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Direct and Spillover Effects of Unconventional Monetary and Exchange Rate Policies

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1. Introduction

Unconventional monetary policy has dominated economic headlines since the Global Financial Crisis of 2008. At that time conventional policy interest rates in the major advanced economies approached the zero lower bound and central banks in these economies searched for other ways to shore up aggregate demand. Policymakers in some emerging markets argued that these unconventional policies were causing capital to flow out of the major advanced economies and into the emerging markets, creating lending booms, pushing up the foreign exchange value of currencies in the emerging markets and threatening to damp their exports.

Somewhat less attention was paid to an earlier trend of unconventional exchange rate policies, mainly in emerging market economies. Led by emerging market economies in Asia, a number of countries purchased unprecedented volumes of foreign exchange reserves and others set up sovereign wealth funds (SWFs) that also sent official capital flows into the major advanced economies.

Our paper explores the effects of unconventional monetary and exchange rate policies, focusing mainly on the current accounts of the countries engaged in these policies as well as the spillovers to current accounts in other countries. We build on the cross-country annual regressions of Bayoumi, Gagnon, and Saborowski (2015), which in turn builds on the seminal work of Chinn and Prasad (2003) and many others.

We proxy unconventional exchange rate policies with net official financial flows, which are dominated by purchases of foreign exchange reserves and SWF assets. An important contribution of this paper is to improve the set of instruments to control for endogeneity of net official flows to exchange rate pressures. We find that net official flows have a large and robust positive effect on a country’s current account when capital mobility is low and a moderate effect when capital mobility is high. We also find a large effect of fiscal policy on the current account when capital mobility is high, a new result in this literature.

We proxy unconventional monetary policies with central bank acquisitions of domestic assets. For the major advanced economies, this proxy corresponds well with the unconventional policy known as quantitative easing (QE). Interestingly, our dataset includes other episodes of significant increases and decreases in central bank domestic assets, including in developing economies. To the extent that these episodes reflect central banks taking risk onto their balance sheet and off of private balance sheets, they should be counted as QE even if

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the specific types of assets differ from those in the recent cases of quantitative easing in major advanced economies. We find that QE has a small but significant effect on a country's current account balance when capital mobility is low, but this effect declines to near zero when capital mobility is high.

We find that the spillovers of these unconventional policies show up in current account balances of all other countries, with relatively more of the effects showing up in countries that are more integrated with global financial markets.

Because unconventional policies in the major advanced economies are a recent phenomenon with few observations in the data, and because quantitative easing is only a subset of unconventional monetary policy, we also explore the effects of unconventional policy announcements in the United States on foreign financial prices using daily data. We find that there are strong spillovers of US bond yields to foreign financial prices consistent with the view that good news about future US economic activity is good news for other countries. However, when we focus on changes in US bond yields associated with revisions to monetary policy, the spillovers are much smaller. Smaller spillovers of pure monetary shocks presumably reflect the absence of good news about US economic activity, and thus higher bond yields on these days are not good news for foreign economies. We note, in particular, that monetary shocks have only a small effect on foreign currencies, which is the main channel by which unconventional policy in the United States could reduce current account balances abroad.

Finally, we develop a stylized macroeconomic model with imperfect asset substitution with which we can assess the empirical results. The model confirms the finding that net official flows have a larger and more consistent effect on the current account than quantitative easing. Imperfect asset substitution creates additional tools that central banks can use to offset unwanted influences from foreign shocks and policies. In addition to their conventional interest rate tool, they can use net official flows and quantitative easing to achieve objectives for the exchange rate, current account, or bond yields.

2. Current Account Effects of Foreign Exchange Intervention and Quantitative Easing in Annual Panel Data

This section extends the analysis in Bayoumi, Gagnon and Saborowski (2015) in three ways. First, we use a new set of instruments to identify exogenous variation in net official flows (NOF), which includes official intervention in foreign exchange markets. Our results confirm the important effect of official flows on the current account, including the interaction of this effect with capital mobility. Second, we explore the impact of quantitative easing (QE) on current accounts, which is one potential channel for such policies to affect other countries. Finally, we address the question how policies in each country affect the current accounts of other countries.

A. Empirical Specification

We run our regressions on a sample period of up to 30 years, from 1985 through 2014. The regressions use up to 2088 observations for 141 countries, including low-income economies. The coefficient standard errors in all regressions, including those using instruments, are robust to heteroskedastic and first-order autoregressive errors. Further information on the data can be found in the Appendix. Equations 2.1 and 2.2 present our baseline specifications.

$$\frac{CAX_{it}}{GDP_{it}} = \alpha_1(NOF_{it}/GDP_{it}) + \alpha_2(NOF_{it} \times MOB_{it-1}/GDP_{it}) + \beta_1(NOA_{it-1}/GDP_{it-1}) + \beta_2(NOA_{it-1} \times MOB_{it-1}/GDP_{it-1}) + \gamma_1 AUX_{it} + \gamma_2 AUX_{it} \times MOB_{it-1} + \gamma_3 QE_{it-1} + \gamma_4 QE_{it-1} \times MOB_{it-1} + \gamma_5 SPILL_{it} + \gamma_6 year_t + u_{it} \quad (2.1)$$

$$\frac{NPFX_{it}}{GDP_{it}} = (\alpha_1 - 1)(NOF_{it}/GDP_{it}) + \alpha_2(NOF_{it} \times MOB_{it-1}/GDP_{it}) + \beta_1(NOA_{it-1}/GDP_{it-1}) + \beta_2(NOA_{it-1} \times MOB_{it-1}/GDP_{it-1}) + \gamma_1 AUX_{it} + \gamma_2(AUX_{it} \times MOB_{it-1}) + \gamma_3 QE_{it-1} + \gamma_4 QE_{it-1} \times MOB_{it-1} + \gamma_5 SPILL_{it} + \gamma_6 year_t + v_{it} \quad (2.2)$$

CAX and NPFX are the current account and net private flows, each excluding net investment income to remove the influence of steady-state differences in stocks of net foreign assets.[2] NOF is net official flows, NOA is the stock of net official assets and MOB is the Aizenman, Chinn and Ito (2015) measure of capital mobility, normalized to [0,1], for which a higher value indicates fewer restrictions on private capital flows.[3] We define NOF as the acquisition and disposition of assets and liabilities denominated in foreign currencies by public-sector institutions in the reporting country.[4] NOF×MOB and NOA×MOB are interaction terms. The auxiliary variables (AUX) include MOB, lagged PPP GDP per capita relative to the United States, the 10-year forward change in old-age dependency ratio, the lagged real GDP growth rate over the previous 5 years, net energy exports relative to GDP, and the cyclically adjusted fiscal balance relative to GDP.[5]

Equation 2.1 presents the current account as a function of net official flows and several control variables. The coefficient α_1 represents the effect of net official flows on the current account and the coefficient α_2 allows for a differential effect depending on the level of capital mobility. The coefficient β_1 represents the effect of lagged net official asset stocks on the current account while the coefficient β_2 allows for a differential effect with higher capital mobility.

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[2] See Bayoumi, Gagnon and Saborowski (2015) for a detailed discussion.

[3] MOB is lagged in all regressions, including in interaction terms, even when the interacted variable is not lagged.

[4] The dominant form of official flows is purchases of foreign exchange reserves. However, public-sector borrowing in foreign currency counts as a negative official flow. Foreign asset purchases by sovereign wealth funds (SWFs) also count as official financial flows. We exclude countries with significant SWFs for which data do not allow the construction of comprehensive official flows.

[5] The adjusted fiscal balance is the residual from a regression of the fiscal balance on the level and growth rate of the output gap.

Equation 2.2 is a restatement of the link between official flows and the current account in Equation 2.1 that takes advantage of the BOP identity: any effect of net official flows on the current account that is less than 1 must show up as a negative effect on net private flows. When net official flows have no effect on the current account (α_1=0) then they must cause a one-for-one reduction of net private flows. Because of errors and omissions in the BOP data, these regressions are not identical. The bias from measurement error in net official flows in the estimate of α_1 is downward in Equation 2.1 and upward in Equation 2.2, helping to put a range on its true value, and taking the average of the results is a convenient way to reduce measurement error.

The specifications in Equations 2.1 and 2.2 further include interactions between all our auxiliary variables and the MOB term. We include the additional interaction terms because there are good reasons to believe that the effect of some of the auxiliary variables could vary with capital mobility (e.g., the fiscal balance). Finally, we include our measure of quantitative easing (QE) and SPILL, a measure of spillovers of aggregate global net official outflows on countries' current accounts.

A key empirical issue is the potential endogeneity of official flows to shocks to current account balances and net private flows. Endogenous movements are most likely to arise from attempts to stabilize the exchange rate in the face of trade or financial market shocks. On the other hand, examples of exogenous movements in official flows include increasing holdings of foreign assets for precautionary reasons, saving resource revenues for future generations, borrowing for economic development, and achieving economic growth through higher net exports. Gagnon (2012, 2013) shows that endogeneity through stabilization of the exchange rate leads to a positive bias of the coefficient on net official flows if current account shocks dominate and a negative bias if private financial shocks dominate.

We use instrumental variables to address the potential endogeneity of net official flows to shocks to current account balances and net private flows. The challenge is to isolate the variation in net official flows that is not driven by shocks that simultaneously drive the current account and/or private financial flows. Valid instruments must reflect exogenous motives for reserve accumulation.

A key difference between this paper and Bayoumi, Gagnon, and Saborowski (2015) is the choice of instruments. In this paper, we use two instruments that we believe improve upon those chosen in the previous paper.[6] The first is the incidence of a financial or currency crisis in the previous three years; the second is the portion of net official flows that is not related to reserve asset flows. The idea behind the former is that it would capture a higher propensity to build up reserves for precautionary reasons following a crisis episode. The latter would capture SWF related asset flows as well as development loans. We would expect both SWF flows and development loans to reflect longer-term savings and investment motives and, conditional on

[6] The set of instruments also includes their interaction with the capital mobility measure since the net official flows and its interaction with capital mobility need to be instrumented.

the control variables in the second stage, generally not to respond systematically to exchange rate shocks.[7]

In principle, we would like to analyze the impact of all unconventional monetary policies on current accounts. However, unconventional policies include a range of actions, such as guidance over future interest rates, lending to distressed banks and firms, purchases of long-term bonds and other assets, and negative policy interest rates. For tractability, we limit our analysis to quantitative easing (QE), defined as an increase in central bank domestic assets. This definition measures the extent to which the central bank expands its balance sheet to take risk off the balance sheets of domestic market participants, thus potentially easing financing conditions. Indeed, the measure looks broadly as expected in known QE cases (Figure 2.1). Interestingly, in other countries, large variations in central bank domestic assets often occur during or after financial crises, consistent with the theory of how QE works.

The effect of quantitative easing on the current account could be either positive or negative, since a monetary expansion would be expected to both boost domestic absorption and depreciate the exchange rate. The former increases imports whereas the latter restrains imports and boosts exports.

Importantly, there is a potential source of endogeneity bias when analyzing the impact of quantitative easing on current accounts. The coefficient on the QE term could be biased down if countries used monetary expansions to combat growth declines associated with declining current accounts. On the other hand, there may be a positive bias from omitted variables if a (negative) shock to domestic demand caused an expansion of QE at the same time that imports declined and caused the current account to increase. In order to attenuate these biases, we cyclically adjust the QE variable and use the lagged value in the regression.[8]

Finally, we ask how net official flows would impact the current accounts of other countries.[9] In principle, any effect of quantitative easing or net official flows on the current account of the country purchasing the net official assets must have an equal and opposite effect on current accounts in the rest of the world. The magnitude and allocation of the spillovers are one focus of this section. The inclusion of a complete set of time effects in our regressions controls for spillovers of each country's policies on the assumption that they are distributed equally to all countries as shares of GDP. However, the framework allows testing alternative assumptions about spillovers. In particular, we test whether spillovers are related to (1) financial integration, (2) capital mobility, (3) financial development, (4) reserve currency

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[7] Changes in energy prices alter revenues to be allocated to SWFs in some countries, but we control for this effect on the right hand side through the net energy exports term. Our results, explored further in Section 2E, show that net energy exports are strongly correlated with the current account only in countries that actively save energy revenues abroad.

[8] The adjusted QE variable is the residual from a regression of the change in central bank domestic assets on the level and change of the output gap, the change in nominal GDP, and NOF.

[9] The effect of QE on a country's current account appears to be too small to find meaningful spillover effects on other countries' current accounts in our regression framework.

shares from the IMF's COFER database, (5) economic size, or (6) a country's stage of economic development. To conduct these tests, we calculate six spillover terms that allocate aggregate global net official flows divided by world GDP to countries based on each relevant hypothesis. We then compare the improvement of fit associated with each of these terms to understand which of the hypotheses is most closely reflected in the data.

In practice, only one of these terms has a statistically significant coefficient. The SPILL term we used in our final regressions is calculated as a measure of financial integration multiplied by aggregate global net official flows divided by world GDP. Financial integration is measured as the share of gross private financial transactions in total current and financial transactions in the balance of payments. The motivation for this variable is that NOF from current account surplus countries tend to go to countries that are more financially integrated, who then run current account deficits.

B. Baseline Regression Results

This section describes the results when estimating equations 2.1 and 2.2 using two-stage least squares. Note that we add 1 to the estimated coefficients on the net official flows term in the tables for all regressions in which net private financial flows (NPFX) is the dependent variable. As illustrated in equation 2.2, adding one to the coefficient gives us an estimate of α_1, the coefficient on the net official flows term in the regression in which the current account is the dependent variable.

Columns 1 and 2 in tables 2.1a and 2.1b illustrate the results from estimating equations 2.1 and 2.2 in the absence of the interaction terms with auxiliary variables, QE, and SPILL. Column 1 is based on a regression of the current account excluding investment income (equation 1) and column 2 is based on a regression of net private flows (equation 2). In essence, columns 1 and 2 are equivalent to the model in Bayoumi, Gagnon and Saborowski (2015). However, in this paper we use a new set of instruments, an updated and expanded dataset, and allow for a full interaction between net official flows and the capital mobility index instead of an interaction with a [0-1] dummy. Moreover, the sample is 2.6 times bigger (including four more years and many low-income countries) than before and we no longer use GDP-weighted regression.

The first stage results are encouraging in that our instruments appear relevant. In each regression, one of the two nonreserves flow instruments is significant. The two crisis instruments are sometimes individually and always jointly significant. The instruments show the expected positive signs in the first stage regression, and the F-test statistic takes values significantly larger than 10; the null hypothesis that our instruments are irrelevant is thus comfortably rejected. Similarly, the Angrist-Pischke first stage chi-squared statistic rejects the null that the net official flows term is unidentified. At the same time, the first-stage R^2s lie around 0.6 and thus do not signal overfitting.

Moving to the second stage estimation results, we observe that the results for net official flows and assets are remarkably similar to those in Bayoumi, Gagnon and Saborowski (2015) (columns 1 and 2 of table 2a in that paper). The coefficients on the auxiliary variables do not differ much from the previous paper except that relative GDP now carries the expected negative coefficient. The estimated effect of net official flows on the current account when capital mobility is lowest (α_1) is 0.7 in column 1 and 0.8 in column 2. The overall effect of net official flows when mobility is highest is the sum of α_1 and α_2, or 0.06 in column 1 and 0.52 in column 2. The effect of net official asset stocks on the current account is somewhat smaller than what was found in the previous paper: it is close to zero under low mobility and rises to around 3 percent under high mobility.

Columns 3 and 4 of table 1 add interaction terms between all control variables and capital mobility (MOB). The coefficients on net official flows (NOF) and lagged net official assets (NOA) are broadly unaffected by the inclusion of the additional regressors. Many of the auxiliary variables seem to be importantly conditioned by capital mobility, and usually in a sensible way. For example, trend growth and the fiscal balance variable have a larger effect when capital is more mobile while net energy exports have a larger effect when private capital is less mobile (perhaps reflecting government control of oil export revenues). The coefficient of 0.6 on the fiscal balance when capital is highly mobile is an important finding since previous studies often struggled to explain coefficients that seemed low compared to theoretical predictions.

The final two columns present our full baseline specification. Compared to columns 3 and 4, we now add our measure of quantitative easing, the interaction of this variable and capital mobility, and the spillover term. The coefficients on NOF and NOA once again do not change much.

The results illustrate that the QE variable is significant with a positive coefficient of around 0.25. Its interaction with capital mobility shows a negative coefficient of about the same magnitude that is marginally significant. This suggests that quantitative easing has a small but significant effect on the current account when capital mobility is low but an effect close to zero as capital mobility approaches its upper bound. The finding is in line with a casual glance at current account movements in known episodes of quantitative easing in advanced economies (Figure 2.2) in which current accounts did not show a systematic tendency to rise following quantitative easing. The finding that QE has a larger effect when capital is less mobile is somewhat surprising. Below, we further examine this result, looking both at robustness checks and the underlying story for influential observations.

Finally, the median value of our financial integration measure is 0.1, so a coefficient of about -20 on SPILL implies that moving from the median to twice the median value of financial integration lowers a country's current account by twice the value of world NOF divided by world GDP, or around 2 percent of GDP.[10]

[10] In 2013, the ratio of world NOF to world GDP was about 1 percent. Note also that around 90 percent of observations of the financial integration measure take values less than twice the median value.

C. Robustness Checks

Table 2.2 presents a number of robustness checks for our results. For brevity, the table omits the coefficient estimates for auxiliary variables. It shows average coefficients and standard errors between the current account and net private flow regressions.[11] The first column is the baseline result, which is the average of the last two columns in Table 2.1.

The second column is the OLS version of this regression. All coefficients are similar to those in the first column. The bias in the NOF coefficients can go in either direction when NOF is responding endogenously to exchange rate pressures depending on whether the pressures arise from trade or financial shocks. These results suggest that shocks in both directions are roughly equally important, with biases that cancel out.

The third column replaces the instruments with a full set of country dummies after dropping a few countries that had less than 5 observations with available data. To the extent that current account shocks are more persistent than financial shocks, the country dummies may not fully control for endogeneity from current account shocks, giving rise to an upward bias on the NOF coefficient. Following this reasoning, one would expect the estimated effect of net official flows on the current account to be larger. We indeed find that this set of instruments somewhat increases the NOF coefficient. However, it also increases the magnitude of the coefficient on the interaction term, with the average effect only slightly larger for high values of MOB.

The fourth column is a regression weighted by each country's share of world nominal GDP (so the weights sum to 1 in a given year). This regression is particularly informative about the impact of recent quantitative easing by major central banks, given that the euro area, Japan, the United Kingdom, and the United States account for more than half of global GDP. The results are broadly unchanged. In particular, the coefficient on our measure of QE and its interaction with capital mobility are very similar to the baseline case and imply little or no impact of QE on the current account when capital is highly mobile, as is the case for the major economies.[12] The only major change in this regression is that the spillover effect is no longer significant. This result may suggest that our spillover term does not well explain spillovers of global net official flows to the United States and some other major economies.[13]

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[11] Using average standard errors is valid on the assumption of perfect correlation between the two coefficients. To the extent that coefficients are less than perfectly correlated, the true standard error would be smaller. Thus, our significance levels are conservative.

[12] The coefficient on the QE interaction with MOB is not significant in either the baseline or weighted regressions. However, dropping this term from the regressions yielded a much smaller (0.07-0.10) and insignificant coefficient on QE.

[13] We find weak evidence for an extra spillover of net official flows to the US current account. An additional spillover term that equals global NOF divided by global GDP for the United States and zero for all other countries has a moderately sized negative coefficient that is not quite significant at the ten percent level.

The fifth column is based on a robust regression that aims to reduce the influence of outliers in the data. These regressions use fitted values of the instrumented variables from separate first-stage regressions. The net official flow coefficients are, however, not much affected, although the QE and spillover coefficients are somewhat smaller and less significant.

The sixth and seventh columns explore the importance of the exchange rate regime.[14] As discussed above, the QE coefficient could be subject to a negative bias if policymakers have more freedom to use monetary policy during a downturn or in response to exchange rate movements. If this source of bias were important, we would expect the coefficient on QE to be smaller for flexible exchange rate regimes than for fixed ones. Columns 6 and 7 test this assertion. Interestingly, however, we find that the coefficient is, if anything, larger in the case of flexible exchange rate regimes.

The eighth and ninth columns explore the importance of trade openness for the coefficient on the QE term. Countries with high trade openness are subject to more frequent and larger terms of trade shocks than closed economies. To the extent that countries respond to negative terms of trade shocks by expanding monetary policy, the coefficient on the QE term may be biased down. We may thus expect that more open economies should see a lower QE coefficient to the extent that this source of bias is important. However, this assertion is not supported by the results presented in columns 8 and 9. Rather, it appears that quantitative easing has a larger effect on the current account in countries that are more open to trade. This effect disappears with high capital mobility.

In regressions not shown in table 2.2, we tried alternative measures of quantitative easing: the current unadjusted and cyclically adjusted changes in central bank domestic assets and the lagged or current changes in the cyclically adjusted monetary base.[15] All had smaller (and often slightly negative) coefficients than those in the baseline regressions. We also tested for a positive bias from omitted effects of financial crises, which would depress domestic spending and increase the current account at the same time that the central bank might engage in quantitative easing. Adding a dummy variable for a current financial crisis had little effect on the QE (or any other) coefficient.

D. Influential Observation Analysis

In this section, we focus on specific observations that are influential in identifying the effects of key variables on the current account. The goal is to provide a qualitative assessment of the validity of the underlying theory of how these variables may affect the current account. In particular, we wish to assure ourselves that coefficient estimates do not reflect spurious factors or coincidences unrelated to the underlying theory. The analysis also sheds light on the instruments for net official flows as measures of exogenous influences on the current account.

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[14] We use the Aizenman, Chinn, and Ito (2015) rolling measure of exchange rate volatility, but the results are robust to using the IMF's de facto exchange rate regime classification and the Reinhart-Rogoff classification.

[15] One reason we did not focus on the monetary base as a measure of QE is that it was correlated with net official flows in countries in which foreign assets are an important tool of monetary policy.

We identify influential observations using the “dfbeta” command in Stata, which provides an estimate of the marginal effect of a given observation on a chosen coefficient. The most influential observations are those with the largest marginal effects on (and the same sign as) the estimated coefficient. However, as shown in the robust regression and GDP-weighted regression in table 2.2, most coefficients are not sensitive to data outliers.

NOF coefficient (and associated instruments)

Three of the four most influential observations for the NOF coefficient are Azerbaijan 2008, 2010, and 2011.[16] According to the IMF’s coarse index of exchange rate arrangements, Azerbaijan has a managed exchange rate. It also has a relatively closed capital account. Azerbaijan had rapid growth in net energy exports over the past decade. The government set up a SWF, the State Oil Fund of the Republic of Azerbaijan, in 2001 during the development stage of major new oil fields. As shown in figure 2.3, the SWF began major financial outflows in 2008 shortly after oil revenues began to grow, which contributed to a notable increase in the current account balance.

Although both reserves and SWF flows appear to have contributed importantly to the current account surplus, they are only weakly correlated. This supports our view that the purposes of these flows are distinct. While SWF flows react to oil revenues and saving-investment objectives, reserves flows are used to manage exchange rate objectives. This is why we exclude reserves flows from our instrument for NOF.

Azerbaijan’s current account is also highly correlated with its net energy exports. It is interesting, in this context, to consider the example of a country with a similar energy export pattern that did not take the decision to save much of the revenues through a SWF. Figure 2.4 displays the current account and financial flows of Nigeria, a country without a SWF during this period.[17] Nigeria’s nonreserves flows are dominated by the repayment of official loans in 2005 and 2006. The Nigerian current account reflects influences of all of these factors. Note, in particular, that the current account declined after 2006 despite a large increase in net energy exports. This comparison supports our regressions, which show that NOF is a more important determinant of the current account than net energy exports.

The second most influential observation is Republic of Congo 1994. Figure 2.5 shows that nonreserves flows had a noticeable, though not dominant, effect on Congo’s current account in the 1990s. These flows are mainly official development loans. Congo has a fixed

[16] An observation that would be highly influential if we had not dropped it from the regression is Kuwait 1991, immediately after the Gulf War. Kuwait drew down its SWF assets by nearly $40 billion in 1991 (174 percent of trend GDP) to rebuild the country. These official flows clearly were exogenous to any exchange rate pressures. They depressed the current account by a comparable magnitude. This observation was dropped from our regressions because the difference in scale from other observations would have raised the issue of potential nonlinear effects that would be difficult to address in our regression model.

[17] Similar to Azerbaijan, Nigeria has a tightly managed exchange rate and a low level of capital mobility.

exchange rate as part of the CFA franc zone and low capital mobility. The loans have little effect on the nominal exchange rate, but they may affect the real exchange rate to the extent that domestic spending boosts domestic prices. What is more, there is an additional channel to the extent that the government spent the loan proceeds directly on imported materials for development projects. Direct government purchases of imports are similar to a shift in preferences towards imports, which would lower the current account. Given Congo's exchange rate regime (which is effectively managed by the French finance ministry), it is clear that the nonreserves flows are not responding endogenously to exchange rate pressures.

QE coefficient

The 4 most important observations (in the positive direction) for the QE coefficient are Malaysia 2008, Angola 2001, Thailand 1998 and 1999. The variable is lagged, so it refers to 1 year before each of those dates. In Malaysia, there was a large increase in central bank lending to domestic banks, who in turn bought a lot of foreign assets. Examination of the details of these transactions reveals that they were driven by central bank loans in domestic rather than foreign currency. The central bank of Malaysia was injecting large amounts of liquidity into its financial system as global financial conditions were tightening in 2007.

In Angola, the central bank sold off domestic assets to buy foreign assets. The positive QE coefficient means this tended to lower the current account, but nonreserves flows picked up (some of the assets bought by the central bank were not foreign exchange reserves) so the fitted value of net official flows went up, helping to explain an increase in the current account despite the decline in central bank domestic assets (QE). In 2000 the Angolan central bank engaged in quasi-fiscal spending and experienced an operational deficit in the context of rapid changes in the financial system. (The currency was floated in 1999 and two new banks started up.)

In Thailand, both years reflect central bank lending to domestic banks in the Asian crisis. This support was important in allowing banks to weather the sudden stop in foreign inflows. The central bank engaged in a quantitative monetary program to ease the effects of changes in the velocity of money. By itself, this policy should not have increased the current account, but it may be a case of bias caused by the same unobserved factor (financial crisis) that both reduced domestic absorption (raising the current account) and caused the central bank to intermediate. However, if the alternative to such easing is fiscal intervention, then there is a case that the quantitative monetary program raised the current account relative to the alternative because it depreciated the exchange rate more.

E. Fiscal Balances, Net Official Flows, and Energy Exporters

Energy exporting countries comprise an important element of global current account imbalances. A potential question is whether there is a direct effect of energy exports on the nonreserves component of official flows. If nonreserves flows always move with net energy exports, and if energy exports, in turn, have a large effect on the current account, then nonreserves flows may not be a valid instrument because they are endogenous to the current account.[18] In this section, we show that there is little direct effect of energy exports on either nonreserves flows or the current account. As a matter of policy, some countries decide to save a large share of energy revenues and others do not. The current account follows net official flows and the fiscal balance, not net energy exports.

Figure 2.6 displays countries in which governments decide to save a large share of net energy exports abroad through net official flows. In two of these countries, Norway and Saudi Arabia, the fiscal balance is almost identical to NOF. In Norway and Saudi Arabia, the current account moves closely with NOF and the fiscal balance, consistent with the sum of the NOF and fiscal coefficients being around 0.8 with high capital mobility and around 0.9 with low mobility.[19] In Algeria, which has the lowest capital mobility of these countries, the fiscal balance is noticeably lower than NOF and the current account is closer to NOF than to the fiscal balance, consistent with the larger coefficient on NOF than on fiscal balance when capital mobility is low. The top four rows of table 2.3 show that NOF, the fiscal balance, and net energy exports (all as shares of GDP) are highly correlated with each other in these countries.

Figure 2.7 displays countries in which governments do not save a large share of net energy exports. These countries have intermediate capital mobility.[20] Table 2.3 shows that the correlation between net energy exports and NOF is low or negative in these countries. The correlation between net energy exports and the current account is negative in all three countries. Nevertheless, the correlations between NOF and the current account are substantially positive. Interestingly, the correlations between the fiscal balance and the current account are highest in the countries with higher capital mobility (Indonesia and Mongolia) and lowest in the country with lower capital mobility (Colombia).

On balance, it appears that there is no direct connection between net energy exports and the current account. The strongest connections are between NOF and the current account (when mobility is low) and between the fiscal balance and the current account (when mobility is high). In other words, the government's choice in using net energy revenues is what matters, not the energy revenues themselves.

3. Financial Market Effects of US Unconventional Monetary Policy in Daily Data

In the previous section, we find that QE, measured by the increase in central bank domestic assets, has a small but significant effect on the current account when capital is less mobile and an effect close to zero when capital is highly mobile. In this section, we use high frequency (daily) data to explore further the spillovers of QE and other unconventional monetary policies

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[18] Note that our regressions control for the impact of net energy exports on the current account. Hence, to the extent that nonreserves flows and energy exports are not perfectly correlated, nonreserves flows are a valid instrument even if energy exports are correlated with both nonreserves flows and the current account.

[19] On a scale of 0 to 1, with 1 representing highest mobility, in 2010 Algeria's mobility index was 0.16, Saudi Arabia's was 0.70, and Norway's and Yemen's were 1.00.

[20] In 2010, Indonesia and Mongolia had mobility indexes of 0.7, while Colombia had a mobility index of 0.4.

(UMPs) across markets.[21] Because GDP and the current account are not observed at daily frequency, we explore the effects on international (non-US) financial asset prices, and, in section 4, we use a theoretical model to link financial and real effects of unconventional monetary policy. We focus on the cross-border effects of UMP in the United States, as the United States is the largest economy in the world and its financial markets have an outsized effect on other countries (Bayoumi and Bui 2010 and Bowman, Londono, and Sapriza 2015). Also, the United States was the first country to implement unconventional monetary policies in the context of the Global Financial Crisis.

In the first part of this section, we estimate the effect of daily changes in US long-term (10 years) Treasury bond yields on changes in the prices of financial assets of 40 emerging and advanced economies. The regressions cover the period of November 2008 to July 2015, in which the US Federal Open Market Committee (FOMC) was forced to turn to unconventional policies after its conventional policy instrument reached the zero lower bound. Research has shown that UMP, especially in the United States, primarily operates through yields on long-term bonds (Gagnon, Raskin, Remache, and Sack 2011, and Rogers, Scotti, and Wright 2013). Because FOMC use of UMP is a recent development, daily data provide more observations for analysis than those available in the annual regressions in section 2.

In the second part of the section, we bring closer the results from the daily regressions to the annual regression results, in section 2, by exploring the economic determinants of the cross-country variation in the effects of US unconventional monetary policy. In particular, we use a panel-data setting to understand whether each country's financial development, capital mobility, sovereign risk, trade linkages with the United States, and exchange rate regime explain the cross-country variation in the basic results. One result that supports the findings of our annual regressions is that the effect of US monetary policy shocks on the US current account is likely to be small because US monetary shocks have only a small effect on exchange rates.

A. Daily Co-Movements, Empirical Specification and Results

Tables 3.1 to 3.3 show the estimated coefficients from individual-country regressions of the daily change in international asset prices on the daily change in the yield of 10-year Treasury bonds. The non-US asset prices, in vector ***X***, are (1) the 10-year sovereign local-currency bond yield, (2) the log of the stock market price index, and (3) the log of the exchange rate (in dollars per unit of non US currency). The benchmark regression setting for country *i* is the following:

$$\Delta X_{i,t} = \alpha_i + (\beta_{1,i} + \beta_{2,i} D_{US,t}) \Delta Y_t^{US} + u_{i,t} , \tag{3.1}$$

[21] In the previous section, we were limited to examining the effects of QE owing to the lack of a good measure of overall UMPs across countries and over time. In this section, our regressions pick up the joint effect of all monetary policy actions. Because conventional monetary policy, embodied in the short-term interest rate, was pinned at the zero lower bound throughout our sample, we infer that our results reflect the effects of UMPs, including, but not limited to, QE.

where Y_t^{US} is the yield of 10-year US Treasury bonds and $\mathrm{D}_{\mathrm{US,t}}$ is a dummy that takes the value 0 on most days and 1 on days on which the FOMC released either a policy statement or policy minutes or there was a monetary policy speech by the FOMC chair. In separate regressions, D takes the value 1 on days on which data were released on US nonfarm payrolls or the ISM purchasing managers' index, and 0 otherwise.[22] Thus, the β_1 coefficient in Equation 3.1 measures the average effect of US yields on asset prices on days outside FOMC or economic data events, while the β_2 coefficient reflects the additional response on these special days.

To interpret these coefficients we note that on days not associated with news about monetary policy, bond yields tend to rise when there is good news about future US economic activity.[23] To be sure, part of the reason for the rise in yields is that market participants expect that faster growth in the US economy will lead the FOMC to tighten policy more than otherwise. But the news element is one of stronger growth and not a change in the FOMC's policy reaction function. The coefficient β_1 captures the effect of these good news shocks on the rest of the world. On days with an FOMC announcement or FOMC Chair speech, bond yields rise or fall because market participants expect monetary policy to be tighter or looser for a given path of the economy. The sum of the coefficients, $\beta_1 + \beta_2(FOMC)$, captures the effect of these monetary shocks on the rest of the world. In reality, there is news about economic prospects, including economic data releases, on FOMC days, so that β_1+ $\beta_2(FOMC)$ blends the effects of economic news and monetary policy news. But the sign of the $\beta_2(FOMC)$ coefficient tells us in which direction the effects of a pure monetary shock lie relative to the effects on non-FOMC days.

The evidence in table 3.1 shows that sovereign yields of almost all advanced economies and of many emerging markets move positively with US sovereign yields—the estimated β_1 coefficient is positive and significant. However, yields of a few emerging markets, in which default risk is important, are significantly negatively correlated with US yields (significant for Hungary, Russia, and Greece). In these cases, good news about the US economy appears to lower the risk premiums in their sovereign yields. Interestingly, the additional effect of changes in US Treasury yields on FOMC days, $\beta_2(FOMC)$, usually has the opposite sign as β_1. That is, in most cases, the positive average correlation between non-US yields and US yields is reduced but not eliminated on FOMC days—the estimated β_1+$\beta_2(FOMC)$ is closer to zero than the estimated β_1 but remains significant at the same confidence levels for most countries. For countries with an average negative estimated correlation with US Treasury yields, the general negative correlation is reduced or even reversed on FOMC days and becomes not significant at any standard confidence level for all countries. Of note, there are interesting variations in the responses of yields in the euro area. In particular, the average response of yields for peripheral euro-area countries is considerably smaller—in some cases not significant—than that of core

[22] Bartolini, Goldberg, and Sacarny (2008) find that these two economic announcements have the biggest impact on asset prices.

[23] Another possibility, common in past years but not during this sample, is that higher bond yields reflect worries about higher inflation and the need for tighter monetary policy to fight inflation.

euro-area countries, while the additional responses on FOMC announcement days, $\beta_2(FOMC)$, for peripheral countries are smaller and often positive. Tighter US monetary policy appears to increase sovereign risk premiums in these peripheral countries. Overall, our evidence suggests that spillover effects on non-US yields tend to be smaller around monetary policy announcement days, presumably because these changes in US yields are not associated with any boost to demand in foreign economies that would call for higher yields overseas. In contrast, the additional effect of changes in US yields on US economic data release days, $\beta_2(Econ.)$, although significant for a small number of countries, is generally positive, implying greater co-movement of yields when the underlying news concerns prospects for the US economy.[24]

The results for stock prices (table 3.2) are notably uniform across countries. Specifically, stock prices in all countries except Pakistan move positively and significantly with US bond yields. Hence, good news about the US economy boosts international stock prices. The additional effect on FOMC announcement days on non-US stock prices is almost always negative and significant at the 10 percent confidence level for 16 countries. Thus, as for yields, the spillover effects on stock prices are reduced around monetary policy announcement days. For the vast majority of the economies in our sample, the negative additional effect on FOMC announcement days implies a smaller but still positive correlation between changes in non-US stock prices and changes in US Treasury yields. The total effect on FOMC announcement days, β_1+$\beta_2(FOMC)$, remains significant at for 24 countries. Much of this remaining positive effect on FOMC days may reflect the impact of economic news on FOMC days that we are not able to remove from our data. The additional effect of changes in US yields on specific US economic data release days is modestly positive but rarely significant and implies no considerable changes in the total effect on economic data release days.

The results for exchange rates (table 3.3) show that most currencies depreciate with respect to the US dollar when US sovereign bond yields rise. Although the effect of changes in US sovereign bond yields on exchange rates against the US dollar is significant for most currencies, the economic magnitude of the estimated effect is fairly small: a one percentage point increase in US bond yields (which is much larger than a typical daily move) causes a one to three percent depreciation in most currencies against the dollar (which is close to the size of a typical daily move). Not surprisingly, the effect of changes in US bond yields is smaller for currencies pegged to the US dollar, such as the Hong Kong dollar and the Chinese renminbi, and it seems to be positive for traditional funding or safe-haven currencies, such as the Swiss Franc and the Japanese Yen.[25] The additional effects of changes in US yields on US FOMC and economic data days are small and rarely significant, but they do reduce the magnitude and significance of the total effect on FOMC and economic data days.

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[24] To prevent identification problems, we use FOMC and economic data dummies in separate regressions. In addition, for all assets and all countries, the β_1 coefficient shown in Table 3.1 to 3.3 is that from a restricted regression setting with no dummy ($\beta_2 = 0$). The estimated β_1 coefficient is virtually unchanged in the specifications with dummies.

[25] Londono and Zhou (2015) highlight the common component in currency appreciation rates and the relatively low average correlation between the Japanese Yen and the Hong Kong dollar with several other currencies.

In unreported results, we assess the persistence of the spillover effects by adding lags to the right-hand-side variables in equation 3.1. Our results show that spillover effects for non-US sovereign yields on regular days, FOMC days, and economic data days are persistent, which suggests that sovereign bonds in most countries tend to co-move with US Treasury yields but less so after monetary policy announcements. Spillover effects for stock prices are also persistent; that is, stock prices tend to co-move (positively) with US Treasury yields but the effect is also reduced around monetary policy announcement days, and the overall effect on FOMC announcement days remains positive and significant for almost half the countries in our sample. For exchange rates, adding lags to the effect of FOMC announcements implies a larger (positive) additional effect on these announcement days. Although the total effect of US yields on exchange rates around FOMC announcement days is still fairly small, it becomes positive for some countries; that is, some currencies appreciate following an increase in US sovereign bond yields on FOMC days. This last result supports the finding that effects of US unconventional monetary policy on exchange rates are small, and thus effects on the US current account are also likely to be small.

B. Relating Financial Spillovers to Country Characteristics

In this section, we explore the economic determinants of the cross-country variation in the spillover effects of US QE. Specifically, in table 3.4, we show the results for the following panel-data regressions:

$$\Delta \mathrm{X}_{\mathrm{i,t}} = \alpha_{\mathrm{i}} + (\beta_{1,1} + \beta_{1,2} * \mathrm{C}_{\mathrm{i}})\ \Delta Y_t^{US} + \mathrm{u}_{\mathrm{it}}, \tag{3.2}$$

$$\Delta \mathrm{X}_{\mathrm{i,t}} = \alpha_{\mathrm{i}} + (\beta_{1,\mathrm{i}} + (\beta_{2,1} + \beta_{2,2} * \mathrm{C}_{\mathrm{i}})\mathrm{D}_{\mathrm{US,t}})\ \Delta Y_t^{US} + \mathrm{u}_{\mathrm{it}}, \tag{3.3}$$

where C_i are country-specific variables, each considered in a separate regression to avoid potential collinearity (Hausman and Wongswan 2011, and Bowman, Londono, and Sapriza 2015). We consider variables that characterize each country's degree of capital mobility, development of the financial system, their exchange rate regime, and sovereign risk as well as trade integration with the US.[26] In particular, we use the same measure of capital mobility, MOB, that is used in section 2. We use the ratio of bank assets to GDP to characterize the degree of financial development, the volatility of the exchange rate with respect to the US dollar to characterize the currency regime, the sample average yield of sovereign bonds to characterize sovereign risk, and the ratio of exports to the United States to domestic GDP to characterize trade linkages between each country and the United States.

We find that sovereign bond yields in economies with high capital mobility or with more developed financial systems co-move more closely with US Treasury yields—the estimated

[26] Because most country characteristics are available only at a low frequency, we use the average values of country-specific characteristics over our sample period.

coefficient $\beta_{1,2}$ is positive and significant at the 1 percent significance level. Also, in line with the evidence in table 3.1 for the inverse relation between β_1 and $\beta_2(FOMC)$, the coefficient associated with the additional effect of US sovereign yields on FOMC announcement days is more negative for high-mobility and more financially developed economies. We find that sovereign bond yields in countries with higher sovereign risk (higher average yields) co-move less with US Treasury yields, but the additional spillover effect on monetary policy announcement days is higher for these riskier economies. Our results suggest that bond yields in economies with high-volatility (more flexible) currencies co-move less with US sovereign yields. Finally, trade linkages with the US are positive and significant at explaining the effect of changes in US sovereign yields—sovereign bond yields in countries with closer trade linkages with the United States co-move more with US sovereign yields.

The results for stocks (table 3.4b) show that stock prices in high-mobility economies, economies with more developed financial systems, and economies with more flexible exchange rates co-move more closely with US Treasury yields. This co-movement is weaker in countries whose sovereign bonds are viewed as risky. Counter-intuitively, trade linkages with the United States reduce the spillover effects. Overall, country-specific characteristics play only a minor role in explaining the cross-country variations in the additional spillovers around FOMC or US economic data release days.

For exchange rates (table 3.4c), capital mobility and exports to the United States have little explanatory power for differences in β_1. Financial depth offsets the negative effect and currency flexibility and sovereign risk increase it. Country-specific factors have little explanatory power for the additional effects seen on FOMC and economic data days, with the possible exception of capital mobility, which offset the negative effect on exchange rates on FOMC days, although this result is only marginally significant.

4. Putting It All Together

Section 2 of this paper examines the direct and spillover effects of net official flows and quantitative easing on current account balances. Because QE in the form of large-scale purchases of long-term bonds by central banks is a relatively new policy, our annual regressions did not contain many observations of this policy.[27] Therefore, section 3 explores the spillover effects of unconventional monetary policy further, regressing changes in various foreign financial prices on changes in US bond yields in daily data during the period of QE in the United States. This section develops a theory model that relates financial prices to current account balances, enabling us to draw broader conclusions from the daily regression results. In addition, the model points to some conclusions on the direct and spillover effects of net official flows and quantitative easing on income.

[27] We do observe other episodes of significant central bank acquisitions of domestic assets which are a form of QE that would be expected to have similar expansionary effects because they take risky assets onto the balance sheet of the central bank and off of private balance sheets. But these episodes tended to occur in emerging markets with less open capital markets.

A. A Model with Imperfect Asset Substitution

International macroeconomic models of policy transmission typically assume that financial assets are perfect substitutes. Thus, bond yields equal the average of expected future short-term interest rates and exchange rates move to fully offset differences in interest rates across countries. However, when assets are perfect substitutes, NOF and QE policies have no effects. These policies operate through the portfolio balance channel, which assumes imperfect substitution across assets. Our model adds portfolio preferences to a standard macro model, with the standard perfect-substitutes model emerging as a special case in which some of the parameters approach infinity. For tractability, the model ignores inflation.

Private domestic demand for domestic short-term bonds:
```
BS  = a1*RS + b1*(RS-n*RL) + UBS                                  (4.1)
```

Foreign demand for domestic short-term bonds:
```
FBS = a2*(RS-E) + b2*(RS-n*RL) + c2*(RS-E-RSF) + UFBS             (4.2)
```

Private domestic demand for domestic long-term bonds:
```
BL  = a3*n*RL + b3*(n*RL-RS) + UBL                                (4.3)
```

Foreign demand for domestic long-term bonds:
```
FBL = a4*(n*RL-E) + b4*(n*RL-RS) + c4*(n*RL-E-n*RLF)+ UFBL        (4.4)
```

Current account responds to income and exchange rate:
```
CA  = -d1*Y - d2*E + UCA                                          (4.5)
```

Absorption responds to interest rates (IS curve):
```
DD  = -e1*RS - e2*n*RL + UDD                                      (4.6)
```

Countercyclical monetary policy (Taylor rule):
```
RS  = f1*Y + URS                                                  (4.7)
```

Demand equals (exogenous) supply of short-term bonds:
```
XS  = BS + FBS + CBS                                              (4.8)
```

Demand equals (exogenous) supply of long-term bonds:
```
XL  = BL + FBL + QE                                               (4.9)
```

Current account equals net financial flows:
```
CA  = NOF - FBS - FBL                                            (4.10)
```

Income equals spending (GDP identity):
```
Y   = DD + CA                                                    (4.11)
```

Central bank balance sheet identity:
```
MB  = CBS + QE + NOF                                             (4.12)
```

<u>Endogenous Variables</u>

```
BS     Private domestic purchases of domestic short-term bonds
FBS    Foreign purchases of domestic short-term bonds
BL     Private domestic purchases of domestic long-term bonds
FBL    Foreign purchases of domestic long-term bonds
CA     Current account balance
DD     Absorption (domestic demand)
Y      Income (GDP)
RS     Short-term domestic interest rate
RL     Long-term domestic interest rate
E      Exchange rate (up is appreciation)
CBS    Central bank purchases of short-term bonds
MB     Growth of monetary base
```

Exogenous Variables

```
UBS    Domestic shock to short-term bond demand
UFBS   Foreign shock to short-term bond demand
UBL    Domestic shock to long-term bond demand
UFBL   Foreign shock to long-term bond demand
UCA    Shock to current account
UDD    Shock to absorption
URS    Shock to monetary policy
RSF    Foreign short-term interest rate
RLF    Foreign long-term interest rate
QE     Central bank purchases of long-term bonds
NOF    Central bank purchases of foreign assets
XS     Supply of short-term bonds
XL     Supply of long-term bonds
```

Parameters (All > 0)

```
ax     Own return effects in bond demand
bx     Cross-maturity effects in bond demand
cx     Cross-currency effects in bond demand
n      Maturity of long-term bonds
dx     Trade elasticities
ex     IS curve effects
fx     Monetary policy reaction coefficient
```

All variables are expressed as deviations from steady state. Interest rates are in percentage points; the exchange rate is in percent; and other variables are in percent of GDP. Variables are assumed to have been in steady state in period 0 and are expected to return to steady state in periods 2, …, n, where n is the term of the long bond. We are interested in the values of the variables only in period 1, hence there is no need for time subscripts. The period is at least one year and possibly several years long.

Because all variables are expected to return to 0 in the future, the interest rate parity conditions are RS=E+RSF for short-term bonds and RL=E+RLF for long-term bonds. The parameters that operate on deviations from parity would be infinite in a model of perfect substitution and 0 in a model of segmented markets. The pure expectations model of bond yields is RL=RS/n. The long yield rises with the short yield but in inverse proportion to the maturity of the bond. Again this condition is not enforced, so that short-term and long-term bonds are only imperfect substitutes.

Demand for bonds is a function of their own return (expressed in the currency of the investor), their return relative to the returns on other maturities in the same currency, and their return relative to the returns on the same maturity in other currencies. For simplicity and without loss of generality, private domestic residents are assumed to hold only domestic assets.[28] The central bank is able to purchase foreign assets. Owing to the small country assumption, the type of foreign asset purchased by the central bank does not matter and it is not tracked in the model.

For simplicity, we define the asset variables as flows to be commensurate with the current account, which is a flow.[29] However, it is possible to define a model in terms of stocks that has identical properties under the assumption that central bank purchases of foreign assets in the future exactly equal any non-zero current account in the current period.

The supply of domestic assets is assumed to be exogenous. Equations 4.8 and 4.9 reflect equilibrium in the bond markets. Equation 4.10 is the balance of payments identity, which states that a current account surplus implies a net acquisition of foreign assets and a current account deficit implies a net incurrence of liabilities to foreigners. The central bank funds its purchases by issuing zero-interest monetary base (equation 4.12).

The model is completed with a standard set of macro equations for the current account, domestic absorption, monetary policy, and the GDP identity.

The general reduced form of this model is complex and difficult to interpret. However, numerical solutions can provide good understanding of its properties. Parameter values were chosen as follows:

- The baseline current account parameters (d1, d2) are (0.25, 0.25). This reflects the median value of domestic content in exports of 25 percent of GDP and income and price elasticities of trade that are assumed to equal 1.
- The baseline absorption parameters (e1, e2) are (0.50, 0.50). These match the effect of monetary policy on US GDP over a two to three year horizon in the Federal Reserve's FRB/US model.
    - Alternative parameter sets are (0.25, 0.25), (0.25, 0.50), and (1.0, 1.0).
- The baseline monetary parameter (f1) is 1. This reflects the coefficient of 0.5 on income in the Taylor rule plus an implicit effect of higher income on inflation, which also has a coefficient of 0.5 in the Taylor rule in real terms.

[28] Private domestic flows between home and abroad would respond to the same relative returns with the same signs as foreign flows.

[29] Blanchard, Adler, and de Carvalho Filho (2015) use a model of imperfect asset substitution that is similarly based on flows.

  - An alternative parameter is 2.
- The ax parameters reflect the response of asset demand to an equal increase in rates of return on all assets. We assume demand changes proportionally for all assets, so that a1=a2=a3=a4. The baseline value is 0.1
  - Alternative values are 0.01 and 1.
- The bx parameters reflect substitution between short-term and long-term bonds. We assume domestic and foreign residents have the same substitution parameters (b1=b2, b3=b4) and that substitution is symmetric between short-term and long-term bonds (b1=b3, b2=b4). The baseline value is 1.
  - Alternative values are 0.1 and 10.
- The cx parameters reflect substitution between domestic and foreign bonds. For simplicity and without loss of generality, only foreigners can buy foreign bonds. Substitution across currencies is assumed to be equal across short-term and long-term bonds (c2=c4). The baseline values are 0.1 for low capital mobility and 1 for high capital mobility. Under high capital mobility, substitution across currencies is equal to substitution across maturities.
  - Alternative values are 0.01 and 10.

Equations 4.1 through 4.12 describe an economy with a flexible exchange rate, E. It is possible to alter the model to that of an economy with a fixed exchange rate in either of two ways. First, the Taylor rule (equation 4.7) may be dropped and E made exogenous. This is the classic case of giving up domestic monetary autonomy (RS) to fix the exchange rate. Second, NOF can be used to target the exchange rate, effectively making E exogenous and NOF endogenous. This is possible because assets are imperfect substitutes.

We note that the theory model is limited to examining temporary, albeit persistent, shocks. The linearity of the model is convenient and necessary to obtain workable results. In the real world, nonlinearities may be important at times, particularly when shocks are large. Nevertheless, we believe the model is useful to convey sensible intuitions for a variety of circumstances.

B. Model Properties and Relation to Annual Regression Results

<u>Effects of NOF</u>

Table 4.2 shows that NOF increases the current account in both flexible and fixed exchange rate regimes. In a flexible regime, this occurs through exchange rate depreciation. In a fixed regime, this occurs because interest rates rise and choke off domestic demand. The rise in interest rates is necessary to maintain the fixed exchange rate when NOF increases. When NOF is used to fix the exchange rate (the final column) it is no longer available as a policy tool. However, the exchange rate could be moved and this would have effects on both NOF and the current account consistent with those under flexible rates.

NOF has a larger effect on the current account when capital mobility is low, regardless of the exchange rate regime. The positive effect of NOF on the current account in all cases, and the larger effect when capital mobility is low, are both supported strongly in the annual regressions.

Table 4.3 shows that NOF increases income under flexible exchange rates and decreases it under fixed exchange rates. The negative effect under fixed rates reflects the need to raise interest rates to maintain the exchange rate.

Effects of QE

When the exchange rate is flexible and when it is fixed using RS, QE has a small and ambiguously signed effect on the current account. When the exchange rate is fixed using NOF, QE has a negative effect. These results hold regardless of capital mobility. Under a flexible rate, there are two offsetting channels: (1) QE lowers long-term interest rates, which depreciates the exchange rate and boosts exports, and (2) lower long-term interest rates increase domestic demand, which boosts imports. When the exchange rate is fixed via NOF, only the second channel operates, implying a negative effect on the current account. When the exchange rate is fixed using RS, RS rises to keep the exchange rate fixed and this directly offsets the stimulus to domestic demand from QE through long-term rates.

In the annual regressions, QE has essentially no effect on the current account under high capital mobility. This result is consistent with the model. There is a small positive effect under low capital mobility, which may be consistent with the model but which is not strongly robust.

The model suggests that QE has a positive effect on income under both a flexible exchange rate and an exchange rate that is fixed using NOF. In both cases, the effect is larger when capital mobility is lower. High capital mobility damps the effect of central bank purchases of long-term bonds on bond yields. When the exchange rate is fixed using RS, RS rises to offset downward pressure on the exchange rate and this damps any effect on income.

Spillovers of NOF

Foreign NOF enters the model as a shock to UFBS.[30] In the model, the effects of UFBS can be fully and exactly offset by equal movements in NOF.[31] Indeed, under a fixed exchange rate (via NOF) regime, that is what happens and UFBS shocks have no effect on either the current account or income. When UFBS is not offset by NOF, then it has economic effects equal and opposite to those of NOF.

Because this is a model of a single small economy, it has nothing to say on the factors that determine the allocation of NOF across partner countries.

---

[30] We assume that foreign central banks buy less risky short-term bonds, but it is straightforward to analyze shocks to inflows into long-term bonds (UFBL).

[31] Shocks to UFBL can be fully offset by a combination of NOF and QE.

Spillovers of QE and Conventional Monetary Policy

RSF and RLF reflect monetary policy in the rest of the world. Conventional monetary policy operates primarily through RSF but also to some extent through RLF. QE and other unconventional monetary policies operate primarily through RLF, especially when RSF is close to the zero lower bound. Monetary policy is also likely to be associated with movements in aggregate demand in the rest of the world, which in turn causes movements in the exogenous component of the current account, UCA. These will be discussed in the context of the daily data regressions next.

C. Model Properties and Relation to Daily Regression Results

The daily regressions attempt to distinguish between anticipated and unanticipated monetary policy. Anticipated monetary policy refers to the normal response of policy to changes in economic prospects. News of stronger current or future spending causes long-term bond yields to rise in anticipation of future monetary tightening. However, changes in bond yields in a narrow window around announcements by the monetary authorities (FOMC days) are more likely to contain news about unanticipated monetary policy changes than news about underlying economic prospects.

A rise in the bond yield on non-FOMC days probably reflects an upward revision to projected economic activity, which is commonly referred to as “good news.” On the other hand, a rise in the bond yield on an FOMC day may reflect a revision in the market’s expectation of future monetary policy toward tighter conditions for a given path of the economy. Broadly speaking, the daily regressions find support for this interpretation. On non-FOMC days, higher US bond yields raise bond yields in foreign countries, depreciate their exchange rates, and increase their stock prices. The latter correlation is particularly strong and consistent across countries and is consistent with the “good news” interpretation on non-FOMC days. On FOMC days, these effects tend to be smaller, especially the stock price effects, which often become insignificant.[32] Tighter US monetary policy, other things equal, is not good news for foreign economies.

Under all parameter values, the model implies that an increase in the foreign bond yield (RLF) depreciates the exchange rate (E) when E is flexible. Higher foreign bond yields also raise domestic bond yields under all exchange rate regimes (table 4.1). These results hold up in the daily regressions for most countries. The effect of foreign bond yields on domestic yields is stronger when capital is mobile, a result that is also supported in the daily regressions.

The model says that increases in foreign interest rates tend to increase the current account under all exchange rate regimes (table 4.2). If these higher rates reflect good economic

[32] The coefficients were usually positive and occasionally significant, however, which probably reflects the existence of some economic news on FOMC days rather than a positive effect of monetary policy per se.

news abroad, demand for exports (UCA) is also likely to rise, which unambiguously points to higher current accounts. On the other hand, if the rise in interest rates reflects an unanticipated monetary shock, then UCA is likely to fall, and the effect on the current account is ambiguous. This result is consistent with the daily regression finding of smaller effects on exchange rates and foreign stock prices on FOMC days.

With respect to income, the exchange rate regime matters. Interest rate increases boost income under a flexible exchange rate, but they depress income under a fixed exchange rate, especially when capital mobility is high (table 4.3). The effect of foreign activity, through UCA, operates in the same direction for all regimes. The bottom line is that unanticipated monetary policy tightening abroad definitely reduces income under fixed exchange rates (because it reduces UCA and has no offsetting effect on the exchange rate) and has an ambiguous effect under flexible rates (because the reduction in UCA is offset by a depreciation of the exchange rate).

The daily regressions of foreign stock prices may provide some insight into effects of US yields on foreign income.[33] In the model, higher foreign rates associated with good news are unambiguously positive for income under flexible rates but have an ambiguous effect under fixed rates. The daily regressions support this conclusion, as higher US yields on non-FOMC days had a larger effect on stock prices in economies with more flexible exchange rates. The model predicts a larger effect of foreign "good news" on domestic income under a flexible exchange rate when capital mobility is high. The daily regressions support this prediction.

The model predicts that higher US yields associated with monetary tightening should have a clear negative effect under fixed exchange rates and an ambiguous effect under flexible rates. However, we did not find much difference across exchange rate regimes in the effects of US bond yields on foreign stock prices on FOMC days.

D. Policy Implications

An interesting property of this model is that officials have other tools besides conventional monetary policy (RS) with which to combat the effects of foreign shocks. For example, NOF can be used to completely neutralize the effects on all domestic variables of foreign capital inflows into short-term bonds, including spillovers of NOF in foreign countries. Moreover, as shown in the final columns of tables 4.1-4.3, NOF can also insulate a country from shocks to foreign short-term interest rates. A combination of NOF and QE can be used to fully offset the effects of foreign capital inflows into long-term bonds and changes in foreign long-term interest rates. The existence of these tools allows the authorities to pursue objectives on exchange rates, current accounts, or long-term bond yields without giving up use of monetary policy for

[33] Stock price movements reflect a combination of changes in expected future income and the discount rate applied to future income. The discount rate, in turn, is affected by changes in bond yields as well as changes in risk premiums. We assume that the income effect dominates; otherwise, good news about the US economy--which also raises foreign bond yields--would not raise foreign stock prices.

stabilization of income.

In addition, other tools exist outside the model, such as fiscal policy, capital controls, and macroprudential measures, which also can influence desired objectives. Pushed to the extreme, these considerations suggest that domestic officials are not as much at the mercy of global shocks as many observers suppose.

On the other hand, some central banks may be uncomfortable with taking large net positions in long-term bonds and foreign exchange. Political realities may constrain full use of fiscal policy, capital controls, and macroprudential measures. The model is too simple to fully assess the benefits, costs, and risks involved. Nevertheless, the model does highlight the richness of policy options in a world of imperfect financial substitution.

5. Conclusions

This paper explores the direct effects and spillovers of unconventional monetary and exchange rate policies. Our annual regressions focus on direct effects and spillovers of official purchases of foreign and domestic assets on the current account. Our daily regressions focus on spillovers to foreign financial prices of unconventional monetary policy in the United States, which includes, but is not limited to, official purchases of long-term bonds (QE). These results are broadly consistent with the predictions of a simple macroeconomic model of a small economy with imperfect substitution of assets across currencies and maturities.

Official purchases of foreign assets, or net official flows (NOF), have a large direct effect on a country's current account when capital mobility is low. This effect diminishes considerably as capital mobility rises, but it remains significant at high levels of mobility, and there is an important additional effect through the lagged stock of net official assets. At the lowest level of capital mobility, each dollar of net official flows raises the current account about 75 cents. This effect declines to around 20 cents at the highest level of mobility, but the lagged stock of net official assets increases the current account by about 4 cents on the dollar when capital mobility is high. These effects are robust to a wide range of specifications.

Official purchases of domestic assets, or quantitative easing (QE), appear to have no significant effect on a country's current account when capital mobility is high. By contrast, there does appear to be a modest but significant positive impact when capital mobility is low. The finding of a significant effect only with low capital mobility is somewhat puzzling, and may reflect some unmodeled difference in effects between the major advanced economies, which have high capital mobility, and smaller emerging markets that engaged in QE and had low capital mobility. We plan to research this further.

Because current accounts add up to zero around the world, any effect of official policies on a country's current account must spill over to other countries. We find that the effects of official flows spill over to other countries in proportion to their degree of international financial integration. This effect is moderately robust, although it does not seem to work as well for the

United States and the euro area. The United States, in particular, seems to receive relatively more of the spillovers than is explained by its degree of international financial integration, although the difference is not statistically significant.

Our daily regressions find that US economic developments have important spillovers to foreign economies. In particular, increases in current and expected economic activity in the United States, working in part through expected monetary policy reactions, raise US bond yields and also raise foreign bond yields, increase foreign stock prices, and depreciate foreign currencies. Our theory model suggests that stronger US activity unambiguously raises foreign activity and foreign current account balances. These spillovers are stronger when capital mobility is higher and when financial markets are deeper.

However, increases in US bond yields associated with tighter than expected future monetary policy (including QE) for a given path of the economy have smaller effects on foreign financial variables, consistent with a roughly neutral effect on foreign activity and foreign current account balances—although there may still be direct contractionary effects on foreign financial markets. Our theory model suggests that pure monetary shocks have small and ambiguous effects on current account balances and activity in foreign economies. This result is also consistent with the results of our annual regressions, at least for countries with high capital mobility.

The theory model highlights the potential usefulness of domestic net official flows and quantitative easing as responses to the effects of foreign policies of a similar type. In particular, negative spillovers on the current account from the rest of the world can be fully offset by increasing net official flows at home. Similarly, spillovers onto bond yields from the rest of the world can be offset by countervailing quantitative easing or tightening at home. However, it is possible that central banks will be uncomfortable with taking large net positions in long-term bonds and foreign exchange. The model is not able to balance all of the benefits, costs, and risks involved. What it does do is to provide a rich framework within which to compare conventional and unconventional policy options.

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APPENDIX: DATA SOURCES AND DEFINITIONS

Sources: IMF, *Balance of Payments Statistics* (BOP); IMF, *International Financial Statistics* (IFS); IMF, Monetary and Financial Statistics; IMF, *World Economic Outlook* (WEO); United Nations, *World Population Prospects* 2010 (UN); World Bank, *World Development Indicators* (WDI); World Bank, *Worldwide Governance Indicators* (WGI); Norway, Norges Bank; and Singapore, Ministry of Finance. Data on capital controls and exchange rate volatility are from Aizenman, Chinn, and Ito (2015). Daily financial data are from Bloomberg.

CAX: The BOP current account balance minus BOP net investment income.

NPFX: BOP net financial account flows minus BOP net investment income minus NOF.

NOF: Based on the BOP data, NOF is the sum of reserves flows and net portfolio investment and other investment flows for central bank and general government except that portfolio liability flows are set at zero for advanced economies because they do not borrow significantly in foreign currency. Data for Norway are from the Norges Bank website for the Norwegian Pension Fund (Global). Debt forgiveness is removed from NOF but not NOA.

NOA: Based on the IIP data, NOA is defined as the stock version of NOF. Missing values are filled in from the World Bank's external debt data. In countries in which less data is available for the stock than the flow variable, we use perpetual inventory to project NOA backwards.

GDP: Nominal GDP in US dollars and in local currency, and real GDP, are from WEO.

MOB: Capital controls index available at Aizenman, Chinn, and Ito (2015).

QE: Central bank domestic assets divided by trend GDP. Source: IMF Monetary and Financial Statistics (MFS) and International Financial Statistics (IFS).

SPILL: Global Financial Integration multiplied with the sum of NOF across countries and divided by the sum of trend GDP across countries.

Relative PPP GDP Per Capita: WEO (relative to US level). We set this as missing before 1996 for European transition economies.

Aging: 10-year forward change in ratio of elderly to working age population. Historical elderly ratios through 2010 are from WDI. Ratios for 2020 and 2020 are from UN and are interpolated and extrapolated in order to create 10-year changes for 2001–15.

Growth: 5-year moving average of growth rate of real GDP based on WEO. We corrected an error in Malta real GDP using IFS data. We set real GDP growth as missing for European transition economies before 1996.

Net Energy Exports: Difference between energy production and consumption in tons of oil equivalent (WDI), converted into dollars using Brent oil price (IFS) assuming 7.33 barrels per ton and divided by nominal GDP (WEO).

Fiscal Balance: General government balance in percent of GDP (WEO) is cyclically adjusted as the residual in a panel regression of the fiscal balance on the level and change of the GDP gap with no country or year effects. The GDP gap is the difference between log real GDP and its 11-year centered moving average using WEO forecasts for 2015–18. A missing value for South Africa in 2005 is interpolated.

Global Financial Integration: Defined as the ratio of BOP private financial account transactions divided by the sum of financial and current account transactions.

Nonreserve Flows: NOF minus reserve assets flow divided by trend GDP.

Crisis: A dummy that takes the value 1 if the respective country experienced a financial or currency crisis in the previous three years. Source: Laeven and Valencia (2011).

Trade Openness: Exports of goods and services plus imports of goods and services divided by trend GDP.

Exchange rate regime: Aizenman-Chinn-Ito (2015) rolling measure of ER volatility.

Scaling by trend GDP: When scaling data by GDP, we use the 11-year centered moving average of nominal GDP in US dollars (WEO), including forecast data through 2018.

Table 2.1a. Baseline Regressions - First Stage

First stage for NOF

	CAX	NPFX	CAX	NPFX	CAX	NPFX
Nonreserve Flows	0.851***	0.851***	0.851***	0.851***	0.868***	0.868***
Interaction with MOB	-0.108	-0.108	-0.108	-0.108	-0.133	-0.133
Crisis	0.004	0.004	0.004	0.004	0.004	0.004
Interaction with MOB	0.004	0.004	0.004	0.004	0.008	0.008
R-squared	0.59	0.59	0.59	0.59	0.59	0.59
F-test	68.5 (0.000)	68.5 (0.000)	68.5 (0.000)	68.5 (0.000)	55.8 (0.000)	55.8 (0.000)
AP Chi-sq test	69.9 (0.000)	69.9 (0.000)	69.9 (0.000)	69.9 (0.000)	58.1 (0.000)	58.1 (0.000)

First stage for NOFxMOB

	CAX	NPFX	CAX	NPFX	CAX	NPFX
Nonreserve Flows	0.032	0.032	0.032	0.032	0.024	0.024
Interaction with MOB	0.709***	0.709***	0.709***	0.709***	0.718***	0.718***
Crisis	-0.001	-0.001	-0.001	-0.001	-0.002	-0.002
Interaction with MOB	0.009*	0.009*	0.009*	0.009*	0.015**	0.015**
R-squared	0.61	0.61	0.61	0.61	0.60	0.60
F-test	56.0 (0.000)	56.0 (0.000)	56.0 (0.000)	56.0 (0.000)	43.3 (0.000)	43.3 (0.000)
AP Chi-sq test	98.6 (0.000)	98.6 (0.000)	98.6 (0.000)	98.6 (0.000)	87.3 (0.000)	87.3 (0.000)

Table 2.1b. Baseline Regressions – Second Stage

	CAX	NPFX	CAX	NPFX	CAX	NPFX
MOB, lagged	0	-0.002	0.031***	0.044***	0.011	0.01
	0	0	0	0	0	0
MOB squared and lagged					0.035*	0.046**
					0	0
Global Financial Integration					0.140**	0.146*
					0.1	0.1
Interaction with MOB					-0.150**	-0.089
					0.1	0.1
Relative GDP PPP pc, lagged	-0.011	-0.026**	0.01	0.024	0.012	0.027
	0	0	0	0	0	0
Interaction with MOB			-0.023	-0.061***	-0.012	-0.054**
			0	0	0	0
Aging	2.165***	2.211***	3.045*	1.26	2.831	1.37
	0.7	0.8	1.7	1.8	1.9	2
Interaction with MOB			-2.394	-0.179	-0.59	0.564
			2	2.3	2.3	2.6
Growth, lagged	-0.186***	-0.233***	0.025	0.085	0.101	0.179*
	0.1	0.1	0.1	0.1	0.1	0.1
Interaction with MOB			-0.529***	-0.741***	-0.752***	-0.999***
			0.1	0.2	0.2	0.2
Net Energy Exports	0.171***	0.143***	0.272***	0.256***	0.280***	0.259***
	0	0	0	0	0	0
Interaction with MOB			-0.254***	-0.292***	-0.251***	-0.268***
			0.1	0	0.1	0.1
Fiscal balance	0.392***	0.349***	0.205***	0.117	0.176**	0.132
	0.1	0.1	0.1	0.1	0.1	0.1
Interaction with MOB			0.358***	0.442***	0.421***	0.459***
			0.1	0.1	0.1	0.2
NOF	0.701***	0.780***	0.696***	0.760***	0.724***	0.775***
	0.1	0.2	0.1	0.2	0.2	0.2
Interaction with MOB	-0.643***	-0.26	-0.643***	-0.247	-0.715***	-0.421*
	0.2	0.3	0.2	0.3	0.2	0.3
NOA, lagged	0.007	-0.021**	0.005	-0.025***	0.006	-0.027***
	0	0	0	0	0	0
Interaction with MOB	0.032*	0.03	0.043***	0.047**	0.040**	0.059**
	0	0	0	0	0	0
QE, lagged					0.231**	0.255**
					0.1	0.1
Interaction with MOB					-0.302*	-0.22
					0.2	0.2

SPILL					-18.638***	-24.077***
					5.4	5.8
R-squared	0.457	0.239	0.491	0.305	0.525	0.376
Observations	2088	2088	2088	2088	1745	1745

* p<0.1, ** p<0.05, *** p<0.01

Table 2.2. Robustness Checks

	Baseline	OLS	Alt Instr	Weighted	Robust	Fixed	Flexible	Tradeopen	Tradeclosed
NOF	0.750***	0.674***	0.970***	0.765***	0.804***	0.83***	0.654***	0.688*	0.781
	0.2	0.1	0.2	0.1	0.1	0.2	0.2	0.2	0.3
Interaction with MOB	-0.568**	-0.408***	-0.7305**	-0.4135**	-0.751***	-0.981**	-0.3565	-0.52***	-0.5385***
	0.2	0.1	0.3	0.3	0.1	0.4	0.3	0.3	0.4
NOA, lagged	-0.0105	-0.0085	-0.0145	-0.007	-0.0155**	0.004	0.017	-0.0155	0.012
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interaction with MOB	0.0495**	0.0455***	0.0505**	0.084***	0.0655***	0.012	0.029	0.0525*	-0.046*
	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
QE, lagged	0.243**	0.248**	0.269**	0.2165**	0.0965	0.092	0.1985	0.41**	0.0905
	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.1
Interaction with MOB	-0.261	-0.279*	-0.2995	-0.1845	-0.175	0.014	-0.234	-0.495	0.001
	0.2	0.2	0.2	0.1	0.1	0.3	0.2	0.3	0.1
SPILL	-21.4***	-21.5***	-21.2***	1.7	-11.8***	-16.8*	-14.9***	-39.2***	-0.5
	5.6	4.2	5.9	2.9	3.4	8.7	5.8	8.7	3.7
R-squared	0.45	0.37	0.46	0.64	0.50	0.52	0.46	0.51	0.43
Observations	1745	1755	1699	1745	1745	650	1095	873	872

* p<0.1, ** p<0.05, *** p<0.01

Coefficients and standard errors are averages across CAX and NPFX regressions

Table 2.3. Correlations in Energy Exporters, 2000-2014 (percent of GDP)

	NOF-Energy	NOF-Fiscal	NOF-CAX	Fiscal-CAX	Energy-CAX
Algeria	0.92	0.90	0.98	0.94	0.91
Norway	0.73	0.90	0.80	0.86	0.58
Saudi Arabia	0.87	0.90	0.94	0.90	0.88
Yemen	0.74	0.86	0.87	0.93	0.89
Colombia	0.37	0.62	0.35	-0.03	-0.34
Indonesia	-0.23	0.41	0.66	0.43	-0.75
Mongolia	-0.33	0.76	0.66	0.91	-0.85

Table 3.1. Spillovers to Sovereign Bond Yields - Daily Regressions

Country	β_1	β_2(FOMC)	$\beta_1+\beta_2$(FOMC)	β_2(Econ.)	$\beta_1+\beta_2$(Econ.)
Canada	0.613***	-0.061**	0.539***	0.013	0.599***
Australia	0.598***	0.019	0.597***	0.110	0.662***
Hong Kong	0.562***	-0.101*	0.513***	0.076	0.663***
United Kingdom	0.457***	-0.286***	0.179***	0.088	0.502***
Germany	0.434***	-0.228***	0.215***	0.060	0.461***
Euro Area	0.434***	-0.239***	0.211***	0.055	0.461***
Denmark	0.400***	-0.198***	0.183***	0.087	0.425***
Finland	0.386***	-0.217***	0.196***	0.016	0.392***
New Zealand	0.379***	-0.048	0.325***	0.028	0.392***
Netherlands	0.377***	-0.196***	0.200***	0.013	0.375***
Sweden	0.337***	-0.196***	0.147**	0.071	0.376***
Singapore	0.306***	-0.010	0.282***	0.087*	0.363***
France	0.299***	-0.168**	0.171***	0.008	0.318***
Mexico	0.244***	0.179*	0.259***	0.148	0.255***
Norway	0.229***	-0.189***	0.073	0.042	0.271***
Switzerland	0.220***	-0.102**	0.135***	0.002	0.224***
South Korea	0.216***	0.126***	0.313***	0.172***	0.352***
Belgium	0.206***	-0.100	0.163***	-0.072	0.178***
Thailand	0.185***	0.217***	0.352***	-0.009	0.165***
Brazil	0.153**	0.344**	0.303**	0.423**	0.395*
Czech Republic	0.127***	-0.070	0.062	-0.071	0.074
Japan	0.125***	-0.023	0.120***	0.040**	0.169***
Taiwan	0.077***	0.001	0.078**	0.024	0.096***
Malaysia	0.077***	0.070	0.152***	0.008	0.098***
Indonesia	0.074	0.457	0.328	-0.106	-0.182
South Africa	0.055*	0.066	0.053	0.219***	0.224***
Colombia	0.031	0.310**	-0.002	0.428***	0.185***
Poland	0.030	-0.068	-0.039	0.099	0.104*
Chile	0.016	-0.343***	0.017	-0.237*	0.037
China	0.015	-0.020	0.001	0.034	0.044
Turkey	0.004	0.038	0.028	0.184	0.156
Ireland	0.004	-0.038	0.090	-0.305***	-0.161
Spain	-0.009	-0.037	0.068	-0.186*	-0.073
Pakistan	-0.013	-0.010	-0.019	0.257***	0.218***
Italy	-0.046	-0.096	-0.018	-0.140*	-0.065
Philippines	-0.049	0.220**	0.070	-0.069	-0.192*
Portugal	-0.073	0.058	0.097	-0.507***	-0.417**
Russia	-0.164*	-0.375	-0.495	0.326**	0.111
Hungary	-0.187***	0.169	-0.036	-0.046	-0.229
Greece	-0.672***	0.110	-0.267	0.137	-0.247

* p <0.1, ** p<0.05, *** p<0.01

Table 3.2. Spillovers to Stock Prices - Daily Regressions

Country	β_1	β_2(FOMC)	$\beta_1+\beta_2$(FOMC)	β_2(Econ.)	$\beta_1+\beta_2$(Econ.)
Belgium	0.101***	-0.055**	0.037***	0.125	0.198
Spain	0.088***	-0.035*	0.045**	0.024	0.098***
Euro Area	0.082***	-0.028	0.050***	0.023	0.095***
France	0.082***	-0.030	0.047***	0.017	0.089***
Germany	0.081***	-0.018	0.056***	0.027	0.097***
Russia	0.080***	-0.003	0.077***	0.029	0.103***
Netherlands	0.077***	-0.013	0.059***	0.022	0.090***
Finland	0.075***	-0.028	0.042**	0.028	0.091***
Norway	0.072***	-0.023	0.049**	0.006	0.073***
Brazil	0.071***	-0.068***	0.022	-0.003	0.076***
Sweden	0.069***	-0.024	0.043**	0.019	0.079***
Japan	0.065***	-0.023	0.046**	0.037*	0.097***
Hungary	0.064***	-0.018	0.041**	-0.003	0.055***
Greece	0.063***	0.009	0.065***	0.025	0.080***
United Kingdom	0.061***	-0.020	0.041***	0.009	0.067***
Ireland	0.061***	-0.036**	0.031*	0.003	0.063***
Portugal	0.061***	-0.034**	0.025*	0.002	0.057***
Canada	0.060***	-0.023	0.042*	0.011	0.072***
Mexico	0.056***	-0.034	0.037*	0.006	0.069***
Switzerland	0.054***	-0.022*	0.032***	0.007	0.057***
Czech Republic	0.052***	-0.041**	0.015	0.019	0.071***
Poland	0.051***	-0.031**	0.023*	0.002	0.053***
Denmark	0.049***	-0.029**	0.022*	-0.004	0.043***
Turkey	0.048***	-0.003	0.048**	-0.029	0.025
Italy	0.048***	-0.022	0.021	0.013	0.053***
South Africa	0.041***	-0.028	0.017	0.008	0.049***
Hong Kong	0.038***	-0.039*	0.008	0.029	0.066***
Australia	0.038***	-0.018	0.028*	0.020	0.060***
Philippines	0.034***	-0.029**	0.013	-0.008	0.032**
South Korea	0.033***	-0.026	0.014	0.009	0.043**
Colombia	0.031***	-0.020**	0.013	0.005	0.034***
Taiwan	0.031***	-0.018	0.020	-0.009	0.026
Chile	0.030***	-0.027***	0.009	0.001	0.032***
Indonesia	0.027***	-0.037**	0.000	-0.009	0.020
Singapore	0.025***	-0.026*	0.007	0.017	0.043***
New Zealand	0.020***	-0.007	0.016*	-0.003	0.021**
Malaysia	0.017***	-0.012	0.010	0.003	0.023***
Thailand	0.015***	-0.027*	-0.006	-0.014	0.004
China	0.011*	-0.045***	-0.018	0.003	0.024
Pakistan	0.003	0.018	0.023	-0.016	-0.009

* p <0.1, ** p<0.05, *** p<0.01

Table 3.3. Spillovers to Exchange Rates (with respect to US dollar) - Daily Regressions

Country	β_1	β_2(FOMC)	β_1+β_2(FOMC)	β_2(Econ.)	β_1+β_2(Econ.)
Poland	-0.033***	0.012	-0.013	-0.018	-0.040***
Hungary	-0.033***	0.016	-0.011	-0.001	-0.027
South Africa	-0.030***	0.008	-0.022*	0.014	-0.018
Russia	-0.029***	0.005	-0.015	0.001	-0.019**
Australia	-0.028***	-0.004	-0.027***	0.009	-0.016
Sweden	-0.027***	-0.007	-0.024*	0.001	-0.018
Norway	-0.026***	-0.008	-0.026***	0.014	-0.008
Brazil	-0.026***	-0.009	-0.037***	0.011	-0.019
Czech Republic	-0.023***	0.008	-0.008	-0.013	-0.027**
Canada	-0.023***	0.004	-0.015**	0.006	-0.012
Mexico	-0.022***	0.004	-0.017**	-0.006	-0.025**
Turkey	-0.022***	0.024**	-0.005	0.014	-0.013
New Zealand	-0.020***	-0.004	-0.022**	0.004	-0.016
Chile	-0.017***	-0.007	-0.020***	0.008	-0.007
Colombia	-0.016***	0.010	-0.008	0.007	-0.010
South Korea	-0.014***	0.011	-0.006	0.010	-0.006
United Kingdom	-0.013***	-0.011	-0.018**	-0.005	-0.015
Denmark	-0.011***	0.003	-0.003	0.002	-0.005
Belgium	-0.011***	0.003	-0.003	0.002	-0.005
Euro Area	-0.011***	0.003	-0.003	0.002	-0.005
Finland	-0.011***	0.003	-0.003	0.002	-0.005
France	-0.011***	0.003	-0.003	0.002	-0.005
Germany	-0.011***	0.003	-0.003	0.002	-0.005
Greece	-0.011***	0.003	-0.003	0.002	-0.005
Ireland	-0.011***	0.003	-0.003	0.002	-0.005
Italy	-0.011***	0.003	-0.003	0.002	-0.005
Netherlands	-0.011***	0.003	-0.003	0.002	-0.005
Portugal	-0.011***	0.003	-0.003	0.002	-0.005
Spain	-0.011***	0.003	-0.003	0.002	-0.005
Singapore	-0.010***	-0.002	-0.009*	0.003	-0.005
Malaysia	-0.009***	-0.003	-0.010***	0.000	-0.008*
Indonesia	-0.008**	-0.011	-0.017**	0.000	-0.007
Philippines	-0.005***	0.001	-0.004	-0.002	-0.006
Taiwan	-0.003**	0.001	-0.002	0.002	-0.001
Thailand	-0.003**	0.000	-0.003	0.005	0.001
Pakistan	-0.001	-0.005	-0.006	0.006***	0.004**
China	-0.001*	-0.001	-0.002	-0.001	-0.001
Hong Kong	0.000***	0.000	0.000	0.000	0.000
Switzerland	0.007*	-0.003	0.009	0.006	0.015*
Japan	0.033***	-0.002	0.033***	0.011*	0.043***

* p <0.1, ** p<0.05, *** p<0.01

Table 3.4a. Determinants of Spillover Effects on Sovereign Yields - Panel-Data Regressions

Country characteristics	β_{12}	β_{22}(FOMC)	β_{22}(Econ.)
MOB	21.75***	-16.70***	-9.90*
Bank assets to GDP	3.39***	-3.74**	-1.90
Currency flexibility	-0.11**	-0.01	0.06
Sovereign risk	-4.31***	4.36***	0.31
(Exports-to-US)/GDP	3.78**	1.92	-3.12

* p <0.1, ** p<0.05, *** p<0.01

Table 3.4b. Determinants of Spillover Effects on Stock Prices - Panel-Data Regressions

Country characteristics	β_{12}	β_{22}(FOMC)	β_{22}(Econ.)
MOB	5.05***	-1.50	2.04
Bank assets to GDP	0.76***	-0.28	0.27
Currency flexibility	0.07***	-0.03	0.00
Sovereign risk	-0.24***	0.14	-0.21
(Exports-to-US)/GDP	-0.75***	0.37	-0.18

* p <0.1, ** p<0.05, *** p<0.01

Table 3.4c. Determinants of Spillover Effects on Exchange Rates - Panel-Data Regressions

Country characteristics	β_{12}	β_{22}(FOMC)	β_{22}(Econ.)
MOB	0.39	0.80*	0.47
Bank assets to GDP	0.20***	0.07	0.06
Currency flexibility	-0.06***	0.02*	0.01
Sovereign risk	-0.14***	-0.07	-0.02
(Exports-to-US)/GDP	-0.01	-0.02	-0.23

* p <0.1, ** p<0.05, *** p<0.01

Table 4.1. Effects of Selected Exogenous Variables on Bond Yield

	E Flexible		E Fixed Using RS		E Fixed Using NOF
NOF, Low Mobility	±	<	+		n.a.
	∨		∧		
NOF, High Mobility	±	<	+		n.a.
QE, Low Mobility	-		±		-
	∧				∧
QE, High Mobility	-		±		-
RSF, Low Mobility	±		±		0
	∨		∨		‖
RSF, High Mobility	±		±		0
RLF, Low Mobility	+		+		+
	∧		∧		∧
RLF, High Mobility	+		+		+
UCA, Low Mobility	+	>	-	<	+
					∨
UCA, High Mobility	+	>	-	<	+

Note: The first column is based on equations 1-12. The second column deletes equation 7 and converts E to an exogenous variable. The third column keeps equation 7 but makes NOF endogenous and E exogenous. Equality and inequality signs are placed between cells when the indicated relationship holds for the baseline and all alternative parameters. (Alternatives were tried one at a time and not in combination.)

Table 4.2 Effects of Selected Exogenous Variables on the Current Account

	E Flexible	E Fixed Using RS		E Fixed Using NOF
NOF, Low Mobility	+	+		n.a.
	∨	∨		
NOF, High Mobility	+	+		n.a.
QE, Low Mobility	±0	±0	>	-
				∧
QE, High Mobility	±0	±0	>	-
RSF, Low Mobility	+	+	>	0
	∧	∧		‖
RSF, High Mobility	+	+	>	0
RLF, Low Mobility	+	+		+
	∧	∧		∧
RLF, High Mobility	+	+		+
UCA, Low Mobility	+	+	<	+
	∧	∧		∨
UCA, High Mobility	+	+	<	+

Note: The first column is based on equations 1-12. The second column deletes equation 7 and converts E to an exogenous variable. The third column keeps equation 7 but makes NOF endogenous and E exogenous. Equality and inequality signs are placed between cells when the indicated relationship holds for the baseline and all alternative parameters. (Alternatives were tried one at a time and not in combination.)

Table 4.3 Effects of Selected Exogenous Variables on Income (GDP)

	E Flexible		E Fixed Using RS		E Fixed Using NOF
NOF, Low Mobility	+	>	-		n.a.
	V		Λ		
NOF, High Mobility	+	>	-		n.a.
QE, Low Mobility	+	>	±0	<	+
	V				V
QE, High Mobility	+	>	±0	<	+
RSF, Low Mobility	+	>	-	<	0
	Λ		V		‖
RSF, High Mobility	+	>	-	<	0
RLF, Low Mobility	±0	>	-	<	-
			V		V
RLF, High Mobility	±0	>	-	<	-
UCA, Low Mobility	+	<	+	>	+
	Λ		V		Λ
UCA, High Mobility	+	<	+	>	+

Note: The first column is based on equations 1-12. The second column deletes equation 7 and converts E to an exogenous variable. The third column keeps equation 7 but makes NOF endogenous and E exogenous. Equality and inequality signs are placed between cells when the indicated relationship holds for the baseline and all alternative parameters. (Alternatives were tried one at a time and not in combination.)

Figure 2.1. Central Bank Domestic Assets in Major QE Episodes

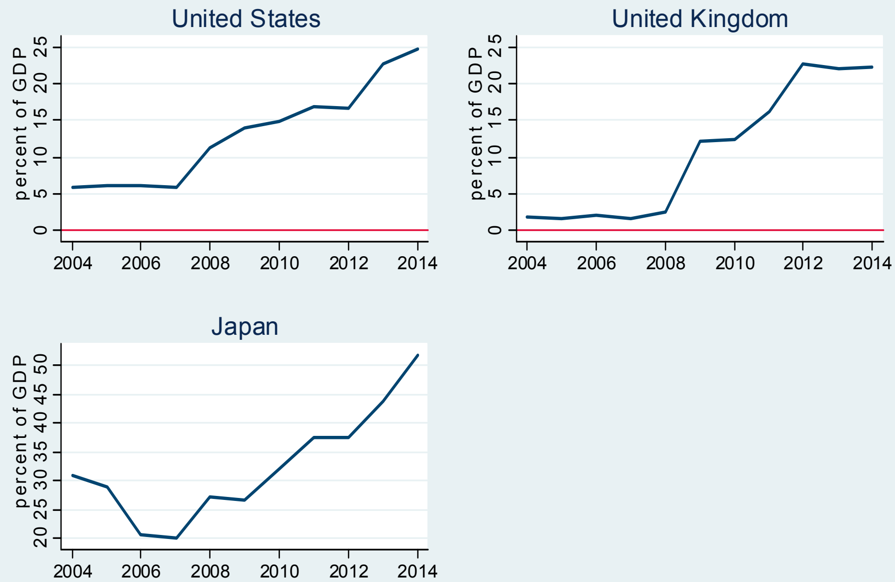
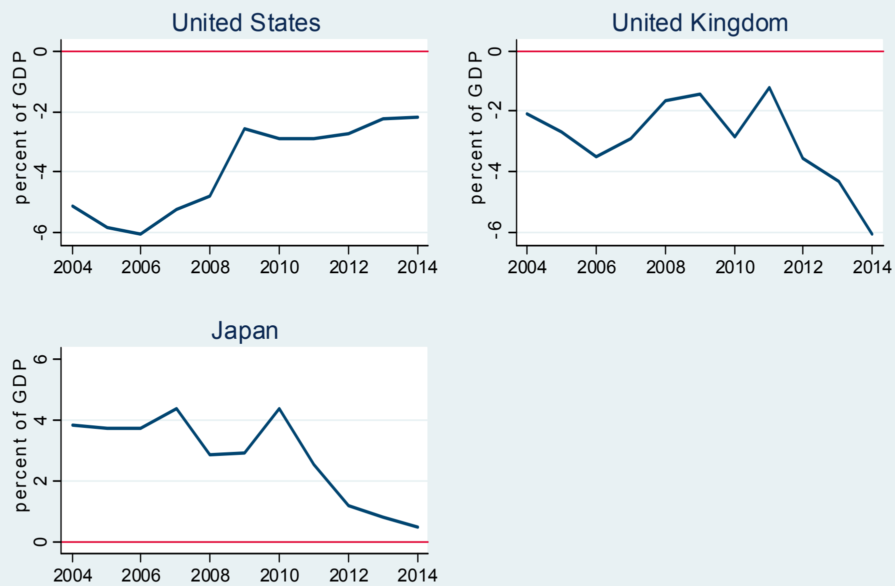


Figure 2.2. Current Accounts in Major QE Episodes



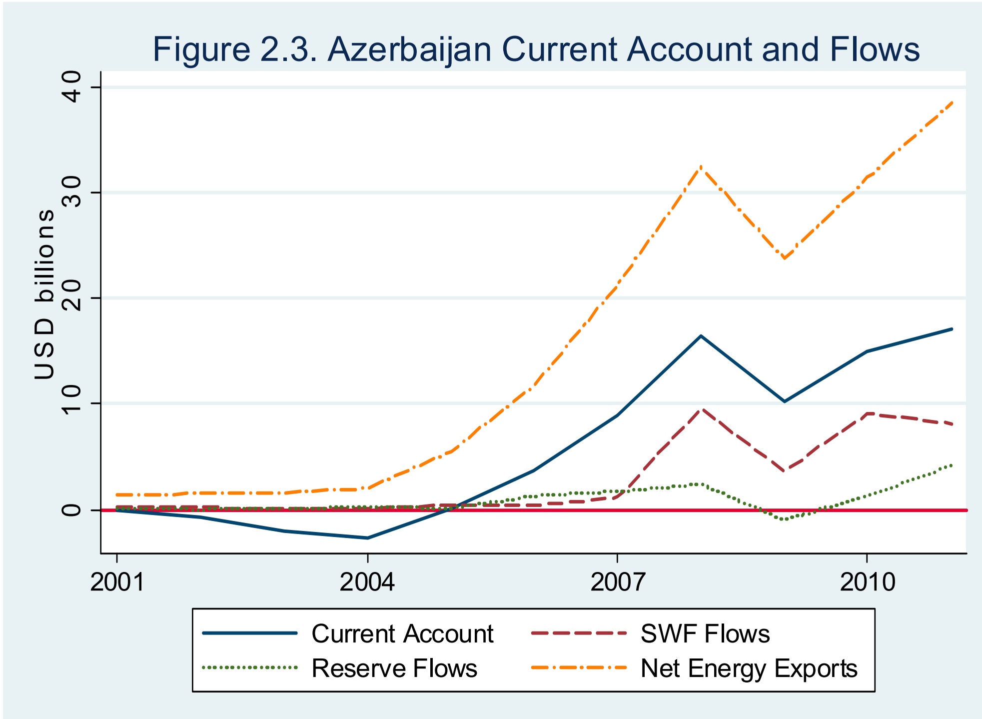


Figure 2.3. Azerbaijan Current Account and Flows
USD billions
0
10
20
30
40
2001
2004
2007
2010
Current Account
SWF Flows
Reserve Flows
Net Energy Exports

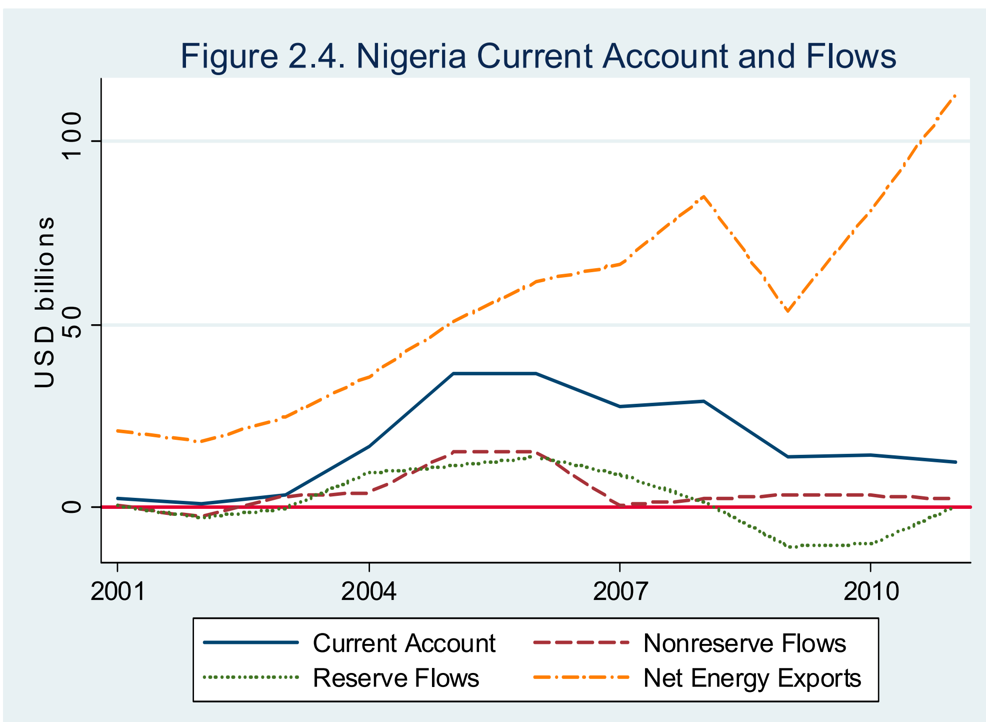


Figure 2.4. Nigeria Current Account and Flows
USD billions
0
50
100
2001
2004
2007
2010
Current Account
Nonreserve Flows
Reserve Flows
Net Energy Exports

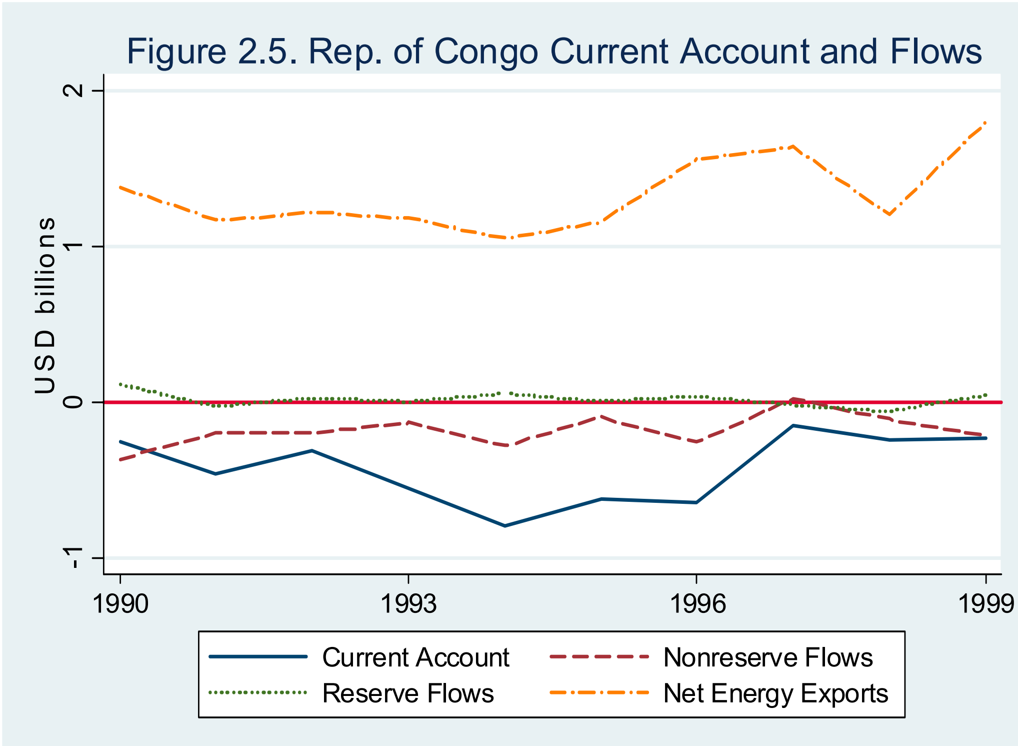


Figure 2.5. Rep. of Congo Current Account and Flows
USD billions
2
1
0
-1
1990
1993
1996
1999
Current Account
Nonreserve Flows
Reserve Flows
Net Energy Exports

Figure 2.6. Energy Exporters with Substantial NOF

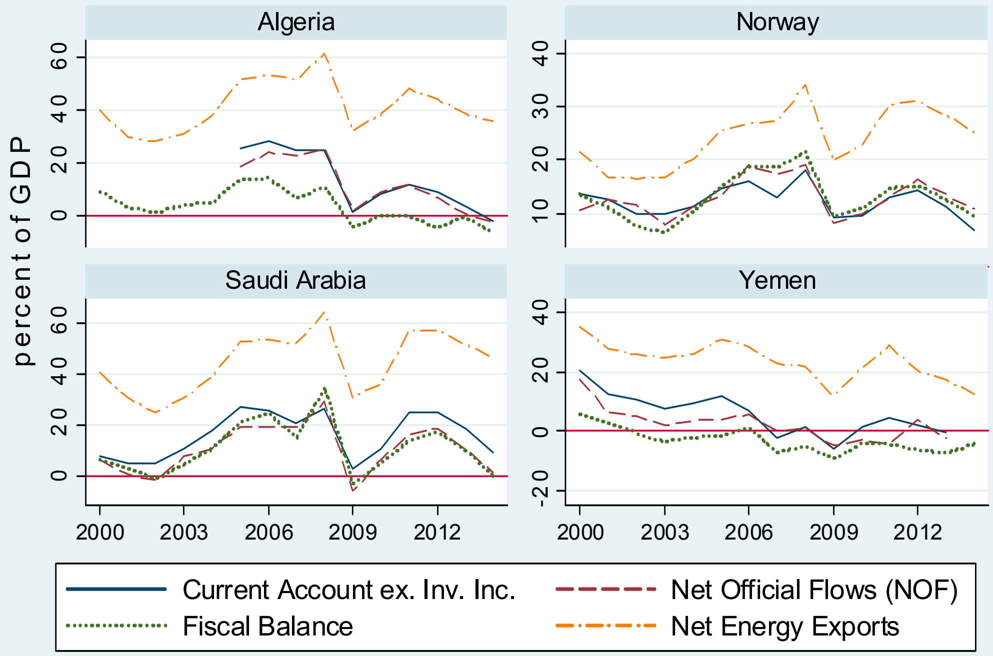


Figure 2.7. Energy Exporters with Small NOF