Immigration and large banknotes*

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March 2010

Abstract

Do immigrants have a higher demand for large denominated banknotes than natives? This micro study examines whether cash orders for CHF 1,000 notes, a banknote most likely used for storage purposes, is concentrated in Swiss municipalities with a high foreign-to-native ratio. Controlling for a range of regional indicators across 251 Swiss municipalities, European immigrants in Switzerland are found to hoard less CHF 1,000 banknotes than natives. This result says that immigration reduces seignorage (per person) as measured by currency orders. A 1% increase in the immigrant-to-native ratio is coincident with a reduction in currency orders by CHF 4,000. The dampening effect is attributed to specific traits linked to immigrants.

Key words: immigration, large banknotes, hoarding, money demand
JEL classification: E41, E69

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* The author would like to thank Kathrin Degen, Tommaso Frattini, Saul Lach, and Rafael Lalive for helpful comments. The views expressed in this paper are those of the author and do not necessarily reflect the position of the Swiss National Bank.

1. Introduction

An unresolved puzzle in money demand studies is what drives the demand for large denominated banknotes? While it is frequently acknowledged that large banknotes are used for storage purposes, the motives for hoarding are disputed. Rogoff (1998) links the demand for EUR 500 notes to Europe's shadow economy. Porter and Judsen (1996) estimate that two-thirds of the USD 100 notes are held outside the United States. Boeschoten and Fase (1992) with the use of survey data show that the hoarding of large Dutch banknotes is motivated by tax evasion. In this micro study, I examine an alternative channel that considers the hoarding preferences between immigrants and natives at the municipality level. More specifically, I ask whether European immigrants residing in Switzerland have a higher or lower demand for large banknotes than Swiss citizens?

This study examines whether cash orders for CHF 1,000 notes is concentrated in Swiss municipalities with a high foreign-to-native ratio. The Swiss case of matching immigrant municipalities to large banknotes is of particular interest. First, immigration in Switzerland is an economic phenomenon unmatched in the industrialized world. Immigrants constitute 22.1% of the Swiss resident population in 2007 with 60.1% coming from the European

Union. On the European continent only Liechtenstein (33.9% in 2007) and Luxembourg (41.6% in 2007) yield higher percentages. Second, the CHF 1,000 note possesses unique characteristics. It is the banknote with the largest nominal value worldwide.[1] The CHF 1,000 note is rarely used in daily transactions, yet its volume makes up 55% of total Swiss currency. The currency volume of CHF 22.4 billion for the CHF 1,000 note means that the average Swiss resident (Swiss population was 7.4 million in 2007) holds at least three such bills. Third, the CHF 1,000 banknote is largely believed to be held within the national borders, see Maradan (2007). This feature and the fact that Switzerland's shadow economy is considered to be small by international standards, narrows the motives for holding large banknotes.[2]

The empirical analysis uses a micro framework to investigate the impact of the immigrant-to-native ratio on large banknotes across 251 Swiss municipalities from 2006:Q1 to 2007:Q4. A priori, the correlation's direction is unclear. A positive relation between cash and immigrant municipalities may reflect a low level of financial participation in banking services or distinct preferences on the part of immigrants driven by remittances. Alternatively,

[1]The EUR 500 note is the second largest banknote in nominal value. Historically, the CHF/EUR exchange rate has hoovered around 1.5, yielding 666 euros.

[2]See Schneider (2008) for recent international comparisons of the shadow economy.

a negative correlation may arise because of long-standing preferences of Swiss citizens to hold large sums of cash. Here, traditional motives for precautionary money demand linked to Switzerland's country-specific factors of high income, low inflation, low tax regime, and low crime serve as explanations.

The empirical analysis makes two contributions to the vast literature on money demand; each touching the domains of immigration and monetary policy. First, this country study is the first to estimate a currency demand specification at the municipality level. Previous studies on regional money demand frequently used bank deposits as a measure of narrow money.[3] I overcome this data problem for regional cash holdings through the use of currency orders at the bank-branch level.

A second contribution of the paper is the identification of immigration's impact in money demand. Previous studies that link immigration to monetary policy issues yielded conflicting results. Micro studies by Lach (2007),

[3]Recent micro studies include Bover and Watson (2007), Fischer (2007), Fujiki (2002). See also the earlier studeis by Fujiki and Mulligan (1996), Mulligan (1997), and Mulligan and Sala-i-Martin (1992). In a related study, Jankowski et al. (2007) match currency orders with Hispanic immigrant concentration for the Chicago area using census data from 2000. It is unclear whether the cross-section estimates are valid at the state level or nationwide.

Cortes (2008), and Frattini (2008), for example, show that immigration's impact on consumer prices is not uniform across goods and countries.[4] A contentious issue in these studies is the separation between demand and supply effects. This identification issue in the case of currency orders is simplified, because it is strictly demand oriented.

The empirical results find that the hoarding of Swiss large banknotes is less prevalent in immigrant municipalities. A 1% increase in the immigrant-to-native ratio is coincident with a reduction of CHF 4,000. This result says that immigration reduces seignorage per person as measured by currency orders. The dampening effect of immigration is attributed to two factors. First, immigrants wealth is lower than native wealth. Second, specific traits linked to immigrants explain the willingness to adapt to alternative financial technologies.

The paper is organized as follows. Section 2 reviews several channels between immigration and large banknotes. Section 3 lays out the empirical framework together with the data. Section 4 presents the main results with robustness checks. Section 5 offers conclusions.

[4]See also Ottiviano and Peri (2005, 2006) and Saiz (2007) for evidence of an immigration effect on house prices.

2. Motivating immigration and large banknotes

Four channels linking the hoarding activity of large banknotes to immigrants at the municipality level are reviewed in this section. Below, it is argued only the channels of precautionary money demand and tax avoidance are germane for the Swiss case. Both channels conjecture that immigrants should hold less large denominated banknotes than natives.

I begin with the traditional arguments of precautionary money demand. In the microfoundations literature developed by Whalen (1966), Miller and Orr (1966), and Frenkel and Jovanovic (1988), the real quantity of money balances demanded for transactions and precautionary purposes is a function of real income, the variance of real income, the rate of interest on an alternative asset, and a set of demographic variables. Aside from income differences between regions, immigration captures important socio-demographic traits such as age and education. Mulligan and Sala-i-Martin (1996) argue that the cost of adopting financial technologies is positively related to age and negatively related to the level of education.[5] The willingness to adopt to

[5]Tin (2008), for example, using information from the Survey of Income and Program Participation estimates a precautionary money demand function for U.S. households that includes family traits. He finds that age and education are positively correlated with non-interest earning checking accounts. Similarly, Duca and Whitesell (1995) show that age is

new financial technologies is a decision that confronts newly arriving immigrants.

Immigrants in Switzerland reveal contrasting demographic traits with respect to natives. First, immigrants on average are younger in age than natives. The share of immigrant workers below the age of 40 was 56% in 2006, whereas for Swiss workers it was 44% according to the Swiss Bureau for Statistics (BfS) (2008). The lower average age of immigrants should yield a negative correlation between immigrant municipalities and large banknotes. Second, the average educational background of immigrants is lower than of the Swiss. Table 1 shows the absolute numbers and their percentages for three education categories: high school certificate, apprenticeship, and university degree. A striking feature of the data is the high percentage of immigrants with only a high school degree (32%) compared to the Swiss (13%) in 2006.[6] The demographic features of low immigrant education and their willingness to adopt to new financial technologies should yield a positive correlation between immigrant municipalities and large banknotes.[7]

positively correlated with the demand for credit cards.

[6]The level of education is not uniform across immigrant groups. This feature will be tested in the empirical section.

[7]Although many European countries have good regional data on immigration flows,

A second motive for holding large banknotes is tax avoidance, see Boeschoten and Fase (1992). The avoidance of Swiss wealth taxes is frequently mentioned as a motive for holding large banknotes, see Maradan (2007). The Swiss wealth tax is annual and is levied at the cantonal level.[8] The basis of assessment is as follows. Residents pay an annual wealth tax on the value of all assets located in Switzerland, whereas non-residents pay an annual wealth tax on assets derived from firms and real estate situated in Switzerland. The progressive wealth tax varies slightly between cantons with a maximum of around 1.5% levied on net assets. Individuals whose wealth is below a threshold of CHF 250,000 are exempted from the tax.

In a low inflation and low interest rate environment, cash holdings are a simple means for avoiding the wealth tax. Because the wealth tax is based on

more detailed demographic information is often difficult to obtain. Hence, the immigrant-to-native ratio may serve as a simple proxy for omitted variables in a precautionary money demand function. Crucial is that average immigrants traits differ from average native traits.

[8]Several other European countries impose a wealth tax. They include France, the Netherlands, Norway, Greece, and Liechtenstein. This tax was recently lifted in Austria (1997), Finland (2006), Germany (1997), Iceland (2006), Luxembourg (2006), Sweden (2007), and Spain (2008). Countries without a wealth tax include Belgium, Italy, Portugal, and the United Kingdom.

the end-of-year financial position, cash holdings for tax-avoidance purposes are expected to be a temporary phenomenon with a distinct seasonal pattern. Under the assumption of tax evasion, the holding of large banknotes should increase before the end of the year to reduce the stated wealth on the financial statements. To reap the interest income, the holdings of large banknotes should fall after the new year. Thus at the quarterly frequency, a rise in the fourth quarter and a fall in the first quarter is expected for the CHF 1,000 notes.

In the aggregate, the seasonal pattern of tax evasion should behave similar to a Christmas shopping effect but only stronger because of the larger wealth effect. Figure 1 shows the seasonal pattern of notes in circulation for transaction purposes (i.e., CHF 10, 20, 50, and 100 notes summed together) and for storage purposes (i.e., CHF 1,000 note) from 1980:1 to 2009:12. The graph shows indirect evidence consistent with the tax evasion argument in that the seasonal pattern for the CHF 1,000 note is larger than the combined Christmas effect stemming from the aggregated amount of notes for transaction purposes. The values are normalized at 1980:1. Because the CHF 1,000 note is not readily available at ATM machines and is not accepted in all stores, the marked seasonal pattern in Figure 1 is attributed to other non

shopping domestic activities - tax evasion (i.e., CHF 1,000 notes dispersed regionally) or bank window dressing (i.e., CHF 1,00 notes concentrated in cities at major bank headquarters).[9]

The high tax deductible means that the less wealthy, which includes immigrants, have a lower incentive to evade (or better are not affected by) the wealth tax. While there is no direct comparative information on the wealth of immigrants and natives in Switzerland, several indicators suggest that the average wealth of natives is higher than that of immigrants. A first measure is salary and employment. Immigrants in Switzerland on average earn less and are more likely to be unemployed than the Swiss. According to the BfS (2008), the median monthly salary for immigrants was just over CHF 5,000 in 2006, while for Swiss it was just under 6,000. Similarly, the unemployment rate for immigrants was 7.1% in 2006, while the rate for Swiss was only 2.6%. A second measure of wealth is home ownership. Again according to the BfS (2008), Swiss home ownership stood at 52.7% in 2007:Q2, whereas immigrant home ownership was just 18.6%. The incentive to avoid wealth taxes on the

[9]The rise in the volume of the CHF 1,000 note relative to the other notes starting in 1997 is partially explained by the introduction of the CHF 200 note that replaced the CHF 500 note in the same year. The newly introduced note is used both for transaction and storage purposes, while the CHF 500 banknote was used primarily for storage purposes.

part of wealthier natives means that a negative (with a seasonal) correlation between immigrant municipalities and large denominated notes is expected.

A third channel that links large banknote holdings to immigrants is migrant remittances to low-income countries with weak banking services. Jankowski et al. (2007) argue that currency remittances operating through global cash transfer services are attractive for select immigrant groups that send cash to recipient countries with a weak financial infrastructure. Although the practice of cash remittances is widespread in the United States and Saudi Arabia, several factors speak against this argument as a viable explanation of currency holdings among immigrants in Switzerland.

The first counterargument is the small size of currency remittances to poor countries. Arapovic and Brown (2009) estimate the total amount of remittances to the Balkans and Turkey; the most likely immigrant groups to use cash transfer services. The estimated sum is only CHF 0.7 billion for 404,000 immigrants in 2006. This total yields CHF 1,700 per immigrant: an amount well below the average holdings of three CHF 1,000 notes per person. Further, irrespective of whether these figures are measured correctly, immigrants from the Balkans and Turkey comprise only 25% of the immigrant population living in Switzerland. It is thus unlikely that these immigrant

groups at the municipality level can influence the demand for large banknotes in the aggregate.

Lack of financial participation is another motive advanced why immigrants hoard. This argument again rests on the U.S. experience. Jankowski et al. (2007) show empirically for the Chicago area that Hispanics, in contrast to other immigrant groups, hoard USD 100 notes. The conjectured motive advanced by the authors is that Hispanics exhibit a low level of financial participation. Frictions in banking services for Hispanic immigrants in the United States include the lack of a common language, the lack of residence documentation, and the salary payment in cash or check.

The unbanked argument does not readily apply to immigrants in Switzerland. Independent of their skill-level or language skills, employees in Switzerland need a bank account to receive their salary. Almost all salary payments in Switzerland are electronic transfers.

3. Econometric specification and data

This section first presents the empirical model together with the instrumentation strategy. Empirical estimates from the first-stage regression are shown. In a second subsection, the data are discussed.

3.1 Empirical specification

The econometric model estimates the demand effect of immigrants to natives of a Swiss municipality on currency orders in the same city. Currency orders are volume measures in Swiss francs for six banknotes: CHF 10, CHF 20, CHF 50, CHF 100, CHF 200, and CHF 1,000. The following specification adapted from Lach (2007) and Frattini (2008) defines the currency order, CO_{mt}, for municipality, m, ($m = 1, \cdots, 251$) for time, t, covering the quarterly sample from 2006:Q1 to 2007:Q4 (defined by data availability) as

$$logCO_{mt} = \mu_t + \mu_m + \delta(I_{mt}/N_{mt}) + \beta log(I_{mt} + N_{mt}) + \lambda X_{mt} + u_{mt}, \quad (1)$$

where I_{mt} and N_{mt} are the number of immigrants and natives in municipality, m, in quarter, t, $\mu's$ are time and municipality effects, X_{mt} are additional municipality specific factors (i.e., the unemployment rate serves as a proxy for economic activity and should enter with a negative coefficient), and u_{mt} is a shock to currency orders in quarter t. Total population, $(I_{mt} + N_{mt})$, should be positively correlated with currency volume. Its impact for the different notes may be nonlinear because of the greater distribution of ATM services in larger cities.[10]

[10]See Lach (2007) for a discussion of nonlinear effects for population in a similar specification for CPI prices.

The coefficient of interest in equation (1) is δ. An insignificant coefficient estimate for I/N says that preferences for cash holdings between immigrants and natives are similar. Alternatively, when δ is positive this says that European immigrants in Switzerland have strong preferences to hold large banknotes. Such behavior is consistent with remittances or a lack of financial participation. Alternatively, when δ is negative, this says that possible immigrant traits such as age, education, or income matter.

Irrespective where immigrants settle in Switzerland, currency orders are demand driven. Thus, there is no endogeneity conundrum between supply and demand. However, omitted variables, such as prices or income unavailable at the municipality level, influence an immigrant's decision to reside in a particular Swiss city and are certainly correlated with money orders. The omitted variables problem biases the estimates of δ in (1). In the case of rising income, this leads to an upward biased estimate of δ. I resolve this problem of omitted variables by instrumenting for I_{mt}/N_{mt}.

The instrumental variable is based on settlement patterns of previous immigrants. Following Card (2001), I construct a variable that predicts immigrant flows for each municipality and for each quarter. The intuition is to exploit the location choices of past immigrants from each area of origin to

predict the settlement decisions of immigrants from the same country. The instrument variable predicts immigrant inflows filtering local contemporary demand factors.

In a first step, immigrants are divided into 11 European countries of origin. I then calculate I_{it}, the number of immigrants from each country, i, that reside in Switzerland in quarter t.[11] Next, the fraction of immigrants from country, i, in municipality, m, is the quarterly average for the year 2004, $\bar{\lambda}_{mi} = \bar{I}_{mi}/\bar{I}_i$. The predicted number of immigrants from country i in quarter t is $\bar{\lambda}_{mi} I_{it}$. By summing over i, a measure of the predicted total immigrant inflow into municipality, m, at time, t, is obtained that is free of local shocks. A final step normalizes the instrument by the number of natives in the municipality two years before at $t-8$:

$$SP_{mt} = \sum_{i=1}^{11} \frac{\bar{\lambda}_{mi} I_{it}}{N_{mt-8}}. \tag{2}$$

Table 2 presents the first-stage regressions of the immigrant-to-native ratio on the supply push instrument, SP_{mt}. The OLS regressions are from 2006:Q1 to 2007:Q4 with municipality effects. In each regression, the instrument has a t-value above 5, suggesting that SP passes the critic of weak

[11]The countries of origin are Austria, France, Germany, Italy, Netherlands, Serbia, Portugal, Serbia, Spain, Turkey, United Kingdom, and others.

instruments. The first regression in column 1 is unrestricted. It includes information on immigrants from 2675 municipalities. Next in column 2, the sample is restricted to 243 municipalities receiving cash orders for CHF 1,000 notes in 2006 and 2007. Column 3 shows the restricted first-stage regression of column 2 with time effects. The last specification in column 4, which is used in the analysis in section 4, includes log(population) and the unemployed-to-population ratio in the specification of column (3).

3.2 The data

The quarterly sample from 2006:Q1 to 2007:Q4 covers a maximum of 251 municipalities. Data on cash orders at the bank-branch level are aggregated to the municipality level. The quarterly data are from UBS, the largest national distributor of banknotes in Switzerland.[12] UBS handles roughly one-third of the total distribution activity in Switzerland.

Coverage of the currency orders is documented graphically together with statistical information. The geographical coverage of UBS's distribution activities in Swiss municipalities is shown in figure 2. The darker dots denote

[12]The distribution of banknotes is fully privatized in Switzerland. Currency orders have delivery lags of three and half hours or less. Most distributors operate only regionally. Information on the location of notes returned to the Swiss National Bank is unavailable.

the banks served by UBS and the lighter shaded dots denote the remaining municipalities. The sparse areas in figure 2 are consistent with Switzerland's mountain regions.

Table 3 provides further information on currency orders. The first column shows the number of municipalities served. They range between 199 and 251, depending on the size of the banknotes. Column 2 shows the percentage of German speaking municipalities served. Apart from the CHF 50 note, the currency percentages lie close to the national average of 72% for the German-speaking population. Next, columns 3 to 6 provide information on the average, the minimum and the maximum, and the standard deviation of the quarterly total of the distributed currency. In the last column, the quarterly average from column 3 is divided by the average quarterly outstanding currency for the respective banknote. Except for the CHF 10 and the CHF 200 banknote, the percentages lie between 10% and 15%. The low percentage for the CHF 10 note (0.005%) suggests that UBS coverage is problematic for the smallest banknote, whereas the distribution of CHF 200 note (46%) may be over-representative with respect to the others.

The postal code from the currency orders is matched with other data sources. From the Federal Office for Migration, I obtained data on the num-

ber of foreigners grouped by their origin for each municipality in Switzerland. The data are available at the quarterly frequency. Further, the number of unemployed workers for each community is from the State Secretariat for Economic Affairs. The monthly data are averaged at the quarterly frequency. In addition, I obtained data on the total resident population for each municipality from the Federal Office of Statistics. The population data, available only at the annual frequency, are disaggregated by a linear interpolation over a 20-year period from 1989 to 2008.

4. Empirical results

This section presents the empirical results. In the first subsection, the main result for large banknotes is documented: the correlation between currency orders and the immigrant-to-native ratio is negative.[13] The second subsection presents robustness tests that control for income effects by excluding geographical areas where poorer natives reside (i.e., mountainous and rural areas). These results show that the hoarding effect is linked to wealthier natives. The third subsection presents empirical results that examine the

[13]Table Appendix A shows that this negative relationship for municipalities with the 10 highest and 10 lowest immigrant to native ratios.

seasonal pattern of equation (1). The empirical findings are inconsistent with the tax evasion argument.

4.1 The main results

Table 4 presents OLS and IV regression estimates for CHF 200 and CHF 1,000 banknote orders, controlling for municipality and time effects. All regressions are for the full sample and control for municipality effects. The coefficient estimates for the immigrant-to-native ratio are sensitive to estimation type and the introduction of time effects. The sequential introduction of population and the number of unemployed do not influence the coefficient estimates for the immigrant-to-native ratio.

OLS estimates are presented in the top panel of Table 4. The immigrant-to-native ratios are insignificant for all specifications of the CHF 200 banknotes. The introduction of municipality size (log population), economic activity (unemployed-to-population ratio), or time effects does not change the result that the demand for 200 banknotes does not differ between immigrants and natives.

A somewhat similar picture emerges for the OLS estimates for the CHF 1,000 notes. The immigrant-to-native ratio is positive and significant in the regression without time effects, see column 5. The introduction of time dum-

mies to control for aggregate trend effects, such as interest rates, reduces the coefficient estimate of the immigrant-to-native ratio fourfold and eliminates its significance, see columns 7 and 8. The introduction of population or unemployed-to-population ratio has no significant bearing on the results for the immigrant-to-native ratio.

The bottom panel of Table 4 shows IV estimates of different specifications of equation (1). The F-tests from the first-stage regression are all high, suggesting that the critic of weak instruments does not apply. The coefficient estimates for the immigrant-to-native ratio are negative and significant at the 1% critical level in the regression for the CHF 200 banknotes. The coefficient size for I/N jumps from -10 to -20 with the introduction of time effects. In other words, a 1% increase in the immigrant-to-native ratio leads to a reduction by CHF 4,000. This result is partially compensated by population size by 1,000 (i.e., it has a coefficient size of 5).[14] These results are not sensitive to the introduction of the unemployed-to-population ratio. This latter variable enters with a positive coefficient and is significant at the 5% level.

[14]This estimate needs to be treated with caution in that population is not necessarily exogenous in this specification. See Lach (2007).

The IV estimates for CHF 1,000 banknotes resemble those for CHF 200 banknotes. The coefficient estimates for I/N fall from 7.7 to -7.7 with the introduction of the time effects, see columns 6 and 7. The coefficient estimates of I/N are negative and significant at the 10% level in the regressions with time effects, see column 7. The regressions with time effects show that a 1% increase in the immigrant-to-native ratio leads to a CHF 7,000 reduction in the demand for large banknotes. Again, this result is compensated by population size in the order of CHF 3,000.

Next, I examine whether the disproportionate effect between immigrants and natives for large banknotes holds for other banknote denominations. A significant negative result across all banknote denominations is consistent with the traditional and not the precautionary demand for money. The IV regressions in Table 5 are based on specifications (4) and (8) from Table 4. Only the coefficient estimates for the immigrant-to-native ratio are shown. The results show that the immigrant demand for smaller banknotes is not distinct from natives, except for the CHF 20 notes. The coefficient estimates are insignificant for the CHF 10, CHF 50, and the CHF 100 banknote, whereas for the CHF 20 note it is negative and significant at the 5% level. These results are consistent with the precautionary demand specification and

that natives hoard larger banknotes than do immigrants.

A further consideration is whether the hoarding of large CHF banknotes by natives is more pronounced with a particular immigrant group linked to education. If education matters for the immigrants ability to adopt to new financial technologies, then the demand for large banknotes by well educated immigrants should be lower than for less educated immigrants. The four largest immigrant groups in Switzerland are Germans, Italians, Serbians, and Portuguese. A striking feature is that these nationals have different levels of education. German immigrants have the highest percentage of university degrees (64% in 2007, see Table 1) and the Portuguese the lowest (6% in 2007). The IV regressions in Table 6 again show only the estimates of the immigrant-to-native ratio for the full specification of equation (1) for the CHF 200 and CHF 1,000 banknotes. The instruments have been adjusted so that only the fixed immigrant share at the municipality level in 2004 is multiplied by the aggregate of the respective immigrant group.[15] The IV regressions show that the coefficients are all negative except for Serbian immigrants in the demand specification for CHF 1,000 notes. The negative

[15]Data for Swiss education levels at the local level is not available for the observed sample.

and significant results for the more educated immigrants (i.e., Germans and Italians) is consistent with the micro evidence in Mulligan and Sala-i-Martin (1996) that find education to be negatively correlated with money.

4.2 Controlling for municipality and regional characteristics

Robustness checks are presented in Tables 7 and 8. They control for income and non linear effects based on sample splits for municipality and geographic characteristics. The evidence reveals that these factors are non neutral, however the main result that natives hoard more than immigrants holds.

Table 7 presents coefficient estimates for I/N in regressions with CHF 200 and CHF 1,000 banknotes that control for municipality characteristics. Panel A divides the sample based on a municipality population below or above 10,000 residents. The results show stronger evidence of hoarding on the part of natives for CHF 200 notes in smaller municipalities. The opposite result holds for the largest banknote. The immigrant-to-native ratio is negative and significant at the 10% level for large municipalities. This hoarding result is consistent with the fact that incomes are higher in larger municipalities.

The role of special tax reductions is examined in panel B of Table 7. The sample is divided between municipalities that are exempt from special taxes because of their weak fiscal position. The coefficient estimates for I/N

show that municipalities not benefitting from the tax reduction, hoarding prevails. The coefficient estimates are close to the full sample estimates recorded in Table 4 but their level of significance is higher. The insignificant estimates for the sample of municipalities enjoying tax benefits however must be interpreted with care. The sample size is small and the F-test values from the first-stage regressions are low.

Table 8 considers the influence of geographic location on the distribution of CHF 200 and CHF 1,000 banknote orders. The sample is split at the municipality level in two ways: rural versus urban areas and mountain versus low-land regions. The sample splits are motivated by location of commercial activity: agriculture sector (rural) and tourism (mountain region). The agriculture (8.1% immigrant labor participation in 2006) and tourist (51%) sector control for income effects and contrasting immigrant participation rates in the labor force.

Panel A shows the results for rural and non rural areas. This sample split controls for higher-income effects and higher labor participation effects on the part of immigrants in non rural areas. Only for the non rural areas is a negative and significant result obtained. Again, the results reconfirm the conjecture that wealthier Swiss are driving the demand for large banknotes.

The result for the rural areas has to be interpreted with caution because of the low F-test values from the first-stage regressions.

Panel B divides the sample based on elevation. Only for the low lands is a negative and significant result for I/N obtained. The estimates for the immigrant-to-native ratio are insignificant for municipalities in mountain areas. The insignificance result can be explained by the fact that the incomes of municipalities in the mountain areas lie well below the national average.

4.3 Seasonal patterns and tax evasion

The empirical results in the previous sections show that the higher level of native wealth is an important factor associated with the negative correlation between large denominated banknotes and the immigrant-to-native ratio. This result is inconsistent with the unbanked and remittance arguments. An open issue remains whether the negative coefficient on the immigrant-to-native ratio captures tax evasion or immigrant traits in a precautionary demand function.

A simple test for tax evasion examines the seasonal patterns between cash orders and immigration flows: a strong demand for cash in the fourth quarter followed by a sudden fall in demand for cash orders in the first quarter. The rationale for this seasonal pattern is that higher cash holdings in the fourth

quarter leads to a lower end-of-year balance on financial statements used for tax declarations. The forgone loss on interest income is compensated by reducing the cash holdings in the first quarter.

Table 9 reruns the IV regressions of Table 4 of columns 4 and 8 for the four quarters. The quarterly regression results do not show a seasonal pattern consistent with tax evasion. Because of the low degrees of freedom, the results need to be treated with caution. Despite this shortcoming, the quarterly estimates for the CHF 200 and the CHF 1,000 notes are significant at the 10% level only for the fourth quarter. Furthermore, the strength of the first-stage regions is reasonable only for the fourth quarter. The absence of a significant seasonal pattern in the fourth and the first quarter suggests that currency orders are not driven by tax evasion considerations.

5. Conclusions

This paper presents new evidence on the impact of European immigration on money demand in Switzerland. Despite a diverse literature studying demographic effects on money demand, this is the first country study to examine the impact of immigration on banknote circulation. Immigrants in Switzerland are younger and less wealthier than natives. I use the immi-

grant population as a control group to examine the role of hoarding for large banknotes.

The empirical results show that immigrant municipalities have a lower demand for the largest Swiss banknotes. This result implies that immigration reduces seignorage per person as measured by currency orders. Controlling for population size, a 1% increase in the native-to-population ratio reduced the demand for the CHF 1,000 note by CHF 4,000. The effect for the CHF 200 note is found to be similar, while for most of the smaller denominated notes no immigrant effect was found. Consistent with a precautionary demand function, I attribute this dampening effect to specific immigrant traits such as lower average age and lower average income.

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Table Appendix A: Descriptive Statistics

District	Immigrant to Population Ratio $(I / Pop)_{2007Q4}$	Population Pop_{2007Q4}	Cash Orders per Population in 2007Q4					
			CHF 1000	CHF 200	CHF 100	CHF 50	CHF 20	CHF 10
Largest immigrant-municipalities								
Renens (VD)	0.50	18904	0.92	6.45	0.00	0.00	0.53	0.00
Vernier	0.43	31105	0.93	1.65	2.79	0.28	1.13	0.02
Kreuzlingen	0.41	18452	0.50	1.31	2.23	0.03	2.26	0.04
Rorschach	0.40	8646	0.98	6.05	0.02	1.40	3.42	0.07
Ecublens (VD)	0.40	10677	0.00	1.21	2.39	0.00	5.67	0.00
Vevey	0.40	17381	0.96	7.02	3.85	0.75	5.64	0.03
Schlieren	0.40	14054	0.51	4.41	1.71	0.06	2.85	0.13
St. Margrethen	0.39	5351	2.04	3.92	6.19	2.24	4.58	0.41
Dietikon	0.38	22577	0.66	3.72	1.24	0.40	2.70	0.00
Rolle	0.38	4950	1.77	10.81	9.09	2.63	12.73	0.99
Average	***0.41***	***15'210***	***0.93***	***4.66***	***2.95***	***0.78***	***4.15***	***0.17***
Smallest immigrant-municipalities								
Freimettigen	0.05	362	8.70	41.16	64.36	2.21	80.11	1.10
Bolligen	0.05	6021	0.53	2.49	2.82	0.02	2.99	0.00
Koppigen	0.05	2142	2.33	5.70	5.79	0.19	5.18	0.05
Schüpfen	0.05	3306	1.69	4.48	4.36	0.03	2.96	0.03
Hasle bei Burgdorf	0.05	2970	1.43	5.35	3.20	0.03	5.05	0.13
Mötschwil	0.04	133	31.35	194.74	239.85	33.08	240.60	0.75
Grächen	0.04	1357	0.41	3.24	3.61	0.00	3.61	0.00
Deisswil bei Münchenbuchsee	0.02	99	40.40	217.17	213.13	11.11	364.65	7.07
Ursenbach	0.02	909	.	11.22	9.35	0.00	11.11	0.00
Aeschlen	0.02	311	14.79	57.88	79.42	1.29	81.99	0.32
Average	***0.04***	***1'761***	***11.29***	***54.34***	***62.59***	***4.80***	***79.83***	***0.95***

Notes: Table A shows the municipalities with the 10 largest and 10 smallest immigrant-to-population ratios (in 2007Q4). Cash orders per population are shown for CHF 1000, CHF 200, CHF 100, CHF 50, CHF 20 and CHF 10 notes.

Figure 1: Seasonal pattern of notes for transaction and storage purposes

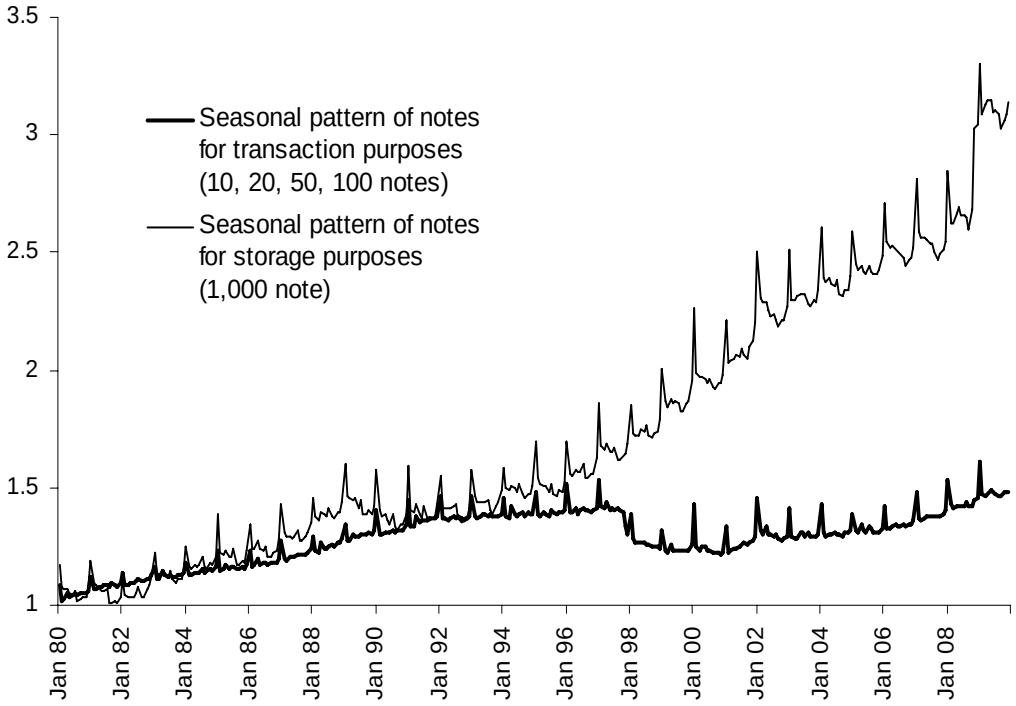

Figure 2:

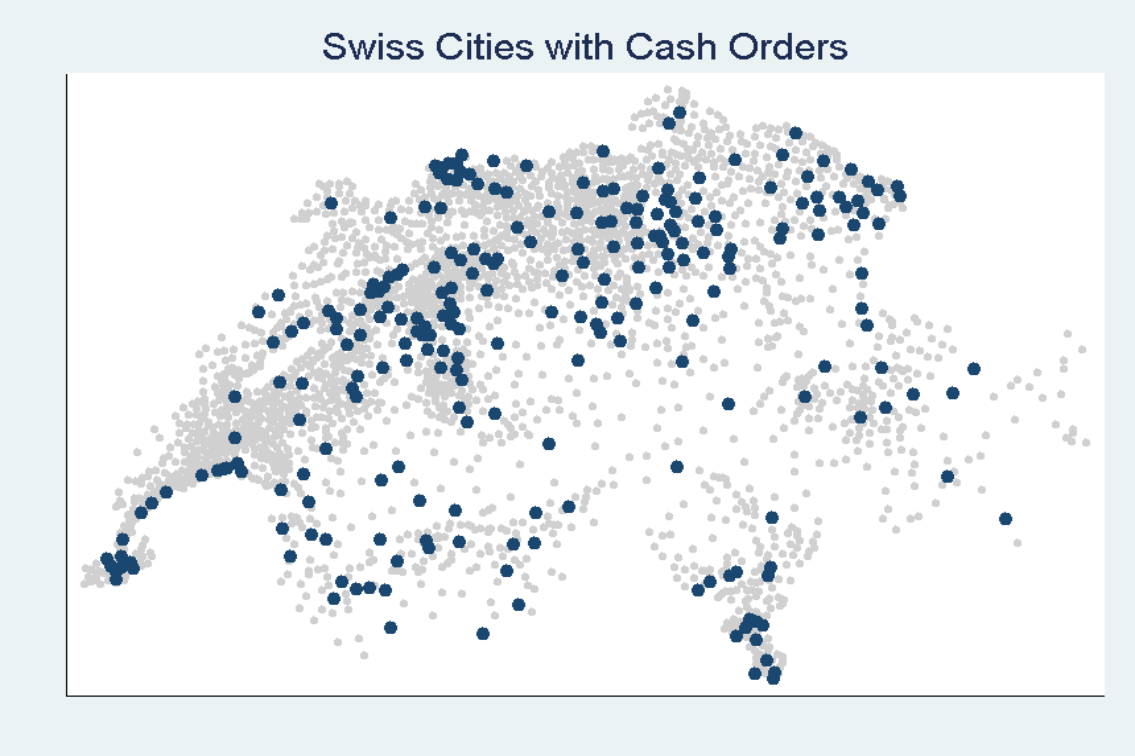

Table 1: Education of Swiss and Immigrants (thousands)

	2006	2007	2006	2007
High School Certificate	680	675	0.168	0.164
Swiss	410	408	0.128	0.128
Immigrants	270	267	0.318	0.305
Germany	3	3	0.031	0.023
France	3	4	0.067	0.082
Italy	54	52	0.332	0.318
Spain and Greece	18	15	0.337	0.309
Portugal	70	73	0.676	0.661
Serbia	71	70	0.445	0.431
Appenticeship	2198	2204	0.543	0.535
Swiss	1852	1850	0.579	0.570
Immigrants	346	354	0.407	0.404
Germany	36	38	0.348	0.333
France	16	16	0.381	0.357
Italy	83	84	0.510	0.518
Spain and Greece	25	23	0.479	0.467
Portugal	28	31	0.273	0.281
Serbia	79	82	0.494	0.507
University Degree	1173	1243	0.290	0.302
Swiss	939	988	0.293	0.304
Immigrants	234	255	0.275	0.291
Germany	64	74	0.622	0.644
France	23	25	0.553	0.561
Italy	26	26	0.158	0.163
Spain and Greece	10	11	0.184	0.224
Portugal	5	6	0.051	0.058
Serbia	10	10	0.060	0.062
Total	4051	4122	1.000	1.000
Swiss	3201	3246	1.000	1.000
Immigrants	850	876	1.000	1.000
Germany	103	115	1.000	1.000
France	43	45	1.000	1.000
Italy	163	162	1.000	1.000
Spain and Greece	52	50	1.000	1.000
Portugal	103	110	1.000	1.000
Serbia	159	161	1.000	1.000

Notes: source Swiss Federal Statistics Office. Sake Survey

Table 2: Immigrant-to-Native Ratio and the Instrument SP

	(1)	(2)	(3)	(4)
	unrestricted	*restricted* CHF 1,000 only	*restricted* CHF 1,000 only	*restricted* CHF 1,000 only
OLS Estimation				
SP	1.690***	1.730***	1.931***	2.028***
	(0.310)	(0.1760)	(0.424)	(0.400)
ln population	no	no	no	yes
unemployment/population	no	no	no	yes
time effects	no	no	yes	yes
Number of observations	20414	1859	1859	1859
Number of cities	2675	243	243	243

Notes: Estimation is OLS with fixed (city) effects. SP is the instrument. Sample is from 2006:Q1 to 2007:Q4. *,**, *** denotes significance at the 10%, 5%, and 1% level. Standard errors are in parentheses.

Table 3: Statistics on UBS Currency Orders

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	total cities	German speaking cities only	average per quarter	min	max	St. Dev.	ave cur. order.to ave outstanding
CHF 10	199	0.754	3.0	2.3	3.8	0.6	0.005
CHF 20	249	0.715	194	169	213	14.7	0.148
CHF 50	173	0.867	188	150	229	26.7	0.106
CHF 100	242	0.736	948	835	1280	149.0	0.125
CHF 200	251	0.708	2760	2560	3110	178.0	0.461
CHF 1,000	244	0.713	2220	1870	2840	392.0	0.102

Notes: Total cities are number of cities covered by UBS currency orders. German speaking cities is the percentage of German speaking cities to total cities served by UBS. Ave. per quarter denotes the average currency volume for a particular banknote in millions.
min and max are with respect to the quarterly volume from 2006:Q1 to 2007:Q4. st. dev. is the standard deviation in millions.
ave cur order to ave outstanding is the average quarterly volume of currency orders to the quarterly average of notes in circulation.

Table 4: Immigrant-to-Native Ratio and large Banknotes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CHF banknotes	*200*	*200*	*200*	*200*	*1,000*	*1,000*	*1,000*	*1,000*
OLS Estimation								
Immigrant/Natives	-0.042	0.500	-0.421	-0.472	3.523***	2.727***	0.753	0.725
	(0.950)	(0.983)	(0.909)	(0.910)	(0.213)	(0.791)	(0.622)	(0.603)
ln population		-2.099***	-0.321	-0.281		3.058**	0.473	0.495
		(0.784)	(0.800)	(0.802)		(1.077)	(1.048)	(1.046)
unemployment/population				4.839*				3.382
				(2.584)				(2.366)
time effects	no	no	yes	yes	no	no	yes	yes
Number of observations	1911	1911	1911	1911	1859	1859	1859	1859
Number of cities	249	249	249	249	243	243	243	243
R-square	0.940	0.942	0.945	0.945	0.930	0.930	0.954	0.961
IV Estimation								
Immigrant/Natives	-9.790***	-10.845**	-21.047***	-20.586***	9.206***	7.741**	-7.703*	-7.416*
	(3.412)	(4.411)	(6.313)	(6.241)	(2.928)	(3.746)	(4.129)	(4.091)
ln population		1.188	5.192**	5.106**		1.651	2.753*	2.693*
		(1.716)	(2.202)	(2.185)		(1.465)	(4.129)	(1.464)
unemployment/population				6.586**				3.913*
				(3.315)				(2.314)
time effects	no	no	yes	yes	no	no	yes	yes
Number of observations	1911	1911	1911	1911	1859	1859	1859	1859
Number of cities	249	249	249	249	243	243	243	243
R-square	0.130	0.001	0.061	0.063	0.175	0.286	0.115	0.120
F-test (first stage regression)	184.3	129.95	34.24	31.10	181.04	127.83	33.81	30.65

Notes: Estimation is OLS or IV with fixed (city) effects. Sample is from 2006:Q1 to 2007:Q4.
*,**, *** denotes significance at the 10%, 5%, and 1% level. Standard errors are in parentheses.

Table 5: Immigrant-to-Native Ratio on Currency Orders of Different Denomination

CHF banknotes	10	20	50	100	200	1,000
Immigrant/Natives	-11.465	-21.938**	7.476	-11.936	-20.568***	-7.416*
	(14.095)	(8.715)	(11.831)	(7.753)	(6.241)	(4.091)
Number of observations	896	1764	1497	1884	1991	1859
Number of cities	198	248	241	250	249	243
R-square	0.158	0.056	0.126	0.110	0.063	0.120
F-test (first stage regression)	21.64	29.25	23.01	31.24	31.10	30.65

Notes: Only the estimates of the immigrant-to-native ratio from an IV regression with fixed effects at the city time level (that includes ln population, unemployment/ population, and time effects) are shown. F-Test(10, Observations-cities-10) is from the first stage regression that includes the instrument (see equation 2). Sample is from 2006:Q1 to 2007:Q4. *,**, *** denotes significance at the 10%, 5%, and 1% level. Standard errors are in parentheses.

Table 6: Ethnic cities and large currency orders

CHF 200 banknote				
Immigrant group	Germans	Italians	Serbians	Portuguese
Immigrant/Natives	-19.277***	-69.889	-593.963	-8.516
	(5.592)	(63.580)	(848.131)	(22.308)
Number of observations	1911	1911	1911	1911
Number of cities	249	249	249	249
R-square	0.197	0.130	0.018	0.108
F-test (first stage regression)	224.79	27.31	20.84	23.06
CHF 1,000 banknote				
immigrant group	Germans	Italians	Serbians	Portuguese
Immigrant/Natives	-0.864	-80.994*	1.020	-6.368
	(3.944)	(47.887)	(161.464)	(15.985)
Number of observations	1859	1859	1859	1859
Number of cities	243	243	243	243
R-square	0.247	0.119	0.245	0.192
F-test (first stage regression)	223.33	27.10	20.84	22.94

Notes: Only the estimates of the immigrant-to-native ratio from an IV regression with fixed effects at the city time level (that includes ln population, unemployment/ population, and time effects) are shown. F-Test(10, Observations-cities-10) is from the first stage regression that includes the instrument (see equation 2). Sample is from 2006:Q1 to 2007:Q4. *,**, *** denotes significance at the 10%, 5%, and 1% level. Standard errors are in parentheses.

Table 7: City Characteristics, Immigrant-to-Native Ratio, and Cash Orders

CHF Banknotes	200	200	1,000	1,000
A: City population < 10000	yes	no	yes	no
Immigrant/Natives	-22.799**	-11.592	-5.454	-9.052*
	(8.965)	(8.375)	(6.459)	(4.796)
Number of observations	1096	815	1060	799
Number of cities	143	107	139	105
R-square	0.018	0.104	0.000	0.045
F-test (first stage regression)	15.79	20.10	15.21	20.91
B. Special Tax Treatment	yes	no	yes	no
Immigrant/Natives	-132.339	-18.146***	91.544	-10.533***
	(363.628)	(6.302)	(126.117)	(3.970)
Number of observations	343	1569	333	1526
Number of cities	43	206	42	201
R-square	0.130	0.070	0.100	0.102
F-test (first stage regression)	1.50	30.94	1.34	30.44

Notes: Only the estimates of the immigrant-to-native ratio from an IV regression with fixed effects at the city time level (that includes ln population, unemployment/ population, and time effects) are shown. F-Test(10, Observations-cities-10) is from the first stage regression that includes the instrument (see equation 2). Sample is from 2006:Q1 to 2007:Q4. *,**, *** denotes significance at the 10%, 5%, and 1% level. Standard errors are in parentheses.

Table 8: Geographical Characteristics, Immigrant-to-Native Ratio, and Cash Orders

CHF Banknotes	200	200	1,000	1,000
A: Rural area	yes	no	yes	no
Immigrant/Native	-63.301	-15.416**	12.297	-10.075***
	(68.018)	(6.239)	(20.009)	(3.881)
Number of observations	608	1303	595	1264
Number of cities	79	170	77	166
R-square	0.004	0.003	0.001	0.064
F-test (first stage regression)	7.64	30.04	7.50	29.13
B: Alp - mountain area	yes	no	yes	no
Immigrant/Native	-10.658	-20.098***	4.961	-11.760**
	(7.338)	(7.814)	(6.638)	(4.762)
Number of observations	762	1149	760	1099
Number of cities	98	151	98	145
R-square	0.039	0.149	0.045	0.191
F-test (first stage regression)	18.46	20.09	18.57	19.85

Notes: Only the estimates of the immigrant-to-native ratio from an IV regression with fixed effects at the city time level (that includes ln population, unemployment/ population, and time effects) are shown. F-Test(10, Observations-cities-10) is from the first stage regression that includes the instrument (see equation 2). Sample is from 2006:Q1 to 2007:Q4. *,**, *** denotes significance at the 10%, 5%, and 1% level. Standard errors are in parentheses.

Table 9: Seasonal Characteristics, Immigrant-to-Native Ratio, and Cash Orders

CHF 200 Banknotes	Q1	Q2	Q3	Q4
Immigrant/Native	-7.836	-52.52*	-200.791	-12.734*
	(9.856)	(30.052)	(807.577)	(7.219)
Number of observations	486	476	475	474
Number of cities	246	246	249	247
R-square	0.236	0.054	0.121	0.027
F-test (first stage regression)	6.01	4.80	16.10	35.72
CHF 1,000 Banknotes	Q1	Q2	Q3	Q4
Immigrant/Native	-4.740	-7.527	-48.306	-9.425*
	(7.338)	(11.351)	(132.139)	(5.610)
Number of observations	471	463	461	464
Number of cities	241	241	240	242
R-square	0.272	0.189	0.143	0.275
F-test (first stage regression)	7.54	4.34	14.67	35.28

Notes: Only the estimates of the immigrant-to-native ratio from an IV regression with fixed effects at the city time level (that includes ln population, unemployment/ population, and time effects) are shown. F-Test(10, Observations-cities-10) is from the first stage regression that includes the instrument (see equation 2). Sample is from 2006:Q1 to 2007:Q4. *,**, *** denotes significance at the 10%, 5%, and 1% level. Standard errors are in parentheses.