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Abstract: This paper investigates the conditions under which developing and transition nations engage in currency redenomination. Given that many governments of developing countries experience high levels of inflation and deterioration in their currency's value against other currencies, why do some elect to redenominate, while others do not? And why do some governments wait many years after a bout of hyperinflation, or after their currency is priced at 1000 or 5000 units to the dollar, to redenominate, while others do so relatively quickly? I suggest that the explanations rest in a combination of economic and political factors, including inflation, governments' concerns about credibility, and the effect of currencies on national identity. I employ survival analysis to test these expectations, using a set of data for developing and transition nations, covering the 1960-2003 period. I find, not surprisingly, that inflation is an important predictor of redenomination. Redenomination also is related to political variables, including governments' time horizons, the governing party's ideology, the fractionalization of the government and legislature, and the degree of social heterogeneity.

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Since 1960, governments of developing and transition economies have redenominated their currencies on approximately seventy occasions. These redenominations generally involve reducing the value of the currency by a factor of ten. For instance, in January 2005, Turkey replaced its currency (the Lira) with the “New Turkish Lira” (YTL), with a conversion rate of one million old lira to one new lira. And in July, Romania introduced a new “heavy” version of its currency, the *leu*, with four fewer zeros. In both cases, governments noted that redenomination would send a signal to citizens, as well as to the international community, that economic policy mistakes were in the past.

While decisions about the denomination and design of currencies may seem more technical than political, a government’s control and administration of its currency – and, more broadly, of transactions within its boundaries -- is one of the hallmarks of the modern nation-state. Governments began to achieve such monetary control in the mid-nineteenth century; today, many struggle to maintain this control, particularly in the face of civil conflict or economic collapse (e.g. Woodruff 1999). Currency redenomination, then, may come as part of a broad package of economic and political reforms, as was the case in Afghanistan in October 2002; following years of decline in the currency’s value, a new afghani was introduced, with three zeros removed. This introduction was meant to herald, along with a series of other measures, the emergence of Afghanistan from years of civil conflict, and its movement toward modern nationhood.

Currency redenomination also can be a means by which governments attempt to reassert monetary sovereignty. If citizens lose confidence in the national currency, they may begin to use foreign currencies, particularly those with greater prestige. This may be both a psychological and an economic blow to the government: with widespread foreign currency substitution (or, more extremely, full dollarization), the central bank no longer controls the money supply, rendering it unable to provide lender of last resort functions (Cohen 2004). Economic policy is influenced not only by international capital markets (e.g. Mosley 2003), but also by foreign central banks. Currency redenomination, then, is a means by which governments can attempt to reverse this currency substituting behavior: if citizens are confident that the new Turkish lira will hold its value, they may be willing to shift from using euros and dollars to using lira. While the act of dividing a currency’s value by a factor of ten is somewhat symbolic, it also can help to convince citizens of a currency’s worth. As a result, redenominations often occur after economic crises, as governments attempt to convince citizens and markets that hyperinflation is a thing of the past. In some cases, the timing is correct, in that redenomination caps off high levels of inflation. In other cases, governments are not able to reign in inflation immediately after redenomination, and they may make multiple efforts at currency reform. Argentina and Brazil during the 1980s and early 1990s exemplify this pattern.

Yet not every country with high levels of inflation, or with a low local currency/dollar exchange rate (so that thousands of local currency units are required for everyday transactions), chooses to redenominate its currency. Some governments are content for citizens to spend two thousand lira or manta for a cup of coffee, even if this leads citizens to question the legitimacy of the local currency. In other cases, governments do choose to redenominate, but only after a sustained period during which inflation has been reigned in; the time between hyperinflation and redenomination, then, may stretch to over a decade. Were redenomination a purely technocratic exercise, this pattern would be surprising: redenomination seems to have few real costs, beyond the short-run expense of printing new notes and advertising the change to citizens and financial markets.

This paper investigates the conditions under which developing and transition nations engage in currency redenomination. Given that many governments of developing countries experience high levels of inflation and a deterioration in their currency's value against other currencies, why do some elect to redenominate, while others do not? And why do some governments wait many years after a bout of hyperinflation, or after their currency is priced at 1000 or 5000 units to the dollar, to redenominate, while others do so relatively quickly? I suggest that the explanations rest in a combination of economic and political factors, including inflation, governments' concerns about credibility, and the effect of currencies on national identity. I employ survival analysis to test these expectations, using a set of data for developing and transition nations, covering the 1960-2003 period. I find, not surprisingly, that inflation is an important predictor of redenomination. Redenomination also is related to political variables, including governments' time horizons, the governing party's ideology, the fractionalization of the government and legislature, and the degree of social heterogeneity.

I. Trends in Redenomination

Redenomination¹ has a long history: in the 19th century, when governments faced shortages of gold or silver, they sometimes adjusted the value of their coins accordingly ("recoinage;" see Helleiner 2003). Among developing and transition nations, currency redenomination was employed on 60 occasions during the 1960-2003 period.² These redenominations varied in size, from removing one zero from the currency (14 instances) to removing six zeros (9 instances); the median redenomination was three zeros, dividing the currency by 1000. Nineteen countries have used redenomination on one occasion, while ten countries have redenominated twice (sometimes, with many years in between, as in Bolivia, in 1963 and 1987; in other cases, redenominations follow rather quickly, as in Peru in 1985 and 1991). Argentina (4), the former Yugoslavia/Serbia (5), and Brazil (6) are the most frequent users of redenomination.

Table 1 demonstrates significant variation in terms of the way in which redenomination is employed. The table lists the country-years in the dataset during which annual inflation exceeds 100 percent; some of these country-years are clearly hyperinflationary, while others are more moderate instances. In some cases, as in Argentina in 1992, redenomination marks the culmination of dramatic economic reform packages; by the time governments redenominate, they have addressed the monetary policy problems that generated the large local currency to dollar ratios. In other nations (e.g. Chile, Croatia), redenomination comes during, not after, the economic stabilization process. In still other cases, particularly those marked by long-running civil conflicts (Angola and the Democratic Republic of the Congo, Nicaragua), redenominations are employed, perhaps repeatedly, but high rates of inflation persist afterward. And not all periods of high inflation generate a subsequent redenomination: Ghana in the late 1970s and early 1980s and Indonesia in the late 1960s are two examples.

Many nations with high levels of inflation also have relatively lowly valued local currencies, making large denomination currencies necessary for basic transactions in the economy. While it is high or hyperinflation that often causes this situation, the presence of

¹ Some authors use "currency reform" and "redenomination" almost interchangeably (e.g. Leijonhufvud 2000, Mas 1995). Others use "currency reform" to refer to exchange rate-based stabilizations, rather than to the specific act of removing zeros from a currency (e.g. Bernholz 1995).

² In a few cases, nations have added zeros to their currency, often in the immediate post-independence period. Some also have changed their local currency from the pound to the dollar. Among countries that added digits to their currencies, Mas lists South Africa (1961), Sierra Leone (1964), Ghana (1965), Australia (1966), The Bahamas (1966), New Zealand (1967), Fiji (1969), the Gambia (1971), Malawi (1971) and Nigeria (1973). See Mas (1995), fn. 15.

large-denomination notes may be the most obvious sign to citizens of a potential need for redenomination (e.g. Mas 1995). In Argentina in the 1960s, for instance, one US dollar was equivalent to 1,100 (1962) to 3500 (1969) Argentine *pesos moneda nacional*. The 1970 redenomination addressed this issue, removing two zeros while creating the *peso ley*. And in the early 1980s, one US dollar was equivalent to between 18,000 (1980) and 180,000 (1982) *pesos ley*; the 1983 currency reform (resulting in the *peso Argentino*) divided currency values by 10,000. Where redenomination is employed, but where overall economic reform is ineffective, these large ratios persist: the Azerbaijani *manat* was equal to 0.06 US cents in 1994 and to 0.02 cents in 2003.

Table 1: Inflationary Episodes and Redenomination Outcomes

Country	Years & Annual Inflation Rates	Redenomination?
Albania	1992 (226%)	No
Angola	1992 (299%), 1993 (1379%), 1994 (949%), 1995 (2672%), 1996 (4145%), 1997-2002 (average, 194%).	Yes, 1995.
Argentina	1975-1982; average annual rate 267%	Yes, 1983.
Argentina	1983 (344%), 1984 (627%), 1985 (672%)	Yes, 1985.
Argentina	1987, 1988, 1989 (3080%), 1990 (2314%), 1991 (172%)	Yes, 1992.
Armenia	1994 (4962%), 1995 (176%)	No.
Azerbaijan	1992 (912%), 1993 (1129%), 1994 (1665%), 1995 (412%)	Yes, 1992.
Belarus	1993 (1190%), 1994 (2221%), 1995 (709%)	Yes, 1992.
Belarus	1999 (294%), 2000 (169%)	Yes, 2000.
Bolivia	1981-1986; peaked at 11749% in 1985.	Yes, 1987.
Brazil	1981-1985, average annual rate 151%.	Yes, 1986.
Brazil	1986 (147%), 1987 (228%), 1988 (629%), 1989 (1431%)	Yes, 1989.
Brazil	1990 (2948%), 1991 (433%), 1992 (952%), 1993 (1928%), 1994 (2076%)	Yes, 1993 and 1994.
Bulgaria	1991 (338%), 1996 (122%), 1997 (1058%)	Yes, 1999.
Chile	1973 (362%), 1974 (505%), 1975 (375%), 1976 (212%)	Yes, 1975.
Congo, Dem. Rep.	1979 (101%), 1989 (104%), 1991 (2154%), 1992 (4129%), 1993 (1987%)	Yes, 1993.
Congo, Dem. Rep.	1994 (23773%), 1995 (542%), 1996 (542%), 1997 (176%)	Yes, 1998.
Congo, Dem. Rep.	1999 (285%), 2000 (514%), 2001 (360%)	No.
Croatia	1992 (625%), 1993 (1500%), 1994 (107%)	Yes, 1994.
Georgia	1995 (163%)	Yes, 1995.
Ghana	1977 (116%), 1981 (117%), 1983 (123%)	No.
Indonesia	1962 (131%), 1963 (146%), 1964 (109%), 1965 (307%), 1966 (1136%), 1967 (106%), 1968 (129%)	No.
Israel	1980 (131%), 1981 (117%), 1982 (120%), 1983 (146%), 1984 (374%), 1985 (305%)	Yes, 1980 and 1985.
Kazakhstan	1994 (1877%), 1995 (176%)	No.
Laos	1999 (128%)	No.
Latvia	1992 (243%), 1993 (109%)	Yes, 1993.
Lebanon	1987 (488%), 1988 (128%)	No.
Lithuania	1993 (410%)	Yes, 1993.
Macedonia	1994 (126%)	Yes, 1993.
Mexico	1983 (102%), 1987 (132%), 1988 (114%)	Yes, 1993.
Mongolia	1993 (268%)	No.
Nicaragua	1985-1991. Highest in 1989 (4770%), 1990 (7485%) and 1991 (2945%)	Yes, 1998.

Country	Years & Annual Inflation Rates	Redenomination?
Peru	1983 (112%), 1984 (110%), 1985 (163%)	Yes, 1985.
Peru	1988 (667%), 1989 (3399%), 1990 (409%)	Yes, 1991.
Poland	1982 (104%), 1989 (245%), 1990 (555%)	Yes, 1995.
Romania	1991 (231%), 1992 (211%), 1993 (255%), 1994 (137%), 1997 (155%)	Yes, 2005.
Russia	1993 (875%), 1994 (308%), 1995 (197%)	Yes, 1998.
Sierra Leone	1987 (179%), 1990 (111%), 1991 (103%)	No.
Sudan	1991 (124%), 1992 (118%), 1993 (101%), 1994 (115%), 1996 (134%)	Yes, 1992.
Suriname	1993 (144%), 1994 (368%), 1995 (236%)	No.
Turkey	1980 (110%), 1994 (106%)	Yes, 2005.
Uganda	1981 (109%), 1985 (9158%), 1986 (161%), 1987 (200%), 1988 (196%).	Yes, 1987.
Ukraine	1993 (4735%), 1994 (891%), 1995 (377%)	Yes, 1996.
Uruguay	1968 (125%)	Yes, 1975.
Uruguay	1990 (113%), 1991 (102%)	Yes, 1993.
Zambia	1989 (123%), 1990 (107%), 1992 (166%), 1993 (183%)	
Zimbabwe	2002 (140%), 2003 (estimated 1000%)	No.

^a Inflation data from the World Bank, *World Development Indicators*, annual percent change in consumer prices.

^b There are additional redenominations, often in response to high levels of inflation; but comparable inflation data are not available. These include Brazil (redenominates 1967 and 1970), Estonia (1992), Kyrgyz Republic (1993), Moldova (1993), Uzbekistan (1993), and Vietnam (1975 and 1985).

If we use local currency/dollar ratios (rather than inflation rates) as indicative of the potential for redenomination, we observe a larger set of country-years than those listed in Table 1. In 360 country-years, this ratio exceeds 1,000. (And, in 160 country-years, the ratio exceeds 5,000). This set contains most countries that ultimately elect redenomination (such as Mexico, Peru and Poland). For instance, 1422 Turkish lira purchased a dollar in 1988; by 2003, the number had grown to 1,500,890. In Romania, the *leu's* value sank to 1655 to the dollar in 1994, and further to 33200 by 2003. Turkey, like Romania, redenominated earlier this year.

This set also includes a significant number of countries that do not drop zeros. The latter group includes Cambodia, with a *riel*-dollar rate ranging from 1037 to 3973 during the last fifteen years; Ecuador, which chose near-full dollarization in the face of *sucre*-dollar rates of 25000; Indonesia, where 10,000 *rupiah* purchased a dollar in 1998; and Paraguay, with local currency-dollar rates ranging from 1,000 to 6,400 during 1989-2003. Of course, local currency ratios to the dollar do not always correlate with inflation: in some cases, ratios remain high long after inflation has been addressed. South Korea, for instance, has had single digit inflation since 1982; but the *won*-dollar rate has been at four digits since late 1997. As a result, policymakers in Korea discussed the possibility of currency redenomination in 2004, as did government officials in Japan at various times during the 1990s.³ And several countries presently have high-denomination (100,000 local currency units) bills in circulation – Indonesia, Cambodia, Lebanon, Mozambique, Paraguay and Vietnam (Central Bank of the Republic of Turkey 2004a).

³ In 1993, Liberal Democratic Party (LDP) members suggested the redenomination could help stimulate the sagging Japanese economy. In 1994, observers argued that redenomination would increase public confidence in the yen as the country attempted to emerge from recession. (*The Daily Yomiuri*, November 8, 1994; *Report from Japan*, March 30, 1993). In 1999, the LDP formed a committee to investigate removing two zeros from the yen, motivated in part by a fear that the yen's reputation as an international currency would suffer with the circulation of the euro. (*Financial Times*, November 19, 1999).

Furthermore, for those nations that do adopt redenomination as a strategy – and particularly those that redenominated at the end of an economic reform progress – there are substantial variations in timing. The lag between the appearance of high inflation, or of high local currency/dollar ratios, and of the removal of zeros from the currency varies. Poland, for instance, experienced its highest levels of inflation in 1989 and 1990; redenomination did not occur until 1995. Similarly, Romania’s inflationary years were in the early and mid-1990s, but its redenomination occurred in July 2005, perhaps more as a signal of its interest in taking part in EMU than as an effort to reassure its citizens that hyperinflation was no longer a threat.

What, then, explains the use of redenomination by developing and transition nation governments? Why do some government eschew redenomination in the face of, or after the resolution of, high inflation, while others embrace it? And why do some nations embrace redenomination, but with a long lag? What might explain, for instance, the fact that Bolivia removed zeros from its currency in 1987, less than two years after successfully launching a stabilization program; while Poland waited five years between the introduction of its (also successful) stabilization program and the dropping of zeros? How might redenomination serve as a signal, both to domestic constituents and to external market participants? And is there a connection between redenomination and national identity? The following section explores three sets of mechanisms that might influence redenomination – credibility, domestic politics, and identity.

II. The Rationales for Redenomination

Why do governments engage in the redenomination of their currencies? In an era when money is backed by confidence (*fiat money*) rather than by gold and silver, governments may be tempted to manipulate the value of the public’s currency stocks as a revenue-generating measure. One means of manipulation is inflation: a government can reduce its own domestic currency-denominated obligations by allowing a dramatic expansion of the money supply. Another means of manipulation is currency reform, in which the government introduces a new currency, but makes it difficult for citizens to convert their holdings of old currency. Ignacio Mas (1995) suggests that, while the use of currency redenomination as a mechanism of confiscation is more the exception than the rule, it has been used as such throughout history. For instance, when governments require citizens to exchange old currency for new during a very short period (e.g. one day in Laos in 1976, or three days in Nicaragua in 1988 and in the Soviet Union in 1991), it is very likely that not all old currency will be exchanged. The old currency that is rendered worthless is essentially revenue – indirect seignorage -- for the government.

This account suggests that we might think about two types of redenomination: the more common case, in which redenomination is motivated by hyperinflation (and by a desire to signal that inflationary days are over); and the less common case, when redenomination is motivated by the government’s desire to squeeze additional resources from society. This does not predict that democratic governments will be more likely, in general, to redenominate; but it does suggest that redenomination in the absence of high inflation is more likely in authoritarian societies, or during instances of civil conflict (as in Nicaragua in 1988, or in Rwanda in 1993).⁴

Hypothesis 1: Both authoritarian and democratic governments may have political reasons for redenomination. Democratic governments are likely to redenominate in response to high inflation. Authoritarian governments may

⁴ Indeed, Mas (1995) suggests that authoritarian governments will choose confiscatory currency reform rather than direct inflation as a strategy of financing.

redenominate even without high inflation, particularly in the presence of civil conflict.

Mas' (1995) account is one of the few academic treatments of redenomination. Yet he assumes that, in the realm of "clean" redenominations, there is little role for politics. Redenomination has little economic significance, beyond the one-time transition costs it imposes on countries (p. 487). Redenomination absent monetary reform will not halt inflation, and redenomination should not change individuals' behavior. Indeed, taken separately from a broader program of macroeconomic reform and monetary tightening, redenomination seems unlikely to generate winners and losers, in the same way that changes in exchange rate or trade policy do (e.g. Frieden 1991, Rogowski 1989). But might there be a role for politics, even in such seemingly technical cases? Three sets of mechanisms, sometimes overlapping, could influence decisions regarding redenomination.

Credibility, Local and Global. Governments often are interested in establishing their credibility – specifically, in establishing a commitment to low-inflation policies – vis-à-vis their own citizens, as well as international capital markets (Maxfield 1997). Enhanced credibility can improve a government's electoral fortunes, as citizens reward economic growth and macroeconomic discipline (Armijo 1996, Stokes 2002); and it can improve a government's treatment – as a borrower, as a location for private investment, and as a defender of an exchange rate – in the eyes of global capital markets (Jensen 2005, Leblang 2002, Mosley 2003). As part of their efforts to establish credible commitments, governments in recent years often have increased the (statutory) independence of their central banks and have made explicit commitments to macroeconomic targets (e.g. Bernhard et al 2002). For countries that seek to join regional currency areas (e.g. EMU), assuring international markets of their commitments is essential. Romania's central bank, for instance, portrayed its redenomination as indicating that "the days of hyper-inflation are over and the new currency will help keep things that way" (BBC 2005). Romania has established a goal of joining EMU by 2012, and a currency that was worth 29,890 to the dollar was seen as an impediment to doing so.

In countries where hyperinflation has occurred, governments face an uphill struggle when it comes to regaining the confidence of international markets and domestic constituents. The most direct means is through a stabilization program, which generally involves using either exchange rate-based or monetary-oriented targeting; increasing the operational independence of the central bank; and removing distortionary economic policies. In many cases, such stabilization occurs the aegis of an IMF standby agreement. Redenomination can play into this process, in two ways: first, it can be used at the end of a stabilization, to signify to citizens and private markets that the days of high inflation are over. Used in this way, redenomination is largely symbolic: inflation has been tamed via other means, and the removal of zeros simply serves to remind citizens and investors of the success in fighting inflation – or to remove a very visible reminder of an inflationary past. A new currency is largely the result of, not the cause of, stabilization (Bernholz 1995). When this mechanism holds, we should expect that redenomination will occur after a period of high inflation, but also after that inflation has been removed from the system; a dramatic downward change in inflation should increase the chances for redenomination. Pressures from international capital markets, from the IMF, and from politically independent central banks can help motivate anti-inflationary measures (e.g. Simmons 1994, Stone 2002), as well as subsequent redenomination.

Along these lines, in the run-up to its recent redenomination, the Turkish central bank pointed to two main motivations. The first was technical, in that multiple zeros complicated statistics and transactions. The second was about credibility: that the existence of a 20,000,000

lira banknote, unique globally, “had a negative effect on the credibility of our currency.” The removal of zeros was a means of restoring credibility; one benefit would be that “the determination in bringing inflation down to single digits permanently is better comprehended” (Central Bank of the Republic of Turkey, 2004b). Indeed, 2004 was the first year of single-digit inflation in Turkey since 1972, making 2005 an apt time to reinforce the commitment to low inflation. And some of the onus for Turkey’s reforms comes from its IMF-backed stabilization plan, agreed to after the 2001 economic crisis, and from its interest in joining the European Union (e.g. *Financial Times*, December 22, 2004). Similarly, in August 1997, the Russian government announced that the ruble would be redenominated as of January 1, 1998, with three zeros removed from the currency. This was intended to assure the public that Russia’s economic crises were behind it; inflation was on the decline, falling from 875% in 1993, to 200% in 1995 and further, to 15%, in 1997 (Washington Post, January 3, 1998). Ultimately, of course, the ruble redenomination did not mark the end to Russia’s hard times. In the wake of the Asian financial crisis, the ruble was hit by a speculative attack in August 1998; the Russian government became unable to repay its international debts. Although hyperinflation did not return to Russia, annual inflation spiked to 86% in 1999.⁵

Second, redenomination can be used directly in the stabilization process, as part of an effort to change citizens’ inflationary expectations. For instance, Israel’s most recent currency reform was undertaken in September 1985, with the creation of the new – divided by 1,000 – *shekel*. Israel was in the midst of a stabilization program at the time; but in August 1985, inflation was still at an annual rate of 386 percent (Central Bank of the Republic of Turkey 2004a). Similarly, in December 1993, the Yugoslav National Bank slashed nine zeros from the *dinar*, hoping to quell persistent hyperinflation (Financial Times, December 30, 1993).

The rationale for using redenomination in this way is that the physical act of using large-denomination notes has an impact on agents’ expectations. When a newspaper costs 10,000 *lira*, consumers and firms are constantly reminded that prices increased dramatically in the past, and they continue to expect such increases in the future. When the highest banknote in circulation is the 100 *lira*, on the other hand, citizens may grow more confident that a return to high inflation is unlikely. A sort of money illusion is assumed to operate in this case: zeros matter, and they drive inflationary expectations. Governments, then, could argue that redenomination is part of the stabilization package itself. Of course, the problem with this logic is that it may assign too great a role for the physical currency in the reduction of inflationary pressures; redenomination absent economic stabilization may well result in a new currency, but continued hyperinflation. Table 1 suggests that this has occurred on several occasions, including Azerbaijan (redenomination in 1992, but with hyperinflation in subsequent years) as well as some “repeat redenominators,” in which initial efforts at removing zeros failed to stem the inflationary tide.

If we consider the impact on credibility of redenomination, we should expect that the former type – redenomination as an end to a reform process, rather than as an instrument itself of stabilization – is more likely to reassure investors and citizens. The latter type is more a stopgap measure, implemented by governments that do not have the domestic political wherewithal to push through tough stabilization programs, or that do not face strong international pressures to do so. We expect, like Mas, that “confiscatory” redenominations will be much more the exception than the rule. In terms of credibility, then:

⁵ Also see Bernholz’s account of Bolivia’s (1985-1986) stabilization and subsequent (1987) redenomination.

Hypothesis 2: Redenomination is more likely following a period of high inflation and a subsequent stabilization. A dramatic downward movement in inflation increases the probability of a redenomination. This is particularly likely in countries that are more open to international capital flows, that are under an IMF adjustment program, and that have politically independent central banks.

Domestic Politics. The use of redenomination as a means of improving credibility is ultimately an account rooted in domestic politics. Governments want to keep inflation low because they are rewarded by voters for strong economic performance, and low inflation helps the economy. Alternatively, governments want to impress international markets, as this allows them to borrow more cheaply and to attract foreign investment, which in turn facilitates government spending and domestic economic growth. All of this assumes that governments are responsive to the views of citizens, which may be more true in democracies.

Beyond this broad claim, how might domestic politics matter? First, in democracies, the electoral calendar can be an important determinant of the timing of redenomination. If governments want to signal to voters in the pre-election period that times have changed, redenomination could be more likely as elections approach. At the same time, however, redenomination can be seen as an admission of failure – the government, or some past government, allowed rampant inflation and the deterioration of the local currency’s purchasing power in world markets. Governments may be hesitant to remind voters of such policy mistakes, just as they are hesitant to devalue just before an election (Frieden et al 2001; also see Leblang 2002). Once elected, with the next election in the more distant future, these same governments should be more willing to redenominate – particularly if they can blame the need for redenomination on their predecessors (Edwards 1996, Leblang 2003).⁶ Moreover, concerns about redenomination as an admission of failure may be particularly pronounced with single-party governments; coalition partners can share blame for past policy mistakes, while single party governments have difficulty avoiding blame.

Hypothesis 3: Redenomination is more likely immediately after an election (or with many years remaining until the next election), less likely immediately before an election, and more likely in more fractionalized political systems.

Second, we might expect an ideological dimension to decisions to redenominate. If redenomination has no distributional consequences, then it is difficult to make a case for the role of ideology. But, if redenomination does sometimes succeed in lowering (or helping to lower) inflation, or if it occurs in tandem with an inflation stabilization program, then it will benefit creditors and harm debtors (e.g. Leijonhufvud 2000). As such, we might expect left-leaning governments to be less inclined to redenominate than their right-leaning counterparts. Moreover, if we expect that left governments are generally less responsive to international market pressures than other governments, we might also see an ideological effect on redenomination. Leblang’s (2002) study of speculative attacks against fixed exchange rate systems, for instance, finds that such attacks are more likely under left governments, because markets view such governments as less committed to defending the currency. Such a hypothesis

⁶ On elections and the selection of stabilization programs, also see Schamis and Way (2003); they argue that exchange rate-based stabilizations (currency reforms) are more likely in the pre-election period, while money-oriented stabilizations are more common just after elections. We might also expect that governments are more likely to redenominate when governing as part of a coalition, because each party can blame past policy mistakes on other members of the coalition. See Section III.

assumes, of course, that left governments are more interested in defending the interests of their constituents than in demonstrating to financial markets that they are trustworthy.

Hypothesis 4: Redenomination is less likely, all else equal, when left-leaning parties are in office, and more likely when right-leaning politicians hold office.

Third, when redenomination is seen as taboo, governments are less likely to employ it. But, if redenomination has been used by past governments – or by the same government in previous years – it may become less tainted, less an admission of policy failure. As a result, I expect that the probability of redenomination at a given point in time is higher in countries that have employed redenomination in the past.⁷

Hypothesis 5: Redenomination is more likely in nations where it has been used in the past. The total past experience with redenomination increases the hazard of its use.

Identity and money. Many observers view money largely as a medium of exchange: territorial currencies are instruments that facilitate transactions in the economy and assist governments in macroeconomic management, while also providing revenue at the time of printing (seignorage). Others take a broader view of national currency: it not only facilitates economic interactions, but also affects citizens' identity and, subsequently, the legitimacy of the national government (e.g. Cohen 2004, Helleiner 2003, McNamara 2005).

The latter view is rooted in the analysis of money as a social phenomenon. For instance, sociologist George Simmel argues that “the use of money does not express numerical calculation but rather allows it” (quoted in Woodruff 1999, p. 16). Exchanges between citizens can occur without money, but money allows citizens to quantify exchanges, and to seek out parity in transactions. Moreover, monetary transactions help to create community, as a currency draws together individuals who use the currency and who assume that others in the community will accept the currency (Simmel 1907, Woodruff 1999; also Polanyi 1957). Money, then, can serve as a means of creating or cementing political identities (Helleiner 2003, McNamara 2005). Along these lines, a major goal of territorial currencies in the nineteenth century was to “build up the nation, as far as possible, as a unified economic and political community...” (Cohen 2004, p. 5).⁸ Similarly, Woodruff (1999) argues that the widespread use of barter and the emergence of “surrogate monies” in Russia in the early 1990s retarded efforts to create a unified market economy. Once the government lost its monopoly on monetary control, its overall capacity to govern the economy diminished substantially.

Decisions about the denomination of money therefore could influence citizens' views of the market and of their country. And, as the denomination of currencies changes – and

⁷ The opposite claim may also be plausible: citizens are willing to tolerate one redenomination, but repeated redenominations may drive them away from the national currency – so that past redenomination renders future redenomination less likely.

⁸ The nation-building motivation also may explain why some governments choose to leave their currency's names largely unchanged, despite redenomination. For instance, in Turkey, “the ‘Lira’ expression has been kept unchanged when selecting a name for the new currency owing to its being an already accustomed term, the unique currency unit valid for the Republican period, and its being identified with the country's name.” (Central Bank of the Republic of Turkey 2004). On other occasions, governments choose different names for their currencies (e.g. moving from pesos to *australs*), perhaps to convince citizens and investors that they are making a fresh start, or perhaps to avoid confusion in countries with repeat redenominations.

particularly as their denomination comes into question – citizens’ views of the currency and the market also will evolve. This logic suggests that governments will worry when citizens come to view their currencies as diminished in value, both economically and symbolically. The economic aspect ties into the discussion of credibility above: governments want citizens to hold the domestic currency, as this makes domestic economic management much easier, and as it may tie the interests of citizens more tightly to that of the central government (Helleiner 2003).⁹ And the best means of convincing residents to hold the territorial currency is to boost its credibility (Cohen 2004). Prior to its recent redenomination, Turkey cited this – “reestablishing public confidence toward the national currency” – as one of several benefits to removing zeros from the *lira* (Central Bank of the Republic of Turkey 2004a).

The symbolic aspect adds to this a worry that when citizens have disdain for national money – when, for instance, they prefer instead to hold dollars – they may develop disdain for the national government or for their national identity.¹⁰ Problems with the currency, resulting from hyperinflation and manifest in multi-digit local currency/dollar rates, may spell problems for the governing coalition or even for the survival of the nation. Cohen argues, for instance, that when widespread currency substitution occurs,

an instrument that was intended to symbolize the power and nobility of the nation becomes instead a daily reminder of inadequacy and impotence—not sound currency but “funny money,” an object of derision and disrespect. Governments that issue such currencies are not apt to command much respect, either (p. 22).

In some cases, near-full dollarization of the economy ensues, either *de facto* or *de jure*.¹¹ If concerns about the symbolic dimension are accurate, when citizens begin to (or threaten to) engage in widespread currency substitution, governments will be more apt to redenominate.¹² Currency substitution, in turn, tends to be driven – at least initially -- by high inflation (Feige et al 2002, Leijonhufvud 2000). The identity mechanism, then, also provides another means by which Hypothesis 2 should hold. Given the difficulty of measuring the level of foreign currency substitution in a cross-sectional time-series, the indirect effect of currency substitution (via inflation and high local currency/dollar ratios) may be easier to observe empirically.¹³

⁹ For instance, in the immediate post-WWII period, US officials (including Robert Triffin) advised Latin American governments to “eliminate the use of foreign currencies within their territory wherever that practice was still widespread” (Helleiner 2003, p. 191), as a means of ensuring that the central bank had a monopoly on the currency and, therefore, could develop a strong and independent monetary policy.

¹⁰ Along slightly different lines, Towers and Borzutzky (2005) report that many interviewees in El Salvador “expressed a sense of loss of a cultural symbol” (p. 50) after dollarization was legalized (2001).

¹¹ *De facto*, or unofficial dollarization, involves the substitution of any foreign currency for the domestic currency, without foreign currency being recognized as full legal tender by the national government. Official dollarization, which is less common, involves recognition as legal tender. On the costs and benefits of dollarization, see Balino et al (1999), Berg and Borenszstein (2000), Feige et al (2002), Towers and Borzutzky (2005).

¹² The reverse might also be true: where citizens have great respect for their national currency, they will be more hesitant to substitute away from it. While Germans – with a low-denominated, stable currency -- were quite reticent to give up the deutsche-mark in the mid to late 1990s, Italians – with multiple zeros at the end of high-circulation banknotes -- were quite happy to do so.

¹³ Balino et al (1999) report annual data for 1990-1995 on one measure of dollarization, the ratio of foreign currency deposits to broad money. Their data exist for as many as fifty countries in 1995, and for as few as 18 nations in 1990. Feige (2003) estimates foreign currency holdings in 25 transition nations for 2001; Feige et al (2002) provide similar estimates for 13 Latin American countries, for 1998.

We also expect that currency substitution will be more widespread as financial globalization intensifies. Financial globalization places national currencies into direct competition with one another, and financial openness allows citizens to engage more easily in currency substitution (Balino et al 1999, Cohen 1999, 2004). A recent study of currency substitution, for instance, reports that in the mid-1990s, foreign currency notes accounted for 20 percent or more of the local money stock in more than thirty nations; another study cited 18 nations in which foreign currency comprised at least 30 percent of the broad money supply (Krueger and Ha 1996; Balino et al; cited in Cohen 2004, pp. 13-14).

Hypothesis 6: Redenomination is more likely, all else equal, where foreign currency substitution is more prevalent in the domestic economy. This is more likely in nations with high inflation, with high local currency/dollar ratios; and foreign currency substitution is more likely after 1989 (as financial globalization expands) than before.

The potential symbolic link between currency and respect for the national government also suggests that different types of societies will be more or less willing to engage in redenomination, as a means of reestablishing the value of their territorial currency. We might expect that, in heterogeneous societies, where building a common national identity is more challenging, governments will be particularly anxious to promote the use of national money. And in newly independent nations, where the national identity is quite nascent, governments will want to ensure that citizens see the territorial currency as credible. In both cases, then, when the need to redenominate presents itself, governments will be more apt to act.

Hypothesis 7: Redenomination is a more likely response to economic problems in more heterogeneous societies, and in younger nation-states.

In the following section, I offer an initial assessment of the various rationales for redenomination. I do so using survival analysis, which estimates a nation's risk of redenomination, and the contribution of various independent variables to that hazard. The following section also discusses the operationalization of the main independent variables.

III. Statistical Analyses and Results

The dataset includes developing and transition economies during the 1960-2003 period. Many countries enter the dataset after 1960, because they do not gain independence until later in the period. Country-years that coincide with official dollarization, either fully or nearly, are omitted from the analysis.¹⁴ I also include Portugal, Spain and Greece – long classified as part of “emerging Europe” – until they join EMU (1999 for Portugal and Spain, 2001 for Greece). This results in a dataset of 5,736 country-years although, for many variables, missing data render the number of cases included significantly smaller.

The aim of the analysis is to estimate the correlates of redenomination: which variables serve to increase or to decrease the likelihood (or the hazard) that a government will redenominate its currency (“failure,” in the language of event history analysis). To do so, I employ Cox regression, which uses a partial likelihood estimation method to derive a baseline hazard rate and to assess the effect of covariates on this rate. Additionally, redenomination is a phenomenon for which repeated events are possible; that is, it is possible that a government will drop zeros from its currency several times during the period under observation (in fact, we

¹⁴ I rely on the list provided by Cohen (2004): Ecuador from 2000, El Salvador from 2001, Kiribati from 1943, Kosovo from 1999, Nauru from 1960, and Panama from 1904.

assert in Hypothesis 4 that experience with redenomination renders it more likely in the future). Were we to exclude countries from the analysis once they experience their first redenomination, as many event history analyses do, we would lose an important set of observations, and this might bias the results.

Therefore, I use a duration model that allows for repeatable events. When a country redenominates, it does not exit the sample, as future redenominations remain possible. This model, the “conditional risk set model,” assumes that the baseline hazard for each failure (per country) is different, while the coefficient estimates are the same across the entire set of observations. The conditional risk model (proposed initially by Prentice, Williams and Petersen 1981; also see Box-Steffensmeier and Jones 2004, Box-Steffensmeier and Zorn 2002, Cleves 1999) also assumes that a country does not become at risk for a second redenomination until it has experienced the first redenomination. For this model, the ordering of events matters (first failures are taken to be different from second failures), and the “time to failure” count begins anew once a redenomination occurs. The hazard models, therefore, are estimated as stratified Cox models, with stratification according to how many failures have already occurred for a given country.¹⁵ Furthermore, given that the use of cross sectional time-series data can lead to problems with the independence of within-country observations, I employ robust variance estimation (the Lin and Wei estimator); and the standard errors are adjusted for clustering by country. Finally, in specifying the models, I am conscious of the relatively small number of failures present in the dataset; many statisticians (e.g. Allison 1984) recommend that covariates be limited to one-fifth to one-tenth of the number of failures.

Tables 2 and 3 reports results from several hazard models, designed to test many of the hypotheses developed in Section II. The coefficients reported are exponentiated, so that they provide a direct estimate of the contribution of each covariate to the hazard rate. Estimates above 1.0 indicate an increased hazard (*countries are [estimate-1] times more likely to redenominate*), while estimates below 1.0 reflect a diminished hazard. The first model is a basic model that includes three widely available variables (inflation, democracy, and being under an IMF arrangement), and that assess the intuitions contained in Hypotheses 1 and 2. The inflation variable is used to measure the “need to redenominate;” it captures the annual percentage change in consumer prices. The models reported in Table 2 employ the natural log of inflation, which addresses the issue of extreme values of inflation during hyperinflationary periods. Other types of inflation variables, including inflation and the three year moving average of inflation, result in estimates of similar significance and similar size (in terms of effects on hazard rates).¹⁶ The rate of growth of the money supply also proxies for inflation.¹⁷

Insert Table 2 here

Inflation. If we add an “inflation change” variable to the basic model, measuring the annual (or the t-2 or t-3) movement in the exchange rate, we find that it is associated significantly with the hazard of redenomination. Its exponentiated coefficient, however, is 0.99, suggesting little effect (that is, an effect very close to 1) on the overall likelihood of

¹⁵ Estimation is performed in Stata 8, using `stcox`, with stratification by a country’s number of redenominations. Country-years with no failures are classified as sequence 1, with one failure as sequence two, and so on. All models use the Efron option for dealing with ties.

¹⁶ Also, models using only inflation data from the *World Development Indicators*, as opposed to data supplemented (for post-Communist nations in the early 1990s) with observations from the Economist Intelligence Unit produce very similar results. I elect to use the supplemented inflation data, as this increases the number of country-years by approximately 100.

¹⁷ In the models estimated, inflation has a correlation of .61 with the rate of money growth.

redenomination. Analysis of the scaled Schoenfeld residuals for such models, however, indicates that *rho* (the correlation between the scaled residuals and the rank of survival time) is significantly different from zero; models including this indicator, then, are likely to violate the proportional hazards assumption. As a result, we focus on models including the overall level of inflation.

Another potential measure of the need for redenomination is the exchange rate; specifically, the presence of “excess zeros” is indicated by a country’s US dollar to local currency exchange rate. This rate varies markedly across countries and over time, reflecting the fact that some currencies are nearly on par with the dollar, while others are worth very little compared to the dollar. When I include the natural log of the exchange rate variable in the models reported, it rarely is statistically significant. Interestingly, there is only a small positive correlation (.16) between inflation and the dollar/local currency rate. Inflation rates turn out to be a much better correlate of the hazard of redenomination. They support the contention that inflation, or an inflationary past, makes redenomination more likely.¹⁸

Democracy. The main model also includes a measure of democracy; this variable assesses the impact of democracy on the likelihood of redenomination. Are democracies more likely to redenominate following an inflationary episode, as they aim to please voters? Or are they less willing to admit to past policy mistakes? Or do all types of regimes have their reasons – albeit potentially different ones – for employing redenomination? We employ the *POLITY2* measure (ranging from -10 for full autocracy to 10 for full democracy, with adjustments made for “transition” country-years) in the basic Cox model. The democracy variable’s exponentiated coefficient is slightly larger than 1, indicating that increases in democracy are associated with increases in the likelihood of redenomination. In Model 1, however, this estimate is not statistically significant. This may be consistent with Mas’ (1995) claim: it is not that democracies and autocracies vary in their use of redenomination, but that they vary in their motives (to bid farewell to a past inflationary crisis, versus to extract resources from society). An alternate dichotomous measure of regime type (from Cheibub and Gandhi, an updated dataset of that used in Przeworski et al 2000) also results in a hazard rate estimate that is slightly greater than 1, but statistically insignificant.

Might it be, then, that the effect of inflation on the probability of redenomination is contingent on the degree of democracy? If we add an interaction term (democracy*inflation) to the basic model, the hazard ratio estimate for democracy remains slightly greater than 1, but insignificant. The interaction term, which is largest when democracies experience high inflation, and smallest when autocracies experience low inflation, displays a statistically significant hazard ratio. The ratio, however, is 0.99997, indicating that democracies are slightly less likely to redenominate in the face of high inflation, but that the difference is a very small one. This may provide initial evidence that democratic governments are disinclined to redenominate because of concerns about the public’s response, but a one percent change in the interaction term is predicted to generate a very small (.00003) change in chance of redenomination.

IMF Pressure. The third covariate included in Model 1 is a dichotomous variable, indicating whether a country is under an IMF program during a given year. This variable assesses one form of external influence on redenomination (and on economic reform more generally): direct pressure from the IMF, via some sort of structural adjustment lending. The significant hazard rate estimate (2.55) suggests that IMF programs have a strong influence on a

¹⁸ The rate of economic growth per capita, which is correlated positively with inflation (.54) also influences the hazard of redenomination. When included in the basic model, its exponentiated coefficient is 1.05, significant at a 95% confidence level.

country's chance of redenominating in a given year. An alternate variable, the total number of years (since 1960) that the country has been under an IMF program, also produces a statistically significant hazard rate estimate. With each additional year (total) of IMF oversight, the probability of redenomination increases by nearly 5 percent. Given that countries in the sample are, on average, under IMF programs for an average of 3 (and up to 36, of 43) years, this effect is substantively important.

The IMF variables, of course, may partially be proxies for past economic troubles: we would expect nations under IMF programs to have some past (and/or current) experience with high levels of inflation. The correlation, however, between contemporaneous inflation and IMF program participation is only .11; the inclusion of both variables does not generate estimation problems. This result also suggests that, despite recent concerns about its effectiveness in helping countries to promote economic growth (e.g. Vreeland 2003), the IMF does influence redenomination decisions and, perhaps, inflationary outcomes (e.g. Stone 2002). If we add to Model 1 an interaction term between IMF programs and democracy, we find no evidence that the effect of IMF programs varies according to regime type. The exponentiated coefficient is greater than one (indicating an increase in the hazard rate as the variable increases), but it is not statistically significant. In Model 1, the standard test of the proportional hazards assumption (generating the *rho* for each covariate, where the null hypothesis is that rho is equal to zero) does not reveal any problems. There are no grounds for rejecting the proportionality assumption.

External and Credibility-Related Variables. The next set of effects to analyze, as suggested by Hypothesis 2, is “credibility-related” variables. Theoretically, we want to measure the extent of international pressure, or pressure for market-friendly policies. Participation in an IMF program is one means of doing so; but we also could include the degree of openness to international capital flows, the actual amounts of international capital flows, or the existence of a politically-independent central bank (as the latter tend to be market-oriented in ideology). The difficulty with these models, given the time period and countries contained in the dataset, is finding appropriate measures of “international influence.” One possibility is to measure flows (e.g. capital inflows to GDP) as a measure of international pressure; but flow measures say little about the cost of capital (e.g. risk assessments, or interest rates), and they assume governments react to actual, rather than potential, capital inflows (see Mosley 2003). Sovereign interest rate data, though, is difficult to use in a comparative context, given variation over time and across countries in the maturity structure and currency denomination of government bonds. Another possibility, then, is to measure legal restrictions: is capital allowed to exit and enter freely? Does the exchange rate float, so that governments might worry more about market reactions to their policies? Such potential for exit should generate a capacity for voice. A final possibility, and one rooted more in domestic politics, is to use a measure of central bank independence.

I explore several of these possibilities and report one set of results in Model 2. The reported model includes a measure of international capital flows (scaled to GDP) as well as a measure of the type of exchange rate regime (higher values indicate more floating). Both maximize the number of available country-years (although it falls relative to Model 1), and this model meets both the global and the covariate-specific tests for proportionality. While the estimates for the other three independent variables remain similar in signs and significance, neither international variable is statistically significant. These results, then, fail to provide evidence that external market pressures – beyond those, of course, that come through the IMF – drive redenomination decisions.

Of course, neither measure captures international influences perfectly: the capital flows indicator includes all types of capital (short and long term), and it is likely that different types of flows (e.g. equity vs. FDI) will affect government policymaking in different ways. Moreover, the exchange rate regime could cut either way, assuming (and this is an assumption, given the time frame) capital mobility. Governments with fixed rates may worry more about external pressures, as they need to impress markets, lest they face a speculative attack on their peg. Alternatively, governments with flexible rates may worry about their currency's value, particularly if they are more trade dependent.

In other estimations, then, we employ different “credibility-oriented” variables. For instance, Simmons and Elkins (2004) employ measures of capital account openness (a dichotomous indicator) and of central bank independence. Including these measures constricts the domain of our analysis from 1960-2003 (although some countries enter later, given later dates of independence) to 1967-1996. When we do so, the results suggest that capital account openness positively and significantly affects the hazard rate for redenomination: countries with full market openness are more than four times as likely to redenominate as others. The estimated hazard for central bank independence, on the other hand, is not statistically significant. Our confidence in the capital mobility result, however, is low: models that include this indicator (either alone, or in conjunction with central bank independence) have acceptable variables for the overall model test of the proportional hazards assumption, but not for the covariate-specific tests. We cannot be sure that the estimation meets the assumptions of the Cox model and this, combined with the smaller set of observations for which data exists, lends caution. Likewise, two final measures of external economic openness – a country's ratio of trade (imports plus exports) to GDP; and its current account deficit or surplus to GDP -- do not significantly influence the hazard rate.¹⁹

Electoral and Party Politics. Turning more fully to domestic political variables, Hypothesis 3 suggests that there is a link between the timing of elections and redenomination, as well as between the degree of parliamentary fractionalization and the likelihood of redenomination. To test the first of these, I rely on various measures of national elections: a parliamentary election in a given year (or in the next year), a presidential election in a given year, or either type of election. I also create a variable that measures the number of years until the next election (of either sort), as a means of assessing the extent to which governments must worry about the ballot box when considering redenomination.

The election variables tend to be somewhat collinear (.5 to .6) with the dichotomous “under IMF program” variable, so I exclude the IMF variable from Model 3 (as well as from some subsequent models). Model 3 includes a lagged election measure; here, I use a measure of either parliamentary or presidential elections. In other specifications, I substituted the parliamentary or the executive variable for the any election variable. In all three cases, the estimated hazard rate for lagged elections is less than one (meaning that an election in the previous period decreases the hazard of redenomination, so that a country-year that has just experienced an election is approximately half as likely to redenominate) and is statistically significant.²⁰ It also is interesting to note that the democracy variable becomes significant in Model 3. Again, analysis of the Schoenfeld residuals indicates that the covariates in this model, and the model overall, does not violate the proportional hazards assumption.

¹⁹ In both cases, however, the democracy variable displays a significant (at a 94% level of confidence) association with the hazard of redenomination, and neither model violates the proportional hazard assumption.

²⁰ For lagged parliamentary elections, the exponentiated coefficient is 0.48, with a 92% level of confidence; for lagged executive elections, the exponentiated estimate is .40, at a 95% level of confidence.

Interestingly, contemporaneous election variables (an election in the current period) also generate exponentiated coefficients (hazard rates) of less than 1, but they are not statistically significant, either when included in place of, or along with, the lagged election variable. Elections appear to have effects, but only after they occur. Moreover, the election effect directly contradicts Hypothesis 3: once an election is over, we predicted that governments would be more likely to redenominate, following the logic of “redenominate and blame one’s predecessor.” In fact, governments are less likely to redenominate on the heels of an election. This may reflect the technical fact that, in some cases, there is a delay between a government’s decision to redenominate and the actual redenomination, particularly for redenominations that address long-standing (or long-since-resolved) problems. In this case, the result on the lagged election variable may be more about the practicalities of redenominating just after an election rather than about political calculations.

Political calculations, however, could play a role: governments may avoid redenomination early in their term because they worry that it could erode public confidence (if the public disapproves of the dropping of zeros) at a time when they want voters’ support for other items on the economic agenda. One means of distinguishing between political and technical effects of the election variable would be to recode the failure date, using the date of the decision to redenominate rather than the date on which it was effective. Another way of assessing the importance of electoral calculations is to consider the effect of the “time until elections” on the hazard rate of redenomination.

The “time until elections” variable measures the number of years until the next election; it is zero in election years. This variable assumes, of course, that politicians can anticipate when the next election will occur, which should be the case with fixed electoral calendars, but may not be true with endogenous election timing. When added to Model 3 (which also includes the degree of democracy, the rate of inflation, and the occurrence of an election in the previous year), the “time until elections” variable is slightly greater than 1 (1.03), but is not statistically significant. This result provides little support, then, for the notion that governments are more (or less) likely to redenominate when their electoral time horizons are long.

Interestingly, though, if we include both the “time until elections” variable and an interaction term (time until elections*inflation), both the time and the interaction measures are statistically significant, as are the democracy and inflation variables (again, the IMF variable is excluded because of collinearity concerns). This model is reported in Column 4 of Table 2. Time until the next election, on its own, reduces significantly the hazard of redenomination.²¹ Hence, governments are less likely to redenominate earlier in their terms, just as the lagged “any election” variable suggests. The interaction variable, however, increases the hazard of redenomination. Where governments have both high levels of inflation and a long electoral time horizon (thereby generating the largest values of the interaction term), they become more at risk for redenomination.

This is broadly consistent with the expectations developed in Section II: governments with the need to redenominate (higher inflation) may be more inclined to do so earlier in their terms (with more years until the next election). This result also supports the conclusion that the lagged election coefficient – which remains statistically significant – reflects the practical difficulties of redenominating just after an election, rather than a political resistance to doing so.

²¹ If we use “years left in the chief executive’s term” (YRCURNT, from DPI), the result is similar: the variable is associated with a statistically significant reduction in the hazard of redenomination. Such results, however, are based on fewer (1756) country-years than those reported in Model 4.

The final element of Hypothesis 3 involves the degree of fractionalization in the political system. Fractionalization may push in two different directions. On the one hand, when facing problems of fractionalization – of keeping together a diverse parliamentary coalition, for instance – governments may lack the political will to implement redenomination, despite economic pressures to do so. This is somewhat akin to the notion that financial markets are less confident that coalition governments will defend a fixed exchange rate (e.g. Leblang 2002). On the other hand, a fractionalized governing coalition (including many parties) provides cover to political parties. They can implement policies for which no coalition member wants to be held responsible, and each party can blame the policy on another coalition member (e.g. Pacek and Radcliffe 1995; also see Mosley 2003, Chapter 5).

Insert Table 3 here

To assess the impact of fractionalization on redenomination, I estimate a model that includes a measure of government fractionalization (in the legislature). This measure is a Herfindahl index for the governing coalition, from the Database of Political Institutions (DPI, from Beck et al 2001, updated 2004). The DPI contains observations for a wide set of developing and transition economies, but its coverage begins in 1975; as a result, this model relies on fewer observations, and includes some additional left censoring of the data. Because of a high correlation (-.63) between the fractionalization measure and the inflation variable, this model is estimated without inflation. In this model (Model 5, reported in Table 3), higher values of the Herfindahl index, indicating less fractionalization, are associated with a significantly reduced hazard of redenomination. Put differently, when the government coalition is more fractionalized (spread across a greater number of legislative parties), redenomination is more likely, all else equal. Furthermore, if we include instead a dummy variable for presidential (vs. parliamentary) systems, the hazard estimate is statistically significant, and it suggests that redenomination is less likely in presidential systems.²² These results, then, give credence to the “blame avoidance” view of fractionalization rather than to the “lack of political will” view.

Ideology. Another element of domestic politics is ideology: contrary to predictions regarding the “end of ideology,” government partisanship continues to be an important influence on many economic policy choices, in both the developed and the developing world (for instance, see Brooks 2002). We might expect, then, that government ideology plays a role in determining the hazard of redenomination. Hypothesis 4 suggests that left-oriented governments are less likely to employ redenomination, while right-oriented governments are more inclined to do so.

Data on government ideology are taken from the DPI, which covers the 1975-2000 period. When included in the Cox models, the ideology variables produce mixed results. On the one hand, hazard rate estimates for the presence of left parties in government (either the chief executive’s party, or the largest participant in the parliamentary governing coalition) are below 1, but are statistically insignificant. And, where the main opposition party is a left party, the hazard rate is greater than one, but also insignificant.

²² This model, which is not reported in Table 2, is based on 3,373 observations. It includes the inflation variable, but excludes “under IMF.” The hazard rate estimates on inflation (2.38), democracy (1.06), lagged elections (0.47) and presidentialism (0.53) are all statistically significant, and the model satisfies the proportionality assumption. A model including a proportional representation dummy variable produces similar results: that variable’s hazard estimate is 3.53 (also statistically significant), indicating that proportional representation systems have a 253% larger hazard of employing redenomination.

On the other hand, hazard rate estimates for the presence of right parties²³ are statistically significant and greater than 1 (2.05 in Model 6, using “right executive” and 2.21 for a model with “right government party”). And, along similar lines, the hazard estimate for the ideology of the largest opposition party is significant and less than one (0.22). The former result suggests that, when right parties dominate the government, the chance of redenomination expands; and when right parties are in opposition (implying a left or center party in office), redenomination is less likely. If we consider right parties to be market-friendly, we can take this as indirect evidence of market-based influences on the decision to redenominate. Of course, the results reported in Model 6 are based on a relatively small set of cases (and on ideology scores, which are sometimes difficult to assign in underdeveloped party systems), lessening our confidence in the validity of these results. They do suggest, however, that there may be an ideological component to choices regarding the using and timing of redenomination.

Repeated Redenomination. Hypothesis 5 suggests that redenomination is more likely if it has been used in the past. Governments’ hesitation regarding dropping zeros is reduced when past governments have done so. To test this intuition, I add a “number of past redenominations” variable to the main model. This variable records the number of times (since 1960) that a country has removed digits from its currency. Again, I omit the “under IMF” variable from the model, given its collinearity with the redenomination count measure.

The results of this estimation (Model 7) are reported in Table 3. As before, the inflation and election variables are statistically significant. The past redenominations variable also is significantly associated with a much greater hazard of redenomination. This relationship, of course, is due in part to economic policy: as the positive correlation between the IMF program variable and the redenomination count suggests, nations’ economic difficulties often persist over time. Countries with the need to redenominate in 1970 may again have this need in 1980. The hazard estimate also leaves open the possibility, again, for political considerations to affect redenomination: once the redenomination dam has been broken, it becomes a more viable political option. This assertion could be tested in future work using case studies of (the consideration of) redenomination, as well as assessing public opinion data before and after various rounds of redenomination (or in countries with similar economic problems, but with more or less redenomination experience).

Currency and Identity. The final two hypotheses developed in Section II concern the relationship among confidence in currency and government, national identity and redenomination. Along these lines, hypothesis 6 suggests that foreign currency substitution will influence positively the hazard of redenomination. Unfortunately, data on foreign currency substitution is not available for most of the country-years included in the analyses. One means of assessing these hypotheses would be the analysis of public opinion data: holding all else equal, are changes in the inflation rate or the dollar to local currency rate correlated with changes in approval of the government, or changes in affinity with the nation-state? Or, in a cross-sectional sense, do citizens of nations with higher levels of foreign currency denomination have significantly lower levels of confidence in their governments? The latter analysis would necessitate only cross-sectional (as in Feige et al 2002, Feige 2003) data on currency substitution, rather than a fuller set of time series data.

Another possibility is to use, as a very rough proxy, the post-1989 (versus 1960-1989) period; despite cross-national variation in financial openness, the early 1990s often are treated as the advent of contemporary financial openness. With post-Communist transitions and post-

²³ The left party and right party measures are strongly correlated with one another, but not perfectly so. In some cases, a centrist party is in office, and all measures are coded as zero for centrist parties.

debt crisis restructurings, nations were increasingly exposed to the possibility of foreign currency substitution. Citizens that had lost confidence in domestic currencies were more able to obtain foreign currencies. The addition of a “post-1989” variable to the basic model, however, does not generate a statistically significant hazard rate estimate. I leave the further testing of Hypothesis 6 for future research.

Lastly, Hypothesis 7 suggests linkages between the age of the nation-state and redenomination, and between the social heterogeneity and redenomination. I test the former by including the logged value of a country’s “years since independence” in the duration model. The hazard rate is 1.08, suggesting a slightly elevated hazard of redenomination as states age, but the estimate is not statistically significant. Interacting the state age variable with inflation, or with ethnic heterogeneity, also does not result in significant estimates. One possibility is that state age cuts both ways: on the one hand, newer states must worry more about national identity, making them more likely to redenominate as a means of boosting currency (and, therefore, identity). On the other hand, newer states may hesitate to reform or replace one of the symbols of their independent status – a national currency. This impulse might then deter redenomination in the face of economic troubles.

I turn, then, to a model that considers the impact of social heterogeneity on the risk of redenomination, both on its own, and in conjunction with the rate of inflation. This model (Model 8) suggests that social heterogeneity may play a role. The effective number of ethnic groups (which varies across countries, but not over time) in a nation is significantly associated with redenomination; as ethnic diversity increases, the hazard of dropping zeros *decreases*. Ethnic heterogeneity on its own points in the direction opposite Hypothesis 7. But when interacted with inflation – high inflation in the presence of ethnic diversity – the diversity indicator produces a statistically significant, and increased, hazard of redenomination. Inflation in the presence of social heterogeneity, as well as being under an IMF agreement,²⁴ increases the hazard of redenomination. The results are consistent, therefore, with the assertion that governments of heterogeneous societies may be particularly worried about the erosion of public confidence in their currencies (and, therefore, will be quicker to redenominate).

IV. Conclusions and Future Directions

This paper generates a set of hypotheses regarding the role of political factors in governments’ decisions to redenominate their currencies. In a way, this is a most difficult case for politics: currency redenomination may be seen as a largely technical issue, in that – if done in a way that allows the public sufficient ability to exchange old cash for new, and if it has little impact on inflationary expectations – it has few real effects. Redenomination often comes at the end, rather than at the beginning, of a process of economic reform; so it may be viewed as much less contentious than other economic policy choices.

At the same time, however, not every nation with an objective need to drop zeros from its currency does so, and not every nation does so at the same pace. This suggests that there are causal pathways through which politics may influence redenomination decisions. It is not that economic factors do not play a role, but that political variables also can. I discuss three overlapping mechanisms through which politics may affect redenomination – concerns about credibility (internationally as well as domestically), factors in the domestic political economy

²⁴ Again, because of collinearity, I do not include the lagged election variable in the model at the same time as the IMF variable. If, however, I substitute the IMF variable for the election variable, the results for other covariates remain very similar. Like other models reported in Tables 2 and 3, this model’s covariates satisfy the proportional hazards assumption of the Cox model.

(election timing, government time horizons, partisanship, and fractionalization), and the influence of money on social identity.

The statistical analyses presented in Section III often an initial assessment of these hypotheses. On the basis of the redenomination experience of developing and transition nations, I conclude that inflation – contemporary or past – is an important predictor of the likelihood of redenomination. I also find that pressure from the IMF, via a loan arrangement, increases the likelihood of redenomination (suggesting at least one area in which the IMF is effective). In terms of domestic politics, the degree of democracy is associated significantly, in some models and to a small degree, with redenomination. Perhaps because of the need to maintain public confidence in their currencies, democratic governments are slightly more likely to remove zeros.

Other domestic political factors generate stronger results: the odds of redenomination fall just after elections and when governments have longer time horizons (the opposite of what I predict in Section II). But when governments face the combination of high inflation and long remaining terms in office, the likelihood of redenomination grows. Put differently, governments in (economic) need of redenomination seem more likely to do it early in their terms, a wise decision if they expect redenomination to upset or confuse the public. Additionally, right governments are more likely than center or left governments to redenominate, perhaps reflecting some interest in “market-pleasing” policies. Moreover, governments characterized by greater fractionalization, rather than those marked by greater unity, are more likely to redenominate their currencies. One causal pathway for this result is the possibility that multiparty government facilitates “blame avoidance.”

The statistical analyses also suggest that there may be a link between social heterogeneity and redenomination, at least in the face of high inflation. While ethnically diverse societies are generally less at risk for redenomination, ethnically diverse societies experiencing high inflation are more likely to undertake a currency reform. This may, to some extent, harken back to the linkage between multiparty government and redenomination. But it may also provide evidence of a link between currency and identity, and of the governments’ particular interest in maintaining confidence in their currencies in diverse nations.

These findings leave room for future research, both qualitative and quantitative. On the quantitative side, collecting better data on various political indicators would improve the validity (and the country-year coverage) of the analysis. Additionally, it would be useful to generate another measure of redenomination (specifically, of failure), based on the date of the (political) decision to redenominate rather than on the date that redenomination goes into effect. The size of this gap varies across countries, from weeks to over a year; for instance, the law regarding the new Turkish lira was passed on January 31, 2004, but the new lira was not introduced until January 1, 2005. If political factors are important, then a more politically-focused measure is justified.

The quantitative analyses also would benefit from the inclusion of other explanatory variables. Civil conflict, for instance, may play a role in redenomination, at least in some (and perhaps so in more heterogeneous) polities. Some of the redenominations in the dataset occur in nations riven by civil conflict -- Angola, Sierra Leone, Nicaragua, and Rwanda. While these countries often experience high levels of inflation, such redenominations may be motivated more by the government’s desire to seize revenue, or to reduce the funds held by rebel groups, than by the desire to establish credibility or to stem currency substitution (Mas 1995).

Furthermore, estimations of the hazard of redenomination could be coupled with an analysis of public opinion data. For instance, does redenomination enhance governments' credibility in the eyes of citizens? Are nations with higher levels of foreign currency substitution characterized by a lack of public trust in the government, or by lower levels of affinity with the nation-state?

Finally, research on this topic should address the broader question of how redenomination fits with other economic strategies. Does redenomination have real effects, in terms of altering expectations regarding (or even rates of) future inflation? Does it lead to improved capital market access and credibility, enhanced public trust in governments, and sustained stability of macroeconomic policies, as its proponents suggest? Presumably, policymakers anticipate these benefits when choosing to enact currency reform; but there are few systematic investigations of the effects of dropping zeros. We also might ask about alternatives to redenomination: rather than reform the national currency, governments could simply dollarize, as Ecuador and El Salvador have done in recent years. What, then, determines whether a government will abandon, or attempt to shore up, its currency? Such questions require that we consider the political motivations behind what seem to be very technical decisions – how to assign numerical values to national monies.

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Table 2: Stratified Cox Model Estimation Results, Part I

Variable	Basic Model (1)	International Variables (2)	Elections (3)	Time Horizons (4)
Inflation (log)	2.1910*** (0.2152)	1.9100*** (0.3119)	2.3313*** (0.2610)	1.9984*** (0.2787)
Democracy (Polity 2)	1.0276 (0.0236)	1.0309 (0.0295)	1.0431** (0.0218)	1.0560** (0.0230)
IMF Program	2.5772** (1.0287)	6.5979*** (3.2443)		
Exchange Rate Regime		1.0288 (.0788)		
Capital Flows (Net/GDP)		0.0039 (0.0183)		
Elections, Parliamentary or Presidential (Lagged)			0.4476* (0.1711)	0.4159** (0.1691)
Years until Election				0.8528* (0.0745)
Years until Election * Inflation (log)				1.0551** (0.0247)
LR Chi²	106.38	38.75	61.20	101.66
Prob<Chi²	0.00	0.00	0.00	0.00
Schoenfeld Global Test (Prob<Chi²)	0.2764	0.7526	0.9484	0.5695
N Failures	46	30	44	44
N Countries	131	95	131	131
N Observations	3496	2000	3470	3466

*10%, **5%, ***1% level of confidence.

Reported estimates are exponentiated coefficients (hazard rates).

Standard errors are robust (Lin-Wei estimator).

Table 3: Stratified Cox Model Estimation Results, Part II

Variable	Elections and Fractionalization (5)	Elections and Ideology (6)	Redenomination History (7)	Social Heterogeneity (8)
Inflation (log)		1.9534*** (0.3005)	2.3254*** (0.2549)	1.2406 (0.2003)
Democracy (Polity 2)	1.0387* (0.0215)	1.0254 (0.0328)	1.0327 (0.0225)	1.0327 (0.0306)
IMF Program	2.2479** (0.7636)			4.4582*** (2.1118)
Elections, either type (Lagged)	0.3503*** (0.1435)	0.4876 (0.2499)	0.4326** (0.2031)	
Fractionalization (Herfindahl Index, Governing Coalition)	0.4648* (0.2134)			
Ideology: Right Party Executive		2.0493* (0.8362)		
Past Redenomination (total count)			6.2821*** (2.7612)	
Effective Number of Ethnic Groups				0.2438*** (0.1139)
Number of Ethnic Groups*Inflation (10g)				1.4214*** (0.1380)
LR Chi²	18.34	21.91	82.01	77.14
Prob<Chi²	0.0011	0.0002	0.00	0.00
Schoenfeld Global Test (Prob<Chi²)	0.7853	0.3501	0.9773	0.6915
N Failures	38	31	44	38
N Countries	134	95	131	103
N Observations	2502	1358	3470	2889

*10%, **5%, ***1% level of confidence.

Reported estimates are exponentiated coefficients (hazard rates).

Standard errors are robust (Lin-Wei estimator).

Data Appendix

Capital Account Liberalization: A dichotomous measure, indicating whether a government restricted capital flows in a given year. Coding, where liberalization=1, is based on annual IMF volumes on exchange restrictions and controls. Data taken from Simmons and Elkins (2004).

Capital flows: net capital inflows, scaled to gross domestic product (both provided in current US dollars). Both indicators are taken from the World Bank's *World Development Indicators*.

Central Bank Independence: from Simmons and Elkins (2004), a 0 to 1 scale indicating the degree of political independence of the national central bank. Higher values indicate more independent central banks; Simmons and Elkins take this data from Cukierman and from McNamara and Castro's update of Cukierman.

Currency redenomination (failure variable): uses the list provided by the Central Bank of the Republic of Turkey 2004a; see <http://www.tcmb.gov.tr/yeni/eng/index.html> This source also indicates the number of zeros (ranging from 1 to 6) removed. Mas (1995) also provides a list of redenominations, as well as other currency reforms; his list spans the 1944 to 1994 period (see pp. 488-489, Table 1).

Democracy: Measured using the Polity IV dataset, "Political Regime Characteristics and Transitions, 1800 to 2003," Monty G. Marshall and Keith Jagers, principal investigators. <http://www.cidcm.umd.edu/inscr/polity/>. My estimates use the Polity 2 score, which is the combined Polity scale (-10 to 10, with transition codes -88 replaced with best estimates; -77 replaced as zero; and -66 as missing).

Elections: For 1975-2000, election dates are based on the executive election and legislative election variables in the Database of Political Institutions (these indicate the election month, in many cases). For elections prior to 1975 and after 2000, election years are collected from the International IDEA Voter Turnout Website (<http://www.idea.int/vt/>), as well as from www.electionworld.org, and (in a few cases) from national sources.

Ethnic heterogeneity: measured as the effective number of ethnic groups, which varies across countries, but not across years. This measure applies Laakso and Taagepera's (1979) method, for calculating the effective number of political parties, to ethnic groups. Data on ethnic groups are taken from Minority Rights Group International (1997) and from Gurr (1993). The variable ranges from 1 to 11.32.

Exchange rate: average official exchange rate, US dollar to local currency, from *International Financial Statistics*. When redenominations occur, the IMF adjusts the exchange rate data to account for the change, so that all of a nation's data reflect "new" currencies. Given the subject of this project, these readjustments were reversed. Where a country had a redenomination in January to June, data for the previous years are converted to old values. Where a country had a redenomination in July to December, data for the present year also are converted to old values. If the data source does not provide a month for the redenomination (e.g. the Democratic Republic of the Congo), it is assumed to have occurred in the first half of the year.

Exchange rate regime: Reinhart and Rogoff's "fine exchange rate" classification, annual measure. This variable ranges from 1 to 15, with 1 indicating the most fixed regimes, and 15 indicating the most freely floating. Data are available from 1946 to 2001. Carmen M. Reinhart

and Kenneth Rogoff, “The Modern History of Exchange Rate Arrangements: A Reinterpretation,” University of Maryland.

Government Fractionalization: from Beck et al’s Database of Political Institutions, the government Herfindahl index. This measures concentration (and fractionalization) by calculating the sum of the squared seat shares of all parties in the government. When there are fewer parties in the governing coalition, the index takes on higher values (with the index ranging from zero to one). When there are no political parties in the legislature, the variable is coded as blank. This variable is available for 1975-2000.

IMF participation: from Vreeland (2003), as updated (through 2003) by Vreeland and Gandhi, using information from *IMF Annual Reports* and the *IMF Survey*. I updated the Vreeland and Gandhi data for 2001-2003 using information from *IMF Annual Reports*. In all cases, programs included are Standby Arrangements, Extended Fund Facility Arrangements, Structural Adjustment Facility Arrangements, and Enhanced Structural Adjustment Facility Arrangements.

Inflation: annual percentage change in consumer prices, from the *World Development Indicators*. For transition countries in the early 1990s (approximately 100 country-years), these data are supplemented with consumer price data found in the Economist Intelligence Unit’s *Country Profiles*.

Past Redenomination: A count of the number of occasions, 1960 to 2003, on which the government has redenominated its currency. This variable ranges from zero to 6.

Presidentialism: dichotomous variable, based on Cheibub and Gandhi’s INST variable (0=dictatorship, 1=parliamentary democracy, 2=mixed democracy, 3=presidential democracy). Coded 1 where INST equals 3.

Proportional representation: dichotomous variable, coded 1 for proportional electoral systems, from Beck et al’s Database of Political Institutions.

Right party executive: based on the EXECRLC variable from Beck et al’s Database of Political Institutions. “Right executive” is coded as 1 when EXECRLC=R, and coded as zero when EXECRLC=L or C. Similarly, “left executive” is 1 when EXECRLC=L, and zero when EXECRLC=C or R. This variable is available for 1975-2000.

Right party government: based on the GOVRLC variable from Beck et al’s Database of Political Institutions. “Right government” is coded as 1 when GOVRLC=R, and as zero when GOVRLC=L or C. Similarly, “left government” is 1 when GOVRLC=L and zero when GOVRLC=C or R.

Right party opposition: based on the OPPLRC variable from Beck et al’s Database of Political Institutions. “Right government” is coded as 1 when OPPLRC=R, and as zero when OPPLRC=L or C. Similarly, “left government” is 1 when OPPLRC=L and zero when OPPLRC=C or R.

Years since independence: based on date of national independence, collected from the CIA *World Factbook*, <http://www.cia.gov/cia/publications/factbook/index.html>

Years until election: Number of years until the next election, legislative or executive. The value of the variable is set at 20 throughout the period for countries that have never had competitive elections (e.g. Bhutan, Brunei, Saudi Arabia).