Paying with Cash:
A Multi-Country Analysis of the Past and Future of the Use of Cash for Payments by Consumers

By:

David S. Evans, Karen Webster, Gloria Colgan, and Scott Murray*

June 1, 2013

Email for corresponding author: david.evans@marketplatforms.com

Abstract:

This paper focuses on the value of consumer payments made with cash, which we refer to as "total cash spending", and the share of total spending that is made with cash, which we refer to as the "cash-spending share". We provide estimates of these measures of cash use for 2000-2011 and forecasts of these measures of cash use for 2012-2022 for ten diverse countries: France, Germany, Italy, Poland, Portugal, Spain, Sweden, Turkey, the United Kingdom, and the United States. We summarize the results across these countries using GDP-weighted compound annual growth rates. We estimate that total real cash spending increased by 2.4 percent annually between 2000 and 2011 and forecast that this growth will decline to an increase of 0.9 percent annually between 2012 and 2022. We also show that the cash-spending share increased by 1.6 percent annually between 2000 and 2011 but will likely decline by 1.5 percent annually between 2012 and 2022. We find that total cash spending will increase between 2012 and 2022, despite the decline in the cash-spending share, because total spending will increase over this period. There is great diversity in the details across countries in the historical and future evolution of cash use by consumers. However, our key finding is that, contrary to popular reports, cash is not dying. In most countries total cash spending will continue to increase, although at a slower rate than historically, and the share of spending with cash will decline but at a modest rate.

---

*Evans is Founder Market Platform Dynamics, Executive Director the Jevons Institute for Competition Law and Economics and Visiting Professor at University College London, and Lecturer, University of Chicago Law School; Webster is CEO of Market Platform Dynamics; Colgan is a Managing Director at Market Platform Dynamics; and Murray is a Principal at Market Platform Dynamics. This paper is based on research sponsored by Loomis AB. We would like to thank Patrik Anderrson of Loomis with whom we worked closely on the research, Lars Blecko, Loomis's CEO, and the Loomis Board, for their support as well as their comments and suggestions on the research. We also thank Richard Schmalensee and Margaret Weichert for many helpful comments that have improved the paper. We benefited from an exceptional research team lead by Matthew Kennedy and Jacqueline Murphy. They worked with several excellent researchers for individual countries including Moa Funk, Isabel Nazare, Alexis Pirrchio, Moa Funk, and Cemre Rasgelener.

I. Introduction

This paper reports estimates of the use of cash by consumers to pay for goods and services in ten diverse countries between 2000 and 2011: France, Germany, Italy, Poland, Portugal, Spain, Sweden, Turkey, the United Kingdom, and the United States. It then presents projections of the use of cash in these countries from 2012 through 2022. These estimates are based on a combination of the historical trajectory of cash use in these countries and an analysis of various developments, including innovations in mobile payments, in those countries that could alter the historical trends.

Our historical estimates are based on the total amount of cash that is withdrawn annually by consumers from ATM machines, over-the-counter (OTC) at bank branches, or from getting cash back at the point of sale (POS). This measure corresponds closely to the total amount of cash used by consumers for payments unlike the stock of currency much of which is used for hoarding.[1] To investigate the extent to which there are likely to be changes in the historical use of cash in a country we collected detailed information concerning a variety of factors that are likely to influence the future of payments and evaluated the likelihood of changes in historical evolution of cash use.

This paper makes a distinction between the share of consumer payments that are made with cash ("cash-spending share") and the total amount of cash used by consumers for payments ("total cash spending"). The cash-spending share reflects the propensity of consumers to pay with cash rather than paying with another payment instrument. Total cash spending depends on the propensity to use cash for payments and overall consumer spending. We generally adjust "total cash spending" for inflation and report "total real cash spending".

The paper reaches several key findings:

- Between 2000 and 2011, total real cash spending decreased in five countries and increased in five with a GDP-weighted compound annual growth rate of 2.4 percent.[2]
- Between 2000 and 2011, the cash-spending share declined in six countries and increased in four with a GDP-weighted increase of 1.6 percent per year.[3]

[1] Takala, K., & Viren, M. (2012). *Estimating cash usage in the euro area*. Working Paper, Bank of Finland, Retrieved from http://www.bundesbank.de/Redaktion/EN/Downloads/Core_business_areas/Cash_management/conferences/2012/2012_02_27_eltville_05_takala_paper.pdf?__blob=publicationFile

[2] When we report growth rates over time we always use the compound annual growth rate (CAGR). To economize on words we usually refer to these as annual growth or growth per annum when there is no ambiguity. We

- Between 2012 and 2022, total real cash spending is forecast to decrease in three countries and increase in seven with a GDP-weighted increase of 0.9 percent per year.
- Between 2012 and 2022, the cash-spending share is forecast to decline in all countries with a GDP-weighted decline of 1.5 per year.

These averages mask significant diversity across countries.

Two aspects of modern payments motivated the research we report here.

A number of commentators have claimed that cash is a rapidly dying payment system as a result of the spread of electronic payments. David Wolman's 2012 popular book *The End of Money* made the case that cash use is declining around the world and that the earlier this death occurs the better.[4] Many observers have highlighted the impact of recent mobile devices on cash use. Miguel Helft's article, "The death of cash", noted: [5]

> Tech giants—and startups like Square—want you to use your phone to pay for everything from gum to train rides. Here's how they plan to achieve cash-free-nirvana.

These sorts of claims are based on anecdotal evidence and lack any quantitative foundation. This paper provides quantitative evidence concerning what has happened over the last decade and a rigorous approach for evaluating trends over the next decade. Our research finds that the decline in the propensity by consumers to use cash has been gradual and, although the decline will accelerate in many countries, it is likely to continue to be slow in most countries.

Our research was also motivated by the dearth of reliable information on the extent to which consumers use cash. Although cash is the leading payment system in most underdeveloped and developing countries and continues to be a significant payment system in most developed countries, there is little systematic information on the use, and changes in the use, of cash by consumers for making payments. Central Banks operate the cash

---

[3] As we discuss below we use the percent changes in shares because these percent changes summarize the extent to which total cash spending is declining holding constant total spending. In fact, we show that the percent change in total cash spending is approximately, for small changes, the percent change in the cash spending share plus the percent change in total spending. Two countries would have the same percent change in the spending share if in one country the share declined by 5 percent to 4 percent and in the other it declined from 20 percent to 16 percent. While the absolute change in share is larger in the second country both countries would have a 20 percent decline in total cash spending holding total spending constant.

[4] Wolman, D. (2012). *The end of money: counterfeiters, preachers, techies, dreamers and the coming cashless society*. Boston, MA: Da Capo Press.

[5] Helft, Miguel, "The death of cash" - Fortune Tech. *Fortune Tech: Technology blogs, news and analysis from Fortune Magazine,* Retrieved May 3, 2013, from http://tech.fortune.cnn.com/2012/07/09/dorsey-square-death-cash/

payment system and determine the amount of notes and coins in circulation.[6] Most Central Banks, however, do not collect data or conduct research on the use of cash for payments. In most countries, in fact, there is scant time series evidence on the use of cash for payments. This paper develops a methodology for estimating cash use, and the change in cash use, from available data. It is possible to extend our approach to many other countries.

We present our analysis in the next five sections. Section II describes our methodology for estimating the historical use of cash and presents our estimates for 2000-2011. It also reports "naïve" forecasts of changes in the use of cash based only on observable the historical trend. Section III describes our methodology for estimating the extent to which there is a risk that cash would decline more rapidly than predicted by the historical trend. It then summarizes and discusses the "cash-at-risk scores" that we have estimated for the countries. Section IV presents a model of how payments innovations diffuse across age groups over time and the interaction with this and changes in the distribution of ages over time. Section V then reports our estimates of changes in the overall use of cash, and its share of payment use, based on adjusting our naïve forecasts with the cash-risk scores and the diffusion model. Section VI discusses the results and their implications. Two appendices provide additional details.

II. Estimates of the Historical Use of Cash Payments

This section reports estimates of the use of cash payments for the study countries between 2000 and 2011. Part A explains why the standard measure of cash use based on notes and coins in circulation is a poor measure of cash for consumer payments. Part B explains our methodology for estimating the use of cash by consumers and Part C presents our estimates based on this methodology. Part D discusses these results. Part E then reports our naïve forecasts of cash use for 2012-2022 based on the historical use of cash; these estimates are subsequently adjusted by subjective estimates of the impact of innovation on the historical trends in Section IV.

A. The Problem with Notes and Coins in Circulation as a Measure of Cash Use

The most widely available measure of cash is the amount of notes and coins in circulation. Virtually all Central Banks report this figure annually and several organizations

[6] Central banks of countries in the Eurozone do this in concert with the European Central Bank.

such as the Bank for International Settlements (BIS) compile these data for many countries.[7] Unfortunately, the amount of currency in circulation at a point in time does not provide an accurate measure of the amount of cash that is used for payments for two reasons.

The first reason is that a portion of domestic currency is not used for domestic spending, either because it has been diverted to a foreign market or because domestic or foreign entities are using currency as a store of value rather than a medium of exchange. A Federal Reserve Study concluded, for example, that around 66 percent of US currency circulates abroad and consists disproportionately of $100 bills or discontinued bills of even larger denominations.[8] While some of this currency is used for ordinary payments in place of domestic currencies, or for illegal activities, it is likely that a large fraction of it is used as a store of value and not as a medium of exchange. A portion of the 34 percent of US currency that is not used abroad is also hoarded in the US as well. Thus, only a small portion of the US currency in circulation is used by consumers to pay for goods and services in the US.

The second reason is that the amount of spending that is supported by a given value of currency also depends on the velocity with which currency change hands. As is well known in monetary economics, the total volume of monetary transactions over a period of time equals the velocity of money times the stock of money.[9]

$$P = v\,M$$

where P is the total value of transactions, M is the stock of money, and v is the velocity of money. The velocity of money is in effect the frequency with which money changes hands

$$v = \frac{P}{M}.$$

A given amount of notes in a country could correspond to a higher or lower amount of annual cash payments depending on whether the velocity of spending notes is higher or lower.

Changes in the value of notes in circulation also result in an unreliable estimate of changes in cash spending. Let f represent the share of cash that is held outside of the

[7] Bank of International Settlements, "Statistics on payment, clearing and settlement systems in the CPSS countries: Figures for 2011," Committee on Payment and Settlement Systems, January 2013.
[8] See Judson, R. (2012). Crisis and Calm: Demand for U.S. Currency at Home and Abroad From the Fall of the Berlin Wall to 2011. *International Finance Discussion Papers*, November 2012 from http://www.federalreserve.gov/pubs/ifdp/2012/1058/default.htm Also see Williams, J. (2012). Cash Is Dead! Long Live Cash!. *Federal Reserve Bank of San Francisco*, *1*. Retrieved May 3, 2013, from http://www.frbsf.org/publications/federalreserve/annual/2012/
[9] Mankiw, N. G. (2010). *Macroeconomics*. (7 ed.). New York: Worth Pub.

country and h the share of cash that is hoarded domestically. Then, assuming M represents cash in circulation and P represents cash spending:

$$P = v\,(1-h)(1-f)M$$

It is easy to see through total differentiation of this equation that changes in total cash spending depend on changes in currency, changes in velocity changes in domestic hoarding and changes in the diversion of cash to foreign markets.

One could consider "spending notes" in circulation as a proxy for cash that is used for payments rather than hoarding.[10] Spending notes are usually defined as those that consumers take from ATMs and use daily for payments. In the US, for example, ATMs do not distribute notes larger than $20 and most people pay with denominations of $20 or less. Although spending notes are less likely to be hoarded, by domestic or foreign consumers, this measure is still subject to the problem that the amount of spending supported by spending notes depends on the velocity of money and that some spending notes could be diverted to foreign markets. Moreover, spending notes excludes large value notes that are used for domestic purchases; while few people may use these large notes for purchases they could add up to a significant amount of spending. For these same reasons changes in spending notes are not likely to provide a reliable estimate of changes in cash spending.

Our conclusion is that time series data on the value of notes in circulation and the value of spending notes in circulation are not likely to provide accurate estimates of the level or changes in cash spending. In fact, we will show below that the correlation between changes in the stock of notes and coins in circulation and changes in use of cash by consumers for payments is small and not always positive; the same statement is true for spending notes and coins.[11]

B. Measuring the Use of Cash for Payments

We now turn to our approach for measuring the use of cash by consumers for payments. Consider a consumer on January 1st of given year. She has a certain amount of cash on hand. Over the course of the year she spends cash and replenishes her cash. Depending on which country she lives in, she obtains cash from ATMs, from her bank "over-

[10] For an example of this approach see Amromin, G., & Chakravorti, S. (2007). Debit Card and Cash Usage: A Cross-Country Analysis. *FRB of Chicago Working Paper, March*. Retrieved May 3, 2013, from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=981236

[11] Furthermore, an inspection of the time series of total notes and spending notes reveals trends and year-to-year fluctuations that appear implausible.

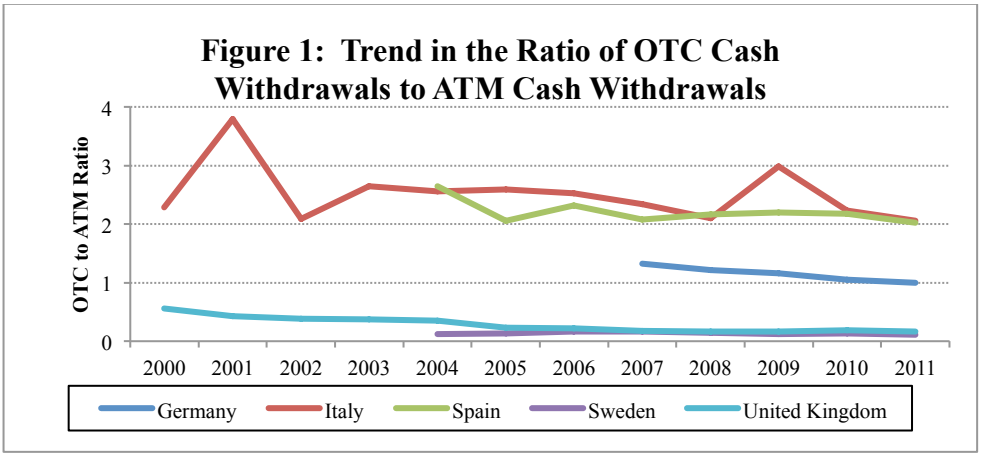
the-counter" (OTC), by getting cash back at the point of sale (POS), from cash she receives from other consumers, for example in the form of gifts, and from cash payments for services she provides. On January 1 of the next year she will have a certain amount of cash on hand. Assuming that her cash on hand at the beginning of each year is similar—so she is not increasing or decreasing her cash hoard—the amount of cash she has spent over the course of the year is given by the amount of cash she has obtained from the various sources listed above.

To measure the amount of cash spending we therefore calculate the amount of cash that consumers in a country withdraw from ATMs, OTC at banks, and at POS at merchants.[12] This measure is not subject to most of the problems that affect the value of notes in circulation. Conceptually this measure corresponds to the flow of cash used for spending rather than the stock of recyclable cash. The variability of the velocity of cash is therefore not an issue. Cash withdrawals within a country are likely to be used primarily for domestic spending. It is possible, however, that some of these funds withdrawn are used for domestic hoarding. While we do not want to dismiss this bias we suspect that domestic cash hoarding is less prevalent than foreign cash hoarding and that it is more stable over time so that changes in cash withdrawals may be a more reliable proxy for changes in cash spending.

Although cash withdrawals provides a more accurate measure of cash spending than alternatives based on the value of notes, there are two practical challenges in obtaining the necessary data for all of the components of cash withdrawal. Data on OTC withdrawals of cash from banks is not available in many countries. In fact, OTC withdrawals were not available systematically from published sources for 5 of the 10 countries we consider including the US. That is a serious gap since we know for two of the countries in which those data are available—Italy and Spain—that the value of OTC withdrawals are more than twice the value of ATM withdrawals. To estimate OTC withdrawals we have used the ratio of OTC to ATM withdrawals where data is available to estimate the OTC withdrawals for countries where only ATM withdrawal data is available. ATM withdrawals are available for all of the countries we have studies so this method can be implemented for all of the countries.

[12] See Takala and Viren for a detailed discussion of this approach and an implementation of some aspects of it for some countries, op. cit.

It is likely that the ratios of OTC to ATM withdrawals have varied over time. In some countries banks have made more concerted efforts than in other countries to discourage consumers from using bank branches and have tried to shift cash withdrawals in particular from bank tellers to ATMs. Figure 1 reports the time series of the OTC/ATM ratio for the 5 countries for which we have data; Table A1 in the appendix reports the raw data.



The ratios have declined significantly in Germany, Spain, and the United Kingdom and have remained roughly constant in Italy and Sweden. By 2011 the ratio in Germany was 1.0, in Italy and Spain slightly more than 2.0, and much smaller in Sweden (0.11) and the United Kingdom (0.17). As shown on the figure, the OTC to ATM ratio is declining—although erratically— for every country for which data is available. Even through some countries still have large OTC/ATM ratios, the overall trend is for consumers to stop going to banks to obtain cash and get it from ATMs and for banks to reduce bank branches and otherwise discouraging consumers from relying on branch branches and tellers. Countries in which the OTC/ATM ratio is smaller or has declined tend to be countries in which the number of bank branches per capita is smaller or has declined as well and in which there is a higher and increasing density of ATMs.

To interpolate the OTC figure for countries where we lack OTC data, we have compared each country for which we have missing data to one or more "similarly situated" countries based on the trend in bank branches, ATM use, and information on the extent to which banks were discouraging the use of ATMs. When we had more than one country as a comparison we took the arithmetic average of the ratios for each year. Table 1 lists the countries for which we lacked OTC data, the countries chosen for comparison, and an

explanation for that choice.[13] In the case of Portugal and the United States we have confirmed from confidential discussions with bank executives in those countries that the level of our estimates of OTC to ATM withdrawals is approximately correct. As a result we are quite confident in our estimates of the level of cash use in all of the countries except France, Poland, and Turkey.

Table 1: Countries with Missing OTC Data and Comparison Country

Country	Comparison Country	Rationale
France	Italy	French ATM withdrawal as % of GDP and bank branch trends and levels lined up very well with Italy
Poland	Germany	Bank branch and ATM terminalization most similar to Germany. . Card payment levels were closest to Germany
Portugal	UK & Sweden	Portuguese ATM as % of GDP was very high and card payments as % of GDP were close to UK and Sweden.
Turkey	Germany	Trends in Turkey do not align well with other countries for which data is available. However, modernization in Turkey is likely to focus more on ATM deployment than bank branches.
United States	Italy	Bank branch trends very similar to Italy

In some countries consumers are also able to take out cash at the POS although the amounts are limited. We consulted with knowledgeable individuals in each country to determine whether POS withdrawals were possible or common. That investigation revealed that POS withdrawals are material only in Sweden, the UK, and the US. For the UK, POS withdrawal data were available annually from publicly available statistics. However, for the US and Sweden we interpolated this data from available survey data points which provided the ratio of POS to ATM withdrawals for some years.

Cash recycling is the final material source of cash for consumers but there are no systematic data available. However, Takala and Viren estimate that cash recycling is about 15 percent in the 12 Eurozone countries they consider.[14] We ignore cash recycling and therefore our estimates understate total cash spending for payments by consumers at a point in time. So long as cash recycling as a percent of total cash use has not changed much over time our estimates of changes in cash growth should not be affected. Since most of our

[13] The comparison was straightforward for all countries but Turkey. In particular, the number of bank branches per capita is much lower in Turkey than in the comparison countries, but the number of bank branches per capita is growing in Turkey whereas in the comparison countries the number is falling. The same is true for ATM terminals per capita, where they are relatively low but growing much faster than any of the comparison countries. Our judgment was that the OTC to ATM ratio was likely to be similar to Germany, which is relatively low, on the grounds that modernization in Turkey has resulted in greater reliance on ATMs than bank branches. However, we are least confident in our estimates of the level of cash use in Turkey than in the other countries.

[14] See Takala and Viren, op. cit.

analysis concerns changes in cash use rather than the absolute amount the exclusion of recycling is not likely to have material impact on our key findings.

C. Historical Estimates of Cash Use for Payments by Consumers

The total amount of cash (C) used in a country at a point in time depends on the total amount of spending by consumers (T) and the share (s) of that spending that takes place with cash rather than another payment instrument. The two identities we use are:

$$C = s\,T$$

where

$$s = C \div T$$

This decomposition highlights the fact that the total cash use in a country depends on the propensity of consumers to pay with cash and the total amount of consumer spending which depends on the size of the economy. Cash spending can therefore increase even though the propensity to pay with cash (that is, the cash-spending share) decreases.

Personal consumption expenditure is the obvious proxy for total consumer spending. We chose Gross Domestic Product (GDP) instead because consistent historical time series data for GDP are available for most countries and because there are forecasts of GDP available for most countries from the International Monetary Fund (IMF). The correlation between GDP and PCE in the countries exceeds 0.99.[15] Therefore, for the purposes of our analysis we use

$$C = s\,GDP$$

where

$$s = C \div GDP$$

We use IMF data for the historical time series of GDP and for annual forecasts over the next decade. To show the cash propensity on a normalized basis across country for historical purposes we also report below total cash use as a percent of PCE.

As discussed above we measure the cash share by

$$C = ATM + OTC + POS$$

where ATM is the total ATM withdrawals, OTC is total bank OTC withdrawals and POS is total withdrawals at retail stores. Appendix A describes our sources of data for each of

[15] The median ratio of PCE/GDP across countries is 0.61 and the ratio ranges from a low of 0.47 in Sweden to a high of 0.71 in Turkey.

these components for each country including details of our interpolations for OTC for countries for which we lack data. It also reports total cash usage and the three components for each country.

1. Estimates of Levels in Nominal and Real Values

Table 2 summarizes the results using the total nominal value of cash. For each country we show total nominal cash, the cash-spending share, and GDP for 2000-2011 although in some cases we have complete data for a fewer number of years. The figures are in local currency for this table; in the remainder of the paper we convert figures to euros.

Table 2: Historical Estimates of Cash Use by Country and Year as Reported in Local Currency Units

	France			Germany			Italy			Poland			Portugal		
	Cash	GDP	Share	Cash	GDP	Share	Cash	GDP	Share	Cash	GDP	Share	Cash	GDP	Share
2000	253	1,440	17.6%	254	2,048	12.4%	233	1,198	19.5%	215	744	28.9%	25	127	19.8%
2001	263	1,496	17.6%	261	2,102	12.4%	351	1,256	28.0%	239	780	30.7%	26	134	19.5%
2002	276	1,543	17.9%	265	2,132	12.4%	291	1,302	22.3%	269	809	33.3%	28	141	19.6%
2003	289	1,588	18.2%	304	2,148	14.1%	262	1,342	19.5%	297	843	35.2%	28	143	19.9%
2004	301	1,656	18.2%	340	2,196	15.5%	274	1,398	19.6%	344	925	37.2%	30	149	19.9%
2005	358	1,718	20.8%	382	2,224	17.2%	284	1,436	19.8%	380	983	38.6%	32	154	20.6%
2006	364	1,798	20.3%	381	2,314	16.5%	294	1,493	19.7%	412	1,060	38.9%	34	161	20.9%
2007	386	1,887	20.4%	693	2,429	28.5%	304	1,554	19.6%	470	1,177	39.9%	35	169	20.9%
2008	411	1,933	21.3%	691	2,474	27.9%	304	1,575	19.3%	508	1,275	39.8%	36	172	21.0%
2009	429	1,886	22.7%	685	2,375	28.8%	367	1,520	24.1%	523	1,344	38.9%	36	169	21.4%
2010	436	1,937	22.5%	646	2,496	25.9%	398	1,553	25.6%	527	1,416	37.2%	37	173	21.2%
2011	450	1,997	22.6%	666	2,593	25.7%	379	1,580	24.0%	547	1,525	35.9%	36	171	20.8%

Table 2 (continued): Historical Estimates of Cash Use by Country and Year as Reported in Local Currency Units

	Spain			Sweden			Turkey			United States			United Kingdom		
	Cash	GDP	Share	Cash	GDP	Share	Cash	GDP	Share	Cash	GDP	Share	Cash	GDP	Share
2000	n/a	630	n/a	271	2,291	11.8%	n/a	167	n/a	n/a	9,951	n/a	181	975	18.5%
2001	n/a	680	n/a	282	2,378	11.9%	111	240	46.3%	n/a	10,286	n/a	188	1,020	18.4%
2002	82	729	11.2%	269	2,475	10.9%	120	350	34.2%	n/a	10,642	n/a	195	1,069	18.2%
2003	91	783	11.6%	282	2,581	10.9%	146	455	32.2%	1,789	11,142	16.1%	204	1,137	17.9%
2004	350	841	41.6%	341	2,686	12.7%	202	559	36.1%	n/a	11,853	n/a	224	1,200	18.7%
2005	310	909	34.1%	338	2,794	12.1%	249	649	38.4%	1,548	12,623	12.3%	219	1,263	17.4%
2006	358	986	36.3%	333	2,978	11.2%	289	758	38.1%	1,805	13,377	13.5%	226	1,333	17.0%
2007	351	1,053	33.3%	292	3,165	9.2%	330	843	39.2%	1,966	14,029	14.0%	226	1,412	16.0%
2008	369	1,088	33.9%	286	3,240	8.8%	381	951	40.1%	2,039	14,292	14.3%	231	1,441	16.0%
2009	362	1,048	34.6%	270	3,147	8.6%	433	953	45.5%	2,057	13,974	14.7%	230	1,402	16.4%
2010	363	1,049	34.6%	258	3,383	7.6%	480	1,099	43.7%	2,181	14,499	15.0%	227	1,467	15.5%
2011	343	1,063	32.2%	263	3,537	7.4%	542	1,298	41.8%	n/a	15,076	n/a	230	1,516	15.2%

Notes:
Cash is equal to the total cash withdrawals in billions of local currency units for each country. Total cash withdrawals are equal to the sum of ATM and OTC withdrawals for all countries. For the UK, US and Sweden we also include data for cash withdrawals at the POS. GDP is equal to the nominal GPD for each country in billions of local currency units as reported by the IMF. Share is equal to the total cash withdrawals divided by the nominal GDP in each country. Local currency units are Euros for France, Germany, Italy, Portugal, and Spain. The local currency units for other countries are the following: Polish Zloty, Swedish Krona, Turkish Lira, Great British Pound and the US Dollar. The share is the ratio of total cash to GDP.

Figure 2 reports the total nominal cash use in euros for the countries in 2011. The smallest amount of total nominal cash use is in Sweden while the largest is in the United States. These figures are driven to a large degree by the size of the economies.

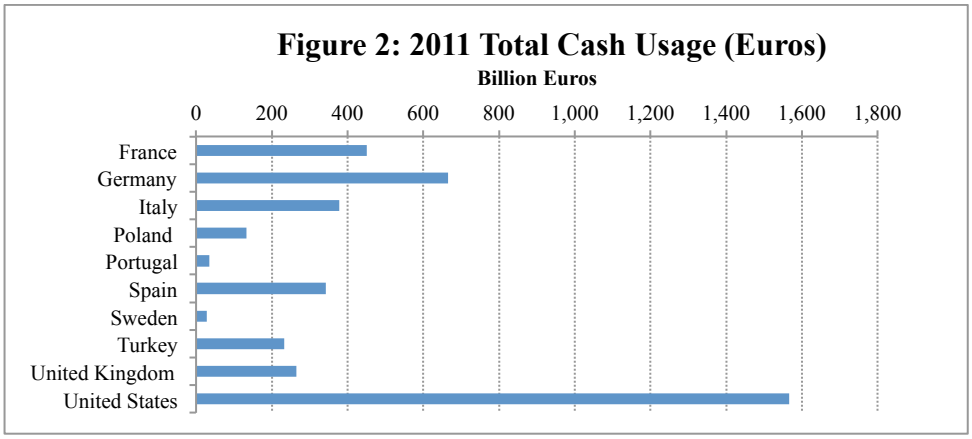
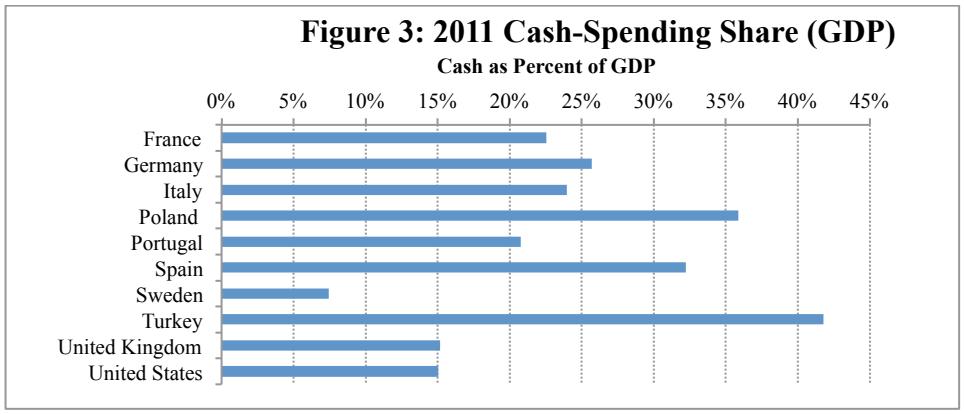
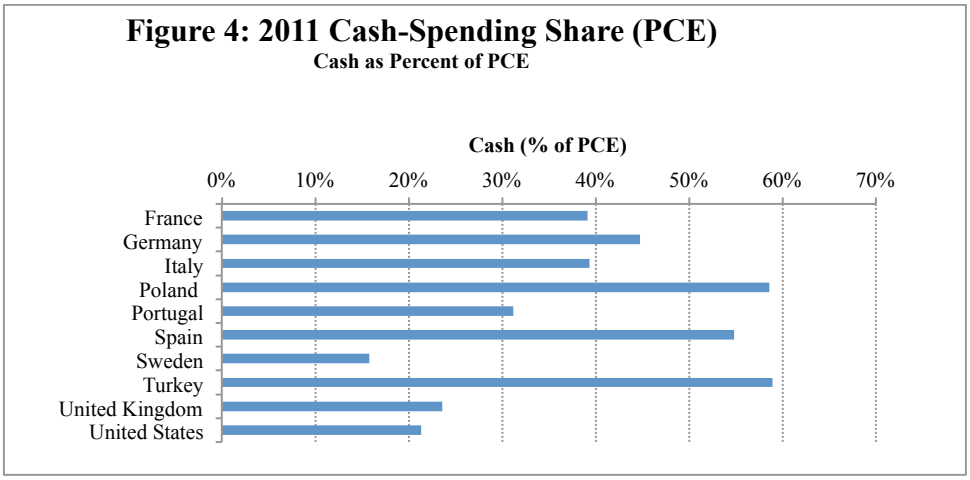


Figure 3 reports the cash-spending share for countries in 2011 based on GDP. The median cash-spending share is 23.3 percent and the GDP-weighted share is 19.5 percent. The cash-spending shares range from 7.4 percent in Sweden to 41.8 percent in Turkey.

These figures can be used to assess differences in the propensity to use cash across countries. Sweden, the United Kingdom, and the United States have relatively low propensities by consumers to use cash while Poland, Spain, and Turkey have relatively high propensities.

Figure 4 reports the cash-spending share based on PCE. The GDP-weighted cash-spending share is 30.6 percent and the shares range from 15.8 percent in Sweden to 58.9 percent in Turkey. The rankings of the countries are similar to those we had for GDP.





2. Estimates of Changes

The change in total cash use depends on the change in the cash-spending share and the change in GDP. In fact, for small changes the percent change in cash equals the percent change in share plus the percent change in GDP:

$$\frac{\Delta C}{C} = \frac{\Delta s}{s} + \frac{\Delta GDP}{GDP}$$

where Δ denotes a small change.[16] In the remainder of the paper we will report CAGRs for each of these three quantities.

In the case of the cash-spending share, s, it is important to note that we are focusing on and report the percent change in the share, $\frac{\Delta s}{s}$, rather than the change in the share itself Δs. To see the difference consider the case in which the cash-spending share is 5 percent in country A and 20 percent in country B. Holding total spending constant, a 20 percent change in the cash-spending share would result in the cash-spending share declining from 5 percent to 4 percent in country A and 20 percent to 16 percent in the country B. The absolute change in the share, however, is 1 percent for country A and 4 percent for country B. The percent change in the share is the relevant metric for understanding changes in total cash spending. A one percentage point drop in the share for country A would result in a 20 percent decline (1/5) in total cash spending holding total spending constant while a one percentage point drop in the share for country B would result in a 5 percent decline (1/20) in total cash spending.

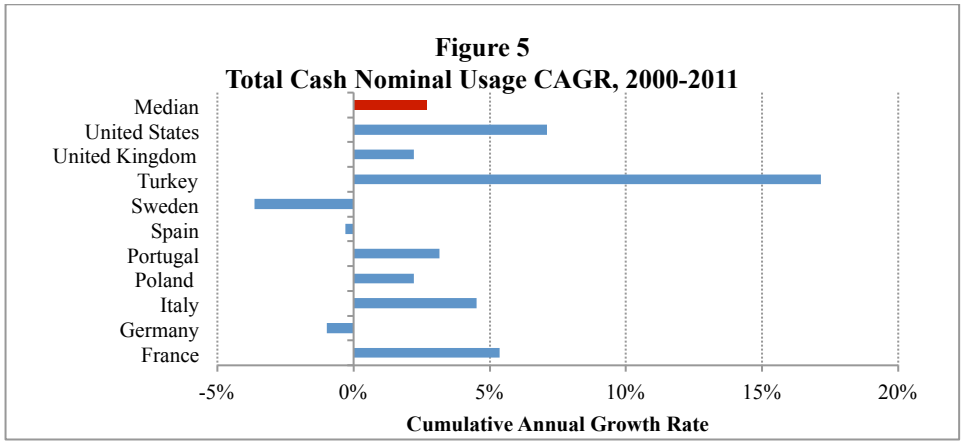
Table 3 reports the estimated annual changes in total nominal cash use.

Table 3: Changes in the Total Nominal Cash

	France	Germany	Italy	Poland	Portugal	Spain	Sweden	Turkey	UK	US
2000	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2001	3.8%	n/a	50.7%	6.0%	3.9%	n/a	n/a	n/a	4.0%	n/a
2002	4.8%	n/a	-17.2%	8.7%	5.4%	n/a	n/a	7.8%	3.8%	n/a
2003	5.0%	n/a	-10.1%	5.7%	3.3%	n/a	n/a	22.1%	4.6%	n/a
2004	3.9%	n/a	4.9%	5.9%	4.5%	n/a	n/a	37.8%	9.8%	n/a
2005	19.1%	n/a	3.6%	3.8%	6.8%	-11.5%	-0.8%	23.5%	-2.1%	n/a
2006	1.7%	n/a	3.5%	0.7%	6.0%	15.4%	-1.3%	15.9%	3.1%	16.6%
2007	5.9%	n/a	3.5%	2.8%	5.1%	-2.0%	-12.6%	14.4%	0.1%	8.9%
2008	6.5%	-0.4%	-0.1%	-0.3%	2.1%	5.2%	-2.0%	15.5%	2.1%	3.7%
2009	4.3%	-0.9%	20.6%	-2.2%	-0.3%	-1.8%	-5.6%	13.7%	-0.3%	0.9%
2010	1.7%	-5.7%	8.5%	-4.3%	1.4%	0.2%	-4.4%	10.7%	-1.2%	6.0%
2011	3.4%	3.2%	-4.7%	-3.6%	-2.8%	-5.6%	1.9%	13.0%	1.1%	n/a
CAGR	5.4%	-1.0%	4.5%	2.0%	3.2%	-0.3%	-3.6%	17.2%	2.2%	7.1%
GDP-weighted CAGR across all Countries										**4.9%**
Median CAGR across all Countries										**2.7%**

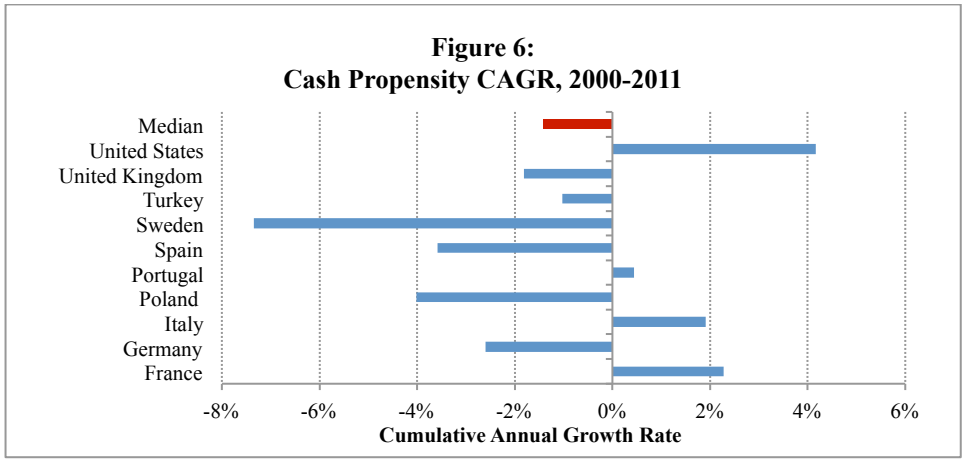
[16] This formula, however, is not exact for large changes and includes the cross product of the two right-hand terms so that $\frac{\Delta C}{C} = \frac{\Delta s}{s} + \frac{\Delta GDP}{GDP} + \frac{\Delta s}{s} x \frac{\Delta GDP}{GDP}$. For small changes the cross-product is very small and can be ignored.

For each country, Table 3 reports the percent annual change for each year and the compound annual growth rate (CAGR) over the years for which we have data. Figure 5 reports the CAGR for total nominal cash use across the countries over time.



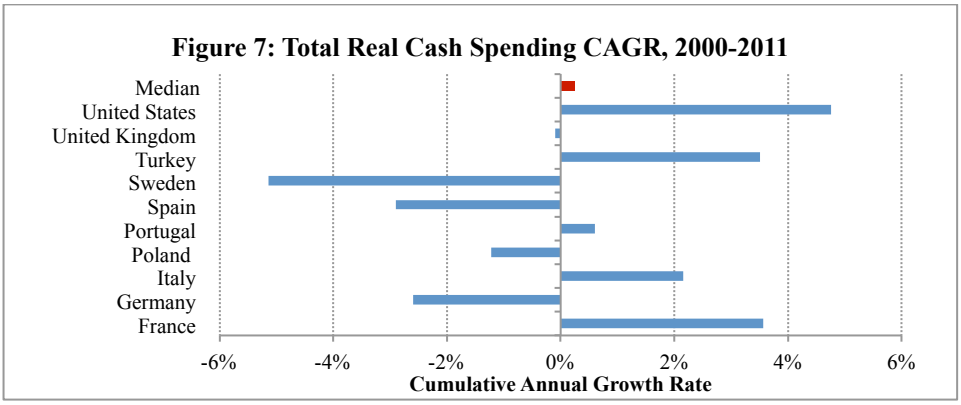
The median change in total nominal cash use, based on the CAGRs over 2000-2011 for the ten countries, is 2.7 percent and the GDP-weighted change was 4.9 percent. It ranges from -3.6 percent in Sweden to 17.2 percent in Turkey.

Figure 6 reports the CAGR for the cash share across the countries between 2000 and 2011. The median is -1.4 percent and the GDP-weighted average is 1.6 percent. The weighted average is positive while the median is negative because several large countries, particularly the US and France have had increases in total cash use. The growth rates range from -7.4 percent in Sweden to 4.2 percent in the US.



3. Inflation-Adjusted Estimates

Of course, over time inflation erodes the purchasing power of cash and other money. An interesting question is whether the total value of cash has increased after accounting for inflation. Figure 7 reports the CAGR for total real cash spending. The median percent change in total cash payments by consumers in real terms was 0.3 percent and the GDP-weighted figure was 2.4 percent. The percent change ranges from a low of -5.1 percent in Sweden to a high of 4.8 percent in the United States. For the remainder of this paper we focus on total real cash spending and changes in this real quantity.



D. The Evolution of Cash Use in the 2000s

During the last decade consumers in most countries have not reduced their use of cash for payments significantly and in some cases not at all. The median annual decline in the cash-spending share was only 1.4 percent per year and six of the ten countries had essentially no decrease in the share of cash. This result may seem surprising given that the use of electronic payments has increased in most countries. It appears that most of this increase has come at the expense of checks whose use has plummeted everywhere. Moreover, over the decade using cash has become more convenient as a result of the spread of ATM/debit cards and the penetration of ATMs.

Total cash spending has increased in most countries. The median annual increase was 2.7 percent in nominal currency and 0.3 percent in inflation-adjusted currency. The only country that did not have a significant increase was Sweden in real or nominal terms; Spain and Germany also showed some declines in real terms.[17] This result is not surprising.

[17] Spain's decline is largely due to data in 2004 and recent trends are quite flat. Germany data is based on only 5 years of data.

The total amount of cash used for payments increases as long as consumer spending increases at a faster rate than the share of spending made with cash declines. The decline in cash spending share has in fact been relatively small compared to the growth in GDP.

We have examined the relationship between our estimates of cash use and the estimates that would be obtained from using either total notes or spending notes. Table 4 shows the estimates of total cash use as a percent of GDP by year for the five countries for which we have complete data on ATM, OTC, and POS withdrawals of cash. It is apparent that total notes and spending notes give much different estimates of cash use and, more importantly, vastly different estimates of the growth in the use of cash. Moreover, the annual changes for total and spending notes are highly erratic. The data for the United Kingdom is particularly notable since we have the most accurate data on ATM, OTC, and POS in that country. Our measure shows a relative decline in the use of cash in the UK, which is consistent with anecdotal evidence, while total and spending notes by contrast shows a cash boom, which is not consistent. Since our measure provides a close approximation to total cash payments by consumers we can conclude that both total and spending notes provide highly inaccurate estimates of the level and growth of cash payments by consumers.

Table 4: Total Cash Use as a Percent of GDP using Alternative Measures

	United Kingdom			Spain			Sweden		
	Total Cash Use	Total Notes	Spend-ing Notes	Total Cash Use	Total N&C	Spend-ing Notes	Total Cash Use	Total Notes	Spend-ing Notes
2000	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2001	4.0%	7.1%	6.7%	n/a	n/a	n/a	n/a	9.7%	14.2%
2002	3.8%	7.0%	8.1%	n/a	n/a	n/a	n/a	-0.1%	2.2%
2003	4.6%	9.0%	8.1%	n/a	17.5%	n/a	n/a	1.8%	5.4%
2004	9.8%	6.9%	7.2%	n/a	13.8%	n/a	n/a	0.0%	0.1%
2005	-2.1%	3.2%	2.7%	-11.5%	12.8%	n/a	-0.8%	2.0%	3.5%
2006	3.1%	5.1%	5.2%	15.4%	11.1%	n/a	-1.3%	1.2%	6.9%
2007	0.1%	6.2%	5.3%	-2.0%	7.6%	n/a	-12.6%	1.7%	7.7%
2008	2.1%	3.6%	2.0%	5.2%	12.4%	n/a	-2.0%	-1.8%	3.3%
2009	-0.3%	8.0%	7.5%	-1.8%	16.1%	n/a	-5.6%	-2.8%	-0.3%
2010	-1.2%	3.4%	2.5%	0.2%	4.1%	n/a	-4.4%	-4.2%	-2.2%
2011	1.1%	5.3%	6.1%	-5.6%	5.6%	n/a	1.9%	-4.9%	-2.2%
Correlation		**0.52**	**0.55**		**0.07**	**n/a**		**-0.34**	**-0.43**

Table 4 (continued): Total Cash Use as a Percent of GDP using Alternative Measures

	Germany			Italy		
	Total Nominal Cash Spending	Total Notes	Spend-ing Notes	Total Nominal Cash Spending	Total Notes	Spend-ing Notes
2004	n/a	n/a	n/a	n/a	n/a	n/a
2005	n/a	n/a	n/a	n/a	n/a	n/a
2006	n/a	n/a	n/a	n/a	n/a	n/a
2007	n/a	n/a	n/a	-10.1%	17.5%	n/a
2008	n/a	n/a	n/a	4.9%	14.1%	n/a
2009	n/a	n/a	n/a	3.6%	12.8%	n/a
2010	n/a	n/a	n/a	3.5%	11.2%	n/a
2011	n/a	n/a	n/a	3.5%	6.3%	n/a
2000	-0.4%	12.4%	n/a	-0.1%	12.4%	n/a
2001	-0.9%	-2.6%	n/a	20.6%	5.3%	n/a
2002	-5.7%	4.1%	n/a	8.5%	4.1%	n/a
2003	3.2%	5.6%	n/a	-4.7%	5.6%	n/a
Correlation		**0.15**	**n/a**		**-0.55**	**n/a**

Note: Notes includes notes and coins in circulation.

E. Naïve Forecasts of Cash Use for the Next Decade

We have used the historical trend in cash to forecast the growth of cash in the next decade. These forecasts are "naïve" in the sense that they are based only on looking at the historical trend and do not consider any additional information concerning innovation or other prospective factors, discussed in the next section, on the likely evolution of cash. Our basic methodology for forecasting cash use involved forecasting the cash spending share and then applying that to IMF forecasts of GDP to determine total case use.

To forecast the propensity to use cash we used a simple log regression over time to estimate future share based only on the historic trend. Our regression specification was:

$$s = \alpha + \beta \times Log(Year) + \epsilon$$

The trend in the cash payment share was positive in five of the ten countries: France, Italy, Portugal, Spain and the United States.[18] In most cases these rising shares appeared to be the result of increased cash use during the financial crisis. It appeared implausible given the increased use of electronic payments that the increasing use of cash could continue. We therefore capped the increase in the cash share at 0 percent in these countries and assumed

[18] In the case of Spain, the trend was negative but has been flat since 2005. As such, the future trend in Spain is assumed to be flat even through the statistical calculation would indicate a negative trend.

that the cash share would remain at its 2011 level. This approach could result in an overstatement in the rate of decline in cash over the next decade to the extent that recent historical trend concerning increasing use of cash continued. We decided to take this conservative approach given that many observers have the prior belief that cash will decline at a rapid rate and our results indicate that this prior belief is not consistent with the evidence.

Table 5 reports the projections of total cash use and spending shares for the 10 countries as well as the CAGRs for each. We will use these naïve forecasts as an input into forecasts that consider the effect of innovation in Section IV.

Table 5: Naïve Cash Projections, 2012-2022

	Nominal GDP			Total Cash Use in 2022 (Index 2012=100)			CAGR 2012-2022		
	2011 (Local)	Euro FX Rate	2011 (Euros)	GPD	Share	Total Cash Use	GPD	Share	Total Cash Use
France	1,997	1.000	1,997	143.4	100.0	143.4	3.7%	0.0%	3.7%
Germany	2,593	1.000	2,593	132.4	82.9	109.8	2.8%	-1.9%	0.9%
Italy	1,520	1.000	1,520	128.6	80.5	103.5	2.5%	-2.2%	0.3%
Poland	1,525	4.117	370	178.8	85.6	152.9	6.0%	-1.5%	4.3%
Portugal	171	1.000	171	133.2	100.0	133.2	2.9%	0.0%	2.9%
Spain	1,063	1.000	1,063	129.2	100.0	129.2	2.6%	0.0%	2.6%
Sweden	3,537	9.031	392	154.7	70.5	109.1	4.5%	-3.4%	0.9%
Turkey	1,298	2.335	556	243.9	100.0	243.9	9.3%	0.0%	9.3%
United Kingdom	1,516	0.868	1,747	163.9	94.3	154.6	5.1%	-0.6%	4.5%
United States	15,076	1.393	10,826	164.8	100.0	164.8	5.1%	0.0%	5.1%
GDP Weighted Average			**21,233**	**156.3**	**95.3**	**149.7**	**4.5%**	**-0.5%**	**4.0%**
Median				**149.0**	**97.2**	**138.3**	**4.1%**	**-0.3%**	**3.3%**

Note**:** Nominal GDP is reported in billions. Total cash use shows the indexed value for GDP, naïve share and total cash use in 2022 (Indexed to 2012). CAGR is the cumulative annual growth rate from 2012-2022.

III. Analysis of the Impact of Payments Innovation on Cash Use

A. Risks to Cash

At least by the end of the last decade cash was not anywhere near death's door in these ten countries although it was certainly withering in Sweden. However, the pace of innovation in payments started accelerating at the end of the last decade. The explosive growth of smart mobile devices, which followed the June 2007 introduction of the iPhone has, in particular, resulted in the introduction of a variety of mobile payment alternatives. For example, in the United States, the Starbucks mobile payment had more than 7 million

users who account for 2 million transactions per week by the end of 2012.[19] Some have speculated with that mobile payments are a particular threat to cash. To quote Miguel Helft again, "Tech giants—and startups like Square—want you to use your phone to pay for everything from gum to train rides." Square and similar devices enable merchants that used to primarily take cash to take cards. Moreover, it is likely that at least some of the people paying with the Starbucks mobile app for their cups of coffee used to pay for cash. Around the world, entrepreneurs are introducing new ways to pay with mobile devices.

Payments innovation is not the only thing that threatens cash in the next decade. As a result of the continuing financial crisis in some parts of the world, especially the European Union, some countries have focused on the fact that people and businesses use cash to avoid taxes. In many EU countries, for example, when consumers pay in cash, merchants can avoid paying VAT taxes as well as business taxes. They therefore can, and many do, offer consumers a significantly lower price for paying in cash; some only take cash. The Swedish government tackled this problem by requiring that merchants use cash registers that reported the receipt of cash payments electronically to the government as of January 1, 2010.[20] In late 2011, Italy prohibited the use of cash for payments over €1000 and the French government has proposed a similar restriction.[21]

Meanwhile, the electronic payment card industry views displacing cash as a main avenue of growth going forward. MasterCard's CEO, for example, has "declared war on cash."[22] The payment card industry is displacing cash in part through a seemingly inexorable march into more and more sectors of the economy in which cash was the predominant form of payment. In the last few years taxi drivers in many cities around the world have started taking cards for payment and a few merchants—for example some airlines for inflight purchases—have stopped taking cash altogether. Recent articles on the sharp decline in the use of cash in Sweden have noted that even a church has installed a card reader to take donations.[23]

---

[19] Handford, R. (2013, January 29). Over 7M users for Starbucks payment app, *Mobile World Live* Retrieved May 3, 2013, from http://www.mobileworldlive.com/over-7m-users-for-starbucks-payment-app

[20] Skatteverket, Cash register legislation becomes effective 1 January 2010 | Skatteverket. (n.d.). *Startsida* Retrieved May 3, 2013, from http://www.skatteverket.se/foretagorganisationer/startadrivaavslutaforetag/kassaregister/cashregister legislationbecomeseffective1january2010.4.69ef368911e1304a6258000272.html

[21] Matonis, J. (2013, February 14). France Plans To Prohibit Cash Payments Over a €1,000 . *Forbes*, Retrieved from http://www.forbes.com/sites/jonmatonis/2013/02/14/france-plans-to-prohibit-cash-payments-over-e1000/

[22] Bajaj, V., & Martin, A. (2010, October 16). Who Needs Cash (or Borders)?. *The New York Times*. Retrieved May 3, 2013, from http://www.nytimes.com/2010/10/17/business/global/17banga.html?pagewanted=all&_r=0

[23] Tomlinson, S. (2012, March 20). Sweden: Country could be first to go cashless as even churches are accepting cards for offerings *Mail Online*. Retrieved May 3, 2013, from http://www.dailymail.co.uk/news/article-2117643/Sweden-Country-cashless-churches-accepting-cards-offerings.html

B. Cash-At-Risk Score™ Framework

Therefore, it is possible that over the next decade the use of cash could decline at a faster rate than it declined in the previous decade and that by the end of the next decade cash could go the way of checks and become, so to speak, the "typewriter" of the payments industry. To investigate this issue further we have identified seven possible sources of influence—essentially the major stakeholders in the payments system—on the propensity by consumers to use cash. Table 6 lists the sources of influence and provides examples of how these could influence the propensity to use cash.

Table 6: General Sources of Influence on Consumer Cash Use

Sources	Examples of How Source Can Influence Cash Propensity
Economy	Slower economic growth and decreasing employment encourages consumers to increase their use of cash relative to other payment types because they desire more control or because they have decreased access to electronic methods.
Government	Governments may implement policies to limit the use of cash payments to reduce tax avoidance or to provide more efficient distribution of benefits.
Merchants	Merchants in developing countries may increase card acceptance thereby reducing cash use and in developed countries may encourage cash use to reduce card fees.
Consumers	Consumers may have a high rate of use of smart mobile phones thereby providing a critical mass of mobile payments users for new schemes.
Banks	Banks may be interested in reducing the cost of handling and dispensing cash and providing new payment options with additional sources of revenue.
Payment Networks	Networks are interested in increasing the number and volume of electronic transactions that cross their networks and may invest in contactless, mobile, and other forms of payments that tend to compete with cash.
Innovators	Innovators may develop new ways of paying that are particularly attractive to cash users.

For each of these sources of influence we have considered a variety of factors that could affect the future of cash use in each country. Table 7 reports the full list of 35 factors. We then conducted research on each of these countries concerning these sources of influence and the related factors. If we found information on a country that did not fit exactly into one of the categories we allocated that information to the closest category.

Table 7: Factors Considered in Analysis of Future Cash Use

Economy
Trend in inflation rate
Political and economic stability
Trend in unemployment rate
Trend in immigration rate
Trend in size of underground economy
Government
Government efforts to reduce cash for efficiency reasons
Social service making social benefit payments available on stored value cards
Regulatory hurdles for mobile payments
Regulations that will change interchange fees
Merchants
Cost of electronic payment acceptance
Opportunity for further increase in card use
Investment in terminals for EMV/contactless
Merchant surcharging of cards
Move to electronic payments in cash-intensive sectors
Trend in cash back at point of sale
Consumers
Smartphone penetration
Trend in percent unbanked
Ability to increase carded portion of population
Percent of purchases online
Cultural preference for cash
Trend in average size of payment card transaction
Perception of security for new cash-substitute payment types and offers
Banks
Trend in ATM availability
Implementation of mobile payments schemes
Likely increases in cash withdrawal fees
Contactless cards issued per capita
Trends in restrictions on consumers access to cash
Payment networks
Success in contactless card penetration
Likely early implementation of mobile payments schemes
Capital investments in alternative payment technologies
Innovators
High degree of new players with alternative solutions
Traction in market: active trials with consumers and merchant involved
PayPal penetration
iTunes penetration
Capital investment in payments

To summarize and implement the results we developed a scoring methodology. It involved two elements—the importance of the source in reducing cash use as a general matter and the strength of the source given the facts in the particular country.

1) General ***Importance*** in Reducing Cash Use. We developed subjective weights concerning the importance of each detailed source of influence. The weights varied from 0 for no influence to 10 for the greatest influence. For example, government efforts to reduce the use of cash was scored a 10 since effective efforts such as in Sweden can reduce cash use dramatically; issuance of contactless payment cards was scored a 2 since there is little evidence that contactless card issuance has resulted in a significant decrease in cash by itself, although in combination with other factors it could reduce cash use.
2) Country-Specific ***Strength*** in Reducing Cash Use***.*** For each detailed source of influence we scored the degree to which factors in that country would tend to decrease (maximum score of 10) or increase the use of cash (maximum score of -10).

For each detailed source we multiplied the "degree of influence" by the "importance of source" weight and summed these products across all detailed sources. That yielded the "***Cash-At-Risk-Score™ (CARS)***." For example, because of significant efforts in Italy to cap cash payments, we rated this a 6; that then contributed to the overall score by 60 since a "strength" of 6 times an "importance" of 10 yields 60.

A team of experts on payments and innovation used the results of the research to score each country.[24] The scoring was done independently by the experts, who then met and formed a consensus view on the scores. The experts engaged in several iterations of considering these scores and then reconciling the results across countries. Obviously, this methodology involves making educated guesses about the future as it depends on the opinions of experts concerning the future. However, the guesses are based on significant research in each country where the research was organized around the scoring framework.[25]

[24] The experts were Gloria Colgan, David Evans, Karen Webster, and Margaret Weichert who together have approximately 70 years of experience in the payments industry, generally working at very high levels in payments organizations including in multiple countries.

[25] Two factors were given the same strength ratings across all countries. The percent increase in *transacting online* was rated a +4, suggesting that as online commerce expands, it will have a moderate reduction in the propensity to use cash. When a transaction takes place online that could have taken place offline, there is necessarily a reduction in the use of cash since some people that used to buy offline paid with cash and cannot do that when they buy online. One of the ways that online commerce could decrease cash use is the payment of off-line services such as taxi rides online (e.g. Uber in the United States and some European capitals) or what PayPal is testing with McDonald's in France (e.g. order in advance online, pay online and pick up in store). The *consumer's perception of security* was rated a -7. Concerns over security are a consistent and persistent theme in every country and was rated as having a highly negative impact on electronic payments and thus a positive impact on cash.

The resulting CARS are not designed to measure precisely the rate of decline in cash in each country nor could they possibly do so. In some countries such as the US, the propensity to use cash has been increasing while in other countries such as Sweden the propensity to use cash has been declining sharply. Rather, the CARS is designed to tell us how sharply those trends are likely to change over the next decade. A high score tells us there is likely to be a decline in cash use relative to historical trend. The maximum possible score is 2460: the score that a country would receive if each factor received a score of +10 in terms of its strength in that country. That, of course, would be a highly extreme situation and it is not surprising that, as we will see, all countries fell well short of this upper bound.

Given the necessary imprecision of the CARS we do not use the exact numbers in our analysis. Rather we rank countries into groups according to whether there is a high, medium, or low likelihood of acceleration in the decline in the use of cash. That then leads to a subjective judgment concerning the timing and extent of the likely decline by age cohorts.

C. CARS Scoring Results

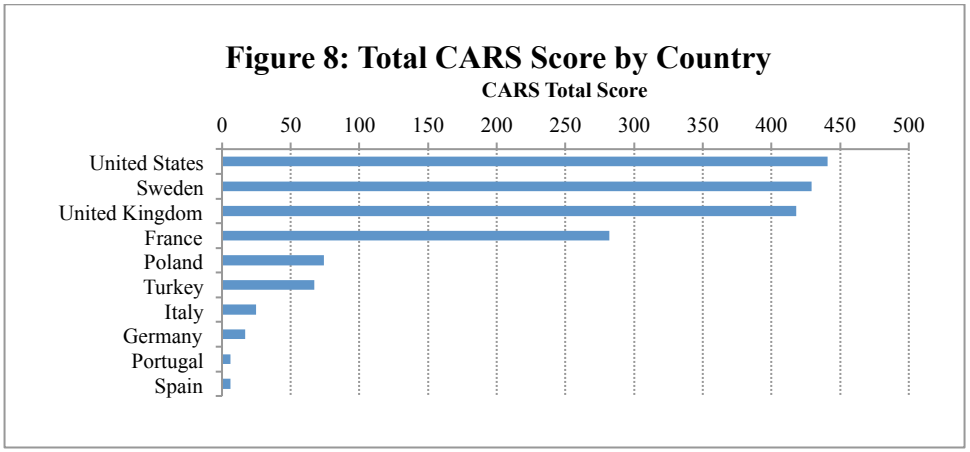
Table 8 reports the results of the overall scores and the individual scores for each source of influence for each country.

Table 8: Overall and Individual Scores for Cash at Risk Analysis

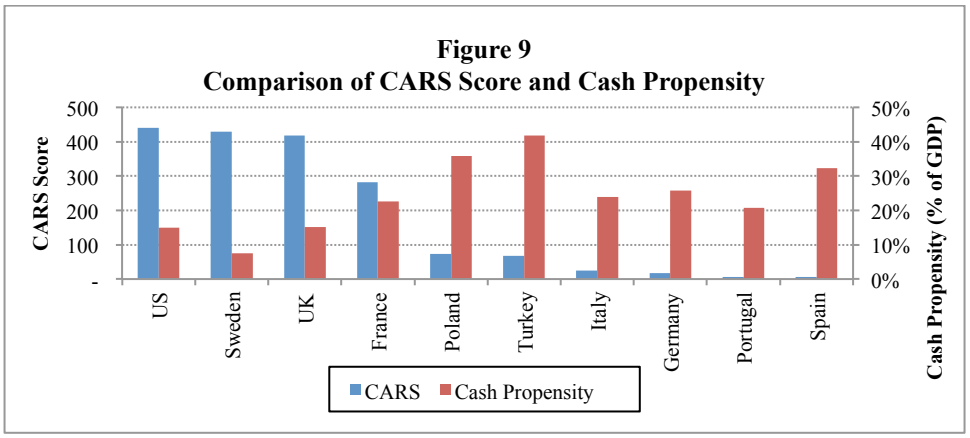
	Economy	Government	Merchants	Consumers	Banks	Payment Networks	Innovators	Total
France	-44	46	71	-28	102	60	75	282
Germany	3	0	6	-3	3	4	4	17
Italy	-8	9	11	-3	6	5	5	25
Poland	5	0	20	0	15	19	15	74
Portugal	-68	31	-10	-46	16	50	33	6
Spain	-68	31	-10	-46	16	50	33	6
Sweden	20	30	48	144	98	0	89	429
Turkey	-45	10	11	-67	30	30	98	67
United Kingdom	-13	21	90	30	80	90	120	418
United States	-15	18	44	13	40	65	276	441

Appendix B summarizes our analysis for each country. The results show that the US has the highest likelihood of acceleration in the decline in the use of cash followed by Sweden. The lowest risks are in Portugal and Spain. Figure 8 shows the countries rank-

ordered from lowest to highest. We have broken the countries down into three categories based on whether they have a low (<25), medium (67 to 282) or high (> 418) CARS Score.



The countries with the highest cash-spending shares are generally the countries with the lowest CARS scores. Figure 9 shows the CARS score by country and the cash propensity for the same countries in order of CARS score from highest to lowest. There is a clear trend to increasing cash propensity with lower CARS scores. In fact the correlation coefficient between the CARS score and the cash propensity for these 10 countries is -0.73.



IV. Diffusion of Payments Innovation over Time and Cohorts

We used the cash-at-risk scores to adjust the naïve forecasts based on historical trends. This section explains our methodology for doing this. Part A explains that payments innovations typically take affect slowly as a result of diffusion across consumers and merchants. An important determinant of the rate of diffusion is the adoption of payments innovation by different age groups and the distribution of spending by these age groups

over time. Part B presents a payments innovation diffusion model for estimating the impact of the changes that place cash at risk based on assumptions concerning when these changes take effect, their rate of diffusion over time, and their impact on different age groups, and the impact of the aging of age cohorts. Part C then describes how we used cash at risk scores to adjust the naïve cash propensity forecasts based on the payments innovation diffusion model.

A. The Diffusion of Payments Innovation

There are four major impediments to the deployment of consumer-facing payments innovations of any kind that result in the slow diffusion of payments innovations.

First, consumers are slow to change their payment behaviors and in fact do so quite gradually. The debit card product was introduced in the mid 1970s and was available to banks to issue then. Yet it did not realize significant use by consumers until almost three decades later.

Second, older consumers are more set in their payment ways than younger consumers. Even widely adopted payment methods such as debit cards are used considerable less by older people than by younger people. Table 9 shows the use of debit cards by demographic groups in in the US as of 2009.

Table 9: Use of Debit Cards by Demographic Group for the US (2009)

Age Range	Card Use			Traditional Methods			Total
	Debit	Credit	Prepaid	Check	Cash	Other	
Number of Transactions per Month							
18/25	26.6	7.5	0.5	3.5	19.0	7.2	64.3
26-35	26.4	13.6	1.2	5.6	14.6	9.7	71.1
36-49	19.8	15.6	0.6	9.1	16.3	10.3	71.8
50+	16.3	18.4	0.5	13.1	16.1	9.5	74.0
Percentage of Monthly Use							
18/25	41%	12%	1%	5%	30%	11%	100%
26-35	37%	19%	2%	8%	20%	14%	100%
36-49	28%	22%	1%	13%	23%	14%	100%
50+	22%	25%	1%	18%	22%	13%	100%

Younger people tend to use debit cards more frequently. People over the age of 50 use debits cards for 22 percent of their monthly transactions. By contrast, people between 26 and 35 use debit cards for 37 percent of their monthly transactions. This tendency is likely to be even more extreme for technology-dependent solutions.

Third, it takes merchants time to implement new technologies at the point of sale. Even if consumers want to use a new payment alternative and have smartphones so are able to, and even if merchants want to accommodate them, it takes time to install and alter point-of-sale equipment and the flow at the register. Merchants would need to make significant investments in equipment and training of cashiers in order to enable mobile payment at the point of sale. They would most likely do that as part of their natural refresh cycles, and it could take more than a decade for that cycle to run its course throughout the entire merchant ecosystem.

Fourth, smaller, and perhaps more "cash-intensive" merchants may be more receptive to new technologies but do not represent the bulk of the cash payment spend. While it is a fact that larger merchants will require more lead-time to implement new payments point of sale technologies given all of the related software and applications that are integrated into those systems, smaller merchants are much more nimble and interested in new technologies that enhance the customer experience. These merchants, however, represent only a small fraction of the total spend with cash. Smaller merchants that may be more cash intensive today, such as convenience stores, Mom and Pop retailers, and casual sellers are also hard to reach since it is literally knocking on the doors of local, and time-impaired merchants, to persuade them to try something new and then to service them once they have agreed.

There are negative feedback effects associated with these impediments. If there are not enough consumers who want to change their payment behavior and use mobile, merchants will be reluctant to change their technologies and acceptance practices. If consumers cannot use a new payment method at many merchants, they will be less likely to want to adopt it. And since in most countries where the percentage of consumers with cards is high, ubiquity with respect to payments acceptance is important, not having that ubiquity will dampen enthusiasm and usage on the part of consumers. That in turn makes merchants less likely to want to adopt.

B. The Payments Innovation Diffusion Model

We developed the ***Payments Innovation Diffusion (PID) Model™*** to assess the extent to which the diffusion of innovation in payments will reduce cash use across a wide swath of the population and, in turn, affect cash use in the future. The PID model is based on age categories and allows us to examine how the decline in the use of cash by mobile and

technology-savvy young people, in particular, could affect overall cash use by consumers over the next decade.

Consider two representative persons. In 2012, Robert is 25 years old and spends $100 a week. John is 35 years old and spends $500 a week. Together they spend $600 a week. Today, Robert pays for 80 percent of the value of his purchases in cash while John pays for 40 percent of his purchases in cash. Their total payments with cash are therefore $280 a week (80% x $100 + 40% x $500) and the percentage of their total payments made with cash is 47 percent ($280/$600). The overall percentage is closer to John's propensity to pay with cash than to Robert because John spends more.

Suppose, a mobile payments solution is introduced in 2017. It is highly regarded by consumers, and it can be used at all merchants. Being younger, more technically savvy, and less set in his payment ways, Robert adopts this new method of payment right away. As he grows older, Robert will use cash 50 percent less than a person in that same age category would have used before the introduction of mobile payments. John is happy to continue to pay with cash and card. He is set in his payment ways and less interested in new-fangled technologies.

Now move the clock forward a decade. In 2022, Robert is 35 years old. He spends $500 a week. Robert's cash use is only 20 percent—that is just half of the 40 percent that John had at that age reflecting Robert's adoption of the new technology. Robert therefore spends only $100 of his $500 of spending in cash. In 2022, John is 45 years old and spends $700 a week. But he continues to pay for 40 percent of his purchases in cash or $280. Their combined income is $1200 and their cash use is $380 or 32 percent.

Between 2012 and 2022, in this two-person world, cash use declines from 47 percent to 32 percent. That results from Robert getting older, making and spending more, and using cash less than the previous generation; and John getting older, making more and spending more, but not using cash less than the previous generation. These composition effects involving age and spending behavior are critical in understanding how the diffusion of payments innovation across age group can affect overall cash use. Importantly, despite the development of a highly regarded mobile payments application in this example, the decline in cash use is relatively modest because, while younger people adopt, older generations do not, and they control spending power.

The PID Model takes into account the number of people in each age category and tracks the effects of their aging over time to estimate the impact of declines in cash use. The

simulation considers the aging of the existing population and the entry of newer generations of younger people into the population. For example, people age 8-14 in 2012 will be 18-24 in 2022; people age 18-24 in 2012 will be 28-34 in 2012. Table 10 shows the percent of the population in each age group in 2012 and 2022 for the study countries.

We note that all of the countries will become relatively older over the decade. The story is more mixed for Sweden where the age distribution is relatively constant over the decade except for a decline in the 19-24 year old category but with an increase in the 25-34 year old age category.

The PID model also takes into account three other critical factors:

1) *The number of people in each age grouping* (i.e. the number of Roberts and Johns and others in the population) in 2012 actually and projected through 2022. These demographic projections are available from various sources for every country.
2) *The fraction of spending accounted for the age group*. These are currently estimated from data for the US and Sweden. Data on the other countries are not available. We assume that the distribution of spending across age groups is the same as in the US for all countries except Sweden.
3) *The fraction of payments made in cash for the age group.* These too are estimated from data for the US, which we use for all countries except Sweden. For Sweden, we used data we obtained from the Swedish central bank.

Table 11 reports cash share of spending by age that we calculate for each country. The relative cash-spending share for each demographic group is estimated based on US survey data on the number of transactions per month and average transaction value by payment type. This data is compared to data on personal consumption per person in the United States to build up relative cash-spending shares by age groups. The relative cash-spending share is then applied to the total cash spending for each country in 2011. All countries in our study except Sweden rely on the US data to estimate the cash-spending propensity for each demographic data. Sweden has its own data that estimates total value of spending per person by payment type and demographic groups.

Table 10: Changes in Demographic Profile for Study Countries

Country	Year	<=18	18-24	25-34	35-44	45-54	55-64	65-74	75+	Total
France	2012	23%	7%	12%	13%	13%	13%	8%	9%	100%
	2022	23%	7%	12%	12%	13%	12%	11%	10%	100%
Germany	2012	17%	7%	12%	13%	17%	13%	11%	10%	100%
	2022	16%	6%	12%	13%	13%	16%	12%	12%	100%
Italy	2012	18%	6%	12%	16%	15%	12%	10%	10%	100%
	2022	17%	6%	11%	13%	16%	14%	11%	12%	100%
Poland	2012	20%	8%	15%	15%	12%	12%	14%	4%	100%
	2022	19%	6%	15%	15%	11%	11%	19%	4%	100%
Portugal	2012	19%	7%	14%	15%	14%	12%	10%	9%	100%
	2022	18%	6%	11%	14%	15%	14%	11%	10%	100%
Spain	2012	19%	6%	15%	17%	15%	11%	8%	9%	100%
	2022	19%	6%	10%	14%	16%	14%	11%	11%	100%
Sweden	2012	21%	8%	13%	13%	13%	12%	11%	8%	100%
	2022	23%	6%	13%	12%	12%	12%	10%	11%	100%
Turkey	2012	33%	8%	17%	14%	12%	8%	5%	3%	100%
	2022	29%	8%	15%	15%	13%	10%	6%	4%	100%
United Kingdom	2012	22%	8%	14%	13%	14%	11%	9%	8%	100%
	2022	23%	7%	14%	13%	12%	12%	9%	9%	100%
United States	2012	25%	8%	14%	13%	14%	12%	7%	6%	100%
	2022	25%	8%	13%	13%	12%	12%	10%	7%	100%

Table 11: Cash Share of Spending by Age and Country

Age Category	Country									
	FR	GE	IT	PO	PT	TU	SP	SW	UK	US
18-24	34.4%	43.9%	36.5%	54.6%	31.6%	63.6%	49.1%	6.6%	23.1%	22.9%
25-34	22.6%	28.9%	24.0%	35.9%	20.8%	41.9%	32.3%	5.2%	15.2%	15.1%
35-44	19.2%	24.6%	20.5%	30.6%	17.7%	35.6%	27.5%	5.2%	12.9%	12.8%
45-54	20.5%	26.3%	21.8%	32.7%	18.9%	38.0%	29.4%	8.0%	13.8%	13.7%
55-64	25.2%	32.2%	26.7%	40.0%	23.2%	46.6%	36.0%	7.2%	16.9%	16.8%
65-74	24.3%	31.0%	25.8%	38.6%	22.4%	45.0%	34.7%	9.5%	16.3%	16.2%
75+	23.9%	30.5%	25.4%	38.0%	22.0%	44.3%	34.2%	12.7%	16.1%	15.9%
Total	22.6%	28.8%	24.0%	35.9%	20.8%	41.8%	32.2%	7.4%	15.2%	15.0%

The model adjusts the naïve forecasts of the cash-spending share for each demographic group in each year from 2012 through 2022. It then calculates the total share of spending made in cash for each demographic group over time. The total spending by each demographic group is then averaged based on the total spending by demographic

group. The country total is then calculated based on total cash spending relative to the total overall spending for all the demographic groups combined.

C. Estimation of Cash-at-Risk Adjusted Cash Propensities

To estimate the cash-spending shares in future years we need to make three important assumptions based on the research we have conducted.

1) The year in which the cash risk factors will start having a material impact on cash use. This input determines when we will start seeing a deviation from the historical trend.
2) The speed of decline between the first year the risk factors will have a material effect and 2022. This input determines the relative decline in each year from the start of the change to 2022. We assumed that the trend would decline according to a logistic (that is, an S-shape relationship involving slow change first, then rapid change, followed by a plateau) curve between the starting year and 2022.
3) The estimated percentage change in the use of cash by each age category for 2022 based on the CARS. This is the most important assumption. Generally, we assume that there will be a greater reduction in cash use by younger people in response to new innovations and other factors.

Table 12 reports the estimated starting year for an acceleration in the decline in cash use and the assumptions we made for the decline in cash use by each age group by 2022. As a reference it also reports the CARS for each country, the share of cash as a fraction of PCE in 2011, and the CAGR for the cash use propensity as of 2012.

In addition, we have conducted sensitivity tests on the decline in cash use. We estimated the future cash propensities under the assumption that the decline in cash use for each age category was 50 percent lower and 50 percent higher than assumed. However, in doing this we maintained our assumptions that certain demographic categories would not show a decline in their propensities to use cash. That is, we examine what would happen if the rate of decline for younger cohorts whose cash use we believe could be affected was significantly higher or lower.

Table 12: Cash Risk Adjustments and Comparison Statistics

Country	Start Year	Demographic Adjustment							Total CARS	Cash Use as a % of PCE	Historic Cash Share Growth
		19-24	25-34	35-44	45-54	55-64	65-74	75+			
France	2015	-25%	-15%	-7%	0%	0%	0%	0%	282	39%	2.3%
Germany	2017	-10%	-6%	-3%	0%	0%	0%	0%	17	45%	-2.6%
Italy	2017	-10%	-6%	-3%	0%	0%	0%	0%	25	39%	1.9%
Poland	2015	-20%	-12%	-6%	-3%	0%	0%	0%	74	59%	-4.0%
Portugal	2017	-10%	-6%	-3%	0%	0%	0%	0%	6	31%	0.4%
Spain	2017	-10%	-6%	-3%	0%	0%	0%	0%	6	55%	-3.6%
Sweden	2015	-50%	-30%	-15%	-2%	0%	0%	0%	429	16%	-7.4%
Turkey	2015	-25%	-15%	-7%	0%	0%	0%	0%	67	59%	-1.0%
United Kingdom	2015	-50%	-30%	-15%	-2%	0%	0%	0%	418	24%	-1.8%
United States	2015	-50%	-30%	-15%	-5%	0%	0%	0%	441	21%	4.2%

V. Estimates of Cash Use over the Next Decade

Using the PID model introduced in the previous section we have estimated the cash-spending shares between 2012 and 2022 for each country. We have then estimated the total real cash spending between 2012 and 2022 for each country by multiplying the estimated shares of cash use by IMF forecasts of the GDP of each country for 2012-2022. Table 13 reports the forecasts of the cash-spending shares. It also reports the CARS-adjusted growth rates and the naïve growth rates reported earlier over the period. For a convenient comparison across countries we index the shares to 100 in 2012 so that 100-the entries reflects the percent changes from this base. The cash-spending share is projected to decline for all countries with a median decline of 1.6 percent annually between 2012 and 2022 and a GDP-weighted decline of 1.5 percent annually. The decline is the greatest for Sweden and the smallest for Portugal and Spain.

Table 13: CARS Adjusted Cash-Share Trends Indexed to 2012

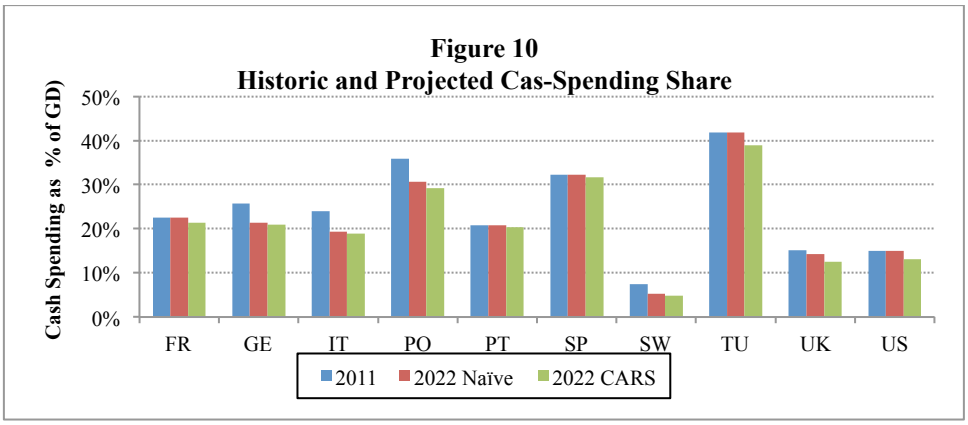
	Country									
	FR	GE	IT	PO	PT	TU	SP	SW	UK	US
Forecast year										
2012	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2013	100.0	97.8	94.4	98.1	100.0	100.0	100.0	95.8	99.3	100.0
2014	100.0	95.7	91.0	96.4	100.0	100.0	100.0	92.1	98.6	100.0
2015	99.9	93.8	88.7	94.6	100.0	99.8	100.0	88.5	97.6	99.7
2016	99.5	92.0	86.9	92.7	100.0	99.3	100.0	84.8	96.2	98.8
2017	98.6	90.2	85.4	90.5	99.9	98.1	99.9	80.8	93.7	96.6
2018	97.3	88.5	84.0	88.0	99.8	96.3	99.8	76.4	90.2	93.3
2019	96.0	86.7	82.6	85.7	99.4	94.6	99.4	72.4	86.8	90.0
2020	95.1	84.8	81.2	83.8	98.9	93.4	98.9	69.2	84.6	87.9
2021	94.7	83.0	80.0	82.4	98.3	93.0	98.4	66.8	83.4	87.0
2022	94.6	81.4	78.9	81.3	98.0	93.0	98.1	64.7	82.9	86.8
Compound Annual Growth Rates										
CARS Adjusted	-0.5%	-2.0%	-2.3%	-2.0%	-0.2%	-0.7%	-0.2%	-4.3%	-1.9%	-1.4%
Naïve	0.0%	-1.9%	-2.2%	-1.5%	0.0%	0.0%	0.0%	-3.4%	-0.6%	0.0%
Difference	-0.5%	-0.2%	-0.2%	-0.5%	-0.2%	-0.7%	-0.2%	-0.8%	-1.3%	-1.4%

Table 14 reports the sensitivity of the CARS-adjusted growth rate for each country based on assuming that the changes for each age group are 50 percent lower or higher than the base case. Figure 10 compares the cash propensity for 2011, the naïve forecast for 2022, and the CARS-adjusted forecast for 2022.

Table 14: CARS Adjusted Cash-Spending Share Sensitivity

	CAGR Sensitivity		
	Low	**Middle**	**High**
France	-0.3%	-0.5%	-0.8%
Germany	-1.9%	-2.0%	-2.1%
Italy	-2.2%	-2.3%	-2.4%
Poland	-1.8%	-2.0%	-2.3%
Portugal	-0.1%	-0.2%	-0.3%
Spain	-0.1%	-0.2%	-0.3%
Sweden	-3.8%	-4.3%	-4.7%
Turkey	-0.4%	-0.7%	-1.1%
United Kingdom	-1.2%	-1.9%	-2.6%
United States	-0.7%	-1.4%	-2.2%
GPD Weighted	**-1.0%**	**-1.5%**	**-2.0%**
Median	**-0.9%**	**-1.6%**	**-2.2%**

Note: Low reflects the assumption that the CARS adjustment is 50 percent lower and high reflects the assumption that the CARS adjustment is 50 percent higher than the base case.



We now turn to estimates of total cash use in nominal and inflation-adjusted units. Table 15 reports the total use cash use by multiplying the cash-spending shares times nominal GDP. For comparison we have indexed the shares and total use to 2012. It also reports the CARS-adjusted and naïve growth rates over the period.

Table 15: Total Cash Use Projections with Naïve and CARS Adjustment

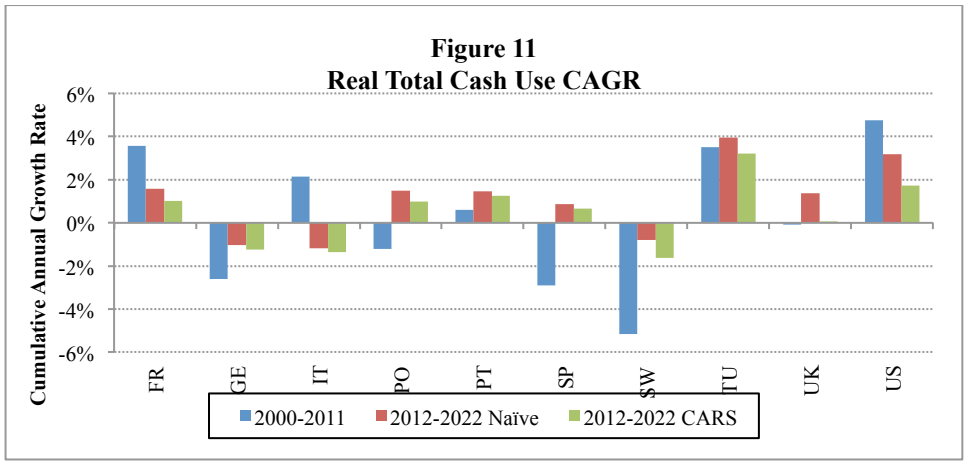
	Nominal GDP	Naïve Projection			CARS Adjusted		
		Share	Total Cash Use	CAGR	Share	Total Cash Use	CAGR
France	143.4	100.0	143.4	3.7%	94.6	135.7	3.1%
Germany	132.4	82.9	109.8	0.9%	81.4	107.7	0.7%
Italy	128.6	80.5	103.5	0.3%	78.9	101.5	0.2%
Poland	178.8	85.6	152.9	4.3%	81.3	145.4	3.8%
Portugal	133.2	100.0	133.2	2.9%	98.0	130.5	2.7%
Spain	129.2	100.0	129.2	2.6%	98.1	126.7	2.4%
Sweden	154.7	70.5	109.1	0.9%	64.7	100.1	0.0%
Turkey	243.9	100.0	243.9	9.3%	93.0	226.8	8.5%
United Kingdom	163.9	94.3	154.6	4.5%	82.9	135.9	3.1%
United States	164.8	100.0	164.8	5.1%	86.8	143.1	3.6%
GDP Weighted	**156.3**	**95.3**	**149.7**	**4.0%**	**86.3**	**135.0**	**2.9%**
Median	**149.0**	**97.2**	**138.3**	**3.3%**	**84.9**	**133.1**	**2.9%**

Table 16 and Figure 11 report similar figures based on real GDP. Unlike the cash propensity analysis we see much more variability across the countries in cash use. Seven of

Table 16: Real GDP Total Cash Use Projections with Naïve and CARS Adjustment

	Real GDP	Naïve Projection			CARS Adjusted		
		Share	Total Cash Use	CAGR	Share	Total Cash Use	CAGR
France	116.9	100.0	116.9	1.6%	94.6	110.6	1.0%
Germany	108.6	82.9	90.1	-1.0%	81.4	88.4	-1.2%
Italy	110.4	80.5	88.8	-1.2%	78.9	87.1	-1.4%
Poland	135.5	85.6	115.9	1.5%	81.3	110.2	1.0%
Portugal	115.6	100.0	115.6	1.5%	98.0	113.2	1.2%
Spain	108.9	100.0	108.9	0.9%	98.1	106.9	0.7%
Sweden	131.1	70.5	92.5	-0.8%	64.7	84.8	-1.6%
Turkey	147.4	100.0	147.4	4.0%	93.0	137.1	3.2%
United Kingdom	121.5	94.3	114.6	1.4%	82.9	100.7	0.1%
United States	136.8	100.0	136.8	3.2%	86.8	118.8	1.7%
GDP Weighted	**126.9**	**95.3**	**121.5**	**1.8%**	**86.3**	**109.6**	**0.9%**
Median	**119.2**	**97.2**	**115.1**	**1.4%**	**84.9**	**108.5**	**0.8%**

the countries are likely to experience an increase in inflation-adjusted cash use and three countries experience a decrease with a median increase of 0.8 percent a year and a GDP-weighted increase of 0.9 percent a year. The great decline occurs in Sweden and the greatest increase, driven by economic development, is Turkey.



VI. Conclusion

This paper has developed and implemented a methodology for estimating the historical and future use of cash by consumers to pay for goods and services across countries. We find a great diversity across countries in the historical evolution of cash use. The cash spending share actually increased between 2000 and 2011 for four countries including the US.[26] Across the countries the median annual growth rate of cash in real terms was a 0.3 percent and the average annual GDP-weighted growth rate was 2.4 percent. The growth on a GDP-weighted basis reflects the fact that large economies including the US and France saw increasing cash-spending shares. The total amount of cash in inflation-adjusted terms increased in half of the countries as a result of real GDP growth exceeding the decline in the propensity to use cash.

A similar diversity appears looking forward. The propensity by consumers to use cash is projected to decline gradually everywhere as a result of the increased use of electronic payments including mobile payments. The median decline is 1.6 percent and the GDP-weighted decline is 1.5 percent annually between 2012 and 2022. That conclusion is based on the assumption that historical increase in the cash-spending share will not continue in five countries including the US. If that assumption were incorrect, the cash-spending share would decline even less than we are forecasting and, in fact, could increase for some countries if those historical trends continued.

Putting this qualification aside, however, our estimates indicate that the share of consumer spending made cash will decline sharply in Sweden, the United Kingdom, and the United States. In many cases this decline in the propensity to use cash will be offset by economic growth. In fact, the median change in total real cash spending is a positive 0.8 percent and the GDP-weighted change is a positive 0.9 percent. Only Germany, Italy, and Sweden are expected to see a decline in the real value of total cash spending by consumers.

Apart from presenting these estimates we have reached two other important findings. First, the stock of notes and coins in circulation, including spending notes, provides a highly unreliable guide to the use of cash by consumers for payments. The trend in the stock of notes and coins over time does not provide an accurate estimate of the use of cash for payments and it provides a highly unreliable guide to changes in the use of cash for payments. Second, the impact of innovations in payments on cash use are likely to occur

[26] In some cases data were not available for the earlier part of the decade.

gradually because of the fact that these innovations are likely to be adopted disproportionately by younger consumers and because it will take time for these younger consumers to gain enough spending power to affect the overall use of cash.

The results of this paper are consistent with the view that in the countries studied here, which include the US and the EU-5, the share of spending that consumers pay for with cash is likely to decline. The surprising result for readers of the popular press, however, is that the rate of decline in the propensity to use cash is likely to be small and further is likely to be overwhelmed by the growth in spending in many countries so that total cash use is likely to rise in those countries. The flip side of this finding is that the penetration of payments innovation, including the use of mobile payments, is likely to happen quite gradually at least for the countries that we have studied here.

Appendix A: Detailed Description of Historical Data Analysis and Sources

People living in all parts of the world rely on two primary sources of obtaining the cash they intend to use to purchase goods and services. The first is from ATM machines and the second is from walking into bank branches and withdrawing cash over the counter (OTC). The use of ATM machines has been increasing as more and more ATM terminal shave been deployed. Most cash used to purchase goods and services is obtained from one of these two sources.

There are other ways to obtain cash used to purchase goods and services and those include obtaining cash at the point of sale at merchant locations although in most places this method represents a very small portion of all cash used. In addition people can recycle cash. Recycling is the use of cash that was received as a form of payment. For example, a babysitter might receive cash as a form of payment for services and then use that cash to purchase some other good or service. This method again represents a small portion of total cash used.

Because these other two forms are small, the most important measures of cash use are cash obtained from ATM machines and cash obtained from OTC withdrawals. While the withdrawals of cash from ATM machines are widely available, the withdrawals from the OTC channel is not. For the 10 countries we study in this paper, 5 countries including the United States have no OTC data available. As such, we have developed a methodology for estimating the amount of OTC withdrawals made in each country.

OTC withdrawals are estimated by comparing the country in question with the other countries for which OTC data is available and then using those countries as proxies for the target country. The overall methodology is fairly simple but does rely on a significant amount of judgment as to the best comparison country to use.

Methodology

The methodology in general is to obtain economic and payment data for the target country and compare that to similar data for countries in which OTC data is available. We then select one or more good comparison countries for each target country. The ratio of OTC cash withdrawals to ATM cash withdrawals for each comparison country is then

calculated for 2000 through 2011. The OTC to ATM ratio is then plotted and used to estimate the following regression model:

$$OTC\ to\ ATM\ Ratio = \alpha + \beta \times Log(Year) + \epsilon$$

The fitted regression result produces a smooth trend of the OTC to ATM cash withdrawals ratio that can then be used in the target country. Since we have ATM withdrawals in the target country we calculate the OTC withdrawals by multiplying the estimated OCT to ATM ratio by the ATM cash withdrawals in the target country.

The hardest part of this overall analysis is to select the appropriate comparison country. We have five countries in which OTC withdrawal data is available. These countries are Germany, Italy, Spain, Sweden and the United Kingdom. We collect data on the cash propensity, ATM and POS terminals, and the trend of overall bank branch data for each comparison and target country. These data are normalized by calculating them as a percentage of GDP or based on the overall population of the country. Relative levels and trends of the target and potential comparison countries can then be compared in order to select the best overall comparison countries.

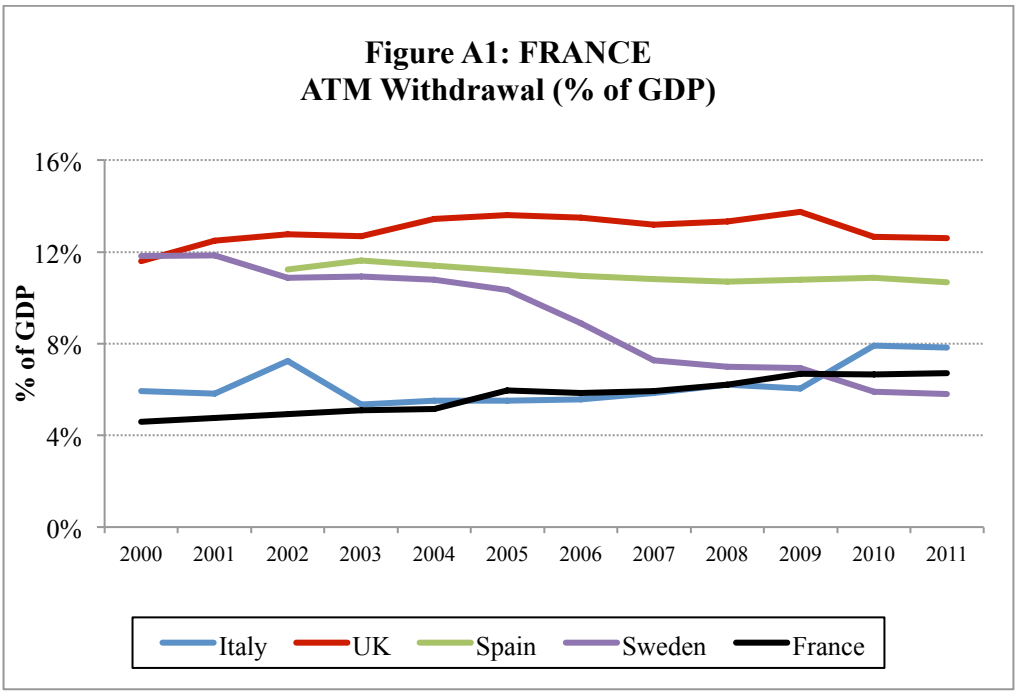
Table A.1 summarizes the OTC-ATM ratios for the five countries for which we have data.

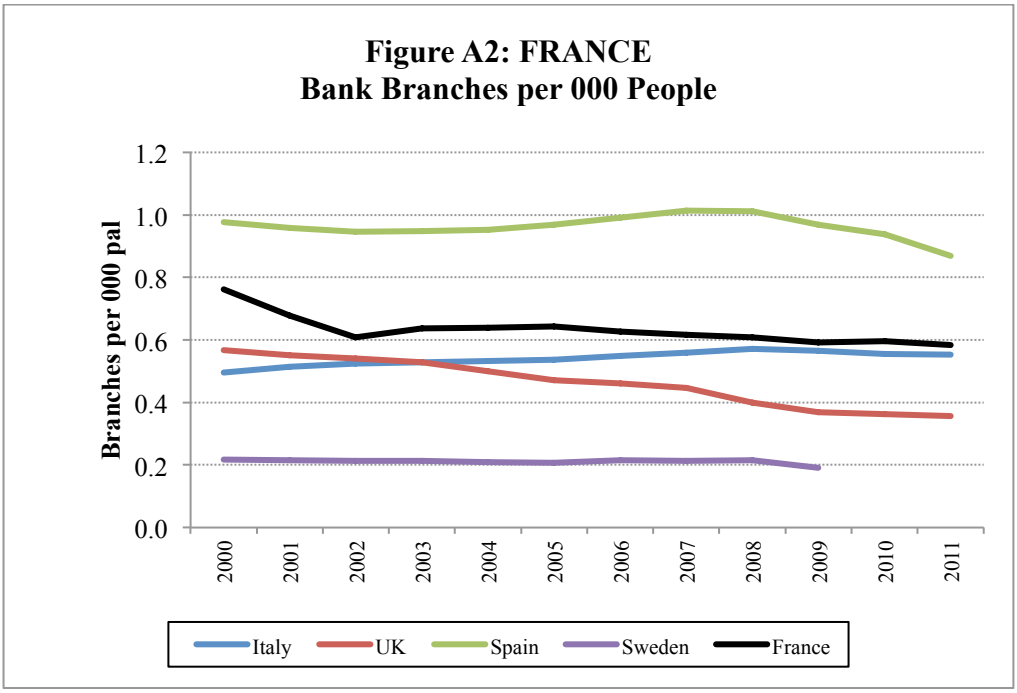
Table A.1: OTC to ATM Ratio 2000-2011

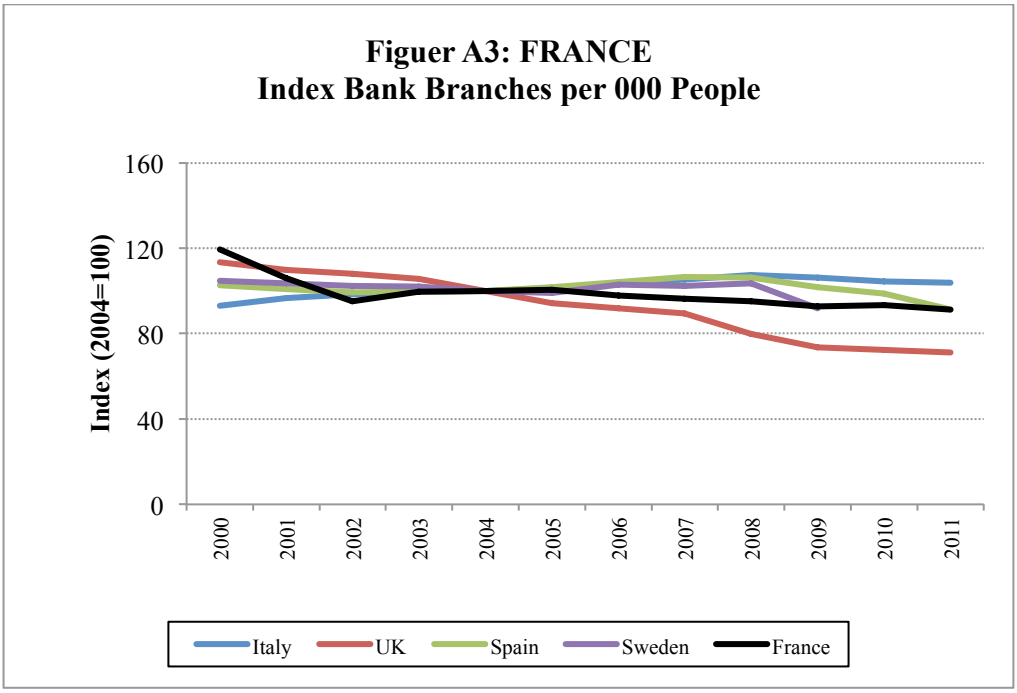
	OTC to ATM Ratio				
	Germany	**Italy**	**Spain**	**Sweden**	**United Kingdom**
2000	n/a	2.28	n/a	n/a	0.56
2001	n.a	3.80	n.a	n.a	0.43
2002	n/a	2.08	n/a	n/a	0.39
2003	n/a	2.65	n/a	n/a	0.37
2004	n.a	2.56	2.65	0.13	0.35
2005	n/a	2.59	2.05	0.13	0.23
2006	n/a	2.53	2.31	0.16	0.22
2007	1.32	2.34	2.08	0.16	0.18
2008	1.22	2.10	2.17	0.14	0.17
2009	1.16	2.99	2.20	0.12	0.16
2010	1.05	2.24	2.18	0.14	0.19
2011	1.00	2.06	2.02	0.11	0.17

France

The best comparison country for France is Italy. This is based on the overall level of ATM withdrawals as a % of GDP as shown in Figure A1; the overall level of bank branches per 1,000 people as shown in Figure A2; and the overall indexed trend in bank branches per 1,000 people as shown in Figures A3. As the figures show, the trends and levels show Italy as the best comparison country.



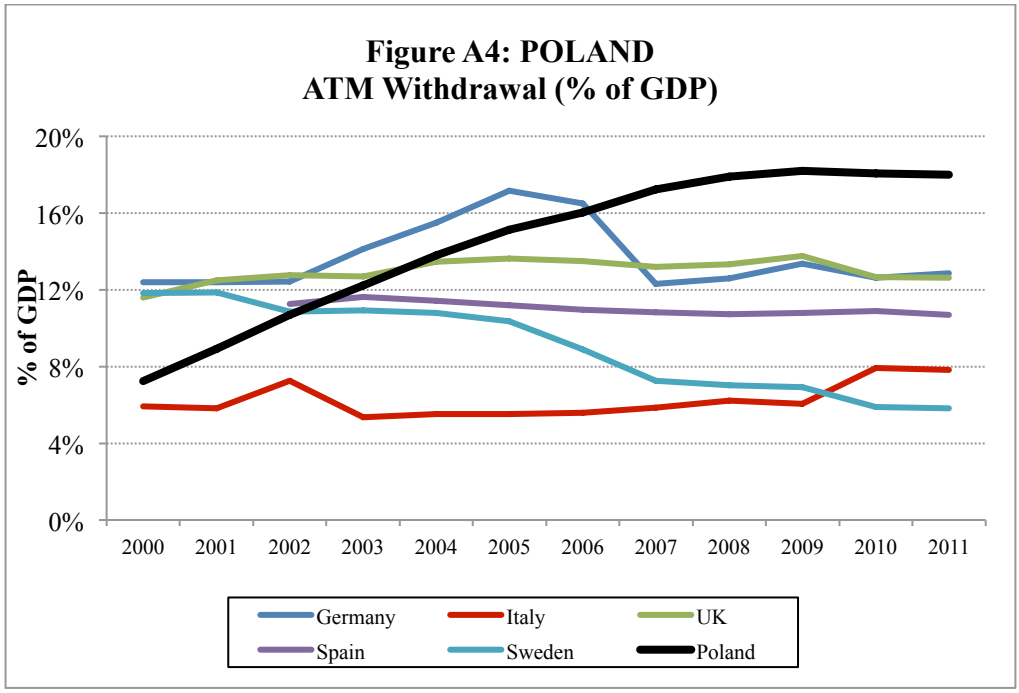


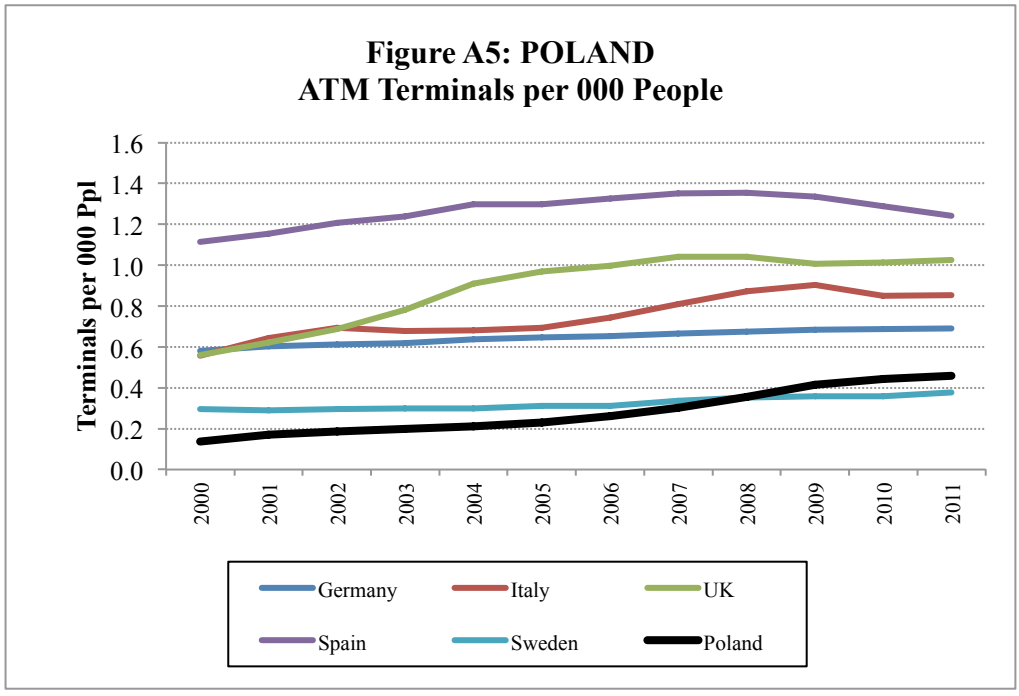


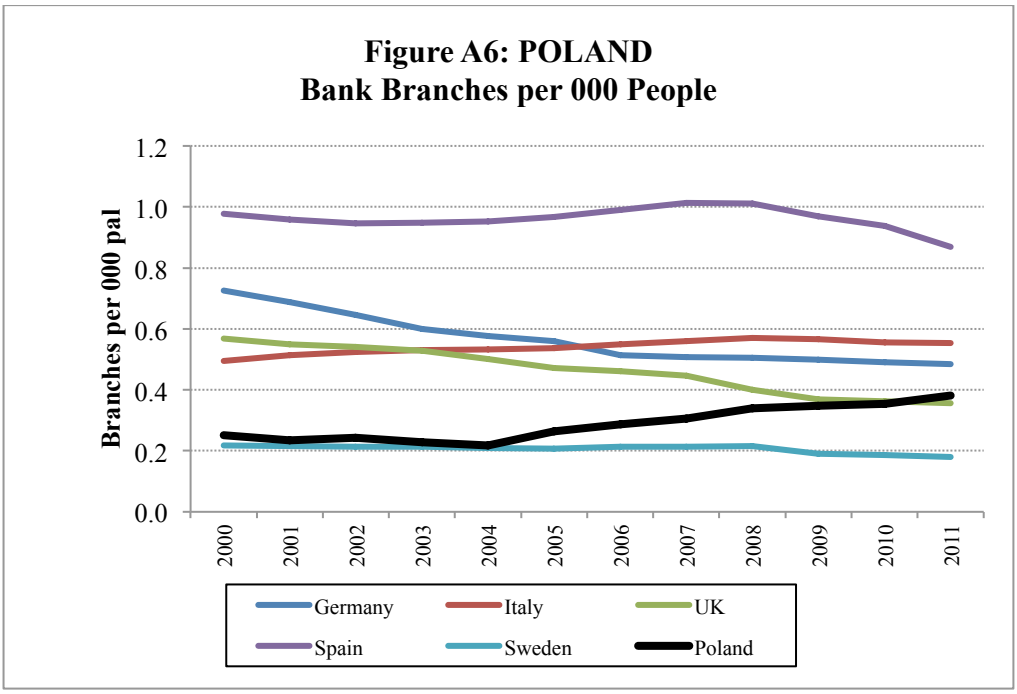
Poland

The best comparison country for Poland is Germany. This is based on the overall level of ATM Terminalization and bank branch density combined with the very high level of

ATM withdrawals. Because ATM withdrawals are so high, as shown in Figure A4, it is implausible that OTC withdrawals could be twice the level of ATM withdrawals as it is in Spain and Italy. The ATM Terminals per 1,000 people shown in Figure A5 and the Bank Branch per 1,000 People shown in Figure A6 demonstrate trends towards Germany.

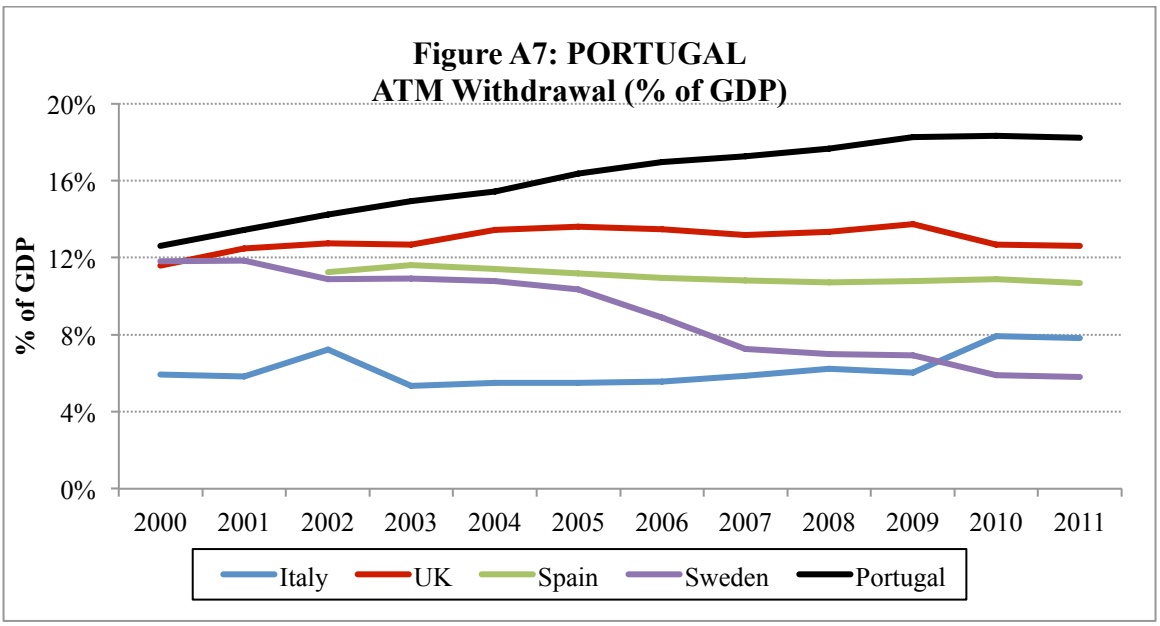


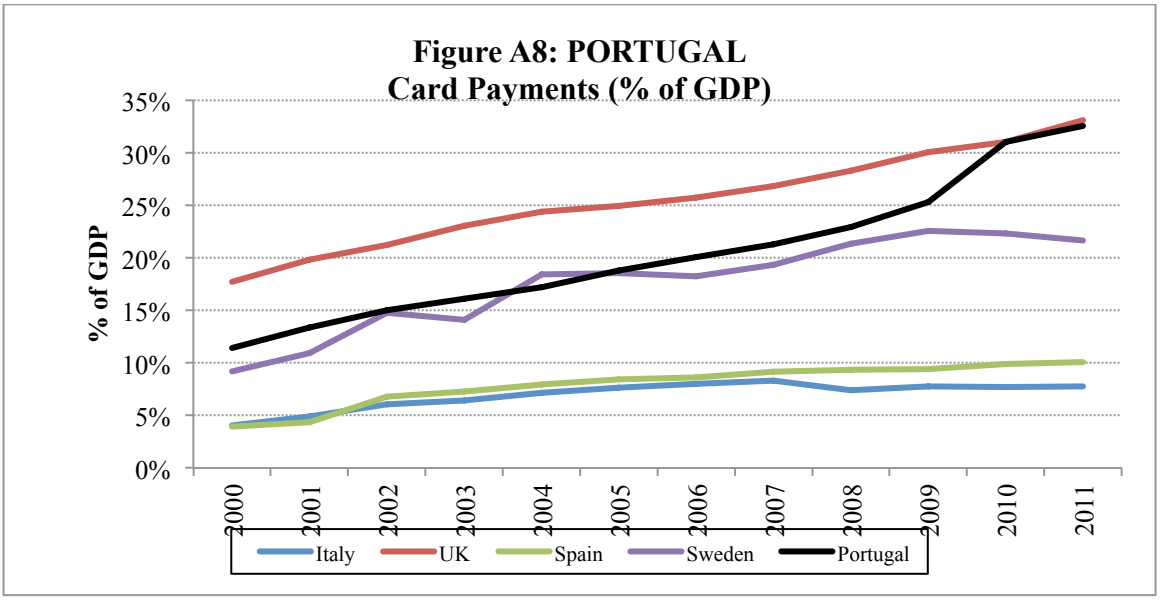




Portugal

The best comparison countries for Portugal are the United Kingdom and Sweden. This is based on the very high level of ATM withdrawals as shown in Figure A7 and the overall levels and trends of card payments as a % of GDP as shown in Figure A8. As with Poland the high level of ATM withdrawals precludes large OTC withdrawals as seen in Italy and Spain and the similarly high card usage would imply lower OTC withdrawals in countries like the UK and Sweden. Since the card payment trends and levels are in line with the UK and Sweden, they have been selected as the best comparison counties.

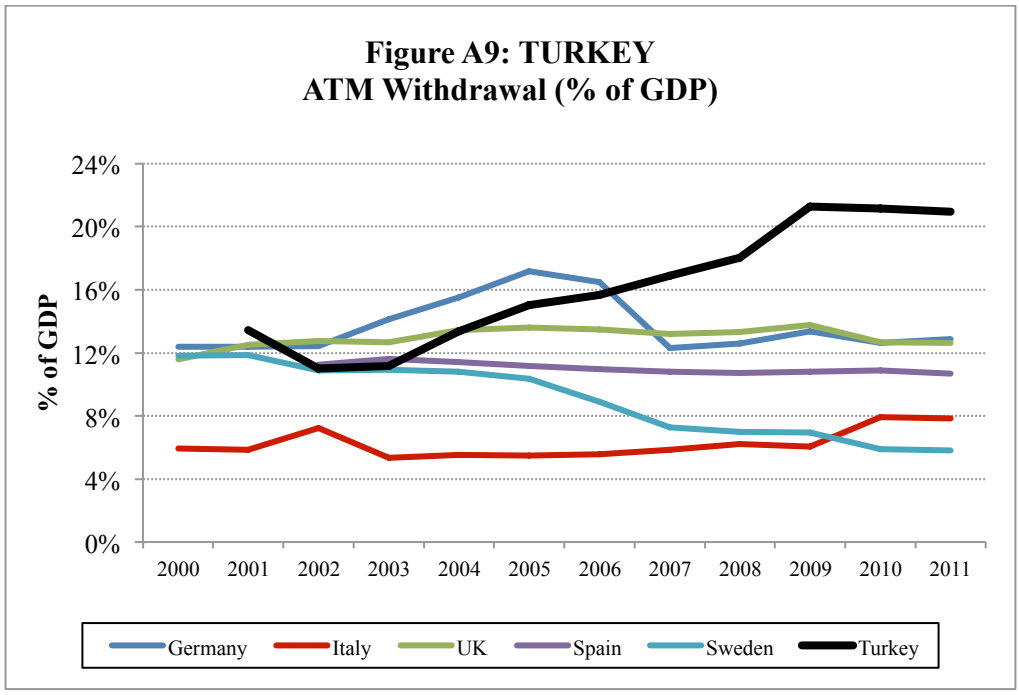


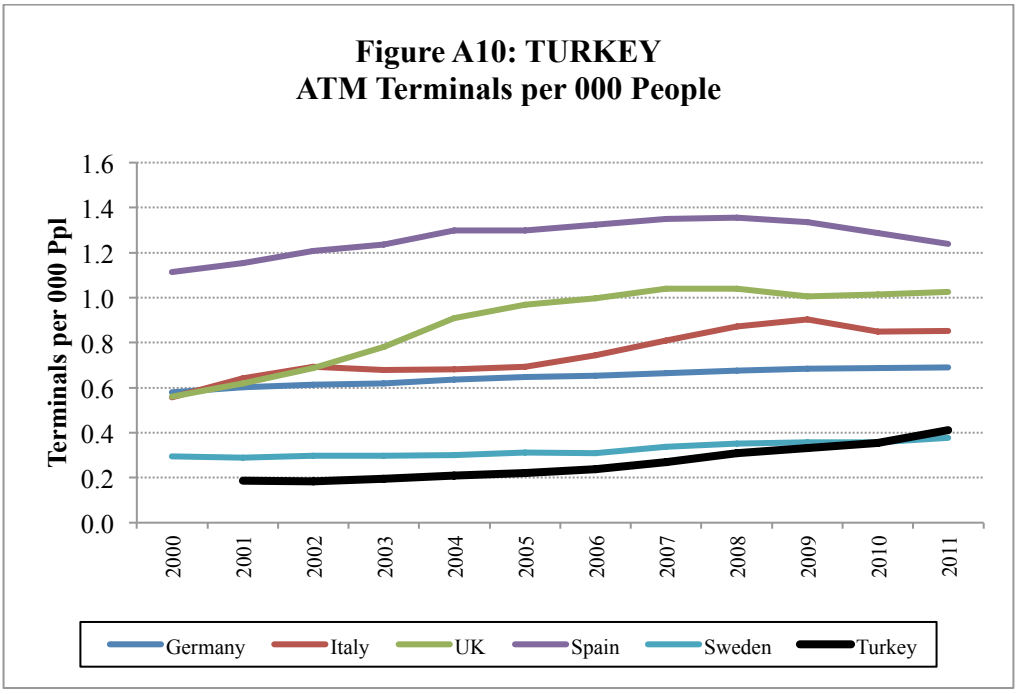


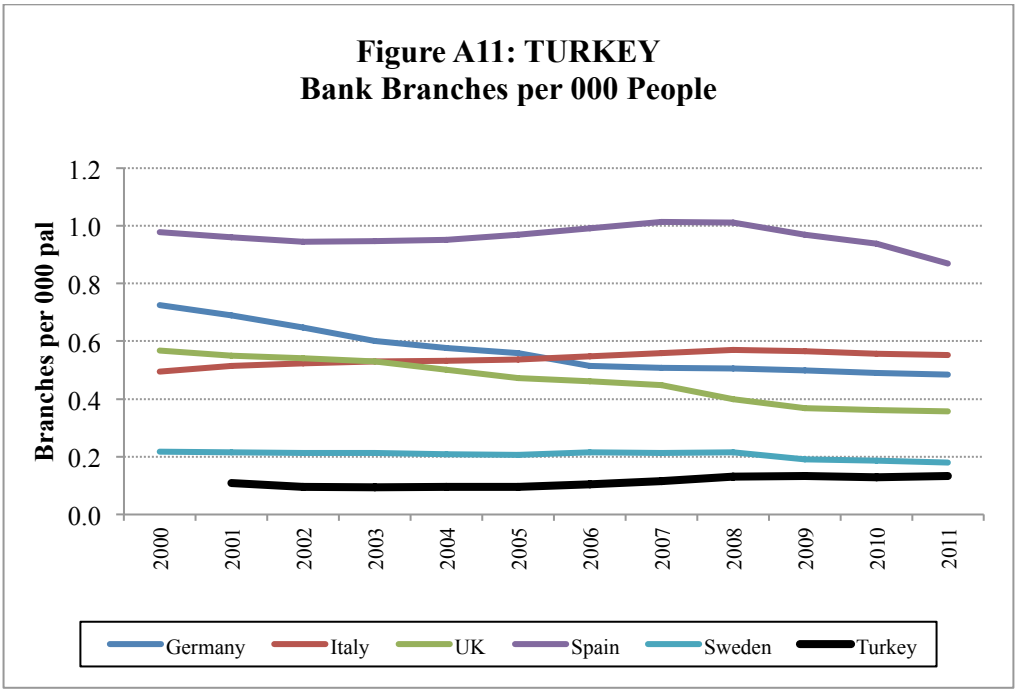
Turkey

The best comparison country for Turkey is Germany. In the case of Turkey, the trends do not align well with any of the comparison countries. However, Turkey is still on an economic development path in which the financial infrastructure is being developed. So

while most countries are seeing increases in ATM machines and reductions in the number of bank branches, Turkey is experiencing growth in both of these metrics. Based on the high level of ATM withdrawals as shown in Figure A9, the OTC to ATM ration could not be similar to Italy and Spain. However, the developing nature of the financial infrastructure as shown in Figures A10 and A11 would preclude comparisons to lower OTC to ATM ration countries like Sweden and the UK. As such Germany was selected as the best comparison.

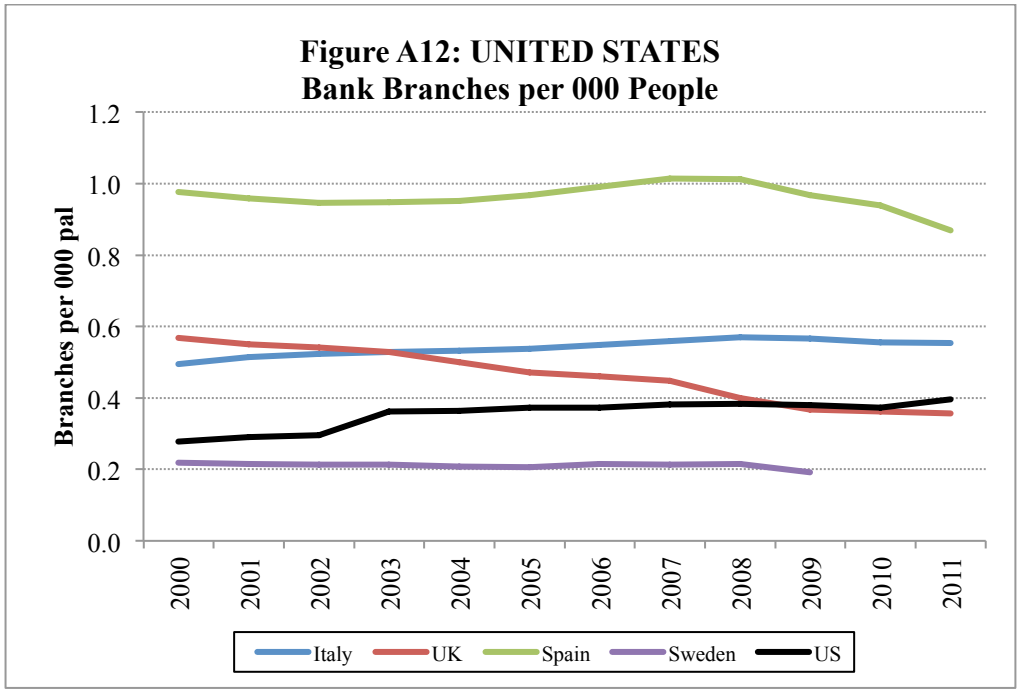


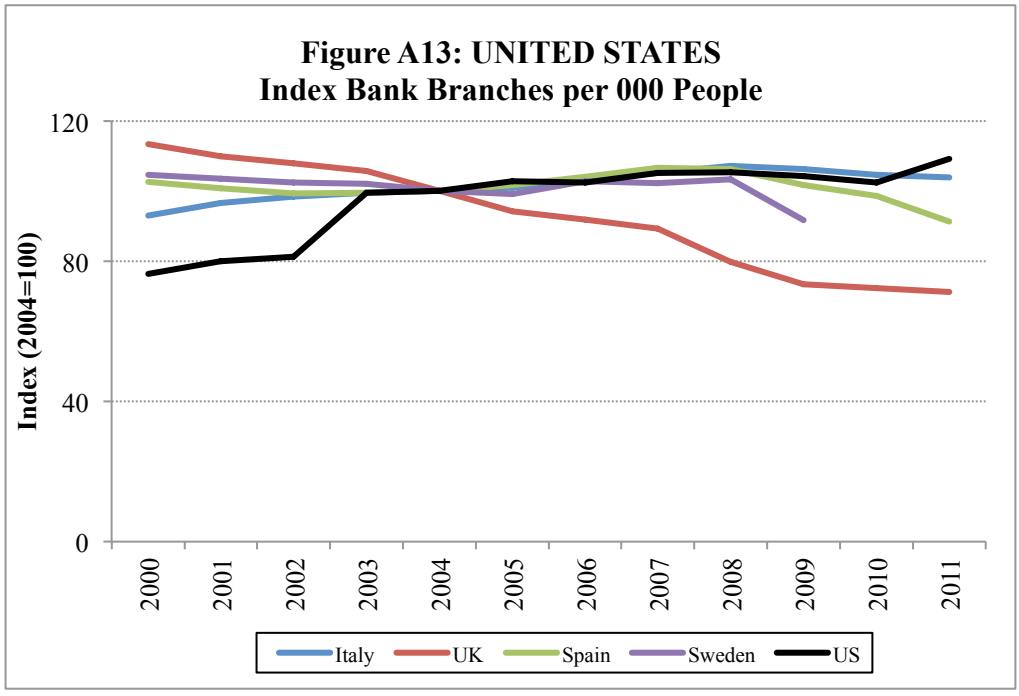




United States

The best comparison country for the United States is Italy. This is based on the overall level and trend of bank branches per 1,000 people. Figures A12 and A13 show both level and indexed trend. AS these chats show, Italy is the best comparison for the United States.





Appendix B: Cash-At-Risk Score Analysis

This appendix summarizes our research concerning whether cash is at risk in each of the countries. Table B1 summarizes the scores for each country. Table B2 reports the percentage of the score attributable to each factor. The remainder of the appendix describes our general rationale for these scores in each country.

Table B1: CARS Scores for Each Country

	Economy	Government	Merchants	Consumers	Banks	Payment networks	Innovators	Total
France	-44	46	71	-28	102	60	75	282
Germany	3	0	6	-3	3	4	4	17
Italy	-8	9	11	-3	6	5	5	25
Poland	5	0	20	0	15	19	15	74
Portugal	-68	31	-10	-46	16	50	33	6
Spain	-68	31	-10	-46	16	50	33	6
Sweden	20	30	48	144	98	0	89	429
Turkey	-45	10	11	-67	30	30	98	67
United Kingdom	-13	21	90	30	80	90	120	418
United States	-15	18	44	13	40	65	276	441

Table B2 reports the CARS and percent of the score attributable to each source of influence. Appendix B contains the detailed scoring framework.

Table B2: CARS and Percent of Score Attributable to Each Source

	France			Germany			Italy		
	Total	**% of Total**	**% Max**	**Total**	**% of Total**	**% Max**	**Total**	**% of Total**	**% Max**
Economy	-44	-15.6%	-14.7%	3	17.6%	1.0%	-8	-32.0%	-2.7%
Government	46	16.3%	23.0%	0	0.0%	0.0%	9	36.0%	4.5%
Merchants	71	25.2%	18.2%	6	35.3%	1.5%	11	44.0%	2.8%
Consumers	-28	-9.9%	-5.1%	-3	-17.6%	-0.5%	-3	-12.0%	-0.6%
Banks	102	36.2%	26.8%	3	17.6%	0.8%	6	24.0%	1.6%
Payment networks	60	21.3%	30.0%	4	23.5%	2.0%	5	20.0%	2.5%
Innovators	75	26.6%	20.8%	4	23.5%	1.1%	5	20.0%	1.4%
Total	282	100.0%	11.8%	17	100.0%	0.7%	25	100.0%	1.1%

	Poland			Portugal			Spain		
	Total	% of Total	% Max	Total	% of Total	% Max	Total	% of Total	% Max
Economy	5	6.8%	1.7%	-68	-1133.3%	-27.2%	-68	-1133.3%	-27.2%
Government	0	0.0%	0.0%	31	516.7%	20.7%	31	516.7%	20.7%
Merchants	20	27.0%	5.1%	-10	-166.7%	-2.6%	-10	-166.7%	-2.6%
Consumers	0	0.0%	0.0%	-46	-766.7%	-9.8%	-46	-766.7%	-9.8%
Banks	15	20.3%	3.9%	16	266.7%	6.2%	16	266.7%	6.2%
Payment networks	19	25.7%	9.5%	50	833.3%	50.0%	50	833.3%	50.0%
Innovators	15	20.3%	4.2%	33	550.0%	10.6%	33	550.0%	10.6%
Total	74	100.0%	3.1%	6	100.0%	0.3%	6	100.0%	0.3%

	Sweden			Turkey		
	Total	% of Total	% Max	Total	% of Total	% Max
Economy	20	4.7%	6.7%	-45	-67.2%	-15.0%
Government	30	7.0%	15.0%	10	14.9%	5.0%
Merchants	48	11.2%	12.3%	11	16.4%	2.8%
Consumers	144	33.6%	26.2%	-67	-100.0%	-12.2%
Banks	98	22.8%	25.8%	30	44.8%	7.9%
Payment networks	0	0.0%	0.0%	30	44.8%	15.0%
Innovators	89	20.7%	24.7%	98	146.3%	27.2%
Total	429	100.0%	18.0%	67	100.0%	2.8%

	United Kingdom			United States		
	Total	% of Total	% Max	Total	% of Total	% Max
Economy	-13	-3.1%	-4.3%	-15	-3.4%	-5.0%
Government	21	5.0%	10.5%	18	4.1%	9.0%
Merchants	90	21.5%	23.1%	44	10.0%	11.3%
Consumers	30	7.2%	5.5%	13	2.9%	2.4%
Banks	80	19.1%	21.1%	40	9.1%	10.0%
Payment networks	90	21.5%	45.0%	65	14.7%	32.5%
Innovators	120	28.7%	33.3%	276	62.6%	76.7%
Total	418	100.0%	17.6%	441	100.0%	18.4%

A. France

Banks, payment networks, the government, merchants, and innovators are engaging in activities that will likely accelerate the decline in the use of cash. Several large pilots involving influential merchants are testing innovative solutions for consumer speed and convenience such as one that PayPal is conducting with McDonald's. However, the economy

and the resistance by consumers, particularly older ones, to non-cash methods of payments are likely to place a severe drag on these efforts.

The banks, partly in collaboration with the MNOs, the payment networks, and some innovators are pushing contactless payments including mobile payments. Together, they account for 267 points of the score. (It is worth noting here that in the category of "innovators", unlike other countries, most of the innovators are the MNOs. There are few entrepreneurial ventures in France.) Banks are also making it harder for consumers to access cash. French banks are implementing "cashless" branches, which, among other things, make it harder for consumers to access cash over the counter.

The French government has also embraced a set of initiatives designed to move transactions to secure digital forms over the next 4 years to develop and implement a number of measures to do so. However, so far these efforts to push consumers from existing cards to the new forms of payment have gotten little traction with merchants or consumers.

There is evidence from attitudinal surveys that consumers are concerned about security – as they are in most countries – but also with ubiquity. The French are used to having one payment card that works just about everywhere that they want to shop (and that payment method is free to them). Contactless experiments held in several French cities and subsidized by the government were slow to catch on with consumers, in part because they failed to see the benefit of tapping versus "dipping and PIN-ing" with their chip cards.

Security and ubiquity, combined with a cultural preference for cash particularly among older people, makes us believe that mobile payments will be slow to catch on and will take share, when it does, more from cards (and even checks which are highly popular and widely used) than cash. It was noted that PayPal's success in France is due to its brand reputation for secure transacting online –which may position PayPal well for ignition as a mobile payment option in this country.

B. Germany

Germany is a highly developed country, with a small underground economy, and with a low fraction (less than 3 percent) of its households without bank accounts. Most people

have a debit card—about 91 percent had at least one "girocard" according to a recent survey. Yet Germany has a cash culture. Consumers like cash, and merchants do not like cards. Debit card use has grown slowly over the last decade and credit card use is negligible. Although this gradual use of cards is likely to continue, little is happening in Germany that is likely to accelerate this process. In particular, German merchants would likely resist investing in changes in point of sale equipment that would encourage the use of cards and the preponderance of German consumers would not resist giving up cash as their preferred method of payment.

The MasterCard "mobile payments readiness" report summarizes the situation in Germany. "Germany has a superb environment, regulatory structure, and widely distributed and affordable financial services. But with low levels of investment in telecommunications and very low consumer readiness, Germany has a long road to travel. Germany's position on the MasterCard Mobile Payments Readiness Index—20th—and score of 31.6 are an expression of the *disparity* between some strong market forces and relatively low scores on consumer interest, infrastructure, and partnerships."[27]

Most merchants have terminals in Germany. According to one study by the central bank "[o]nly in a few areas (such as bakeries, kiosks, cafes, etc.,), in which small payments are mostly predominant, is debit card payment usually not possible." Those areas account for a small portion of retail sales. The migration to EMV in Germany occurred more slowly than in the UK, at least 90% of the terminals have converted to accept EMV due to the European wide migration plan that was enacted in 2005. It is estimated that there are only 1,000 contactless terminals in Germany, less than 1% of the total number of POS terminals. Germany has a relatively small number of POS terminals for the country's size – only about 720,000.

Reflecting the cash culture Germans express relatively low interest in using innovative payment solutions. A survey by YouGov found that 54 percent of people surveyed had heard of NFC but that only 16 percent could see themselves using contactless payments in the future with slightly more than half citing security concerns. German consumers have had little interest in using prepaid cards (Geldekarte) although there has been a strong interest in adopting internet banking.

---

[27] Germany Overall Score, MasterCard WorldWide Insights. (n.d.). *MasterCard WorldWide Insights*. Retrieved May 3, 2013, from http://mobilereadiness.mastercard.com/country/?de

There is widespread ATM availability. At the same time banks have reduced the number of branches. Banks are not actively behind innovations in payment methods that would drive consumers to the use of cash. Much later than in other major EU countries banks have started issuing contactless cards. As has happened in other countries there are some trials involving contactless payments. But these face greater resistance than in other EU countries because of the merchant resistance to cards and lack of incentives to therefore install contactless terminals. Although the German telcos are conducting mobile payments trials and working with some of the card networks (see below) the banks are not actively involved.

There is little evidence of significant innovative payment methods being introduced in Germany. iZettle has entered, Telefonica O2 has introduced mobile payments with mPass contactless stickers, and as noted above MasterCard with Deutsche Telekom is likely to enter. There is no evidence that these initiatives are attracting significant interest on the part of consumers.

C. Italy

Italy is a developed but struggling country, with a large underground economy, and with a large fraction (31 percent) of its households without bank accounts. It also has a culture of tax avoidance where merchants and consumers agree to transact in cash to avoid VAT and other taxes. This is not a conducive environment for the introduction of payments innovation.

Banks have not been heavily involved in the introduction of innovative payment solutions in Italy. Together with the payment networks and mobile carriers, they have been involved in a handful of contactless pilots in Milan and Rome. Only 8 percent of the cards in circulation in Italy are contactless. MasterCard and Visa have been involved in some contactless pilots in Milan and Rome.

Aside from a handful of mobile contactless pilots there are no significant innovative efforts taking place in Italy. Given the low contactless penetration, likely resistance from merchants to efforts to increase card use, and apathy on the part of consumers towards card payments, it is not a conducive market for innovation.

The greatest risk to cash in Italy is that the government is forced by the sovereign debt crisis to restrain the underground economy and prevent the avoidance of taxes by retailers. We view this as a "black swan" event for Italy. It could happen and this could drastically reduce the use of cash. But given the current political environment in Italy, and the limited ability of the Monti government to make progress on this front, it would appear unlikely in the foreseeable future.

D. Poland

When it comes to payments, Poland has a "Jekyll and Hyde" personality.

The "Jekyll of Poland" is one of the most innovative electronic payment environments in the EU. Poland has the highest penetration of contactless terminals in the EU and a small but rapidly growing base of contactless cards. It has become one of the most active countries in the introduction of mobile payments with several partnerships of mobile carriers, banks, and card networks introducing NFC-based mobile phone payments. However, Jekyll lives mainly in Warsaw and some other major cities.

The "Hyde of Poland" is a cash lover. Poles, especially older ones and Poles outside of the major urban centers, use cash for paying most everything except regular bills. Until about 2004, they used special checks to withdraw cash at the post office and that was the only major use of checks. Debit cards and ATMs have replaced that method of obtaining cash. Outside of the major urban centers smaller merchants do not accept cards. Overall, surveys of polls find that they believe cash is more convenient, cheaper, quicker to use, and safer to use than debit cards.

This Jekyll and Hyde personality is seen most vividly from a comparison of reports on payment innovation in Poland with hard statistics on the use of payments. The media paint a rapid conversion to contactless cards and mobile phones. The data show a country that is mainly using cash. Basically what is happening is that card users are being presented with innovative alternatives for paying with traditional chip and pin plastic cards but the base of card users is quite small and concentrated among the younger, urban dwellers, and professionals.

Cash use is sustained by a very large unbanked population. The unbanked accounted for 44 percent of households as of 2010. That percent had not changed

significantly over the previous decade. Cash use is also sustained by an older and rural population that is dedicated to using cash. As Poland continues its remarkable economic development we expect that this will change despite its persistence over the last decade. As Poland becomes wealthier the percent of unbanked will fall. As economic development spreads through the county, card acceptance and use will as well. And as time passes the younger generation will pay more like people in other developed European countries.

The contactless card payments and mobile payments solutions that have been introduced all depend on consumers having a traditional payment card. Therefore, the spread of these solutions will only displace cash transactions for the portion of consumers that have and use cards.

E. Portugal

Historically Portugal has had a high rate of payments innovations. As a result of the financial crisis which has hit Portugal extremely hard most of those efforts have stopped and it is unlikely that efforts will be undertaken in the next few years that could materially affect payments innovation over the period we are considering. As in other countries contactless cards are being introduced by banks but merchants have not made the necessary steps to accept them. There are no significant efforts to introduce mobile payments.

F. Spain

By far, the economy is the significant factor affecting trends in the use of cash. Economic instability, including high and increasing unemployment and slow economic growth, which appears likely to last for much of the next decade, will likely increase the desire to use cash, as well as compromise the ability for consumers to access other forms of payment, such as credit. It also stimulates the veracity of the underground economy, as recipients of social services prefer cash payments for services in order not to jeopardize those payments. The severe economic conditions also make it less likely that merchants will want to (or be able to) invest in any new POS equipment that would be essential for accepting mobile payments.

Not surprisingly, there is little evidence of activity occurring in Spain on the part of Innovators and Payments Networks to introduce mobile payments solutions. The continued stress on the economy makes it a challenging environment to attract new investment capital and merchants and consumers are ill equipped to spend the money required to adopt new solutions.

All of this is in the context of smartphone penetration, which is quite high at 56 percent, even in spite of the recent reports that suggests consumers are increasingly cancelling mobile phone subscriptions (many Spanish consumers had multiple phones and are now streamlining them into one subscription). Once the economy improves, consumers may be well positioned to adopt new solutions, but it will take some time for merchants and innovators and networks to catch up.

G. Sweden

For Sweden, we find that every source of influence—with the exception of the payment networks, which are not very active in Sweden—will tend to decrease the use of cash relative to the historical trend. In other words there are forces in play that will reduce the use of cash more and more quickly than the historical trends indicate. Consumers are highly receptive to cash alternatives, are highly banked, and highly carded. Nearly 70% of transactions are electronic today, and in some sectors, it is as high as 90%. Further, smartphone penetration in Sweden is rising, 51 percent of the population now has a smartphone, a 21 percent increase over 2011. This makes Sweden a likely place for mobile payments to take off, and with it, a further reduction in cash use.

Banks are pushing consumers away from cash, as well. There are 4 banks in Sweden which makes coordination of mobile payments initiatives easy to manage. Further, they are consolidating bank branches and ATM locations thru the activities of their bank-owned JVs. There is rumored to be increases in ATM withdrawal fees on the horizon, and cash counters in the more rural parts of Sweden have been closed, forcing consumers to digital forms of transacting.

Merchants in Sweden tend to be much more amenable to adopting changes in technology and cards than in many countries. In addition to this cultural proclivity to change, the government is trying to further reduce the small underground economy by requiring merchants to register their cash registers, which automatically document

payments taken by that merchant in her store tied to the production of a receipt of purchase given to the customer. This makes it nearly impossible for merchants to transact any other way.

From an economic perspective, Sweden is part of the European Union, but not tied to the euro, which makes the Swedish economy much more stable and consumers more comfortable with less tangible means of payment.

It is also important to keep in mind that Sweden is a small country – roughly 9 million people. In a country as small and concentrated as Sweden, it becomes much easier to organize all of the influencers in order to drive mass adoption of electronic payments (and against cash) than most other countries.

H. Turkey

Turkey is a rapidly growing economy with a relatively young population. More than 55 percent of its population is under the age of 30 – prime candidates for electronic and/or mobile payments initiatives.

Their interest is stimulated by a recent government announcement to make Turkey the first cashless country before its 100th anniversary as a republic in 2023.[28] One might infer that would result in a higher score for Government, but that announcement was made some time ago so we have assumed that as having no ***additional*** impact on its policies over the next decade.

There are also a number of other indicators that Turkey is committed to a cashless country. It has a well-organized banking network – BKM – which effectively organizes a number of initiatives that are necessary "to compete" effectively. For example, in 2005, it decided to be the first country to adopt Chip and Pin. Four years later, every merchant terminal in the country – 2M – of them were EMV enabled and nearly every consumer card had a chip (50M of the 75M cards in circulation). When the banks get behind something, they work together to implement and ignite it – mobile payments is the next item on its agenda.

There are, however, a number of things that pull the overall CARS down. There is large percentage of the population that is unbanked (only 58 percent of its population has a

[28] CITE

bank account) stemming from a high immigrant population. It also has a high mobile phone adoption at 88 percent, but a low overall smartphone penetration (14 percent). In order for mobile to become a preferred form of payment, smartphone usage must increase or an alternative to NFC/contactless has to be presented to merchants and consumers. Unless the banks fund merchant contactless terminals, which they may, there will be little appetite to invest in new POS equipment given how few NFC mobile enabled phones there are. On the merchant's side, there are only 40 thousand contactless terminals in Turkey (out of 2 million) and very few consumer contactless cards – those who have them don't really know how to use them.

Turkey is also a highly carded country. Roughly 46% of its population has a credit card, triggered by banks efforts to incent consumers to use cards given the high rates of inflation that characterized the 1990s. In fact, card spending as a percentage of GDP doubled in the 5 year period 2004- 2009 and credit cards account for nearly 60 percent of all purchasing volume. Consumers also used cards for purchases of all sizes – flowers at the markets and big ticket items given their ability to "finance" purchases in a time of high inflation. Many consumers, however, found themselves on the "wrong side" of those cards over time, and now have little access to credit and/or no longer use them as frequently. In spite of this, consumers prefer cash and use it 30 percent of the time to pay. Consumers in Turkey like cash and surprisingly feel that it is a very secure form of payment and don't seem to want to give it up.

Cash usage and preference is also stimulated by the high immigration rates in Turkey. It is considered the "gateway" to Europe from Africa and the Middle East and attracts a highly transient and therefore highly cash-centric population who is otherwise unbanked.

I. United Kingdom

There is a significant amount of payments innovation occurring in the United Kingdom that is likely to accelerate the decline in the use of cash. PayPal, most recently, launched a number of its mobile payment technology initiatives in the UK. Visa, in conjunction with its Olympics sponsorship, put forth a massive effort to "terminalize" merchants in and around the Olympics Village to accept contactless payments. In fact, it was touted as the "cashless Olympics," its payment network failure one day notwithstanding. In

addition to its Olympics efforts, Visa and MasterCard both are promoting contactless payments quite heavily. In combination with the merchant acquiring banks, they are subsidizing contactless terminal installation, which could lay the groundwork for mobile payments. And, unlike the US, the UK has a small number of banks that need to get on board this initiative.

UK merchants seem to be more willing than in other places, perhaps because of the subsidies, to embrace contactless terminals. The UK, relative to other countries, is likely to have a higher degree of contactless terminalization and so, in theory, could more easily support a mobile payments program that is based on NFC. From the consumer's standpoint, the UK is also a highly penetrated smartphone market, with 43 percent of its citizens as smartphone owners. The combination of consumers with smartphones and merchants capable of processing mobile payments – seems like a fertile environment for the launch of mobile contactless payments.

These efforts may face some headwinds. In particular, the payment networks and banks in the UK have placed a significant bet on the future of NFC payments. It is not at all clear that consumers will see value in paying by waving with their cards or mobile phones and contactless creates negative security impressions on the part of consumers (rational or not). In the US, Square and Starbucks and others have been more successful with mobile payments using barcodes. Thus, it is possible that the contactless initiative in the UK, by locking merchants into a particularly technology choice, may retard other solutions that consumers may prefer.

J. United States

Payments innovators are highly active in the US and they account for more than half of the score we assigned. The August 2012 agreement between Square and Starbucks as well as the partnership with PayPal and Discover, announced in WHEN, to accelerate point of sale acceptance highlights both the significance of and the speed at which innovators in the US can ignite new initiatives and challenge existing payment methods.

Even at the start of 2011, Square was a fledgling mobile payments solution targeted to small merchants. It was not the first mobile POS solution, but its Jack Dorsey/Twitter lineage certainly popularized it. It now has a reported market cap of over $3 billion. Starbucks has a mobile payments application that is the most successful mobile payments application in the world with more than 4 million consumers using it and volume of roughly

$1M per week after about 18 months in the market. Starbucks has invested in Square and will be using Square's payments application for all of its US locations beginning in the Fall of 2012. This provides Square with an important jumping off point in building out the Square mobile payments network, amassing consumers from Starbucks who like to use their mobile phones to pay at the point of sale, and merchants that are geographically contiguous to Starbucks locations and who might be motivated to consider Square given its Starbucks-expanded consumer base.

The PayPal/Discover partnership signals the degree to which PayPal is committed to moving its online acceptance to physical stores and to leverage its 130 million online registered accounts to do so. This announcement accelerates the technical process of physical store acceptance for PayPal by providing access to Discover's 7 million merchant acceptance locations, as well as its 40 million account holders.

Meanwhile, there are other mobile payment players such as LevelUp that are gaining traction with the more cash intensive merchant sectors such as coffee shops and quick serve restaurants. ISIS (a joint venture of the major MNOs with partnerships with networks and banks), Google, and PayPal are just a few of the firms that are also actively pursuing mobile payments. Of those, PayPal and Google have the most traction with visible pilots in market and deep pockets with which to fund their efforts to shift transactions to mobile using their digital wallets.