

# **THE DEMAND FOR MONEY AROUND THE END OF CIVIL WARS \***

**Ibrahim A. Elbadawi \***

**Klaus Schmidt-Hebbel \*\***

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## **Abstract**

This paper analyzes the empirical behavior of the demand for real balances in countries that have gone through an armed conflict and in comparison to non-conflict countries. The empirical analysis is based on annual data for a large panel comprised by 99 countries (including 48 civil-war countries) and covering three decades, from 1975 through 2004. The results show that money demand is highly unstable during the conflict cycle. After peace onset, significant real monetization takes place in countries that have suffered from civil wars. Monetization results from output recovery and inflation stabilization observed immediately after conflict resolution. However, the elasticities of real money demand to income and the cost of holding money also change significantly around the end of civil wars. Therefore strong monetization and structural changes in money demand should be carefully considered by authorities responsible for monetary policy and macroeconomic stabilization at the end of conflicts.

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\*\* The World Bank. Email: [ielbadawi@bcentral.cl](mailto:ielbadawi@bcentral.cl)

\*\*\* Central Bank of Chile. Email: [kschmidt@bcentral.cl](mailto:kschmidt@bcentral.cl)

## 1. Introduction

The literature on macroeconomic policy in post-conflict experiences has been largely confined to fiscal policy, aid effectiveness, and growth. In contrast, little is known about exchange-rate and monetary policy around the end of civil wars. However, particular features of conflict and post-conflict economies may have significant implications for the design of “appropriate” monetary and exchange rate policy for these countries. For example, standard money-based stabilization may be deflationary if it does not account for possible structural shifts in the demand for money during conflicts or after their resolution. It has been argued that as institutions for contract enforcement start to break down during civil wars and the collapse of social order, agents might choose to disengage from transaction-providing activities (e.g. transport and commerce) and asset-providing activities (transport), as well as economic sectors that are intensive in assets and/or transactions, such as manufacturing. As the latter institutions are built-up following the end of conflicts, the same sectors that are most severely impacted by wars are likely to be the ones that would experience the most dynamic recovery following end of conflicts (Collier, 1999).

Naturally civil wars cause immediate and substantial decline of output, and when they last for long enough time they can also destroy the physical, human, and social capital of affected countries.<sup>1</sup> The loss of productive capital takes more time to reverse than the recovery of output (conditional on lower capital) after the end of civil wars. These consequences of civil wars have been documented in the various strands of the literature.<sup>2</sup> Collier (1999a) estimates a cross-country growth model that accounts for the duration and legacy of civil wars and finds that, relative to the counter-factual of peace, the marginal effect of a civil war causes per-capita output to decline by about 2% per annum during wars. In short civil wars the growth decline is likely to continue during the immediate post-conflict period due to low desired capital (and hence very low investment) in response to high perceived risks of conflict renewal. Collier distinguishes between five channels through which conflicts are likely to affect the economy. The most direct channel is the destruction of physical assets. Second, government spending is diverted from productive sectors, such as education and infrastructure, to military expenditure. Third, the collapse of contract enforcement raises transactions costs and lowers the cost of opportunistic behavior, leading to a breakdown of social capital. Fourth, as income levels are seen as temporarily low, saving – a fundamental source of domestic investment – declines. Finally, as investment opportunities are unusually poor and risky during conflicts, agents shift their assets abroad.

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<sup>1</sup> Social capital is defined as “the features of social organization, such as trust, norms, and networks that can improve the efficiency of society by facilitating coordinated actions”.

<sup>2</sup> See, for example, the cross-country studies by Addison et al. (2001, 2002), Collier (1999a), Caplan (2002), FitzGerald (1997), Gupta et al. (2004), Staines (2004). There are also numerous case studies, including those in Fosu and Collier (2004) and the country studies by Collier (1999b), Elbadawi (1999), and Starr (2004).

Analyzing data from Uganda, Collier (1999a, b) shows that the latter channels have affect not only aggregate output but also its composition. Relative to aggregate output, the sectors that are intensive in, or are suppliers of, capital and transactions – including manufacturing, construction, transport, distribution, and finance – suffer larger losses during conflicts and therefore experience stronger recoveries in post-conflict. On the other hand, those sectors that are less intensive in capital and transactions experience the opposite cycle: their GDP shares grow during conflicts and decline in post-conflict periods.

The case for structural shifts in the demand for money before and after the end of civil wars, we will argue, hinges on the disruption of transaction and asset-related activities during conflicts. Therefore, we may expect a corresponding cycle in the demand for money linked to transaction motives. It is also possible that the perceived risk of conflict renewal is another source of instability in money demand, beyond the traditional factors that determine the opportunity cost of holding money. However, to the extent that the perceived risk of conflicts is an important determinant of agents' expectations of inflation or exchange-rate devaluation, it will be difficult to disentangle its independent influence. In a related analysis that focuses on financial development, Addison et al. (2002) find that conflicts have robust negative effects on financial development indicators, including risk sharing and information services by banks, as well as overall financial depth. They argue that the combination of low confidence in domestic money holdings and the collapse of contract enforcement are the main channels through which civil wars (and severe state failure) could inhibit financial development.

In this paper we analyze the empirical behavior of the demand for real balances in countries that have gone through an armed conflict and in comparison to non-conflict countries. We focus on evidence about money demand instability during pre-conflict, conflict, and post-conflict periods. The empirical analysis is based on annual data for a large panel comprised by 99 countries (including 48 civil-war countries) and covering three decades, from 1975 through 2004.

The paper is organized as follows. Section 2 reviews specification, estimation, and data measurement issues that are relevant to our analysis. Section 3 describes data sources and definitions. We conduct a preliminary analysis of the evidence in section 4, using an event-study approach to identify the behavior of real money holdings and its main determinants (real GDP and alternative measures of the cost of holding money), and their correlations, during the conflict cycle. Section 5 reports empirical results for the behavior of the long-run demand for money it the world at large and in conflict countries in particular, including unit-root and co-integration test results and coefficient estimates, focusing on evidence for instability during the conflict cycle. Section 6 concludes.

## **2. The demand for money: Empirical specification issues**

Macroeconomic theory suggests that the demand for money is a function of an appropriate scale variable and a vector of returns and opportunity cost variables that

reflect the forgone earnings due to holding alternative interest-bearing assets.<sup>3</sup> Empirical work on money demand has usually focused on the following long-run specification,<sup>4</sup>

$$m - p = \theta_0 + \theta_y y + \theta_r r + \varepsilon \quad (2.1)$$

where  $m$ ,  $p$ , and  $y$  are the natural logarithms of nominal money, the price level, and the constant-price scale variable (represented here by income), respectively;  $r$  is a vector of nominal returns on different assets. Parameter  $\theta_y$  represents the elasticity of the demand for real money balances with respect to income, which under standard conditions is positive, i.e.,  $\theta_y > 0$ <sup>5</sup>,  $\theta_r$  is a vector of parameters representing the semi-elasticities of money demand with respect to own rates of return and to alternative asset returns. The expected signs of the parameters in the vector  $\theta_r$  are positive for the returns in  $r$  relative to money components (own rates) and negative if returns are relative to financial assets alternative to money (outside rates).

Regarding the choice of the scale variable, the standard portfolio theory of asset demands suggests using financial wealth as the appropriate scale variable. According to transaction theories of money, a flow variable such as real GDP or real private consumption is the appropriate scale variable, depending on the choice of (narrow or broad) money and the agents that hold money. Following many empirical studies, we choose M1 (currency and non-interest demand deposits at commercial banks) as our measure of monetary holdings and real GDP as our scale variable. An important consideration for the choice of the latter measures, as well as the subsequent selection of rates of return, is data availability for our large country panel.

On the vector of rates of return, money demand depends on the own rate(s) of return of money and the rates of return of alternative assets (Ericsson, 1998). In our study we consider four alternative measures of the cost of holding money: the domestic rate of inflation (as a proxy for inflation expectations), the domestic interest rate, the rate of nominal exchange-rate depreciation (as a proxy for exchange-rate depreciation expectations), and the foreign interest rate augmented by the rate of nominal exchange-rate depreciation. We use actual one-period-ahead measures of inflation and exchange-rate depreciation as proxies for expected values due to restrictions imposed by data availability.

Inclusion of (expected) inflation has its theoretical foundation in Friedman (1956, 1959). According to Arestis (1988), the real value of money falls with inflation while that of real

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<sup>3</sup> The choice of scale variable depends on the theory in which the demand of money is embedded and the corresponding agents that hold money. The choice of opportunity cost variables depends on the alternative asset returns held by the agents. Detailed discussions of the literature on money demand are found in Barnett, Fischer, and Serlitis (1992), Ericsson (1998), Sririam (1999), Soto and Mies (2000), and Duca and VanHoose (2004).

<sup>4</sup> A standard assumption implicit in the following is that money demand and supply equilibrium holds. i.e.,  $m$  denotes both money demanded and actually held.

<sup>5</sup> For example, the simply quantitative theory of money predicts a unitary income elasticity,  $\theta_y = 1$ .

assets is maintained; hence there is an incentive for agents to switch out of money and into real assets when inflation expectations rise. Domowitz and Elbadawi (1987) and Easterly, Mauro, and Schmidt-Hebbel (1995) claim that in countries where financial assets do not constitute good substitutes for cash balances or are experiencing high inflation, the rate of inflation is a dominant measure of the opportunity cost of holding money.

Easterly et al. (1995) specify and use three alternative measures of the cost of inflation:

(i) a conventional measure of inflation, defined as the percentage rate of change of the

$$\text{price index, } \pi_t = \frac{P_t - P_{t-1}}{P_{t-1}};$$

(ii) a discrete-time change in the natural logarithm of the price level,  $\ln p_t - \ln p_{t-1}$ ; and

(iii) the capital loss due to inflation,  $\frac{\pi_t}{1 + \pi_t}$ .

The third measure is theoretically consistent for discrete-time variables and therefore the most appropriate measure of the inflation cost of holding money (as shown for example by Calvo and Leiderman 1992). By assuming that agents have perfect foresight we use the forward-looking proxy for the expected cost of inflation:  $\frac{\pi_{t+1}}{1 + \pi_{t+1}}$ .

Regarding the returns on financial assets alternative to money, several empirical studies use short-term interest rates like yields on government securities, commercial papers or saving deposits. We use the nominal interest rate on demand deposits at banks and, akin to the cost of inflation, we specify the consistent measure of the cost of holding money as

$$\frac{i_t}{1 + i_t} \text{ (Easterly et al. 1995, Walsh 2003).}$$

In most economies, domestic holders of domestic money face the option of holding – legally or otherwise – foreign assets, including foreign money and foreign financial assets. Therefore the corresponding alternative costs are the (expected) rate of exchange rate depreciation (when the alternative is holding non-interest bearing foreign money) and the foreign interest rate augmented by the rate of nominal exchange-rate depreciation (when the alternative is holding interest-bearing foreign assets). Again, assuming perfect foresight, we use the theoretically-consistent, forward-looking cost due to nominal exchange-rate depreciation,  $\frac{\Delta e_{t+1}}{1 + \Delta e_{t+1}}$ , and due to the foreign interest rate augmented by

the rate of nominal exchange-rate depreciation,  $\frac{i_{\text{int}}}{1 + i_{\text{int}}} = \frac{(1 + i_t^*)(1 + \Delta e_{t+1})}{1 + (1 + i_t^*)(1 + \Delta e_{t+1})}$ . For convenience, we will refer to the latter expression as the international arbitrage rate.

### 3. Data sources and definitions

Now we briefly describe the sources and definitions of the data used in the subsequent empirical analysis. We use annual data for a large country sample comprised by 99 countries covering three decades, from 1975 through 2004. The main data sources are the IMF's International Financial Statistics, The World Bank's World Development Indicators, and the OECD's Economic Outlook Database. The full list of countries in our sample and a more detailed description of data sources and variable definitions are provided in Appendix 2. Descriptive statistics for each variable and country are reported in Appendix 3.

As noted above, our measure for money is M1. For most of the countries in the sample, the price level is measured as the Consumer Price Index (CPI) but for some countries, for which CPI data is not available, we use the GDP deflator. Accordingly, the cost of inflation is calculated using the annual change of the CPI or the GDP deflator. For the three other measures of the alternative cost of holding money we use the nominal interest rate on domestic time and savings deposits, the rate of change of the nominal exchange rate (the price of the US\$ in local currency units), and LIBOR (the London Interbank Offered Rate). The scale variable is constant-price domestic GDP.

In our 99-country sample, 48 countries were involved in at least one civil war within the 1975-2004 sample period. In order to identify periods of conflict with clear start and end dates, we use the definition of civil war and the data presented in Sambanis (2004) and Doyle and Sambanis (2005). As presented in the latter reference, an armed conflict is defined as a civil war if the conflict caused more than 1,000 deaths, jeopardized state sovereignty or involved the state as a combatant. Appendix 1 presents the 48 countries and the dates identified as conflict periods. In many cases, countries experienced a sequence of conflicts that were separated by short periods of peace (i.e., less than five years). In the latter cases, both conflicts were treated as a single conflict, including the short inter-war peace. However, when the two conflicts were separated by at least five years of peace in between, they were treated as independent conflict periods. Under this convention, 3 countries experienced two separate conflicts, giving a total number of 51 civil wars suffered by 48 countries. The country distribution by time periods of pre-conflict, conflict, and post-conflict is depicted in Figure 1. Civil-war countries experienced between 1 and 28 years of armed conflict between 1975 and 2004, with a median conflict length of 11 years.

### 4. A first look at the evidence

For a first look at the evidence, we adopt an event-study approach to explore the changes in our core variables when countries shift from peace-time periods to armed conflict and then to post-conflict peace. Our event-study approach follows previous cross-country empirical work, including Bruno and Easterly's (1998) on macroeconomic stabilization and, more recently, Chen, Loayza, and Reynal-Querol's (2005) on growth during and after civil wars. Following the latter studies, we reorganize the data around the beginning and end of conflicts converting calendar time into event time. This exercise will shed

light on the dynamics of money and its determinants in conflict countries, as a useful preview of the econometric analysis performed in the following section.

We start by exploring co-movements between real money balances, real GDP, and the costs of holding money (measured by inflation, the nominal interest rate, exchange-rate depreciation, and the international arbitrage rate) in countries that experienced armed conflict. We compute correlations between the log of the share of real money balances to GDP, the log of real GDP, and the four measures of alternative costs of holding money. Since our variables might be non-stationary, we also compute correlations between variables in first differences. Correlation coefficients are reported in Appendix 4 separately for pre-conflict, conflict, and post-conflict periods.<sup>6</sup>

We find that for all three periods, the money share to GDP ( $m - p - y$ ) shows negative correlations with the four cost measures, and most of these are statistically significant. Magnitudes of correlations decline in conflicts and tend to remain lower than in pre-conflict after peace onset. For example, the correlation coefficient of money with inflation is -0.21 before conflict and declines to -0.06 during conflict and -0.02 after conflict – and the two latter correlations are not significantly different from zero. This may suggest that conflict makes it harder to substitute away from money – in response to higher alternative costs, such as inflation – due to difficulties of acquiring alternative assets during conflict and, possibly, in the first years after the end of civil war. The correlations between real money growth rates and inflation changes (reported in the next 3 matrixes of Appendix 4) confirm the latter results: correlations decline during conflicts. Regarding the correlations between real money growth and the three other measures of alternative costs, the results are more ambiguous. Finally, both panel and cross-section correlations between real money growth and real GDP growth exhibit a similar pattern than that observed for the correlation between money growth and inflation change: they decline significantly between pre-conflict and conflict periods, and recover somewhat in post-conflict.

To explore more deeply the effects of the start and end of armed conflict, we compare now the behavior of money and its determinants in pre-conflict against conflict periods, in conflict against post-conflict periods, and in pre-conflict against post-conflict periods. Figure 2 depicts the mean sample values of real money growth, real GDP growth, inflation, the nominal domestic interest rate, the real domestic interest rate, and the rate of nominal exchange-rate depreciation for each of 10 years during pre-conflict, conflict, and post-conflict. Each data point represents the cross-section mean value of the corresponding variable for a varying country group whose size and composition changes along the event timeline. (Recall that Figure 1 reports the corresponding number of conflict countries for each year during the event-timeline). For example, when war starts

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<sup>6</sup> The first table in Appendix 4 reports panel correlations between the money to GDP share and the four alternative cost measures, for pre-conflict, conflict, and post-conflict periods. The subsequent three matrices – for pre-conflict, conflict, and post-conflict periods – report correlations between the rate of growth of real money balances and the rates of growth of real GDP and the four alternative cost measures. Panel correlations are reported in each lower triangular sub-matrix and cross-section correlations are reported in each upper triangular sub-matrix.

all countries belong to the sample, but as we move forward in event-time and countries attain a resolution to their armed conflict, the number of countries in conflict declines accordingly.

The graphic evidence in Figure 2 reflects that real money growth is lower before and during conflict than after peace is achieved. The mean growth rate of real money balances rises from around 2.1% during conflict to 5.8% once peace is achieved. GDP growth is severely reduced at the onset of conflict but tends to recover as conflict proceeds. Average GDP growth falls from 2.3% in pre-conflict to 1% during conflict, rising to a high rate of 4.5% in post-conflict. Inflation – which tends to rise over the conflict period – falls immediately with peace onset, to levels below those recorded in pre-conflict times. The opposite is observed in the case of domestic nominal interest rates: their average level increases in post-conflict in comparison to conflict and pre-conflict times. Therefore the average ex-post real interest rate – which is typically negative during most of the pre-conflict and conflict years – rises to small, positive levels after peace onset. Average nominal exchange-rate depreciation exhibits a dynamic pattern over the conflict cycle – and even values – that are very similar to those of inflation: rising during conflict years and declining to much lower levels from the start of peace onwards.

In order to explore the statistical significance of the latter results we perform comparisons of the mean of each variable across the three pairs of event periods. We do this by using a fixed-effect panel estimation to control for country-specific characteristics. This event-study methodology restricts its application to countries that have experienced the corresponding pairs of events under study.

Table 1 presents the results of estimating a fixed-effects model reporting the difference in means of each variable of interest for each of the three bi-period comparisons. In line with our previous results, we find that real money growth before conflict is 1.7% higher (but not statistically significantly different) than in conflict periods, while it rises significantly, by 6.4%, between conflict and post-conflict. Likewise, GDP growth is about 3.9% lower during conflict than before conflict, increasing significantly in post-conflict. The ratio of real money holdings to real GDP declines significantly during post-conflict, possibly a result of more financial diversification options as a result of peace.

Finally, post-conflict periods are also characterized by lower costs of holding money across our four measures – and most of these reductions are statistically significant. However, real interest rates rise significantly after peace onset.

In sum, the results show that the conflict period is characterized by low (and even negative) real GDP growth rates and rising inflation and nominal exchange-rate devaluation. After the start of peace, growth rates of real money holdings and of GDP exceed those observed during conflict and pre-conflict periods, while monetary stabilization is reflected in significantly lower inflation and lower exchange-rate devaluation rates than those observed in both preceding periods. While nominal interest rates are lower in post-conflict than in conflict periods, their reduction is less than the

decline in inflation rates, pushing real ex-post interest rates to low but positive levels, well above the negative real rates observed in pre-conflict and conflict periods.

## 5. Money demand during the conflict cycle

In this section we test for the behavior of money demand in conflict countries during the conflict cycle and in comparison to our control group of non-conflict countries. We focus on evidence about money demand instability during pre-conflict, conflict, and post-conflict periods. Our aim is to track down if this instability can be characterized by a change in the level, the income elasticity or the opportunity cost semi-elasticity of money demand.

We follow the empirical approach of specifying a long-run money demand as a co-integrating relationship but use panel co-integration techniques that allow us to pool information to extract common long-run relationships across our panel sample, while allowing for country fixed effects. We base our estimations on the following long-run money demand equation,

$$m_{it} - p_{it} = \theta_0 + \theta_y y_{it} + \theta_\pi r_{it} + \mu_i + v_{it} \quad (5.1)$$

where  $m_{it}$ ,  $p_{it}$ , and  $y_{it}$  are the natural logarithms of nominal money, the price level and real GDP for country  $i$  at time  $t$ , respectively. For the opportunity cost of holding money,  $r_{it}$ , we use the four alternative cost measures that were introduced above. Finally,  $\mu_i$  is a fixed country specific characteristic.

In order to assess the stability of money demand in countries involved in civil war we modify the latter base-line model by introducing three dummy variables,  $d_{pre,it}$  (equal to 1 in pre-conflict periods, 0 otherwise),  $d_{conf,it}$  (equal to 1 in conflict periods, 0 otherwise), and  $d_{post,it}$  (equal to 1 in post-conflict periods, 0 otherwise).<sup>7</sup> Thus we estimate the following money demand equation,

$$\begin{aligned} m_{it} - p_{it} = & \theta_{10} + \theta_{20} d_{pre,it} + \theta_{30} d_{conf,it} + \theta_{40} d_{post,it} \\ & + \theta_{1y} y_{it} + \theta_{2y} d_{pre,it} y_{it} + \theta_{3y} d_{conf,it} y_{it} + \theta_{4y} d_{post,it} y_{it} \\ & + \theta_{1\pi} r_{it} + \theta_{2\pi} d_{pre,it} r_{it} + \theta_{3\pi} d_{conf,it} r_{it} + \theta_{4\pi} d_{post,it} r_{it} + \mu_i + v_{it} \end{aligned} \quad (5.2)$$

The appropriate estimation technique for the long-run money demand will depend on the time-series behavior of real money, output, and the opportunity cost measures of holding money. Therefore we will rely on recently developed panel co-integration techniques to

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<sup>7</sup> For our control group of countries that have not experienced civil wars in our 1975-2004 sample period, the three dummy variables take a value of 1 throughout the full sample period.

test for the presence of unit roots and co-integration as well as for the estimation of co-integrated regression models, to obtain estimates for parameters  $\theta_y$  and  $\theta_r$ .

### 5.1 Panel unit root and co-integration tests

We start by testing for the existence of unit roots in the variables under study, relying on unit roots tests developed by Hadri (2000) and Im, Pesaran and Shin (2003). The Im, Pesaran and Shin (IPS)  $t$ -bar statistic is defined as the average of individual augmented Dickey-Fuller (ADF) statistics and tests the null hypothesis that each series in the panel contains a unit root. On the other hand, Hadri proposes a residual-based Lagrange multiplier (LM) test where the null hypothesis is that there is no unit root in any of the series in the panel against the alternative of a unit root.<sup>8</sup> Since we want to prove that the variables under study are non-stationary, the appropriate hypothesis is the one tested by Hadri (2000). However, for robustness we conduct both tests on each variable, allowing for heterogeneous intercepts. Hadri's tests,  $LM_1$  with heterogeneous residuals and  $LM_2$  with serially dependent residuals, indicate that the null hypotheses of stationarity for the dependent and explanatory variables are rejected at the 1% significance level. The results based on the IPS  $t$ -bar tests show that the null hypotheses of non-stationarity for the dependent and explanatory variables cannot be rejected at the 10% significance level for most variables. The only exceptions are the nominal exchange-rate devaluation and the international arbitrage rate (see Appendix 5).

Since the panel unit root tests suggest that the variables under study are non-stationary, we need to test the existence of panel cointegration in all of the specifications of the model in order to reject the possibility that the associated regressions are spurious. We apply the panel co-integration tests developed by Kao (1999) and Pedroni (1995, 1997). These tests are a generalization of time-series co-integration tests for panel data. Therefore they test if the residual,

$$\begin{aligned} v_{it} = & m_{it} - p_{it} - \theta_{i0} - \theta_{1y} y_{it} - \theta_{2y} d_{pre,it} y_{it} - \theta_{3y} d_{conf,it} y_{it} - \theta_{4y} d_{post,it} y_{it} \\ & - \theta_{1r} r_{it} - \theta_{2r} d_{pre,it} r_{it} - \theta_{3r} d_{conf,it} r_{it} - \theta_{4r} d_{post,it} r_{it} - \mu_i \end{aligned} \quad (5.3)$$

is stationary, implying the existence of a co-integration vector. Annex 5 reports the results of the DF and ADF-type tests suggested by Kao (1999) and the two tests presented in Pedroni (1995, 1997). All statistics test the null hypothesis of no co-integration. The results show that the null hypothesis of no co-integration is rejected for all models. Therefore we can proceed with estimating the co-integration vector and be confident that the regressions do not reflect spurious relationships. Hence the coefficient estimates can be interpreted as representing long-term relationships between the variables (see Appendix 6).

### 5.2 Estimation results

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<sup>8</sup> Appendix 7 contains a brief description of the tests used in this section. For a more detailed exposition see Breitung and Pesaran (2005).

We estimate the cointegration vector using the Dynamic Least Squares (DOLS) estimator proposed by Kao and Chiang (1999). In contrast to the OLS estimator, this method is not inconsistent and does not suffer from finite-sample bias, making it the most appropriate technique for the problem at hand.<sup>9</sup> The estimation results for the full 99-country sample and for each of the four alternative measures of the cost of holding money are reported in Table 2. Next, in Table 3, we report results for the sub-sample of 48 conflict countries, using the inflation cost of holding money and controlling for different country features, as discussed below.

In Table 2 we report the full-sample results in the first sub-column of each of the four columns for equation (5.1) (assuming common coefficients for non-conflict and conflict countries) and in the second sub-column of each of the four columns for equation (5.2) (allowing for different coefficients for pre-conflict, conflict, and post-conflict periods). For the full-sample common-coefficient results reported in the first sub-columns and for the non-conflict sub-sample in the reported in the second sub-columns, we find that estimated coefficients of the scale variable and of all cost variables exhibit expected signs and are surprisingly precisely estimated; all are statistically significant at 1% confidence levels. Therefore we find strong world evidence in favor of a conventional specification for the long-run relationship between M1 and its determinants, consistent with economic theory. However, for the sub-sample of conflict countries we find significant differences in coefficients across different periods and with the coefficients estimated for non-conflict countries.

The world income elasticity of money demand lies between 0.61 and 0.86 (see first sub-columns). However, the latter range masks significant differences (see second sub-columns) between the non-conflict country group (where income elasticities range between 0.78 and 1.04) and the conflict country group (where income elasticities range between 0.48 and 0.82). Conflict countries present an income elasticity that varies between pre-conflict, conflict, and post-conflict periods. The income elasticity is about 0.63 in pre-conflict, it declines to 0.53 during conflict, and rises back slightly, to 0.56, when conflict comes to an end. However, the results suggest that the differences in income elasticities between conflict periods are not statistically different. Hence we only find evidence of significant differences in income elasticities between non-conflict and conflict countries but our evidence suggests that this elasticity does not change significantly over the conflict cycle.

The worlds' semi-elasticities of money demand with respect to alternatives measures of money holding costs vary between -0.65 (for the inflation cost measure) and -1.13 (for the domestic interest cost measure). However, only in the case of the inflation cost measure, the semi-elasticity is significantly and robustly larger for non-conflict than for conflict countries; for the other three measures the results depend on the particular period considered for conflict countries. Behind the -0.65 estimate for the semi-elasticity of world money demand with respect to inflation lies an estimated semi-elasticity of -1.22 for non-conflict countries, which exceeds massively and significantly the estimates for

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<sup>9</sup> See Appendix 8 for a brief discussion of the differences between OLS and DOLS estimators.

conflict countries, which are -0.74 for pre-conflict, not significantly different from zero for conflict, and -0.38 for post-conflict periods.<sup>10</sup>

The semi-elasticity with respect to the domestic interest rate is even more unstable than that of inflation, shifting from -2.68 in pre-conflict to -0.18 during conflict, and partly back to -0.70 in post-conflict. The estimated semi-elasticities of money demand with respect to nominal devaluation and the international arbitrage rate are comparatively more stable and generally smaller in magnitude than those estimated for non-conflict countries.

Now we conduct robustness tests of the preceding results, investigating if our results on instability of money demand are driven by a specific sub-group of conflict countries. We do this by controlling for three particular country features: high inflation, long conflicts, and conflicts ended by a peace treaty. On the first feature, it is possible that parameter instability could be largely driven by high inflation. The literature on conflict also suggests that civil-war duration and conflicts ended by treaty (instead of victory imposed by one of combating parties) may affect instability. Therefore we estimate money demand allowing separately for the effects of the latter features on parameter estimates.

Table 3 reports the corresponding estimation results for a variant of equation (5.2), restricted to the sample of conflict countries and to the inflation measure of the cost of holding; on the latter measure, results are comparable to those presented in column 2 of Table 2.

We start by reporting the results of the baseline regression for the full sub-sample of conflict countries in column 1 of Table 3, which are identical – as they should be – to those reported for conflict countries in the second sub-column of column 2 in Table 2.

Column 2 in Table 3 expands the latter regression by introducing separate pre-conflict and conflict dummies for high-inflation countries, defined as countries that have experienced an inflation rate above 100%, for at least one year falling within 1975-2004. High-inflation conflict countries – in contrast to low-inflation conflict countries – exhibit a very large inflation semi-elasticity (in magnitude) during pre-conflict. However, during conflict, when inflation shoots up, the inflation semi-elasticity is not significantly different from zero in high-inflation countries, like in low-inflation countries during conflict periods, confirming our previous results. Regarding the income elasticity, we find that high-inflation countries do not behave differently from low-inflation countries over the conflict cycle.

The third column makes a distinction between countries whose longest conflict lasted 10 years or more (long conflicts) and those where conflict were shorter. The results are somewhat surprising. For the income elasticity there is little evidence that it is more

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<sup>10</sup> only exception is for the semi-elasticity with respect to the nominal interest rate during pre-conflict. However, the high control over interest rates in many of these countries make this variable a bad proxy for the alternative cost of holding money and suggests caution at the time of interpreting our estimates.

unstable over the conflict cycle in countries experiencing long conflicts. However, in long-conflict countries the inflation semi-elasticity is uniformly not significantly different from zero over the conflict cycle – in contrast to shorter-conflict countries, where it is massively unstable over the cycle of conflicts.

Finally, the fourth column of Table 3 makes a distinction between countries whose conflicts ended as a result of a peace agreement (treaty conflict end) and those where it did not. While in the latter countries the income elasticity is relatively stable along the conflict cycle, it is significantly unstable in countries that ended conflicts by a treaty. The inflation semi-elasticity is also more unstable over the conflict cycle in countries that ended conflicts by treaty, in comparison to other conflict countries.

All our previous results are based on defining the length of pre-conflict, conflict, and post-conflict periods as the actual, variable-length periods of conflict that each country actually experienced during 1975-2004. In our final robustness test, we explore if our empirical results are affected by considering a fixed number of years of pre-conflict, conflict, and post-conflict periods. Therefore, we estimate money-demand equation (5.2) considering alternative definitions of the dummy variables  $d_{pre}$ ,  $d_{conf}$ , and  $d_{post}$ , as follows:  $d_{pre}(x)$ , takes a value of 1 up to  $x$  years before the conflict starts;  $d_{conf}(x)$  takes a value of 1 up to  $x$  years after the conflict starts; and  $d_{post}(x)$  takes a value of 1 up to  $x$  years after the conflict is resolved. For example, when  $x = 3$ , the conflict dummy is equal to 1 in each year, from the first to the third year after the start of conflict, and assuming that country suffers from civil war for at least 3 years. Notice that in countries where conflict length is less or equal than three years, the conflict dummy  $d_{conf}(x)$  is the same as in the previous definition, since it equals 1 in all conflict periods. In contrast, in countries where conflicts last more than three years, the dummy will only consider the first three years of conflict. Similar reasoning is used in the construction of pre-conflict and post-conflict dummies. Consequently, as  $x$  rises toward the total number of years in the sample, the estimates reported below converge to the estimates presented above, since the dummy variables under both definitions become identical.<sup>11</sup>

Figures 3 to 6 depict the income elasticity and the semi-elasticity with respect to our four cost measures for different values of  $x$  (labeled as years), ranging from 1 to 20. For example, when  $x$  equals 3 years, the depicted elasticity or semi-elasticity is calculated from the coefficients estimated by using dummies that take a value of 1 up to 3 years before (pre-conflict line), during (conflict line), and after conflict (post-conflict line). The first row of figures shows the estimated elasticities or semi-elasticities, while the second and third row present a comparison between pre-conflict and conflict estimates, and post-

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<sup>11</sup> Since our estimates consider non-conflict as well as conflict countries, we also add two more dummy variables to the estimation:  $d_{peace}$ , which captures periods that a conflict country is not going through an armed conflict but are not captured by our new definition of pre-conflict and post-conflict dummy, and  $d_{war}$ , which takes a value of 1 over the remaining periods of conflict not captured by  $d_{conf}$ . These variables contain no observations when  $x$  equals the maximum number of periods in the sample and the model estimates converge to our baseline case.

conflict and conflict estimates, identifying confidence intervals to represent the statistical significance of estimates along the conflict cycle.

For the income elasticity, most of our estimates remain stable around base-line estimates, particularly after  $x$  reaches the median conflict duration of 11 years. We also find a stable income elasticity along the conflict cycle, even under these alternative definitions of pre-conflict, conflict, and post-conflict length.

Similarly, the semi-elasticity with respect to alternative measures of the cost of holding money is negative during the post-conflict and pre-conflict periods. It also remains stable after  $x$  reaches the median conflict period for all definitions of the alternative cost of holding money, confirming our previous results. During the conflict period and after  $x$  exceeds the median conflict duration, the semi-elasticity of money demand with respect to the alternative cost of holding money is statistically no different from zero, as reported above. However, when we consider a number of conflict years smaller than the median value, the semi-elasticity is not only statistically significant but it attains a positive value, an anomaly that may be consistent with abnormal times of internal war. This result may suggest that during the first years of conflict, or during the onset of short-lived conflicts, the start of conflict combined with increasing inflation leads agents to expect heightened macroeconomic and financial chaos. The latter, combined to a growing difficulty of substituting into alternative financial assets as a result of the civil war, may lead agents to raise monetary holdings during these abnormal times.

### 5.3 Decomposition of the change in real money balances

Now we will make use of our empirical results to decompose the predicted (and observed) average increase in real money holdings between conflict and post-conflict periods, according to the observed changes in money demand determinants and the estimated changes in demand elasticities. The estimated change of real money balances can be expressed as,

$$\begin{aligned} (m-p)_{post} - (m-p)_{conf} = & \hat{\theta}_{1y}(y_{post} - y_{conf}) + \hat{\theta}_{1\pi}(r_{post} - r_{conf}) + \hat{\theta}_{40}d_{post} - \hat{\theta}_{30}d_{conf} \\ & + \hat{\theta}_{4y}d_{post}y_{post} - \hat{\theta}_{3y}d_{conf}y_{conf} + \hat{\theta}_{4\pi}d_{post}r_{post} - \hat{\theta}_{3\pi}d_{conf}r_{conf} \end{aligned} \quad (5.4)$$

where the term  $\hat{\theta}_{1y}(y_{post} - y_{conf}) + \hat{\theta}_{1\pi}(r_{post} - r_{conf})$  represents the estimated change in money demand between conflict and post-conflict periods due to changes in GDP and in the opportunity cost of money holdings; the additional terms represent changes in money demand due to changes in estimated coefficients. A final term captures the change in the dynamics of the equation.<sup>12</sup>

Table 4 summarizes the results of the latter exercise, based on the parameters that were obtained for the full sample of conflict countries and using inflation as the cost measure

<sup>12</sup> The term for the dynamics, not included in equation (5.4), is derived from the assumption of DOLS estimation that independent variables are integrated of order 1 (see Appendix 8).

(columns 2, Table 2). We calculate the terms of equation (5.4) for each country and report the median value of each term. As shown in Table 4, the average increase in actual real monetary holdings is close to 20% between conflict and post-conflict periods. The estimated rise in real money holdings is approximately 25%. More than the latter percentage rise in real M1 is explained by the changes in money demand determinants: the combined effect of higher real GDP (plus 20%) and lower inflation (plus 9%) adds up to 29%. Conversely, the combined effect of the changes in parameters is -15%, due to a massive 105% rise in money demand stemming from the significantly higher income elasticity and an equivalently large 107% decline in money demand due to the intercept reduction between conflict and post-conflict. The increased inflation elasticity contributes by -13% to lower money holdings. Finally, the changes in independent-variable dynamics contribute 11% of the rise in real money holdings after the onset of peace.

## 6. Conclusions

In this paper we have analyzed the behavior of the demand for real balances in 48 countries that have gone through an armed conflict between 1975 and 2004, in comparison to a control group of 51 non-conflict countries. We investigate the behavior of the long-run demand of money during pre-conflict, conflict, and post-conflict periods and test the stability of the income elasticity and of the semi-elasticity with respect to different measures of the opportunity cost of holding money.

For a first look at the evidence, we adopt an event-study approach to explore the changes in money holdings and its determinants when countries shift from peace-time periods to armed conflict and then to post-conflict peace. The event-study results show that the conflict period is characterized by low (and even negative) real GDP growth rates and rising inflation and nominal exchange-rate devaluation. After the start of peace, growth rates of real money holdings and of GDP exceed those observed during conflict and pre-conflict periods, while monetary stabilization is reflected in significantly lower inflation and lower exchange-rate devaluation rates than those observed in both preceding periods. While nominal interest rates are lower in post-conflict than in conflict periods, their reduction is less than the decline in inflation rates, pushing real ex-post interest rates to low but positive levels, well above the negative real rates observed in pre-conflict and conflict periods.

Next we test for the behavior of money demand in conflict countries during the conflict cycle and in comparison to our control group of non-conflict countries. We focus on evidence about money demand instability during pre-conflict, conflict, and post-conflict periods. Our aim is to track down if this instability can be characterized by a change in the level, the income elasticity or the opportunity cost semi-elasticity of money demand. We follow the empirical approach of specifying a long-run money demand as a co-integrating relationship but use panel co-integration techniques that allow us to pool information to extract common long-run relationships across our panel sample, while allowing for country fixed effects.

The appropriate estimation technique for the long-run money demand will depend on the time-series behavior of real money, output, and the opportunity cost measures of holding money. Therefore we rely on recently developed panel co-integration techniques to test for the presence of unit roots and co-integration as well as for the estimation of co-integrated regression models. Our panel unit root test results show that generally the variables under study are non-stationary. Hence we test subsequently for the existence of panel co-integration for all our model specifications. The results show that the null of no-co-integration is rejected for all models; hence the coefficient estimates represent long-term relationships between the variables.

Our empirical results for the long-run money demand are based on dynamic least squares. For the world sample results, we find that estimated coefficients of the scale variable (real GDP) and of all four alternative cost variables exhibit expected signs and are surprisingly precisely estimated; all are statistically significant at 1% confidence levels. Therefore we find strong world evidence in favor of a conventional specification for the long-run relationship between M1 and its determinants, consistent with economic theory. For the sub-sample of conflict countries we find significant differences in coefficients across different periods and with the coefficients estimated for non-conflict countries.

The world income elasticity of money demand lies between 0.61 and 0.86 (see first sub-columns). However, the latter range masks significant differences (see second sub-columns) between the non-conflict country group (where income elasticities range between 0.78 and 1.04) and the conflict country group (where income elasticities range between 0.48 and 0.82). Conflict countries present an income elasticity that varies between pre-conflict, conflict, and post-conflict periods. The income elasticity is about 0.63 in pre-conflict, it declines to 0.53 during conflict, and rises back slightly, to 0.56, when conflict comes to an end. However, the results suggest that the differences in income elasticities between conflict periods are not statistically different. Hence we only find evidence of significant differences in income elasticities between non-conflict and conflict countries but our evidence suggests that this elasticity does not change significantly over the conflict cycle.

The worlds' semi-elasticities of money demand with respect to alternatives measures of money holding costs vary between -0.65 (for the inflation cost measure) and -1.13 (for the domestic interest cost measure). However, only in the case of the inflation cost measure, the semi-elasticity is significantly and robustly larger for non-conflict than for conflict countries; for the other three measures the results depend on the particular period considered for conflict countries. Behind the -0.65 estimate for the semi-elasticity of world money demand with respect to inflation lies an estimated semi-elasticity of -1.22 for non-conflict countries, which exceeds massively and significantly the estimates for conflict countries, which are -0.74 for pre-conflict, not significantly different from zero for conflict, and -0.38 for post-conflict periods.<sup>13</sup>

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<sup>13</sup> only exception is for the semi-elasticity with respect to the nominal interest rate during pre-conflict. However, the high control over interest rates in many of these countries make this variable a bad proxy for the alternative cost of holding money and suggests caution at the time of interpreting our estimates.

The semi-elasticity with respect to the domestic interest rate is even more unstable than that of inflation, shifting from -2.68 in pre-conflict to -0.18 during conflict, and partly back to -0.70 in post-conflict. The estimated semi-elasticities of money demand with respect to nominal devaluation and the international arbitrage rate are comparatively more stable and generally smaller in magnitude than those estimated for non-conflict countries.

Next we conduct robustness tests of the preceding results, investigating if our results on instability of money demand are driven by a specific sub-group of conflict countries. We do this by controlling for three particular country features: high inflation, long conflicts, and conflicts ended by a peace treaty. We also test if our results change are affected by considering fixed numbers of pre-conflict, conflict, and post-conflict years instead of the actual variable number of conflict years observed in each case, which underlies our preceding results. Generally we confirm that our previous results are robust to alternative specifications and conflict length measures.

Finally we make use of our empirical results to decompose the predicted average increase in real money holdings between conflict and post-conflict periods, according to the observed changes in money demand determinants and the estimated changes in demand elasticities. The average increase in actual real monetary holdings is close to 20% between conflict and post-conflict periods. The estimated rise in real money holdings is approximately 25%. More than the latter percentage rise in real M1 is explained by the changes in money demand determinants: the combined effect of higher real GDP (plus 20%) and lower inflation (plus 9%) adds up to 29%. Conversely, the combined effect of the changes in parameters is -15%, due to a massive 105% rise in money demand stemming from the significantly higher income elasticity and an equivalently large 107% decline in money demand due to the intercept reduction between conflict and post-conflict. The increased inflation elasticity contributes by -13% to lower money holdings. Finally, the changes in independent-variable dynamics contribute 11% of the rise in real money holdings after the onset of peace.

We conclude that M1 money demand (and therefore real monetary holdings) is highly unstable during the conflict cycle. After peace onset, significant real monetization takes place in countries that have suffered conflicts. This monetization results from output recovery and inflation stabilization observed immediately after conflict resolution. However, the sensitivities of real money demand to income and the cost of holding money also change significantly around the end of civil wars. Therefore strong monetization and structural changes in money demand should be carefully considered by authorities responsible for monetary policy and macroeconomic stabilization at the end of conflicts.

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**Table 1. Event-study estimation results for differences in variable means across pairs of events in conflict countries**

<b>Variables in Levels</b>	$m - p - y$	$\frac{\pi_{t+1}}{1 + \pi_{t+1}}$	$\frac{i_t}{1 + i_t}$	$\frac{\Delta e_{t+1}}{1 + \Delta e_{t+1}}$	$\frac{i_{int}}{1 + i_{int}}$	$\frac{1 + i_t}{1 + \pi_{t+1}}$
<i>Conflict – Pre-conflict</i>	0.060 (0.220)	0.035 (0.015)**	0.005 (0.539)	0.044 (0.021)**	0.027 (0.133)	0.025 (0.107)
Observations	428	475	338	479	479	330
Number of countries	31	33	26	32	32	26
<i>Post-conflict – Conflict</i>	-0.174 (0.000)***	-0.107 (0.000)***	-0.013 (0.043)**	-0.077 (0.000)***	-0.106 (0.000)***	0.087 (0.000)***
Observations	679	689	538	702	702	515
Number of countries	48	48	46	48	48	46
<i>Post-conflict – Pre-conflict</i>	-0.237 (0.000)***	-0.066 (0.000)***	-0.012 (0.219)	-0.050 (0.011)**	-0.084 (0.000)***	0.070 (0.000)***
Observations	365	396	322	400	400	315
Number of countries	28	29	28	29	29	28
<b>Variables in First Differences</b>	$\Delta(m - p)$	$\Delta y$	$\Delta \frac{\pi_{t+1}}{1 + \pi_{t+1}}$	$\Delta \frac{i_t}{1 + i_t}$	$\Delta \frac{\Delta e_{t+1}}{1 + \Delta e_{t+1}}$	$\Delta \frac{i_{int}}{1 + i_{int}}$
<i>Conflict – Pre-conflict</i>	-0.017 (0.469)	-0.039 (0.000)***	-0.004 (0.760)	-0.002 (0.781)	0.006 (0.812)	0.002 (0.931)
Observations	433	463	459	318	464	464
Number of countries	32	33	33	26	32	32
<i>Post-conflict – Conflict</i>	0.064 (0.000)***	0.043 (0.000)***	-0.017 (0.086)*	-0.006 (0.203)	-0.027 (0.173)	-0.030 (0.115)
Observations	680	702	690	684	511	700
Number of countries	48	48	48	48	46	48
<i>Post-conflict – Pre-conflict</i>	0.031 (0.225)	0.013 (0.015)**	-0.015 (0.247)	-0.002 (0.740)	-0.009 (0.736)	-0.015 (0.559)
Observations	367	387	383	304	385	385
Number of countries	29	29	29	28	29	29

Note: p values are reported in parentheses.

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.

**Table 2. Long-run money demand estimation results for full country sample and alternative cost measures (DOLS)**  
*Dependent variable: log of real money balances*

	$r = i / (1 + i)$	$r = \pi_{t+1} / (1 + \pi_{t+1})$	$r = \Delta e_{t+1} / (1 + \Delta e_{t+1})$	$r = i_{int} / (1 + i_{int})$
$y$	0.861 (0.031)***	0.605 (0.033)***	0.634 (0.033)***	0.605 (0.035)***
$d_{pre}y$	1.037 (0.040)***	0.782 (0.046)***	0.867 (0.046)***	0.823 (0.048)***
$d_{conf}y$	-0.223 (0.068)***	-0.201 (0.072)***	-0.293 (0.074)***	-0.259 (0.076)***
$d_{post}y$	-0.333 (0.065)***	-0.301 (0.068)***	-0.390 (0.070)***	-0.356 (0.073)***
$r$	-0.345 (0.065)***	-0.262 (0.068)***	-0.355 (0.070)***	-0.322 (0.073)***
$d_{pre}r$	-1.133 (0.127)***	-1.033 (0.172)***	-0.920 (0.135)***	-0.867 (0.140)***
$d_{conf}r$	-1.645 (0.425)***	-0.652 (0.093)***	-0.670 (0.087)***	-0.712 (0.091)***
$d_{post}r$	0.852 (0.375)**	1.288 (0.216)***	0.736 (0.207)***	0.675 (0.219)***
<i>Constant</i>	0.332 (0.287)	0.839 (0.246)***	0.232 (0.242)	0.103 (0.248)
$d_{pre}$	-2.952 (0.834)***	3.995 (0.891)***	3.166 (0.903)***	4.021 (0.938)***
$d_{conf}$	-3.424 (0.875)***	-1.747 (0.490)***	-0.950 (0.509)***	-1.830 (0.510)***
<i>Observations</i>	2055	2453	2453	2453
<i>Number of Countries</i>	98	99	99	99

Note: All estimated models include unreported fixed effects, one lead and one lag of first-differenced independent variables. Standard errors are reported in parentheses.

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%..

**Table 3. Long-run money demand estimation results for civil-war country sample and inflation cost measures estimates, and for alternative country features (DOLS)**  
*Dependent variable: log of real money balances*

	$d_1 = 1$ for high inflation countries	$d_1 = 1$ for long conflicts	$d_1 = 1$ for treaty conflict end	
	(1)	(2)	(3)	(4)
$y$	0.520 (0.049)***	0.527 (0.050)***	0.538 (0.049)***	0.663 (0.049)***
$d_{pre}y$	0.061 (0.017)***	0.072 (0.030)**	-0.006 (0.038)	0.063 (0.018)***
$d_{conf}y$	-0.039 (0.013)***	-0.042 (0.019)**	-0.008 (0.026)	0.009 (0.014)
$\pi_{t+1}/(1+\pi_{t+1})$	-0.376 (0.189)**	-0.370 (0.189)*	-0.259 (0.185)	-0.190 (0.178)
$d_{pre}\pi_{t+1}/(1+\pi_{t+1})$	-0.360 (0.267)	0.473 (0.599)	-0.679 (0.291)**	-0.723 (0.349)**
$d_{conf}\pi_{t+1}/(1+\pi_{t+1})$	0.450 (0.231)*	0.227 (0.378)	2.382 (0.367)***	0.130 (0.229)
<i>Constant</i>	6.349 (1.380)***	6.153 (1.406)***	5.842 (1.370)***	2.316 (1.363)*
$d_{pre}$	-1.747 (0.476)***	-2.150 (0.820)***	0.160 (1.016)	-1.667 (0.515)***
$d_{conf}$	1.071 (0.363)***	1.155 (0.517)**	0.076 (0.744)	-0.267 (0.390)
$d_1d_{pre}y$		-0.028 (0.038)	0.073 (0.043)*	0.107 (0.048)**
$d_1d_{conf}y$		0.007 (0.026)	-0.032 (0.030)	-0.249 (0.030)***
$d_1d_{pre}\pi_{t+1}/(1+\pi_{t+1})$		-1.721 (0.572)***	0.982 (0.340)***	0.263 (0.337)
$d_1d_{conf}\pi_{t+1}/(1+\pi_{t+1})$		0.255 (0.339)	-2.196 (0.352)***	1.330 (0.255)***
$d_1d_{pre}$		1.410 (1.056)	-2.236 (1.159)*	-2.850 (1.294)**
$d_1d_{conf}$		-0.169 (0.729)	0.997 (0.851)	6.809 (0.822)***
Observations	1133	1133	1133	1133
Number of Countries	48	48	48	48

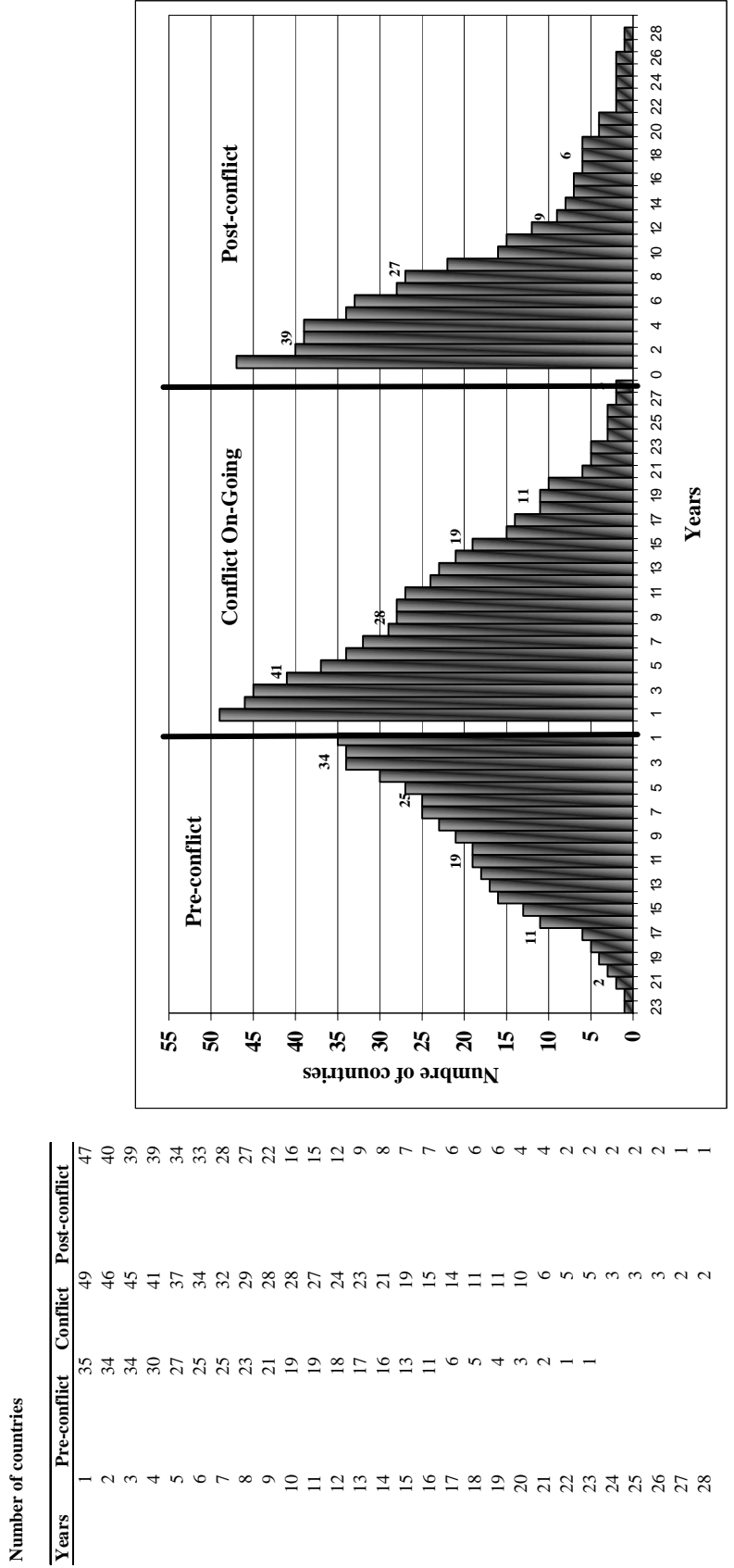
Note: All estimated models include unreported fixed effects, one lead and one lag of first-differenced independent variables. Standard errors are reported in parentheses.

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.

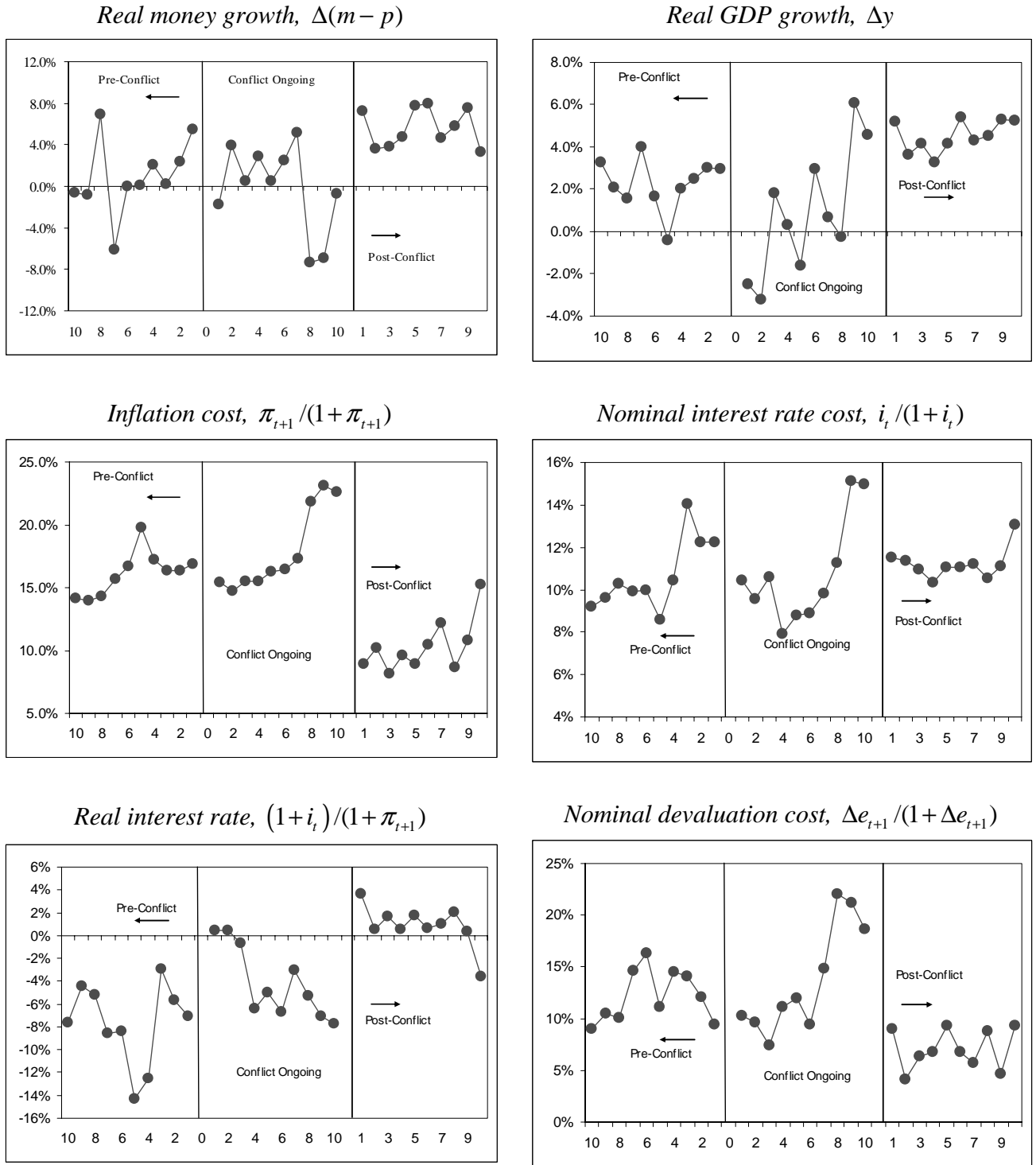
**Table 4. Decomposition of the median country change in real money demand between conflict and post-conflict periods**

	Value
Observed	
$(m-p)_{post} - (m-p)_{conf}$	0.2005
Predicted	
$(m-p)_{post} - (m-p)_{conf}$	0.2541
Due to changes in variables	0.2903
$\hat{\theta}_{1y} (y_{post} - y_{conf})$	0.1996
$\hat{\theta}_{1\pi} (r_{post} - r_{conf})$	0.0907
Due to changes in parameters	-0.1460
$\hat{\theta}_{4y} y_{post} - \hat{\theta}_{3y} y_{conf}$	1.0507
$\hat{\theta}_{4r} r_{post} - \hat{\theta}_{3r} r_{conf}$	-0.1258
$\hat{\theta}_{40} - \hat{\theta}_{30}$	-1.0708
Due to changes in dynamics	0.1098

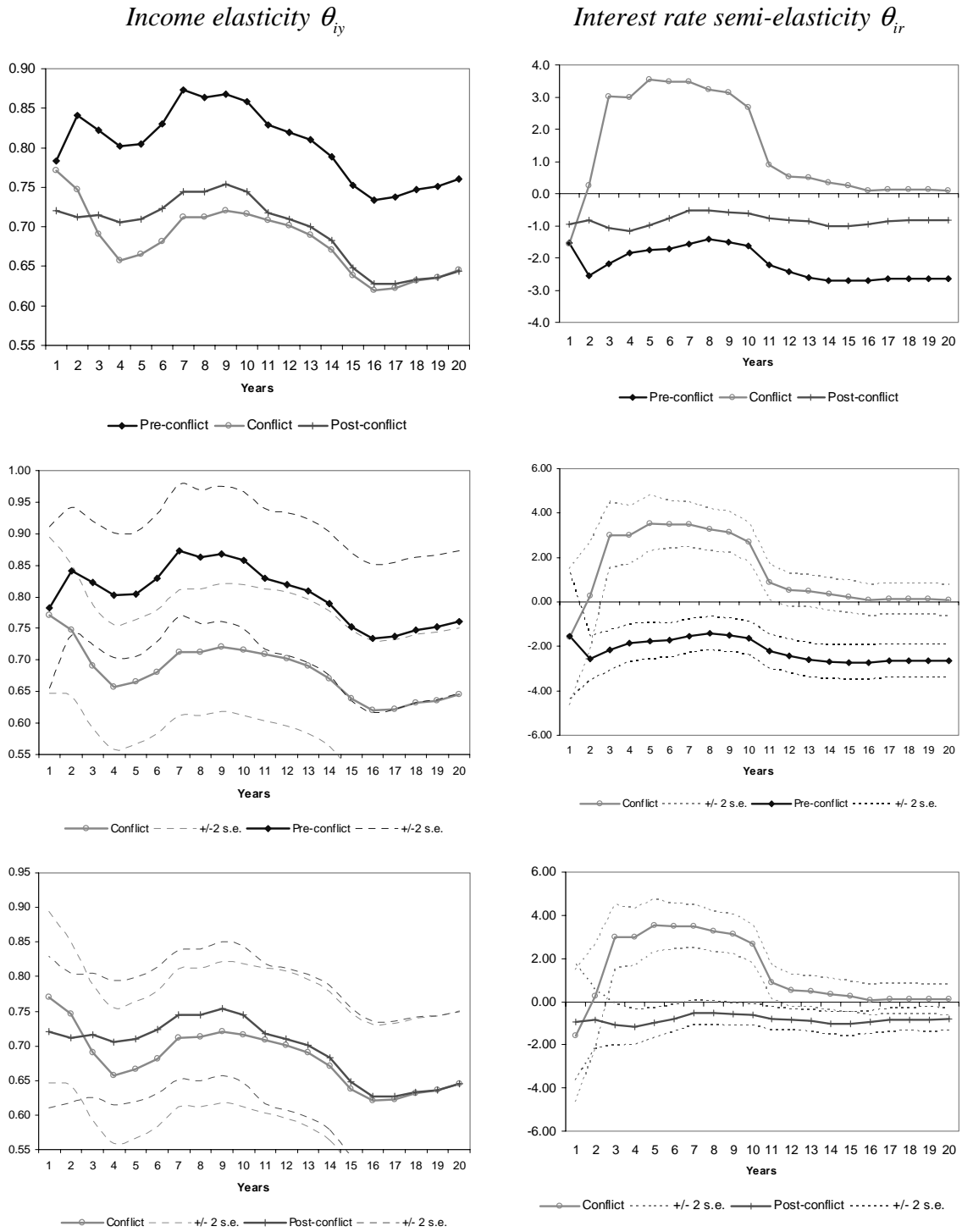
Figure 1. Distribution of countries before, during, and after conflict



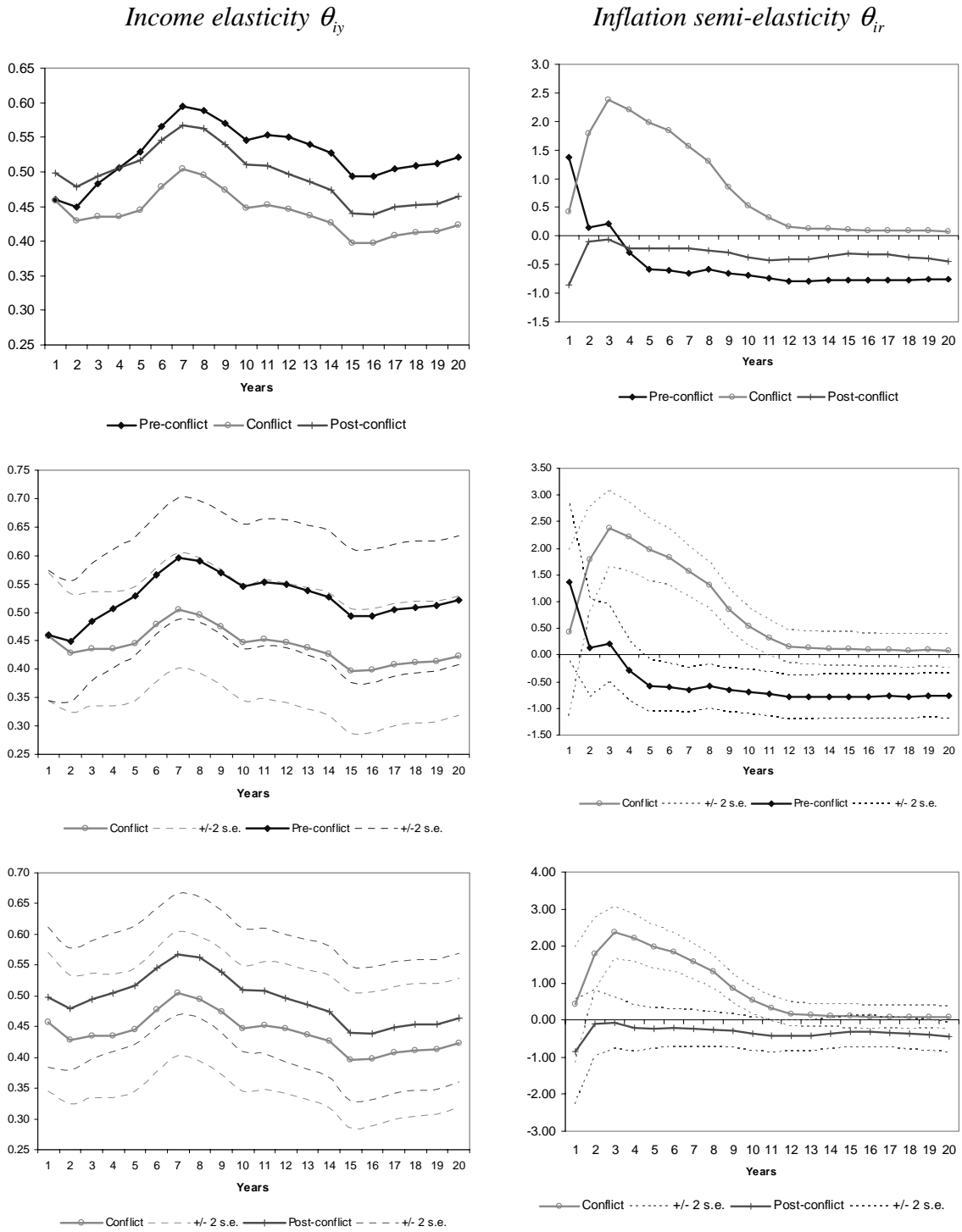
**Figure 2. Mean values of selected variables before, during and after ten periods of conflict**



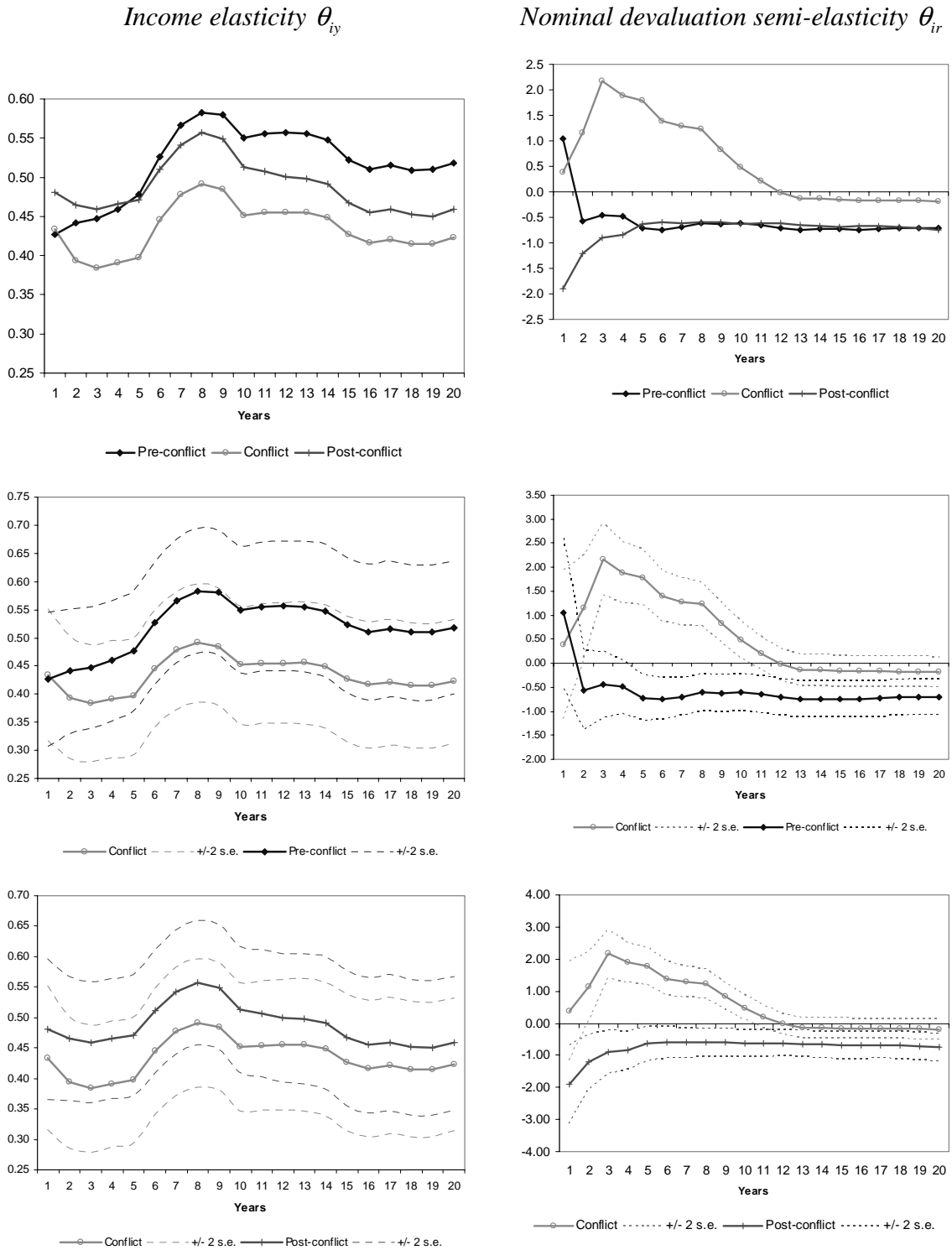
**Figure 3. Estimates of income elasticity and semi-elasticity with respect domestic interest rates under alternative definitions of pre-conflict, conflict, and post-conflict length**



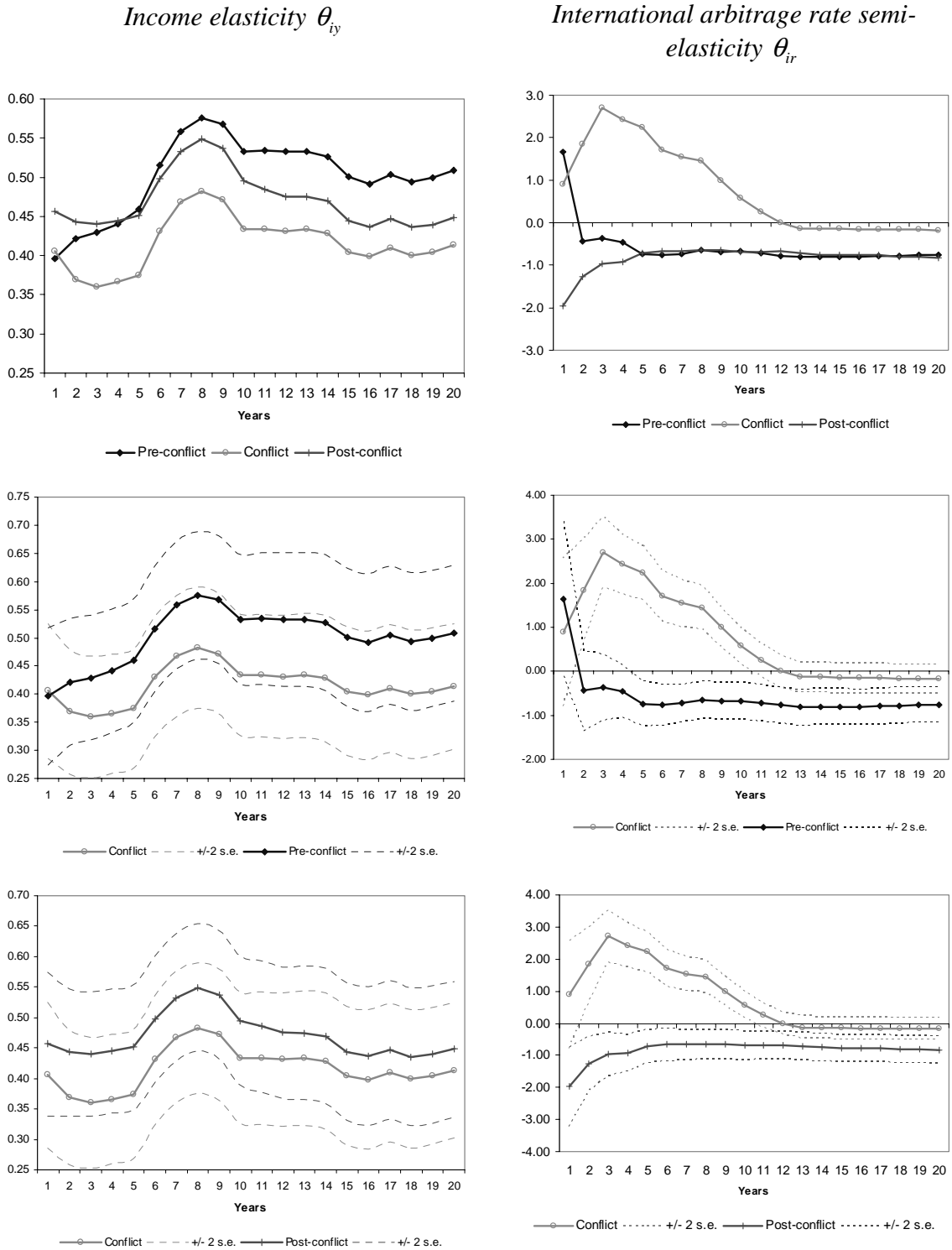
**Figure 4. Estimates of income elasticity and semi-elasticity with respect inflation under alternative definitions of pre-conflict, conflict, and post-conflict length**



**Figure 5. Estimates of income elasticity and semi-elasticity with respect nominal devaluation under alternative definitions of pre-conflict, conflict, and post-conflict length**



**Figure 6. Estimates of income elasticity and semi-elasticity with respect the international arbitrage rate under alternative definitions of pre-conflict, conflict, and post-conflict length**



**Appendix 1. Identified periods of conflict**

Country Name	Years of conflict	
Algeria	1992-2004	
Angola	1975-2002	
Argentina	1975-1977	
Bangladesh	1975-1997	
Burundi	1988-2002	
Central African Republic	1995-1997	
Chad	1975-1997	
Colombia	1978-2004	
Congo, Dem. Rep.	1977-1978	1996-2001
Congo, Rep.	1993-1999	
Djibouti	1991-1994	
Egypt, Arab Rep.	1994-1997	
El Salvador	1979-1992	
Ethiopia	1975-1991	
Georgia	1991-1994	
Guatemala	1975-1994	
Guinea-Bissau	1998-1999	
Haiti	1991-1995	
India	1984-2004	
Indonesia	1975-2002	
Iran, Islamic Rep.	1978-1984	
Israel	1987-1997	
Kenya	1991-1993	
Lebanon	1982-1991	
Liberia	1989-2004	
Mali	1990-1995	
Morocco	1975-1991	
Mozambique	1979-1992	
Burma/Myanmar	1975-1995	
Namibia	1975-1989	
Nepal	1996-2002	
Nicaragua	1978-1990	
Nigeria	1980-1984	
Oman	1975-1975	
Pakistan	1975-1977	1994-1999
Peru	1980-1996	
Rwanda	1990-1994	
Senegal	1989-1999	
Sierra Leone	1991-2001	
South Africa	1976-1994	
Sri Lanka	1983-2002	
Sudan	1983-2002	
Syrian Arab Republic	1979-1982	
Thailand	1975-1982	
Turkey	1984-1999	
Uganda	1978-1992	
Yemen, Rep.	1986-1986	1994-1994
Zimbabwe	1975-1987	

## Appendix 2. Variable definitions and sources

Variable	Definition	Source
Money	M1, currency and demand deposits outstanding at the end of the year.	International Financial Statistics.
Price Level	End-of-year consumer price index (CPI). Missing data were completed using the annual change of the GDP deflator for Angola (1985-1989), Benin (1975-1990), Bangladesh (1975-1985), Brazil (1975-1978), Central African Rep. (1975-19979), Republic of Congo (1975-1988), Georgia (1975-1990), Guinea-Bissau (1975-1979), Mauritania (1975-1994), Malawi (1975-1979), Namibia (1980-2000), Oman (1975-1990), Chad (1975-1983), Djibouti (1988-2004), Lebanon (1995-1996) and Liberia (1990-1997).	International Financial Statistics, World Development Indicators and OECD Economic Outlook Database.
Scale Variable	Real GDP.	World Development Indicators, OECD Economic Outlook Database and IMF country statistics for Liberia, Oman and Zimbabwe.
Interest Rate	Nominal interest rate offered for demand deposits, end-of-period.	International Financial Statistics.
Nominal Exchange Rate	End-of-period nominal exchange rate, local currency per US\$ dollars.	International Financial Statistics.
International Interest Rate	LIBOR nominal interest rate.	International Financial Statistics.

## Appendix 3. Country list and descriptive statistics

Country	$m-p$		$y$		$\pi/(1+\pi)$		$\Delta e/(1+\Delta e)$		$(1+i^*)(1+\Delta e)/[1+(1+i^*)(1+\Delta e)]$		$i/(1+i)$	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Angola	17.50	0.33	21.27	0.19	0.50	0.35	0.31	0.38	0.36	0.35	0.29	0.17
Argentina	18.97	0.38	26.10	0.17	0.40	0.35	0.37	0.37	0.41	0.35	0.37	0.30
Australia	20.38	0.56	26.95	0.29	0.05	0.03	0.01	0.11	0.08	0.12	0.07	0.03
Burundi	20.54	0.18	25.37	0.18	0.09	0.08	0.08	0.10	0.14	0.10	0.08	0.03
Benin	21.33	0.38	26.98	0.33	0.05	0.07	0.01	0.16	0.08	0.16	0.05	0.02
Burkina Faso	21.16	0.42	27.50	0.32	0.05	0.07	0.01	0.16	0.08	0.16	0.05	0.02
Bangladesh	20.92	0.46	27.89	0.36	0.06	0.07	0.05	0.05	0.11	0.07	0.09	0.02
Bahrain	14.95	0.41	21.35	0.37	0.02	0.05	0.00	0.01	0.07	0.03	0.05	0.02
Bolivia	17.42	0.54	23.56	0.20	0.21	0.28	0.18	0.29	0.23	0.27	0.19	0.12
Brazil	19.95	0.46	27.04	0.23	0.46	0.34	0.45	0.35	0.48	0.34	0.53	0.33
Barbados	15.68	0.37	20.69	0.15	0.04	0.04	0.00	0.00	0.07	0.03	0.05	0.01
Botswana	16.19	0.52	22.77	0.70	0.09	0.02	0.04	0.14	0.11	0.15	0.09	0.02
Central African	20.48	0.25	26.64	0.09	0.04	0.08	0.01	0.16	0.08	0.16	0.06	0.01
Canada	20.94	0.45	27.37	0.24	0.04	0.03	0.00	0.06	0.07	0.08	0.06	0.03
Switzerland	20.91	0.26	26.58	0.14	0.02	0.02	-0.04	0.14	0.03	0.14	0.03	0.02
Chile	23.62	0.63	29.16	0.49	0.15	0.13	0.12	0.16	0.18	0.16	0.18	0.13
Cote d'Ivoire	23.20	0.19	29.35	0.14	0.06	0.06	0.01	0.16	0.08	0.16	0.05	0.02
Cameroon	22.51	0.27	28.24	0.26	0.06	0.07	0.01	0.16	0.08	0.16	0.06	0.01
Congo, Rep.	21.49	0.19	26.64	0.31	0.06	0.08	0.01	0.16	0.08	0.16	0.06	0.01
Colombia	25.56	0.25	31.63	0.30	0.16	0.06	0.13	0.11	0.19	0.12	0.20	0.07
Costa Rica	21.94	0.38	27.52	0.35	0.14	0.09	0.11	0.14	0.17	0.13	0.14	0.03
Cyprus	15.53	0.47	21.32	0.48	0.04	0.03	0.00	0.11	0.06	0.12	0.05	0.01
Djibouti	19.77	0.15	25.26	0.06	0.04	0.03	0.00	0.00	0.07	0.03	0.03	0.02
Denmark	21.70	0.36	27.66	0.16	0.04	0.03	-0.01	0.13	0.05	0.14	0.06	0.03
Dominican Rep	19.21	0.36	24.90	0.35	0.13	0.11	0.09	0.18	0.15	0.17	0.14	0.02
Algeria	23.05	0.29	26.03	0.22	0.10	0.10	0.08	0.13	0.14	0.13	0.06	0.03
Ecuador	19.97	2.64	23.29	0.22	0.22	0.12	0.19	0.18	0.24	0.17	0.20	0.10
Egypt, Arab Rep	20.22	0.22	25.52	0.44	0.10	0.06	0.08	0.15	0.14	0.15	0.09	0.02
Ethiopia	18.26	0.44	23.28	0.23	0.06	0.07	0.04	0.11	0.10	0.10	0.06	0.03
Fiji	15.18	0.35	21.33	0.18	0.05	0.03	0.02	0.09	0.08	0.10	0.03	0.02
Gabon	21.64	0.19	28.03	0.18	0.04	0.09	0.01	0.16	0.08	0.16	0.06	0.01
Georgia	15.07	0.30	21.50	0.55	0.16	0.30	0.04	0.11	0.08	0.12	0.13	0.06
Ghana	23.88	0.48	22.69	0.30	0.25	0.15	0.21	0.22	0.27	0.20	0.16	0.05
Gambia	15.58	0.46	21.26	0.30	0.09	0.07	0.07	0.17	0.13	0.16	0.11	0.03
Guinea-Bissau	19.48	0.84	20.54	0.23	0.19	0.18	0.18	0.22	0.24	0.21	0.10	0.11
Guatemala	18.44	0.37	22.01	0.25	0.10	0.07	0.06	0.13	0.12	0.13	0.09	0.03
Honduras	18.25	0.27	22.36	0.28	0.10	0.06	0.06	0.13	0.13	0.12	0.11	0.03
Haiti	18.51	0.23	22.27	0.09	0.11	0.09	0.06	0.12	0.12	0.11	0.10	0.02
Indonesia	27.22	0.67	34.37	0.50	0.09	0.07	0.09	0.15	0.15	0.15	0.12	0.06
India	23.67	0.50	29.64	0.47	0.07	0.04	0.05	0.08	0.11	0.09	0.09	0.01
Iran, I.R.	27.48	0.24	30.25	0.24	0.16	0.06	0.06	0.24	0.12	0.23	0.10	0.00
Iceland	19.67	0.55	26.90	0.25	0.15	0.13	0.10	0.19	0.15	0.20	0.13	0.10
Israel	18.89	0.63	26.37	0.38	0.24	0.24	0.20	0.25	0.25	0.25	0.17	0.18
Jamaica	19.68	0.25	25.99	0.16	0.15	0.10	0.11	0.17	0.17	0.16	0.13	0.06
Jordan	16.71	0.24	22.00	0.41	0.05	0.06	0.02	0.08	0.09	0.09	0.05	0.02
Japan	28.01	0.46	33.61	0.25	0.02	0.02	-0.05	0.13	0.02	0.14	0.02	0.02
Kenya	20.86	0.13	25.20	0.29	0.11	0.07	0.06	0.16	0.12	0.16	0.09	0.04
Korea, Rep.	26.20	0.66	33.29	0.61	0.06	0.05	0.01	0.15	0.08	0.15	0.09	0.03
Lebanon	24.19	0.54	30.64	0.30	0.19	0.20	0.14	0.26	0.20	0.24	0.10	0.03
Liberia	15.12	1.08	20.17	0.83	0.05	0.06	0.04	0.20	0.10	0.19	0.07	0.02
Sri Lanka	20.58	0.27	27.07	0.40	0.09	0.05	0.08	0.08	0.14	0.09	0.11	0.03

### Appendix 3. Country list and descriptive statistics (cont.)

Country	$m-p$		$y$		$\pi/(1+\pi)$		$\Delta e/(1+\Delta e)$		$(1+i^*)(1+\Delta e)/[1+(1+i^*)(1+\Delta e)]$		$i/(1+i)$	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Morocco	20.88	0.51	25.33	0.29	0.05	0.03	0.02	0.10	0.08	0.12	0.06	0.02
Madagascar	22.54	0.24	26.67	0.12	0.12	0.08	0.11	0.16	0.17	0.15	0.14	0.03
Mexico	21.87	0.40	27.76	0.25	0.22	0.16	0.17	0.21	0.23	0.21	0.20	0.14
Mali	21.61	0.44	27.28	0.26	0.02	0.07	0.01	0.16	0.08	0.16	0.05	0.02
Malta	15.40	0.20	19.72	0.42	0.03	0.04	-0.01	0.10	0.05	0.10	0.04	0.00
Myanmar	21.69	0.38	24.82	0.40	0.13	0.12	-0.01	0.07	0.06	0.08	0.05	0.04
Mozambique	24.96	0.29	30.70	0.35	0.21	0.14	0.15	0.22	0.21	0.21	0.14	0.08
Mauritania	19.30	0.19	24.88	0.27	0.06	0.04	0.05	0.08	0.12	0.08	0.05	0.01
Mauritius	18.39	0.36	24.93	0.40	0.08	0.06	0.04	0.10	0.11	0.11	0.09	0.01
Malawi	18.14	0.19	23.06	0.25	0.15	0.11	0.13	0.19	0.19	0.18	0.15	0.06
Malaysia	19.70	0.72	25.38	0.57	0.03	0.02	0.01	0.07	0.08	0.08	0.06	0.02
Namibia	17.59	0.42	23.17	0.23	0.09	0.05	0.05	0.18	0.11	0.18	0.09	0.02
Niger	20.69	0.23	27.32	0.15	0.04	0.09	0.01	0.16	0.08	0.16	0.05	0.02
Nigeria	22.25	0.25	25.65	0.23	0.16	0.11	0.13	0.21	0.19	0.20	0.10	0.04
Nicaragua	17.82	1.02	23.89	0.15	0.32	0.35	0.22	0.34	0.27	0.32	0.20	0.29
Norway	21.66	0.65	27.67	0.28	0.05	0.03	0.00	0.11	0.06	0.12	0.06	0.02
Nepal	19.41	0.50	25.86	0.38	0.07	0.04	0.06	0.07	0.12	0.08	0.09	0.03
New Zealand	18.44	0.29	25.13	0.21	0.06	0.05	0.00	0.13	0.07	0.14	0.10	0.04
Oman	15.07	0.70	21.52	0.54	-0.02	0.13	0.00	0.02	0.07	0.04	0.06	0.02
Pakistan	22.37	0.53	28.48	0.45	0.07	0.03	0.06	0.06	0.12	0.07	0.08	0.03
Peru	19.05	0.63	25.31	0.17	0.34	0.29	0.31	0.30	0.36	0.29	0.26	0.28
Philippines	21.43	0.44	27.30	0.24	0.09	0.07	0.06	0.11	0.12	0.12	0.10	0.04
Paraguay	23.59	0.34	27.47	0.30	0.13	0.07	0.11	0.16	0.17	0.16	0.15	0.04
Rwanda	20.22	0.11	26.85	0.24	0.08	0.09	0.05	0.14	0.11	0.13	0.07	0.02
Saudi Arabia	20.74	0.55	26.96	0.17	0.01	0.05	0.00	0.01	0.07	0.04	0.05	0.02
Sudan	21.89	0.50	20.60	0.33	0.26	0.18	0.20	0.26	0.25	0.24	0.09	0.03
Senegal	22.02	0.22	28.03	0.26	0.04	0.06	0.01	0.16	0.08	0.16	0.05	0.02
Singapore	18.95	0.58	25.02	0.63	0.02	0.02	-0.02	0.05	0.05	0.06	0.04	0.02
Sierra Leone	21.40	0.36	25.17	0.16	0.23	0.18	0.18	0.29	0.23	0.28	0.12	0.08
El Salvador	16.89	0.85	24.48	0.22	0.10	0.07	0.03	0.12	0.10	0.11	0.12	0.02
Suriname	14.98	0.42	15.21	0.09	0.20	0.21	0.08	0.23	0.14	0.21	0.10	0.04
Swaziland	15.42	0.24	20.82	0.42	0.10	0.04	0.05	0.18	0.11	0.18	0.08	0.02
Seychelles	15.08	0.74	21.19	0.35	0.04	0.06	-0.01	0.08	0.06	0.08	0.07	0.02
Syrian Arab Rep	21.61	0.33	26.78	0.35	0.10	0.09	0.02	0.12	0.09	0.12	0.04	0.00
Chad	20.71	0.26	27.19	0.30	0.04	0.09	0.01	0.16	0.08	0.16	0.05	0.01
Thailand	21.82	0.61	28.16	0.57	0.05	0.04	0.01	0.11	0.08	0.12	0.08	0.04
Trinidad and Tobago	17.78	0.24	24.49	0.17	0.08	0.04	0.03	0.08	0.09	0.08	0.06	0.02
Turkey	18.09	0.24	31.99	0.34	0.34	0.12	0.30	0.18	0.35	0.18	0.30	0.14
Uganda	22.10	0.62	29.33	0.40	0.22	0.23	0.21	0.29	0.25	0.29	0.13	0.06
Uruguay	18.72	0.17	19.23	0.18	0.28	0.15	0.25	0.16	0.30	0.16	0.37	0.15
United States	23.23	0.19	29.56	0.27	0.04	0.03	0.00	0.12	0.06	0.10	0.06	0.03
Venezuela, RB	25.34	0.39	26.90	0.14	0.20	0.12	0.16	0.19	0.22	0.17	0.18	0.08
Samoa	13.16	0.40	20.09	0.14	0.07	0.06	0.04	0.10	0.10	0.12	0.07	0.02
Yemen, Rep.	21.71	0.32	25.93	0.24	0.17	0.11	0.12	0.24	0.16	0.23	0.13	0.02
South Africa	20.97	0.54	27.35	0.17	0.10	0.04	0.05	0.18	0.11	0.18	0.11	0.04
Congo, Dem. Rep.	19.21	1.30	20.79	3.83	0.50	0.30	0.49	0.34	0.52	0.32	0.30	0.19
Zambia	23.19	0.52	28.47	0.09	0.26	0.16	0.22	0.27	0.27	0.25	0.14	0.09
Zimbabwe	19.71	0.28	23.65	0.25	0.23	0.20	0.19	0.24	0.25	0.23	0.14	0.11

Note: Countries in conflict are highlighted.

#### Appendix 4. Simple correlation between selected variables

	<i>m - p - y</i>		
	Before conflict	During conflict	After conflict
$\frac{\pi_{t+1}}{1 + \pi_{t+1}}$	-0.2105* (0.000)	-0.061 (0.174)	-0.021 (0.665)
$\frac{\Delta e_{t+1}}{1 + \Delta e_{t+1}}$	-0.1730* (0.002)	-0.1147* (0.010)	-0.1239* (0.012)
$\frac{i_t}{1 + i_t}$	-0.3923* (0.000)	-0.3364* (0.000)	-0.2522* (0.000)
$\Delta \frac{i_{int}}{1 + i_{int}}$	-0.1705* (0.003)	-0.0896* (0.044)	-0.1240* (0.012)

Note: The table reports simple correlations of panel variables, p-values are reported in parenthesis.

\* Significant at 10%.

**Appendix 4. Simple correlation between selected variables (cont.)**

*Pre-conflict period*

	$\Delta(m-p)$	$\Delta y$	$\Delta \frac{\pi_{t+1}}{1+\pi_{t+1}}$	$\Delta \frac{i_t}{1+i_t}$	$\Delta \frac{\Delta e_{t+1}}{1+\Delta e_{t+1}}$	$\Delta \frac{i_{int}}{1+i_{int}}$
$\Delta(m-p)$	1.000	0.6370* (0.000)	-0.5048* (0.004)	-0.028 (0.903)	-0.054 (0.777)	0.041 (0.828)
$\Delta y$	0.1691* (0.004)	1.000	-0.5229* (0.003)	-0.131 (0.560)	0.033 (0.865)	0.102 (0.592)
$\Delta \frac{\pi_{t+1}}{1+\pi_{t+1}}$	0.1468* (0.012)	-0.002 (0.969)	1.000	0.6120* (0.003)	0.275 (0.141)	0.284 (0.129)
$\Delta \frac{i_t}{1+i_t}$	-0.1156* (0.086)	-0.030 (0.648)	0.2020* (0.003)	1.000	0.290 (0.190)	0.331 (0.132)
$\Delta \frac{\Delta e_{t+1}}{1+\Delta e_{t+1}}$	0.009 (0.885)	-0.012 (0.830)	0.1902* (0.001)	0.028 (0.673)	1.000	0.9549* (0.000)
$\Delta \frac{i_{int}}{1+i_{int}}$	0.009 (0.879)	-0.021 (0.714)	0.1854* (0.001)	0.025 (0.709)	0.9930* (0.000)	1.000

Note: The lower diagonal reports simple correlations of panel variables while the upper diagonal reports cross-section correlations. p-values are reported in parenthesis.

\* Significant at 10%.

### Appendix 4. Simple correlation between selected variables (cont.)

*Conflict period*

	$\Delta(m-p)$	$\Delta y$	$\Delta \frac{\pi_{t+1}}{1+\pi_{t+1}}$	$\Delta \frac{i_t}{1+i_t}$	$\Delta \frac{\Delta e_{t+1}}{1+\Delta e_{t+1}}$	$\Delta \frac{i_{int}}{1+i_{int}}$
$\Delta(m-p)$	1.000	0.146 (0.346)	-0.078 (0.617)	0.5514* (0.001)	-0.173 (0.261)	-0.170 (0.271)
$\Delta y$	0.1285* (0.004)	1.000	-0.2461* (0.099)	0.179 (0.296)	-0.011 (0.943)	-0.003 (0.984)
$\Delta \frac{\pi_{t+1}}{1+\pi_{t+1}}$	0.1187* (0.008)	0.020 (0.653)	1.000	-0.4843* (0.003)	0.3787* (0.010)	0.3701* (0.012)
$\Delta \frac{i_t}{1+i_t}$	-0.025 (0.624)	0.015 (0.765)	0.1611* (0.001)	1.000	-0.3623* (0.030)	-0.3731* (0.025)
$\Delta \frac{\Delta e_{t+1}}{1+\Delta e_{t+1}}$	-0.036 (0.421)	-0.048 (0.263)	0.4161* (0.000)	0.1408* (0.005)	1.000	0.9995* (0.000)
$\Delta \frac{i_{int}}{1+i_{int}}$	-0.034 (0.448)	-0.049 (0.259)	0.4169* (0.000)	0.1381* (0.006)	0.9963* (0.000)	1.000

Note: The lower diagonal reports simple correlations of panel variables while the upper diagonal reports cross-section correlations. p-values are reported in parenthesis.

\* Significant at 10%

**Appendix 4. Simple correlation between selected variables (cont.)***Post-conflict period*

	$\Delta(m-p)$	$\Delta y$	$\Delta \frac{\pi_{t+1}}{1+\pi_{t+1}}$	$\Delta \frac{i_t}{1+i_t}$	$\Delta \frac{\Delta e_{t+1}}{1+\Delta e_{t+1}}$	$\Delta \frac{i_{int}}{1+i_{int}}$
$\Delta(m-p)$	1.000	0.165 (0.292)	-0.2727* (0.077)	-0.238 (0.129)	-0.029 (0.853)	-0.017 (0.912)
$\Delta y$	0.1756* (0.000)	1.000	-0.050 (0.749)	-0.152 (0.330)	-0.095 (0.541)	-0.088 (0.571)
$\Delta \frac{\pi_{t+1}}{1+\pi_{t+1}}$	0.077 (0.118)	0.028 (0.569)	1.000	0.6252* (0.000)	0.6292* (0.000)	0.6119* (0.000)
$\Delta \frac{i_t}{1+i_t}$	-0.1147* (0.022)	-0.039 (0.429)	0.2107* (0.000)	1.000	0.2838* (0.065)	0.2704* (0.080)
$\Delta \frac{\Delta e_{t+1}}{1+\Delta e_{t+1}}$	-0.050 (0.310)	0.032 (0.513)	0.3504* (0.000)	0.069 (0.191)	1.000	0.9981* (0.000)
$\Delta \frac{i_{int}}{1+i_{int}}$	-0.044 (0.369)	0.032 (0.512)	0.3410* (0.000)	0.070 (0.184)	0.9969* (0.000)	1.000

Note: The lower diagonal reports simple correlations of panel variables while the upper diagonal reports cross-section correlations. p-values are reported in parenthesis.

\* Significant at 10%

### Appendix 5. Panel unit root tests

	$m-p$	$y$	$\frac{i}{1+i}$	$\frac{\pi_{t+1}}{1+\pi_{t+1}}$	$\frac{\Delta e_{t+1}}{1+\Delta e_{t+1}}$	$\frac{i_{int}}{1+i_{int}}$
	<i>All sample</i>					
<i>Hadri LM<sub>1</sub></i>	54.54 (0.000)***	58.27 (0.000)***	22.77 (0.000)***	25.31 (0.000)***	9.30 (0.000)***	11.00 (0.000)***
<i>Hadri LM<sub>2</sub></i>	16.83 (0.000)***	18.21 (0.000)***	10.45 (0.000)***	15.75 (0.000)***	10.01 (0.000)***	9.81 (0.000)***
<i>IPS <math>\bar{t}</math></i>	-2.12 (0.387)	-2.10 (0.473)	-1.46 (0.664)	-2.02 (0.758)	-2.51 (0.000)***	-2.48 (0.000)***
	<i>Conflict countries</i>					
<i>Hadri LM<sub>1</sub></i>	33.50 (0.000)***	44.19 (0.000)***	18.63 (0.000)***	19.40 (0.000)***	8.07 (0.000)***	8.85 (0.000)***
<i>Hadri LM<sub>2</sub></i>	10.16 (0.000)***	12.73 (0.000)***	5.15 (0.000)***	10.41 (0.000)***	6.91 (0.000)***	6.87 (0.000)***
<i>IPS <math>\bar{t}</math></i>	-1.93 (0.846)	-1.61 (0.999)	-2.43 (0.035)**	-2.84 (0.000)***	-3.93 (0.000)***	-3.92 (0.000)***

Note: The  $LM_1$  and  $LM_2$  statistics test the null hypothesis of stationarity, while the null hypothesis of the Im, Pesaran and Shin (IPS) statistic is the presence of a unit root in all series. Both tests allow for individual fixed-effects.  $LM_1$  allows heterogeneous error terms and,  $LM_2$  test allows serially correlated error terms.

p-values are reported in parentheses.

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.

### Appendix 6. Panel cointegration tests

	No dummy variables for conflict periods			Dummy variables for conflict periods		
	$r_{it} = \frac{i_{it}}{1+i_{it}}$	$r_{it} = \frac{\pi_{i,t+1}}{1+\pi_{i,t+1}}$	$r_{it} = \frac{\Delta e_{i,t+1}}{1+\Delta e_{i,t+1}}$	$r_{it} = \frac{i_{it}}{1+i_{it}}$	$r_{it} = \frac{\pi_{i,t+1}}{1+\pi_{i,t+1}}$	$r_{it} = \frac{\Delta e_{i,t+1}}{1+\Delta e_{i,t+1}}$
Kao (1999)						
$DF_{\rho}^*$	-74.10 (0.000)***	-26.14 (0.000)***	-26.33 (0.000)***	-98.66 (0.000)***	-26.44 (0.000)***	-26.64 (0.000)***
$DF_t^*$	-38.01 (0.000)***	-7.84 (0.000)***	-7.88 (0.000)***	-47.69 (0.000)***	-7.94 (0.000)***	-7.98 (0.000)***
$ADF$	-19.74 (0.000)***	-7.85 (0.000)***	-7.86 (0.000)***	-25.81 (0.000)***	-7.95 (0.000)***	-7.92 (0.000)***
Pedroni (1995)						
$PC_1$	-17.56 (0.000)***	-43.98 (0.000)***	-44.18 (0.000)***	-23.90 (0.000)***	-44.32 (0.000)***	-44.71 (0.000)***
$PC_2$	-14.47 (0.000)***	-43.21 (0.000)***	-43.41 (0.000)***	-22.88 (0.000)***	-43.55 (0.000)***	-43.93 (0.000)***

Note: The null hypothesis is that the variables are not cointegrated.

p-values are reported in parentheses.

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.

## Appendix 7. Panel unit root and cointegration tests

### *Panel unit root tests*

Im, Pesaran and Shin (2003) suggest constructing a statistic based on separate augmented Dickey-Fuller (ADF) regressions for each cross section allowing for different serial correlation properties. Our calculations will be based on the following equation,

$$\Delta y_{it} = \rho_i y_{i,t-1} + \sum_{\tau=1}^p \theta_{i\tau} \Delta y_{i,t-\tau} + \varepsilon_{it}$$

where the null hypothesis is that each series in the panel contains a unit root ( $H_0 : \rho_i = 0$  for all  $i$ ) and the alternative hypothesis allows for some to have unit roots ( $H_1 : \rho_i < 0$  for some  $i$ ). The Im, Pesaran and Shin (IPS) t-bar statistic is defined as the average of the individual ADF statistics,

$$\bar{t} = \frac{1}{N} \sum_{i=1}^N t_{\rho_i}$$

where  $t_{\rho_i}$  is the individual ADF t-statistic. The asymptotic distribution of  $\bar{t}$  is nonstandard when the lag order  $p_i$  is nonzero for some or all countries and the critical values are obtained from Im, Pesaran and Shin (2003).

Hadri (2000) proposed a generalization of the KPSS test from time series to panel data. He derives a residual-based Lagrange Multiplier (LM) test where the null hypothesis is that there is no unit root in any of the series in the panel against the alternative of a unit root in the panel.

### *Panel cointegration tests*

Consider the panel regression model,

$$y_{it} = \alpha_i + x_{it}' \beta + u_{it}$$

where  $y_{it}$  and  $x_{it}$  are  $k \times 1$  integrated processes of order one  $I(1)$ . Kao (1999) proposed DF and ADF-type tests for  $u_{it}$  as a test of no cointegration. The DF-type tests can be calculated from the fixed effects residuals,

$$\hat{u}_{it} = \rho \hat{u}_{i,t-1} + v_{it}$$

To test the null hypothesis of no cointegration,  $H_0 : \rho = 1$ , Kao (1999) proposes, among others, the following statistics,

$$DF_{\rho}^* = \frac{\sqrt{NT}(\hat{\rho} - 1) + 3\sqrt{N}\hat{\sigma}_v^2 / \hat{\sigma}_{0v}^2}{\sqrt{3 + \frac{3\hat{\sigma}_v^2}{10\hat{\sigma}_{0v}^2}}}$$

$$DF_t^* = \frac{t_{\rho} + \sqrt{6N}\hat{\sigma}_v^2 / 2\hat{\sigma}_{0v}^2}{\sqrt{\frac{\hat{\sigma}_v^2}{2\hat{\sigma}_{0v}^2} + \frac{3\hat{\sigma}_v^2}{10\hat{\sigma}_{0v}^2}}}$$

While the ADF-type test can be obtained running the following regression,

$$\hat{u}_{it} = \rho\hat{u}_{i,t-1} + \sum_{i=1}^p \varphi_i \Delta\hat{u}_{i,t-j} + v_{it}$$

With the null hypothesis of no cointegration, the ADF statistic is defined as,

$$ADF = \frac{t_{ADF} + \sqrt{6N}\hat{\sigma}_v^2 / 2\hat{\sigma}_{0v}^2}{\sqrt{\frac{\hat{\sigma}_v^2}{2\hat{\sigma}_{0v}^2} + \frac{3\hat{\sigma}_v^2}{10\hat{\sigma}_{0v}^2}}}$$

Pedroni (1995, 1997) developed a series of cointegration tests based on residuals regressions. He proposed the following statistics under the null hypothesis of no cointegration,

$$PC_1 = T\sqrt{N}(\hat{\rho} - 1) / \sqrt{2}$$

$$PC_2 = \sqrt{NT(T-1)}(\hat{\rho} - 1) / \sqrt{2}$$

## Appendix 8. Estimation and inference of a cointegrated regression in panel data

Consider the following fixed-effect panel regression,

$$y_{it} = \alpha_i + x_{it}'\beta + u_{it}$$

We assume that  $\{x_{it}\}$  are  $k \times 1$  integrated processes of order one for all  $i$ , where,

$$x_{it} = x_{it-1} + \varepsilon_{it}$$

We maintain the assumption of cross-sectional independence. Under these specifications, these set of equations describes a system of cointegrated regressions, i.e.,  $y_{it}$  is cointegrated with  $x_{it}$ .

The OLS estimator of  $\beta$  is given by,

$$\hat{\beta}_{ols} = \left[ \sum_{i=1}^N \sum_{t=1}^T (x_{it} - \bar{x}_i)(x_{it} - \bar{x}_i)' \right]^{-1} \left[ \sum_{i=1}^N \sum_{t=1}^T (x_{it} - \bar{x}_i)(y_{it} - \bar{y}_i) \right]$$

Kao and Chiang (2000) show that this estimator is inconsistent, and propose a bias-corrected OLS estimator given by,

$$\hat{\beta}_{ols}^+ = \hat{\beta}_{ols} - \hat{\delta}/T$$

where,  $\hat{\delta} = -3\hat{\Omega}_\varepsilon \hat{\Omega}_{\varepsilon u} + 6\hat{\Omega}_\varepsilon^{-1} \hat{\Delta}_{\varepsilon u}$ . Chen, McCoskey and Kao (1999) investigated the finite sample properties of the bias-corrected OLS estimators and found that it does not improve over the OLS estimator in general. Pedroni (1995) and Phillips and Moon (1999) proposed a “fully-modified” OLS (FMOLS) approach to obtain an asymptotically efficient estimator. This estimator adjusts for the effects of endogenous regressors and short-run dynamics of the errors. To correct for the effect of (long-run) endogeneity of the regressors, the dependent variable is adjusted for the part of the error that is correlated with the regressor,

$$\hat{\beta}_{FM} = \left[ \sum_{i=1}^N \sum_{t=1}^T (x_{it} - \bar{x}_i)(x_{it} - \bar{x}_i)' \right]^{-1} \left[ \sum_{i=1}^N \sum_{t=1}^T (x_{it} - \bar{x}_i) y_{it}^+ - T \hat{\Delta}_{\varepsilon u}^+ \right]$$

where  $y_{it}^+ = y_{it} - \hat{\Omega}_{u\varepsilon} \hat{\Omega}_\varepsilon^{-1} \Delta x_{it}$ . Kao and Chiang (1999) proposed an a panel version of the dynamic least squares (DOLS), that can be obtained running the following regression,

$$y_{it} = \alpha_i + x_{it}'\beta + \sum_{j=-p_1}^{p_2} \phi_{ij} \Delta x_{it+j} + v_{it}$$

which has the same limiting distribution as the FMOLS estimator. However, Kao and Chiang (1999) found that this estimator outperforms both the OLS and FMOLS estimators.