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Regional inflation and financial dollarisation

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Abstract

In this paper, we exploit variation in consumer price inflation across 71 Russian regions to examine the relationship between the perceived stability of the local currency and financial dollarisation. Our results show that regions with higher inflation experience an increase in the dollarisation of household deposits and a decrease in the dollarisation of (long-term) household credit. The negative impact of inflation on credit dollarisation is weaker in regions with less integrated banking markets, suggesting that the asset-liability management of banks constrains the currency-portfolio choices of households.

Keywords: Financial dollarisation, financial integration, regional inflation

JEL Classification Number: E31, E42, E44, F36, G21, P22, P24

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1. Introduction

The widespread holding of assets and liabilities in a foreign currency, known as financial dollarisation, is viewed as both a constraint on monetary policy and a threat to financial stability in many emerging markets (Levy Yeyati, 2006).[1] In the aftermath of the financial crisis, policy makers have emphasised the need for de-dollarisation (or de-euroisation) of deposits and loans, particularly in Latin America and eastern Europe (Garcia-Escribano and Sosa, 2011; Nagy, Jeffrey and Zettelmeyer, 2011). A credible monetary policy with low and stable consumer price inflation, such as through an inflation targeting regime, is seen as the key ingredient to kick-start de-dollarisation (Lin and Ye, 2013). The objective of this paper is to examine how and to what extent the stability of the local currency affects households' propensity to hold foreign currency assets (deposits) and liabilities (loans).

We exploit variation in consumer price inflation across Russian regions to examine the relationship between the perceived stability of the local currency and financial dollarisation. Our analysis is based on quarterly data on asset and liability dollarisation as well as on local consumer price inflation for 71 regions over the period 2005 (second quarter) to 2008 (second quarter). This is an interesting period to analyse as exogenous factors, particularly food and oil price spikes, caused substantial cross-regional and time variation in Russian inflation. Moreover, a year before the start of our observation period, Russia introduced a comprehensive deposit insurance scheme which led to a rapid increase in household deposits. The scheme significantly reduced households' sensitivity to bank-specific risk (Karas, Pyle, and Schoors, 2013), potentially giving further prominence to monetary risks in households' deposit allocation decisions.

Our within-country data allow us to tackle two major shortcomings of previous studies that rely on cross-country data. Firstly, unobserved heterogeneity in economic policies and institutions may cloud the cross-country relationship between monetary conditions and dollarisation. We alleviate this concern by examining cross-regional variation within a country with a common macroeconomic policy and institutional framework. Secondly, cross-country studies cannot disentangle the impact of inflation on dollarisation from that of (correlated) changes in exchange rates. We can isolate the impact of inflation on financial dollarisation given that exchange rate movements are uniform over all regions within the currency union of the Russian Federation.

We show that regions with high inflation experience higher deposit dollarisation and lower dollarisation of (long-term) household credit. The impact of inflation on credit dollarisation is weaker in regions which are financially less integrated with the rest of the Russian Federation – that is to say, regions with a higher share of local banks or local bank branches and regions where banks are more reliant on local funding. In such regions the negative impact of inflation on households' demand for foreign currency loans is partially offset by banks' efforts to locally intermediate the

[1] For a theoretical discussion of currency substitution –the use of foreign currency as a payment medium rather than as a medium to hold assets and liabilities – see Uribe (1997) and Engineer (2000). Valev (2010) provides empirical evidence.

increased supply of foreign currency deposits. In contrast, in regions with more nationwide banks and banks that are not locally funded, an inflation-driven influx of foreign currency deposits can be easily distributed to other regions, reducing the need to offload them locally. Such integrated banking markets therefore allow households to respond to inflation shocks by adjusting both their assets and liabilities whereas the asset-liability management of banks constrains the currency-portfolio choices of households in less-integrated banking markets.

In robustness tests we find a significant positive impact of regional inflation on foreign currency cash sales by exchange bureaus to private individuals. This suggests that not only households that save with banks but also those that save in cash reallocate their assets to foreign currencies when local inflation rises. By contrast, we find no robust impact of inflation on enterprise deposits or credit, suggesting that the currency composition of firms' liabilities and assets is less influenced by portfolio considerations than that of households.

Our results provide partial support to the portfolio theory of financial dollarisation (Ize and Levy Yeyati, 2003). This theory argues that the currency composition of assets and liabilities of risk-averse households is determined by real interest rate differentials as well as the volatility of inflation and of the real exchange rate.[2] In line with this theory, we find that higher inflation and therefore lower real interest rate differentials are associated with more (less) foreign currency deposits (loans). We find some evidence that variation in inflation volatility across regions impacts on foreign currency deposits but not on foreign currency loans.

Our contribution to the literature is threefold. Firstly, we complement cross-country studies which examine the relationship between domestic monetary conditions and financial dollarisation.[3] Examining aggregate data for 46 countries for the years 1990-95, Ize and Levy Yeyati (2003) find the share of foreign currency deposits is positively related to inflation volatility and negatively related to exchange rate volatility. De Nicoló et al. (2005) examine a sample of 100 countries for the period 1990-2001 and confirm the impact of inflation and exchange rate volatility on aggregate deposit dollarisation. They also find that high inflation is associated with more dollarisation. More recently, Lin and Ye (2013) document that adoption of inflation targeting in emerging market countries results in a decline in dollarisation compared to a matched sample of countries without an inflation-targeting regime. For emerging Europe, Luca and Petrova (2008) find that aggregate shares of foreign currency loans are positively related to interest rate differentials and inflation volatility whereas they are negatively related to exchange rate volatility. These results are confirmed by Basso et al. (2010) who examine aggregate credit and deposit dollarisation for 24 transition countries for the period 2000-06. Our contribution to this literature is to examine cross-regional variation within the same macroeconomic and institutional framework. This reduces

[2] When the uncovered interest rate parity holds (no real interest rate differential) the currency composition of assets and liabilities is determined by the minimum variance portfolio (MVP).

[3] Özbilgin (2012) provides a within-country analysis of the relation between inflation and financial dollarisation for Turkey based on a DSGE model.

concerns about omitted unobserved heterogeneity and allows us to empirically isolate the impact of inflation on dollarisation from that of (correlated) exchange rate movements.

Secondly, we provide new insights into how inflation impacts financial intermediation. At the country level, Boyd et al. (2001) document a negative relationship between inflation (once it surpasses a certain threshold) and banking development. Lower real returns exacerbate credit market frictions, increase credit rationing and limit the depth of the banking sector. De Nicoló et al. (2005) show, also at the country level, that deposit dollarisation moderates this adverse effect of inflation as dollarisation allows households to keep deposits onshore when they face high inflation. We document how inflation affects the interaction of the demand for and supply of foreign currency funds between banks and households. In particular, we show how the impact of inflation on asset and liability dollarisation depends on the interregional integration of the banking sector.

Thirdly, our analysis contributes to the growing literature on regional inflation disparities within currency unions. Beck et al. (2009) compare the size and persistence of regional inflation differentials in the euro-zone and the US and show that such differentials are larger and more persistent in the euro-zone. Regional inflation differences in both currency unions are related to structural characteristics of non-labour factor markets rather than labour market frictions or growth dynamics.[4] Nagayasu (2011) and Vaone and Ascari (2012) confirm the persistence of regional inflation differences for Japan and Italy respectively. We add to this literature by documenting how regional inflation variation may lead to the differential use of the common currency by households.

2. Data and methodology

2.1 Data

The units of our analysis are 71 federal 'subjects' (субъекты Российской Федерации) of the Russian Federation (referred to henceforth as regions).[5] We collect quarterly end-of-period data on both consumer price inflation and credit and deposit dollarisation in each of these regions from the Central Bank of Russia (CBR) and the Federal State Statistics Service (Rosstat).

Our data are particularly well suited for testing the impact of regional inflation on dollarisation. To facilitate cross-regional analysis and provide a consistent purchasing power measure, Rosstat has devised a consumer price index that tracks monthly price dynamics of a fixed basket of consumer goods and services across all Russian regions. We use this index to calculate for each region and for

[4] Rogers (2007) documents that regional price dispersion in the euro-zone has declined more strongly for traded than for non-traded goods since the introduction of the common currency.

[5] There are 83 federal subjects in Russia. From our analysis, we exclude three regions that contain autonomous districts (Nenetsk, Hanty-Mansiysk, and Yamalo-Nenetskiy) as the district data are part of the consolidated regional data. We also exclude two federal city-regions (Moscow and St. Petersburg) and, due to severe data limitations, the North-Caucasian conflict zones Chechnya, Dagestan, Ingushetia, North Ossetia, Kabardino-Balkaria, Karachay-Cherkessia and Adygea. This leaves us with 71 regions.

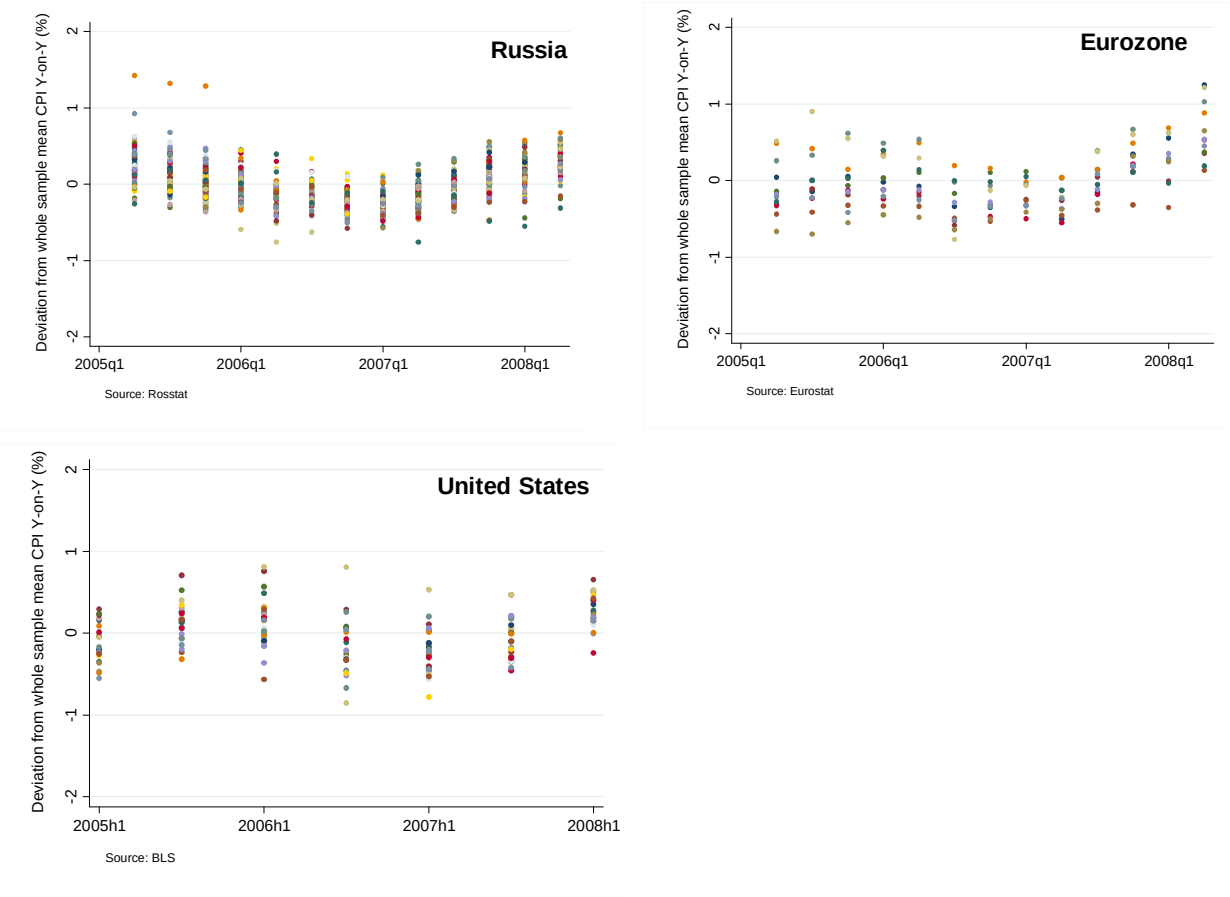
each quarter a year-on-year inflation rate and inflation volatility. We define the latter as the standard deviation of the monthly price index in the twelve months before the end of a quarter.

Figure 1 shows the cross-regional dispersion and time-variation in Russian inflation that we exploit. Individual observations indicate the deviation from the country-sample mean of the year-on-year consumer price index (CPI). As we use a uniform consumer goods basket for all regions, regional dispersion does not reflect different weights. By way of comparison, we present similar data for two other large currency unions – the eurozone (12 countries) and the US (25 metropolitan areas).

Figure 1

Dynamics of regional inflation dispersion across Russia, the Eurozone, and the United States

These graphs compare the development of inflation dispersion across 71 Russian regions (top left), 12 Eurozone countries (top right), and 25 US urban areas (bottom left). Regional observations measure the deviation from the country-sample mean of the year-on-year CPI. Source: Central Bank of the Russian Federation, US Bureau of Labor Statistics, and Eurostat.



The data show that in Russia, as in the US and the eurozone, cross-sectional variation in inflation is substantial and at least as high as the time variation. For instance, in the first quarter of 2006 the median regional year-on-year inflation rate in Russia was 14.37 per cent but ranged between 5.84 and 20.88 per cent across regions. This inflation dispersion was also persistent. Throughout the sample period the difference between the highest and the lowest regional inflation rate within a year was on average 19.94 percentage points. By comparison, the time variation in average year-on-year inflation for Russia as a whole ranges only from 12.36 in 2006 to 17.92 in the first half of 2008.

The high persistence in regional inflation differences reflects, among other things, the continuation of administrative (mainly food) price controls by local authorities and official temporary restrictions on inter-regional exports and imports, as well as informal trade restrictions resulting from organised crime that block imports in order to maintain local rents. Moreover, Russia's nation-wide infrastructure for the marketing, distribution and selling of consumer goods is still limited, leading to relatively regionalised markets (Gluschenko, 2001).

The sample contains two periods in which inflation accelerated – early 2005 and April 2007 to June 2008. Both episodes were driven by external factors.[6] The first spike was caused by a sharp increase in the price of heating services which coincided with rising oil prices. The second spike was largely driven by food inflation. World food prices accelerated dramatically in 2007-08 following droughts in a number of grain-producing countries, the increased use of bio-fuels and high oil prices which raised transportation and fertiliser costs. These dynamics played out differently across Russia depending on regional natural resource endowments and infrastructure quality.

Our data on bank deposits and household loans are obtained from the CBR. The central bank requires all commercial banks to submit detailed information on their quarterly activities by geographical location. These region-specific data on bank lending and borrowing are classified by client type (households or firms) and by currency denomination (domestic or foreign). This setting thus allows us to trace how regional consumer inflation affects the currency denomination of household deposits and loans with banks.[7]

For our analysis we employ information on net deposit flows from households to banks and newly extended mortgages and consumer credit by banks to households. This allows us to relate changes in inflation across regions to the currency denomination of the flows of household assets and liabilities. Data on net deposit flows by households are available since the second quarter of 2005 which sets the beginning of our sample period. The variable "deposit dollarisation" for each region and quarter measures the ratio of net deposit inflows denominated in foreign currency as a share of total net deposit inflows to banks. Data on newly extended loans to households are available from the second quarter of 2006.

[6] While Russia's 2004 capital account liberalisation lifted all restrictions on foreign currency transactions by residents and non-residents, there were no dramatic changes in monetary policy during the period we study (though the authorities did react to an overheating economy by raising the policy rate in 2008).

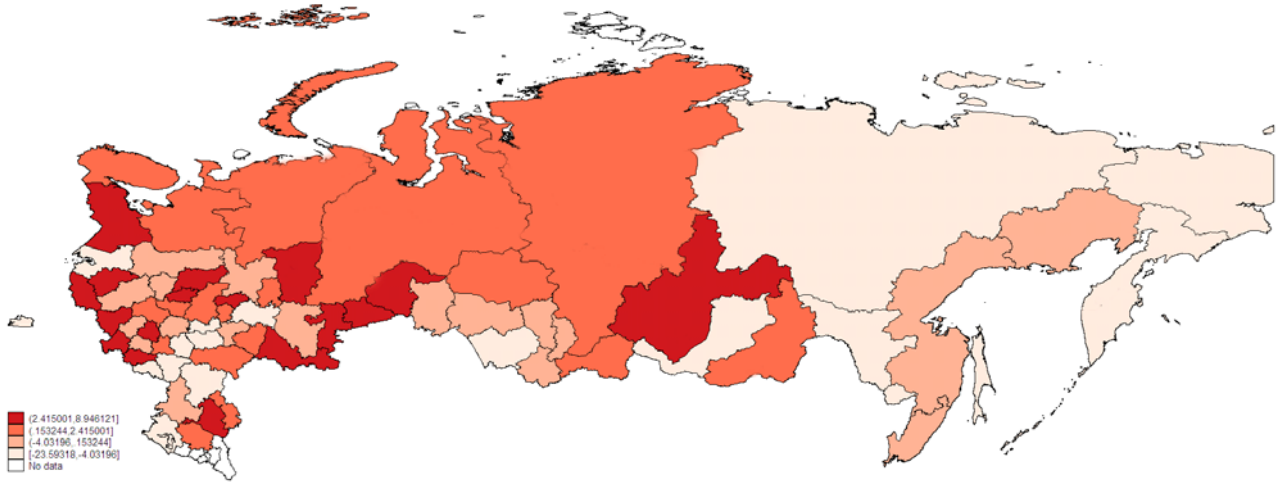
[7] All banks in Russia offer multi-currency deposits that allow retail customers to easily convert savings between different currencies through automatic teller machines (ATM) or online accounts. A competitive deposit market has made conversion costs quite low. According to central bank statistics the average bid-ask spread for rouble-US$ retail transactions was 1.63 per cent during the period of our study.

Figure 2

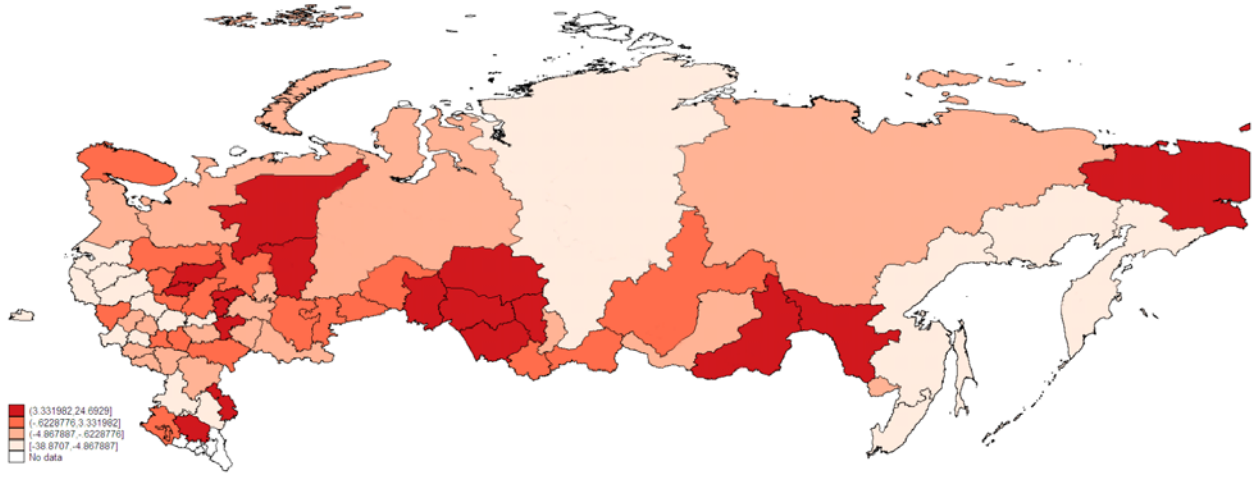
Dynamics of regional inflation and dollarisation in Russia

These maps of the Russian regions show the change in annual consumer price inflation over the period Q1 2005-Q1 2008 (upper map); the change in the share of new bank deposits denominated in a foreign currency (Q2 2005-Q2 2008, middle map); and the change in the share of new mortgage lending denominated in a foreign currency (Q2 2006-Q2 2008, lower map). Source: Central Bank of the Russian Federation and the Federal State Statistics Service of Russia (Rosstat).

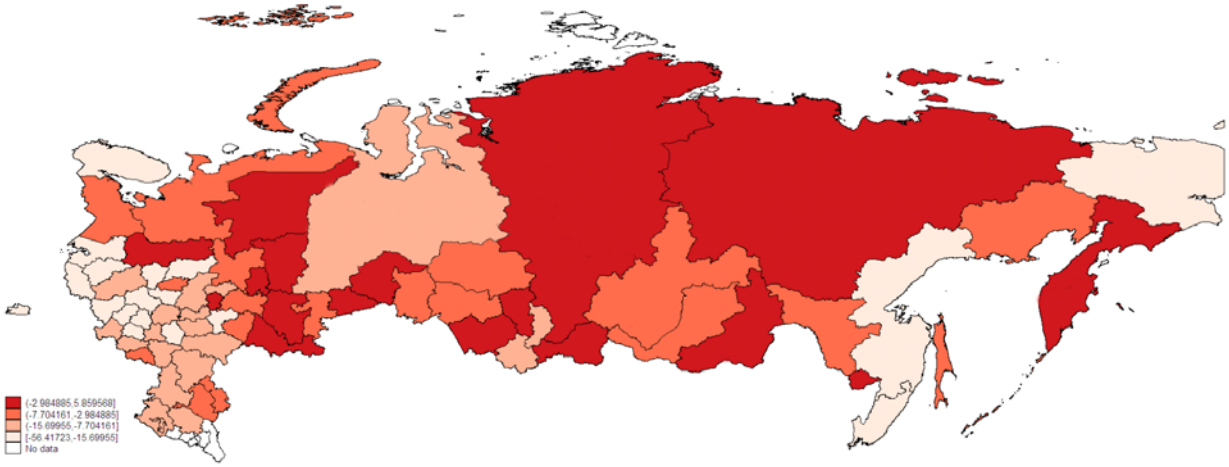
Change in inflation



Change in share of new FX deposits



Change in share of new FX mortgage lending



The variable "mortgage dollarisation" measures the share of newly extended mortgages in foreign currency as a share of total new mortgage loans by banks. Mortgages in Russia typically have fixed nominal interest rates rather than variable, making inflation expectations at the time of the signing of the mortgage contract a potentially important determinant of the preferred currency of denomination. In robustness tests (see section 3.3) we examine the impact of inflation on consumer credit (short-term, unsecured loans), enterprise credit, as well as cash sales of foreign currency at exchange offices.

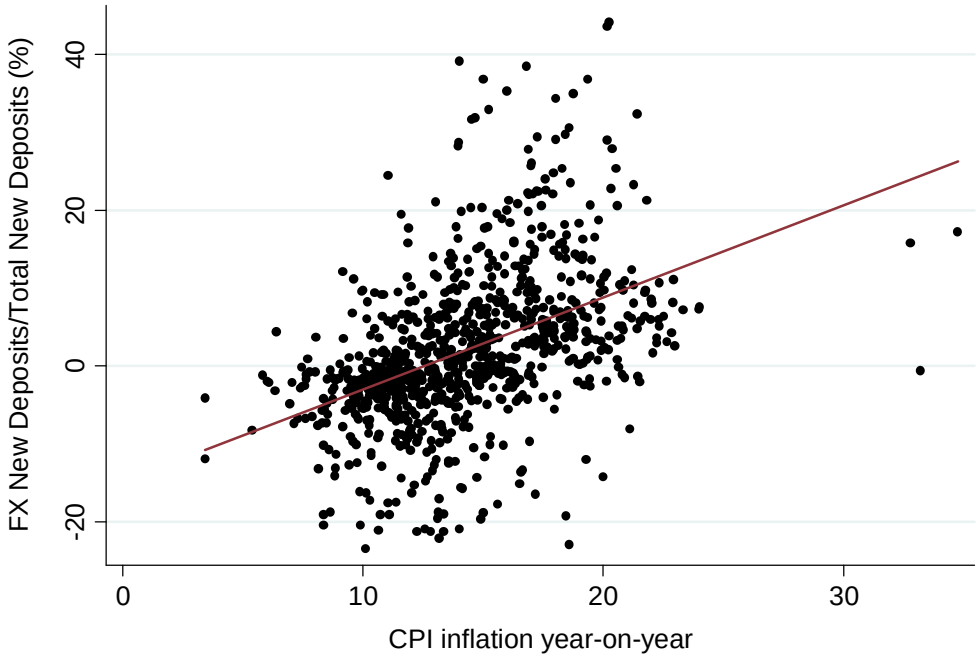
Figure 2 shows geographical 'heat maps' of the changes in inflation, deposit dollarisation and mortgage dollarisation across regions. The first panel displays the changes in consumer inflation between the first quarter of 2005 and the first quarter of 2008. The substantial cross-regional variation is again apparent. In the first quarter of 2008 CPI in the Mari El region was 8.9 percentage points higher than in the first quarter of 2005, while it declined by 23.6 percentage points in Kamchatka over the same period. The second and third maps show the change in the share of net deposits and new mortgage lending in foreign currency respectively. Again, there is substantial variation in the changes of deposit and mortgage dollarisation across regions. For example, the proportion of mortgage loans denominated in a foreign currency increased by 5.85 percentage points in the Evreiskaya region between the second quarter of 2006 and that of 2008 while it decreased by 56.1 percentage points in the Chukotsk region.

Figure 3 provides the first evidence of the cross-sectional and time variation in financial dollarisation across Russian regions being related to regional inflation. The figure shows a scatter plot of CPI inflation versus the change in the regional dollarisation of deposits (upper panel) or mortgages (lower panel) for each region and quarter in our sample. There is a clear and strong positive cross-regional correlation between inflation and the share of new FX deposits (ρ=0.43, p-value=0.00). The correlation between inflation and the share of new mortgages in FX is negative and somewhat less strong (ρ =-0.19, p-value=0.00).

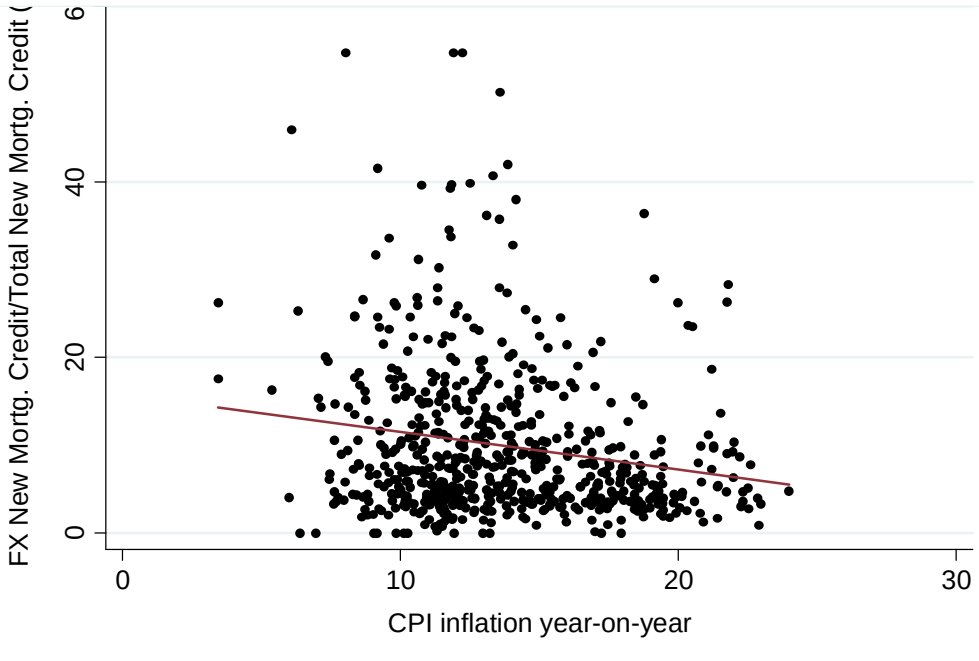
These and all other variables we use in our analysis are defined and summarised in Appendix Tables A1 and A2. The dependent variables are calculated on a constant currency basis by using the exchange rate change over the reported period to adjust the reported FX amounts. With the exception of the regional proportion of local banks and local deposit funding, we winsorise variables at the 1st and 99th percentiles.

Figure 3
Inflation and dollarisation across Russia's regions

These two graphs plot for the Russian regions on the horizontal axis the quarterly CPI inflation (year-on-year) for all quarters in Q2 2005-Q2 2008 and on the vertical axis the share of net deposit inflows to banks that is FX denominated (upper graph) or the share of new mortgages that is FX denominated (lower graph, period Q2 2006-Q2 2008).



Source: CBR, Rosstat, Authors' calculations



Source: CBR, Rosstat, Authors' calculations

2.2 Methodology

Our empirical approach is based on the portfolio theory of financial dollarisation (Ize and Levi Yeyati, 2003). This theory suggests that risk-averse households optimise the currency denomination of their asset and liability portfolio by taking the minimum variance portfolio (MVP) as a benchmark. Higher inflation volatility and lower volatility of the real exchange rate imply a higher share of both FX assets and liabilities in the MVP. In the case of deviations from the uncovered interest parity[8] households deviate from the MVP – they decrease (increase) the share of FX deposits (loans) as the real interest rate differential between the local and foreign currency widens.

Regional inflation can impact on regional dollarisation through two channels in the MVP model. Firstly, given that in our case interest rates on loans and deposits (for local currency and foreign currency funds) are largely homogeneous across Russia, higher regional inflation implies lower real interest rate differentials.[9] Therefore, for given exchange rate expectations, higher regional inflation should encourage households to save in foreign currency and borrow in domestic currency. Secondly, regional inflation may serve as a noisy signal of future exchange rate developments.[10] In particular, if higher observed inflation in a region leads households to expect a depreciation of the local currency, then for given interest rates households will again be more likely to save in foreign currency and borrow in domestic currency.[11] Based on these considerations we estimate the following empirical model:

$$\Delta FX_{it} = \alpha_t + \alpha_i + \beta_1 \cdot INFL_{it-1} + \beta_2 \cdot INFL\_VOL_{it-1} + \gamma \cdot X_{it} + \varepsilon_{it} \qquad (1)$$

The dependent variable ΔFX_{it} is the share of either net deposits flows or newly extended mortgages that is denominated in foreign currency in a region i in quarter t. Inflation ($INFL_{it-1}$) as well as inflation volatility ($INFL\_VOL_{it-1}$) are expected to impact regional dollarisation and we therefore include both, either separately or jointly (the pair-wise correlation coefficient between both variables is 0.29). Both inflation and inflation volatility are included one quarter lagged to allow for a gradual pass through. Note that as we use past inflation as an indicator of future inflation, we implicitly assume that inflation expectations are adaptive in nature (Fuhrer and Moore, 1995).

Exchange rate volatility and interest rates are homogenous across regions and therefore absorbed by time fixed effects α_t. The region fixed effects α_i account for (time-invariant) differences in the risk

[8] See Froot and Thaler (1990) for evidence on deviations from the uncovered interest parity.

[9] While interest rates differ across local banks, the rates of branches of the main nation-wide state banks – in particular Sberbank and VTB – are much more uniform. Sberbank and VTB capture about 50 and 6 per cent of the Russian deposit market, respectively, and are present in all regions. Both banks offer the same deposit terms in all locations.

[10] See Winkelried and Castillo (2010) for a model of how noisy exchange-rate signals can lead to persistent financial dollarisation in an economy with heterogeneous agents.

[11] A third channel – outside the MPV model – works in the same direction. When inflation increases, households need more local-currency cash to pay for the same consumption basket. To the extent they need to liquidate savings in order to get this additional cash, they will mainly draw down their local-currency deposits if there are non-negligible conversion costs associated with converting FX deposits into local-currency cash or if households' mental accounting (Thaler, 1990) tightly links local-currency savings to local-currency cash transactions.

aversion of households across regions, as well as the persistent part of cross-regional inflation differentials. Such persistent differentials can reflect different income levels (the Balassa-Samuelson effect) as well as frictions in factor markets (Beck et al. 2009). All regression specifications are estimated using robust standard errors clustered by region in order to control for possible residual correlation across time for a given region.

The vector X_{it} captures time-varying regional characteristics which may simultaneously drive changes in regional inflation and dollarisation. According to the literature on the determinants of regional inflation, these could include changes in economic structure (such as the relative proportion of tradables and non-tradables that a region produces) and/or changes in local factor market frictions. We therefore include trade openness (quarterly growth of regional trade [imports plus exports] with foreign countries); the value of tradable goods (quarterly growth of the regional value added of the manufacturing and commodity-extraction industries); and the value of non-tradables (quarterly growth of the regional value added of the construction, electricity generation, services, retail and wholesale trade industries) as control variables in our empirical model.

Regional inflation and financial dollarisation might also be correlated because both are impacted by local fiscal policy which differs across regions and over time. For example, De Gregorio (1994) demonstrates that public expenditures can induce an increase in the relative price of non-tradables. Fiscal transfers to specific household types may also alter the currency denomination of their savings. In order to control for these effects we include the year-on-year growth of regional government spending as an additional covariate in X_{it}.

X_{it} also contains four dummy variables which account for the entry and exit of regional or multiregional banks over the previous year. These dummies are switched on if there is an increase or a decrease in the number of locally incorporated banks or an increase or a decrease in the number of branches of banks incorporated in another region. We hereby control for sudden changes in the local banking landscape which may lead to one-off 'jumps' in dollarisation on either the asset or liability side of the regional banking system.

2.3 Accounting for financial integration

Russia's regions vary considerably with respect to how strongly the regional banking sector is integrated with the rest of the financial sector. We employ four indicators to measure the degree to which the banking sector in a region is integrated or closed. Firstly, we calculate the share of locally incorporated banks ("proportion local banks$_i$") in the total number of banks in a region (that is, local and inter-regional banks). Secondly, we calculate the share of branches of locally incorporated banks ("proportion local bank branches$_i$") in the total number of bank branches in a region. Thirdly, we compute the share of a region's bank liabilities that are on the balance sheet of locally incorporated banks ("proportion local bank liabilities$_i$"). Lastly, we use the percentage of regional household deposits in total external bank funding – that is to say, the sum of household deposits,

firm deposits and net credit from other banks ("proportion deposit funding$_i$"). These indicators are time-invariant and measured prior to our observation period to mitigate concerns of endogeneity.[12]

On average, nearly one third of the banks operating in any region in Russia are local and operate in that region only. Yet, the share of local banks varies between zero and 73 per cent (see Table A2). The share of branches operated by local banks is 7 per cent on average but again this varies from zero to 50 per cent across regions. Therefore, only nation-wide banks operate in some regions whereas in other regions the majority of banks and branches are local. This variation is also reflected in the proportion of bank liabilities that are held by local banks. This proportion varies between zero and 94 per cent. Our data also show similar variation in terms of banks' reliance on retail deposits. On average 41 per cent of bank liabilities are made up of customer deposits. But in some regions the share of retail deposits is a mere 9 per cent whereas in others it amounts to 68 per cent.

We exploit the regional heterogeneity in banking sector integration to test the conjecture that the negative impact of inflation on credit dollarisation should be weaker in regions with less-integrated banking sectors. The reasoning is that in regions with less integrated banking sectors, banks cannot allocate FX funds across regions, neither via external markets nor through internal capital markets. This means that if banks aim to avoid currency mismatches on their balance sheet, local FX bank deposits need to be intermediated into local FX credit (for example, Calvo, 2001). The minimum variance portfolio of local households is then the only possible financial equilibrium (Ize and Levy Yeyati, 2003). In contrast, deviations from local MVP occur more easily when banks are regionally integrated as the local supply and demand of FX funds need not coincide. This is because inflation incentivises households to supply banks with FX deposits but also to demand more local currency lending. This implies that financially integrated banking systems allow households to deviate more from MVP and thus to better adjust their currency portfolio.

The above hypothesis relies on the assumption that banks in regions with closed banking sectors manage on-balance-sheet currency risk by adjusting the currency structure of their loans to that of the (given) currency structure of their deposits. Recent evidence suggests that this is the case in emerging Europe. Brown and De Haas (2012) as well as Brown et al. (2013) document that the currency structure of customer deposits (rather than the currency structure of wholesale funding) is a crucial driver of the currency structure of banks' loan portfolios. Based on this evidence we expect that the impact of inflation across Russian regions on the dollarisation of household deposits is independent of the integration of the banking market, while the impact of inflation on household credit is less negative in regions with closed bank sectors.

We empirically test this prediction by augmenting our baseline specification with an interaction term of inflation with one of four measures of integration of the regional banking sector. Equation (2) captures our augmented empirical model in which $INFL_{i,t-1}$*Fin_Closed_i is the interaction term of interest. In our estimations of credit dollarisation we expect the coefficient of the interaction

[12] The exception is *proportion local bank branches*$_i$ which is measured for 2012 due to a lack of earlier data.

terms to be positive – the impact of inflation on credit dollarisation will be less negative in regions with non-integrated banking sectors.[13] By contrast, in our estimation of deposit dollarisation, we expect the interaction term to be insignificant.

$$\Delta FX_{it} = \alpha_t + \alpha_i + \beta_1 \cdot INFL_{it-1} + \beta_2 \cdot INFL_{it-1} \cdot FIN\_Closed_i + \beta_3 \cdot INFL\_VOL_{it-1} + \gamma \cdot X_{it} + \varepsilon_{it} \quad (2)$$

3. Results

3.1 Inflation and dollarisation – baseline results

We report our baseline results in Table 1. As dependent variables we use the dollarisation of the net flow of households' deposits (columns 1-3) and of new mortgage loans (columns 4-6).[14] All specifications include region and time (quarter) fixed effects.

Table 1
Regional inflation and financial dollarisation across Russia
Baseline results

	Deposit dollarisation			Mortgage dollarisation		
	[1]	[2]	[3]	[4]	[5]	[6]
Inflation	0.496***		0.445***	-0.325***		-0.349***
	(3.68)		(2.88)	(2.96)		(2.91)
Inflation volatility		1.704**	0.652		-0.039	0.681
		(2.53)	(0.87)		(0.05)	(0.83)
Change trade openness	-0.014	-0.013	-0.014	0.000	-0.001	-0.000
	(1.31)	(1.20)	(1.29)	(0.03)	(0.10)	(0.01)
Change value tradables	0.002	0.001	0.002	-0.009	-0.009	-0.009
	(0.16)	(0.06)	(0.15)	(0.79)	(0.73)	(0.80)
Change value non-tradables	0.003	0.007	0.002	-0.045*	-0.044*	-0.046*
	(0.07)	(0.19)	(0.06)	(1.80)	(1.77)	(1.82)
Change government expenditures	-0.022	-0.032	-0.024	0.042	0.044	0.042
	(0.62)	(0.89)	(0.65)	(1.46)	(1.49)	(1.47)
Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank entry-exit dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	918	918	918	636	636	636
Regions	71	71	71	71	71	71
R-squared	0.51	0.50	0.51	0.39	0.38	0.39

Notes: This table shows OLS regressions to estimate the impact of regional consumer price inflation on dollarisation across Russia's regions. Sample period: Q2 2005-Q2 2008 (Q2 2006-Q2 2008 for columns 4-6). The pairwise correlation coefficient between regional inflation and inflation volatility is 0.29. Robust standard errors are clustered by region and t-statistics appear in parentheses. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively. Table A1 in the Appendix contains all variable definitions.

[13] The main terms of our cross-sectional measures of financial integration are absorbed in the region fixed effects a_i.
[14] The average maturity of rouble (FX) mortgages in our dataset is 16.3 (14.5) years.

The key message that emanates from Table 1 is that, in line with portfolio theory, higher regional inflation is associated with more foreign currency deposits and less foreign currency lending. The impact of inflation on dollarisation is substantial. A one standard deviation (s.d.) increase in regional year-on-year inflation is associated with a 0.16 s.d. increase in deposit dollarisation in the next quarter and a 0.13 s.d. decrease in mortgage dollarisation.

When we include inflation volatility separately (columns 2 and 5) it has a positive impact on deposit dollarisation, in line with what one would expect on the basis of portfolio theory, but no significant impact on mortgage dollarisation. When we add both variables at the same time (columns 3 and 6) the inflation level wins this horse race, although the imprecisely estimated coefficient for inflation volatility is positive in both cases, in line with theory.

3.2 The role of financial integration

In Table 2 we analyse how the relationship between regional inflation and dollarisation is affected by the local banking structure.[15] The results in columns 1-4 confirm that the impact of inflation on deposit dollarisation is independent of how integrated the local banking sector is. The interaction terms *Inflation*Proportion local banks* (column 1); *Inflation*Proportion local bank branches* (column 2); *Inflation*Proportion deposit funding* (column 3); and *Inflation*Proportion local bank liabilities* (column 4) are weak both in terms of statistical significance and economic magnitude.

In columns 5-8 we examine the impact of banking sector integration on credit dollarisation. We expect that in regions with less-integrated banking systems higher inflation – and the resulting larger FX deposit base – partially offsets the negative direct effect of inflation on credit dollarisation. The results in columns 5-8 show exactly this. The positive and significant interaction terms for *Inflation*Proportion local banks*; *Inflation*Proportion local bank branches*; *Inflation*Proportion deposit funding*; and *Inflation*Proportion local bank liabilities*, together with the negative main effect of *Inflation*, suggest that the negative impact of inflation on mortgage dollarisation is weaker in regions with non-integrated banking sectors.[16]

Financial integration has a sizeable impact on the relation between inflation and credit dollarisation. The estimates in column 5 suggest that for the region with the lowest proportion of local banks (6 per cent in the Penza region), a one s.d. increase in inflation reduces mortgage dollarisation by 0.24 s.d. By contrast, for a region with the highest proportion of local banks (73 per cent in the Altai region) the negative effect of inflation on mortgage dollarisation disappears altogether.

[15] In Table 2 our sample is reduced from 71 to 69 regions as we exclude two outlying (Far Eastern) regions without any locally incorporated banks.

[16] We also estimate a specification where we define local banks as domestic (as opposed to foreign-owned) banks. Here we find a positive but imprecisely estimated interaction term between inflation and the proportion of domestic banks, suggesting that what matters is whether a region's banking sector is integrated with other Russian regions rather than with the rest of the world.

Taken together, the results in Table 2 indicate that the impact of price instability on credit dollarisation depends on the structure of the local banking system. The impact is strongest if banks are more integrated with the rest of the Russian economy.[17]

Table 2
Regional inflation and financial dollarisation across Russia
The impact of financial integration

	Deposit dollarisation				Mortgage dollarisation			
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Inflation	0.361	0.342*	0.660*	0.410**	-0.672***	-0.505***	-0.783***	-0.543***
	(1.28)	(1.69)	(1.90)	(2.05)	(2.82)	(2.84)	(2.67)	(3.43)
Inflation*Proportion local banks	0.054				1.158**			
	(0.09)				(2.12)			
Inflation*Proportion local bank branches		0.682				1.643*		
		(0.84)				(1.82)		
Inflation*Proportion deposit funding			-0.666				1.080*	
			(1.07)				(1.89)	
Inflation*Proportion local bank liabilities				-0.122				0.937***
				(0.34)				(2.78)
Inflation volatility	0.696	0.682	0.814	0.740	0.879	0.767	0.718	0.878
	(0.87)	(0.84)	(0.98)	(0.90)	(1.04)	(0.93)	(0.85)	(1.07)
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time varying controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank entry-exit dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	892	892	892	892	618	618	618	618
Regions	69	69	69	69	69	69	69	69
R-squared	0.52	0.52	0.52	0.52	0.41	0.41	0.41	0.41

Notes: This table shows regression results to estimate the impact of regional consumer price inflation on mortgage and deposit dollarisation across Russia's regions. Sample period: Q2 2006-Q2 2008 for mortgages and Q2 2005-Q2 2008 for deposits. Robust standard errors are clustered by region and t-statistics appear in parentheses. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively. Table A1 in the Appendix contains all variable definitions.

3.3 Robustness

Table 3 presents various robustness tests and extensions. We start by showing a number of replications of our baseline estimates for the impact of inflation on deposit dollarisation as reported in column 1 of Table 1. In column 1 of Table 3 we exclude our standard set of regional time-varying covariates. In column 2 we re-estimate our baseline specification for the 69 regions we use in Table 2. In column 3 we exclude the dummy variables that control for the entry and exit of regional and multiregional banks over the previous year. All three robustness tests yield similar

[17] See Brown and De Haas (2012) for bank-level evidence on the causal impact of FX denominated customer deposits on FX lending. Their instrumental-variable results suggest that a 10 percentage point increase in FX deposits by customers increases the share of FX loans to households by 7 percent. See also Brown et al. (2013) and Luca and Petrova (2008) for evidence on the impact of FX customer deposits on the share of FX lending to households.

estimates for the variable "inflation" as those in our baseline regressions, both in terms of economic magnitude and statistical significance. In columns 4-6 we replicate these robustness tests for our baseline regression of the effect of inflation on mortgage dollarisation (Table 1, column 4). Also, our baseline estimates are robust to changes in the control variables or in sample size.

In column 7 of Table 3 we replicate our baseline regression of Table 1 (column 1) with the dependent variable "FX cash sales". Recent evidence suggests that substantial parts of the population of Russia and other transition economies do not save in bank accounts (Beck and Brown, 2011) and choose to keep their savings in cash (Stix, 2012). If high regional inflation leads households with deposit accounts to reallocate their savings to foreign currency, we also expect households with cash savings to exchange local currency for foreign currency. The column 7 estimates in Table 3 show that this is the case: higher regional inflation increases the cash sales of foreign currency by exchange bureaus to households in that region.

Table 3
Regional inflation and financial dollarisation across Russia
Robustness

	Deposit dollarisation			Mortgage dollarisation			FX cash sales	Firm debt dollarisation	Consumer debt dollarisation
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Inflation	0.466***	0.379**	0.462***	-0.353***	-0.357**	-0.335***	0.319**	-1.903	-0.027
	(2.87)	(2.28)	(2.89)	(2.87)	(2.61)	(2.84)	(2.31)	(1.10)	(0.57)
Inflation volatility	0.730	0.707	0.762	0.660	0.801	0.744	-0.278	1.997	-0.005
	(0.98)	(0.88)	(1.01)	(0.81)	(0.95)	(0.91)	(0.36)	(10.83)	(0.01)
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time varying controls	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Bank entry-exit dummies	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes
Observations	920	892	918	636	618	636	843	921	634
Regions	71	69	71	71	69	71	65	71	71
R-squared	0.50	0.52	0.51	0.38	0.40	0.38	0.64	0.06	0.20

Notes: This table shows OLS regressions to estimate the impact of regional consumer price inflation on dollarisation across Russia's regions. Columns 1 and 4 reproduce columns 1 and 4 of Table 1 without the regional time-varying covariates. Columns 2 and 5 reproduce columns 1 and 4 of Table 1 for the 69 regions used in Table 2. Columns 3 and 6 exclude the dummy variables that control for the entry and exit of regional and multiregional banks over the last year. Column 7 shows regressions for regional FX (euro and US$) cash sales by banks to households. Columns 8 and 9 show regressions for dollarisation of firm and consumer debt, respectively. Robust standard errors are clustered by region. t-statistics appear in parentheses and ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively. Table A1 in the Appendix contains all variable definitions.

Finally, in columns 8 and 9 we present similar regressions for the dollarisation of newly extended enterprise credit and short-term consumer credit respectively. We find little evidence that inflation impacts lending to enterprises or for consumption purposes in the same way as it impacts longer-term mortgage lending. The absence of a clear relationship between inflation and aggregate firm borrowing may reflect that many firms, in particular larger ones, are naturally hedged. To the extent they are not, firms may be much better placed than households to offset currency risk by using forward contracts and derivatives (Mian, 1996). In Russia there is a liquid market in

rouble/US$ FX futures that allow firms to hedge currency risk in ways not available to retail depositors.

For short-term consumer lending the absence of a link is probably related to the fact that these short-term loans (typically 18 months) are often point-of-sale credits granted in shops to finance the purchase of consumer goods. Inflation expectations are likely to play a much smaller role in the currency-denomination decision here.

4. Conclusions

In this paper we exploit regional variation in consumer price inflation, as well as in the dollarisation of household deposits and loans in the Russian Federation, one of the world's largest currency blocks, to analyse the relationship between the stability of the local currency and financial dollarisation. Our within-country data allow us to empirically isolate the impact of observed inflation on financial dollarisation from that of (correlated) nominal exchange rate movements.

In the process we also ease concerns about omitted unobserved heterogeneity in economic policies and institutions. We find robust evidence that regions with higher inflation exhibit stronger dollarisation of household deposits and weaker dollarisation of long-term household credit. The negative impact of inflation on credit dollarisation is weaker in regions where the banking sector is less integrated.

Our findings shed new light on how inflation impacts on financial intermediation in emerging markets. In particular, while inflation stimulates households to *save in a foreign currency* it simultaneously leads them to *borrow in the domestic currency*. Price instability thus tends to create currency mismatches on banks' balance sheets and banks that want to avoid such mismatches can take two courses of action.

Firstly, they can try to offload the FX deposits in the form of FX loans. In this way they transfer the currency risk to (unhedged) households who may actually prefer local currency loans. In this scenario, banks substitute currency-induced credit risk for direct balance sheet exposure to currency risk. Secondly, banks can reallocate the FX deposits elsewhere, either abroad or to branches in other regions where the demand for FX loans may be higher. Our results suggest that regionally integrated banks are better able to take this second course of action compared to local banks.

Regional banking integration may therefore not only prevent banks from accumulating currency mismatches on their balance sheet, it also reduces the offloading of currency risks on households and helps them to rebalance the currency composition of their financial portfolio.

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Table A1
Variable definitions and data sources

	Definition	Source	Unit
Dependent variables:			
Deposit dollarisation	Share of FX deposits in net new household deposits with banks in a region during a quarter	CBR	%
FX cash sales	Net per capita FX cash purchase by individuals from banks during a quarter (Euro cash purchase is converted into USD at current exchange rate)	CBR	USD
Mortgage dollarisation	Share of FX mortgages in total new mortgage lending provided by banks in a region during a quarter	CBR	%
Consumer debt dollarisation	Share of new non-mortgage FX credit to households in total new non-mortgage credit to households in a region during a quarter	CBR	%
Firm debt dollarisation	Share of new FX lending to firms in total new lending to firms provided by banks in a region during a quarter	CBR	%
Independent variables:			
Inflation	One quarter lagged year-on-year change of the price of a fixed basket of consumer goods (same basket applies to all Russian regions)	Rosstat	%
Inflation volatility	Moving standard deviation of regional monthly inflation over the past 12 months (one quarter lagged)	Rosstat	%
Change trade openness	Quarterly growth of regional trade with foreign countries defined as the average of the sum of regional world exports plus regional world imports	Rosstat	%
Change value tradables	Quarterly growth of regional value added of the manufacturing and commodity-extraction industries	Rosstat	%
Change value non-tradables	Quarterly growth of regional value added of the construction, electricity generation, services, retail, and wholesale trade industries	Rosstat	%
Change government expenditures	Quarterly growth of regional government spending	Rosstat	%
Proportion local banks	No. of banks incorporated in region as a proportion of the total no. of banks in the region (i.e. both local banks and branches of inter-regional banks) in 2004-05	CBR	Share
Proportion local bank branches	No. of branches and offices of banks incorporated in the region as a proportion of the total no. of branches and offices of banks in the region (i.e. both local bank branches and offices and branches and offices of inter-regional banks) in 2012	BEPS II	Share
Proportion local bank liabilities	Liabilities of banks incorporated in a region as a proportion of total liabilities of all banks operating in a region in 2004-05 (liabilities include accounts of firms and government bodies, firm deposits, household deposits, and loans from other banks)	CBR	Share
Proportion deposit funding	Customer deposit funding as a proportion of banks' total funding (defined as customer deposits+ firm deposits + interbank borrowing) in 2004-05	CBR	Share

NOTES: CBR and Rosstat are the Central Bank and the Federal State Statistics Service of the Russian Federation, respectively. All dependent variables are on a constant currency basis by adjusting the reported FX amounts using the exchange-rate change over the reported period. BEPS II: EBRD Banking Environment and Performance Survey II.

Table A2
Summary statistics

	Obs.	Mean	Median	St. dev.	Min	Max
Dependent variables:						
Deposit dollarisation	920	2.18	0.60	11.84	-23.41	44.98
Net per capita FX cash purchase	845	16.09	12.09	16.28	-13.48	67.11
Mortgage dollarisation	636	10.23	7.31	9.38	0.00	54.72
Consumer debt dollarisation	634	2.65	1.57	3.72	0.01	22.81
Firm debt dollarisation	923	18.16	9.88	112.12	-439.33	659.04
Independent variables:						
Inflation	923	14.34	13.95	3.84	3.44	34.76
Inflation volatility	923	1.46	1.36	0.58	0.31	6.37
Change trade openness	921	5.97	7.26	32.45	-118.92	110.49
Change value tradables	923	6.88	8.74	21.14	-60.82	67.45
Change value non-tradables	923	6.12	9.21	13.79	-36.45	31.84
Change government expenditures	923	25.03	24.61	12.84	-17.13	63.98
Proportion local banks	69	0.29	0.27	0.14	0.00	0.73
Proportion local bank branches	69	0.09	0.07	0.08	0.00	0.50
Proportion local bank liabilities	69	0.23	0.17	0.19	0.00	0.94
Proportion deposit funding	69	0.41	0.40	0.14	0.09	0.68