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Exchange Rate Implications of Reserve Changes: How Non-EZ European Countries Fared during the Great Recession

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Abstract:

The relationships between exchange rates, capital controls and foreign reserves during the financial crisis suggest that reserve management plays a much more central role than has typically been emphasized in international finance models. Reserves seem to be especially important for non-EZ European countries, not only for those with currencies in the ERM II, but also for those European countries in intermediate regimes that hope to deter currency market pressure, and in so doing help to mitigate trilemma trade-offs.

Key words: foreign exchange reserves, global financial crisis, exchange market pressure
JEL Classifications: F32, F41

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I. Introduction

Countries with fixed exchange rates require foreign exchange reserves, and sometimes capital controls, to maintain the pegged regime. Even countries that allow their exchange rate to be market determined often hold significant foreign reserve stocks and at times resort to capital controls. Exchange rate movements, in turn, influence the value of foreign-currency denominated reserves and often provide the impetus for capital control measures. This paper examines the relationship between exchange rates, capital controls and foreign reserves, focusing on changes in each of these measures in the non-EZ European countries during the global financial crisis and recovery.

There were significant exchange rate realignments among non-EZ European countries during the global financial crisis. Most of these countries experienced unusually large changes in the relative value of their currency against the US dollar as well as the Euro. While some of these same countries introduced capital controls and depleted reserves, other countries continued to maintain reserve levels while allowing the exchange rate to fully absorb the global shock. One explanation for why reserves did not always co-move with exchange rates during the crisis is that large pre-crisis reserve accumulations in some countries seem to have provided protection against the market forces that battered currency values in countries with less substantial accumulations.

The causes and consequences of exchange rate movements are not well understood. Even when governments apparently successfully intervene to change the international value of their domestic currency, as Japan recently seems to have done, or succeed at stabilizing the value of the domestic currency, as Switzerland continues to do, the implications of these exchange rate policies for broader macroeconomic stabilization and economic growth remain contentious. Less controversial is the view that exchange rate crises have significant negative effects on growth. So while the literature continues to debate the relative benefits of fixed versus flexible exchange rate regimes, with recent empirical studies concluding that the choice of exchange rate regime makes little difference (Rose, 2011), studies focused on unusually large and rapid

exchange rate movements provide an unequivocal policy directive: countries should avoid situations that evolve into currency crises.[1]

Governments have a number of policy tools that, at least in theory, can be used to manage exchange rates and counteract undesirable capital flows. If market pressure is toward an undesired rise in the relative value of the domestic currency authorities can: (1) accumulate foreign reserves, (2) lower interest rates to discourage capital inflows, or (3) impose capital inflow controls. The tools available to countries facing undesired downward pressure on the relative value of the domestic currency are mirror images, though sales of foreign reserves are importantly constrained by the size of the country's accumulated stock, and evidence suggests controls on capital outflows are more difficult to maintain than those on inflows (Dell'Ariccia et al. 1999).

The currency crisis-prevention tool-kit is importantly constrained by the international finance trilemma. Policy makers would like to use monetary policy to control interest rates and help stabilize the economy, allow free mobility of capital inflows and outflows, and at the same time maintain a stable exchange rate. The crux of the trilemma is that countries can't simultaneously achieve all three of these goals. If countries allow capital mobility, they must choose between monetary policy independence and exchange rate stability. Likewise, if exchange rate stability is considered paramount, countries must give up monetary policy unless they are willing to impose capital controls. The role of reserves in the trilemma has generally been assumed to be minor.[2] Reserves are essential as part of the mechanics of stabilizing exchange rates, but their potential ability to deter currency market speculation, and in so doing mitigate trilemma trade-offs, has not been emphasized.

The non-Eurozone (non-EZ) European countries provide an interesting set of case studies showing the important role that reserves can play for countries where a priori preferences for exchange rate stability are high. Bulgaria, Croatia, Latvia and Lithuania are all examples of countries that had high foreign reserve accumulations (as a share of GDP) prior to the financial crisis, and as a result were able to maintain relatively stable exchange rates, especially against

[1] There are a number of different definitions of a currency crisis used in the literature; a fairly standard criteria is a fall in the value of the currency of more than 25% over a two month period.

[2] Obstfeld, Shambaugh and Taylor (2010) is an important exception.

the euro. Non-EZ European countries with relatively low pre-crisis accumulations of reserves, including Iceland, Poland, Sweden and Turkey, experienced much larger exchange rate movements during the financial crisis. This paper will document the relationship between pre-crisis reserve accumulations and exchange rate movements among the non-EZ European countries, and will show that reserves seem to provide protection for currencies only if countries are willing to deplete reserves in times of crisis. The Czech Republic, Hungary and Romania all had relatively high pre-crisis reserve accumulations, but these countries did not deplete reserves during the crisis and they each experienced large currency depreciations. Overall, the results in this paper indicate that countries with higher pre-crisis reserve accumulations (as a share of GDP) were better able to stabilize their exchange rates, as long as they were willing to also deplete reserves.

This paper will begin with an examination of the de facto exchange rate regime classifications of the non-EZ European countries in order to understand the a priori preferences of these countries for exchange rate stability. Section three of the paper will discuss the motives for reserve accumulation and how these motives relate to exchange rate regimes. It will also include an empirical examination of the conditions under which higher pre-crisis reserve accumulations protected non-EZ European countries from exchange rate instability during the crisis. Section four will discuss the potential role for capital controls in exchange rate stabilization, and will examine the evidence for capital restrictions in the countries in our sample before and during the financial crisis. Section five examines whether the non-EZ European countries that managed to maintain stable exchange rates during the financial crisis fared better (or worse), in terms of economic growth, than those countries that allowed their exchange rate to adjust. The final section of the paper provides conclusions.

II. Non-Eurozone European Country Exchange Rate Regimes

The focus of this paper is on countries that are not part of the Eurozone, but are members of the European Union (Bulgaria, Croatia, Czech Republic, Denmark, Hungary, Latvia, Lithuania, Poland, Romania, Sweden and the United Kingdom) as well as two candidate countries for EU membership (Iceland and Turkey). All of these countries are potential candidates for Eurozone

membership, which in turn requires them to stabilize the value of their currency relative to the euro by participating in the Exchange Rate Mechanism (ERM II) for at least two years.

The ERM II requires countries to maintain at most a fifteen percent fluctuation band around an agreed central exchange rate between the euro and the country's currency. Currently only three European Union countries officially participate in the ERM II: Denmark, Latvia and Lithuania. Denmark has formally opted-out of joining the Eurozone, though it has maintained its ERM II membership (with a narrower than required fluctuation band at 2.25%) since January 1999. Latvia joined the Eurozone in January 2014; it joined ERM II in May 2005 and maintains a 1% fluctuation band. Lithuania is scheduled to join the Eurozone in January 2015; it joined ERM II in June 2004 and maintains a 15% fluctuation band.

Table 1 shows how the non-EZ European countries fared in March 2013 against the five economic criteria established in the Maastricht Treaty which countries must fulfill in order to be eligible to join the Eurozone. The criteria include the ERM II requirement and reference rates for inflation, budget deficits, debt to GDP ratios and long term interest rates. Bulgaria and Sweden have fulfilled all Eurozone membership criteria except the two-year ERM II requirement. Bulgaria has indicated that it does not plan to join the ERM II until after the Eurozone debt crisis is resolved and Sweden is likely to remain outside the mechanism while political support for Eurozone membership remains low.[3]

Table 2 reports the Reinhart and Rogoff (2004) *de facto* exchange rate regime classifications for European countries over the period 2000 through 2011. Countries are classified as maintaining fixed, intermediate or flexible regimes, and information is provided on the month and year in which countries changed from one regime to another. The countries listed along the diagonal of the matrix in the table are those that did not change exchange rate regime classification over the eleven year period. All of the original Eurozone members have maintained their fixed rate status over this time period, as have Bulgaria and Denmark. The countries listed in the off-diagonal cells of the matrix are those that experienced an exchange rate regime change. Latvia and Lithuania are shown to have switched from the intermediate to the fixed classification in July 2009 and May 2007, respectively. These dates do not coincide

[3] In September 2003 Swedes voted against adopting the euro in a second referendum (the first referendum narrowly passed in 1994), and recent polls do not indicate support for euro adoption.

with the dates on which these countries joined the ERM II (May 2005 for Latvia and June 2004 for Lithuania) because the Reinhart and Rogoff (2004) fixed regime classification requires narrower fluctuation bands than the 15% fluctuation bands dictated by ERM II. [4] The largest number of "switchers" started off in an intermediate regime and then switched to a fixed regime. This group includes three non-EZ countries: Hungary, Latvia and Lithuania, as well as Malta, the Slovak Republic and Slovenia who have all recently joined the Eurozone.

The majority of non-EZ European countries are classified as maintaining intermediate regimes; these include Croatia, Iceland, Poland, Sweden and the UK. The Czech Republic, Hungary and Lithuania (on two dates) switched from fixed to intermediate regimes during this time period. Table 2 also includes Romania and Turkey's transitions to and from what Reinhart and Rogoff (2004) term a "free falling" regime, which is based on annual inflation rates above 40%. Interestingly, neither of the "free falling" transitions occurred during the global financial crisis.

III. Reserves and Exchange Rate Regimes

Countries that maintain fixed or intermediate exchange rate regimes tend to hold the largest stocks of foreign reserves. Three of the non-EZ European countries (Bulgaria, Croatia and Romania) have reserve-to-GDP ratios that place them in the highest quartile of the 160 countries that report foreign reserve holdings to the IMF, and another four (Czech Republic, Hungary, Latvia and Lithuania) are in the second highest quartile. Studies analyzing the motives for foreign reserve accumulations typically emphasize two potentially complimentary incentives: self-insurance and terms-of-trade improvement. The precautionary motive is based on the idea that reserve stocks can serve as self-insurance against adverse economic shocks of one form or another. Reserve accumulation may also be the byproduct of a government strategy to keep the international value of the domestic currency low and stable in order to

[4] The *de facto* exchange rate regime classifications are available online at http://personal.lse.ac.uk/ilzetzki/IRRBack.htm. The monthly data cover the period 1947 through 2010; "fine" classification is on a 1 to 15 scale (1=no separate legal tender and 15= dual market in which parallel market data is missing) and is based on information from Pick's Currency Yearbook, Pick's World Currency Report, Pick's Black Market Yearbook, International Financial Statistics, the IMF's Annual Report on Exchange Rate Arrangements and Exchange Restrictions, and the United Nations Yearbook. In this paper the fine classifications are aggregated into 4 regimes: fixed (1-4), intermediate (5-12), flexible (13), and free falling (14) and are updated through 2011.

boost export growth. Individual European countries in the Eurozone or in the ERM II inherently give up the opportunity to influence their terms-of-trade through nominal exchange rate undervaluation, though they still have the ability to influence their international competitiveness via declines in domestic prices and wages.

Empirical studies find evidence in support for both these motivations for reserve accumulation while at the same time finding it difficult to fully explain the dramatic increase in reserve accumulations by many developing countries starting in 2000 (Jeanne (2007) and Jeanne and Ranciere (2011)). Three studies that come to the conclusion that reserve accumulations through 2007 were not excessive include: Obstfeld, Shambaugh and Taylor (2010) who gauge reserve adequacy against the size of the banking sector, Hashimoto and Ito (2007) who focus on the adequacy of reserves to maintain exchange rate stability, and Dominguez (2010) who focuses on the role for reserves in countries with underdeveloped financial markets.

There are a number of studies that examine reserve policy during the global financial crisis. Aizenman and Sun (2012) document that some emerging market countries made the deliberate decision to allow the exchange rate to adjust rather than deplete their international reserves during the crisis. Obstfeld, Shambaugh and Taylor (2009) and Aizenman, Jinjarak and Park (2011) document the heavy reliance on swap lines of inter-governmental credit during the crisis, especially by developed countries that did not have large reserve accumulations. They suggest that swap lines may substitute for reserves for some countries. Dominguez, Hashimoto and Ito (2012) and Dominguez (2012) document substantial evidence of reserve depletion during the crisis, emphasizing that the country-specific timing of the crisis matters when measuring reserve changes. They show that most countries that sold reserves during the crisis, returned to accumulating reserves soon afterwards. As a consequence, unless reserve changes are measured on a monthly or quarterly basis, researchers will erroneously conclude that reserves were not used and played no role in crisis management.

All countries, regardless of their exchange rate regime, hold foreign reserves. However, the recent dramatic build-up in global reserve stocks is largely driven by developing countries that are classified as maintaining *de facto* pegs or crawling pegs, with China at the top of the list,

followed by Saudia Arabia and Russia. Among developed countries, Japan and the Eurozone are the largest reserve holders, with Switzerland rounding out the top five. In the cases of Japan and Switzerland, reserves were accumulated as part of government intervention strategies to stop excessive appreciation of the domestic currency, though Japan is classified as allowing its currency to float while the Swiss franc is in a moving band. Figure 1 shows the relative shares of global reserves held by countries whose *de facto* exchange rate regime is broadly classified as flexible, intermediate or fixed by Reinhart and Rogoff (2004) and Ilzetski, Reinhart and Rogoff (2010).

Figure 2 shows the average ratio of foreign reserves-to-GDP for floaters, intermediate regimes and fixers starting in 1980. The data indicate that most countries were actively accumulating reserves in the five years prior to the global financial crisis regardless of regime, with those countries classified as having intermediate regimes showing the fastest growth in reserves-to-GDP since 2000. Reserves-to-GDP ratios declined the most for fixers and intermediate regimes in 2008-9, and reserves ratios across all three regimes rapidly "bounced back" to pre-financial crisis levels by 2010. Indeed, among the non-EZ European countries, reserves stocks in Denmark, Hungary, Iceland, Poland and Turkey exceeded their pre-crisis levels soon after the end of the crisis.

Table 3 shows the Reserves-to-GDP ratios of the non-EZ European countries prior to the Global Financial Crisis (in 2006). Bulgaria shows the highest ratio at 34.8, with Croatia, the Czech Republic, Latvia and Romania all reporting ratios above 20. The two highest income countries in this sample, Sweden and the UK, report the lowest ratios. Figure 3 compares the average Reserves-to-GDP ratio for the non-EZ European countries, with the Eurozone countries and the rest of world (ROW). The non-EZ European country average is much higher than that for the Eurozone countries, and slightly below the average ratio for the rest of the world.[5] The final column of Table 3 classifies the 2006 non-EZ European country Reserve-to-GDP ratios in quartiles based on the full sample of countries; on this basis Bulgaria, Croatia and Romania are classified in the "high" ratio quartile.

[5] It is worth noting that when countries join the Eurozone we typically see a dramatic fall in foreign reserves, which reflects the fact that euro-denominated assets are no longer considered foreign reserves for these countries. This pattern is very apparent in the time series for the Slovak Republic and Slovenia.

Did higher reserve accumulations prior to the financial crisis protect countries from exchange rate instability? Table 4 reports the percentage depreciations and reserve changes for each of the non-EZ European countries during the global financial crisis (defined as August 2008 through February 2009). If we exclude the two high-income countries (Sweden and the UK), we find that, perhaps unsurprisingly, the three ERM II countries (Denmark, Latvia and Lithuania) experienced the smallest changes in currency value against the US dollar (and no depreciation against the Euro). Of the countries that are not in the ERM II, two of the high Reserves-to-GDP countries, Bulgaria and Croatia, experienced the lowest rates of currency depreciation and the highest rates of reserve depletion. Interestingly the other high Reserves-to-GDP country in the sample, Romania, experienced a relatively large currency depreciation (41% against the US dollar and 21% against the Euro), but it also chose not to deplete its reserves (which only fell by 14%). Among the countries that entered the financial crisis with relatively low levels of reserves, Poland experienced the largest depreciation of its currency (62% against the US dollar and 39% against the Euro)[6], even with a relatively large percentage depletion of its reserves during the crisis (25%). Hungary and Turkey are the two other countries that experienced the largest currency depreciations against the US dollar. Hungary, which started out with a high reserve ratio in 2006, actually continued to accumulate foreign reserves during this period, while Turkey, which started out with a low reserves ratio, only depleted 11% of its reserves during the crisis.

Overall the percentages reported in Table 4 indicate that countries with higher pre-crisis reserve accumulations (as a share of GDP) where better able to stabilize their exchange rates, as long as they were willing to also deplete reserves. Romania's experience during the financial crisis suggests that just building up a large stock of reserves is not enough. Countries seem to both need significant reserve stocks and the willingness to use them. It is also worth noting that the majority of non-EZ European countries experienced larger exchange rate fluctuations and larger reserve depletions than the average for intermediate regimes in the full sample of countries during the financial crisis (these averages are provided in the bottom row of Table 4). This suggests that policy actions for this group of countries were consistent with allowing larger

[6] One explanation of the relatively large depreciation of the zloty during the financial crisis is that it may have been significantly over-valued at the start of the crisis.

swings in the exchange rate and larger depletions of reserves, than was the case for other intermediate regime countries during this time period.

Figures 4-15 show each of the non-EZ European country foreign reserve accumulations before, during, and after the financial crisis based on data available from the IMF's SDDS database[7] (Romania is the one country not shown in these figures because they only began reporting this data to the IMF in 2007). The black bars in the figures are labeled "active management," they depict the monthly additions or subtractions to each country's foreign reserve stocks (they differ from the monthly IMF reserve numbers in that they exclude interest income and valuation changes in the previously accumulated reserve stock); the solid line depicts the accumulation of these asset purchases and sales showing the growth in reserves due to active management.[8] The countries that show the highest increases in reserve accumulation after the crisis include all the countries that were in the medium-low reserve-to-GDP quartile prior to the crisis (Denmark, Iceland, Poland and Turkey).

When monetary authorities acquire reserve assets they typically sterilize the effect of these purchases on the domestic monetary base by incurring domestic-currency liabilities (often termed "sterilization bonds").[9] Likewise, reserves held by the fiscal authority are typically financed with domestic government bills. Anecdotal evidence suggests that not all reserve accumulations are sterilized (examples include China, Japan and Switzerland). In the case of the non-EZ European countries if reserve accumulations were unsterilized we would expect to see evidence of this showing up in inflation and long-term interest rate movements, which is not evident in the aggregate data (see Table 1).

IV. Capital Controls and Exchange Rates

Controls restricting capital account transactions were used widely by countries in the Bretton Woods era. Indeed Reinhart and Rogoff (2009) argue that these capital controls, even

[7] Data on official reserve assets and the Reserve Template for the SDDS subscribers are publicly available at the IMF's website, http://dsbb.imf.org/Pages/SDDS/ReserveTemplates.aspx.

[8] See Dominguez, Hashimoto and Ito (2012) for a detailed description of the measurement of active management depicted in these figures.

[9] If the central bank does not sterilize its foreign reserve purchases it increases its domestic liabilities when its foreign assets increase. If the central bank sterilizes, it effectively reduces its net assets. In both cases the net worth of the central bank is unchanged.

more than rapid economic growth, should be given credit for dramatically reducing the incidence of banking crises in this period. Capital controls were largely dismantled after the collapse of the Bretton Woods system in developed countries, and many developing countries followed suit in the 1980s and 1990s. The so-called Washington Consensus during this time period was that all countries would benefit if capital was allowed to flow freely across borders. This sanguine view of open capital markets shifted after the dramatic increases in capital inflows to emerging market countries in the early 1990s were suddenly reversed sending many countries into financial crises. Capital controls, under the less objectionable label of macro-prudential policies, have been further rehabilitated in the aftermath of the global financial crisis when many developing countries experienced a renewed round of capital inflows and the resulting appreciation pressure.

Although capital restrictions now seem to be more widely accepted as policy tools, even outside of crisis periods, evidence of the efficacy of these restrictions is less clear cut. Klein (2012) examines the efficacy of capital controls on inflows and outflows, as well as differences between long-standing and episodic controls. He makes the case that temporary controls are less effective than long-standing ones and conjectures that this is because evasion is easier in a country that already has experience with unrestricted capital markets. Argentina in 2001 is a good example of the difficulties of restricting capital in an economy previously accustomed to free mobility.[10]

One of the reasons that the efficacy of capital controls remains controversial is that it is difficult to accurately measure the intensity and enforcement of controls. Two countries might have the same capital restrictions on their books, but they each could approach implementation and enforcement of the restrictions differently. If authorities largely ignore violations of the restrictions, empirical work may erroneously conclude that controls, rather than enforcement, are ineffective. Another problem that arises in empirical analyses of controls is selection bias. Countries may impose controls during times of crisis as a last-resort policy tool. A related problem arises from the endogeneity of capital restrictions, which are likely to be imposed to stave off undesired exchange rate movements, making it difficult to

[10] Auguste, Dominguez, Kamil and Tesar (2006) describe how Argentines used ADRs to evade the capital outflow restrictions put in place during 2001 as part of the *corralito*.

distinguish the effect of controls on exchange rates from the influence of exchange rate movements on the establishment of controls. Finally, distinguishing the influence of capital controls during a financial crisis, when economic activity and capital flows are already subdued, is likely to be difficult.

Table 5 shows which European countries maintained or increased capital controls during the financial crisis. Countries are classified as maintaining "long-standing," "new," or "no" capital controls based on the Chinn-Ito financial openness measure.[11] The middle column reports the year in which new controls were put in place and repeats countries each time they added controls after 2007. The Chinn-Ito measure gauges a country's degree of capital account restrictiveness (with higher index scores denoting fewer restrictions). The index is described in Chinn and Ito (2006) and is based on four binary dummy variables that codify the tabulation of restrictions on cross-border financial transactions reported in the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER).* The downside of the Chinn-Ito measure is that it does not distinguish capital outflow and inflow restrictions; the advantage is that it provides a relative measure of the intensity of restrictions.

A number of non-EZ European countries introduced capital controls during the global financial crisis; while some actually dismantled controls already in place at the time of the crisis. Table 6 reproduces information from Forbes et al (2013, Table 1) that describes the types of controls imposed by non-EZ European countries during the crisis. Iceland is not included in the table, but it also imposed restrictions in the throes of its banking crises. All the countries listed in table 6 experienced undesired capital inflow pressures, and most countries also experienced undesired capital outflows. EU countries that did not have any capital-flow management events during 2009 through 11 include: Denmark, Lithuania, Poland and Sweden.

While measuring the size and effectiveness of capital controls during the financial crisis is beyond the scope of this study, the information reported in tables 5 and 6 indicate that

[11] The Chinn-Ito data are available at: http://web.pdx.edu/~ito/Chinn-Ito_website.htm. The maximum Chinn-Ito financial openness measure in the updated version of the database (used here) is 2.44. Countries with this maximum score are classified as maintaining "no" capital controls. Countries that are continuously coded with a Chinn-Ito score below 2.2 between 2006 and 2011 are classified as maintaining "long-standing" controls. The minimum Chinn-Ito score is -1.86. There are 54 countries that score the "most financially open" value of 2.44 as of 2011 whereas there are 13 countries with the "least financial open" score of -1.86.

controls were used by many European countries, including those already in the Eurozone. Furthermore, the information in the tables indicates that a number of countries imposed new or more restrictive controls during the financial crisis. The trilemma suggests that capital controls can, at least in theory, act as a substitute for exchange rate adjustments during times of crisis. In practice, however, the large European country exchange rate realignments that occurred during the crisis suggest that capital controls at best complemented exchange rate adjustments.

V. Exchange Rates and Economic Growth

A number of recent studies have found little evidence that a country's choice of exchange rate regime has much influence on macroeconomic stabilization or growth (Rose, 2011). The strongest argument in favor of flexible rates is that "floaters" are better able to absorb economic shocks. The global nature of the financial crisis and subsequent recession meant that it was not feasible for the world as a whole to rely on exchange rate depreciation and export growth at the same time, but did those countries that maintained fixed exchange rates during the financial crisis suffer more than countries that allowed their exchange rate to adjust? Figure 16 shows how non-EZ European countries fared before, during and after the crisis relative to the Eurozone countries and the rest of the world. While average real GDP growth fell dramatically for all countries during the crisis, the average decline was largest for the Eurozone countries in this comparison. More generally fixers fared worst, followed by those maintaining intermediate regimes. Floaters fared best.

The growth experience for non-EZ European countries after the financial crisis is similar, in terms of ranking relative to the Eurozone and the rest of the world, to the pattern shown in the pre-crisis period. This pattern also holds for the full sample of countries grouped by exchange rate regime; the countries with intermediate regimes experienced the highest average real GDP growth, followed by fixers. Floaters fared least well after the crisis, with an average real growth rate of below 2%. Although simple averages do not control for the many other factors that might influence economic growth, the message that intermediate regimes (that are neither fully fixed nor fully flexible) are associated with the highest average growth performance in

non-crisis periods seems reasonable. Intermediate regimes can be thought of as the Goldilocks of regimes, simultaneously avoiding the worst characteristics of fixed regimes (overvaluation) as well as the drawbacks of floating regimes (volatility).

Figures 17 through 19 show the changes in real GDP growth for each of the non-EZ European countries over the pre-crisis period (2005Q1-2007Q4), during the global financial crisis (2008Q3 -2009Q4), and after the crisis (2009Q3 - 2010Q4). In the pre-crisis period shown in Figure 17, a number of these countries experienced unusually high rates of growth, with Bulgaria, Latvia and Romania reporting real rates of growth above 10%, and Lithuania and Turkey at over 5% real GDP growth. During the financial crisis growth rates plummeted for all the European countries, only Croatia, Hungary, Iceland and Poland experienced marginally positive growth. Immediately after the financial crisis all the European countries bounced back, with the strongest performers including Bulgaria, Romania and Turkey. Croatia, which had relatively stable but low growth before and during the crisis, experienced negative growth in the post-crisis period.

VI. Conclusions

Foreign currency-denominated reserves have always played an important role in fixed exchange rate regimes, but their role for countries with floating or intermediate regimes is less well understood. Similarly, the role and effectiveness of capital controls for countries that value exchange rate stability, but do not fix their rate, is difficult to measure. The data suggest that prior to the financial crisis most countries, regardless of exchange rate regime, held significant reserve stocks and in many cases maintained some degree of capital account restrictiveness. Put another way, a country's choice of exchange rate regime seems to have only minor implications for reserve and capital account management.

The analysis in this paper focused on the non-EZ European countries which experienced larger exchange rates fluctuations during the financial crisis than the average for other intermediate regime countries. This suggests that policy actions involving reserve management and the use of capital controls during the financial crisis were consistent with allowing larger

swings in the exchange rate in most of these countries relative to other intermediate regime countries around the globe.

The relationships between exchange rates, capital controls and foreign reserves during the financial crisis suggest that reserve management plays a much more central role than has typically been emphasized in international finance models. Reserves seem to be important not only for stabilizing fixed regimes, but they also seem to be able to deter currency market pressure in intermediate regimes for countries that are willing to use them, and in so doing help to mitigate trilemma trade-offs.

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Table 1 Maastricht criteria for Joining the Eurozone

Country	Inflation Rate	Budget Deficit to GDP	Debt-to-GDP	ERM II Member	Long-term interest rate
Reference Values	max 2.5%	max 3%	max 60%	min 2yrs	max 4.81%
	EU members (outside the Eurozone)				
Bulgaria	2.5%	0.8%	18.5%	No	4.03%
Croatia	4.0%	4.6%	53.6%	No	5.73%
Czech Rep	2.9%	4.4%	45.8%	No	2.44%
Denmark	1.9%	4.0%	45.8%	1-Jan-99	1.36%
Hungary	4.9%	1.9%	79.2%	No	7.23%
Latvia	1.6%	1.2%	40.7%	2-May-05	4.00%
Lithuania	2.8%	3.2%	40.7%	28-Jun-04	4.53%
Poland	3.0%	3.9%	55.6%	No	4.61%
Romania	3.9%	2.9%	37.8%	No	6.43%
Sweden	0.8%	0.5%	38.2%	No	1.61%
UK	2.6%	6.3%	90.0%	No	1.67%
	Candidates for EU membership				
Iceland	5.70%	1.70%	96.20%	No	6.70%
Turkey	8.20%	1.90%	36.30%	No	7.90%

Notes: Based on data through March 2013. Latvia joined the Eurozone in January 2014 and Lithuania is expected to join in 2015. Denmark and the UK negotiated Eurozone opt-out agreements; Sweden has chosen not to join the ERM II.

Source: International Financial Statistics (IFS). Washington, D.C.: International Monetary Fund (accessed May 5, 2013).

Table 2 *de Facto* European Exchange Rate Regimes and Dates of Changes in Regime, 2000-2010

	Original Exchange Rate Regime																
Regime between 2001-2010	Fixed Regimes in 2000				Intermediate Regimes in 2000				Flex Regimes in 2000				Falling Regimes in 2000				
	Country	Month	Year		Country	Month	Year		Country	Month	Year		Country	Month	Year		
Fixed Regimes (between 2001-2010)	Austria Belgium Bulgaria Cyprus Denmark Estonia Finland France Germany Greece Ireland Italy Luxembourg Netherlands Portugal Spain				Hungary Latvia Lithuania Malta Slovak Rep Slovenia	October July May January January December	2009 2009 2007 2008 2008 2005										
Intermediate Regimes (between 2001-2010)	Czech Rep Hungary Lithuania Lithuania	January March November April	2002 2010 2003 2009		Croatia Iceland Poland Sweden UK				Turkey	August	2007		Romania	April	2001		
Flexible Regimes (2001-10)													Turkey	April	2003		
Falling Regimes (2001-10)					Turkey	February	2001										

Notes: Countries listed in the diagonal cells maintained the *de facto* regime through-out 2000-2010, countries in off-diagonal cells are those that started in the regime listed in each column header and switched (with year and month of switch given) to the regime type listed in each row header. Monthly regime classifications are from Ilzetzki, Reinhart and Rogoff (2010).

Table 3 Non-EZ European Country Reserves-to-GDP Ratio Comparisons in 2006

Country	Reserves-to-GDP (2006)	Quartile based on full-sample
Bulgaria	34.8	high
Croatia	23.4	high
Czech Republic	21.9	med-high
Denmark	10.9	med-low
Hungary	19.1	med-high
Iceland	13.8	med-low
Latvia	21.9	med-high
Lithuania	18.8	med-high
Poland	13.6	med-low
Romania	23.0	high
Sweden	6.3	low
Turkey	11.5	med-low
United Kingdom	1.7	low

Notes: The high-quartile range is defined by a reserves-to-GDP ratio above 23, the medium-high quartile range is between 16 and 23, the medium-low quartile range is 9 to 15 and the low quartile range is below 9. The quartile ranges are based on a sample of 160 countries.

Source: International Financial Statistics (IFS). Washington, D.C.: International Monetary Fund (accessed May 5, 2013).

Table 4 EU Currency Depreciations and Reserve Changes during the Global Financial Crisis (GFC)

Country	Percent Depreciation against USD	Percent Depreciation against Euro	Percent Change Reserves	Reserves-to-GDP Quartile (2006)
Bulgaria	17	0	-30	high
Croatia	20	3	-25	high
Czech Rep	33	14	-4	med-high
Denmark	16	0	25	med-low
Hungary	45	24	24	med-high
Iceland	36	17	-19	med-low
Latvia	16	0	-10	med-high
Lithuania	16	0	-19	med-high
Poland	62	39	-25	med-low
Romania	41	21	-14	high
Sweden	41	21	-17	low
Turkey	44	23	-11	med-low
UK	29	11	-10	low
Average Intermediate Regimes	19	3	-9	med-high

Notes Exchange rate depreciation and percentage changes in reserves are based on monthly data during the GFC (between August 2008 and February 2009). Averages for "intermediate regimes" are based on relevant countries included in the IFS database excluding the non-Eurozone EU countries.

Source: International Financial Statistics (IFS). Washington, D.C.: International Monetary Fund (accessed May 5, 2013).

Table 5 EU Country Capital Controls 2006-2011

No Controls		New Controls 2008-2011				Long-Standing Controls	
Country		Country	Chinn-Ito	Year		Country	Chinn-Ito
Austria		Iceland	-1.17	2008		Bulgaria	2.18
Belgium		Lithuania	2.18	2008		Croatia	1.12
Czech Republic		Lithuania	1.91	2009		Cyprus	1.91
Denmark		Lithuania	1.65	2010		Malta	1.91
Estonia		Lithuania	1.38	2011		Poland	0.06
Finland		Slovenia	2.18	2008		Romania	2.18
France		Slovenia	1.91	2009		Slovakia	0.59
Germany		Slovenia	1.65	2010			
Greece		Slovenia	1.38	2011			
Hungary		Turkey	0.06	2008			
Ireland							
Italy							
Latvia							
Luxembourg							
Netherlands							
Portugal							
Spain							
Sweden							
United Kingdom							

Notes: Countries are classified as maintaining “no”, “new” or “long-standing,” capital controls based on the Chinn-Ito financial openness measure. The maximum Chinn-Ito financial openness measure is 2.44. Countries with this maximum score are classified as maintaining “no” capital controls. Countries that are continuously coded with a Chinn-Ito score below 2.2 between 2006 and 2011 are classified as maintaining “long-standing” controls. The minimum Chinn-Ito score is -1.86.

Source: The Chinn-Ito data are available at: http://web.pdx.edu/~ito/Chinn-Ito_website.htm.

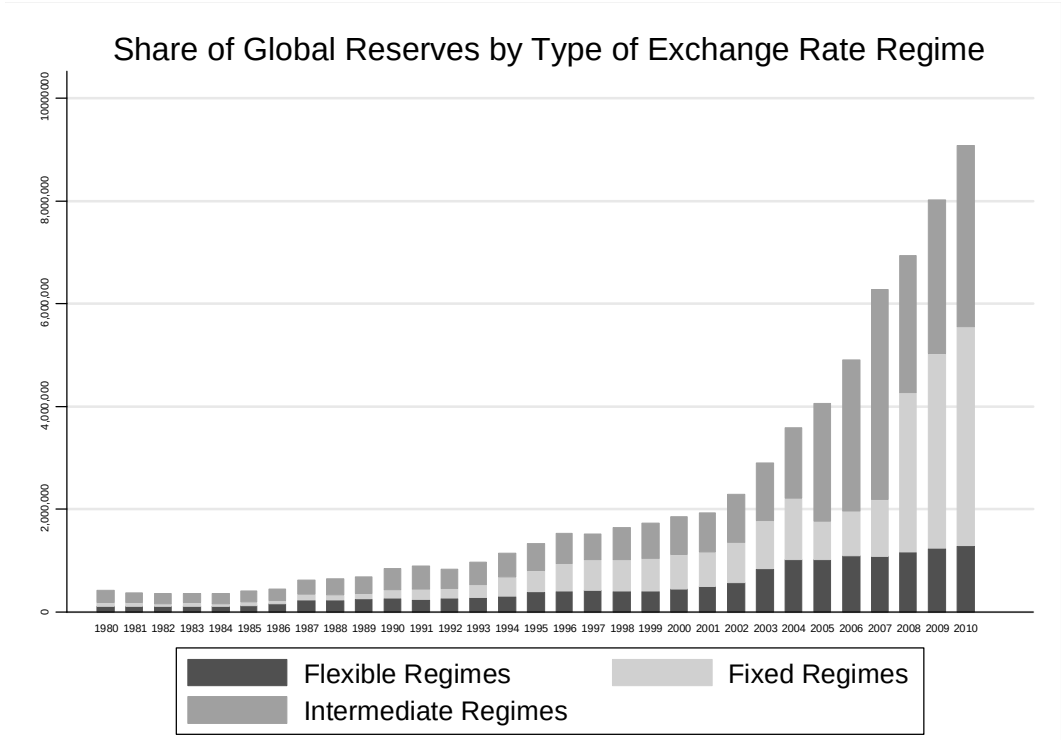
Table 6 Non-EZ European Country Capital-Flow Management Measures (2009-2011)

	Controls on Inflows		Controls on Outflows		Macroprudential Measures		Related to Pressures from Capital:		
	-	+	-	+	-	+	outflows	inflows	total
Bulgaria	1	0	1	0	0	0	1	1	2
Croatia	1	0	3	1	3	2	5	5	10
Czech Rep	0	0	1	0	0	1	0	2	2
Hungary	0	0	0	0	1	2	1	2	3
Latvia	0	0	0	0	0	2	0	2	2
Romania	0	0	0	0	3	1	3	1	4
Turkey	0	0	2	0	5	4	5	6	11

Source: Table 1 in Forbes, Fratzscher and Straub (2013).

Notes: "-"denotes the removal or easing of a control or macro-prudential measure and "+" denotes the addition or tightening of a measure. EU countries that did not have any capital-flow management events in 2009-11 include: Denmark, Lithuania, Poland and Sweden. Iceland is excluded from the sample due to data limitations. The primary data source is the *Annual Report on Exchange Rate Arrangements and Exchange Restrictions* by the IMF.

Figure 1



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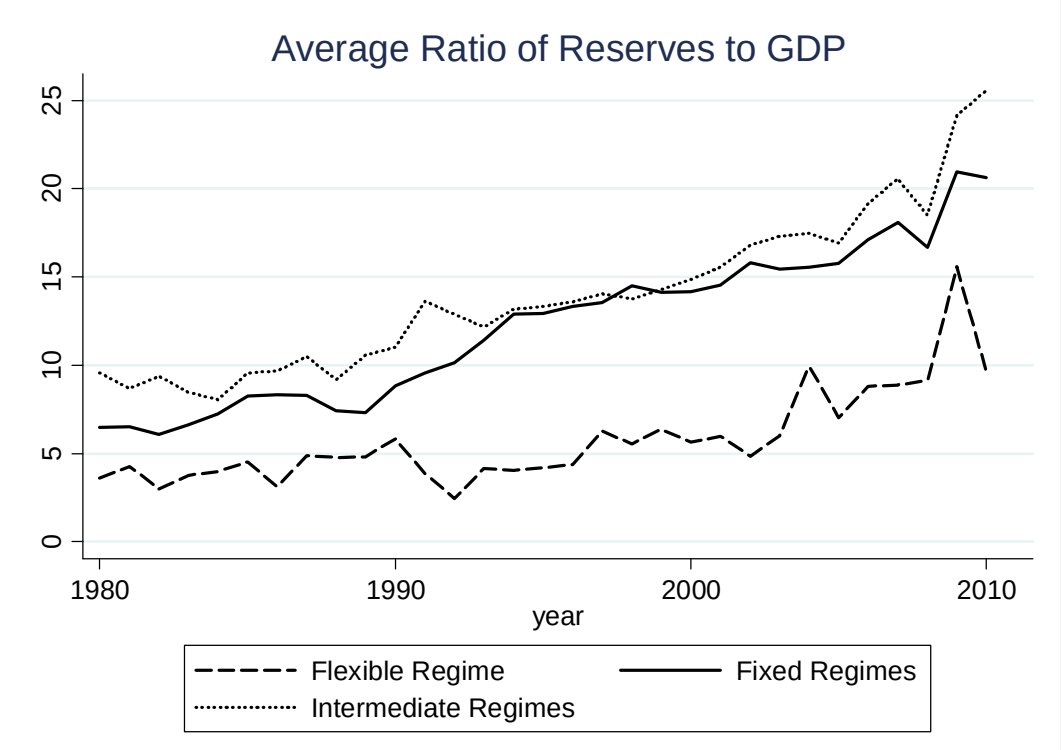

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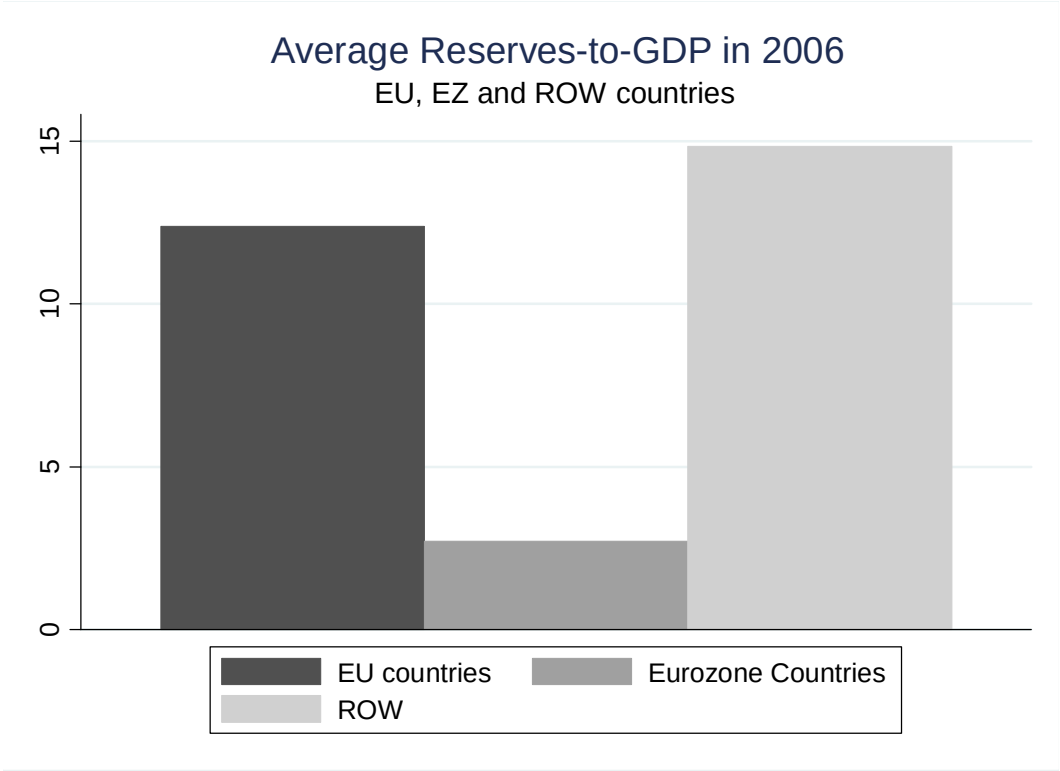
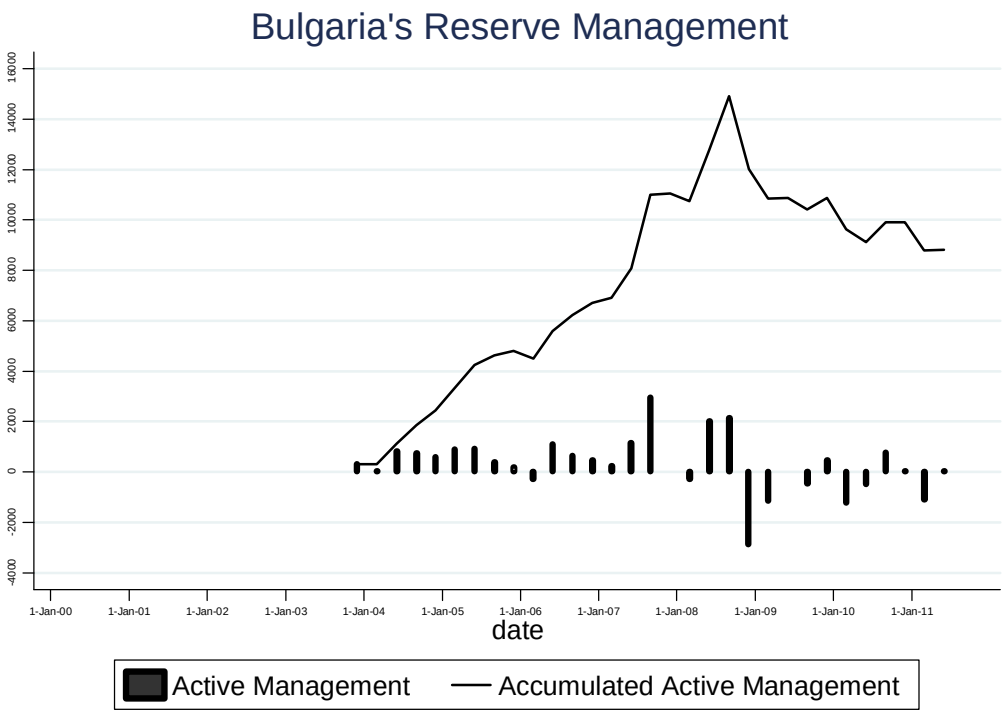

Average Reserves-to-GDP in 2006
EU, EZ and ROW countries
0
5
10
15
EU countries
Eurozone Countries
ROW

Figure 4



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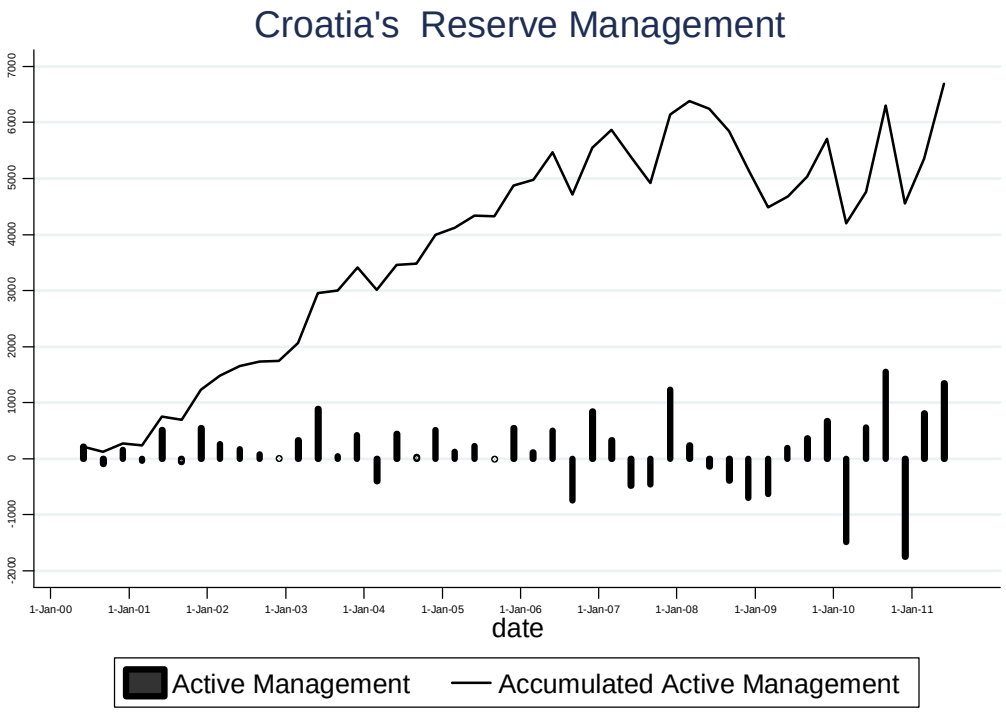

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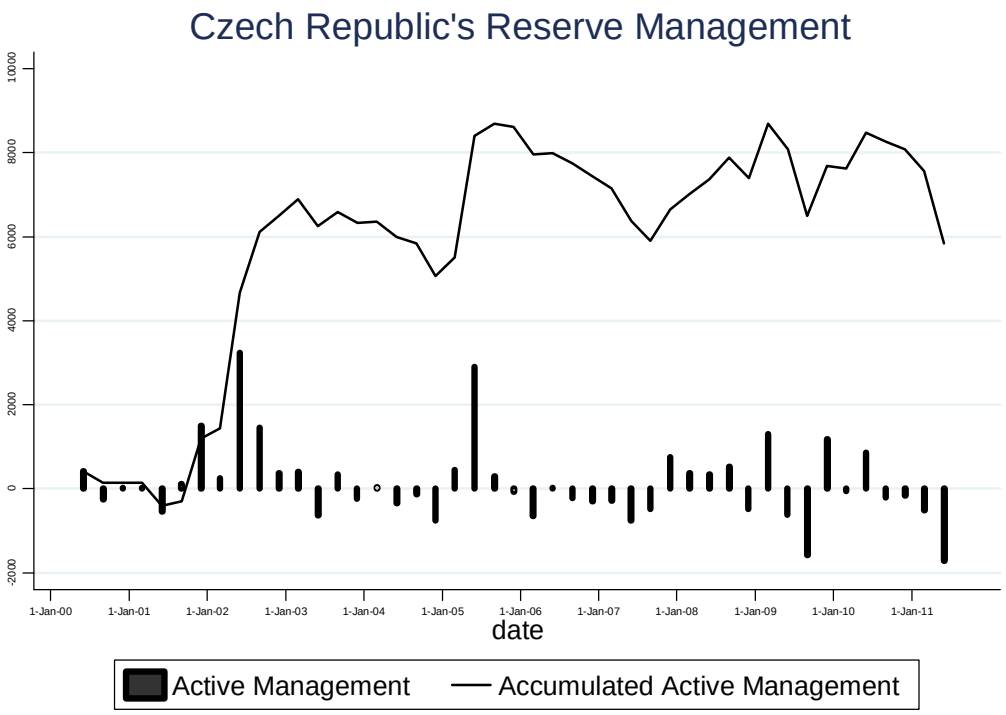

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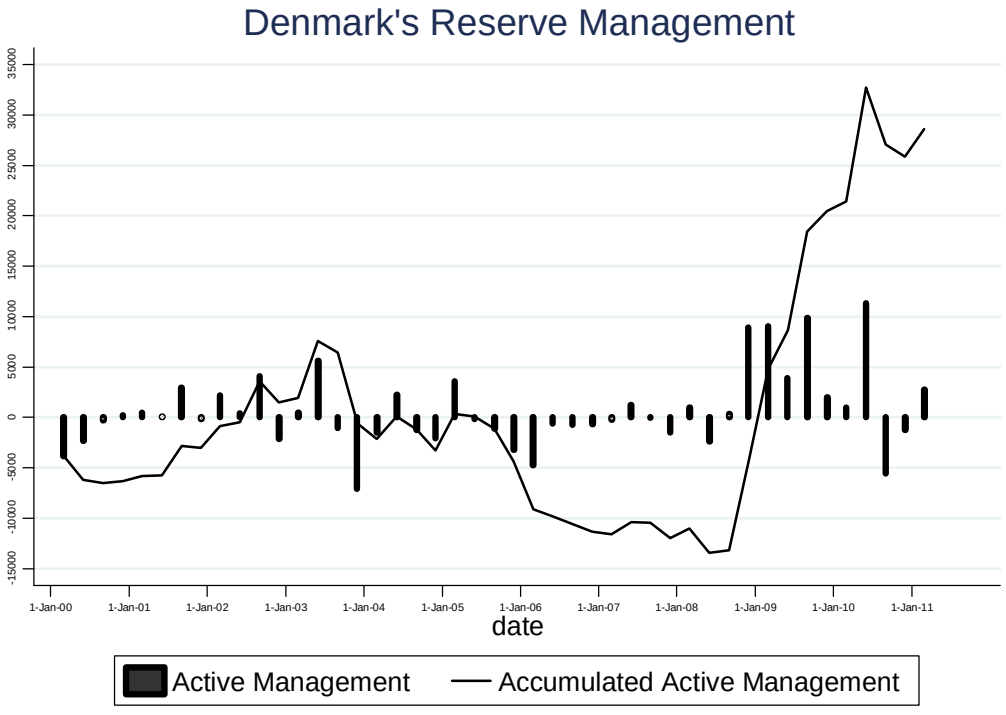

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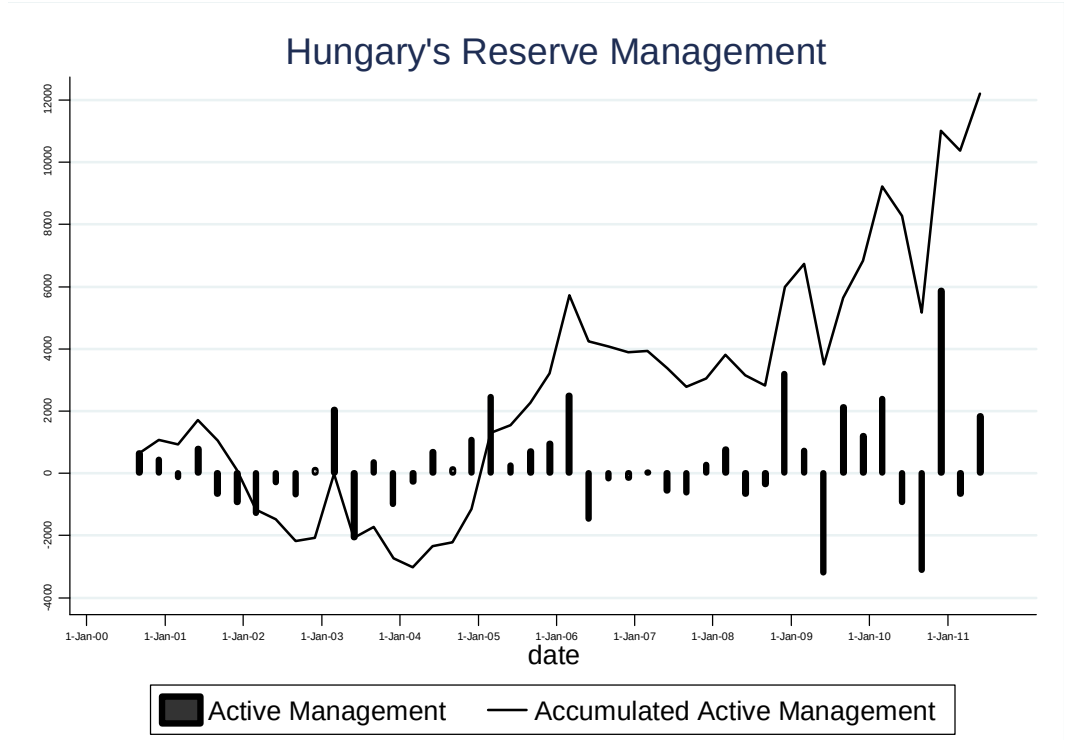

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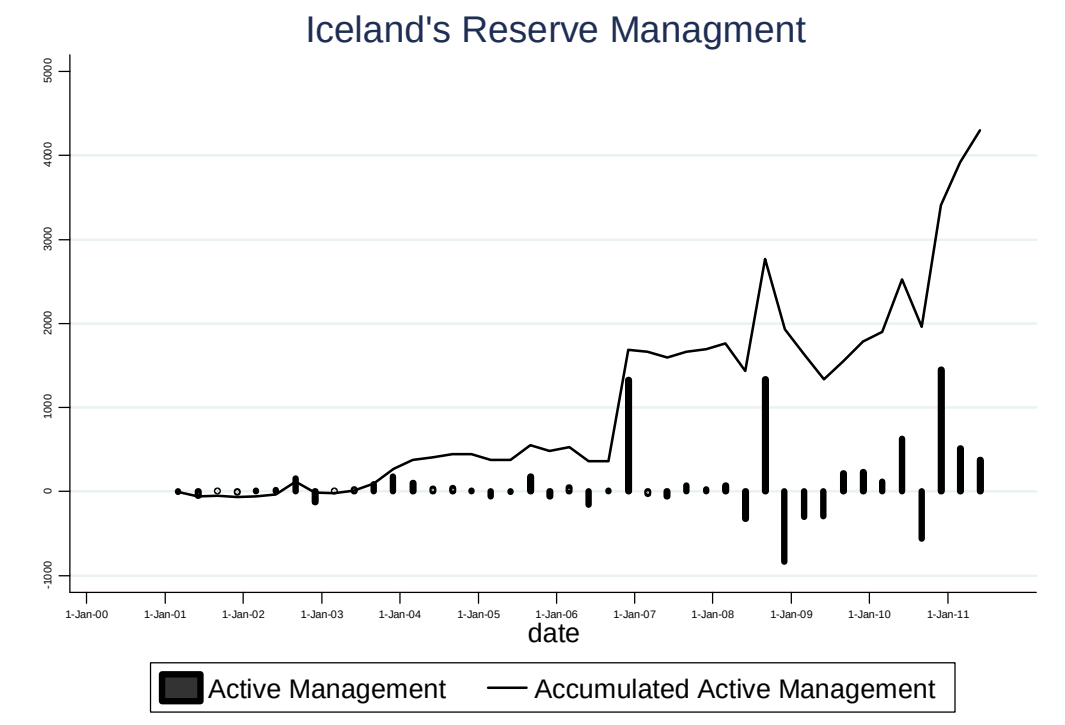

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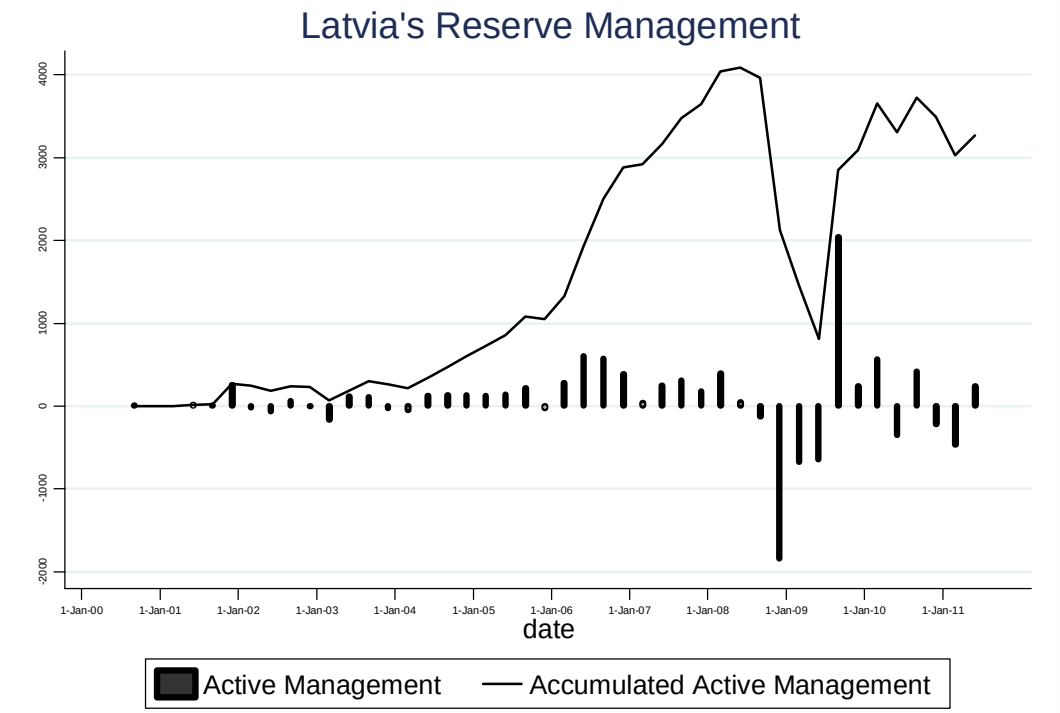

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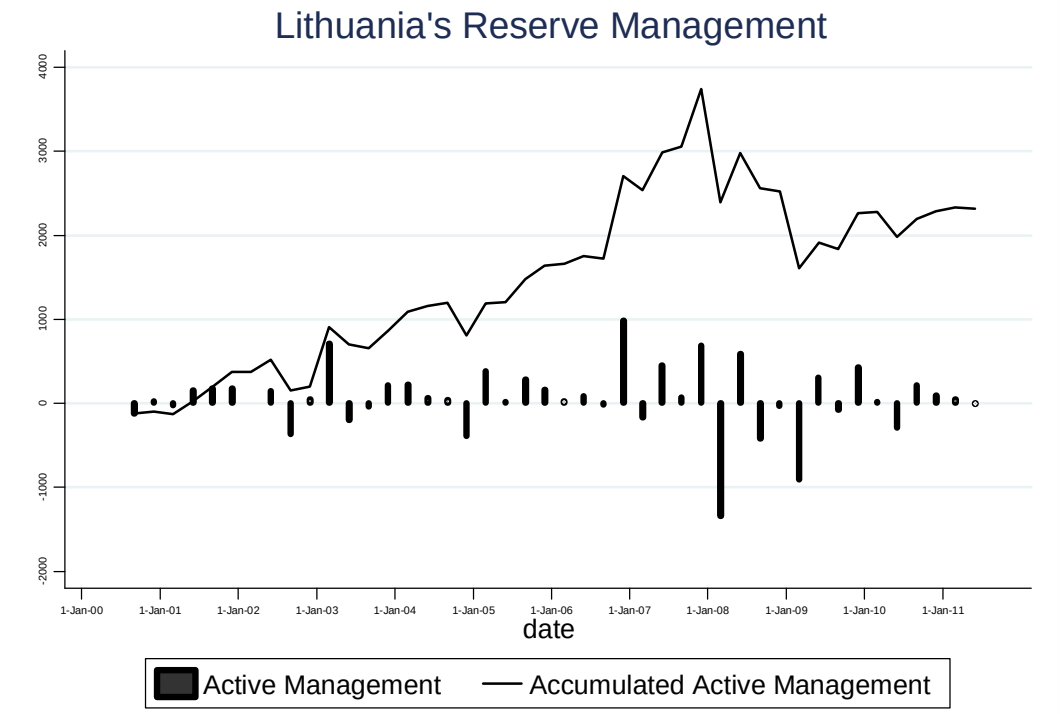
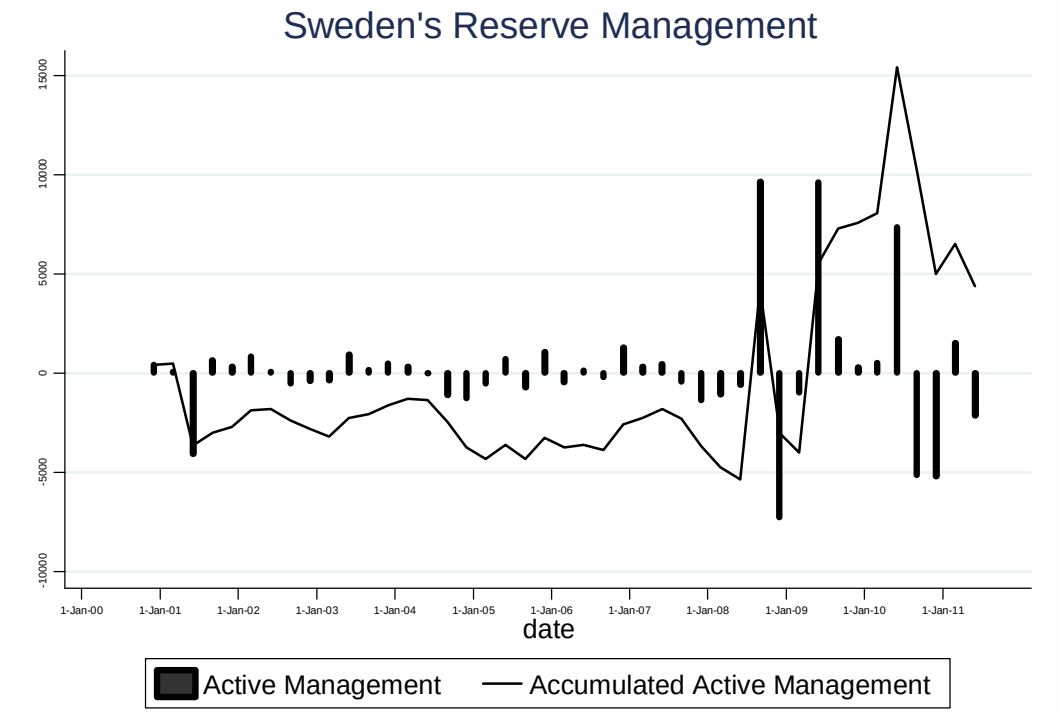


Figure 12

Figure 13



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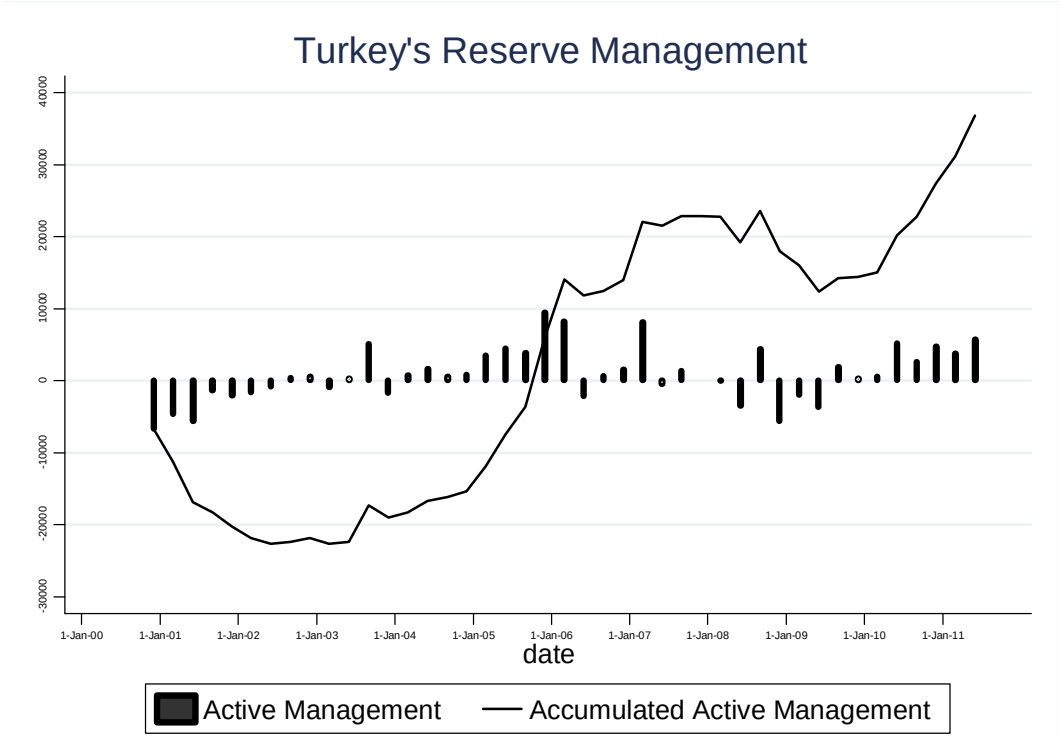

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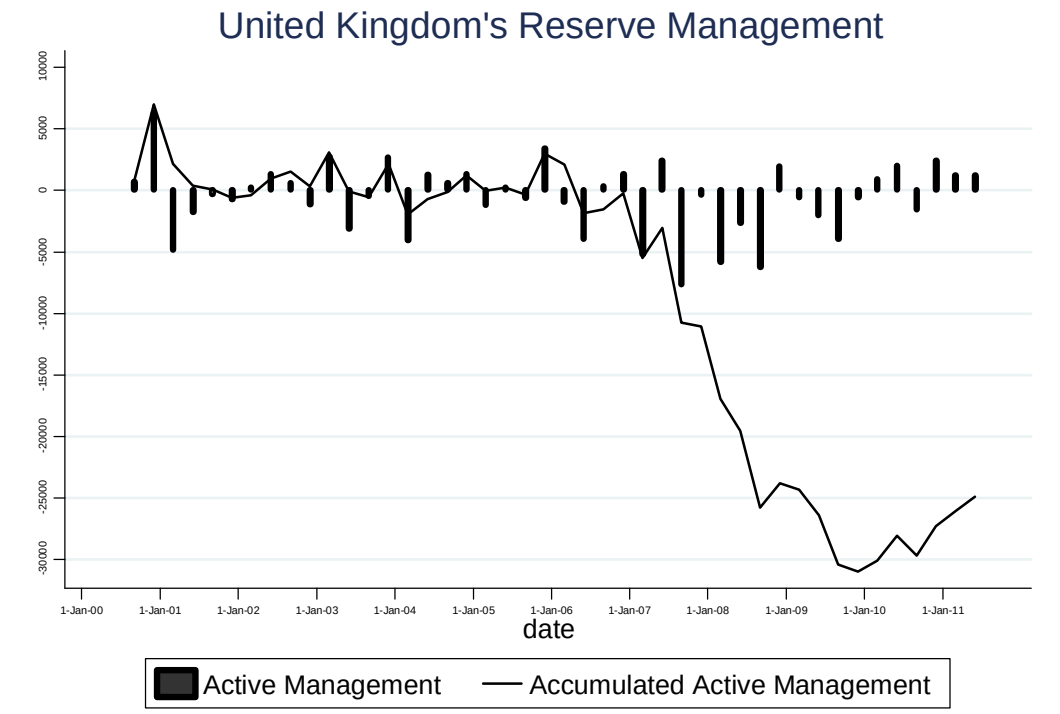

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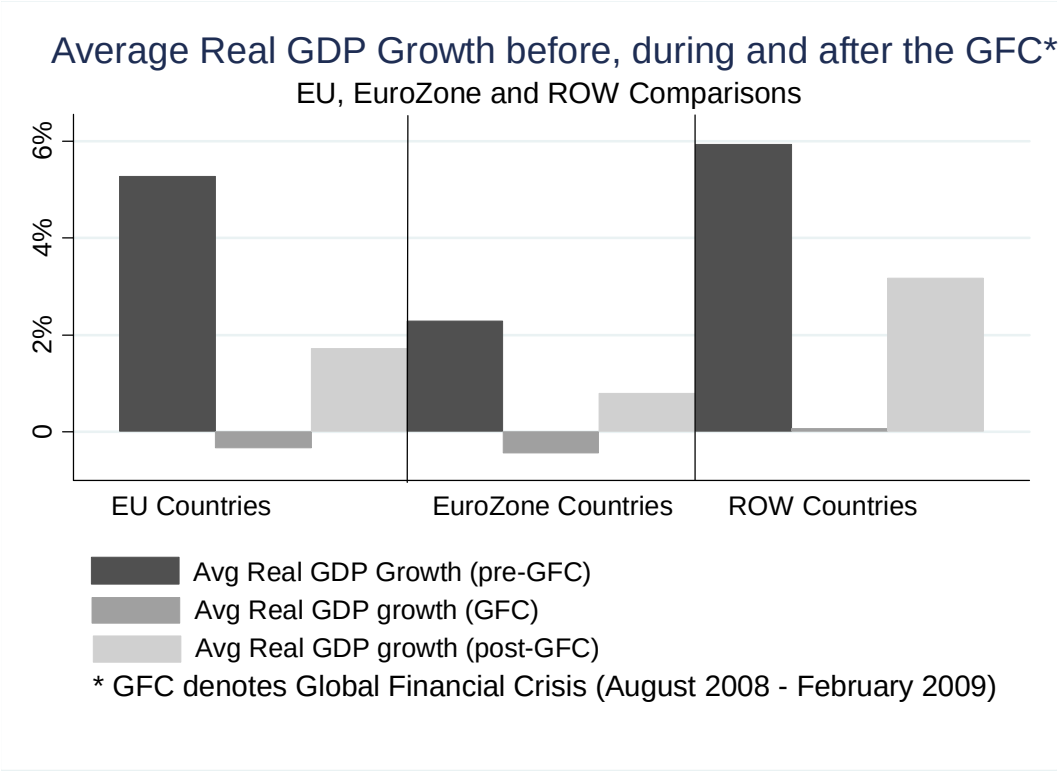

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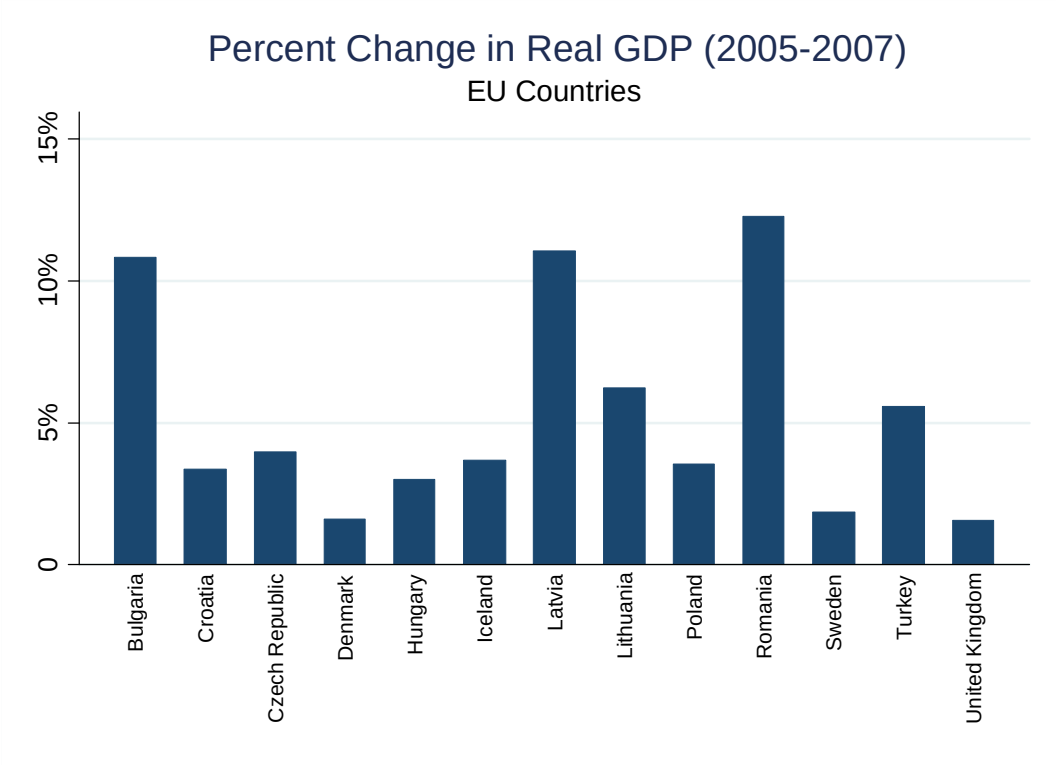

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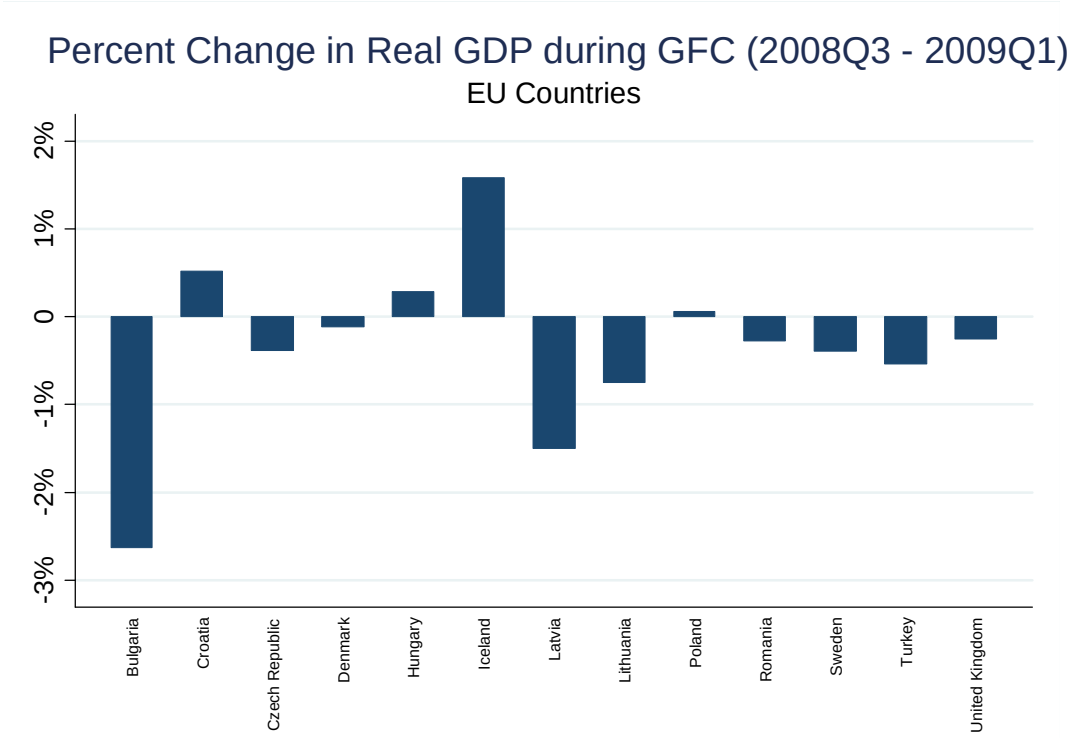

Figure 19