International Reserves and IMF Quotas: Is There A Link?*

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Abstract

The foreign exchange reserves of emerging market economies rose after the East Asian crisis of 1997. This increase has been attributed to a desire by these countries to "self-insure" themselves against similar financial shocks and avoid IMF conditionality. The rise in reserves may also be due to concerns of these countries about the size of their IMF quotas, which set limits on the amount of credit countries may draw from the IMF. These quotas have not been revised to reflect the expansion of the emerging market economies, and their governments may have decided to augment their quotas with foreign reserves. We investigate the relationship of IMF quotas and reserve holdings for a panel of upper- and middle-income economies during the period of 1980-2006, and find evidence that reserves have been inversely related to the countries' IMF quotas.

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I. Introduction

The build-up in the foreign exchange reserves of emerging market nations has been a significant economic development of the last two decades. These countries increased their holdings of reserve assets by incurring current account surpluses which offset the large deficits of the U.S. and other advanced economies and resulted in the emergence of "global imbalances." The willingness of foreign central banks to hold dollar-denominated assets contributed to low long-term interest rates in the U.S. and a mispricing of risk, which was a factor in the run-up to the recent crisis.[1]

The reasons for the rise in foreign reserve holdings have been widely studied.[2] Traditional theoretical models investigated the tradeoff between the benefit of reserves in financing shocks to the trade account and their opportunity costs.[3] Early empirical analyses of this "precautionary demand" focused on the amount of imports and proxies of the difference between the return on reserves and alternative investments.[4] More recent analyses have incorporated the desire of central banks to protect their economies from financial shocks, and have demonstrated that financial openness and development are significant determinants of the demand for reserves.[5]

A related line of reasoning has focused on the response of emerging markets, particularly in Asia, to the financial crises of the 1990s and the early years of the following decade. These countries,it has been claimed, were unhappy about the policy prescriptions attached to the IMF's programs to the countries which borrowed from it. They subsequently sought to "self-insure" themselves against external shocks so that they would not need to turn to the IMF in the event of another crisis.[6]

The impact of the IMF on the demand for reserves, however, may reflect other factors than concern over its lending conditions. A country's ability to draw from the IMF is constrained by its quota. Traditionally a country could draw no more than 100% of its

[1] Obstfeld and Rogoff (2009) provide an analysis of the contribution of the global imbalances to the financial crisis. Astley, Giese, Hume, and Kubelec (2009) offer a similar account from the perspective of the United Kingdom.

[2] See, for example, Aizenman and Lee (2007), Aizenman and Marion (2003), Cheung and Ito (2009), Durdu, Mendoza, and Terrones (2009), International Monetary Fund (2003), Jeanne (2007), Lane and Burke (2001), and Mendoza (2004).

[3] Heller (1966) provided a key contribution to this area of research.

[4] See, for example, Heller and Khan (1978).

[5] See, for example, Obstfeld, Shambaugh, and Taylor (2009, 2010).

[6] See Bird and Rajan (2003) and Mendoza (2004).

quota in one year and 300% cumulatively.[7] The size of the quotas has been the subject of contentious debate, with many emerging markets claiming that their allotted quotas do not reflect their economic size and potential need for financing. Moreover, the total quota has not been increased since 1998, and has lagged behind the growth in international transactions.

Those countries dissatisfied with their quotas may have been concerned about the amount of funding they could receive from the IMF in the event of a crisis. Moreover, they could also have been apprehensive about the conditionality that the IMF would have placed on its loans. Consequently, they may have chosen to hold more reserves to make up the anticipated shortfall in the event of a crisis and to evade conditions which they would regard as burdensome. Upper-income countries, on the other hand, are less concerned about their foreign exchange holdings because their quotas at the Fund are larger. In addition, until the recent economic crisis these countries could have believed themselves to be immune from sudden outflows of capital. Therefore, there may be an inverse relationship between the size of a country's IMF quota and its holdings of foreign exchange reserves.

Figures 1, 2 and 3 show the time paths of foreign exchange reserves scaled by GDP and national IMF quotas normalized by M2, imports and total IMF quotas, respectively. In the top half of each page are the reserves and quotas of three advanced economies, Japan, Austria (until the adoption of the euro) and the United Kingdom, which have different exchange rate regimes: Japan manages its float, Austria fixed the value of its currency until it adopted the euro, and the United Kingdom generally floats. In the latter case there is some indication that reserves and quotas move in the same direction, while there is no apparent relationship with the first two countries. However, in the bottom half are the reserves and quotas of Brazil, China and India. The graphs for these countries clearly indicate a divergence between reserves and quotas over time, particularly for the latter two economies. In the emerging markets, therefore, this is evidence of an inverse relationship between reserve holdings and IMF quotas.

In this paper we examine whether countries' IMF quotas have been a determinant of their foreign exchange reserves. We use a panel of upper- and middle-income countries

[7] These ceilings were raised in 2009. See the discussion in Section II.

with data from 1980 through 2006. Our results indicate that there has been such a relationship, which is distinct from the direct impact of IMF programs on reserve holdings.

The rest of the paper is organized as follows. Section II describes how the IMF's quotas are determined. The following section describes the data and empirical methodology. Section IV presents our basic results with several extensions, and also tests of robustness. The final section summarizes our finding and offers policy implications.

II. IMF Quotas

A country is assigned a quota when it joins the IMF, and must pay one-quarter of this amount in a currency which is used internationally, such as the dollar or the euro. The remaining amount can be paid in the national currency. A member's quota is used to determine its level of access to IMF credit, its voting power at the IMF, and its share in allocations of Special Drawing Rights (SDRs).[8]

The determination of national quotas has been guided by a complex set of five formulas that relate the quotas to a country's GDP, which is converted to a common currency measure with market exchange rates; official reserves; current account receipts and payments; and the variability of current account receipts. The different formulas allow considerable discretion over the actual allocations. The use of GDP measured with market exchange rates works against poorer countries since their lower prices increase the value of their output when GDP is measured taking into account differences in national price levels.

The IMF reviews its quotas in the context of general quota reviews that take place every five years. When such a review does result in an increase, the increase includes equiproportional additions in the quotas of all members, and on occasion additional increases for selected members which raise their relative quota. Rapkin and Strand (2006), however, point out that "...the equiproportional component has ranged from 40 to 98 percent and averaged 70 percent, thus imparting a status quo bias to the process."[9] The actual change in reserves usually occurs in the year after the review.

A member country's voting power at the IMF is based on its quota relative to the

[8]The SDR is a reserve asset created at the IMF in 1969 in response to concerns about the use of the U. S. dollar as an international reserve asset.

[9]Rapkin and Strand (2006), p. 308.

total amount and an allocation of "basic votes" which are equal for each member. Since an increase in the quotas of some members diminishes the relative voting powers of others, there has been a great deal of resistance to any significant reallocation of quotas, despite the growth of the emerging markets economies. There were no quota increases recommended after the 12th (2003) and 13th (2008) quota reviews.

In 1999, the IMF commissioned an external group chaired by Richard Cooper of Harvard University to review the formulas used in the calculation of quotas. The report of the IMF's Quota Formula Review Group (2000) recommended replacing the existing set of formulas with one formula that included two variables: GDP at market exchange rates and a measure of external variability, which included the variability of long-term capital flows. The Group did not recommend increases for any particular group of countries, but did express its expectation that following the adoption of the new formula there would be increases in the quotas of "fast-growing and highly open economies."

The quotas have traditionally been used to set limits on the amount of credit a member nation could obtain from the IMF through the programs funded through the General Resources Account, i.e., the Standby Arrangements and the Extended Fund Facility: up to 100% in a year and 300% cumulatively.[10] However, these limits were exceeded at the time of the Mexican crisis of 1995-95 and during the early stages of the East Asian crisis of 1997-98. The IMF established a special lending program, the Supplemental Reserve Facility (SRF), in 1998 to allow it to augment a traditional lending program with a larger amount of credit. The new facility was used to channel funds to South Korea, Russia and Brazil in 1998, Turkey in 2000, Argentina and Brazil in 2001 and Brazil and Uruguay in 2002. The SRF was abolished in 2009 when the IMF increased its usual access limits to 200% in a year and 600% cumulatively.

Irwin, Penalver, Salmon, and Taylor (2008) have presented a model of IMF lending to explain why some countries decide to self-insure against a crisis through increased holdings of reserves rather than relying on the IMF. In the model the IMF is initially established along the lines of a credit union, and all members are potential borrowers. The members periodically vote on the size of the Fund and its resources. Over time, however, the Fund's membership becomes stratified along the lines of their national economic characteristics,

[10]Countries which borrow from the IMF through multi-year concessional arrangements, such as the Poverty Reduction and Growth Facility, have higher limits and no cumulative access limit.

and a significant proportion no longer draw upon the IMF's financial resources. The authors show that in these circumstances the size of the IMF will be limited, which constrains the ability of the Fund to provide loans in the event of a crisis. Those members with higher probabilities of experiencing a crisis, therefore, will turn to self-insurance through foreign reserves.

In recent years the disparity between the relative economic positions of the emerging markets and their quotas at the IMF have led to calls for a wide-ranging reform of the current system. The IMF has moved to increase the quotas of its fastest-growing members and to change the method for allocating quotas. The quotas for China, Korea, Mexico and Turkey were raised in 2006. The IMF's Executive Board in March 2008 approved the adoption of a new formula to be used for calculating quotas and a second round of selective quota increases with the largest gains allocated to emerging markets, including the four countries which received increases in 2006. In 2009, the G20 agreed to advance the timing of the IMF's next general quota review so that it would be completed by January 2011, two years ahead of its scheduled completion.

III. Data and Methodology

We drew our data from a panel of upper- and middle-income countries over the period of 1980 through 2006.[11] The full list of countries appears in the Data Appendix, as do the sources of our data.

Our dependent variable is the amount of foreign exchange reserves held by a central bank. This variable is initially scaled by GDP, which is converted to dollars using market exchange rates. The control variables include measures of economic wealth (GDP per capita) and size (population). While studies such as those of Aizenman and Marion (2003) predict that an increase in the standard of living will raise the demand for reserves, others such as Cheung and Ito (2009) find evidence of a negative linkage which they attribute to the square-root effect of transaction demand.[12]

The control variables also deal with the impact of international trade and the nature of the exchange rate regime on the demand for reserves. The ratio of imports and exports

[11] We used data from the members of the Eurozone from 1980 until their adoption of the euro.
[12] See Baumol (1952).

to GDP measures the importance of trade to an economy, which would increase the precautionary demand for reserves. The terms of trade indicates the relative price a country receives for its exports, and the sign is ambiguous: an increase would increase a country's ability to accumulate reserves, but may lower its desire to do so. Our exchange rate variable is a binary indicator of whether a country has a fixed exchange rate, and is based on Reinhart and Rogoff's (2004) classification. The variable takes the value of one if the Reinhart and Rogoff system indicates the existence of some form of a pegged rate, or a crawling band that is less than or equal to 2%.[13]

In addition, we include variables which measure the influence of the financial sector. For a measure of de jure capital openness, we use the Chinn and Ito (2008) measure of capital controls, which is based on data reported in the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions* on the existence of multiple exchange rates, restrictions on the current and capital accounts and requirements to surrender export proceeds. The Chinn-Ito index is the first principal component of these indicators, and an increase in the index signals a move toward more openness in the financial account.

We also have the ratio of M2 to GDP, which has been used by Obstfeld, Shambaugh, and Taylor (2009, 2010) and others as a measure of financial development. They point out that in the case of a "sudden stop" of capital, countries with larger financial sectors are more vulnerable to capital outflows. Central banks may want to hold more reserves to forestall such a crisis.

Our innovation to the literature is the inclusion of a country's annual quota at the IMF to determine whether there is an inverse relationship with foreign exchange reserves. We use three different variables to scale a country's quota. The first two relate the quota to the size of a potential balance of payments need. We first use quota/M2, since M2 represents an economy's financial vulnerability in the case of a balance of payments crisis.[14] Second, we scale quotas by a country's imports, quotas/imports, for trade shocks. The third scaling factor, relative quotas, represents a country's relative position at the IMF. This specification is based on the assumption that countries with lower influence at the IMF may accumulate more reserves because of concerns of facing more conditionality

[13]This definition corresponds to categories 1 through 8 in the Reinhart and Rogoff (2004) classification system.

[14]This is analogous to Calvo and Mendoza's (1996) use of the relationship of M2 and reserves as an indicator of financial vulnerability.

and less access to the Fund's financial resources.

We also add an indicator of the emerging markets in our sample to determine whether these countries exhibit a higher demand for reserves even when we control for all the factors noted above. In addition, we have a dummy variable which takes the value of one in those countries which adopted IMF programs in the first year of the program and the following years.[15]

The estimating equation, therefore, takes the form:

$$\begin{aligned}\log\left(\frac{Reserves}{GDP}\right)_{it} =& \beta_0 + \beta_1 \log\left(GDP\ per\ capita\right)_{it} + \beta_2 \log\left(Population\right)_{it} + \beta_3\ Peg_{it} + \\ & \beta_4 \log\left(\frac{Imports + Exports}{GDP}\right)_{it} + \beta_5\ \ Chinn - Ito_{it} + \\ & \beta_6 \log\left(\frac{M2}{GDP}\right)_{it} + \beta_7 \log\left(\frac{Quota}{X}\right)_{it} + \beta_8 \log\left(Terms\ \ of\ \ Trade\right)_{it} + \\ & \beta_9\ \ \left(Emerging\ \ Market\right)_{it} + \beta_{10}\ \ \left(IMF\ \ Program\right)_{it} + \epsilon \qquad (1)\end{aligned}$$

where the observations take place over i $(i = 1, 2, \ldots, m)$ countries and t $(t = 1, 2, \ldots, n)$ periods and X ={M2, Imports, Total Quota}. We initially estimate the equation with pooled OLS. In subsequent estimations we add time and country fixed effects.

IV. Results

Table 1 reports our first set of results, with each country's foreign exchange reserves scaled by GDP and its IMF quota scaled by M2. In the first equation, GDP per capita and the terms of trade have negative and significant coefficients, while trade openness appears with a positive significant coefficient. The population variable and the pegged exchange rate indicator are not significant. When financial openness (Chinn-Ito) and M2/GDP are added in the next equation, both variables have positive coefficients and are significant. These results support the hypothesis that central banks in countries with larger and more open financial sectors accumulate more reserves.

The IMF quota variable is added in the third equation. It has a negative coefficient

[15] Bird and Mandilaras (2010a, 2010b) find some evidence that countries which have had IMF programs accumulate more reserves. However, this result is sensitive to the choice of countries for the empirical analysis.

which is significant at the 1% level. Foreign exchange reserves, therefore, are inversely related to a country's quota at the IMF. In addition, population now has a highly significant negative coefficient. The significance of the coefficient of M2/GDP falls, however, perhaps due to collinearity with the quota measurement.

The next equation tests whether the IMF quota measure is still significant in the presence of a proxy for emerging markets. The coefficient of the emerging market variable has a positive and significant sign, and the R2 of the equation rises from .268 to .437, indicating that there is an "emerging market" effect. The coefficient on income per capita switches sign: once we control for whether an economy is an emerging market, increases in income raise the demand for reserves. The IMF quota variable, moreover, continues to have a negative and highly significant coefficient. The final equation adds the IMF program variable, which is not significant.

Table 2 repeats the specification of the last equation of Table 1, using different estimation methods. First, annual time dummies are added to estimation. The quota variable continues to be significant and rises in absolute value from .177 in the preceding equation to .287. Moreover, the IMF program variable is negative and significant. In the second column, the estimation is undertaken with country fixed effects, and the emerging market variable drops from the estimation. The IMF quota variable falls in size and significance to the 10% level. The coefficient of the pegged exchange rate indicator, however, is now positive and significant, whereas the IMF dummy is not. When both time dummies and fixed effects are utilized in the third equation, the results show that the coefficient of the quota variable has a value of -.274 that is significant at the 1% level. The pegged exchange rate continues to be significant, but the IMF program dummy is not. For comparison purposes, we also report the results of an estimation done with random effects in the last column. These results do not support the significance of the quota variable.

The specifications and estimation methods utilized in Tables 1 and 2 are repeated in Tables 3 and 4, but the IMF quota variable is now scaled by imports, the traditional measure of balance of payment vulnerability. The results for the control variables are very similar. The one change is that the M2/GDP measure of financial development remains significant when the IMF quota variable is added. The quota variable is initially significant when added in the third equation of Table 3. However, its coefficient sign is

positive and insignificant when the emerging market dummy is added to the following two estimations.

The significance of the quota variable is restored when time dummies are added in the first and third equations of Table 4. The pegged rate variable is significant when fixed effects are utilized, whereas the IMF program dummy is only significant if time dummies are included. In the random effects estimation, the quota variable is not significant, although both the pegged exchange rate and IMF variables are.

Finally, we scaled the individual country quotas in each year by the IMF's total quota for the year to determine if a country's relative quota affected its acquisition of reserves. Tables 5 and 6 report the results, using the same format as the preceding tables. In Table 5 we see that the results for the control variables are again similar to those reported in the previous tables. The relative quota variable has a negative and significant coefficient in the third estimating equation. Moreover, this variable retains its significance when the emerging market dummy is added in the next two equations.

The significant negative coefficient persists when time dummies are added in the first equation in Table 6. But the relative quota variable has a positive and significant coefficient in the two equations where fixed effects are utilized in the estimation. The reversal of sign, which only occurs when the relative IMF quota is specified and fixed effects are used in the estimation, reflects the relatively stability of this variable for each country over time. When the estimation is repeated with a random effects model, the negative and significant coefficient reappears. Again, the coefficient of the pegged rate variable is significant whenever fixed or random effects are utilized, whereas the IMF program dummy is only significant if time dummies or random effects are included.

To test the robustness of our results, we also undertook estimations with foreign reserves scaled by external debt as the dependent variable.[16] There is a significant drop in the number of observations, 1077 in the fifth equation in Table 1 versus 547 when external debt replaces GDP. Many of the results, however, are similar to those reported above. The quota variable is significant and has a negative sign in all estimations where quotas were scaled by M2. The measurement of quota scaled by imports was only significant when time dummies or random effects were utilized. The relative quota variable was significant

[16]These are available from the authors.

in the initial estimations but not when time dummies, fixed effects or random effects are used.

V. Conclusions

Our results confirm many of the hypotheses regarding the determinants of a country's holdings of foreign exchange reserves that have been suggested in the literature on this issue. Countries with large and growing economies accumulate more reserves, as do economies with more trade and financial openness and larger financial sectors. An increase in the terms of trade leads to a decline in reserve holdings. The hypothesis that countries with fixed exchange rates are more likely to hold onto reserves is supported when the estimations are done with fixed effects or random effects.

Our results also indicate that there is an inverse relationship between a country's quota position at the IMF and its reserves. When the quota is scaled by M2 or total quota and the estimation undertaken with all the control variables and time dummies (the first column in Tables 2 and 6), the coefficient is quite similar in magnitude: -.287 in the first case and -.298 in the second. A one percentage point rise in the quota is associated with about a .3 percentage decline in reserves/GDP. The result for an impact of an IMF program on reserves, on the other hand, is not robust to alternative specifications.

However, the significance of the emerging market variable and the rise in the R2 in all the estimations when it is included indicates that there remains an unobserved component of the demand for reserves in these countries, which may resume as the world economy recovers from the recent crisis. Central banks have an array of assets which provide international liquidity: foreign exchange reserves, credit from the IMF, SDR allocations, bilateral swap arrangements and regional monetary arrangements.[17] Whether or not these assets are seen as complements or substitutes, however, is not clear (Aizenman 2009, Aizenman, Jinjarak, and Park 2010, Jeanne 2010). The distinction is important for the stability of the global economy, since how central bankers regard these options will determine whether global imbalances re-emerge on a significant scale.

[17]The list of alternative assets has expanded since Black (1985) surveyed the literature on the composition of reserve portfolios. See Aizenman and Pasricha (2010) for an analysis of swap lines and Desai and Vreeland (2010) on regional funds. Sussangkarn (2010) provides an update on recent changes in the Chiang Mai Initiative.

Emerging markets with larger holdings of reserves experienced less currency instability during the recent crisis (Obstfeld, Shambaugh, and Taylor 2009), and there is little reason to expect that these countries will reverse their position on the need for international liquidity.[18] If their central banks view the alternative assets as close substitutes, then increases in IMF quotas or the establishment of new lending programs might limit the accumulation of reserves by central banks. On the other hand, if the cost of using IMF credit is seen as excessive, then the central banks will want to maintain their own reserve holdings.

The IMF has sought to make its lending arrangements more appealing to possible borrowers. In addition to increasing the access limits, it has relaxed the degree of conditionality attached to traditional programs and introduced a new arrangement-the Flexible Credit Line (FCL)-which is designed to disburse credit to countries with records of strong policies without conditions. However, the nations which qualify only have access to the FCL for six months, and then must either reapply or undergo a review for access for another six months. To date, only three countries-Colombia, Mexico and Poland-have signed up for the FCL, and none have needed to draw upon it.

It is unlikely, therefore, that emerging markets will reduce their demand for international reserves. The European Central Bank (2010) has reported that reserve holdings by emerging market economies have been higher after the crisis than before. However, there are other reasons for reallocating countries' relative IMF quotas related to voting power and the governance of the Fund. In addition, the IMF may be able to indirectly contribute to the lessening of the demand for international reserves by fulfilling its purpose of contributing to the provision of the international public good of financial stability (Joyce and Sandler 2008).

[18] Aizenman and Sun (2009) investigate the use of reserves by emerging market countries during the crisis.

Table 1: Results using Reserves/GDP and Quota/M2

	(1)	(2)	(3)	(4)	(5)
log(GDP per capita)	-.080	-.156	-.227	.088	.090
	(.019)***	(.025)***	(.032)***	(.033)***	(.033)***
log(Population)	.018	-.029	-.077	-.109	-.109
	(.019)	(.022)	(.026)***	(.023)***	(.023)***
log(Imports+Exports/GDP)	.897	.757	.751	.596	.603
	(.046)***	(.055)***	(.059)***	(.053)***	(.056)***
Peg	.056	.044	.007	.016	.018
	(.048)	(.050)	(.050)	(.044)	(.044)
log(Terms of Trade)	-.275	-.409	-.582	-.695	-.695
	(.122)**	(.127)***	(.138)***	(.121)***	(.121)***
Chinn–Ito Index		.043	.056	.054	.054
		(.018)**	(.019)***	(.016)***	(.016)***
log(M2/GDP)		.164	-.057	.100	.099
		(.049)***	(.083)	(.073)	(.073)
log(Quota/M2)			-.172	-.177	-.177
			(.057)***	(.050)***	(.050)***
Emerging Market				1.177	1.171
				(.066)***	(.067)***
IMF Program					.024
					(.058)
Constant	.254	1.549	4.134	1.441	1.384
	(.651)	(.702)**	(1.001)***	(.891)	(.901)
Observations	1202	1105	1077	1077	1077
R^2	.301	.312	.268	.437	.437
F-stat	103.066	70.96	48.826	92.05	82.798

Note: The dependent variable is log(Reserves/GDP).

Table 2: Results using Reserves/GDP and Quotas/M2: Fixed Effects, Time Dummies and and Random Effects

	Time Dummies	Fixed Effects	Time Dummies Fixed Effects	Random Effects
log(GDP per capita)	-.034	.423	.041	.454
	(.031)	(.109)***	(.130)	(.067)***
log(Population)	-.189	1.805	.818	.183
	(.021)***	(.176)***	(.268)***	(.048)***
log(Imports+Exports/GDP)	.437	.657	.656	1.005
	(.052)***	(.093)***	(.099)***	(.079)***
Peg	.058	.163	.172	.222
	(.041)	(.047)***	(.048)***	(.047)***
log(Terms of Trade)	-.882	-.354	-.502	-.454
	(.110)***	(.107)***	(.109)***	(.112)***
Chinn–Ito Index	.005	.025	-.021	.059
	(.015)	(.017)	(.018)	(.017)***
log(M2/GDP)	-.105	.104	-.130	.282
	(.069)	(.094)	(.105)	(.091)***
log(Quota/M2)	-.287	-.112	-.274	-.051
	(.048)***	(.059)*	(.071)***	(.058)
Emerging Market	.900			1.400
	(.063)***			(.176)***
IMF Program	-.145	.021	.284	.428
	(.053)***	(.210)	(.214)	(.133)***
Constant	5.920	-8.925	-1.171	-6.717
	(.873)***	(.998)***	(1.749)	(.960)***
Observations	1077	1077	1077	1077
R^2	.558	.446	.477	
F-stat	36.452	91.271	25.925	

Note: The dependent variable is log(Reserves/GDP).

Table 3: Results using Reserves/GDP and Quota/Imports

	(1)	(2)	(3)	(4)	(5)
log(GDP per capita)	-.080	-.156	-.155	.151	.153
	(.019)***	(.025)***	(.026)***	(.029)***	(.029)***
log(Population)	.018	-.029	-.045	-.067	-.067
	(.019)	(.022)	(.022)**	(.020)***	(.020)***
log(Imports+Exports/GDP)	.897	.757	.662	.567	.574
	(.046)***	(.055)***	(.059)***	(.053)***	(.056)***
Peg	.056	.044	.055	.021	.023
	(.048)	(.050)	(.051)	(.045)	(.045)
log(Terms of Trade)	-.275	-.409	-.527	-.511	-.512
	(.122)**	(.127)***	(.130)***	(.115)***	(.115)***
Chinn–Ito Index		.043	.037	.049	.050
		(.018)**	(.019)*	(.017)***	(.017)***
log(M2/GDP)		.164	.148	.308	.307
		(.049)***	(.050)***	(.045)***	(.045)***
log(Quota/Imports)			-.060	.015	.015
			(.015)***	(.014)	(.014)
Emerging Market				1.199	1.194
				(.070)***	(.071)***
IMF Program					.021
					(.058)
Constant	.254	1.549	2.692	-.971	-1.017
	(.651)	(.702)**	(.730)***	(.680)	(.692)
Observations	1202	1105	1077	1077	1077
R^2	.301	.312	.272	.431	.431
F-stat	103.066	70.96	49.999	89.828	80.792

Note: The dependent variable is log(Reserves/GDP).

Table 4: Results using Reserves/GDP and Quotas/Imports: Fixed Effects, Time Dummies and and Random Effects

	Time Dummies	Fixed Effects	Time Dummies Fixed Effects	Random Effects
log(GDP per capita)	.069 (.027)**	.444 (.107)***	.099 (.127)	.475 (.065)***
log(Population)	-.121 (.018)***	1.811 (.177)***	.859 (.268)***	.197 (.047)***
log(Imports+Exports/GDP)	.393 (.052)***	.572 (.098)***	.449 (.102)***	.985 (.079)***
Peg	.058 (.042)	.163 (.047)***	.172 (.048)***	.227 (.047)***
log(Terms of Trade)	-.585 (.105)***	-.327 (.105)***	-.435 (.106)***	-.430 (.109)***
Chinn–Ito Index	.002 (.016)	.025 (.017)	-.019 (.018)	.060 (.017)***
log(M2/GDP)	.236 (.041)***	.213 (.072)***	.141 (.073)*	.336 (.067)***
log(Quota/Imports)	.031 (.013)**	-.081 (.051)	-.196 (.060)***	-.006 (.033)
Emerging Market	.957 (.066)***			1.401 (.189)***
IMF Program	-.149 (.054)***	.015 (.210)	.260 (.214)	.422 (.134)***
Constant	2.010 (.675)***	-9.263 (.943)***	-2.159 (1.686)	-7.204 (.848)***
Observations	1077	1077	1077	1077
R^2	.545	.446	.475	
F-stat	34.613	91.06	25.694	

Note: The dependent variable is log(Reserves/GDP).

Table 5: Results using Reserves/GDP and Relative Quotas

	(1)	(2)	(3)	(4)	(5)
log(GDP per capita)	-.080	-.156	.302	.430	.430
	(.019)***	(.025)***	(.037)***	(.035)***	(.035)***
log(Population)	.018	-.029	.493	.331	.337
	(.019)	(.022)	(.039)***	(.037)***	(.038)***
log(Imports+Exports/GDP)	.897	.757	.784	.657	.636
	(.046)***	(.055)***	(.052)***	(.048)***	(.051)***
Peg	.056	.044	.039	.043	.039
	(.048)	(.050)	(.045)	(.041)	(.042)
log(Terms of Trade)	-.275	-.409	-.871	-.858	-.864
	(.122)**	(.127)***	(.118)***	(.108)***	(.108)***
Chinn–Ito Index		.043	.088	.078	.078
		(.018)**	(.017)***	(.015)***	(.015)***
log(M2/GDP)		.164	.050	.197	.198
		(.049)***	(.045)	(.043)***	(.043)***
log(Quota/Total Quota)			-.754	-.558	-.567
			(.047)***	(.045)***	(.046)***
Emerging Market				.933	.946
				(.064)***	(.065)***
IMF Program					-.074
					(.055)
Constant	.254	1.549	-1.770	-2.924	-2.781
	(.651)	(.702)**	(.684)***	(.630)***	(.639)***
Observations	1202	1105	1086	1086	1086
R^2	.301	.312	.405	.502	.503
F-stat	103.066	70.96	91.556	120.66	108.865

Note: The dependent variable is log(Reserves/GDP).

Table 6: Results using Reserves/GDP and Relative Quotas: Fixed Effects, Time Dummies and and Random Effects

	Time Dummies	Fixed Effects	Time Dummies Fixed Effects	Random Effects
log(GDP per capita)	.229	.406	.114	.645
	(.039)***	(.107)***	(.125)	(.065)***
log(Population)	.102	2.019	1.158	.547
	(.042)**	(.196)***	(.278)***	(.061)***
log(Imports+Exports/GDP)	.459	.666	.600	.863
	(.052)***	(.091)***	(.096)***	(.075)***
Peg	.072	.198	.214	.175
	(.040)*	(.048)***	(.048)***	(.046)***
log(Terms of Trade)	-.788	-.274	-.344	-.493
	(.104)***	(.105)***	(.106)***	(.105)***
Chinn–Ito Index	.024	.034	-.003	.046
	(.016)	(.016)**	(.018)	(.016)***
log(M2/GDP)	.188	.215	.174	.197
	(.041)***	(.068)***	(.068)**	(.062)***
log(Quota/Total Quota)	-.298	.477	.588	-.689
	(.051)***	(.187)**	(.190)***	(.083)***
Emerging Market	.842			.905
	(.063)***			(.178)***
IMF Program	-.156	-.171	-.038	.223
	(.053)***	(.217)	(.219)	(.129)*
Constant	.713	-10.205	-4.513	-8.157
	(.706)	(.822)***	(1.521)***	(.754)***
Observations	1086	1086	1086	1086
R^2	.559	.447	.474	
F-stat	36.936	92.24	25.839	

Note: The dependent variable is log(Reserves/GDP).

Figure 1: Reserves/GDP and Quotas/Imports: Selected Countries.

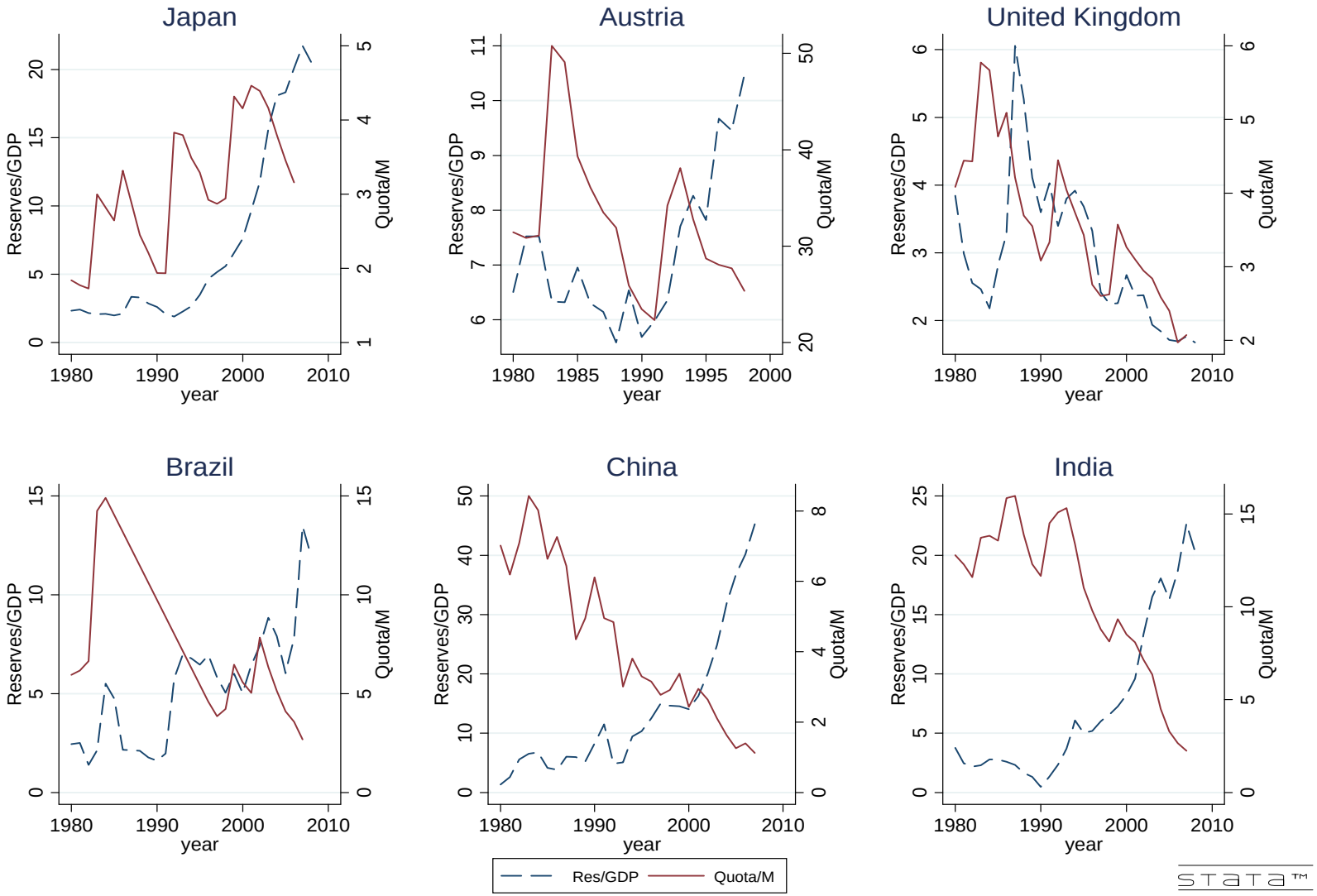


Figure 2: Reserves/GDP and Quotas/M2: Selected Countries.

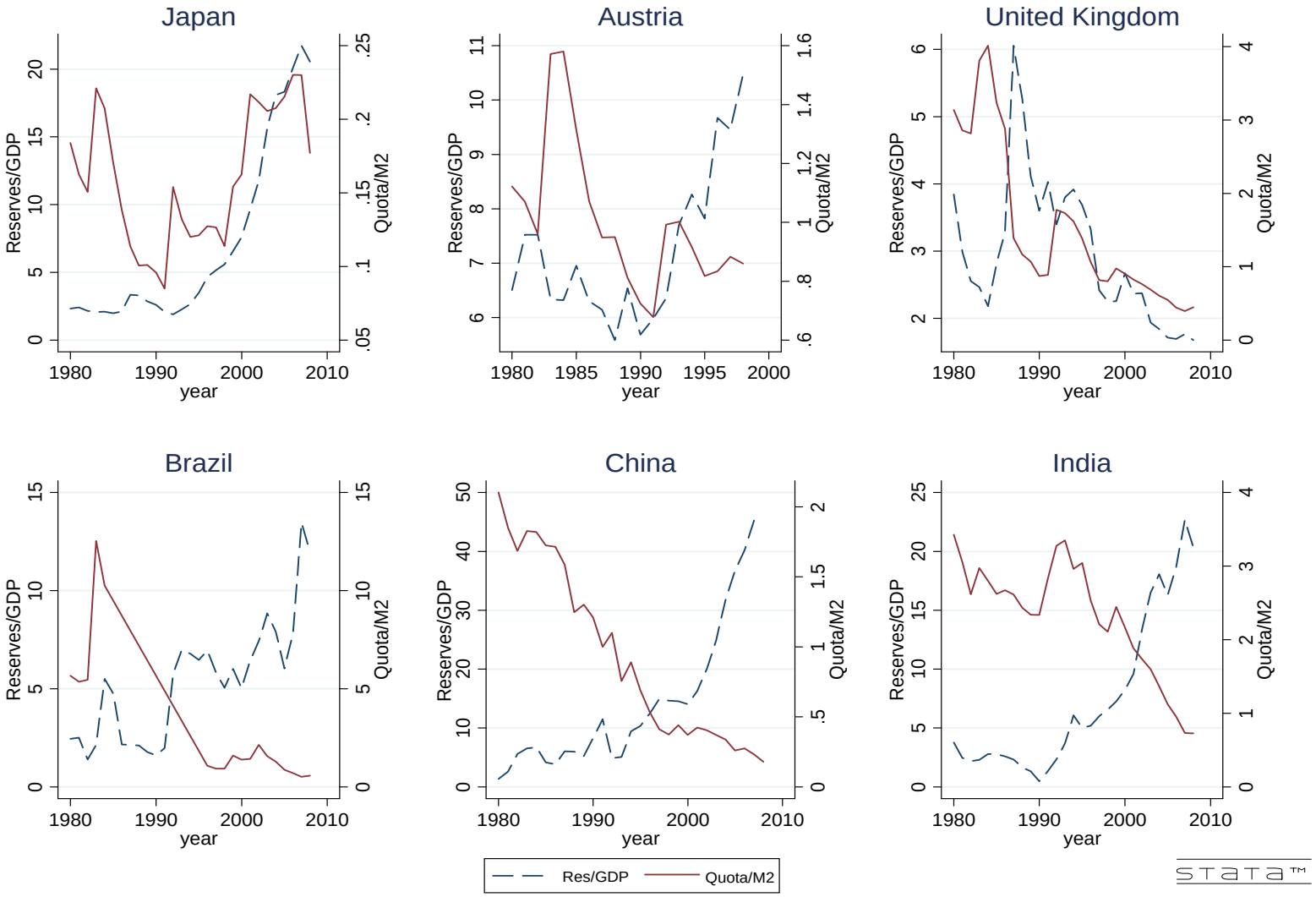
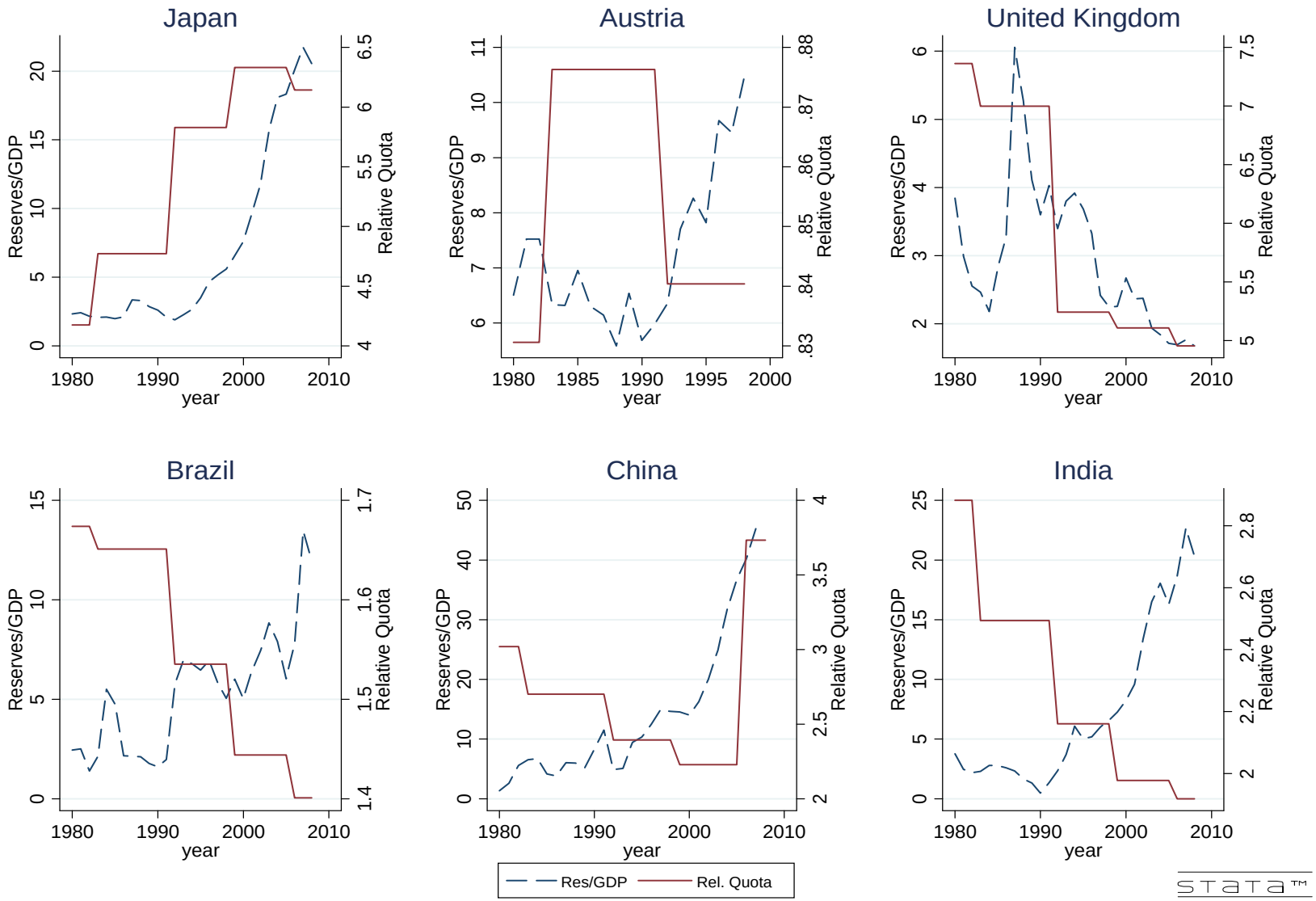


Figure 3: Reserves/GDP and Quotas/Total Quota: Selected Countries.



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A Data

I.1. Data Sources

Variable	Source	Definition or Transformation	Units
M2♯	World Bank WDI and IFS	Money + Quasi Money	National Currency
RESERVES	IFS Line 1L	Total Reserves - Gold	U.S. Dollars
EXPORTS/GDP	World Bank WDI	Exports of Goods and Services/GDP	%
IMPORTS/GDP	World Bank WDI	Imports of Goods and Services/GDP	%
RGDP	World Bank WDI	Real Gross Domestic Product	2000 U.S.$
GDP	World Bank WDI	Nominal Gross Domestic Product	U.S. dollars
GDPNC	World Bank WDI	Nominal Gross Domestic Product	National Currency
$\frac{M2}{GDP}$	WDI and IFS	M2/GDP	%
POPULATION	IFS	Population	
GDP per capita	GDP/Population	Real GDP per capita	2000 U.S.$
FINANCIAL OPENNESS	Chinn and Ito Index	Financial Openness	Index
PEG	Reinhart and Rogoff (2004)	See text for definition	Binary
IMF program	IMF Website	See text for definition	Binary
QUOTA	IFS Line 2F	Country Quota	SDR

Notes: IFS stands for International Financial Statistics.
♯ For Eurozone members we use data from the Yearbook of International Financial Statistics.

I.2. Classification of Countries

Upper-Income Countries (27)		
Australia	Iceland	Portugal
Austria	Ireland	South Africa
Belgium	Italy	Spain
Canada	Japan	Sweden
Denmark	Malta	Switzerland
Finland	Netherlands	Turkey
France	New Zealand	United Kingdom
Germany	Norway	United States
Greece		
Middle-Income Countries (29)		
Argentina	India	Panama
Brazil	Indonesia	Peru
Bulgaria	Israel	Philippines
Chile	Jordan	Poland
China	South Korea	Russia
Colombia	Malaysia	Singapore
Czech Republic	Mexico	Sri Lanka
Ecuador	Morocco	Thailand
Egypt	Nigeria	Venezuela
Hungary	Pakistan	