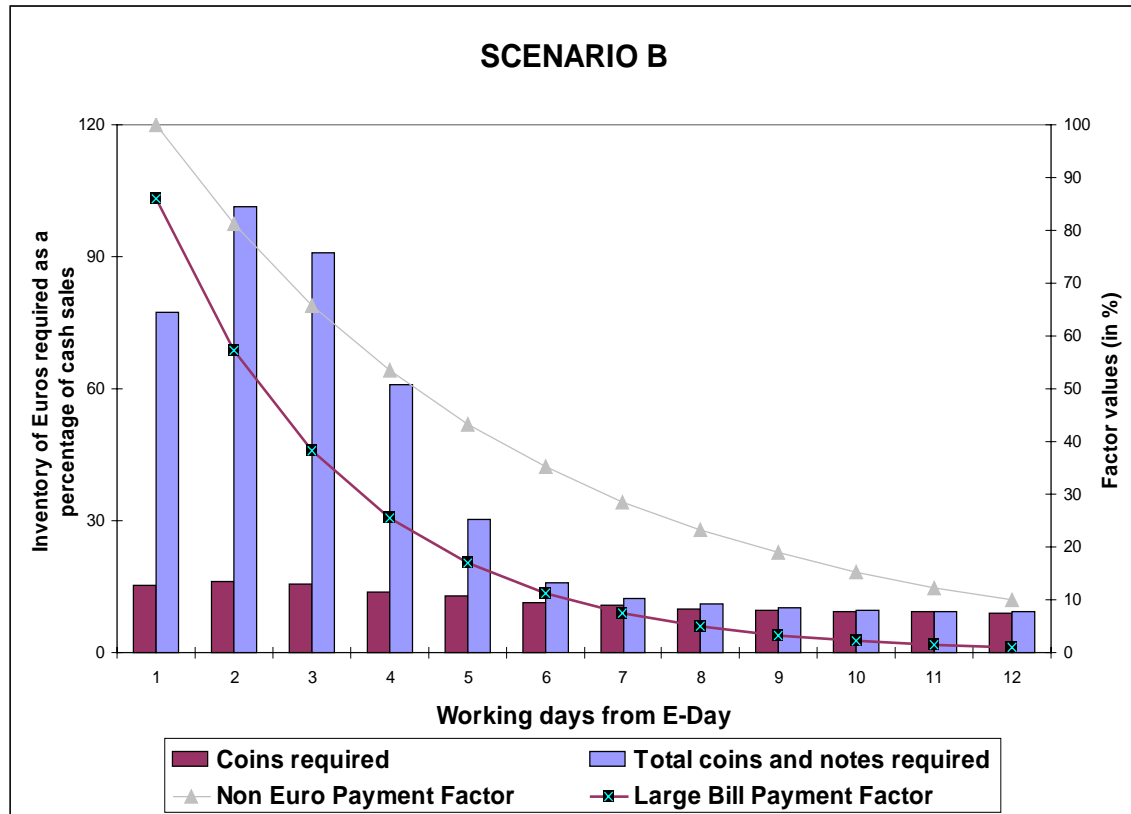


Figure 4: Scenario B for a Retail Store

Scenario B assumes that the large notes factor decreases over time. As can be seen in Figure 4, the peak requirements for coins and notes are still significant: there is a peak demand for cash on day 2 at 102%. Overall, for the two-week period, average inventory for coins and notes as a percent of cash sales is 36.6%. Average inventory of coins as a percentage of sales is 12.0%.

On first sight, these results seem « manageable ». However, it should be noted that the simulation results are based on optimistic or conservative assumptions (as argued above). For example, when most customers pay with 100 Euro notes then the requirements for cash will double. Also, if the in-take of « old » currency is not credited on the same day, there are opportunity costs in the order of magnitude of 100% of cash sales as well. For example, if the crediting of the in-take of cash – e.g., in DM or FF -- takes two (three, four, etc.) days rather than one working day, these opportunity costs double (triple, quadruple, etc.). This scenario seems likely and may be the « most hidden threat/cost » to the transition. In addition, if there is a shortage of cash deliveries, retailers will need to stockpile Euro cash for several working days. Financing charges can therefore easily double, triple and so fourth. If retailers are unprepared, they may be forced to shut down due to a lack of cash. Overall, the combined effect of these risks may in fact result in financing requirements and charges (at relatively high costs !) that may cost retailers, and the retail industry as a whole, multiple years of profit.

A final point needs to be made with regard to the front-loading of consumers with Euro coins only. (From the analysis above, it becomes apparent that there is a significant demand for coins AND notes. Thus, consumers should be front-loaded with both coins and notes!) We have analysed the requirements for 5 Euro notes in more detail, as shown in Table 1. In this case, we varied the Large Notes Factor (from 100% to 0%) and the Non-Euro Payment Factor (from 100% to 0%) for the data set provided by one retailer. These two factors are inputs to the NEURO model. (Observe that in case of a 100% Non-Euro Payment Factor, the large notes factor does not apply since all consumers are paying with their old currency and change is given in Euros only. Therefore, the need for 5 Euro notes does not change.)

In case that the switchover is completed, then all customers are assumed to pay with Euros only (Non-Euro Payment Factor is zero) and the use of large notes is the same than under the old currency regime (Large Notes Factor is zero). At the time of the changeover, however, both the Non-Euro payment factor and the Large Notes Factor can be assumed to be relatively high (e.g., from 100% to 40%).

		Non-Euro Payment Factor					
		1.0	0.8	0.6	0.4	0.2	0.0
Large	1.0	12.6%	17.0%	21.0%	25.9%	30.0%	33.9%
	0.8	12.6%	15.1%	17.5%	20.6%	22.6%	25.0%
Notes	0.6	12.6%	13.5%	14.2%	15.5%	16.0%	17.0%
	0.4	12.6%	12.1%	10.9%	9.7%	8.2%	7.4%
Factor	0.2	12.6%	10.5%	7.6%	4.7%	1.6%	0.2%
	0.0	12.6%	8.6%	3.4%	0.1%	0.1%	0.1%

Table 1: Requirements of 5 Euro Notes

It becomes apparent that on day one (upper left hand corner), the requirements for 5 Euro notes are much larger than under normal conditions (lower right-hand corner). In the worst case, the requirements for 5 Euro notes are 33.9% as opposed to 0.1% for the complete switchover case. This is an increase of 65,200%.

The main conclusion from these simulation studies is that front-loading of coins has marginal value in terms of total cash requirements. Supplying the consumers with notes of small denomination, i.e., 5 Euro and 10 Euro notes, may be more beneficial to support a smooth transition process. However, due to the capacity requirements, the distribution of small notes may be greatly hampered by the limited capacity in ATM machines, the store hours of retail banks and the availability of armoured vehicles.

5. A discussion of retailer concerns about the Euro introduction

In the previous sections, we have underlined the heavy cash requirements for retailers in the first few weeks of the introduction of the Euro. Our scenarios reveal substantial inventory requirements that can easily be 20 to 50+ times current cash requirements (as a percentage of daily sales).¹⁵

This raises several concerns for retailers. First, it is difficult to make a hard forecast about which scenario might actually be realized. Especially as the behaviour of the entire supply chain system is, as we argued earlier, the result of the interactions amongst its components (ECB, national central banks, commercial banks, retailers, consumers). It is not unreasonable, however, to argue that in view of the huge variability in the possible cash requirements needed, a certain percentage of stores will actually face shortages of Euro coins and notes in the first few days. Should this occur, news of such shortages will rapidly be broadcasted worldwide, possibly inducing further hoarding behaviour of Euro customers, eager to conserve their Euro currency ... and thereby greatly contributing to worsening the shortage of Euro coins and notes, by virtue of their withdrawal of the Euro currency from the payment system.

The second concern that needs to be addressed pertains to the financial costs of the inventory of coins and notes retailers will need to dispose of. The cost of this inventory, when it is 20 to 50 times larger than current levels, also multiplies financial charges considerably. But the financial charges are only one aspect of the costs. Another potential cost item includes the possibly delayed crediting in retailer accounts of the national currencies brought in by consumers (in case of the dual currency period) that need to be returned to the national or commercial banks. These amounts could be considerable (possibly including most of the cash transactions in the early days), leading to potentially huge financial opportunity costs. This scenario is actually quite likely due to expected bottlenecks in the safe transportation of coins and notes. Indeed it is unlikely that this sector will be able to provide adequate transportation capacity in these early days, leading to delays in transportation and holding of considerable sums of money in the stores, turned into real « unsafe deposit banks. »

This brings us to the potential security problems of these early days. With retail stores presenting much larger amounts of Euro cash (to be supplied to consumers) and national cash (to be returned to central or commercial banks), big retailers will become a prime target for robberies, especially that they appear much less defensible than banks and that they are not equipped for storing huge amounts of money. At this point, security services will be required, and it is also likely that an insufficient amount of security will be available (either

¹⁵ Our simulation results suggest that smaller stores will have larger *average* cash requirements than large stores. This is due to the (risk) pooling effect of a large number of transactions at the big retail stores. Consequently, the need for Euro coins and notes expressed in terms of average cash needs increases by a much smaller factor. However, observe that the Euro coin and notes requirements in absolute terms are the highest for the small stores. Thus, the financial burden and the associated safety risks may be prohibitive.

from private or public sources). Also, the possibility of serious fraud is not to be excluded at that time.

Storage of cash might even be more of a problem for public transportation providers, who have cash registers in buses which already are the targets of hold-ups today. Such hold-ups will prove much more profitable in the early days of January 2002. Some big retail chains already are requesting the assistance of the Army in these early days. Even if feasible, it is not clear that an invasion of Euro-land will be helped by scenes of substantial military force in streets, shopping centres, ...

The dual currency period presents retailers with further problems. In some countries like France a virtual dual currency regime is already in place — all financial systems dealing with both Euros and national currencies. But this dual « accounting regime » does not translate as such to the « real » cash transactions at the counter. The additional times required for counters handling two currencies is estimated to be between 20 and 50%. This will force retailers to employ as much as twice the number of cashiers during the dual currency period. In addition, it is generally acknowledged that the dual currency regime greatly increases the potential for fraud and thus decreases the quality of service provided to consumers, who will not be clear whether they simply lost some money, or whether a particular retailer cheated them on their cash return. Retailers do not expect to install special fraud checking equipment or fraud checking procedures during these early days.

What is interesting in the interviews with retailers that none of them currently plan coordinated efforts with other retailers, safety transporters, banks, or other firms. In other words, all companies plan for the adequate level of services to be provided, though all plan for a much larger request of such services in early January. This connotes a level of planning that is still very preliminary: task forces are working, but generally at a fairly low level of intensity. Generally, retailers interviewed stated that they were waiting for more precise scenarios to become known before reacting to them. None interviewed expected any level of support from banks, industry associations, and other service providers. It is clear from our interviews that all parties in the « cash supply chain » are planning matters on their own and that coordination is nil, or very limited.

Another difficulty – not really addressed in this paper largely devoted to consumer/retailer perspective -- in the transition to the Euro is represented by the vending industry (whose machines represent a major user of coins in the economy, though diminishing through the increasing introduction of electronic payments as well as coin payments). It is hard to imagine anything but a gradual conversion of machines to the Euro currency. However, large manufacturers of modern retail vending machines have already indicated that they will be able to handle the new currency from January 1, 2002.

In some parts of Euro-land, the density of the banking system – measured by the number of bank locations per inhabitant, can be relatively small, e.g., in Greece. Consequently, consumers are more dependent on the

financial institutions and thus the speed of diffusion of the Euro is quite hampered. It has been argued that in this case, a dual currency period may be quite favourable as well. However, it is our view that in such cases the danger of fraud and the non-availability of basic services is largest when there is no possibility for front-loading of Euro currency. This point is directly related to the problem of the vending industry as stated above. In particular, these consumers are prohibited from hedging against service disruptions by not being able to stockpile Euro cash in advance. In general, not having a choice (to buy Euros in advance) may negatively impact consumers more than there are possible downsides.

In view of the difficulties mentioned above one should recall that most of these problems occur only because the physical cash system is handling the conversion in a « reactive manner », following the crucial date of January 1st 2002. Proper preparation involving a substantial distribution of the small notes and of the small coins would indeed solve many of the difficulties mentioned, by « smoothing » the introduction of the new currency through the introduction of a large number of not insignificant small notes and coins to consumers. These small notes and coins would then be introduced before E-Day and in the early days of the new Euro currency, and immediately help alleviating the possibility of shortages (as consumers instead of demanding the new currency now would also supply it). A dual currency regime risks indeed exacerbating the problem by encouraging consumers to pay with the « old » national currency, just at a time when the system would most benefit from additional infusions of Euro coins and small notes.

Our proposal to greatly liberalize the distribution of small notes and coins does not meet the « letter » of the ECB directive prohibiting front-loading of notes, but in fact meets the « spirit » of the directive, since basically the letter would be violated only for small 5 and 10 Euro notes. But, naturally, the biggest change we would recommend, based on the above arguments, is to avoid any dual currency regime. Indeed, the benefits of such a dual currency period are not clear, whereas the costs are. It is hard to imagine consumers unable to pay with their national currencies, even after January 1st 2002. Retailers, used to transactions in national currencies, will in all likelihood offer as a supplementary service to their customers the ability for the latter to pay in national currencies should they wish to. Hence, the flexibility for consumers to pay with the national currency would seem to be present even under a single currency scenario.

It is the legal requirement to handle two currencies that creates logistical difficulties and eventual bottlenecks. Retailers will need to prepare for the transition on January 1st 2002. But to customers ready to join, it would be akin to telling them something like « You can arrive any time between January 1st and February 28th ». It is this asymmetry which we have argued to be potentially detrimental to the entire cash supply chain, as retailers, as a consequence of this relaxed consumer timing, cannot count on consumers to be ready for that time. In any supply chain, the bottleneck is the weakest link of the chain. With the dual currency regime, consumers turn out to become the weakest link in the system.

6. Conclusions

Our analysis of store cash transaction data, projected forward to January 2002, has tried to highlight some potential logistical difficulties facing the introduction of Euro coins and notes on that date. Rather than present definite solutions, our major aim is to present issues for consideration by retailers and policy makers.

Our simulations reveal that if consumers cannot front-load Euros, then retailers will be faced with the need to store huge quantities of the new currency, and will therefore incur prohibitive change over costs. Front-loading of coins only risks creating great difficulties for retailer cash requirements in these early days of the new currency. Front-loading of notes seems to be part of the actions that will need to be given due attention to alleviate unreasonable change over costs on one of the components (i.e., retailers) of the currency « supply chain ».

Our analysis shows further that front-loading of small notes (5 and 10 Euros) actually should have higher priority than the distribution of larger notes. This seems an important result as it stresses the need to upgrade the 10-Euro kits to 50-Euro or 100-Euro kits, to alleviate the difficulties that retailers will face during the change over.

Our final conclusion is that this change over is of unprecedented magnitude. It is hard to forecast the exact dynamics of the « cash economy » during these early days. Having illustrated some of the potential bottlenecks that may arise, one should probably contemplate several « contingency » actions that will further diminish both the risks of major disturbances and the costs that such risks will entail for *all* parties in the currency supply chain. Some of these actions might include a public campaign to encourage consumers to contribute to a smooth introduction of the Euro coins and notes, rather than to exacerbate any problems that may start arising.

This historic event might also be an opportunity to recognize that technological solutions like checks, electronic payments (via bank cards) and “e-cash” money cards all have their role to play to alleviate the risk of major problems. Indeed, all these means of payments entail very small costs in terms of currency conversions and, at the margin, reduce the need for cash exchanges. Hence, campaigns that will encourage consumers to really use their Euro-kits as a favoured means of payment during these early days, and then to turn to checks, electronic cards, or “e-cash” money rather than turn to their national currencies, will also contribute to an easier introduction of the new currency. Clear information programs on the desired behaviour of Euro consumers are an integral part of the smooth entry into « Euro-land. »

Technological solutions need not be considered as an alternative to solutions involving coins and notes, but rather as a complement and insurance to a smooth transition. Such technological solutions are in fact widely available today. However, their usage varies amongst Euro countries due to differing regulatory and pricing practices. In particular, Euro “e-cash” cards might be a

very attractive solution for consumers eager not to have to carry a (possibly) large amount of Euro coins in their pockets. And one that would greatly facilitate the change-over to the Euro, since, as is the case for all technological solutions, conversion from one currency to another one is essentially a matter of programming (hence, “e-cash” could be launched as the national currency first, and convert automatically and painlessly to Euro-cash at midnight on December 31st, 2001). At this point in time, though, the introduction of an “e-cash” card system on a European level may come too late to support the changeover process effectively.

For such a technological solution to impose itself the entire supply chain needs to adopt it. This implies that retailers (and vending operators) need to equip themselves for these “e-cash” cards. Commercial banks also should not – as is the case in certain countries today -- charge excessive fees for the use of these cards, as this seems to be one of the current impediments to a larger diffusion of this means of payment. One key difficulty encountered by this promising technological development lies in satisfactory commercial terms between different actors of the “money” supply chain.

This allows our final conclusion. The effective management of supply chains is a key competitive requirement for most industries today. Effective coordination, favourable pricing, exchange of information, customer service are some of the practices that are being generalized amongst the different actors of the supply chain in Europe and across the world. Effective supply chain practice is similarly what is needed for the effective provision of Euro coins and notes. This requires the development of a common strategy amongst the various parties (ECB, national central banks, commercial banks, retailers, consumers, operators of vending machines) active in the supply chain. Coordinated action and especially careful and continued planning are likely to be the best guarantees for a successful invasion of Euro-land. Given that the event is still two years ahead, it does appear that there is sufficient time left to do so.

But the gravest error might, as this study underlines, be to believe that a dual currency regime in the early days of the invasion denies, by virtue of its apparent flexibility, the need for substantial anticipative action ahead of that day. Making consumers believe that the change over will be smooth might in fact precisely contribute to the creation of difficulties in these early days. Our viewpoint on this issue, in light of our simulation analyses, and our interviews with retailers, is that a clear scenario, involving a substantial amount of front-loading and a single currency regime, might offer greater chances for a successful introduction of the Euro currency. In any case, the issue warrants further study, and that is the principal conclusion this paper is aiming at.