Can central banks crowd out investment? The importance of reserve data in the relationship between foreign exchange reserves and investment in Asia.

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Thesis Abstract (Outline)

Reinhart, Reinhart, and Tashiro (2016) have suggested that a negative relationship exists between reserve accumulation and investment in part because the central bank can crowd out investment through issuance of central bank bills. Using a different econometric model, but the same measure of reserves and investment as these authors, my initial findings support their research. However, the proxy for reserve changes contains valuation effects, which is problematic given that an increase in reserves through this channel would not be sterilized, thus the potential mechanism for crowding out is not triggered. If the goal of research is to capture the effects of a policy decision, then a separate measure of reserves from the balance of payments data appears to be a better proxy. When using this measure, I find that there is no significant relationship that exists between accumulation and investment. My initial results and methodology contribute to existing reserve literature by bringing to light the strong influence valuation effects has within the reserve stock measurement, and how the subsequent differences between the BOP and reserves measures can drive drastically different research results.

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Introduction:

Central bank holdings of foreign exchange reserves have increased rapidly over the past two decades, especially in many Asian nations. There has been no shortage of explanations as to why countries have accumulated high levels of reserves, with some observers citing mercantile (competitive) reasons while others have claimed that the answer lies in precautionary motives. While the benefits to maintaining large reserves are clear to policymakers and academic economists alike (ensuring liquidity, smoothing foreign exchange volatility, preventing speculation), the potential negative macroeconomic externalities are less well understood. On the 20th anniversary of the crisis, it is important to weigh these costs and benefits, and to question whether foreign reserves have had a quantifiable negative impact on the Asian countries that have seen exponential growth in their reserve holdings. While fiscal and quasi fiscal costs have been considered, less ink has been spilled in trying to evaluate the impact of reserves on the domestic economy.

The goal of this paper is to evaluate one macroeconomic aspect of reserve accumulation, which is the potential relationship between reserve accumulation and domestic investment. Reinhart, Reinhart, and Tashiro (2016), suggest that reserves are negatively related to investment through the possibility that the central bank can crowd out investment when it issues central bank bills. Research has shown that sterilization is usually offset by private capital flows; however, Bayoumi et al (2015) find that when capital accounts are closed this process is inhibited. Theoretically this may be the mechanism where crowding out occurs, as less funding is available for investment based on the inability of sterilization to be offset by private capital flows. In the case that increasing reserve accumulation and low level of investment have a significant relationship it may be prudent for policymakers, especially in developing countries where investment is needed, to consider ways to either encourage investment or curtail reserve accumulation.

My hypothesis, that reserves and investment are negatively related, was evaluated by utilizing panel data employing OLS and fixed effects methods with various controls. The baseline sample included four countries in the Asian region, Indonesia, Malaysia, the Philippines, and Thailand from the 1990 to 2014 time period. In a second sample, I also added Hong Kong, Japan, Korea, India, and Singapore, in order to cover a larger range of countries at different

stages of development. For the dependent variable, I utilized gross capital formation scaled to GDP, and for the independent variable of interest I utilized two separate measures of foreign exchange reserves. In the first model, similar to Reinhart, Reinhart, and Tashiro (2016), I utilized the first difference of stock reserves (FD Reserves). However, as this measure contains valuation effects I also used balance of payments reserve data (BOP Reserves) as an alternate measure.

The baseline model results indicate that FD Reserves are significant and negative at the 99% confidence level. The finding that FD Reserves and investment are negatively related remains robust when using the four countries fixed effects specification, or the expanded nine country sample with OLS and fixed effect specifications. However, the BOP Reserves variable, which is a more accurate proxy for policy induced reserve changes, does not have a significant relationship with investment over GDP. After further analysis, it appears that valuation effects are the driver behind the significance between FD Reserves and investment. Given this fact and the lack of significance between BOP Reserves and investment, my hypothesis is not confirmed. Despite the potential for valuation effects to exacerbate differences and drive divergent results, as my research shows, after a review of current literature it is clear that many scholars completely ignore or fail to mention the valuation effects contained in FD Reserves.

The first section of the paper will give background on the current literature surrounding motives and will review the potential efficacy of reserves accumulation. In addition, the potential mechanism for central bank sterilization to crowd out investment will be discussed. Section two will explain the methodology of the paper and introduce the econometric models employed. Section three will go over the empirical findings of the baseline model, robustness checks, and a discussion about BOP Reserves valuation effects. Finally, section four will discuss the implications of the research, followed by a brief conclusion.

1. Literature Review:

Before evaluating the potential macroeconomic side effects of reserve accumulation, it is important to consider whether policymakers have accumulated too few or too many reserve. Yet, this judgement in and of itself is a divisive issue; what some countries see as “hoarding” of reserves, others deem as necessary to maintain stability in financial markets and the capital account. While there are a variety of traditional measures to gauge reserve adequacy (Box 1), there is no consensus on appropriate level of foreign exchange reserves or which measure is most

accurate. Of these traditional measures, Garcia and Soto (2004) find that reserves as a ratio of short term debt may be the best measure of reserve adequacy. In their research, short term debt is a key factor in explaining the occurrence of an economic crisis, after controlling for other variables.

Box 1: Source: IMF 2011

Traditional Metrics to Reserve Ratio	**Explanation**	**Suggested Level**
Import Cover	Time period imports can be sustained if all inflows stop.	2-6 months
Short Term Debt	Time period short term debt can be paid, also known as "Greenspan-Guidotti" Rule.	12 months
Broad Money	Represents M2 level in the economy, appropriate level unclear.	20 Percent

In going beyond the traditional metrics, many economists have also attempted to measure appropriate reserve levels by employing various econometric methods. Garcia and Soto (2004) in their model conclude that Asian reserve levels were appropriate post Asian financial crisis; while on the other hand, Jeanne and Ranciere (2006) conclude that Asian countries hold reserves in excess of what is needed for insurance reasons.

Drivers of reserve growth

A great deal of academic literature has attempted to tackle the question as to why countries in Asia have greatly increased their holdings of foreign exchange reserves over the past two decades, with a wide variety explanations cited, ranging from mercantile (competitive) reasons to precautionary motives.

Tsangarides et al. (2012) claim that following the Asian financial crisis, collapses of exchange rates in many countries demonstrated the benefits of undervalued currencies, and that starting from the early 2000s deliberate currency undervaluation became an important determinant of reserve accumulation. Pointes and Rajan (2011) also find that Asian countries

have a “fear of floating in reverse”, in other words policymakers intervene when their currency is appreciating but not necessarily when it decreases. In regards to the efficacy of these reserve interventions, Adler and Tovar (2014) find that regardless of motivation, accumulation helps negate currency appreciation.

In direct contradiction to the mercantilist motivation theory, Calvo et al (2012) do not find evidence that policymakers have utilized reserves to boost economic competitiveness. Instead, they claim that optimal reserves are determined by the probability of a sudden stop in capital. Aizenman and Lee (2005) also find that from 1980-2000 trade openness and exposure to financial crises are statistically and economically more important than undervaluation of currency in determining reserve accumulation. Obstfeld Shambaugh and Taylor (2010) reach similar conclusions, finding that reserve growth can be accounted for by financial stability, the size of domestic financial liabilities convertible to foreign currencies, financial openness, and the ability to access foreign currency through debt markets. Within those who view mercantile or competitive motivations as the most important factor in driving reserve accumulation, some authors are clearer in identifying mercantile motives as a factor in driving persistent current account imbalances between developing and developed countries prior to the 2008 crisis (Gagnon 2013).

Taking a more nuanced approach, Delatte and Fouquau (2012) recognize both mercantile and precautionary motives as having role in motivating authorities to accumulate reserves, but identify the former, in the form of management of exchange rates, as the largest driver of reserve rapid reserve accumulation in the 2000s. Paladino and Cifarelli (2007) also highlight the influence of both motives and find that in the short run reserves are accumulated to avoid a loss of economic competitiveness, but in the long run precautionary concerns contribute more to accumulation of reserves.

Within this debate is the issue of whether reserve accumulation is made by policy decisions or through other non-policy related phenomenon. Alfaro and Kanczuk (2009) using a theoretical stochastic dynamic equilibrium model find that reserve accumulation is best explained by political economy motivations. On the other hand, other research points out that economic growth, capital account openness, trade openness and exchange rate volatility drive the accumulation of reserves (Shrestha & Wansi 2014).

Benefits of reserves

In regards to the utility of reserves, research tends to suggest that they play a positive role in preventing crisis. Bussiere et al. (2014) found that countries that held more reserves as a percentage of short term debt were less negatively impacted in the 2008 financial crisis. This finding is supported by Frankel and Saravelos (2012) who suggest that if foreign reserves are scaled to GDP then increasing foreign reserve ratios makes it less likely that a country would fall into an economic crisis after 2008.

In terms of the capital account, Alberola et al. (2012) find that in high reserve countries, domestic capital outflows were significantly lower during financial distress than those with lower level of reserves. Concerning economic output, Llaudes et al. (2010) find a positive relationship between larger foreign exchange reserves and output after 2008. Working with multiple proxies for reserve intervention, Dominguez et al. (2012) also find that active purchases or sales of reserves during the financial crisis in 2008 is positively correlated with GDP growth in the post-crisis. On the other hand, Blanchard et al. (2010) working with a smaller sample, find that reserves do not serve as a buffer during times of crisis.

Ghosh and Qureshi (2016) in a probit model further find that a larger stock of reserves is associated with lower likelihood of a currency crisis. In addition, they note that reserves most likely act as an effective buffer through signaling and maintaining market confidence, rather than through actual intervention. This is again confirmed by Aizenman and Hutchison (2010) who find that many countries with high levels of reserves let their currencies depreciate during the financial crisis in 2008, rather than sell their stockpiles of reserves. In other words, countries may wish to forgo sales in the "fear of losing reserves".

Costs associated with reserve accumulation

Other scholars have tried to measure the potential economic distortions or costs related to excess foreign exchange holdings. Rodrik (2006) found income loss associated with holding "excessive" reserve assets to be on average around 1 percent of GDP. This is mainly due to the fact that reserve holdings are often placed in low yielding conservative investments, sometimes with returns lower than the inflation rate. In addition to previously mentioned fiscal costs, Alberola and Serena (2007) find that there are also quasi fiscal costs, such as conflict of interest between fiscal authorities and central banks. This can occur when sterilization instruments are

government paper or when the central bank paper competes with government bonds. Sterilization can also impact domestic financial stability and restructuring, which could lead to divergent policy goals between monetary and fiscal authorities.

While it is more controversial, some authors have claimed larger distortionary effects associated with reserve accumulation. Mohanty and Turner (2006) through their research claim that reserve holdings are not only excessive, but that in certain cases it may lead to financial instability. Garcia and Soto (2004) also claim that large reserves stocks may create moral hazard problems that could weaken the overall financial system.

Reserves and domestic investment

Until recently, research related to my research question--on the connection between domestic investment levels and reserve holdings--has been scarce. Fukuda and Kon (2010) in a previous paper measured the macroeconomic effects of reserves on exports, consumption and investment. The findings suggest that increased reserves reduce investment in the short run, but may help increase investment in the long run.

Cook and Yetman (2012) utilizing bank level data, find evidence that excessive levels of reserves may have negative effects on bank lending and investment. The authors also suggest that low levels of domestic investment, caused in part by the reserve accumulation channel, could also be one contributor to global current and capital account imbalances.

Reinhart and Tashiro (2013) in more recent literature suggest that reserves may crowd out investment due to the transfer of domestic savings abroad. More specifically the crowding out occurs when the central bank competes with domestic borrowers in the loanable funds market. Reinhart, Reinhart, and Tashiro (2016) in subsequent and related research also utilize a VAR model to quantify the connection between reserves and investment. The results suggest that a one standard deviation upward shock to reserves is associated with a statistically significant decrease in investment over a three-year period. They also find that knowing the history of investment is not a useful predictor of reserve accumulation.

The reserve crowding out mechanism

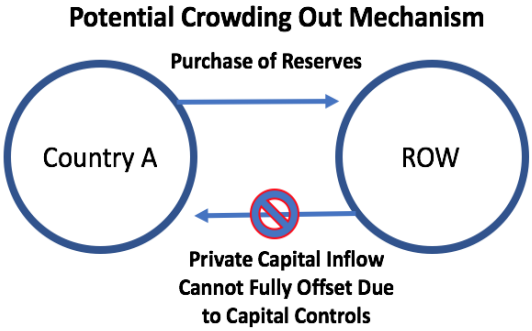
In the traditional definition of "crowding out" the central government issues more debt which competes for loanable funds. According to Reinhart, Reinhart, and Tashiro (2016), the

central bank can also crowd out investment through the issuance of central bank bills, which are issued to the market in order to draw out liquidity. The concept that reserve accumulation transfers domestic money abroad is far from controversial; this is simply a mechanism of the balance of payments (Identity 1). Where NCO is net capital outflows, CA is capital account surplus and RA is change in reserves. Any value of RA smaller than zero suggests accumulation. In the case that reserves change they will be offset by flows in either NCO or CA.

Identity 1: NCO+CA+RA=0

This "offset", when private capital flows in while reserves flow out, can occur for a number of reasons. For example, private investors may be enticed to send money to a country that accumulates reserves in order to arbitrage the potential interest rate changes induced by reserve sterilization. In the case where a country accepts a higher level of inflation rather than conduct sterilization, arbitrage opportunities would continue to exist in the form of longer term currency valuation changes, and thus could still be offset by private capital.

If reserve accumulation is truly offset by capital inflows than it would not be expected that reserves would crowd out investment or change the equilibrium of loanable funds market. However, a country which inhibits the potential return of private capital, could be one potential scenario where crowding out could occur (see diagram below). Bayoumi et al (2015) in an empirical study find that when capital accounts are open, reserve outflows are offset by private inflows. The caveat is that this offset occurs only partially when countries have more capital controls. While this does not prove crowding out, theoretically this may be the mechanism where less domestic funds for investment are available based on the inability of sterilization to be offset by private capital flows.



Sterilization of reserves

It is important to briefly review exactly how a central bank can carry out sterilization policies. If a central bank purchases foreign exchange reserves, when equity capital is unchanged and demand for reserves remains constant, in order to prevent inflation, the central bank must issue domestic monetary liabilities. The central bank can achieve this by selling domestic assets or issuing its own securities. The latter can be specifically achieved using market (sterilization securities, direct borrowing from banks, repo transactions, or foreign exchange swaps) or non-market based means such as controls on bank lending, transfers of government assets from the commercial banking sector to the central bank, or changing reserve requirements (Mehrotra 2012).

Research has indeed shown that for many Asian countries reserve accumulation was effectively sterilized in the 2000s (Filardo and Grenville 2012). More specifically, Aizenman and Glick (2009) find increasing utilization of sterilization by China, Thailand, Malaysia and India through the 2000s. Specifically for the case of China, Ouyuang et al (2008) find that 90% of reserve accumulation was sterilized between 1999 and 2005. Overall the above research suggests that countries in Asia have a high propensity to sterilize reserves. If sterilization does in fact crowd out investment, then Asian countries who have utilized this policy would potentially bear out the relationship between increased reserves and lower rates of investment.

Chinese sterilization policy is an interesting case study due the massive scale it has been conducted on and the plethora of research that has probed its effects. The country has carried out sterilization mainly through raising the commercial bank reserve ratio, implementing 21 such increases between 2002 and 2008. The central bank has also issued large quantities of central bank bills to commercial banks, further sopping up liquidity in the banking system. Sterilization is thought to be less costly in the case of China, as the central bank can force banks to purchase

central bank bills. For commercial banks these forced purchases are accompanied by opportunity costs because the PBOC pays a rate on sterilization bills below what banks could earn by lending to the private market. It is due to financial repression (control of bank lending rates and interest rates) that the PBOC does not have to pay a higher rate for the central bank bills, further reducing the cost of accumulation and subsequent sterilization (Lardy 2008).

Descriptive review of investment and foreign reserves

It will be further informative to quickly refer to the pattern of investment and reserve accumulation for a select group of Asian countries over the 1990 to 2014 period. In terms of reserve levels as measured against GDP (Table 1), what stands out is that Singapore and Hong Kong, by a large margin, have the highest level of reserves. They are able to finance these high levels of reserves in part because of large current account surpluses and the necessity to defend their currency regimes. Being financial centers and small city states also differs these countries from the rest of the sample, and it is clear that they are both qualitative and quantitative outliers. While the reserve levels of China are also quite high (37% as of 2014), the country is not an extreme outlier compared to Thailand (38%), the Philippines (27%), and Malaysia (34%). This fact runs contrary to the often-reported media narrative portraying Chinese reserves as excessive, and it brings up a broader point that reserve levels should be understood not just through the headline numbers, but also in the context of other measures such economic size. The overarching takeaway from looking at the sample is that while reserve accumulation differs by country, in every instance reserves are higher in 2014 than prior to the financial crisis.

On the other hand, gross capital formation as a percentage of GDP (Table 2) has fallen in almost every country since 1990. It could be argued that investment was unsustainable prior to the crisis, and that levels have simply returned to equilibrium. However, the decrease in investment took place across a broad spectrum of countries. Thailand, the Philippines and Malaysia, now exhibit similar levels of investment to more economically advanced countries such as Singapore and Japan. This is despite the fact that we would expect less developed nations to have a higher need for fixed investment. Another important point is that China is an outlier among my sample, with investment representing almost half of all economic activity after the great recession.

Table 1: Reserves/GDP %	1990	1995	2000	2005	2010	2014
China	9.554	10.930	14.180	36.370	47.761	37.206
Hong Kong	32.050	38.315	62.656	73.075	117.541	112.804
India	1.726	6.237	8.615	16.522	18.139	15.986
Indonesia	8.156	7.375	17.787	12.149	12.742	12.562
Japan	28.297	35.348	7.399	17.809	19.229	26.000
Korea	5.238	5.865	17.138	23.443	26.692	25.709
Malaysia	24.211	27.844	30.548	49.088	41.773	34.300
Philippines	4.595	10.498	18.604	17.924	31.227	27.956
Singapore	76.870	78.298	84.610	92.657	97.817	85.388
Thailand	16.707	21.821	25.845	27.507	50.459	38.871
Sample Average	20.740	24.253	28.738	36.654	46.338	41.678
Table 2: Gross Capital Formation/GDP %	1990	1995	2000	2005	2010	2014
China	34.734	39.685	34.430	41.391	47.612	47.008
Hong Kong	27.171	34.291	27.582	22.357	23.890	23.844
India	24.909	26.053	24.115	34.280	40.668	34.184
Indonesia	36.148	31.928	22.246	25.081	32.880	34.568
Japan	32.487	29.883	27.307	24.749	21.297	23.883
Korea	34.750	34.824	32.942	32.163	32.023	29.277
Malaysia	32.360	43.640	26.867	22.396	23.386	25.017
Philippines	24.151	22.451	18.368	21.550	20.541	20.527
Singapore	35.640	33.841	34.899	21.367	27.870	28.926
Thailand	41.354	42.863	22.283	30.421	25.370	24.073
Sample Average	32.370	33.946	27.104	27.576	29.554	29.131

2. Methodology:

Dependent variables and the econometric model

In order to explore the relationship between foreign reserve accumulation and investment I will use panel data employing both OLS and fixed effects specifications. The dependent variable of interest across all models will be gross capital formation in local currency units scaled to GDP in local currency units (henceforth referred to as Investment), which bounds the variable between 0 and 100. Gross capital formation is defined as fixed asset investment, including changes in inventories. For the baseline model Investment will be first differenced to create flow data. For the independent variable of interest, I utilized the log first difference of reserves stock including gold (henceforth FD Reserves) which is the same variable as Reinhart, Reinhart and Tashiro (2016). My hypothesis is that that FD Reserves will be negatively related to investment through central bank crowding out via sterilization or sterilization-like policies.

OLS Model:

- **Baseline Model: $\Delta I/Y_{it}=\beta 0+\beta 1 Log\,\Delta(FD\ Reserves/Y)_{it}+Controls+Country\_Dummy\_i+uit$**

Where in the above expressions I denotes gross capital investment, Y denotes GDP measured in USD and FD Reserves represents stock of reserves including gold. The calculation utilized to convert FD Reserves into a log first difference is listed in the data appendix under the Reserve Variables Formula 1.

List of Controls

The controls will consist of GDP per capita measured in USD (proxy for economic development), working age population (proxy for demographics), growth of broad money (proxy for domestic economic conditions), and a crisis dummy for the years 1998, 1999. All of the previously mentioned variables were retrieved from the World Bank's WDI database.

The controls will also include monetary independence, which is a de jure measurement from the Chinn-Ito "trilemma indexes" (Aizenman, Chinn, Ito 2010). This is included as the degree of monetary independence of a country can greatly impact the central bank's response to the domestic business cycle. In the case of lower levels of monetary independence, investment levels may be lower due to the fact that monetary policy does not have the complete freedom to respond to economic downturns.

Sample and time series

I will focus my sample first on four countries in the Asian region, Indonesia, Malaysia, the Philippines, and Thailand. The time series will include the 1990 to 2014 period, as prior to 1990 reserve accumulation was just a small fraction of the economy. The rational in picking my sample and time series is straightforward. Between these countries and over this time period, we see both sterilization (large amounts of accumulation) and capital controls present, both conditions which I posit are the potential mechanisms to crowd out investment. If reserves do in fact crowd out investment, then we would expect at a minimum to be able to see these effects in the countries with the highest levels of reserves. In countries with low levels of reserves and thus little to no amounts of sterilization, according to my logic the potential for crowding out is not expected be present.

The reason to include mainly countries with some degree of capital controls is that reserve sterilization in an environment with no capital controls can be offset by private capital inflows. In the case of this offset, we would not expect increased reserves to be related to

decreased investment. Another motivation to initially sample only Indonesia, Malaysia, the Philippines, and Thailand is that they are at similar stages of development, share close geographic proximity to one another, and were all greatly affected by a financial shock around 1997.

Limiting the sample to only these four countries raises the chance that results will be biased on the basis of self-selection. As such, a second sample will further include Hong Kong, Japan, Korea, India, and Singapore. Although the samples do not include non-Asian countries, the second sample covers a range of countries in various stages of development, which will provide a sufficient robustness check for the original four country sample.

I will also briefly discuss the various reasons why China is left out of the initial samples. China in general presents challenges for economic studies using a panel of Asian countries. Conducting macroeconomic research about Asia without including China could be lacking an essential piece of the puzzle. On the other hand, at the risk of sounding cliché, particularly in regards to investment and reserves, China has unique characteristics setting it apart from other countries. The first unique aspect is that Chinese gross capital formation (at times almost 50% of GDP) is far higher than other countries, not only in our sample but also across history and time. More than being an outlier in terms of investment levels, the process in which investment decisions are made is also different from those economies in my sample. This is due to the fact that Chinese investment is most likely driven by many non-market forces. An example of this is deposit controls (in effect until 2015) and lending rates controls (in effect until 2013), which were only recently relaxed and abolished.[1] An even larger factor for non-market forces at play in investment is that SOEs and other quasi government entities make investment decisions not only on returns but also at the behest of government plans or initiatives. Although it is unclear, some estimates put the public share of fixed investment as high as 60 percent as of 2016 (Scissors 2016).

3. Empirical Findings:

For the baseline model the initial regression results (Regression Table 1) suggest that there is a significant negative relationship between investment and reserves. These findings are consistent with the Reinhart, Reinhart, and Tashiro's findings (2016), and this should not be

[1]Bloomberg News. "China Takes 'Riskiest' Step by Ending Deposit-Rate Controls" October 23, 2015.

surprising given that the FD Reserves and Investment variables are the exact same data employed in their research.

In Regression Table 1 the difference between the OLS and FE models is that the fixed effects model clusters standard errors across countries while the OLS model does not. The significance of the variable of interest does not change between the two models. The findings also hold when running the regressions without controls and a varying degree of controls (Regression Appendix, Table 1).

With regards to the economic significance, a 1% increase in the reserves to GDP ratio is related to a 0.0609 decrease in the investment to GDP. Considering the average year to year reserve change is 3.5%, in any given year we would expect the average increase of reserves to be significantly associated to a 0.21 decrease in the investment over GDP ratio. While the economic effect is not large, as investment is a potential avenue to increase productivity over the long term, there could be a larger economic impact than the headline number suggests. Regardless, sacrificing only millions of dollars of investment would seem to be worth the cost, if as the literature suggests reserves act as a buffer against multi-billion-dollar financial meltdowns.

Regression Table 1: Baseline Model

1990-2014, 44 Countries	Baseline: OLS	Baseline: FE
Dependent Variable:	Δ Investment/GDP	Δ Investment/GDP
FD Reserves	-6.099***	-6.099***
	(1.772)	(0.845)
Asian Financial Crisis	-6.693***	-6.693**
	(1.766)	(1.524)
GDP Per Capita	-0.000191	-0.000191
	(0.000205)	(0.000105)
Age Dependency Ratio	-0.100	-0.100
	(0.396)	(0.101)
Broad Money Growth	-0.0289	-0.0289*
	(0.0210)	(0.0107)
Monetary Independence	3.757**	3.757*
	(1.731)	(1.310)
_cons	0.695	0.695
	(2.763)	(0.984)
N	100	100
R-sq	0.3662	0.4228
*p<0.10, **p<0.05, ***p<0.010		
Country Fixed Effects	Yes	Yes
Time Fixed Effects	No	No

With regards to the controls, the Asian Financial Crisis Dummy (1998 & 1999) has an expected negative coefficient, which is consistent with the notion that investment contracted sharply in the years following the Asian Financial Crisis. Monetary Independence was also significant and negative, which could be explained by the fact that countries with higher levels of central bank independence have higher rates of investment, as they may be able to more freely counter economic downturns. Despite the presence of domestic economic crisis and conditions that call for lower interest rates, sometimes central banks are forced to raise interest rates to prevent capital outflows further exacerbating poor domestic economic conditions. Broad money growth is significant and negative which is surprising as you would expect higher levels of investment to be associated to boom periods when the money supply is also growing. When the baseline regression utilizes the expanded 9 country sample, the significance of Monetary Independence disappears although the dummy variable and the FD Reserves remain the same (Regression Appendix, Table 2).

While these results appear to confirm the hypothesis that reserves crowd out investment, the reserve measurement we used in the baseline model are an imperfect proxy for reserve accumulation. As discussed earlier, central bank crowding out is most likely to occur through the issuance of central bank bills, but it is important to note that in most cases these bills are issued only in the event that authorities actually make a policy decision to accumulate reserves. Thus, it is of utmost importance to utilize a proxy for reserves that captures changes based on policy decisions rather than other non-policy related factors.

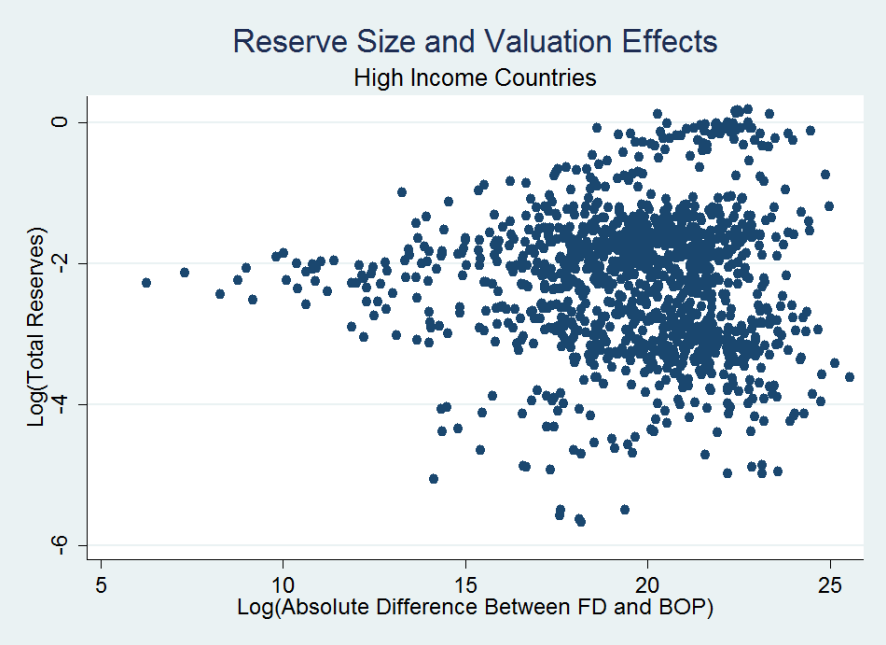
Valuation effects and actively managed reserves

In the baseline regressions other than purchases and sales of reserves, the variable FD Reserves also includes valuation effects. Since reserves are almost always measured in USD, valuation effects arise when the value non-USD denominated change against the dollar. If the goal of research is to capture the effects of a policy decision, then balance of payments reserve data appears to be a better proxy. This measure, henceforth referred to as BOP Reserves, does not capture valuation effects.

If both BOP Reserves and FD Reserves data is available, quantifying the valuation effects contained with FD Reserves is straightforward. One must simply subtract BOP Reserves from FD Reserves. In this we are essentially removing the policy decision from FD Reserves and the

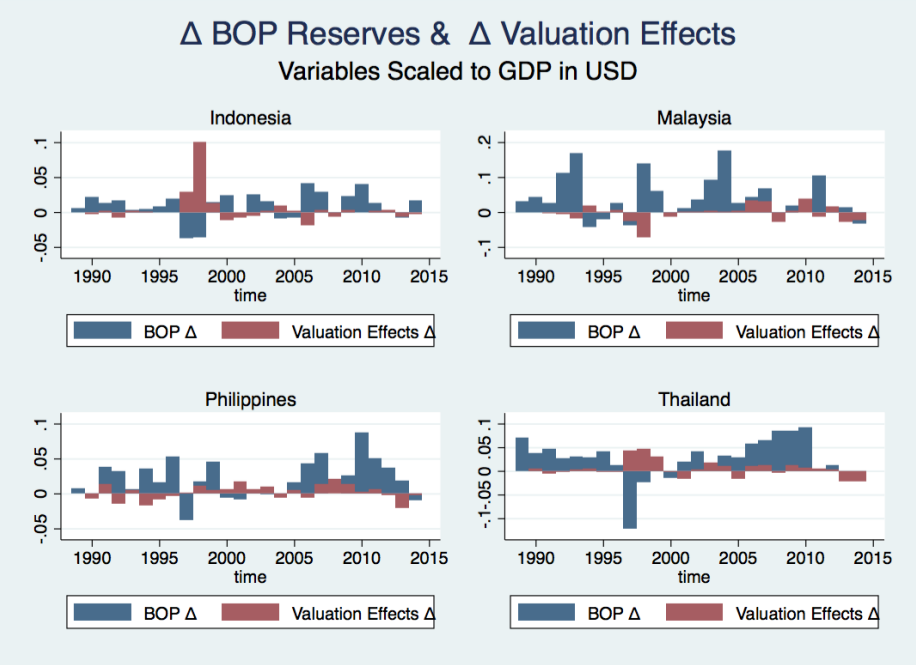
remaining difference is the valuation effects. In theory, if there were no valuation effects or if all reserves were held in USD then the first difference of stock reserves should be equal to BOP Reserves. However, this is almost never the case, and by studying the absolute difference between FD and BOP one can see the larger the country's reserves the higher the year over year valuation changes (Graph 1). This is consistent with the logic that as reserves grow, even a small change in valuation effects will represent a larger and larger year over year change.

Graph 1: WDI Data



Comparing year over year changes in both BOP Reserves changes and valuation effects, we can breakdown the components of yearly FD Reserves changes and see which portion is decided by policy and which portion is decided by non-policy related valuation effects. In recent years, especially amongst the countries of my sample (Indonesia, Malaysia, Philippines, Thailand), valuation changes have been both volatile and large; in fact some yearly valuation changes are larger than year over year BOP Reserves changes (Graph 2). If valuation effects represent a large portion of the year of year changes in reserves then it could potentially lead to spurious results if researchers attempt to measure only a policy decision.

Graph 2: WDI Data



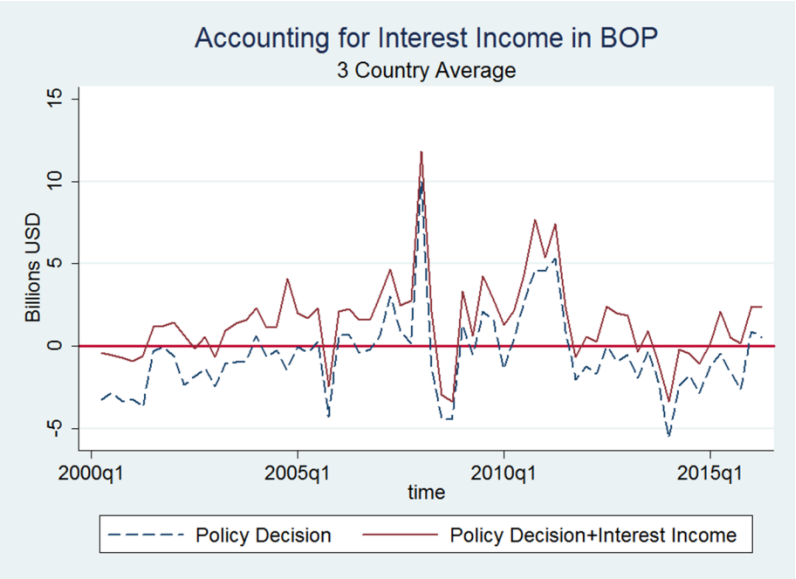
Despite the flaws of the FD Reserve measure, BOP Reserves are far from a perfect proxy for active reserve purchases or sales because the measure also captures earned interest on reserves. In a country with a large stock of reserves, it is conceivable that earned interest could represent a large portion of yearly BOP Reserve changes. Again, similar to valuation effects, passive interest income could mask policy related reserve purchases or sales.

Research has attempted to remove the earned interest effects from the BOP Reserves measure in order to isolate only purchases or sales of reserves by policy makers (Dominguez et al. 2012). This is achieved by simulating interest earnings of each country based on IMF SDDS data, which provides a breakdown of foreign exchange reserves held in securities and deposits. Countries do not release the currency breakdown within the security or deposit data, but the IMF does provide aggregate currency holdings on a world, advanced, and developing market level (COFER Data). Using the COFER data, returns can then be calculated for the portion of each respective currency using the return on ten year bonds (securities return proxy) and three month interbank loans (deposits return proxy). Unfortunately, this measure remains imperfect because we do not know specifically how security or deposits holdings are actually invested, nor do we know the currency holdings of a single country's reserves.

For my sample, I was unable to utilize this method to run regressions, as many of the countries have only recently subscribed to SDDS data standards, and this severely limits the

number of observations. Although, I was able to simulate earned interest for three countries in my sample, Thailand, Malaysia, and the Philippines which have data from the year 2000 (Graph 2). The dotted line in the graph is the change in reserves based on a policy decision, that is to say, change in reserves without the effects of either valuation or earned interest. The red line is simply the BOP Reserves variable (which includes a policy decision and interest rate income), and the difference in the two data points is earned interest. It is quite clear from the graph that prior to the great financial crisis, earned interest could drive a difference between net purchases or net sales year over year. In recent years the difference between the two measures is converging, in other words interest income is shrinking. This is most likely due to the recent slump in returns on safe haven assets and bonds across the world.

Graph 2: IMF SDDS data



Given that FD Reserves and BOP Reserves both contain non-policy related changes, we would expect both the valuation effects and earned interest in time period T to influence policy maker's decision in T+N. In other words, policymakers may come to decisions regarding purchases or sales of reserves based on either valuation or earned interest effects. This feedback mechanism makes it difficult to untangle which of these variables would most accurately reflect a policy decision.

Sterilization data is another potentially more straightforward method to examine the effects of central bank crowding. This measure could test whether sterilization is the central bank crowding out channel, whereby liquidity is drawn out of the economy and investment negatively

affected. However, sterilization data is not widely used in research due to the fact it comes in many forms, including for the purpose of sterilizing capital flows, and the data is less publicly available.

After a closer look at the valuation effects for my sample, while BOP Reserve data is imperfect it is still the best option to capture reserve changes based on sales or purchases. Further, comparing regression results between the FD Reserves and BOP Reserves will demonstrate whether valuation effects have the potential to drive divergent results. If in fact the results are not consistent, it would further call into question the decision to use FD Reserves as a proxy for a central bank policy decision.

A more appropriate measure of reserves (BOP Reserves)

After running the baseline regression using the alternate BOP Reserves we find vastly different results. There is now no significant relationship between reserves and investment, and further the coefficient on the reserves variable is around 10 times smaller than the baseline regression (Regression Table 2).

Regression Table 2:

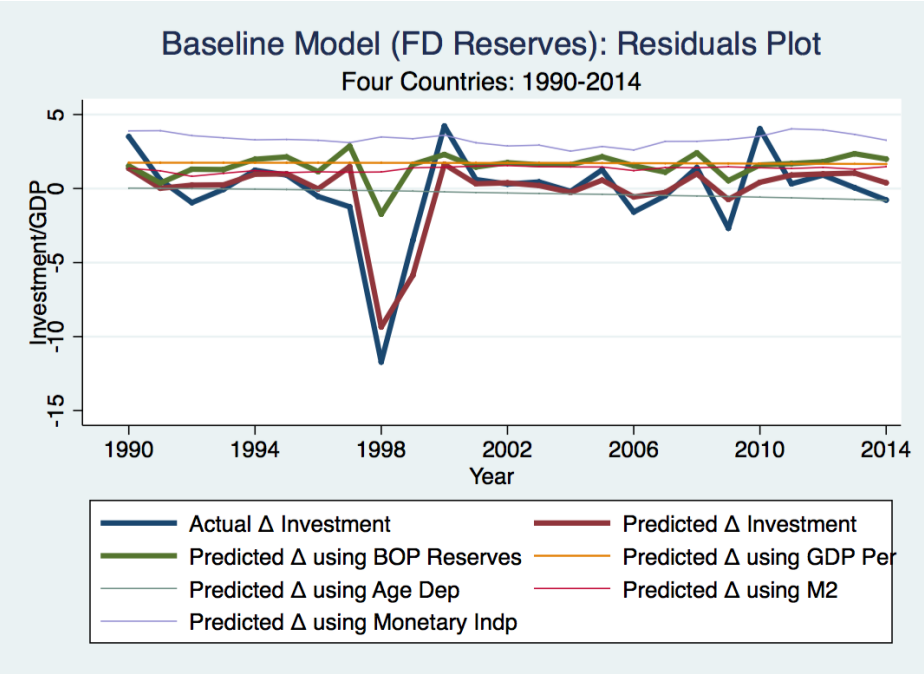
1990-2014, 9 Countries	Alternate Reserves: OLS	Alternate Reserves: FE
Dependent Variable:	Δ Investment/GDP	Δ Investment/GDP
BOP Reserves	-0.674	-0.674
	(1.223)	(1.591)
Asian Financial Crisis	-8.296***	-8.296**
	(2.152)	(1.883)
GDP Per Capita	-0.000107	-0.000107*
	(0.000202)	(0.0000422)
Age Dependency Ratio	-0.197	-0.197**
	(0.400)	(0.0349)
Broad Money Growth	-0.0530**	-0.0530
	(0.0264)	(0.0262)
Monetary Independence	3.036*	3.036**
	(1.743)	(0.882)
_cons	1.803	1.803**
	(2.825)	(0.323)
N	100	100
R-sq	0.2937	0.3567
Country Fixed Effects	Yes	Yes
Time Fixed Effects	No	No
Standard errors in parentheses	*p<0.10, **p<0.05, ***p<0.010	

The lack of significance between reserves and investment persists across the 9 country sample in addition to the models with no controls and varying degrees of controls (Regression

Appendix, Tables 3 & 4). The differences in the two models can be visualized in the following predicted value models.

Predicted value models

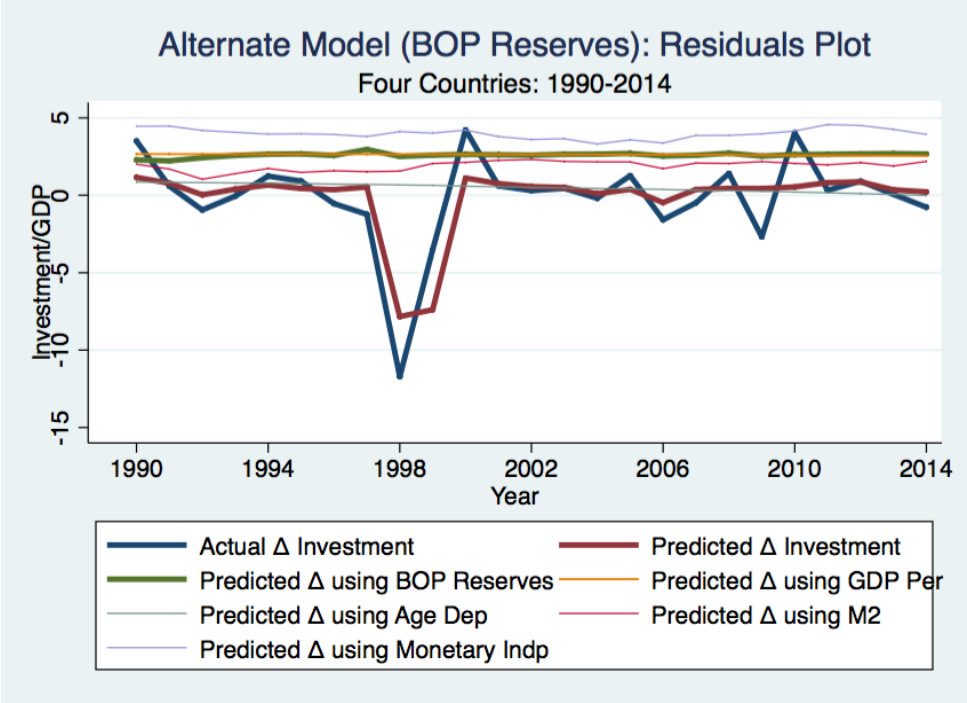
Graph 3:



Graphs 3 and 4 are predicted value plots derived from Baseline Model and Alternate Model. Each graph utilizes a four-country average of actual observed changes in investment (blue), predicted investment based on the overall model (maroon), predicted investment based on the reserve residuals (green), and predicted values based on the remaining controls. Graph 3 shows strong correlation between the predicted model residuals using FD Reserves and actual investment, this can be seen in the correlation between the green and blue lines. On the other hand, Graph 4 demonstrates a weak relationship between actual investment and the predicted model using BOP Reserves, in other words the green and blue lines are nonresponsive to one another's movement. Most importantly the residual plots show us what we see in the regression results, BOP and Reserve data yield drastically different results.

The graphs and models are similar in that there is a weak relationship between the controls and observed investment. Further, despite my inclusion of a crisis variable, each graph illustrates the failure of my model to properly control for the Asian Financial Crisis.

Graph 4:



Robustness checks

I also conducted a variety of other robustness checks to explore the persistence of the significance of FD Reserves and insignificance of BOP Reserves. The first test inquired as to whether the relationship between reserves and investment changes over time. The most logical point to split the series is around the financial crisis of 2008, as the behavior of accumulation shifted post-crisis, with less reserve accumulation occurring. The two separate time samples I utilized were the periods prior to (1990-2008) and post (2010-2014) the Great Financial Crisis. For both the FD Reserves and BOP Reserves, the results indicate that the relationship between reserves and investment has changed over time. The period prior to the financial crisis indicates the same results as the full sample regression, a negative and highly significant relationship between FD Reserves and investment and a lack of significance between BOP Reserves and investment (Regression Appendix, Table 5). While in the post financial crisis environment (Regression Appendix, Table 6), the FD Reserves and BOP Reserves are insignificant and positive. In the instance that crowding out effects exists, we would at minimum expect a significant negative relationship between BOP Reserves and Investment to be present in the pre-crisis sample, a time that many view as the most egregious accumulation period. Yet, we do not see any significance.

For another robustness check, I added China to the sample (not shown), and again the significance of the reserve variables and controls remained unchanged from other models. My assumption was that Chinese reserves and investment would lessen or remove the significance of FD Reserves because the variables are highly and positively correlated, but this was not the case.

My final robustness check involved time fixed effects. When employing this method for both the OLS and Fixed Effects models, the significance of FD Reserves disappears (Regression Appendix, Table 7). On the other hand, when including the time fixed effects with the expanded 9 country sample the negative and significant result of FD Reserve remains (Regression Appendix, Table 8). In both cases the BOP Reserves remains insignificant.

The four-country sample countries in particular experienced accumulation more or less simultaneously, and while removing such time trends may help control for spurious correlation, due to the small country sample, it may indiscriminately remove the effects of reserve accumulation on investment. The obvious reason for simultaneous accumulation in all four countries is that they were all hit by a financial shock in 1997, which changed their macroeconomic management. In a larger country sample, in which there is more diversification across countries, then we wouldn't expect the time trends to completely remove the significance of results. This is in fact what the results demonstrate, with a significant finding on FD Reserves in the diverse nine country sample and insignificant findings on the four-country sample.

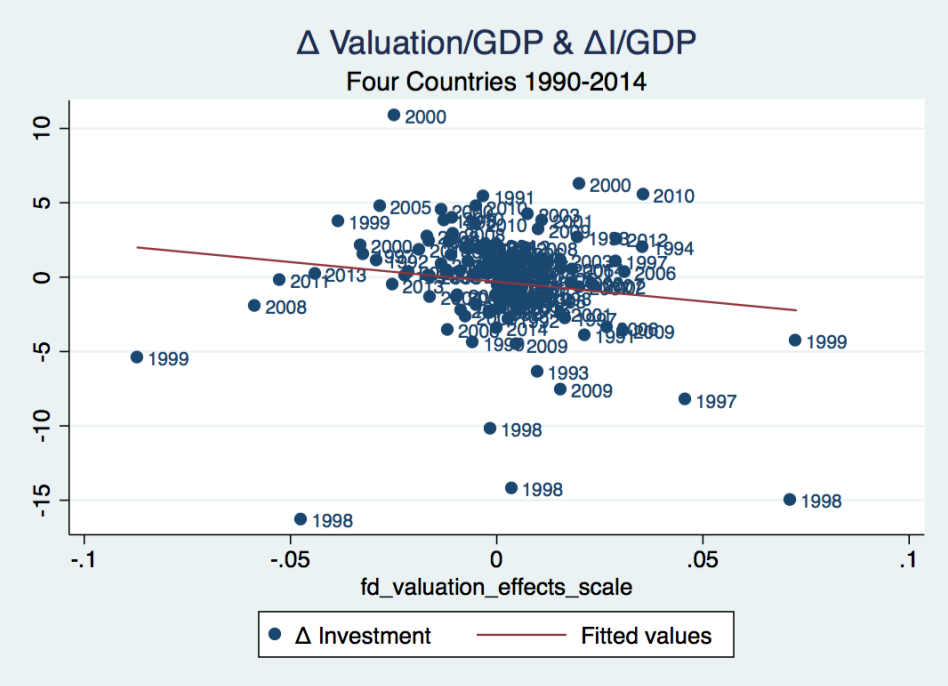
Throughout the robustness checks, the puzzle remains as to why FD Reserves are significant but BOP Reserves are not. The consistent insignificant relationship between BOP Reserves and Investment supplements evidence that valuation effects are potentially driving the negative significance in the FD Reserves variable.

Evaluating the baseline model's valuation effects

In my initial results, the largest question is why such a stark difference exists between the baseline regression and alternative regression, with the former's FD Reserve indicating high significance at the 99% confidence, and the latter's BOP Reserves indicating no significance. My initial expectation is that if anything valuation effects drive a positive relationship between reserves and investment, as an increase in reserve value could contribute to a larger reserve buffer. This buffer could be related to higher rates of investment because of its role in preventing economic shocks.

It may be enlightening to visually study the valuation effects in the regressions, in other words the exact difference between FD Reserves and BOP Reserves. This is carried out by subtracting ΔBOP/GDP from ΔFD/GDP, which will produce Δvaluation/GDP variable. When valuation effects are plotted against the dependent variable (investment over GDP), a clear negative relationship exists (Graph 5). These valuation effects scaled to GDP could be the driver behind the significant and negative relationship between FD Reserves and Investment in our baseline regression results. An important distinction to make here is that valuation effects can take place both in the numerator and denominator. In fact, we would expect that the valuation effects taking place on GDP measured in USD would be far greater considering that it is a much larger gross measure than the non-USD denominated reserves of the numerator. However, if GDP valuation effects were the only driver behind the negative relationship between reserves and investment then we would expect the BOP model to have been significant as well. In either case the lack of significance of BOP and potential for the FD Reserves to be skewed by valuation does not confirm my hypothesis that reserve accumulation is negatively related to investment.

Graph 5:



The most ideal way to further investigate how valuation effects interact with investment is to decompose the FD reserves variable used in the regressions. FD Reserves is made up of three parts which are BOP Reserves, valuation effects and GDP. The decomposition calculation

can be found in the appendix (Reserve Variables Formula 3). If the decomposition is done correctly the left side "Decomposition" of Regression Table 3, will a decomposed version of the "Baseline OLS" on the right side.

Regression Table 3:

1990-2014, 90 Countries	Decomposition	Baseline OLS
Dependent Variable:	Δ Investment/GDP	Δ Investment/GDP
FD Reserves		-9.425***
		(2.672)
Log Change GDP	16.77***	
	(3.991)	
Log Change BOP	2.565	
	(36.47)	
Log Change Valuation Effects	-5.036*	
	(2.918)	
_cons	-0.984**	0.158
	(0.487)	(0.346)
N	100	100
adj. R-sq	0.3191	0.1911
Country Fixed Effects	Yes	Yes
Time Fixed Effects	No	No
Standard errors in parentheses	*p<0.10, **p<0.05, ***p<0.010	

The most important take away is that BOP Reserves is not significantly related to investment and it is in fact positive. Thus, there is more evidence that accumulation of reserves does not appear to be negatively and significantly related to investment. The results of the decomposition also indicate as expected that both GDP and valuation effects are significantly related to investment. The positive relationship between GDP and investment is expected given that investment tends to increase in economic booms (Dell'Ariccia, Giovanni, et al. 2012).

Another lesson from the decomposition is that the negative and significant relationship between FD Reserves and investment in the baseline regressions appears to be driven by valuation effects. If that is the case, it indicates that the first baseline OLS regression was not demonstrating crowding out effects of reserve accumulation but instead it was capturing some other phenomenon in the relationship between investment and valuation effects. This could be manifested in many ways. One example is that valuation effects could be closely related to dollar appreciation or depreciation, which would potentially affect domestic investment levels. There are many more potential connections between investment and valuation effects, but the important

point is that the baseline model's significance is not driven by reserve changes, but instead by other factors not expected to be related to sterilization policies that crowd out investment.

4. Discussion:

Initially my baseline results appeared to confirm my hypothesis that reserve accumulation is negatively related to investment. However, when using BOP Reserves, which is an alternate measure of reserve that does not include valuation effects, the relationship between reserves and investment appears to be insignificant. For both FD Reserves and BOP Reserves, the results remain consistent across a wide range of robustness checks.

Through both qualitative and quantitative reasoning it appears that the baseline model's reserve measure (FD Reserves) is most likely significant due to valuation changes contained within the variable. While actual purchases of foreign currencies by a central bank are often sterilized, an increase of reserves through passive effects like valuation changes would not be followed by any direct policy action. As such valuation effects are not expected to crowd out investment.

My research calls into question the findings of Reinhart, Reinhart, & Tashiro (2016) for a number of reasons. First, the authors appear to utilize an inappropriate measure for reserves given that the theoretical underpinnings behind their model state that, "In the narrower conventional definition of crowding out, the government issues more debt: in the more encompassing definition, the government need not as the central bank- either by selling its holdings of government debt or by selling its own sterilization bonds- does so" (Reinhart, Reinhart, & Tashiro 2016). In other words, in order to confirm their theory, it is essential to utilize a reserve measure that serves as a proxy for reserve sterilization or sterilization-like policies. BOP Reserves appears to be a more appropriate measure for their research, but despite this they utilize FD Reserves. My initial baseline results are exactly the same as their overall findings, which could indicate that their results (similar to mine) may be driven by valuation effects rather than a policy decision that they were seeking to measure. The reason our results are comparable is that despite the fact there are differences in our models (their time series begins in 1973 and employs a VAR model), the variables used for reserves and investment are exactly the same. In addition my nine-country expanded sample is as their sample.

Unfortunately, Reinhart, Reinhart and Tashiro are not alone. Despite the potential for valuation effects to greatly influence reserves levels, a large portion of academic research (including articles published in prestigious economic journals) often utilizes reserves stock rather than BOP. In some cases, it is ambiguous as to which measure is employed despite the large difference between the two. I do not mean to suggest this is done for nefarious reasons or to massage the results, most likely the choice to utilize reserves stock is arrived at because BOP data is less widely available. Nonetheless, it is worrisome that more attention isn't given to the stark difference between balance of payment reserve data and stock reserve data.

In research attempting to explain motives for reserve accumulation, the inclusion of valuation effects is not expected to have distortionary effects. Any changes in valuation would cause policy makers to adjust their behavior to meet their original reserve targets. In addition, valuation changes wouldn't be expected to change the policy maker's original motives over the long run. However, in order to properly study whether increased reserves serve as buffer against macroeconomic shocks such as currency crisis, economic contraction, or current and capital account deterioration, it is important for researchers to consider the potential for valuation changes to be related to these same macroeconomic variables, and to investigate whether valuation changes are driving the results.

Overall these results based on my econometric model and decomposition analysis suggest that there is no significant negative relationship between policy related reserve changes (BOP Reserves) and investment, rejecting my initial hypothesis that accumulating reserves crowds out investment. The relationship between BOP Reserves and investment could be insignificant on behalf of buffer effects, where countries with large reserves are better able to withstand economic shock. One manifestation of this resilience could in higher levels of investment. Another potential channel to drive insignificance of the negative relationship between reserve and investment is that reserve accumulation may lead to increased exports through undervaluation of the domestic currency. This undervaluation would be expected to contribute to a stronger positive relationship between investment and reserves.

While a negative and significant finding for BOP would have confirmed my hypothesis, the measure is still imperfect in part because it contains earned interest. Thus, in future research, for countries that have SDDS data it would be ideal to remove earned interest, as I did previously with the example calculation (Graph 2) for three countries in my sample, Thailand, Malaysia,

Philippines. Also, it may be prudent to think of other appropriate controls, as my original model was not the most efficient predictor of actual investment. One significant control could be a pegged currency or the degree of exchange rate flexibility. Moving forward, I would also like to study the interaction between reserve accumulation and the openness of a country's capital account. In doing so, I could test my initial logic that crowding out occurs in countries that do not allow for private capital to offset reserve accumulation.

From my initial model, it is impossible to draw conclusions about the casual relationship between reserves and investment as I do not control for the possibility of endogeneity. The endogeneity in my models could be manifested in a number of ways. For example, the motivation to increase reserves may occur during uncertain economic times or in a recession, causing investment to be lower regardless of reserve accumulation. In order to support my initial research, finding an instrumental variable will be pivotal in further exploring the robustness of my findings. I will also consider using a GMM model to control for endogeneity.

It is important to also state that even in the case where a negative relationship exists between reserves and investment, this is not necessarily problematic considering there is no agreed upon optimal level of investment. In fact, it is not necessarily an ominous sign that investment levels are low; if for example the domestic market had poor marginal capital productivity then it would be ideal to fund more productive investments abroad.

5. Conclusion:

The large expansion of foreign exchange reserves was one notable development in the post Asian financial crisis world. While most academics and policymakers in Asia have touted the economic benefits of reserves, the costs have remained less visible. The goal of this paper was to consider one such cost, the potential negative relationship between reserves and domestic investment.

The initial regression results I obtained appeared to confirm my hypothesis that reserves are negatively related to investment, but after closer examination it seems that valuation effects are most likely driving the results. In order to cross check whether valuation effects may be behind the significance, I utilized a more accurate proxy for reserve changes that does not include valuation effects (BOP Reserves). The results do not indicate a significant negative

relationship between reserves and investment, thus failing to confirm my initial hypothesis and the findings of Reinhart, Reinhart & Tashiro (2016).

My initial results and methodology contribute to existing reserve literature by bringing to light the strong influence that valuation effects have within the reserve stock measurement, and how subsequent differences between the BOP and stock reserves measures can drive drastically different research results. Unfortunately, through my review of current literature, not only do scholars completely ignore or fail to mention the valuation effects contained in reserve stock, many fail to make clear which data they employing. If researchers wish to measure the impact of policy induced reserve changes, it is clear that BOP Reserve is the more appropriate data set and it should be used whenever available. In addition, in the case that SDDS data is available, the process created by Dominguez (2012) should be employed to isolate the earned interest from the BOP data.

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Appendix:

Data

All the data was acquired from the World Bank's World Development Indicator database excluding Monetary Independence which was acquired from the Chinn-Ito Index (Aizenman, Chinn, Ito 2010).

Gross Capital Formation: Gross capital formation is always scaled to GDP in the above models, making the variable bounded between 1 and 100.
Gross capital formation (formerly gross domestic investment) consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories. Fixed assets include land improvements (fences, ditches, drains, and so on); plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. Inventories are stocks of goods held by firms to meet temporary or unexpected fluctuations in production or sales
BOP Reserves: Reserves and related items is the net change in a country's holdings of international reserves resulting from transactions on the current, capital, and financial accounts. Reserve assets are those external assets that are readily available to and controlled by monetary authorities for meeting balance of payments financing needs, and include holdings of monetary gold, special drawing rights (SDRs), reserve position in the International Monetary Fund (IMF), and other reserve assets.
Stock Reserves: Total reserves comprise holdings of monetary gold, special drawing rights, reserves of IMF members held by the IMF, and holdings of foreign exchange under the control of monetary authorities. The gold component of these reserves is valued at year-end (December 31) London prices. Data are in current U.S. dollars.
Asian Financial Crisis: Takes value of 1 on the years 1998, 1999 and 0 if otherwise.
GDP Per Capita: Current year GDP Per capita in USD
Age Dependency Ratio: Percentage of the population working age (64 and younger) divided by total population. Dependency ratios capture variations in the proportions of children, elderly people, and working-age people in the population that imply the dependency burden that the working-age population bears in relation to children and the elderly.
Broad Money Growth: The year over year growth in sum of currency outside banks; demand deposits other than those of the central government; the time, savings, and foreign currency deposits of resident sectors other than the central government; bank and traveler's checks; and other securities such as certificates of deposit and commercial paper.

Monetary Independence Index: Available online and updated data through 2014, the indexes are derived from Aizenman, Chinn, Ito (2010) . The extent of monetary independence is measured as the reciprocal of the annual correlation between the monthly interest rates of the home country and the base country.

The index for the extent of monetary independence is defined as:

$$MI = 1 - \frac{corr(i_i, i_j) - (-1)}{1 - (-1)}$$

where *i* refers to home countries and *j* to the base country. By construction, the maximum value is 1, and the minimum value is 0. Higher values of the index mean more monetary policy independence

Reserve Variables

Formula 1:

1. Log(Reserves T) – Log(Reserves period T-1)

In order to properly compare log changes of Model 1 and Model 2 it is necessary to manipulate BOP Reserves. First, BOP reserves, which is a flow variable, must be converted into a stock variable. The new stock variable is subsequently divided by GDP, making the series similar to Stock Reserves. In the four-country sample, since all the yearly changes are positive it is possible to calculate log changes without any further manipulation.

Formula 2:

1. Convert the BOP (unscaled to GDP) data into a stock variable
2. Divide new BOP stock variable over GDP
3. Log(Change in BOP/GDP T) – Log(Change in BOP/GDP T-1)

Formula 3:

1. Log(FD Reserves) = Log(BOP+Valu)/Y = Log(BOP)+Log(Valu)-Log(Y)
2. Rearrange equation → Log(Valu) = Log(FD Reserves)-Log(BOP)+Log(Y)
3. Plug in available data to calculate Log(Valu)

Where Log(BOP) is derived from above Formula 2, Log (Y) is calculated using a log first differences of GDP measured in USD, and Log(FD Reserves) is derived from above Formula 1.

Descriptive Statistics (4 Countries Sample):

Variable	Obs	Mean	Std. Dev.	Min	Max
BOP Reserves	100	0.094913	0.1848686	-0.5608439	0.7273179
FD Reserves	100	0.0357916	0.1979978	-0.2914483	1.115608
I/GDP (1-100)	100	27.01261	7.342694	11.3674	43.6401
Δ I/GDP	100	-0.1581811	3.929665	-16.2982	10.8783
Asian Financial	100	0.0833333	0.2778363	0	1
GDPPC	100	3350618	8512295	6538.925	4.15E+07
Age Dep	100	7.494592	1.974087	5.395077	14.01578
Broad Money	100	14.09508	12.1492	-43.73826	7.19E+01
Monetary	100	0.4338799	0.1679011	0.0105614	0.7962717

Correlation Table (4 Countries):

	BOP Reserves	FD Reserves	Stock Reserves	I/GDP (1-100)	Δ I/GDP	Crisis	GDPPC	Age Dep	Broad Money	Monetary
BOP Reserves	1									
FD Reserves	0.2696	1								
I/GDP (1-100)	0.0935	-0.1583	-0.1938	1						
Δ I/GDP	0.1944	-0.4675	-0.0791	0.2592	1					
Asian Financial	-0.3534	0.1937	0.0176	-0.107	-0.3794	1				
GDPPC	-0.0603	-0.064	-0.3764	0.1657	0.0884	-0.0018	1			
Age Dep	-0.1332	-0.0769	0.4268	-0.0027	-0.0123	0.0096	-0.0046	1		
Broad Money	-0.0219	0.2543	-0.3071	0.1694	-0.1457	0.047	0.0295	-0.2245	1	
Monetary	0.1918	0.1714	-0.1043	0.0839	0.0782	-0.0416	0.2196	-0.1036	0.0696	1

Regression Appendix

Table 1: Baseline Model Staggered Regressions

1990-2014, 24 Countries	1) Baseline OLS	2) Baseline OLS	3) Baseline OLS	4) Baseline OLS	5) Baseline OLS	6) Baseline OLS
Dependent Variable: Δ Investment/GDP						
FDI Reserves	-9.358***	-5.765***	-5.850***	-5.364***	-5.883***	-6.099***
	(2.686)	(1.711)	(1.714)	(1.797)	(1.823)	(1.772)
Asian Financial Crisis		-6.413***	-6.522***	-6.646***	-6.594***	-6.693***
		(1.797)	(1.791)	(1.769)	(1.737)	(1.766)
Age Dependency Ratio			-0.220	-0.279	-0.279	-0.100
			(0.308)	(0.306)	(0.297)	(0.396)
Broad Money Growth				-0.0289	-0.0299	-0.0289
				(0.0235)	(0.0215)	(0.0210)
Monetary Independence					3.540**	3.757**
					(1.767)	(1.731)
GDP Per Capita						-0.000191
						(0.000205)
_cons	0.189	0.620	2.202	3.173	1.695	0.614
	(0.728)	(0.629)	(2.323)	(2.321)	(2.348)	(2.757)
N	100	100	100	100	100	100
adj. R-sq	0.1895	0.3552	0.3525	0.3525	0.3692	0.3662
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	No	No	No	No	No	No
Standard errors in parentheses	*p<0.10, **p<0.05, ***p<0.010					

Table 2: Baseline Model, 9 Countries Sample

1990-2014, 9 Countries	Baseline: OLS	Baseline: FE
Dependent Variable:	Δ Investment/GDP	Δ Investment/GDP
FDI Reserves	-5.249***	-5.249***
	(1.373)	(0.753)
Asian Financial Crisis	-3.673***	-3.673**
	(1.298)	(1.359)
GDP Per Capita	0.0000235	0.0000235
	(0.0000422)	(0.0000289)
Age Dependency Ratio	-0.129	-0.129
	(0.0867)	(0.0717)
Broad Money Growth	-0.00915	-0.00915
	(0.0212)	(0.0121)
Monetary Independence	1.020	1.020
	(1.320)	(1.440)
_cons	1.228	1.228
	(0.913)	(0.698)
N	208	208
R-sq	0.1872	0.2384
Country Fixed Effects	Yes	Yes
Time Fixed Effects	No	No
Standard errors in parentheses	*p<0.10, **p<0.05, ***p<0.010	

Table 3: Alternative Model, 9 Country Sample

1990-2014 9 Countries	Alternate Reserves: OLS	Alternate Reserves: FE
Dependent Variable:	Δ Investment/GDP	Δ Investment/GDP
BOP Reserves	-0.0641	-0.0641
	(1.448)	(1.428)
Asian Financial Crisis	-4.889***	-4.889**
	(1.560)	(1.627)
GDP Per Capita	0.0000382	0.0000382
	(0.0000427)	(0.0000239)
Age Dependency Ratio	-0.142	-0.142
	(0.0944)	(0.0830)
Broad Money Growth	-0.0264	-0.0264
	(0.0259)	(0.0236)
Monetary Independence	1.010	1.010
	(1.370)	(1.251)
_cons	1.264	1.264
	(1.024)	(0.921)
N	208	208
R-sq	0.1073	0.1636
Country Fixed Effects	Yes	Yes
Time Fixed Effects	No	No
Standard errors in parentheses	*p<0.10 **p<0.05 ***p<0.010	

Table 4: Alternate Model Staggered Regressions

1990-2014 44 Countries	1 Alt OLS	2 Alt OLS	3 Alt OLS	4 Alt OLS	5 Alt OLS	6 Alt OLS
Dependent Variable: Δ Investment/GDP						
BOP Reserves	-0.702	-0.253	-0.318	-0.249	-0.576	-0.674
	(1.363)	(1.144)	(1.180)	(1.188)	(1.238)	(1.223)
Asian Financial Crisis		-8.079***	-8.179***	-8.156***	-8.211***	-8.296***
		(2.236)	(2.246)	(2.146)	(2.129)	(2.152)
Age Dependency Ratio			-0.174	-0.284	-0.295	-0.197
			(0.307)	(0.315)	(0.309)	(0.400)
Broad Money Growth				-0.0510*	-0.0532**	-0.0530**
				(0.0264)	(0.0261)	(0.0264)
Monetary Independence					2.885	3.036*
					(1.766)	(1.743)
GDP Per Capita						-0.000107
						(0.000202)
_cons	0.0615	0.653	1.911	3.659	2.592	2.013
	(0.925)	(0.679)	(2.339)	(2.433)	(2.443)	(2.835)
N	100	100	100	100	100	100
adj. R-sq	-0.0361	0.2821	0.2770	0.2927	0.3002	0.2937
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	No	No	No	No	No	No
Standard errors in parentheses *p<0.10 **p<0.05 ***p<0.010						

Table 5: Pre-Crisis Regression (OLS 4 Country Sample)

Pre-GFC(1990-2008)-4-Countries	Baseline:-OLS	Alternate-Reserves:-OLS
Dependent-Variable:	Δ-Investment/GDP	Δ-Investment/GDP
FD-Reserves	-6.152***	
	(1.973)	
BOP-Reserves-		-0.608
		(1.337)
Stock-Reserves		
Asian-Financial-Crisis	-8.525***	-6.908***
	(2.198)	(1.793)
GDP-Per-Capita-	-0.000492	-0.000697*
	(0.000340)	(0.000374)
Age-Dependency-Ratio	0.274	0.547
	(0.573)	(0.592)
Broad-Money-Growth	-0.0597**	-0.0296
	(0.0278)	(0.0231)
Monetary-Independence	3.526	4.313*
	(2.571)	(2.528)
_cons	-0.698	-2.932
	(4.512)	(4.642)
N	76	76
R-sq	0.3342	0.4091
Country-Fixed-Effects	Yes	Yes
Time-Fixed-Effects	No	No
Standard-errors-in-parentheses	*-p<0.10--**-p<0.05--***-p<0.010	

Table 6: Post-Crisis Regression (OLS 4 Country Sample)

Post-GFC(2010-2014)-4-Countries	Baseline:-OLS	Alternate-Reserves:-OLS
Dependent-Variable:	Δ-Investment/GDP	Δ-Investment/GDP
FD-Reserves	2.810	
	(5.834)	
BOP-Reserves-		0.364
		(4.489)
GDP-Per-Capita-	-0.00169*	-0.00164*
	(0.000801)	(0.000891)
Age-Dependency-Ratio	-3.312**	-3.197**
	(1.115)	(1.286)
Broad-Money-Growth	0.0546	0.0592
	(0.0713)	(0.0804)
Monetary-Independence	-3.307	-3.845*
	(2.063)	(1.949)
_cons	40.74***	39.74***
	(7.525)	(8.875)
N	20	20
R-sq	0.4506	0.4654
Country-Fixed-Effects	Yes	Yes
Time-Fixed-Effects	No	No
Standard-errors-in-parentheses	*-p<0.10--**-p<0.05--***-p<0.010	

Table 7: Time Fixed Effects (OLS 4 Country Sample)

1990-2014, 24 Countries	Baseline: OLS	Alternate Reserves: OLS
Dependent Variable:	Δ Investment/GDP	Δ Investment/GDP
FD Reserves	-2.942	
	(3.067)	
BOP Reserves		-0.708
		(1.454)
Stock Reserves		
GDP Per Capita	-0.0000278	-0.0000537
	(0.000359)	(0.000346)
Age Dependency Ratio	-0.0463	-0.0692
	(0.373)	(0.380)
Broad Money Growth	-0.0233	-0.0110
	(0.0271)	(0.0227)
Monetary Independence	0.889	1.206
	(2.520)	(2.615)
_cons	4.039	3.537
	(3.257)	(3.319)
N	100	100
R-sq	0.3717	0.3807
Country Fixed Effects	Yes	Yes
Time Fixed Effects	Yes	Yes
Standard errors in parentheses	*p<0.10, **p<0.05, ***p<0.010	

Table 8: Time Fixed Effects (OLS 9 Country Sample)

1990-2014, 9 Countries	Baseline: OLS	Alternate Reserves: OLS
Dependent Variable:	Δ Investment/GDP	Δ Investment/GDP
FD Reserves	-3.000*	
	(1.568)	
BOP Reserves		-0.322
		(0.664)
Stock Reserves		
GDP Per Capita	0.0000457	0.0000405
	(0.0000436)	(0.0000434)
Age Dependency Ratio	-0.0671	-0.0681
	(0.120)	(0.112)
Broad Money Growth	-0.0130	-0.00284
	(0.0219)	(0.0192)
Monetary Independence	0.140	0.520
	(1.887)	(1.865)
_cons	3.767**	2.739
	(1.819)	(1.734)
N	202	208
adj. R-sq	0.2036	0.2485
Country Fixed Effects	Yes	Yes
Time Fixed Effects	Yes	Yes
Standard errors in parentheses	*p<0.10, **p<0.05, ***p<0.010	