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Emerging Market Local Currency Bond Yields and Foreign Holdings in the Post-Lehman Period-a Fortune or Misfortune?

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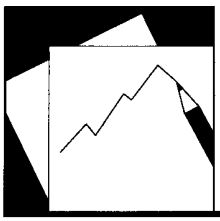

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Emerging Market Local Currency Bond Yields and Foreign Holdings in the Post-Lehman Period—a Fortune or Misfortune?

Christian Ebeke and Yinqiu Lu

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Emerging Market Local Currency Bond Yields and Foreign Holdings in the Post-Lehman Period—a Fortune or Misfortune?[1]

Prepared by Christian Ebeke and Yinqiu Lu

Authorized for distribution by Julie A. Kozack

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Abstract

The paper shows that foreign holdings of local currency government bonds in emerging market countries (EMs) have reduced bond yields but have somewhat increased yield volatility in the post-Lehman period. Econometric analyses conducted from a sample of 12 EMs demonstrate that these results are robust and *causal*. We use an identification strategy exploiting the geography-based measure of EMs financial remoteness vis-à-vis major offshore financial centers as an instrumental variable for the foreign holdings variable.The results also show that, in countries with weak fiscal and external positions, foreign holdings are greatly associated with increased yield volatility. A case study using Poland data elaborates on the cross country findings.

JEL Classification Numbers: C32; C33; F30; G15

Keywords: Foreign Holdings; Domestic Bonds; Yields; and Volatility

Author's E-Mail Address: Cebeke@imf.org; Ylu@imf.org

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I. INTRODUCTION

This paper analyzes the influence of foreign investors on the level and volatility of local currency government bond yields with a focus on the post-Lehman period. While foreign holdings of emerging market (EM) debt have increased markedly across EMs after the 2008–09 financial crisis (IMF, 2012), the increase has been particularly prominent in their holdings of local currency bonds—a result of both pull and push factors (Figure 1). Our econometric analyses, complemented with a number of robustness tests, suggest that an increase in the share of foreign investors in EM local currency bond markets contributes to lower yields but higher yield volatility, the later effect being mostly observed in countries with weak macroeconomic fundamentals. A case-study using Polish data supports the main cross-country findings that a higher share of foreign holdings of local currency government bonds is associated with lower yields. The results also point to a positive, albeit smaller, association between foreign holdings and yield volatility in Poland despite Poland's strong fundamentals. The prominent role of Poland as a proxy for investors seeking exposure to the Central and Eastern European region is likely to explain this result.

[Figure 1]

The paper is interesting from a number of angles. *First,* intuitively speaking, foreign investors should play both positive and negative roles in local currency bond markets.

- As EM financial markets are becoming more globally integrated, medium- and longer-term local currency bond yields are increasingly influenced by foreign investors who take positions in these buoyant markets. This is a fortunate development. Foreign investors' interest in local currency bonds enables EMs to borrow "abroad" in their own currency instead of hard reserve currencies—reducing the "original sin" and the associated vulnerabilities. In addition, as pointed out by Peiris (2010), foreign investors could act as catalysts for the development of local bond markets, particularly by diversifying the investor base, creating greater demand for local EM debt securities, and increasing market liquidity.

- However, at the same time, a larger foreign presence could also lead to greater volatility in local bond markets. Experience shows that EMs can be hit hard by the sudden drying-up of capital flows resulting from an increase in global risk aversion or a rise in global interest rates, sometimes irrespective of a country's fundamentals (see Calvo et al., 2006). The recent turmoil in EM markets in the wake of Fed's "tapering talk" on May 22 is a case in point. Thus, foreign participation in the local currency bond market can make host economies more susceptible to adverse shifts in market sentiment—a misfortune in some sense. During "good times", large inflows of funds into EMs can also prove excessive, complicating macroeconomic management, possibly leading to asset price and credit bubbles, and exposing these economies to potential flow reversals.

Second, analytically it is challenging to prove the relationship between foreign purchases and local yield dynamics. As acknowledged by Wu (2006) and Beltran et al. (2013), challenges arise from several factors, most of which have not always been adequately addressed in the literature. Notably, the direction of causality between foreign demand and their prices (or yields) is likely to go both ways. Moreover, long-term interest rates are influenced by forward looking variables which are typically unobservable, such as expectations of long-run inflation and other macroeconomic factors, which makes identifying the effects of foreign inflows more difficult.

Scatter plots show that EMs that have been able to attract more foreign investors have been able to enjoy lower yields (Figure 2: Panel A) while the correlation with yield volatility seems unclear (Figure 2: Panel B). However, our results show that looking at simple correlations between foreign holdings and volatility of yields could be misleading, as one could be tempted to conclude that foreign holdings are associated with lower yield volatility without correcting for the negative endogeneity bias arising from the fact that foreign investors could be less likely attracted by highly volatile and uncertain markets. Correcting for this bias (alongside additional robustness tests) reveals the true impact of foreign holdings. Taken together, this makes us confident that the empirical results are robust and capture the causality from foreign holdings to the level of yields and their volatility.

[Figure 2]

Third, it is interesting from a policy perspective to assess whether macroeconomic fundamentals matter. In this regard, our study tests the hypothesis of the existence of non-linearities in the effects of foreign holdings by focusing on the role played by countries' macroeconomic fundamentals on the marginal effects of foreign holdings on yields. To our knowledge, this is the first paper that explicitly tests for such non-linearities.

Our paper examines whether external and fiscal buffers play a critical role in shaping the relationship between foreign holdings and the dynamics of yields. Our results show that countries' fundamentals matter less in the relationship between foreign holdings and the level of bond yields but more in the relationship between foreign holdings and yield volatility. It suggests that foreign inflows affect linearly and significantly the level of the yields irrespective of countries' fundamentals. When global liquidity is ample, foreign investors did not necessarily regard EM assets as a heterogeneous risk exposure in their portfolio choices and the run toward such assets was shared uniformly across EMs, hence lowering the yields. On the relationship between foreign holdings and yield volatility, investors seem to differentiate among EM assets. Countries with weaker fundamentals tend to suffer more from the yield volatility induced by a higher dependency upon foreign investors. This suggests that the direct/immediate benefits of increased foreign attraction and broadened international investor base appear to be conditional on superior economic performance.

Fourth, to reinforce the main message, it is worth going beyond average effects which may hide countries' specificities to examine the specific case of Poland, a country which has experienced one of the biggest surges in foreign holdings among EMs (the share of foreign investors reached a peak at 37 percent in April 2013 from about 14 percent in early 2009). The analysis is performed using time-series approaches to allow us to take advantage of the

availability of high frequency data. An error-correction model and the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) framework are explored to quantify the effects of foreign holdings on the level and volatility of yields. The result suggests that an increase in foreign holdings is associated with lower but somewhat volatile yields in Poland. This contrasts with the pre-crisis study by Peiris (2010) which did not find a positive association between foreign holdings and yield volatility in Poland over the period 2000–09. The prominent role of Poland as a proxy investors seeking exposure to the Central and Eastern European region is likely to explain this result.

The paper is organized as follows. Section II provides the framework and results from cross-country estimates. It also provides robustness checks and non-linear effects using interaction terms with countries' macroeconomic fundamentals. Section III examines the specific case of Poland. Section IV concludes.

II. CROSS-COUNTRY ESTIMATES

We use a panel dataset consisting of 12 EMs with wide geographical allocation and, for which quarterly data on the foreign ownership of local currency government bonds (EM bonds issued in local currency) are available. We focus on the post-Lehman period during which financial conditions and global volatility have been particularly fluid.[2] The sample therefore starts in 2009Q1 and ends in 2013Q1.

Our econometric framework is similar to previous studies on the determinants on EM sovereign bond yields (Comelli, 2012; Csonto and Ivaschenko, 2013; Jaramillo and Weber, 2012), but it differs insofar as the focus is on explaining the effect of the foreign holdings of domestic government bonds issued in local currency. In this regard, the paper follows closely the recent contributions by Andritzky (2012) in the case of advanced economies, and Peiris (2010) regarding emerging market economies.

The empirical contribution of this paper is three-fold.

- First, we focus on the post-crisis period to explore the role played by foreign investors in EMs local currency bond markets. Rather than identifying average effects over longer time periods such as in Andritzky (2012) or the pre-crisis period as done in Peiris (2010), we analyze the most recent period.

- Second, we focus on a comprehensive set of EM countries for which we are able to gather the variables of interest and follow a panel data approach similar to Baldacci, Gupta, and Mati (2011), and Jaramillo and Weber (2012). Starting with such a homogenous sample, the paper proposes several robustness exercises aimed at

[2] Countries included in the sample are Brazil, Czech Republic, Hungary, Indonesia, Republic of Korea, Malaysia, Mexico, Poland, Slovakia, South Africa, Thailand, and Turkey. Even though a few of them are classified as advanced economies by the IMF (i.e., Czech Republic, Republic of Korea, and Slovakia), they are often treated as EMs in the investment community.

strengthening the empirical framework. Various identification strategies are proposed to assess causal effects of the foreign holdings of government local currency bonds on the level and the volatility of the yields—one of the main empirical challenges. Instrumental variable strategies are used to rule out endogeneity issues and provide estimates that are in line with our expectations of the direction of the bias.

- Third, we explicitly test the existence of non-linear effects by allowing the marginal effects to depend upon some quantitative measures of countries' fundamentals (current account, foreign exchange reserves, and public debt) and global risk aversion. Such non-linear effects would suggest that yields respond differently to surges in foreign holdings conditional on macroeconomic performance. Previous papers have highlighted the existence of non-linear effects from foreign holdings to yield volatility across EMs. For example, Peiris (2010), using pre-crisis data from 2000 to 2009, found that greater foreign participation significantly increases yield volatility in one country (Korea) and decreases it in a few others (Malaysia, Mexico, Turkey), while being an insignificant explanatory variable in most other EMs. A recent study by Arslanalp and Tsuda (2013) also looks at the potential effects of a higher degree of financial integration (through higher foreign holdings ratio) on funding risks and domestic financial stability through simulation exercises using underlying data for selected countries. Their results suggest that under various scenarios of shifts in foreign investor behavior, EMs would be affected differently in terms of the magnitude of assets sold by foreign investors, capacity of the domestic banks to absorb foreign sales, and the subsequent movements in the bond yields. However, the simulation exercise does not incorporate the role of countries' macroeconomic fundamentals in the scenarios. To our knowledge, ours is the first study to do so.

A. Empirical Design

Estimating the effects of the foreign ownership on the *level* of local currency bond yields

The econometric model exploits the panel data structure and allows us to control for other determinants of local currency bond yields. The following model is therefore specified:

$$y_{it} = \theta_1 f_{it} + X'_{it}\Gamma + c_i + u_t + \epsilon_{it} \qquad [1],$$

where y_{it} denotes the 5-year local currency bond yields in each country *i* at each quarter *t*.[3] X' denotes the matrix of control variables representing the other correlates of local currency

[3] The paper uses the yield on the generic 5-year local currency domestic government bond to ensure consistency and comparison across countries. However, it is worth pointing out that different bond tenor in different countries exhibit heterogeneous liquidity characteristics. The presence of country-fixed effects is therefore crucial in ensuring that such type of country-specific heterogeneity is fully accounted for.

bond yields whereas c_i and u_t are country and quarter fixed-effects, respectively. The presence of country-fixed effects in the model allows us to control for unobservable country-specific factors that may be correlated with the level of yields in each country such as investors' risk perception and countries' historical default risk. Conditional on the presence of fixed-effects, θ_1 would represent the reaction of local currency bond yields to an increase in the share of foreign investors in the local currency bond markets within countries (f_{it}).[4] While it would have been useful to break down the foreign holdings into the various types of holders (foreign officials, foreign bank, and foreign nonbanks), this level of disaggregation is not available in our data. We therefore use the aggregate data instead.[5]

The matrix of control variables distinguishes between country-specific factors and global factors.[6] Regarding country-specific determinants, we control for central bank policy rates, the inflation rate, and changes in the real GDP growth rate. We expect the policy rate to be positively correlated with local bond yields as central bank rates are usually the leading reference price for other assets. A higher inflation rate and a negative change in the GDP growth rate should drive up the yields as investors may demand higher yields from countries with high inflation rate and low growth prospects, all else equal. To check the robustness of the results, additional control variables such as the public debt-to-GDP ratio, the current account balance-to-GDP ratio, and the foreign reserve-to-GDP ratio are also included. As foreign investors may be measuring returns in exchange rate adjusted terms, we also control for the 2-year forward exchange rate between each currency against the US dollar. We assume that expectations regarding a depreciation of EM currencies against the dollar will cause investors to demand higher yields. However, due to data constraints, controlling for this variable leads to a reduction in the sample size as only 10 out the 12 EMs covered here report these data.

As has become common in this literature, global factors are separated into global risk aversion factors and global liquidity factors. Regarding the former, the model controls for the Chicago Board Options Exchange Volatility Index (VIX), which measures the implied volatility of S&P500 index options, and is a proxy for investors' risk appetite. The VIX is expected to be positively associated with the local yields. Indeed, an increase in risk aversion would raise the yields requested by investors to hold emerging market local debt securities. We also control for global liquidity conditions using the U.S. federal funds rate. As a lower Fed funds rate is assumed to be associated with higher global liquidity, it is expected to have a positive relationship with local yields (since investor appetite for EM assets should increase when returns in advanced economies decline). It is also worth noting that, to some

[4] Because exchange rate valuation effects could probably affect the dynamic of the nominal value of foreign holdings, we prefer to use the normalized series (scaled by the total amount of outstanding local currency bonds) to minimize such effects.

[5] EPFR data could be a good compromise, but with the drawback they only cover a relatively small fraction of external flows.

[6] It is worth noting that under the presence of global factors as explanatory variables, including time dummies is no longer required.

extent, U.S. monetary policy decisions (captured by the Federal funds rate) can at least partially reflect global risk aversion as well, contributing to driving down local yields in periods of low risk aversion when markets are desperately search for yields. On the flipside, an increase in the Federal funds rate can be associated with an increase in EM local yield in periods of high risk aversion when markets flock to safe heavens (Csonto and Ivaschenko, 2012).

Estimating the effect of the foreign ownership on the *volatility* of local currency bond yields

The econometric model is specified to fit the quarterly data on both the yield volatility and the control variables. The quarterly yield volatility indicator for each country is computed as the standard deviation of weekly changes in the 5-year local currency government bond yields over 12 weeks (one quarter). This gives one data point per country per quarter and has the advantage of capturing the within-quarter volatility of the bond market in each country over the time. The fixed-effects specification allows us to measure the effect arising from a "within-country" increase in foreign holdings of local currency bonds on the country's yield volatility. The model is therefore specified as follows:

$$\sigma_{it}^{B} = \theta_2 f_{it} + X_{it}'\phi + c_i + \epsilon_{it} \qquad [2],$$

where σ_{it}^{B} denotes the quarterly yield volatility in each country. The matrix of control variables includes the VIX and the inflation rate (aimed at capturing domestic macroeconomic instability). To check the robustness of the results, additional control variables such as government debt, current account balance or the international reserve-to-GDP ratio are also included. We also control for the quarterly standard deviation of the 2-year forward nominal exchange rate between each currency against the US dollar. We expect that the volatility of the forward exchange rate will be positively associated with the yield volatility.

B. Data

The data used in the paper are assembled from multiple sources (Table A2). Data on EM local bond yields with a maturity of five years are drawn from DataStream. The foreign holdings ratios are extracted from Haver Analytics and complemented with the data from *Asianbondonline*. Some of the control variables (policy rates, the U.S. Federal funds rate, and VIX index) also come from DataStream. Inflation and real output growth data are from the IMF World Economic Outlook. Other macroeconomic variables such as current account deficit, foreign exchange reserves, and gross government debt ratios are drawn from Haver Analytics.

All data are available in a quarterly frequency and the time dimension spans from 2009Q1 to 2013Q1. Due to data availability issues (mostly driven by the foreign ownership variable), we end up with 12 EMs for which the information is available on all variables.

C. Baseline Estimates and Results

Foreign holdings and the level of local bond yields

The econometric results are presented in Table 1. The results show that foreign participation has a statistically significant and negative effect on the level of local currency bond yields. The impact is substantial. A 10 percentage point increase in the share of foreign investors in the government bond market is associated with a reduction in yields of 70 to 90 bps. The effect is larger (in absolute terms) compared to the pre-crisis estimates found by Peiris (2010). The results also uncover a strong and robust effect of the country's policy rate on yields. The level of international reserves, the U.S. federal funds rate and the level of the current account balance seem also to play a significant role. In columns 7 and 8, the point estimates on the current account balance and international reserves (scaled by GDP) are statistically significant and negative, suggesting that an increase in the size of external buffers has led to declines in yields. For example, a 1 percentage point increase in foreign exchange reserves-to-GDP will tend to lower the yields by about 9 basis points on average. Expectations regarding a depreciation of the local currency against the US dollar are also positively and significantly associated with higher bond yields (column 9).

[Table 1]

Foreign holdings and the volatility of local bond yields

In Table 2, we investigate the effect of foreign holdings on yield volatility. We begin by estimating a pooled OLS version of the model (without country-fixed effects). The results shown in columns 1–2 suggest a negative association between the foreign holdings ratio and the yield volatility although the significance of the coefficient weakens when additional control variables are accounted for. Once country fixed-effects are controlled for (columns 3–8), the foreign holdings ratio is no longer associated with a decline in the volatility of bond yields. In most cases, the point estimate is negative but far from being significant. Regarding the effects of the other control variables, the results highlight a robust and significant association between the VIX and the yield volatility in all specifications. This implies the existence of strong financial spillovers from shifts in global risk appetite into bond market volatility in EMs. The positive correlation between current account surpluses and yield volatility is surprising and counter-intuitive. The volatility of the forward exchange rate between the local currencies against the US dollar is also positively and significantly associated with the yield volatility (column 7).

[Table 2]

It is however important to remain cautious regarding these previous results as the fixed-effects specifications still do not fully rule out the potential endogeneity issues or the existence of potential conditional effects depending on countries' macroeconomic fundamentals.

D. Robustness Checks

Model of the level of yields

Several robustness checks are performed in order to assess the quality of the previous estimates. Regarding the estimations of the effect of the foreign holdings on the level of local bond yields, we provide estimates of the baseline model when accounting for: (i) the potential serial correlation within the panel structure, (ii) detection of influential observations, and finally, (iii) the potential endogeneity of the foreign holdings variable.

Controlling for the serial correlation of the residuals

The econometric results are presented in Table 3. In column 1, we present the results obtained when the assumptions of no serial correlation of the residuals are relaxed. We therefore estimate a panel fixed-effects model with residuals assumed to follow an AR(1) process (see Baltagi and Wu, 1999). The coefficient associated with the foreign holding variable is still negative, significant, and within the range of magnitude.

Dealing with outliers

In column 2, we run the model by excluding influential observations defined as countries with residuals that are more than two standard deviations from zero. Despite the correction, the econometric results do not reject the hypothesis that an increase in the foreign holdings of local government bonds is associated with a decline in government bond yields.

Addressing the endogeneity of foreign holdings

In columns 3–5, we address the endogeneity of the foreign holding variable via an instrumental variable strategy. Endogeneity issues are particularly pronounced in this context as it is obvious that foreign investors target markets depending on the expected return on their assets. In principle, this source of endogeneity should not pose a severe threat to our results as the direction of the bias is likely positive: the reverse causality is likely to be positive from higher (expected) yields to a high share of foreign investors. The resulting effect on our baseline estimates would be an underestimation of the "true" negative association between the foreign holdings and the level of the yields. However, other sources of endogeneity are more difficult to ignore. For example, there may exist some unobservable factors which are both correlated with the foreign holdings of local bonds and the yields. For such reason, our estimates could be biased as well.

[Table 3]

Under the presence of country fixed-effects in the model, the challenge is to find a time-varying instrumental variable which is strongly correlated with the foreign holdings variable but not with the bond yields in the sample conditional on the presence of other correlates. To overcome this challenge, the paper proposes several identification strategies aimed at addressing the endogeneity concerns. First, we resort to a simple strategy which instruments

the foreign holdings variable with its second and third lag.[7] We therefore make the assumption that the lagged levels of the foreign holdings affect the level of bond yields only through their effects on the current level of foreign holdings.[8] The results of this instrumental variable strategy are consistent with the previous estimates of the effect of the foreign holdings of local bonds on the level of yields. Interestingly, the point estimate under the instrumental variable strategy is negative and statistically significant (column 3).

In columns 4–5, we propose an alternative identification strategy which goes beyond the simple use of lagged values of the endogenous variable. We exploit the time-varying effects of the distance vis-à-vis major offshore financial centers on the foreign holdings in each country. The identification strategy is based on the idea that countries closer to the financial centers are more financially integrated and would therefore experience a higher share of foreign investors in the domestic government bond market.[9] The geography-based measure of this financial remoteness has the advantage of plausible exogeneity. We use the estimation of quarter-by-quarter OLS regressions estimates of foreign holdings explained by the financial remoteness and/or its square, while controlling for the policy rate. While the financial remoteness variable is by construction time-invariant within a country, the time-varying estimates (quarter-by-quarter) of its impact on foreign holdings adds to it a time-varying dimension at the country-level. The key idea for instrumentation is to model the foreign holdings ratio based on structural (therefore exogenous) factors, and is to use the time-varying predictions from this model as the main instrumental variable for the observed foreign holdings ratio. To measure financial remoteness, we use the (natural logarithm of great-circle) distance to the closest offshore financial center (OFC), using the 40 OFCs tabulated in Rose and Spiegel (2007).[10] The source of the data is Rose and Spiegel (2009). Depending on the first-stage specifications, the distance variable enters the model linearly or in a quadratic form.[11] As expected, the foreign holdings ratio is negatively correlated with the

[7] See also Beltran et al. (2013) on the treatment of the endogeneity of foreign holdings in a paper focusing on the U.S. and using alternative instrumental variables.

[8] This assumption on the exclusion restrictions may appear fragile but will ultimately be tested empirically via the statistics of strength (First-stage *F*-statistic) and orthogonality of the instruments (Hansen test statistic).

[9] Rose and Spiegel (2009) provide a useful discussion on why geographical distance could matter for international finance. Indeed, while the cost of moving asset holdings electronically is essentially invariant to distance, a battery of empirical evidence suggests that distance exacerbates information asymmetries. For example, Coval and Moskowitz (1999, 2001) demonstrate that fund managers in the United States invest more heavily in and earn abnormally large returns from investing in firms in close proximity. Malloy (2005) finds that geographically proximate analysts tend to be more accurate. Petersen and Rajan (2002) find that borrower quality increases with distance, suggesting that banks are unwilling to lend to distant problem borrowers who would require more active monitoring.

[10] Rose and Spiegel (2007) have introduced a model where the cost of moving assets to offshore banks is increasing in distance, and found that the share of offshore banking is decreasing in physical distance from the offshore financial center.

[11] The natural logarithm of the great-circle distance to the closest major financial center (London, New York, or Tokyo) has also been tested as a potential source of exogenous variations for the foreign holdings variable. It

(continued…)

financial remoteness and more importantly, the estimates are different across quarters, suggesting shifts in the evolving role of offshore financial centers on capital flows throughout the period.[12]

Armed with this instrumental variable (the exogenous component of the foreign holdings), we run two-stage least squares estimates of the effect of foreign holdings on the yields. As the instrument is time-varying within countries, the model allows for the inclusion of country-fixed effects to capture other potential unobserved factors. The results do not reject the hypothesis of a negative and statistically significant effect of foreign holdings on the level of the yields in EMs. Even when we assume that the financial remoteness affects the foreign holdings ratio in a non-linear way (by using the quadratic form of the variable in the model engineering the instrumental variable) the results remain similar and robust (column 5).[13]

Model of the volatility of yields

Addressing the endogeneity of foreign holdings

We follow the exact same identification strategies laid out in the previous section to tackle the endogeneity concerns. We begin by reporting the results which use the lagged values of the foreign holdings ratio as the instrumental variables. We then report the results when the identification strategy is based on the financial remoteness effect on foreign holdings ratios.

The results of instrumental variable estimates are presented in Table 4. Regardless of the instrumental variable method which is used, the results highlight a positive and significant association between the higher dependency upon foreign investors in the domestic bond market and the yield volatility. The estimates derived from the use of the financial remoteness variable lead to a higher impact (columns 2–3). Interestingly, the instrumental variables also appear to be significantly correlated with the foreign holdings ratio and standard diagnostic tests of instrument relevance are satisfactory. Even when we assume that the financial remoteness affects the foreign holdings ratio in a non-linear way (by using the quadratic form of the variable in the model engineering the instrumental variable) the results remain similar and robust (column 3).

[Table 4]

E. Macroeconomic Fundamentals and the Impact of Foreign Holdings

Is the effect of foreign holdings of local government bonds affected by countries' macroeconomic fundamentals? After establishing that an increase in the share of foreign

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turned out that the foreign holdings ratio is less responsive to this variable than to the distance vis-à-vis offshore financial centers.

[12] Details of these estimation results are available from the authors upon request.

[13] The results are robust to the control for other geographical factors such as continental dummies in the models engineering the instrumental variable.

investors in local government bonds market is on average associated with a decline in the level of the yields and a rise in yield volatility, the paper expands the analysis by investigating the presence of non-linearities in the effects of foreign ownership on EM local government bond markets. We test the assumptions that the effects of the foreign holdings are conditional on domestic policies vulnerabilities (captured by the level of fiscal balance or gross government debt, the current account balance or the level of international reserves) and by the level of global risk aversion.

The econometric specification allows for a non-linear effect of the foreign holdings variable in the model of the level of the yields. More formally, the models are specified as follows:

$$y_{it} = (\theta_3 + \theta_4 P_{it}) f_{it} + \theta_5 P_{it} + X'_{it}\Gamma + c_i + u_t + \epsilon_{it} \qquad [3],$$

Moreover, when θ_3 and θ_4 are individually and jointly statistically significant, a threshold effect arises:

$$\frac{\partial y_{it}}{\partial f_{it}} = \theta_3 + \theta_4 P_{it} < 0, \rightarrow P_{it} < P^* := -\frac{\theta_3}{\theta_4},$$

where *P* denotes the matrix of conditional variables discussed above. P^* measures the level of the given macroeconomic variable beyond which an increase in the share of foreign investors in the local government bond market leads to a modification of the marginal effect.

In the case of the volatility of the yields, the specification is as follows:

$$\sigma^B_{i\tau} = (\theta_6 + \theta_7 P_{i\tau}) f_{i\tau 0} + \theta_8 P_{i\tau} + X'_{i\tau}\phi + u_\tau + \epsilon_{i\tau} \qquad [4],$$

The threshold level of the conditional variable is given by:

$$\frac{\partial \sigma^B_{i\tau}}{\partial f_{i\tau 0}} = \theta_6 + \theta_7 P_{i\tau} < 0, \rightarrow P_{i\tau} < P^* := -\frac{\theta_6}{\theta_7}.$$

When the panel fixed-effects specification is used, the model is as follows:

$$\sigma^B_{it} = (\theta_9 + \theta_{10} P_{it}) f_{it} + \theta_{11} P_{it} + X'_{it}\phi + c_i + \epsilon_{it} \qquad [5],$$

with the thresholds of the conditional variables computed as previously.

Bond yields, fundamentals, and participation of foreign investors

The results are presented in Table 5. Regarding the effects on the level of bond yields, we do not find a statistically significant non-linear effect of the foreign holdings of EMs local bonds on the level of yields except in the case of gross public debt and total external debt ratios. Regardless of the other conditional macroeconomic variables which are used in the test (current account balance and global risk aversion), the marginal effect of foreign holdings does not change significantly. This suggests that the benefit in terms of bond yield decline is not very different across EMs except in the case of highly indebted EMs. However, it is worth noting that the computed debt-to-GDP thresholds are out-of-sample thresholds

suggesting that the results may represent statistical artifacts and should therefore be interpreted with caution.

[Table 5]

Yield volatility, fundamentals, and participation of foreign investors

We now turn to the role of fundamentals as potential factors that shape the relationship between foreign holdings and yield volatility in EMs. The results are presented in Table 6. The effect of countries' fundamentals is statistically significant and consistent with our expectations. The results suggest that the positive association between the share of foreign investors in local currency bond markets and the ex-post historical volatility of government local currency bond yields increases with the level of total external debt-to-GDP ratios while it decreases with the strength of the balance of payment position (lower current account deficits and higher foreign exchange reserves). Interestingly, the effect of foreign holdings does not seem to depend on the degree of global risk aversion.

[Table 6]

Estimates presented in Table 6 allow us to compute the threshold of some conditional variables at which the marginal effect of foreign holdings on yield volatility is fully neutralized. Our estimates suggest that in EMs with current account surpluses amounting to 1.5 percent of GDP or foreign exchange reserves close to 12 percent of GDP, yield volatility is insensitive to increases in foreign holdings. The estimation results show that an increase in the share of foreign holdings in a given country is associated with a decline in the country's yield volatility, as the current account surplus strengthens. In other words, countries with current account surpluses do not appear to suffer from the yield volatility induced by an increase in the share of foreign investors. In contrast, these countries appear to post lower ex-post yield volatility. However, for countries with variables below these thresholds, the resulting volatility of yields is higher. The results also highlight that total gross external debt above 98 percent of GDP is conducive to an increase in yield volatility in response to higher foreign holdings. It is worth noting that these are in-sample thresholds with values within the sample distribution.

These results are important for a number of reasons. First, they suggest that EMs with weak fundamentals compared to others would suffer the most from an initially high exposure to foreign investors in their domestic bond markets. Indeed, they tend to exhibit higher ex-post yield volatility suggesting that they are more prone to sudden-stops or flow reversals. While the impact on the yield level was not found to be broadly influenced by the level of fundamentals, this is no longer the case when focusing on the bond market volatility.

The differentiation in the impact of foreign holdings of local government bonds on the yield volatility brings a certain granularity to the baseline results. Indeed, one can think about two types of volatility affecting bond markets. On the one hand, as foreign investors move into countries with good fundamentals, the reduction in the yields may be accompanied by some volatility as yields are adjusting downward. On the other hand, in countries which enjoy a large influx foreign investors in the local bond market but which eventually suffered from the

deterioration in the levels of the fundamentals, the risk of flow reversals or sudden-stops is higher and yield volatility becomes more pronounced.

III. CASE-STUDY: POLAND

Poland is one of the emerging economies that has experienced one of the biggest increases in the share of foreign investors in its domestic bond market over the past years. The share of foreign investors reached a peak at 37 percent in April 2013 from about 14 percent in early 2009. Alongside this development is the decline of bond yield levels (Figure 3).

[Figure 3]

This section focuses on the case of Poland to reinvestigate the relationship between the participation of foreign investors in local currency government bonds and the level and volatility of Polish local currency bond yields using a time-series approach. The advantage of doing so over the panel framework is to go beyond average effects which may hide countries' specificities. Resorting to a time-series approach also allows us to take advantage of high frequency data on both the yields and other variables available for Poland. The benefit would be the external validity of the results which could be difficult to generalize to other EMs. We believe that providing both panel and an individual country estimates would help reinforce the main message of the paper. The data we used covers the period from end–2004 to August 2013. In addition, a subsample of the period over end–2008 and August 2013 is investigated as this is the period after which the foreign ownership has increased the most.

When resorting to a time-series approach, the very high frequency of the available data is an advantage and help better extract the information contained in the data. However, using high frequency data (daily or weekly) comes with a price as it prevents us from directly assessing the effect of our variable of interest, foreign holdings of local currency bonds. We tried to find a balance between the two goals in a sequential procedure. The estimation framework proceeds in three steps.

- First, we specify an error-correction model with weekly data to assess the relationship between domestic bond yields and traditional indicators. We focus on the role of expected future interest rates and global factors (global risk aversion and the U.S. Federal Reserve balance sheet) as the main correlates of the dynamic of weekly yields in Poland. The benefit of using Federal Reserve balance sheet is to gauge the external spillover to Poland from Fed's quantitative easing policies.
- Second, we assess the critical role of these global financial factors on the level of and volatility of yields in Poland using a GARCH specification with daily data.
- Finally, we revisit the effects of foreign holdings on the domestic government bond market in Poland using monthly data and specifying a GARCH model linking both the mean and variance of the yields to the foreign holdings variable.[14]

[14] For Poland, a comprehensive foreign holdings variable is only available at a monthly frequency.

The first two models/specifications can be taken as reduced form estimates, as most of the proxies for global factors are likely to be strongly correlated with the foreign holdings of Polish government bonds. The last model (using directly the foreign holdings variable) can be seen as the structural model linking foreign holdings to both the yields and their volatility.

A. Error-Correction Specification Using Weekly Data

Analytical framework and data

We begin by specifying the baseline error-correction model relating the bond yields to its traditional determinants. We use an error-correction model to explore both the long-run and short-run dynamics and better factor in the co-integration relationship among the variables.[15] As we did in the cross-country approach, we focus on the 5-year local currency bond yields for consistency purposes. Weekly data covering the period from December 31, 2004 to August 30, 2013 are used. The error-correction specification is as follows:

Long-run dynamics:

$$PL5y_t = \alpha_0 + \alpha_1 PLPR_t + \alpha_2 SRPR_t + \alpha_3 LRPR_t + \alpha_4 \log(VIX_t) + \alpha_5 \log(CDS_t) + e_t,$$

$$SRPR_t = FRA3X6_t - PLPR_t,$$
$$LRPR_t = FRA21X24_t - PLPR_t,$$

Short-run dynamics:

$$\Delta PL5y_t = \beta_0 + \beta_1 \Delta PLPR_t + \beta_2 \Delta SRPR_t + \beta_3 \Delta LRPR_t + \beta_4 \Delta \log(VIX) + \beta_5 \Delta \log(CDS_t) + \beta_6 \Delta \log(FED_{t-1}) + \beta_7 \Delta \log(FED_{t-4}) + \beta_8 \Delta USPLN_t + \beta_9 e_{t-1} + \varepsilon_t,$$

where Δ denotes the first difference operator. $PL5y_t$ is the nominal yield of the 5-year domestic government bond, $PLPR_t$ is the week-end NBP reference rate (key central bank policy rate) set by the Poland's Monetary Policy Council, $FRA3X6_t$ is the forward rate arrangement (FRA) for the forward period of (3m, 6m)—i.e., the interest rate applied for the future period between three and six months. $SRPR_t$, the difference between the $FRA3X6_t$ and NBP reference rate, reflects financial market's outlook on the direction of the reference rate in a short-term period. $FRA\ 21X24_t$ is the week-end FRA for the forward period of (21m, 24m)—i.e., the interest rate applied for the future period between 21 and 24 months. $LRPR_t$, the difference between the $FRA\ 21X24_t$ and reference rate, reflects financial markets' outlook on the direction of the reference rate in a relatively long-term period. In this long-run dynamics, we assume that the bond yield follows the development of reference rate, short-run and long-run reference rate outlooks. The advantage of using future interest rates perceived by markets is that they capture market expectations on the economic and financial

[15] Unit root tests applied to the weekly data suggest that the series are non-stationary in levels and Engle-Granger or Joahansen co-integration tests do not reject the null hypothesis of the existence of a cointegration vector.

prospects of the country. Such developments are therefore already priced in the expected future interest rates.

In addition, log (VIX_t) represents the natural logarithm of VIX, and log (CDS_t) the natural logarithm of 5-year sovereign credit default swap spread for Poland. They would capture the impacts of global financial conditions such financial stress and perceived risks of investing in Polish securities.

Two additional variables are added to the short-run dynamics. The first difference of the log (FED_t) —the natural logarithm of the base money of the U.S. Federal Reserve—is added to capture the direct impact of the U.S. monetary impulses on the yield of Polish government bond.[16] $\Delta USPLN_t$ is the appreciation (+) or depreciation (–) of zloty against USD in the 2 year forward exchange rate of USD/PLN. The expectation is that a more appreciated forward exchange rate would persuade investors to accept a lower bond yield. e_t is the error term, the lag of which is one of the explanatory variables in the short-run dynamics used as the error correction term (adjustment factor in case of any disequilibrium between the variables and the long-run equilibrium).

Estimation results

Long-run results

The results show that reference rate and interest rate outlook can explain most of the bond yield movements over the long run. Column 3 of Table 8 reports the OLS regression results with reference rate and interest rate outlooks as the explanatory variables. Variations in them could account for 87.9 percent of the variation in the yield curve over the sample period. The long-run reference rate outlook is more influential than short-run reference rate outlook in affecting the bond yield—the variation in the reference rate and long-run rate outlook account for 88 percent of the variation compared with the 67.1 percent of the variation explained by the reference rate and short-run rate outlook (Table 7). This is not surprising, as the long-run rate outlook is more relevant for the 5-year bond yield than the short-run rate outlook. Given the high correlation between short-run rate outlook and long-run rate outlook and the dominance of long-run rate outlook, in deriving the error-correction term, we will use only the long-run rate outlook.

The explanatory power of the long-term dynamics is higher if VIX and CDS are added to the list of regressors. Variations in all of the variables could account for 95.3 percent of the variation in the yield curve. The coefficients of VIX and CDS are significant with expected positive signs–high VIX and high CDS are associated with high bond yield. If the subsample of the period over December 31, 2008 and August 30, 2013 is used instead, the coefficient on CDS will turn out to be larger, likely attesting to the important role of CDS after the 2008–09

[16] We tried the 5-year yield of US treasury paper as one explanatory variable, but it turned out to be insignificant in this specification.

financial crisis, and to the closer attention of investors, particularly foreign ones, to the risks of investing in Poland securities.

[Table 7]

Short-run results

In the short-run, the balance sheet of the Federal Reserve is added as one of the explanatory variables. The more immediate (one-week lag) impact of a larger balance sheet is associated with higher Polish government bond yields while a more lagged larger balance sheet (4-week lag) seems to depress the yield. One possible explanation is that there is a lag for the full impact to be felt, and in the meanwhile a larger Fed balance sheet may be linked with some market risk aversion which could play a role in increasing the Polish government bond yield.

The changes of the reference rate and short-run and long-run interest rate outlook influence the short-term yield in an expected way (Table 8). The direction of the influence of the changes of the VIX and CDS to the change of yield is same as expected and significant. Higher VIX and CDS are positively associated with an increase in bond yield in line with the intuition of a greater sensitivity of the Polish financial market—due to its size and relatively higher liquidity—to external financial developments. As expected, a more appreciated forward exchange rate is associated with a lower bond yield. The lags of all these variables turn out to be insignificant in the estimation and therefore are excluded from the estimation. The error term (e_t) derived from the long-run dynamics is significant with the negative sign as expected. It confirms the stable nature of the dynamics.

When the subsample of the period over December 31, 2008 and August, 2013 is used, the VIX, balance sheet of Fed, and the direction of the forward exchange rate cease to become significant, while the coefficient of CDS is larger compared with the estimation result from the whole sample. It is likely that after the 2008–09 financial crisis CDS has dominated other regressors or has incorporated most of the information embedded in other regressors, and hence overshadowed other external variables and contributed the most to the movement in the bond yields.

[Table 8]

B. GARCH Model Using Daily Data

A GARCH approach is employed to help understand the dynamics of Polish government bond yields. The GARCH framework, a standard tool for modeling volatility in financial economics, allows us to estimate the impact of regressors on the mean and volatility of the dependent variable. Following the specification of the error-correction model, and by replacing base money of the U.S. Federal Reserve (daily balance sheet data are not available) with five year US government bond yields, we have the following equation:

$$\Delta PL5y_t = \alpha_0 + \alpha_1 \Delta PLPR_t + \alpha_2 \Delta SRPR_t + \alpha_3 \Delta LRPR_t + \alpha_4 \Delta \log(VIX) + \alpha_5 \Delta \log(CDS_t) + \alpha_6 \Delta \mathrm{US5y_t} + \alpha_7 \Delta USPLN_t + \varepsilon_t,$$

$$\sigma_t^2 = \beta_0 + \beta_1 \Delta \log(VIX) + \beta_2\, \varepsilon_{t-1}^2 + \beta_3 \varepsilon_{t-2}^2 + \beta_4 \sigma_{t-1}^2$$

The first equation is the mean equation, while the second is the variance equation. The lags in the GARCH model—GARCH (1, 2)—are chosen based on their significance. $\Delta \log(VIX)$ enters the variance equation as it is the only regressor that is significant in this equation.

The estimation results for daily data from December 31, 2004 to August 30, 2013 show that, in the mean equation, (i) the changes in the reference rate and interest rate outlook influence the yield, (ii) the direction of the influence of the changes of the VIX and CDS to the change of yields is as expected positive, though the coefficient of VIX is not significant, (iii) a more appreciated forward exchange rate is associated with a lower bond yield (Table 9). The newly added variable, five year US government bond yield, turns out to be significant with the expected positive sign. Moreover, if a subsample covering daily data from December 31, 2008 to August 30, 2013 is estimated, the coefficient of the US bond yield turns out to be larger, attesting to the increasing influence of US bond yields on Polish government bond yields, associated with the increasing role of financial spillovers from financial centers into the Polish local bond market, which is associated with increasing foreign ownership.

The variance equation shows that the volatility of the bond yields increases as the VIX increases, confirming the impact of global risk aversion on the volatility of Polish government bond. Also as expected, this influence has increased after the 2008–09 financial crisis. The estimation results are robust in the sense that results are similar under different types of GARCH models and error distribution assumptions. This suggests that volatility is increasingly influenced by global factors, which in turn are linked to higher foreign holdings of local currency government bonds.

[Table 9]

C. A GARCH Approach Using Monthly Foreign Holdings Data

A second GARCH approach is employed to explore the influence of the share of foreign holdings of Polish government bonds. In this regard, the monthly data of foreign holdings are included in the analysis using a simple version of the GARCH (1, 1) model as follows:

$$PL5y_t = \alpha_0 + \alpha_1 PL5y_{t-1} + \alpha_2 F_t + \varepsilon_t,$$
$$\sigma_t^2 = \beta_0 + \beta_1 F_t + \beta_2\, \varepsilon_{t-1}^2 + \beta_3 \sigma_{t-1}^2\,,$$

where F_t represents the share of foreign investors in the Polish government bond. The sign on it provides an estimate of its impact on the mean and volatility of the bond yield. The estimation results for monthly data from December 2004 to July 2013 (Table 10) show that greater foreign ownership reduced the mean of the yields, while its impact on the yield volatility is insignificant, similar to the results shown in Peiris (2010).

[Table 10]

However, the estimation results from December 2008 to July 2013 show that greater foreign ownership is associated with lower yield, but at the same time with higher volatility, reflecting the mixed role of foreign investors in Polish government bond markets, which is also consistent with the cross-country evidence discussed in previous sections. The results

are also in line with the recent simulations conducted in Arslanalp and Tsuda (2013) focusing on several EMs countries. The authors show in their risk-scenarios that Poland would be significantly hit by a change in foreign investor behavior (sudden-stop of fund inflows, passive sales, and active sales) in terms of capital outflows and subsequent abrupt changes in long-term government bond yields due to a combination of factors: higher initial exposure to foreign investor base and ability of the domestic banks to absorb the foreign sales.

IV. CONCLUSION

This paper finds that foreign investors' participation in EM local currency government bond markets has an impact on the level and volatility of bond yields. This result is confirmed in both a panel framework which covers 12 EMs and a time series approach focusing exclusively on Poland. Our analysis suggests that EMs that have been able to attract a higher share of foreign investors in their local currency government bonds enjoy lower yields, but are more susceptible to market sentiment. This is particularly relevant in the current juncture, as the discussion of Fed's exit from its quantitative easing policy has raised questions about the potential impact in EMs.

Our results suggest that countries with strong macroeconomic fundamentals should experience less volatility as a result of foreign participation in their local currency bond markets. We also find that the benefit of lower yields arising from foreign investors is universal across EMs regardless of their macroeconomic fundaments. When global liquidity is ample, investors' search for yield overshadows the necessity to differentiate across EMs based on fundamentals. However, when liquidity becomes scarcer, investors are more inclined to differentiate across EMs. When this happens, EMs with weak fundamentals would suffer more from higher yield volatility associated with a high exposure to foreign investors in their local currency bond markets. In this sense, fortunes are all alike; every misfortune is misfortune in its own way.

The most direct policy message from our findings is that, in order to benefit most from foreign investors' participation, EMs need to continue to improve their macroeconomic fundamentals and build policy buffers. Policies could include adopting prudent fiscal policies and other policies that would encourage national savings. Another policy suggestion, which is at more microeconomic level, is that countries should aim to manage public debt prudently, attract long-term foreign investors, and create liquid fiscal buffers to deal with uncertainties.

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Appendixes

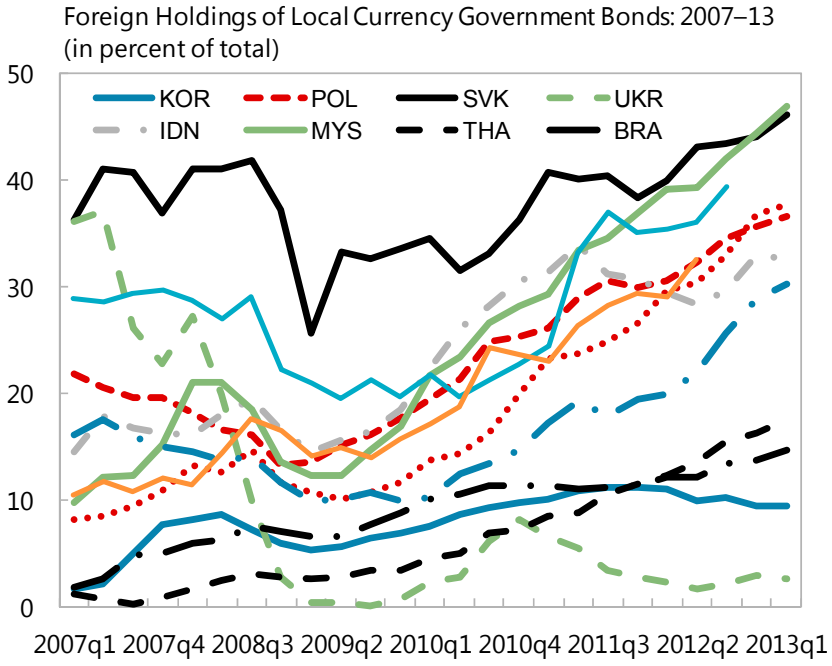
Table A1: Descriptive Statistics: Quarterly Data

Variable	Obs	Mean	Std. Dev.	Min	Max
5-year local currency government bond yield	204	5.99	3.04	0.96	16.96
Quarterly yield volatility	204	2.72	1.72	0	10.44
Foreign holdings (in percent)	191	21.10	10.99	2.60	46.90
Policy rate (in percent)	199	4.35	2.70	0.05	12.25
ln (100+Inflation rate)	204	4.64	0.03	4.57	4.76
Real GDP growth (in percent)	192	0.75	10.58	-48.45	93.14
VIX CBOE, ln	204	3.14	0.33	2.72	3.80
U.S. Federal funds rate	204	0.15	0.05	0.07	0.22
Current account balance (in percent of GDP)	204	-0.23	5.01	-11.60	16.70
Overall fiscal balance (in percent of GDP)	204	-3.00	3.61	-13.28	7.42
External debt (in percent of GDP)	204	46.07	33.30	9.91	149.52
Gross public debt (in percent of GDP)	198	44.72	17.28	22.41	100.86
Foreign exchange reserves (in percent of GDP)	187	23.92	13.07	8.35	55.27

Table A2: Sources and Description of the Data

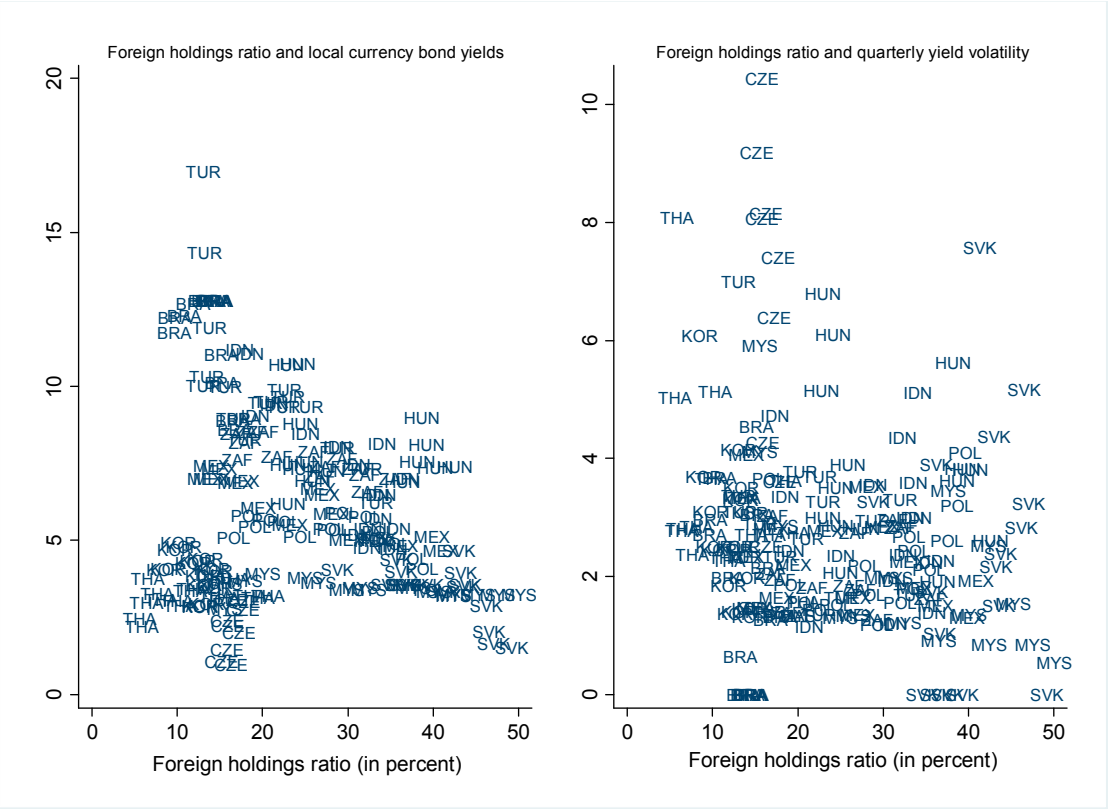
Variable	Description	Source
Data used for the cross-country analysis		
5-year local currency government bond yield	5-year nominal yield on treasury securities in local currency (in percent)	DataStream
VIX CBOE	Chicago Board Options Exchange (CBOE) volatility index	DataStream
U.S. Federal funds rate	U.S. federal funds rate - middle rate (in percent)	DataStream
Policy rate	Central bank key nominal policy rate (in percent)	DataStream
Forward exchange rate	Local currency to US dollar 2 year forward exchange rate	DataStream
Foreign holdings ratio	Share of foreign investors' holdings of domestic government bonds as a percentage of total outstanding amount of local currency bonds (in percent).	Haver analytics; Asianbondonline
Inflation rate	Consumer Prices, period average, seasonally adjusted, quarter-over-quarter percent change, annualized	IMF World Economic Outlook Database
Real GDP growth rate	Gross domestic product, constant prices, National Currency, percent change	IMF World Economic Outlook Database
Current account balance ratio	Current account balance as a percentage of nominal GDP	Haver analytics
Overall fiscal balance ratio	Depending on the country, central or government fiscal balance as a percentage of nominal GDP	Haver analytics
External debt ratio	Gross external debt as a percentage of nominal GDP	Haver analytics
Public debt ratio	Depending on the country, central or general government debt as a percentage of GDP	Haver analytics
Foreign exchange reserves ratio	Total international reserves as a percentage of GDP	Haver analytics
Data used for the Poland's case study		
5-year local currency government bond yield	5-year nominal yield on treasury securities in local currency (in percent)	DataStream
Policy rate	NBP reference rate (in percent)	DataStream
FRA3X6	Zloty forward rate for the period between 3 and 6 months	DataStream
FRA21X24	Zloty forward rate for the period between 21 and 24 months	DataStream
CDS	5-year sovereign credit default swap spread for Poland	DataStream
VIX CBOE	Chicago Board Options Exchange (CBOE) volatility index	DataStream
US5y	US treasury constant maturity 5 years	DataStream
FED	Base money of the U.S. Federal Reserve	DataStream
USPLN	Zloty to US dollar 2 year forward exchange rate	DataStream

Figure 1: Non-Resident Holdings Ratios in Emerging Markets. 2007–13



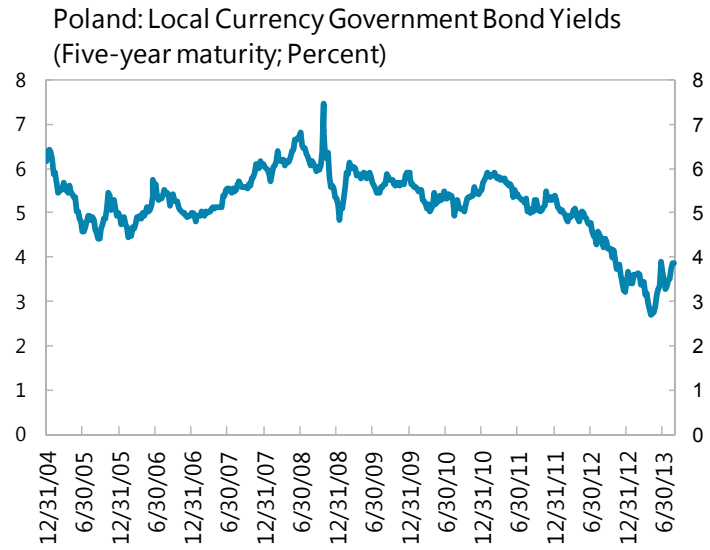
Sources: Countries' authorities; Haver Analytics; Asianbondonline; and IMF staff estimates.

Figure 2: Panel Correlation between Non-Resident Holdings of Local Currency Government Bonds, 5-Year Bond Yields and Yield Volatility (Quarterly Data 2009–13).

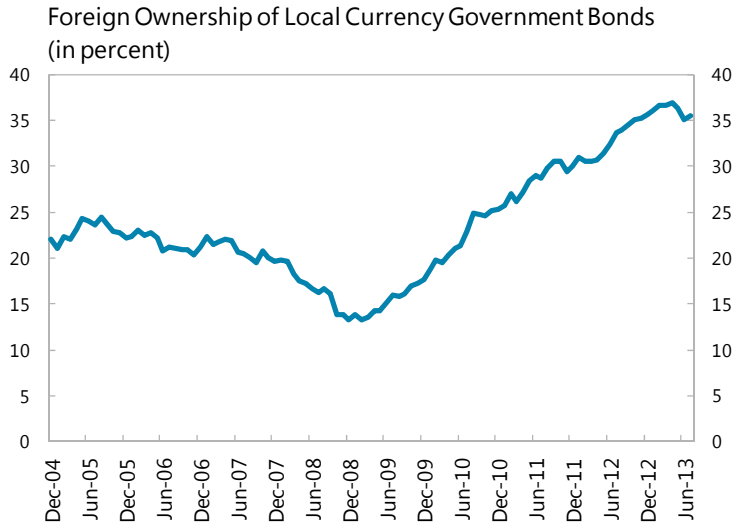


Note: The y-axis represents the 5-year local currency government bond yields (left panel), and the quarterly standard deviation of its weekly changes (right panel), respectively.
Source: Countries' authorities; Haver Analytics; Asianbondonline; Datastream; and IMF staff estimates.

Figure 3. Poland: Bond Yields and Foreign Holdings



Source: Haver.



Sources: Haver; and IMF staff estimates.

Table 1: Baseline Estimates of the Effect of Foreign Holdings of Local Government Bond on Bond Yields in Emerging Markets (EMs)

	Dependent variable: Emerging Markets' Local Currency 5Y Bond Yield Period: 2009q1-2013q1								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Foreign holdings ratio	-0.0893*** [-7.170]	-0.0727*** [-8.206]	-0.0742*** [-8.316]	-0.0835*** [-9.341]	-0.0817*** [-8.418]	-0.0829*** [-8.216]	-0.0787*** [-8.383]	-0.0652*** [-6.846]	-0.0665*** [-5.744]
Policy rate		0.647*** [9.248]	0.645*** [9.234]	0.722*** [9.683]	0.691*** [9.117]	0.688*** [8.988]	0.582*** [8.149]	0.583*** [8.113]	0.441*** [4.277]
Inflation rate, ln			3.387 [1.262]	3.476 [1.309]	3.047 [1.132]	3.132 [1.153]	3.637 [1.481]	3.003 [1.159]	6.511** [2.453]
Change in real GDP growth				-0.00571 [-1.090]	-0.00589 [-1.131]	-0.00573 [-1.041]	-0.00476 [-1.000]	-0.00702 [-1.447]	-0.00526 [-1.101]
VIX, ln					0.253 [1.248]	0.252 [1.237]	0.155 [0.820]	0.156 [0.795]	0.0927 [0.453]
U.S. Federal Fund rate					-1.878 [-1.495]	-1.877 [-1.477]	-2.478** [-2.138]	-2.792** [-2.275]	-2.795** [-2.117]
Current account balance-to-GDP						-0.0124 [-0.475]	-0.0427* [-1.747]		
Overall fiscal balance-to-GDP						-0.00173 [-0.0935]			
Gross government debt-to-GDP							-0.0171 [-1.171]	0.0112 [0.580]	-0.0141 [-0.707]
International reserves-to-GDP								-0.0891*** [-2.874]	-0.0380 [-1.047]
Forward exchange rate									0.00130*** [4.597]
Intercept	7.981*** [29.03]	4.581*** [12.18]	-11.10 [-0.893]	-11.62 [-0.944]	-10.04 [-0.797]	-10.41 [-0.818]	-11.19 [-0.973]	-7.604 [-0.626]	-24.73** [-1.995]
Country fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	191	186	186	176	176	176	170	154	113
R-squared	0.224	0.480	0.485	0.521	0.532	0.533	0.550	0.559	0.613
Number of countries	12	12	12	12	12	12	12	11	9

Note: *T*-statistics in brackets. *** p<0.01, ** p<0.05, * p<0.1.
Source: IMF staff estimates.

Table 2: Panel Fixed-Effects Estimates of the Effects of the Foreign Holdings on Yield Volatility

	Dependent variable: Quarterly Yield volatility Period: 2009q1-2013q1; Quarterly data						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Foreign holdings ratio	-0.0284**	-0.0233*	-0.00836	0.00295	-0.0124	-0.00237	0.0309
	[-2.415]	[-1.763]	[-0.441]	[0.162]	[-0.610]	[-0.115]	[1.584]
Inflation rate, ln		-7.066	-6.093	-5.657	-5.823	-5.510	-3.854
		[-1.374]	[-0.882]	[-0.754]	[-0.825]	[-0.726]	[-0.531]
VIX, ln		0.837*	1.215**	1.226**	1.304***	1.309***	0.468
		[1.695]	[3.001]	[2.914]	[3.441]	[3.293]	[1.451]
Current account balance-to-GDP				0.0924		0.0783	0.0477
				[1.757]		[1.319]	[0.550]
Gross public debt-to-GDP					0.0508	0.0410	0.0205
					[1.735]	[1.194]	[0.489]
Forward exchange rate volatility							0.799***
							[3.463]
Intercept	3.319***	33.39	27.37	25.07	23.66	22.41	16.44
	[10.89]	[1.346]	[0.827]	[0.697]	[0.722]	[0.639]	[0.502]
Country fixed-effects	No	No	Yes	Yes	Yes	Yes	Yes
Observations	191	191	191	191	185	185	141
R-squared	0.031	0.072	0.113	0.138	0.129	0.146	0.183
Number of countries	12	12	12	12	12	12	10

Note: *T*-statistics in brackets. *** p<0.01, ** p<0.05, * p<0.1.
Source: IMF staff estimates.

Table 3: Foreign Holdings and the Level of Yields: Robustness Checks

Dependent variable: Emerging Markets' Local Currency 5Y Bond Yield Period: 2009q1-2013q1					
	Controlling for serial correlation in the residuals	Drop >|2sigma| outliers	IV estimates		
	(1)	(2)	(3)	(4)	(5)
				Second-stage:	
Foreign holdings ratio	-0.0683***	-0.0681***	-0.0912***	-0.0389**	-0.0387**
	[-3.742]	[-7.848]	[-7.588]	[-2.350]	[-2.081]
Policy rate	0.615***	0.667***	0.695***	0.549***	0.549***
	[5.565]	[9.971]	[7.234]	[5.961]	[5.847]
Inflation rate, ln	1.425	5.271**	5.755**	3.862	3.863
	[0.830]	[2.229]	[2.312]	[1.615]	[1.610]
Change in real GDP growth	-0.00359	-0.00381	-0.00517	-0.00289	-0.00288
	[-1.412]	[-0.842]	[-1.386]	[-0.901]	[-0.882]
VIX, ln	-0.0353	0.254	0.152	0.393**	0.394**
	[-0.254]	[1.444]	[0.898]	[1.967]	[2.089]
U.S. federal fund rate	-2.414**	-1.330	-1.880	-1.588	-1.584
	[-2.129]	[-1.205]	[-1.624]	[-1.363]	[-1.334]
Gross public debt-to-GDP				-0.0327**	-0.0327*
				[-1.981]	[-1.917]
Current account balance-to-GDP				-0.0146	-0.0144
				[-0.642]	[-0.599]
Intercept	-1.668	-20.70*			
	[-0.673]	[-1.869]			
			First-stage: Foreign holdings [a]		
Foreign holdings, $_{t-2}$			1.012***		
			[8.202]		
Foreign holdings, $_{t-3}$			-0.092		
			[-0.712]		
Fitted foreign holdings ratio			0.615***	0.710***	0.655***
			[5.565]	[8.412]	[6.143]
Kleibergen Paap F-Stat.			360.70	59.5	37.8
Cragg-Donald F-Stat.			425.71	70.8	37.7
Hansen OID test, *P*-value			0.146	..	..
Country fixed-effects	Yes	Yes	Yes		
Observations	164	169	153	170	170
R-squared		0.557	0.511	0.496	0.496
Number of countries	12	12	12	12	12

Note: *T*-statistics in brackets. [a] For the sake of conciseness, the full set of control variables included in the first-stage regressions is not shown. *** p<0.01, ** p<0.05, * p<0.1
Source: IMF staff estimates.

Table 4: Foreign Holdings and Yield Volatility: Robustness Checks with Panel Fixed-Effects.

Dependent variable: Quarterly Yield volatility Period: 2009q1-2013q1; Quarterly data			
	IV estimates [a]	IV estimates [a]	IV estimates [a]
	(1)	(2)	(3)
		Second-stage:	
Foreign holding ratio	0.0389**	0.0587*	0.116**
	[1.972]	[1.932]	[2.175]
Inflation rate, ln	-1.093	-5.366	-6.026
	[-0.200]	[-0.973]	[-1.023]
VIX, ln	0.510	1.719***	2.169***
	[1.331]	[3.884]	[3.639]
Gross public debt-to-GDP	-0.00644	0.0182	0.000174
	[-0.162]	[0.489]	[0.00412]
Current account balance-to-GDP	0.0773	0.113**	0.149**
	[1.413]	[2.119]	[2.377]
		First-stage: Foreign holding ratio	
Foreign holdings, $_{t-2}$	0.955***		
	[8.112]		
Foreign holdings, $_{t-3}$	-0.011		
	[-0.093]		
Fitted foreign holdings ratio		0.700***	0.523***
		[8.541]	[5.242]
Cragg-Donald F-Stat.	399.6	62.2	28.2
Kleibergen Paap F-Stat.	435.0	72.9	27.5
Hansen OID test, *P*-value	0.563	..	..
Country fixed-effects	Yes	Yes	Yes
Observations	149	180	180
Number of countries	12	12	12

Note: *T*-statistics in brackets. [a] For the sake of conciseness, the full set of control variables included in the first-stage regressions is not shown. *** p<0.01, ** p<0.05, * p<0.1
Source: IMF staff estimates.

Table 5: Foreign Holdings and the Level of Yield: Accounting for Non-Linear Effects

Dependent variable: Emerging Markets' Local Currency 5Y Bond Yield Period: 2009q1-2013q1				
	(1)	(2)	(3)	(4)
Foreign holdings ratio	-0.0804***	-0.107***	-0.139***	-0.0185
	[-8.473]	[-6.586]	[-6.955]	[-0.375]
Foreign holdings * Current account balance	0.00162			
	[1.166]			
Foreign holdings * Gross external debt ratio		0.000509*		
		[1.968]		
Foreign holdings * Public gross debt ratio			0.00129***	
			[3.382]	
Foreign holdings * VIX				-0.0191
				[-1.120]
Current account balance-to-GDP	-0.0704**	-0.0284	-0.0555**	-0.0549**
	[-2.066]	[-1.051]	[-2.317]	[-2.740]
Gross external debt-to-GDP		-0.0248		
		[-1.318]		
Gross public debt-to-GDP	-0.0209		-0.0509***	-0.00525
	[-1.400]		[-2.941]	[-0.204]
VIX, ln	0.151	0.225	0.148	0.499
	[0.800]	[1.115]	[0.812]	[1.073]
Policy rate	0.561***	0.683***	0.567***	0.520***
	[7.606]	[9.037]	[8.184]	[3.611]
Inflation rate, ln	3.599	3.474	3.694	2.803
	[1.467]	[1.298]	[1.555]	[1.203]
Change in real GDP growth	-0.00469	-0.00516	-0.00437	
	[-0.986]	[-0.990]	[-0.949]	
U.S. federal fund rate	-2.492**	-1.602	-2.292**	-3.627***
	[-2.152]	[-1.281]	[-2.042]	[-3.171]
Intercept	-10.70	-10.83	-9.900	-8.522
	[-0.931]	[-0.866]	[-0.890]	[-0.764]
Country fixed-effects				
Observations	170	176	170	180
R-squared	0.554	0.549	0.582	0.520
Number of countries	12	12	12	12

Note: *T*-statistics in brackets. *** p<0.01, ** p<0.05, * p<0.1.
Source: IMF staff estimates.

Table 6: Non-Linear Effect of Foreign Holdings on Yield Volatility: Panel Fixed-Effects Estimates

Dependent variable: Quarterly Yield volatility Period: 2009q1-2013q1; Quarterly data					
	(1)	(2)	(3)	(4)	(5)
Foreign holding ratio	0.00325	0.0209	-0.00216	-0.0457**	0.000284
	[0.255]	[0.696]	[-0.0635]	[-2.455]	[0.00272]
Foreign holdings * Current account balance-to-GDP	-0.00212*				
	[-1.855]				
Foreign holdings * International reserves-to-GDP		-0.00179**			
		[-2.601]			
Foreign holdings * Gross public debt-to-GDP			-0.000614		
			[-1.111]		
Foreign holdings * Gross external debt-to-GDP				0.000465**	
				[2.488]	
Foreign holdings * VIX					-0.00989
					[-0.312]
Current account balance-to-GDP	0.0933***				
	[3.402]				
International reserves-to-GDP		0.154**	0.142**	0.0981*	0.154**
		[3.161]	[2.782]	[1.955]	[2.728]
Gross public debt-to-GDP	0.0292	0.0335	0.0344		
	[1.323]	[0.721]	[0.726]		
Gross external debt-to-GDP				0.0846*	
				[2.185]	
Inflation rate, ln	-2.591	-9.679	-10.05	-8.789	-9.914
	[-0.611]	[-1.637]	[-1.701]	[-1.587]	[-1.591]
VIX, ln	1.292***	1.239**	1.230**	1.160**	1.380
	[3.774]	[3.167]	[3.072]	[3.074]	[1.675]
Intercept	9.111	39.03	41.15	34.42	41.34
	[0.463]	[1.454]	[1.537]	[1.330]	[1.360]
Country fixed-effects	Yes	Yes	Yes	Yes	Yes
Joint significance of the non-linearity: *P-val*	0.221	0.004	0.104	0.059	0.165
Threshold value of the conditional variable	1.53	11.7	..	98.2	..
Observations	173	168	168	174	174
R-squared	0.179	0.249	0.234	0.265	0.228
Number of countries	12	11	11	11	11

Note: *T*-statistics in brackets. *** p<0.01, ** p<0.05, * p<0.1.
Source: IMF staff estimates.

Table 7. Poland Yield Regressions: Long-Run Dynamics

	Dependent. Variable: Local Currency 5Y Bond Yield				
Sample period	2004/12-2013/8	2004/12-2013/8	2004/12-2013/8	2004/12-2013/8	2008/12-2013/8
	(1)	(2)	(3)	(4)	(5)
Reference rate	0.54***	1.05***	1.03***	1.03***	0.89***
	[0.025]	[0.020]	[0.023]	[0.015]	[0.026]
Short-run rate outlook	1.14***		0.087*		
	[0.046]		[0.047]		
Long-run rate outlook		0.85***	0.80***	0.82***	0.82***
		[0.017]	[0.029]	[0.011]	[0.012]
Log(VIX)				0.39***	0.37***
				[0.029]	[0.038]
Log(CDS)				0.063***	0.41***
				[0.011]	[0.041]
Intercept	2.56***	0.17*	0.27**	-1.13***	-2.31***
	[0.11]	[0.093]	[0.11]	[0.075]	[0.12]
R-squared	0.671	0.877	0.879	0.953	0.973
No. of observations	453	453	453	453	245

Note: Standard error in brackets. *** p<0.01, ** p<0.05, * p<0.1.
Source: IMF staff estimates.

Table 8. Poland Yield Regressions: Short-Run Dynamics

Dependent variable: Δ Local Currency 5Y Bond Yield			
Sample period	2004/12-2013/8	2008/12-2013/8	2008/12-2013/8
	(1)	(2)	(3)
Intercept	-0.0026	-0.0043	-0.004
	[0.0036]	[0.0051]	[0.0049]
ΔReference rate	0.77***	0.62***	0.61***
	[0.046]	[0.076]	[0.076]
ΔShort-run rate outlook	0.23***	0.15**	0.14**
	[0.051]	[0.073]	[0.072]
ΔLong-run rate outlook	0.53***	0.50***	0.50***
	[0.029]	[0.040]	[0.039]
ΔLog(VIX)	0.051*	0.055	
	[0.029]	[0.043]	
ΔLog(CDS)	0.10**	0.24***	0.31***
	[0.039]	[0.072]	[0.054]
ΔLog(Fed balance sheet)	0.79***	0.14	
(one-week lag)	[0.18]	[0.28]	
ΔLog(Fed balance sheet)	-0.54**	-0.1	
(four-week lag)	[0.19]	[0.26]	
Δ US/PLN 2 year forward rate	-0.54***	-0.2	
	[0.19]	[0.29]	
Error correction term (one lag)	-0.11***	-0.21***	-0.20***
	[0.021]	[0.038]	[0.036]
R-squared	0.743	0.645	0.641
No. of observations	448	244	244

Note: Standard error in brackets. *** p<0.01, ** p<0.05, * p<0.1.
Source: IMF staff estimates.

Table 9: Poland Yield Regressions: GARCH

Dependent variable: Δ Local Currency 5Y Bond Yield		
Sample period	2004/12/31-2013/8/30	2008/12/31-2013/8/30
	(1)	(2)
Mean Equation		
Intercept	-0.00079	-0.0014
	[0.00076]	[0.0011]
ΔReference rate	0.69***	0.53***
	[0.027]	[0.043]
ΔShort-run rate outlook	0.35***	0.25***
	[0.018]	[0.024]
ΔLong-run rate outlook	0.30***	0.25***
	[0.0093]	[0.012]
ΔLog(VIX)	0.0074	-0.0026
	[0.012]	[0.017]
ΔLog(CDS)	0.052***	0.13***
	[0.016]	[0.038]
ΔUS yield	0.029**	0.043**
	[0.013]	[0.019]
Δ US/PLN 2 year forward rate	-0.80***	-0.80***
	[0.076]	[0.10]
Variance equation		
constant	0.000065***	0.000077***
	[0.0000093]	[0.000014]
RESID(-1)^2	0.19***	0.17***
	[0.022]	[0.029]
RESID(-2)^2	-0.082***	-0.074**
	[0.022]	[0.030]
GARCH(-1)	0.86***	0.87***
	[0.010]	[0.014]
ΔLog(VIX)	0.0014***	0.0021***
	[0.00027]	[0.00035]
R-squared	0.373	0.34

Note: Standard error in brackets. *** p<0.01, ** p<0.05, * p<0.1.
Source: IMF staff estimates.

Table 10. Poland Yield Regressions: GARCH and Foreign Ownership

Dependent variable: Local Currency 5Y Bond Yield		
Sample period	2004/12-2013/7	2008/12-2013/7
	(1)	(2)
Mean Equation		
Intercept	1.34***	1.0**
	[0.52]	[0.41]
Yield, lag	0.84***	0.87***
	[0.067]	[0.054]
Foreign ownership	-0.021	-0.015***
	[0.0078]	[0.0064]
Variance equation		
Intercept	0.018	0.0052
	[0.028]	[0.000014]
RESID(-1)^2	0.13	-0.17***
	[0.092]	[0.029]
GARCH(-1)	0.65***	1.07***
	[0.027]	[0.086]
Foreign ownership	-0.000041	0.00040***
	[0.00054]	[0.00017]
R-squared	0.862	0.909

Note: Standard error in brackets. *** p<0.01, ** p<0.05, * p<0.1.
Source: IMF staff estimates.