Essays in Open Economy Macroeconomics

by

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Abstract

Chapter 2: This chapter analyzes the speed of price adjustment in the aftermath of 207 currency crises in 67 countries between 1957 and 1998. The result of slowly adjusting prices in the context of large shocks to the nominal exchange rate found in previous empirical studies is shown to depend crucially on their identification of the post-crisis equilibrium exchange rate, and in particular the hypothesis that large nominal shocks have no permanent effects either on the level or on the trend of the equilibrium real exchange rate. When large shocks to the nominal exchange rate are allowed to be associated with permanent effects, the adjustment of the real exchange rate–i.e. the convergence to the post-crisis path—is found to be very fast, taking place within one month of the crisis for 65% of the episodes and, on average, 6-7 months for the remaining 35%. Significantly, approximately 30% of the adjustment of the real exchange rate to its new path is found to be, on average, due to prices. This pattern of quick adjustment to a new real exchange rate after a crisis is confirmed when the cross-section of crisis episodes is used to characterize the typical crisis experience.

Chapter 3: This chapter analyzes the response of job flows by new establishments and shutdowns to the level of the real exchange rate between 1973 and 1993, and finds robust evidence of hysteresis in the structure of US 2-digit manufacturing industries. Following a transitory appreciation of the real exchange rate, employment in manufacturing industries is found to drop permanently, following a fall in the employment stock both of continuing firms, and of firms at the entry-exit margins. Starkly, the drop in job destruction explains most if not all of these facts. These results suggest that although the

effects of the real exchange rate on US manufacturing job structure may appear quantitatively small, their persistence makes them an important determinant of the reallocation process of (human) resources. Thus we find support for the classical view that exchange rate shocks relocate labor in and out of the tradable sector depending on whether it is a devaluation or an appreciation. Also, as could be expected from hysteresis models, shutdowns and start-ups systematically account for a disproportionate amount of the response of job destruction and job creation to changes in the real exchange rate.

Chapter 4: This chapter shows that the debate on the Tobin transaction tax, which has focused predominantly on issues of implementability and inefficiencies, is misguided, as in a generic model of noise traders, neither the general equilibrium effects nor the endogenous exit of investors are likely to reduce return volatility. In fact, volatility is likely to increase, a prediction that is borne out in available evidence on transaction tax experiments. Finally, this chapter examines several alternatives to the Tobin tax which hold potentially better prospects.

Thesis Supervisor: Olivier Jean Blanchard

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Contents

Chapter 1

Introduction

This dissertation is a collection of three essays in open economy macroeconomics. They cover very different topics: the characteristics of price adjustment in the aftermath of currency crises, US labor responses to fluctuations in the real exchange rate, and the impact of a Tobin tax and its alternatives on foreign exchange markets. However, they all attempt to better understand the relationships of foreign exchange and real activity.

The first essay, chapter 2, analyzes the speed of price adjustment in the aftermath of 207 currency crises in 67 countries between 1957 and 1998. The result of slowly adjusting prices in the context of large shocks to the nominal exchange rate found in previous empirical studies, is shown to depend crucially on their identification of the post-crisis equilibrium exchange rate, and in particular the hypothesis that large nominal shocks have no permanent effects either on the level or on the trend of the equilibrium real exchange rate. When large shocks to the nominal exchange rate are allowed to be associated with permanent effects, the adjustment of the real exchange rate–i.e. the convergence to the post-crisis path–-is found to be very fast, taking place within one month of the crisis for 65% of the episodes and, on average, 6-7 months for the remaining 35%. Significantly, approximately 30% of the adjustment of the real exchange rate to its new path is found to be, on average, due to prices. This pattern of quick adjustment to a new real exchange rate after a crisis is confirmed when the cross-section of crisis episodes

is used to characterize the typical crisis experience.

Then, chapter 3 analyzes the response of job flows by new establishments and shutdowns to the level of the real exchange rate between 1973 and 1993, and finds robust evidence of hysteresis in the structure of US 2-digit manufacturing industries. Following a transitory 30% appreciation of the real exchange rate[1], employment in manufacturing industries is found to drop permanently by 1.61%, following a fall in the employment stock both of continuing firms, and of firms at the entry-exit margins. Starkly, the 1.46% drop in job destruction explains most if not all of these facts. While the employment impact loses its statistical significance when instruments are used to control for the endogeneity of the real exchange rate, the impact on job destruction and its shutdown component are robust to the specification used, including time effects. These results suggest that although the effects of the real exchange rate on US manufacturing job structure may appear quantitatively small, their persistence makes them an important determinant of the reallocation process of (human) resources. This is particularly true in the tradable sector where employment decreases permanently by 3.78% when the real exchange rate appreciates transitorily by 30%, with almost two thirds of the adjustment coming from job destruction. Thus we find support for the classical view that exchange rate shocks relocate labor in and out of the tradable sector depending on whether it is a devaluation or an appreciation. Also, as could be expected from hysteresis models, shutdowns and start-ups systematically account for a disproportionate amount of the response of job destruction and job creation to changes in the real exchange rate.

Finally, chapter 4 shows that the debate on the Tobin tax, which has focused predominantly on issues of implementability and inefficiencies, is misguided, as in a generic model of noise traders, neither the general equilibrium effects nor the endogenous exit of investors are likely to reduce return volatility. In fact, volatility is likely to increase, a prediction that is borne out in available evidence on transaction tax experiments. Finally,

[1] The 30% figure corresponds roughly to the experience of the US economy during the appreciation of the dollar in the early 80s.

this chapter examines several alternatives to the Tobin tax which hold potentially better prospects.

Chapter 2

The Medium Run Response of Exchange Rates and Prices to Currency Shocks

2.1 Introduction

The adjustment of prices to economic disturbances has long been and is still the subject of considerable debate within the fields of macroeconomics and international economics. A clear divide exists between the neoclassical school of perfectly flexible prices and the new-keynesian school of sluggish price adjustment. The relatively robust[1] finding that deviations from Purchasing Power Parity[2] (PPP) can typically last between 3 and 5 years is often given as evidence of price sluggishness. Alternatively the neoclassical school attributes it to persistent fluctuations in fundamentals.

This chapter analyzes the speed of price adjustment in the aftermath of 207 currency crises in 67 countries between 1957 and 1998. The result of slowly adjusting prices in

[1] Although there is still some debate there, similar estimates come from the long historical sample approach, as in [55], or the large country panel litterature. See Rogoff's survey[60].

[2] Typically defined as the long-run trend component.

the context of large shocks to the nominal exchange rate found in previous empirical studies, is shown to depend crucially on their identification of the post-crisis equilibrium exchange rate. Indeed, most of these studies impose, at least implicitly, that large nominal shocks have no permanent effects either on the level or on the trend of the equilibrium real exchange rate. When large shocks to the nominal exchange rate are allowed to be associated with permanent effects, the adjustment of the real exchange rate–i.e. the convergence to the post-crisis path—is found to be very fast, taking place within one month of the crisis for 65% of the episodes and, on average, 6-7 months for the remaining 35%. Significantly, approximately 30% of the adjustment of the real exchange rate to its new path is found to be, on average, due to prices.

As relatively small windows of time around the crisis were used (4-5 years each way), a potential shortcoming of this first approach is that it can mistake the adjustment path for the long run path when the real exchange rate adjustment takes more than 3-5 years to occur[3]. To control for such potential misidentification of the post-crisis equilibrium exchange rate path, a cross-section of currency crises is used to characterize the equilibrium path using time dummies and a long-run trend. This alternative approach, though it imposes a questionable similarity across the experiences of currency crises, has the advantage of being more agnostic as to the shape of the equilibrium real exchange rate profile. With this specification, after a successful large depreciation, the real exchange rate is found to take less than 9 months to adjust and plateau at about the same (depreciated) level for the next three years. There are signs that after this plateau, the depreciation gets corrected further. However, it seems due to sharp appreciation shocks rather than a slow return to some long run parity.

The important real consequences of currency crises—due in part to their often unexpected nature[4]—have sparked considerable academic research. The last Asian crisis, for example, has created a field of its own. Currency crises have also generated interest

[3] Our results appear to be robust to smaller convergence horizons as 1 or 2 years.
[4] At least for the general public.

as they are often interpreted as excellent "natural experiments" of large fluctuations: both their unexpectedness and the large discrepancy between the time series dispersion of nominal exchange rates (particularly since the end of the Bretton Woods era) as compared to that of most fundamentals making them ideal candidates for study. A number of reports indicate significant persistence of real effects of nominal shocks to the exchange rate in response to large fluctuations in the nominal parity. Most recently Borensztein and De Gregorio[12], analyzing large devaluations, report that in their data "30% of the devaluation is offset by higher inflation after three months, and the offset climbs to about 60% after two years," painting a picture of prices adjusting slowly to the nominal exchange rate. These results, however, depend on Borensztein and De Gregorio's implicit hypothesis of no permanent change to the path of the real exchange rate.

In fact, permanent shocks seem to be more the rule than the exception for currency crises. For approximately two thirds of the 207 episodes examined in this chapter, the hypothesis that the path of the real exchange rate is identical before and after the shock can be rejected. The evidence here presented demonstrates that the relevant models of currency determination, at least in the context of currency crises, must have relatively flexible prices with concurrent, persistent real shocks playing a key role[5]—well in line with the fact that currency crises often occur concurrently with important changes in government policy and industrial organization.

Our work has important consequences for theoretical modelling of currency crises. First, nominal rigidities are mostly irrelevant in that context. Second, models of real rigidities with temporary effects of crises can only matter in the analysis of currency crises if these rigidities imply a convergence time well above 5 years. Third, the feedback channel from nominal shocks into policy or industrial reorganization stressed by second generation models appears as the most attractive option to explain the persistent effects of large nominal shocks on the equilibrium exchange rate.

[5] An alternative is of course that nominal rigidities can have permanent effects. Besides the current lack of convincing models of this sort, a difficulty for this approach is the significant contribution of prices to the real adjustment.

Although, we cannot reject that adjustment takes over ten years or more to occur, our results show that a theory of slow adjustment needs a typical adjustment time well in excess of 5 to 10 years, *and also* needs to explain the initial quick and large response of prices in the first nine months, *and* the stability of the real exchange rate in the following 3 to 4 years. To say the least, this puts a lot of restrictions on such a theory, and a much more likely interpretation of our results is that adjustment is fast, and that the apparent sluggishness of prices reported previously in the literature is solely due to the frequent presence of permanent shocks to the real exchange rate in the aftermath of currency crises. With this caveat, prices contribute very significantly to the adjustment.

The chapter is organized as follows. Section 2 motivates the view of crises as permanent shocks to the underlying equilibrium exchange rate path. Section 3 describes the data and methodology used. Section 4 computes the characteristics of the adjustment when both the level and the slope of the real exchange rate path are permited to vary after the crisis. Section 5 presents the characteristics of the mean real exchange rate adjustment, as measured via GLS, under the hypothesis that the trend over 40 years is unaffected by the crisis. Section 6 interprets the results and concludes.

2.2 Crises: Permanent or Transitory Shocks?

The hypothesis that the underlying equilibrium exchange rate is not affected by the currency crisis is common practice in empirical work. Typically, data is detrended using deterministic linear or quadratic time trends or through the use of an Hodrick-Prescott (HP) filter without the possibility of a break at the time of the crisis. This type of equilibrium real exchange rate identification procedure tends to greatly overestimate the time taken by the real exchange rate to return to its equilibrium when currency crises are allowed to have permanent effects as is shown in the next section. However, before going through our empirical analysis it is important to gage whether we should expect currency crises to have such permanent effects.

Currency crises are typically modeled as a break by the local central bank away from an unsustainable nominal exchange rate policy, and thus the question is in what context will the new policy lead to a new equilibrium exchange rate? First generation models as in Krugman[49], provide no direct channel for currency crises to have permanent effects. Indeed PPP is typically assumed to hold at all times and its determinants given exogenously. Second generation models add such a direct channel by endogenizing monetary policy. In such a context, we can have multiple equilibria for the real exchange rate, the realization of which depending both on factors (debt level, unemployment, trade flows, animal spirits,...) that help determine what agents deem currently a sustainable policy, and on what the government or central bank present preferences are. The same logic can be applied to other government policy feedbacks as well as to feedbacks from the financial and goods sectors. We detail in what follows what are tentatively the most likely such candidates.

Government policy channel. With the disturbances in the real sector that frequently accompanies a currency crisis, governments typically react by trying to reduce their vulnerability from further onslaught. There are usually two methods, both empirically observed. One way is to try to regulate or close off the links between the country and the rest of the world. This is usually the path taken by governments that see themselves as mostly innocent of the importance of the crisis and blame exchange rate traders. Among the regulatory means typically used are capital and foreign exchange controls, transaction taxes...For example, in the wake of the 1997 Asian crisis, blaming hedge fund managers like Soros for Malaysia's woes, Prime Minister Dr Mahathir imposed quite rapidly currency controls. Trade openess is also often altered in the wake of a currency crisis as a means to make the country less sentitive to foreign exchange fluctuations, with a rise in tariffs and non-tariff barriers (NTBs). In fact, this experience is not limited to crises (nor developing economies) and is valid also for large nominal fluctuations. For example, Bhagwati[11] argues that the doubling in Voluntary Export Restraints (VERs) coverage in the US during the early 80s explains in large part why prices rose instead of

falling in response to the large nominal appreciation of the dollar with respect to most currencies.

Interestingly enough, the second way governments often reduce their vulnerability from exchange rate shocks is to carry out exactly the opposite of the previous policies. Indeed, governments concerned that the vulnerability of their exchange rate policy comes from their market intervention will tend to reduce restrictions on capital and foreign exchange flows, as well as opening their trade. It would appear from casual evidence that this behavior is more often than not the fact of a new government or finance minister put in place as a consequence of the crisis and who doesn't have to defend the policies of its predecessor.

What are the implications for the equilibrium exchange rate path? Standard economic theory would predict that countries which try to reduce their vulnerability to foreign exchange fluctuations by freeing and opening up their economy would face a positive supply shock either via lower costs of capital, or lower costs of foreign goods, leading to a permanent real depreciation of the currency. To the extent that the economy is more open then before the build-up to the crisis started, we would expect a currency crisis to lead to a drop of the equilibrium real exchange rate below its pre-build-up level. Similarly, countries which try to ward off their countries from international markets should face an appreciation of the real exchange rate. The reason that such a real appreciation is a rare occurence, at least at low levels of inflation, is probably that such countries increase their probability of a crisis relapse, so much so that the country relapses into crisis, forcing the government to finally open the economy.

A pure level effect? If the fact that such policy changes can lead to a change in the level of the equilibrium real exchange rate is standard, the effect on its trend is maybe more controversial. Still there are good reasons and some evidence for openess to be positively correlated with growth[6], which can then feed into the equilibrium exchange

[6]It's worth noting that this doesn't require growth to be endogenous. Similar results can be obtained, at least for horizons of 20 years or more, in a standard Solow of exogenous growth with imperfect diffusion of technology, where the degree of openess affects the diffusion process.

rate slope via Samuelson-Balassa effects. And indeed, frequently, countries come out much healthier from currency crises than before on a higher growth path.

Another important area of government regulation that can be significantly altered after a currency shock is its supervisory role over financial intermediation. The 1997 Asian crisis, for example, showed the absence of government controls over the financial sector, either from a lack of understanding of the rising vulnerability of firms and banks to a "bank run" by investors, or from the presence of "crony capitalism". Interestingly enough, the countries that have emerged the fastest from the crisis are probably countries like South Korea that have committed to reshape their financial sector quickly[7]. Improved supervision of financial intermediaries is likely to have a large impact on the equilibrium real exchange rate both by reducing the risk faced by entrepreneurs and by lowering the cost of capital to new entrepreneurs.

Besides monetary policy and regulatory discretion, fiscal policy broadly defined is another tool used by governments in the wake of crises which can induce a permanent change in the equilibrium exchange rate. For example, the rising difficulty of raising taxes after a devaluation may be so costly, that governments may be willing to conduct a much needed tax reform. Also the the wage policy in the government sector seems a relevant channel in practice, for example in the CFA devaluation experience. These mechanisms can be reinforced when the devaluation comes after several similar episodes.

Changes in government policy are attractive candidates for permanent shocks in the context of currency crises as the political cycle seems to be approximately of the same order of magnitude as the recurrence of such shocks. Also it's worth noting that the ERM crisis happened just before highly controversial referendums were to take place, and the Mexican crisis right after a new government took power.

Irreversible Entry and Exit channel. There seems to be a subsequent increase in the amount of firm flows and especially in firm destruction during times of currency crises.

[7] One could venture that one reason it is took so long for Japan to address its financial woes, as been the lack of a shock, such as a currency crisis, to boost its political process.

When markets are imperfectly competitive and investments at least partially irreversible, the destruction of production units will lead to a sustained diversion of the pattern of trade as well, which, along with the changes in the strategic interaction between firms, can cause the permanent change of the real exchange rate. Typically, we would expect (a priori) transitory and unexpected devaluations, if large enough, to lead to an increase in the number of firms operating in the exportables sector, while the converse holds in the importables sector. The implications for the real exchange rate are a priori ambiguous depending on the strategic interaction of firms in the market, and in particular on how firms' markups depend on the number of competitors. We should expect these effects to be particularly important in countries were entry and exit costs are relatively more important. Arguably this would fit best the developping countries due to the thinness of their markets.

Although one would anticipate such effects to be most proeminent in goods markets, similar exit of bad lenders happens in the financial sector. Typically these effects should be strong in countries where financial markets are, at least partly, insulated from foreign competition, and when customer loyalty or long-term relationships are important. In both cases, after the crisis the effects should be on the level of the equilibrium real exchange rate. Yet as previously, there could be also a trend effect if the entry-exit has also an impact on the growth process.

Private Regulation channel. A view of currency crises is that they reflect the sudden lack of faith of investors as to the monitoring capacity of their intermediaries, and indeed a striking characteristic of currency crises is that they often reveal an apparent lack of control by companies over the risks that their agents take, in particular in terms of excessive lending (and borrowing). Aside from self-fulfilling considerations, the currency crisis will typically follow a period during which private intermediaries have loosened their control over agents under their supervision, either because the market as a whole as been performing well as of late, or because their agents have been "overachievers" compared to the rest of the market. It seems particularly relevant for financial intermediaries, and a

currency crisis is sometimes the mirror of a financial crisis. For example, many commentators of the recent Asian crisis have denounced the irresponsibility of Asian financiers lending patterns in particular to already heavily indebted cartels. Although it seems clear that these levels were too high in retrospect, few people in the financial industry of these countries were considering such patterns abnormal before the onset of the crisis. Thus imperfect monitoring may come ex-ante from a lack of a clear understanding of the market and its ramifications. The lack of a benchmark seems particularly relevant for the East Asian countries experience as they were always considered a miracle or anomaly in the pattern of world economic development.

There are reasons to believe that monitoring should improve in the aftermath of a currency-financial crisis. To the extent that financiers are able to learn from their past mistakes, we should expect, at least in the medium run[8], that firms performance is better monitored than before the crisis occured, and the efficiency of the allocation of capital improved.

Expectations or Animal Spirits channel. There is a very large amount of uncertainty in practice as to the equilibrium value of any real exchange rate, both among market practitioners and among researchers. This is evidenced both in the fact that market practionners are often surprised by large crises as well as in the fact that academic reasearchers change their predictions quite radically. For example, Larry Summers was a staunch denouncer of the overvaluation of the dollar in the early 80's and correctly predicted the sharp devaluation of the dollar that was to come. However, a few months before the devaluation actually occured, he changed his position stating that the dollar was not overvalued and that changes in fundamentals explained the rise. It is also significant that probably the main forecasting tool for large deviations of the real exchange rate from equilibrium, long-run PPP, is typically computed as an average of past values rather than from some intrinsic model. In such a context, it may not be too surprising that large fluctuations of the real exchange rate can occur. However, for large shocks

[8] The speed of financial innovation is, however, unlikely to enable such effects to last over the long-run.

to have permanent effects, we need a rationale why the foreign exchange dealers seem to have such lasting focal points. Herding behavior can possibly offer such a rationale. When currency traders learn from others actions before them, signs of convergence to a new equilibrium real exchange rate will tend to be self-stabilizing, and conversely it may require a minority of agents to start a crisis.

In the presence of herding behavior the large uncertainty about the true fundamentals may explain, why large nominal exchange rate shocks seem to have permanent-like effects on the real exchange rate. In that context, we would expect that both the level and the trend of the equilibrium real exchange rate can be affected depending on the implicit model of currency determination held by agents.

Finally, currency crises may disclose information to otherwise uninformed agents as to the true model of the economy. For example, though the high costs of the German reunification in the case of the ERM crisis were made public in 1991, and though as early as 1993 Calvo and Dornbusch among others, were predicting the downfall of the Mexican Peso, most investors seem to have neglected these macroeconomic signals. The crisis may have educated investors and traders as to the risks facing the European moneys. A priori, this learning channel should only have a level effect on the real exchange rate path.

2.3 Data and Methodology

2.3.1 Selection Criterion

Defining a currency crisis in purely statistical terms is far from being a straightforward exercise. For matters of comparability, Borensztein and De Gregorio's selection criterion[12] was used—in other words, a fluctuation larger than 3 standard deviations in the monthly log-variation of the nominal exchange rate with the dollar. Given the broad time period being examined, deviations for each subperiod were benchmarked by decade, against decennial standard deviations (i.e. the 1950s-60s, '70s, '80s, and '90s).

This selection criterion has some inherent limitations, the first among them being that it does not always distinctly differentiate crises from their aftermaths. While small initial nominal fluctuations often trigger large nominal variations, only the latter will be picked up by the Borensztein-De Gregorio criterion. For example, the criterion identifies the beginning of the Lira crisis of 1992 as being in October while, in effect, its starting point is best assigned to September. A better, although still imperfect, criterion is to solve backwards in time for the first shock of the same sign. Optimally one would like to have independent information on the start of the crisis, to identify the "causal role" of the nominal exchange rate. Nonetheless, the use of a specific criterion does not, apparently, affect the results obtained in this chapter to any significant degree. Indeed, specifying the time of the shock as a 3-month band around the identified shock, instead of a single month, yields very similar results.

Of more concern might be the fact that we use the nominal exchange rate with the dollar, as it allows one to miss some large-nominal-shock episodes for currencies with smaller variances of nominal shocks than that of the dollar. For instance, Spain's successive devaluations in 1992 are not picked up by the Borensztein-De Gregorio criterion, while they are clear when one uses a DM-pesetas nominal exchange rate. A trade-weighted nominal exchange rate criterion would therefore seem in order. However, as the results obtained in this chapter do not depend critically on the criterion used, the Borensztein-De Gregorio[12] approach was followed.

2.3.2 The Data

Information on nominal exchange rates and consumer prices spanning more than 40 years and 80 countries was obtained from the IMF's International Financial Statistics (IFS) datafiles. All episodes for which insufficient data was available—consisting primarily of recent episodes—were eliminated. (For that reason, none of 1997-1998 crises in Asia, and few of those in former USSR republics, are represented.). Finally, all episodes during

which the monthly log-variation of the nominal rate was less than 2% were eliminated to avoid capturing episodes of negligible realignments of a fixed parity, as was especially common during the Bretton Woods era.

Table 1. Description of Full Data set

		Number	Average Size[9]
Total Crises Episodes		207	
Nominal Devaluations		177	26.0
of which :	Real Devaluations	172	20.1
	Real Appreciations	5	3.8
Nominal Appreciations		30	29.0
of which :	Real Devaluations	0	...
	Real Appreciations	30	30.7
Countries		67	
Median Date of Crisis		July 1984	
Episodes in US $ zone		118	
Episodes in DM zone		46	
Episodes in Japanese ¥ zone		24	
Episodes in French Franc zone		19	

The result comprises of 207 episodes of large fluctuations in the nominal exchange rate in 67 countries between 1957 and 1998. Table 1 presents a quick summary of the dataset's characteristics. Not surprisingly, nominal devaluations dominate the sample, representing 85% of the selected episodes. Immediately apparent, however, is that in five episodes the nominal devaluation actually translated *into a real appreciation*, as

[9] 100 times the absolute change in the log of the nominal exchange rate with reference country if nominal devaluations or appreciations. Of the real exchange rate otherwise.

prices rose more than in proportion in the month following the crisis. (The size of the devaluations and appreciations, one should note, is quite large both in nominal and real terms, with average fluctuations in excess of 20%. More than 40% of the episodes represent a devaluation in real terms in excess of 10%; and 25%, of more than 20%.)

For each country, a reference nation was established to define a bilateral real exchange rate. Ideally, a trade-weighted real exchange rate index would be, in most instances, a better proxy. Unfortunately, no database for tracking cross-country trade flows for such a wide array of countries seems to exist. Therefore, four reference currency zones were defined essentially on geographical grounds[10]: the US dollar zone, including all of the Americas as well as other select countries; the Deutschemark zone, encompassing all of Europe; the Japanese Yen zone, including South East Asian countries; and the French Franc zone, representing the majority of the African countries examined in this sample[11]. Both Germany and Japan were considered part of the US$ zone, and France was allocated to the German mark area.

Of the five cases of real appreciation, four correspond to episodes of high- or hyperinflation—not a surprising finding as hyperinflations are, by their very nature, times during which goods prices become extremely flexible and volatile. Indeed, they are sometimes more so than the nominal exchange rate, a phenomenon accentuated by currency substitution (dollarization).

The episodes can be broken down as follows: Two correspond to hyperinflation peaks immediately before stabilization attempts: Brazil in January 1990, when the *cruzado novo* dropped by 35% in nominal terms while rising by 8% in real terms shortly before the first Collor stabilization attempt, and Croatia in October 1993, when the Kuna fell nominally by 24% while rising by 3% in real terms before a cease-fire with Serbia allowed a relative stabilization of the Croatian economy. These scenarios reflect the

[10] This makes sense as geography plays an essential role in trade flows, as evidenced by the gravity models. Also a significant number of the countries in our sample set explicitly or implicitly their monetary policy in function of one of our reference countries' own policy.

[11] See the appendix for the exact correspondance.

frequent picture of "price overshooting," when, at the end of a period of hyperinflation, the financial markets are quicker to adjust to the rising likelihood of a stabilization than the goods markets—especially when the nominal exchange rate is anticipated to be used as a sturdy and sustainable nominal anchor. One episode reflects continuing hyperinflation: the Nicaraguan Cordoba was nominally devalued by 53% in May, 1990, leading to a real appreciation of 8% real appreciation, as hyperinflation continued. One case—that of Poland in September, 1989—corresponds to high inflation (roughly 25%) due to the country's beginning its transition to a market economy. Finally, the small 2.6% nominal devaluation of the Bolivian currency led to an insignificant 0.03% real appreciation, reflecting a case of low inflation in a country which had a history of moderate inflation.

As this last example suggests and as we checked, our results and notably the contribution of prices to the adjustment process, don't depend on the inclusion or not of ex-ante very high inflation episodes.

2.3.3 Equilibrium Exchange Rate Estimation

The identification of the underlying equilibrium exchange rate is critical to any assessment of the economic properties of the real exchange rate adjustment. There are essentially two candidates, both with some shortcomings:

- Within sample time continuous trends. Maybe the most commonly used in the literature, they include linear or quadratic time trends, as well as HP-filtered trends for the log of the real exchange rate. Though the shortcomings of within sample data analysis are well known, it is important to stress their implications within our context, and in particular the systematic overstatement of the adjustment time after a permanent shock to the level of the real exchange rate. The example in Fig 1. illustrates this quite starkly. Suppose that initially the log of the true equilibrium real exchange rate is constant, and that at time zero there is a permanent drop in its level, after which the log real exchange rate is constant again. Then if we're

looking at a symmetric window of T months around the time of the shock, for example T=60 i.e 5 years, then it's easy to check that asymptotically the estimated mean adjustment time, i.e. the time taken by the real exchange rate to come back to its "equilibrium trend" is almost surely equal to $\frac{2T+1}{3}$ or approximately 3 years and a half. It's worth stressing that this result is quite general and holds for linear or quadratic time trends, and also if some data around the crisis is eliminated from the estimation. Also it is a good approximation for HP-filtered trends as long as the λ parameter is not very close to zero.

Although it is a frequent practice to use HP-filtering to detrend exchange rates, we don't report the results of such detrending. There are three reasons for this. First, HP-filtered trends impose the same type of bias on adjustment times as simple linear or quadratic trends. Secondly, HP-filtering though it is appealing from a conceptual view as it relaxes the hypothesis of determinism of the shadow equilibrium path, often adds wrongfully correlated noise. Lastly, and significantly our results are very similar when using HP-filtering instead of deterministic time trends, which is not too surprising as, at least within our sample of large shocks, the deterministic trend component appears to dominate real exchange rate movements[12].

- (Out of sample) Large sample continuous time trends. A shortcoming of using "small" windows of time before and after the crisis (typically 5 years) is that it may understate the time taken by the real exchange rate to adjust to its equilibrium level, by mistaking the adjustment path for the equilibrium path. The example of the CFA zone devaluation episodes illustrate this quite starkly (see chart [13]. Though our prefered interpretation of the CFA zone experience is that of a "permanent" devaluation of the CFA Franc followed by a new path with an average rate of appreciation in real terms of 2.6% per year after January 1994, one

[12] In the empirical work reported in the next section, pre and post-crisis HP trends were estimated separately to allow a discontinuity of the process.

[13] See chart 4 and the discussion in section 6.2.

could alternatively interpret it as prices being extremely sluggish, taking more than 5 years to converge to their long-run path (see chart 4)[14]. The case of Mexico is probably a more favorable case to this interpretation (See chart 5), with fluctuations of the real exchange rate being consistently along an almost flat deterministic trend for the past.

However, a drawback of using a large, typically more than 20 years, window is that the larger T, the larger the bias in the adjustment time in the presence of permanent shocks as shown above. Yet this seems to mitigated in practice by the presence of multiple crises.

Can theory help us partially out, which type of equilibrium real exchange rate should be used? Given the limited availability of data, and the macroeconomic and thus complex nature of the real exchange rate the unqualified response is unfortunately no, we need to make some identifying hypotheses to isolate the relevant concept(s) in practice. As a consequence we first show how the allowance of permanent effects changes the picture of the adjustment process yielded by an in-sample analysis before turning to a more agnostic approach using the cross-section and long-run trends to identify the equilibrium exchange rate path.

2.4 Crises as Permanent Shocks

This section shows that the adjustment is quite quick, typically less than 6 months, when large nominal shocks are allowed to have permanent effects on the profile of the equilibrium real exchange. These results highlight the dependence of previous results in the empirical literature on their often implicit hypothesis of no permanent effects. Although in the results reported in this section the identification procedure allows both level and trend effects, the results are robust to allowing only level effects as is shown in

[14]Data limitations unfortunately will leave the question unanswered for at least a few years.

table 3b in the appendix[15]. The contribution of prices to the adjustment[16], even during such a few months is shown to be between 30 to 40% for our full sample, and as much as 56% of the nominal exchange rate contribution when only episodes for which adjustment occurs in more than one month are considered.

2.4.1 Methodology

Return to the Post-Shock Trend

To estimate the trend paths of the log of the real exchange rate, we computed linear trends before and after the shocks, as well as the sample's linear trend (9 years when possible). In all cases, observations made on the dates of the shocks were excluded. In order to control for transitory dynamics, we used several post-shock samples to estimate the post-shock trend. In the results presented here, we computed the first post-shock usable observation, as the first observation that wasn't statistically away from the post trend computed from year 2 to year 5 after the crisis. Alternatively, we eliminated all the observations in the first and the second year after the crisis from the post-shock trend estimation, with similar results.

It is worth noting that the specification employed in this analysis imposes, in real terms, a long-run perfect pass-through of the nominal exchange rate into the price level and vice versa. An alternative specification would be to add the log of the nominal exchange rate on the right-hand side to allow for incomplete pass-through effects. However, there are some concerns with such an approach as small sample bias may miss the true long-run cointegration relationship between the nominal exchange rate and consumer prices. Moreover, since both prices and nominal exchange rates are endogenous, and

[15] When only level effects are allowed, the adjustment, according to s_1 is in fact found to be slightly faster, essentially due to the fact that the constraint of a common trend increases the variance along the post-crisis path. Conversely, s_2 is found to be significantly larger, as, the presence of slope shocks systematically biases this measure towards $+\infty$. This effect is illustrated in figure 3, in the case of a pure slope shock.

[16] See section 4.2.3 for a definition of the concepts used.

no "clean" instruments are easily available for such a sample, the selected approach in real terms has some advantages over a more flexible regression of home prices over the nominal real exchange and foreign prices.

A linear approach -- the natural first candidate for an "event study" approach -- is particularly warranted for the study of real exchange rates. Indeed, Engel and Hamilton[29], using the experience of France, Germany and the UK in the 1970-80s, find that a simple binary Markov process of piecewise linear trends outperforms a random walk alternative.

The estimation of the real exchange rate path both before and after the shock enables us to distinguish between temporary shocks and the various types of permanent shocks. For the purposes of this chapter, temporary shocks will be defined as shocks that leave the post-shock real exchange rate path not significantly different from the pre-shock path. Given a linear framework, 3 types of permanent shocks can be defined: those that affect only the intercept, those that affect only the slope, and those that affect both the intercept and the slope, of the post-shock path.

Ideally, one would like to use a multinomial test that would clearly dichotomize the four alternatives. However, to avoid the ambiguity introduced by such a test, another testing procedure which did not allow overlapping between the four alternatives was established:

"No change," or transitory, shocks were defined as episodes for which the joint equality of the post-shock and pre-shock trend coefficients could not be rejected at the 95% (or 99%) confidence level. Among the remaining episodes, "slope change" and "level change" episodes were defined, respectively, as those for which the equality of the slope, but not intercept, coefficients could be rejected and vice versa. Cases in which the pre- and post-shock equality of both coefficients could be rejected were identified as "change in both (slope and level)" episodes. Lastly, any episodes such that we could not reject the equality of either trend coefficients, while still rejecting the joint equality, were labeled "unclear". Although they may seem to belong to the "change in both slope and intercept" category, these episodes may have a more complex path than our linear approach allows, with the

tests capturing a regression mispecification.

To avoid rejecting too easily the hypothesis of no structural change, heteroskedasticity between the pre-shock and the post-shock samples was controlled for with a χ^2 test (Wald statistic):

$$W = \left(\widehat{\beta}_{post} - \widehat{\beta}_{pre}\right)' \left(\widehat{V(\widehat{\beta}_{post})} + \widehat{V(\widehat{\beta}_{pre})}\right)^{-1} \left(\widehat{\beta}_{post} - \widehat{\beta}_{pre}\right)$$

where $\widehat{\beta}_{post}$ and $\widehat{\beta}_{pre}$ are the post-shock and pre-shock trend estimates, and $\widehat{V(\widehat{\beta})}$ represents the estimated variance of the estimator, $\widehat{\beta}$. This measure supposes that the post-shock and pre-shock estimators are independently distributed—not an entirely accurate supposition as the autocorrelation of the real exchange rate across time is important. Nonetheless, this is not a major concern, as the transitory dynamics on either side of the shock were excluded[17]. The use of a probability cutoff higher than the usual (1% chance of error instead of 5%) offered some control for small-sample bias in testing the hypothesis.

For each episode, a first measure of adjustment time—i.e. the time taken by prices to converge to their new post-shock trend—was computed, defining s_1 as the number of periods required for the real exchange rate to be not significantly away from its post-shock trend for two consecutive periods. Two periods (rather than one) were required to avoid biasing the adjustment time s_1 downward in the case of J-shaped real exchange rate dynamics.

Error Correction Estimation

As an alternative to the computation of s_1, a second measure of the speed of the real exchange rate was also computed by calibrating an error-correction process for each crisis episode. Specifically, the 2-step estimation procedure of Engle and Granger[31] was used

[17] In fact we also used a variant of this test adding an estimate of the covariance term with little change to the results.

to calibrate the following error-correction model for all shock and post-shock observations:

$$\Delta LRER_t = a_0 + a_1 * \widehat{LRER}_{t-1} + \varepsilon_t$$

where $\widehat{LRER}_t$ is the residual from the post-crisis trend estimation[18] at time t, ε_t is the error term, and a_0 and a_1 are the two estimated constants. To diminish the influence of small-sample bias, the robustness of the regression results were tested by adding lags of $\Delta LRER_t$ and of $\widehat{LRER}_{t-1}$ as right-hand side regressors, as suggested by Campbell and Perron[18]. This equation was estimated episode-by-episode, using OLS' as well as Cochrane-Orcutt's procedures to control for first-order autocorrelation of the error term[19]. The results appeared to be robust to these alternative specifications.

A second measure of the price-adjustment time to its new path was defined as:

$$s_2 = \frac{\ln(0.1)}{\ln(1 + a_1)}$$

As can be easily verified, this measure corresponds to the number of months taken by the real exchange rate to return within 10% of its post-crisis path after a shock. Although arbitrary, a 10% range was selected as a significantly more demanding measure than the 50% or half-life measures more commonly used.

This definition of the adjustment time s_2 assumes that the process of the detrended log exchange rate is stationary ($a_1 \neq 0$). As is well known, estimates of a_1 tend to be biased to the left of one in small samples if the process of the log exchange rate is I(1). To control for this, augmented Dickey-Fuller tests were computed for each episode. In only half of the crisis episodes could the I(1) hypothesis be rejected, warranting our implicit hypothesis of stationarity. However, for the other half of the sample the I(1) hypothesis could not be rejected. Dickey-Fuller tests, however, are clearly of a low power given the small size of the samples, and will tend to under-reject the lack of first-order

[18] Excluding transitory dynamics as in the previous subsections.

[19] Only the latter are reported in table 2.

integration. This is particularly true in cases for which the likelihood of other permanent shocks occuring is high[20]. For example, the level of non-rejection of the I(1) hypothesis is particularly high for the UK's 1992 crisis. As evidenced in [29], by enlarging the sample and allowing for multiple shocks one can reject the hypothesis of first-order integration for the UK's experience. This, combined with the strong correlation of s_2 with s_1, supports this chapter's implicit assumption of stationarity. It is, however, possible to interpret the estimates detailed below just as local approximations of the speed of adjustment, instead of structural parameters.

2.4.2 Results

Permanent vs Transitory shocks

Permanent shocks in the wake of currency crises are clearly more the rule than the exception. In only 12.1 % of the cases (see Table 2) can one not reject the null hypothesis of no structural change at the 99% level, while for the remaining 87.9 % we can strongly reject the transitory-shock hypothesis.

[20] In these instances, s_2 is in fact biased upward as seems the case for the UK.

Table 2. Frequency of Episodes by Type .

	95% level	99% Level	In %
All Crises	207	207	100
No change	20	25	12.1
Slope change	31	34	16.4
Level change	36	40	19.3
Change in both	119	105	53.6
Unclear	1	3	1.4
Nominal-Real Devaluations	172	172	100
No change	14	19	11.0
Slope change	27	29	16.9
Level change	28	32	18.6
Change in both	103	91	52.9
Unclear	0	1	0.6
Nominal-Real Appreciations	30	30	100
No change	5	5	16.7
Slope change	3	4	13.3
Level change	7	7	23.3
Change in both	15	13	43.3
Unclear	0	1	3.3

Source: Author's computations.[21]

Approximately one half of the large nominal shocks in the sample led to significant changes in both the rate of depreciation/appreciation and the level of the real exchange

[21] The Real-Nominal devaluations sample consists of all 177 nominal devaluations episodes minus the 5 episodes of nominal devaluations that led to a real appreciation.

rate. There is no evidence of any significant asymmetry in the responses of real exchange rate paths between appreciation, versus devaluation, shock episodes.

To complete the assessment, episodes of devaluation alone (both nominal and real) were examined. The results are displayed in Table 2b. In approximately 25% of the episodes, nominal shocks to the exchange rate led to a drop in the level of the real exchange rate path, as well as an increase in is rate of depreciation. Symmetrically, in another 25 % of the cases, nominal exchange rate shocks led to level devaluations with, however, appreciated rates [[onwards]]. In 18%, nominal devaluation shocks led only to level devaluations that left trend slopes unaffected.

Table 2b. Frequency of Devaluations by Type .

	99% Level	In %	Size
Nominal-Real Devaluations	172	100	
No change	19	11.0	
Slope change	29	16.9	
Appreciated rate (AR)	18	10.5	1.0
Depreciated rate (DR)	11	6.4	1.2
Level change	32	18.6	
Appreciation	1	0.6	5.1
Devaluation	31	18.0	29.0
Change in both	91	52.9	
Both Appreciated	5	2.9	0.6/12.8
Appreciation but DR	4	2.3	0.2/17.5
Both Depreciated	41	23.8	1.4/40.0
Depreciation but AR	41	23.8	0.7/28.3
Unclear	1	0.6	

Adjustment time measures

Table 3, below, presents the main results of this chapter's analysis[22]. Allowing for permanent shocks to real-exchange-rate paths in the aftermath of crises, the average adjustment time is in fact quite fast, whether measured by the time taken to be non-significantly away from the new path, or by the error-correction (EC) model outlined above. Using the first measure, adjustment generally takes less than 3 months, while with the second it takes less than 10[23]. In fact, according to our first measure, in 65% of the episodes the adjustment (i.e. convergence to the post-crisis path) tookwithin, on average, 6-7 months for the remaining 35%. Using the EC model/estimate yields an average of 9.7 months. The maximum adjustment time, as measured by s_1, is represented by the long-lasting Argentinian devaluation of April 1989, which was generated by hyperinflation. In this case, the adjustment is estimated to take exactly 2 years (24 months).

The correlation between the two adjustment time measures is .26 for the whole sample. Given, however, that the error-correction model captures the inherent persistence of real exchange rate fluctuations rather than the rapidity of the response to (large) shocks, one can safely conclude that it tends to overestimate the adjustment time in the case of immediate, rapid adjustments. Indeed, in the latter case, $\overline{s_2}$ will tend to capture the persistence of small shocks, which may be very large, rather than the speed at which the crisis is offset. Accordingly, when episodes with adjustment times ($\overline{s_1}$) of one month or less are excluded, the correlation between the two measures jumps to 0.73.

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[22] n is the number of episodes per category.
$\overline{s_1}$, $\overline{s_2}$ are the category average adjustment time, measured in months, of section xx and yy respectively.
$\overline{s_3}$ is the average intersection point of section zz, also measured in months.
See also Annex A for more details.

[23] Note that the level discrepancy between the two measures is not really relevant. By taking a less stringent level than 10%, say $(0.1)^{\frac{2.8}{9.7}} = 51\%$, the two measures would yield the same mean.

Table 3. Adjustment Characteristics.

		n	$\overline{s_1}$	$\overline{s_2}$	$\overline{s_3}$	$\%\|\Delta p\|$
All Crises		207	2.8	9.7	258.9	29.8
	No change	15	2.9	8.8	82.1	28.4
	Change in intercept	33	2.0	12.6	971.3	28.6
	Change in slope	37	3.0	11.2	72.2	27.4
	Changes in both	26	2.3	5.7	37.7	32.7
	Unclear	40	3.4	10.0	125.0	33.5
Nominal-Real Devaluations		172	2.8	9.6	289.6	29.1
	No change	62	2.9	9.0	89.9	26.1
	Change in intercept	25	2.2	12.9	1272.1	28.0
	Change in slope	31	2.8	11.8	76.1	27.4
	Change in both	25	2.3	5.5	37.7	33.4
	Unclear	29	3.6	8.9	123.1	34.6
Nominal-Real Appreciations		30	2.9	10.9	43.1	22.7
	No change	6	3.5	9.7	8.2	23.2
	Change in intercept	7	1.4	12.5	9.1	20.2
	Change in slope	6	4.0	8.0	10.6	27.3
	Change in both	1	1.0	...	...	14.7
	Unclear	10	3.1	13.0	134.2	22.2

Strikingly, the adjustment times are quite similar across the various shock categories for both transitory, and the four types of permanent, shocks.

Prices contribution to the adjustment process

In the previous section, the adjustment of the real exchange rate to its new equilibrium path is shown to be quite fast. However, this yields no information as to whether the

adjustment to the new equilibrium is accomplished solely through changes in the nominal exchange rate, or if prices also contribute to the adjustment. The extent to which prices contribute to the adjustment is important, as it assesses whether prices are indeed quasi-fixed in the short-run, as proposed by standard models of nominal rigidities, or if prices are in fact more flexible. Measuring precisely the contribution of prices to the adjustment process is a little bit complex, and would require, a priori, a structural model or some identifying hypotheses. We offer a more agnostic approach. The first measure, $\%|\Delta p|$ reported in the last column of table 2, is constructed as follows:

$$\%|\Delta p| = 100 * \frac{\sum_{t=0}^{s_1} |\Delta \ln(p_t)|}{\sum_{t=0}^{s_1} |\Delta \ln(e_t)|}$$

where zero is the time of the shock, and $|\Delta \ln(p_t)|$ and $|\Delta \ln(e_t)|$ are the absolute log change of the price level and of the nominal exchange rate at time t respectively.

Figure 2. illustrates the computation of $\%|\Delta p|$ for two crises with the same real exchange rate path. In the "rigid prices" case, prices have a 0% contribution to the adjustment to the new equilibrium exchange rate, as only the exchange rate moves, while in the "very flexible prices" case, prices have a very significant contribution, 50% of that of the real exchange rate, as after the initial nominal exchange rate shock, the adjustment to the equilibrium is done through prices.

This measure is likely to understate the contribution of prices to the adjustment as the dispersion of the nominal exchange rate is in general greater than that of prices. Still we find that on average, prices account for 30% of the adjustment, and 40% if we exclude the episodes that have an adjustment period of one month[24]. Trying to control for the higher dispersion of the exchange rates, we built a second measure of the contribution of prices to the adjustment, similar to that of [12], as:

[24] According to $\overline{s_1}$.

$$\%\Delta p = 100 * \frac{\sum_{t=0}^{s_1} \Delta \ln(p_t)}{\sum_{t=0}^{s_1} \Delta \ln(e_t)}$$

Using this measure, we find that prices contributed to 40 % of the adjustment for the full sample, and 56% if we restrict our estimation to episodes with an adjustment time of over one month. This evidence is quite far from the picture of inflexible prices described by nominal rigidities models.

Crises as Return to Sample Trend

To assess the view that currency crises are just corrections to temporary deviations from trend, we computed a third measure of the adjustment time as the duration between the original shock and the intersection between the pre-shock path and the post-shock path. For about half of the sample, this adjustment time is negative, so this alternative interpretation of the data doesn't hold for these episodes. This is not surprising as we have seen that in many instances the drop in the real exchange rate after the currency shock is followed by a devalued or non significantly altered depreciation rate. To allow some heterogeneity in the data, we report in Table 3, the average, $\overline{s_3}$, of this intersection time between the pre-shock and the post-shock paths when it is positive. Still we find that in many instances that this number is very large, well over 5 years, except for appreciations. More significatively, restricting ourselves to the case of episodes where a real devaluation leads to a drop of the exchange rate followed by an appreciated rate of increase[25], we find that in more than in a large majority of the episodes, when testable, we can reject the return to equilibrium hypothesis. In fact, in most such cases, the pattern seems to be a devaluation having a "J-curve" effect, with the real exchange rate

[25] This is the case most favorable to the return to initial equilibrium hypothesis and represents just a little below a quarter of the total devaluations experience.

dropping below its old path initially, before adjusting to its new path.

2.5 Crises: A Cross-sectional Approach

Though the previous section results are robust to transitory fluctuations of 1 or 2 years before reaching the post-crisis path, very slow adjustment, typically taking more than 5 years, may be misidentified with our previous approach for a permanent shock. The example of the Franc CFA crisis countries, as discussed in the next section, clearly illustrates this concern (See Chart 4). Our interpretation of the CFA zone experience is that of a permanent shock with a new path after January 1994. One could alternatively interpret it as prices being extremely sluggish, taking more than 5 years to converge to their long-run path. This latter interpretation, however, is at odds with the real exchange rate's speed of adjustment as measured by the error-correction model. Moreover, as is detailed in the following appears to be at odds with the relatively strong contribution of prices to the adjustment process. To avoid such a misidentification of the post-crisis path of the real exchange rate, a more agnostic approach was used using time dummies and a trend.

2.5.1 Methodology

The sample of large exchange rate shocks was limited to countries for which data was available since 1957 up to 1998 in order to limit the bias in the long-run trend due to small sample size mentionned earlier. A few episodes for which data was unavailable for a full 5 years after the shock were also eliminated. This left a sample of 65 episodes whose adjustment characteristics were very similar to those of the previous section. To compute the mean response of the log of the real exchange rate after a large nominal shock we ran the following regression using GLS fixed effects:

$$LRER_{it} = \alpha_i + \sum_{s=T_{\min}}^{T_{\max}} \beta_s \, 1_{s=t} + \gamma * trend_i(t) + \varepsilon_{it}$$

where $1_{s=t}$is the indicator function (or dummy) equal to 1 when s is equal to t and 0 otherwise, $trend_i(t)$ is the value of the episode specific long-run trend for episode i in month t (where zero is the month during which the crisis occurs), α_i is an episode specific fixed eff ct, and ε_{it} is an error term. $T_{\min}$ and $T_{\max}$ are the sample time boundaries, ± 4 or 5 years here.

The resulting estimated coefficients $\widehat{\beta}_s$ were then used to compute x_t, the mean response of the real exchange rate, reported separately for successful[26] appreciations and depreciations, as:

$$x_t = \sum_{s=T_{\min}}^{T_{\max}} \widehat{\beta}_s \, 1_{s=t}$$

and the standard errors are simply:

$$\sigma(x_t) = \sum_{s=T_{\min}}^{T_{\max}} \sigma(\widehat{\beta}_s) \, 1_{s=t}$$

The β_{-1} coefficient was imposed to be zero, to normalize the value of the mean exchange rate path to zero the month before the crisis. In the results reported in the next section, the coefficient γ was constrained to one. However, relaxing this constraint had little impact on the results. This is not surprising, as the estimated coefficients were never significantly different from one. Various alternatives for the long-run trend were used: a full sample linear path, a quadratic approximation, as well as one with a break in 1973. The results were similar under these alternatives. The use of fixed effects helps control for many differences in the episodes, including country specific characteristics, the size of the initial appreciation-devaluation, or the overappreciation at the time of the shock.

The main difficulty with this approach is the non trivial heterogeneity of the currency crises experience. Though the average path of the real exchange rate in ere are various

[26] Meaning both nominal and real at the time of the shock.

sorts of devaluations, with different causes and different feedback channels, and aggregating these experiences may lead to spurious results. To control for this, we split the samples in smaller subsets with relatively similar results. There were, of course, a few episodes with a different experience and for which the effects of the currency crisis seem transitory. Still, as we analyze them in more detail in the next section, the time taken by these adjustment was typically less than 9 months as well.

An other concern is that this specification imposes the elasticity of the real exchange rate to the "mean signal" (i.e. the typical real exchange rate response to a crisis) to be the same across episodes. A more flexible approach would allow the elasticities to be different across episodes. One way to achieve this is to run instead the following regression:

$$LRER_{it} = \alpha_i + \sum_{s=T_{\min}}^{T_{\max}} \beta_{is} \, 1_{s=t} + \gamma * trend_i(t) + \varepsilon_{it}$$

where the coefficients β_{is} are constrained to be of the form $\beta_{is} = \theta_s \zeta_i$, where the two sets of coefficients ζ_i and θ_s can be estimated via log-likelihood maximization. The ζ_i represent the episode specific elasticity to the signal θ_s, and the mean crisis experience would be given by:

$$x_t = \sum_{s=T_{\min}}^{T_{\max}} \widehat{\theta}_s \, 1_{s=t}$$

Aside from sample size issues, there is a priori little gain, at least in terms of consistency, from such an estimation procedure as long as the distribution of the signal elasticities around its mean is not correlated with the other endogenous variables, which is a priori unlikely.

2.5.2 Results

Charts 1 shows the mean response of an economy to a successful devaluation for the 54 cases in our sample, while Chart 2 shows the response for a successful appreciation for the 10 examples available[27].

The mean devaluation experience seems to be a slow appreciation starting around 2 years before the currency crisis occurs, with a slight acceleration in the last months of the build-up. At the time of the crisis, the real exchange rate drops sharply, significantly below its pre-appreciation level as well as, yet not statistically significantly, below the mean level at which it plateaus after 9 months or so. This lack of significance of this overshooting of the exchange rate seems to be due to the quasi-immediate convergence of some episodes, while other experiences take a few months to converge. Still despite the large standard errors, the plateau level after 9 months is significantly below the real exchange pre-appreciation build-up mean, by about 25-30% of the initial devaluation size. This is compatible with the view that

Appreciations are even faster as a form of adjustment. For our 10 cases, the real exchange rate is already by its mean level within a month after the large nominal shock. After the shock, the real exchange rate slowly depreciates back to its pre-shock mean level within 5 years or so. On average appreciations in our sample, are following steady devaluations before the appreciation shock. Still it's worth noting that the pre and post-levels of the real exchange rate are not significantly apart from one another.

The mean contribution of prices to the adjusment, using our $\%|\Delta p|$ measure, was fairly large, at 63% for the whole sample after a year, and 51% when we exclude large inflation episodes. Similar yet slightly larger numbers were found after two years. A trouble with our second measure, $\%\Delta p$, of the price contribution is that contrary to the first one, it fails to normalize the measure. As in [12], this is an issue when looking at horizons larger than a few months, the contribution taking negative values. Still it tends to yield a mean and median price contribution larger than our first measure.

[27] As before, by successful we mean a change both real and nominal of the same sign.

As an alternative, we also used a more statistical approach were we detrended the log of the real exchange rate using its long-run trend. Limiting our analysis to a window of 4-5 years, the residual was then weighted by its mean in the first year in the window (via substraction). Yearly means and bi-yearly means in the crisis year (excluding the crisis month however) of the weighted were computed. The mean shape of the devaluation and appreciation profiles were similar to that of our GLS estimation. This is not too surprising at this is equivalent to our GLS approach were the fixed effects are constrained (up to a constant) to be equal to the window's first year mean value.

2.5.3 Adjustment time measures

As a complement to our analysis, we also computed two measures of adjustment times to the long-run trend for the 54 episodes of both nominal and real devaluation. As before, we defined the long-run trend using data from 1957 to 1998. Similarly to the previous section, the first measure, s_4, is defined as the intersection time, when it is positive, between the full sample and the post-shock sample trends, and the second measure, s_5, is computed as s_2 by way of an error correction model where instead of the deviation from the post-shock trend we used the deviation from the full sample trend.

Table 4. Adjustment directly back to the long-run?

	n	$\overline{s_1}$	$\overline{s_4}$	$\overline{s_5}$	$\sigma_{\overline{s_5}}$
Real Devaluations Episodes	54	2.8	77.9	52.8	89.7
Overshooting	13	3.4	154.4	91.7	131.4
Undershooting	10	2.8	20.2	31.2	21.3
Divergence 1	6	1.0	...	14.4	11.8
Divergence 2	2	3.0	...	15.4	2.2
Other	23	2.8	154.4	52.5	88.2

Source: Author's computations.[28]

The results are presented in table 4. In one fifth of all cases the adjustment time s_4 would be negative, implying a divergence from the historical trend. For the remaining episodes, the average adjustment time implied by the post-crisis trend of the real exchange rate, is about 6 years and a half, and 4 years and a half if we use the error correction measure. One interpretation of these results is that the adjustment of the rela exchange rate is in fact a slow process taking about 4 to 7 years to be achieved.

However, the mean is relatively "low" mostly because of cases of "undershooting". For these cases, s_4 tends to be particularly biased downward due to the elimination of episodes with negative implied adjustment time. If we exclude these episodes, the mean convergence time for the rest of the sample is over 10 years.

Although, we cannot reject that adjustment takes over ten years or more to occur, table 4 and the results of the previous section show that a theory of slow adjustment needs a typical adjustment time well in excess of 5 to 10 years, *and also* needs to explain the initial quick and large response of prices in the first nine months, *and* the stability of the real exchange rate in the following 3 to 4 years. To say the least, this puts a lot of restrictions on such a theory, and a much more likely interpretation of our results is that adjustment is fast, and that the apparent sluggishness of prices reported previously

[28] Sample restricted to episodes for which data is available from 1957 to 1998, and for a full 5 years after the shock.

"Overshooting" episodes denotes episodes for which the real exchange rate is initially above its full sample path before the shock, and falls below thereafter but with a post-shock slope greater than the full sample trend one.

"Undershooting" episodes denotes episodes for which the real exchange rate is initially above its full sample path before the shock, yet doesn't fall below after the shock but has a post-shock slope smaller than the full sample trend one.

"Divergence 1" episodes denotes episodes for which the real exchange rate path is before the shock above its full sample path and below after the shock, and yet have a post-shock slope smaller than the full sample trend one.

"Divergence 2" episodes denotes episodes for which the real exchange rate path is always above its full sample path before and after the shock, and yet have a post-shock slope greater than the full sample trend one.

in the literature is solely due to the frequent presence of permanent shocks to the real exchange rate in the aftermath of currency crises. With this caveat, prices contribute very significantly to the adjustment.

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2.6 A Few Recent Crises Examples

To illustrate our results, we analyze three of the most striking recent episodes of currency crises : the 1992 EMU crisis, the 1994 CFA Franc Reallignment, and the Mexican Peso crisis of 1994-95.

2.6.1 The 1992 EMU crisis

Our sample contains 2 European countries, Italy and the United Kingdom that were explicitly part of the EMU and devalued their currency in September-October 1992 as well as two Scandinavian countries, Finland and Sweden which had pegged their currency, officially as of May 1991 in the case of Sweden, and followed the devaluation path of the UK[29]. Starting in the summer of 1992, uncertainty about the outcome of referendums on the Maastricht treaty in Denmark and France, as well as the rising costs of the German reunification, started speculation about the commitment of governments to defend the narrow bands of the ERM. After a period of turbulence, the British pound left the ERM on 16 September 1992. The Italian Lira, which had already been realignement a few days before, followed suit. On November 19, the Swedish central bank abandonned its peg to the DM, and let the Krona float. The crisis continued well into 1993, as Ireland devalued its currency by 10% in January and many European central banks were forced to intervene massively to defend the ERM. Finally, the widening of the ERM bands from 2.25% to 15% on August 2,1993 progressively relaxed speculation on European currencies.

[29] See [13] Chapter 3. for a more detailed account of the crisis.

Using our methodology to analyze these experiences, we can reject in all cases the hypothesis that the real exchange rate path was unaltered in the wake of the crisis. For all countries, except Finland which also saw a small yet significant appreciation in its post-shock trend rate of increase, the experience of the ERM 1992 countries and their satellites seems one of uniform real depreciation of as much as 35% in its trend level. Chart 3. shows the pattern of adjustment of the real exchange rate for each of these four countries. Of all the countries, only the United Kindom has seen its real exchange rate move back in the vicinity of its pre-crisis level. The source brusque upturn of the British Pound in the end of 1996-begining of 1997 is a bit unclear. Reasons evoked include a stronger than expected UK economy as well as a bet that Britain will join the EMU within the pre-1992 ERM bands.

On average prices account for at least 10% of the exchange rate contribution, significantly lower than the average experience of currency crises in our sample. The slowliness of prices to rise in the immediate aftermath of the ERM devaluations as often been described as an example of price stickiness. Yet the persistence of the real exchange rate at depreciated levels not attained since the 1970s, with the exception of the UK, seems to indicate that there is a price equilibrium at these depreciated currency levels. On the goods market side, there are several candidates for the equilibrium displacement. In the case of Italy, in-depth reforms of the economy and of the political system during this period, may explain the persistent devaluation of the Lira[30]. In Sweden, the overhaul of its once-famed welfare system and the rising costs of unemployment may also be an important driving force. Yet, the similarity of the devaluation effects on the real exchange rath between these countries with the exception of the UK, seems to suggest that the explanation needs be a common one.

[30]Doubts about its commitment to the EMU, though it may be relevant for the 1995-1996 period, are unlikely to account for much, as the real exchange rate with the DM is in June 1999 more or less what it was in 1993.

2.6.2 The 1994 CFA Franc Reallignment

Our sample also covers 3 countries, Burkina Faso, Senegal and Togo, of the West African Economic and Monetary Union (WAEMU), which, as part of the Franc CFA[31] zone, had their currency devalued by 50% from 50 CFA Franc to 100 CFAF per French Franc. These countries represent 40% of the 7 WAEMU countries as measured by their share of GNP in 1994, and 23% of the CFA Zone[32].

For all three countries, the devaluation experience has been similar with a real devaluation followed by an appreciation trend. On average for the three countries, the level devaluation is of 38%, with the rate of appreciation increasing by 0.4%. The adjustment to the post-shock path were longer than for most episodes in the sample, taking 6 months on average: 3 months for Burkina Faso, 6 for Senegal and 9 months for Togo. Prices contribution to the adjustment, as measured by $\%|\Delta p|$, is almost half, a significant 49%, of that of the nominal exchange rate. A comparison at the annual frequency hints at a similar response for the other countries of the CFA zone.

Initially, the devaluation of the Franc CFA occured as African governments in the zone were preoccupied by the drop in world market prices for its major export commodities (cocoa, coffee, cotton and petroleum), stagnating growth since the mid-80s and rising labor costs especially in the government sector (See [19]). However, the currency realignment wasn't the only policy enacted at the time as CFA governments were concerned that rising prices would offset the nominal devaluation. Consequently many very important reforms were passed simultaneously. A common experience in the CFA zone has been the reforms of the labor market, the wage chill in the government sector, and the progressive liberalization of important sectors of the economy, all part of the CFA devaluation package negociated with the IMF, the World Bank and the French government. In 1994, the government nominal wage bill increased by only 5.6% in Burkina Faso, 12.5% in Senegal and 28% in the case of Togo. And most governments tightened

[31] For "Colonies Francaises d'Afrique" i.e. French former African Colonies.
[32] Source: Banque de France [7]

wages further in the following years. Simultaneously Senegal adopted a new labor code, and both Burkina Faso and Togo followed as a means to boost labor flows. Also, significant was the rise of external indebtedness due to the devaluation, from 20%, as a share of total government revenue, in 1993 to 28 % in 1994 for Burkina Faso, 34% to 57% for Senegal, and 85% to 99% for Togo. Yet, at this point the economic boom rather than increased taxation seems to be reducing significantly the external debt, which reduces the case that discouraged foreign investment caused the real devaluation.

Therefore important labor reforms and the significant concurrent liberalization of the economy, are good candidates to explain the consequent appreciating path of the real exchange rate, and the very significant and persistent boom that followed the CFA devaluation[33]. Whether these reforms and in particular the major drop in real wages in the government sector could have been enacted by the government in the absence of the devaluation of the Franc CFA is an open question. Also the special role that the French government played by conditioning its financial help and the devaluation to reform, after failed early IMF-World Bank adjustment policies, is unclear, but may make this experience not necessarily universal.

2.6.3 The 1994-95 Mexican Peso Crisis

On December 20, 1994, after a series of small devaluations in February-March[34], the Mexican Peso was devalued by 21%. Though the Peso remained stable the next day, it was further devalued by 12% on December 28. The adjustment, according to our first measure, was done 5 months later, in line with the view that the stabilization of the Peso was probably achieved only via the $52 billion IMF-US Treasury emergency package of March-April 1995. Arguably our measure fails to capture the additional turmoil that

[33] GDP growth in Senegal was a little more than 5% over the 1994-1997 period after years of stagnation. Burkina Faso is still growing at more than 6%.

[34] Interestingly, these devaluations happened before the March 21 assassination of the PRI's presidential candidate, Luis Donaldo Colosio, the latter having a negligible impact (-0.6%) on the Peso at the time.

erupted in October-November 1995[35]. However, it is somewhat unclear whether this is part of the adjustment process or a new shock.

As in the CFA crisis, prices played a significant role in the adjustment process accounting for 31% of the exchange rate contribution if we use $\%|\Delta p|$, and 45% if we use $\%\Delta p$.

Although there is still some debate, the prime suspect behind the currency crisis is a liquidity crisis, along the lines of Diamond and Dybvig[22]'s generic model, with a run on foreign currency (namely dollar) indexed debt, including the Mexican ill-famed Tesobonos, reinforced if not generated by weak and undersupervised banking sectors. In particular, Sachs et al, comparing with the experience of 20 emerging markets "caught in the Tequilla crisis", find evidence that a subtantial part (70%) of the crisis was caused by poor monetary management in the form of too little reserves with respect to the money supply (M2), overvalued exchange rate, and easy lending to the private sector in this election year.

As this example illustrates, the adjustment of the real exchange rate to its new path was quite fast and the contribution of prices to the adjustment quite significant. The persistent dip in value seems to have been more caused by real events, credit crunch in the non-tradable sector, monetary and fiscal management uncertainty,...than by nominal rigidities. Yet as emphasized in [25], one would like to understand why investors took so long to act upon the Mexican looming troubles, when most information seemed available early on.

2.7 Conclusion

This chapter shows that the identification of the equilibrium exchange rate is crucial to determine the properties of the adjustment of nominal exchange and prices. When large nominal shocks can have permanent effects after the crisis the picture of sluggish

[35] This is due to the fact that we use only 2 months to test for the convergence to the post-shock path. Still our main results don't change significatively when we increase the number of months.

adjustment disappears, and convergence is found to occur in less than a year. Our analysis shows that permanent shocks dominate the experience of currency crises. Only in about 10% of the episodes we can't reject the hypothesis of no change in the trend of the real exchange rate. Strikingly, and in line with the observation of Engel and Hamilton[29], it often seems that the real exchange rate displays little variability outside of crises episodes. Despite the maybe controversial nature of allowing for crises to have different equilibrium values before and after the crisis, it seems that this approach caracterizes well the adjustment of recent currency crises such as the 1992 ERM, the 1994 CFA or Mexican crises.

These results are confirmed when we use a cross-section and long-run sample trends instead of a within sample strategy to identify the equilibrium path. It is an important result as this later approach has the advantage of not constraining the speed of the adjusment. Also prices are shown to contribute very significantly to the adjustment even within the span of a few months, leaving little role for nominal rigidities in this context. Standard models of real rigidities are also not the most apt to explain the experience of currency crises as they usually don't generate permanent shocks in response to large nominal shocks. This doesn't mean that real rigidities are irrelevant for crises modeling. Indeed, one interpretation of our episodes experience, is that crises are times of changes where the factor behind the real rigidities, political or other, is readjusted, real rigidities regaining their full force in the aftermath. More figuratively, in this interpretation crises are times when changes are suddenly possible to modify the economy, the window of opportunity soon disappearing.

A striking observation is that large real devaluations seem to be a frequent experience in the wake of large nominal shocks. While, it has been often interpreted as evidence for nominal rigidities, it has some important implications for theorists in the neoclassical tradition as well. Indeed, as we saw, about a quarter of our large nominal fluctuations, correspond to real devaluations in excess of 20%. Also strikingly, in most cases, there is no indication of significant currency depreciation or excess volatility before the crisis.

This is at odds with the standard model of currency crisis of Krugman[49] whose central tenant is precisely that the time of crisis is pinned down by the lack of arbitrage, and thus continuity of the real exchange rate path. Two alternative approaches have been suggested to account for such unanticipated, persistent and large discontinuities as observed in our data. One, the first-generation currency crises models following the analysis of Krugman[49], relies on (at least partially) unanticipated large changes in the fundamentals. The other one, the second-generation currency crises models, relies on multiple equilibria of the real exchange rate path[36].

A major difficulty with the first-generation models, is that no fundamental, except maybe the commitment of the central bank to defend the currency's parity or to act as the lender of last resort, seems to have innovations of the order of magnitude needed to match the evidence above. This is reflected in the fact that though often significant in predicting currency crises, macroeconomic indicators such as international reserves, imports-exports,, tend to overpredict greatly the occurence of crises[37]. Also puzzling is the fact that the information behind the main ex-post explanations is usually available well before the enactment the crisis. To be compatible with the evidence above, the first approach needs to be augmented by some form of market expectations irrationality, as no macroeconomic fundamental seems to display such large fluctuations as that of the real exchange rate, especially at the monthly frequency.

Although it is too early to be completely sure, the recent experience of the Asian crises seems coherent with our finding that currency crises are quickly resorbed. Though some commentators have been surprised, there is ample evidence that the crisis is over and that these economies, restructured during the crisis, are back on a new track, and there is no evidence of remaining inflationary pressures. The two economies maybe still lagging behind in terms of adjustment are Thailand and Indonesia, both due to political indecisiveness it seems.

[36] See the survey by Krugman[52].
[37] See Berg and Pattillo[9].

It would important to know what are the exact sources of the permanent shocks and how they interact with the currency crisis. At this stage, our analysis cannot dissociate at this stage whether permanent shocks are an effect of the currency crisis itself, or whether it is caused by other factors concurrent to the crisis. The possibility of arbitrage still would imply a trigger role to the currency crisis itself.

What could be next? Increasing the number of large nominal shock episodes for which long-run data is available would be very helpful, as it would enable us to diminish the restrictions in our cross-sectional analysis. Though permanent shocks seem to dominate the experiences in our sample, a finer characterization of the variety of currency crises would be possible then. An increase in the window size around the crisis would be also very informative as it would enable a study of the multiplicity of crises and answer questions like: Are countries that have a currency crisis more likely to have a crisis within 6 months, one year, two years,...? It would be interesting to control as much as possible for changes in countries' macro vulnerability variables such as the current account deficit, and others in [61], in order to distinguish between path dependence and heterogeneity induced reccurence.

Appendix. Characteristics of Episodes

Table 3b. Adjustment Characteristics (Level Effect Only).

		n	$\overline{s_1}$	$\overline{s_2}$	$\%\|\Delta p\|$
All Crises		207	2.7	26.9	30.3
	No change	46	2.0	15.2	41.2
	Change in intercept	161	2.9	30.2	27.3
Nominal-Real Devaluations		172	2.7	29.7	29.6
	No change	38	2.1	16.7	42.8
	Change in intercept	134	2.9	33.3	25.9
Nominal-Real Appreciations		30	2.8	13.2	23.8
	No change	6	1.7	9.1	15.4
	Change in intercept	24	3.1	14.2	25.9

Country	Date	Ref Co.	Dev. Type	s_1	s_2	s_3	s_4	%ndev	%rdev
Albania	Sep-92	Germany		1		-11.99	14.44204	955.44	1030.79
Albania	Sep-95	Germany		1		7.17	52.75807	879.33	891.06
Argentina	Apr-89	US	Appr. rate	24	20.50	-6.29	-3.97023	-74.94	-67.32
Bangladesh	May-75	US	Deprec.	4	2.16	66.37	52.84415	-38.06	-41.53
Bangladesh	Feb-81	US	Both Depr.	1	1.54	-4.48	-0.16678	-4.10	-5.49
Bangladesh	Mar-90	US	Appr. rate	1	3.11	1.41	41.18832	-4.36	-3.20
Belgium	Oct-69	Germany	Both Depr.	1	6.40	-28.08	-14.6005	-5.24	-5.36
Bolivia	Feb-85	US	Deprec.	1		40.86	0.259116	-75.42	-26.52
Bolivia	Sep-85	US	Both Depr.	9	15.80	-10.92	-146.502	-93.24	-89.45
Brazil	Jan-90	US		1	17.09	-0.01	44.32883	-35.31	7.64
Burkina Fa	Jan-94	France	Deprec. AR	3	5.85	104.61	42.4823	-50.01	-46.61
Canada	May-62	US	Deprec. AR	1	6.73	7.35	86.87956	-2.99	-2.99
Canada	Jun-70	US		1	4.63	-7.67	1.151122	3.31	3.36
Canada	Dec-76	US	Both Depr.	1	1.91	-5.57	23.69584	-3.26	-3.24
Canada	Jun-82	US	Apprec.	1	24.30	150.06	-4.49372	-3.27	-3.48
Chile	Jun-82	US	Both Depr.	3	2.67	-51.19	-137.669	-9.34	-5.73
Chile	Oct-84	US	Deprec. AR	9	11.26	105.36	139.3325	-13.27	-5.38
Chile	Mar-85	US	Appr. rate	1		1.07	23.23415	-9.51	-5.08
Chile	Jul-85	US	Appr. rate	1	6.60	0.90	123.4345	-9.23	-9.34
Chile	Nov-90	US	Appr. rate	1	5.43	-0.84	30.32042	-4.41	-3.73
Chile	Feb-92	US		1	5.84	-4.77	15.62236	6.28	5.09
Colombia	Jul-57	US	Both Depr.	5	8.44	-18.50	47.2608	-47.82	-48.06
Colombia	Dec-62	US	Both Depr.	4		-10.47	29.03466	-24.27	-23.94
Colombia	Sep-65	US	Both Depr.	6	9.67	-28.22	3.47414	-33.30	-33.30
Colombia	Jul-84	US	no change	1	10.41	6.83	9.364756	-2.97	-2.12
Colombia	Feb-85	US		1	5.74	-1.06	2.578919	-2.60	0.04
Colombia	Oct-86	US	Both Appr.	1	7.69	-4.53	-86.9387	-2.30	-0.32
Colombia	Mar-94	US		1	5.95	-319.32	-21.7616	13.38	15.53
Costa Rica	Jan-61	US	Deprec. AR	7	9.15	114.59	48.46948	-4.00	-4.00
Costa Rica	Oct-81	US	Depr. rate	9	11.69	-0.63	152.3138	-38.01	-33.49
Costa Rica	Jan-91	US	Deprec. AR	1	5.11	30.50	27.25179	-3.28	-1.35
Costa Rica	Jul-92	US	Both Appr.	1	6.27	-25.97	3.35792	-4.86	-4.49
Croatia	Oct-93	Germany		1	4.04	60.79	40.10686	-23.56	3.30
Dominican	Jan-85	US	Both Depr.	1	29.56	-118.64	-411.246	-69.11	-66.97
Dominican	Aug-90	US	no change	1	2.78	1.02	74.11834	-22.49	-14.31
Dominican	Jan-91	US	no change	1	2.46	-28.01	58.05749	-12.63	-13.08
Ecuador	Jul-61	US	Deprec.	1	1.26	648.13	710.1225	-8.33	-8.33
Ecuador	Jul-70	US	Deprec. AR	1	6.75	56.46	45.6949	-16.92	-10.83
Ecuador	Apr-83	US	Deprec.	1	7.78	41.11	-35.1164	-16.81	-14.10
Ecuador	Dec-85	US	Both Depr.	1	2.56	-52.87	-6.06036	-29.84	-28.70
Ecuador	Sep-88	US	Appr. rate	1	7.60	4.46	104.7466	-35.34	-30.95
Ecuador	Sep-92	US	Apprec. DR	10	14.93	107.77	32.10476	-20.35	-12.21
Ecuador	Feb-96	US		1		14.99	0.065843	13.74	16.26
El Salvador	Jan-86	US	Deprec. AR	2	0.46	146.22	23.50558	-22.50	-21.31
El Salvador	May-90	US	Both Depr.	3	7.67	-77.59	33.3143	-27.54	-27.10
Estonia	Jan-97	Germany	no change	1	7.66	12.88	3.07401	-6.56	-5.70
Fiji	Jul-72	US	no change	4	2.95	0.26	-6.42547	-5.16	-4.51
Fiji	Jan-74	US	Depr. rate	1	9.81	-2.05	-115.467	-4.10	-3.11
Fiji	Jul-87	US	Deprec. AR	1	2.76	71.60	83.51931	-16.93	-16.69
Fiji	Jan-98	US	Deprec.	1	2.86	-132.79	-233.325	-19.48	-19.30

Finland	Sep-57	Germany	Deprec.	1	1.01	-276.67	17.32147	-14.06	-13.20
Finland	Oct-67	Germany	Both Depr.	8	6.97	-68.37	-14.2418	-16.27	-15.94
Finland	Apr-77	Germany	Both Depr.	1	27.13	-95.02	48.2952	-6.31	-5.87
Finland	Sep-92	Germany	Deprec. AR	4	4.25	53.52	70.43114	-10.64	-10.22
France	Nov-57	Germany	Deprec.	2	1.06	90.03	-9.86387	-16.65	-15.03
France	Dec-58	Germany	Deprec.	1	9.07	36.04	32.04734	-15.06	-15.31
France	Aug-69	Germany	Both Depr.	1	3.49	-31.81	-9.14758	-7.65	-7.23
France	Jan-74	Germany	Appr. rate	1	11.35	-9.48	378.9271	-3.15	-2.07
Germany	Mar-61	US		1	3.64	-50.81	182.4772	4.39	4.68
Germany	Oct-69	US		1	10 02	0.05	22.65704	6.32	6.43
Germany	Jun-73	US		2	5.56	16.24	3952.33	8.31	8.27
Germany	Mar-91	US	no change	1	4.77	10.40	11.38936	-7.54	-7.63
Greece	Oct-73	Germany		1	2.10	-37.16	-41.9027	3.55	8.02
Greece	Jan-83	Germany	Depr. rate	3	7.14	-5.04	13.50143	-14.88	-14.29
Guatemala	Jun-86	US	Both Depr.	1	4.50	-115.41	100.5036	-60.00	-59.00
Guatemala	Feb-90	US	Deprec. AR	5	3.41	44.11	73.82417	-10.56	-9.04
Guatemala	Aug-90	US	Appr. rate	4	2.47	0.59	64.39629	-9.43	-9.54
Guatemala	Jan-97	US	Apprec. DR	1	2.09	13.75	-81.6351	-9.11	-8.46
Haiti	Sep-91	US	Deprec. AR	12	20.49	156.71	54.73493	-32.88	-31.78
Haiti	Oct-94	US		1	11.30	-43.77	15.10398	27.69	26.02
Honduras	Mar-90	US	Both Depr.	1	15.46	-161.54	-184.997	-39.22	-38.92
Hungary	Jan-76	Germany		1	10.98	6.05	22.18114	4.53	4.35
Hungary	Jul-82	Germany	Both Depr.	5	8.82	-48.10	-7.4384	-4.73	-3.90
Hungary	Apr-89	Germany	Appr. rate	1	3.08	1.84	37.25089	-6.39	-5.64
Hungary	Jan-91	Germany	Apprec. DR	2	3.79	76.36	51.87315	-10.09	-2.30
Hungary	Aug-94	Germany	Deprec.	7	5.64	19738.69	22.22155	-6.54	-5.57
Iceland	Jul-93	Germany	Deprec. AR	1	31.83	105.86	47.18706	-6.33	-5.94
India	Jun-66	US	Both Depr.	10	13.48	-38.71	-1934.35	-18.36	-16.67
India	Jul-72	US	no change	1	2.39	3.61	17.40953	-5.16	-4.05
India	Apr-85	US		3	23.32	-182.54	98.77658	3.76	4.82
India	Jul-91	US	Deprec. AR	1	3.98	16.41	42.20743	-17.68	-15.78
India	Mar-93	US	Both Depr.	5	7.58	-36.68	92.58139	-16.23	-16.15
Indonesia	Nov-78	Japan	Deprec. AR	5	6.29	32.63	2.802662	-15.15	-12.21
Indonesia	Apr-83	Japan	Both Depr.	1	2.59	-65.54	-32.1647	-27.51	-26.01
Indonesia	Sep-86	Japan	Deprec. AR	1	11.27	9.40	70.03123	-20.81	-19.02
Italy	Feb-76	Germany	Deprec. AR	1	24.01	17.10	97.48598	-9.97	-8.54
Italy	Oct-92	Germany	Deprec.	3	10.25	-2156.37	71.90681	-8.19	-7.79
Japan	Jan-72	US		2		-122.55	54.88548	7.74	8.03
Japan	Feb-73	US		1	24.95	-126.86	-137.67	8.18	8.00
Japan	May-80	US		1	8.21	-14.06	17.61413	9.98	9.87
Japan	Oct-85	US		7	14.87	-415.37	57.74018	10.20	10.86
Korea	Jul-71	Japan	Deprec.	19	19.78	552.67	65.65471	-10.55	-8.72
Korea	Dec-74	Japan	Both Appr.	1	32.38	-19.98	-110.623	-13.97	-12.91
Korea	Jan-80	Japan	no change	1	6.50	-54.01	-20.8879	-12.70	-10.66
Latvia	Mar-93	Germany		10	12.26	5.40	46.78197	12.74	15.07
Luxembour	Oct-69	Germany	Both Depr.	1	4.32	-54.99	-60.5355	-5.24	-5.67
Malaysia	Jul-73	Japan		1	4.06	-23.67	-13.3936	6.24	7.54
Malaysia	Aug-75	Japan	Both Depr.	1	28.91	-49.64	-434.033	-7.87	-7.08
Malaysia	May-80	Japan	Appr. rate	1	13.02	-8.31	1.732125	-5.01	-5.17
Mexico	Sep-76	US	Deprec. AR	1	3.31	43.09	11.45043	-37.64	-37.93
Mexico	Mar-82	US	Both Depr.	1	7.74	-43.96	-25.6155	-30.78	-23.75

Mexico	Dec-94	US	Deprec.	5	11.02	-172.772	37.00626	-12.42	-11.70
Myanmar	Jan-72	Japan	Appr. rate	4	3.12	9.12	72.75027	-18.58	-20.76
Myanmar	Jan-75	Japan	no change	4	2.40	4.12	-125.23	-11.57	-14.11
Myanmar	Oct-85	Japan	Deprec. AR	4	9.03	21.01	69.20908	-3.34	-3.14
Myanmar	Aug-94	Japan		1	5.36	7.09	-13.1274	6.79	10.72
Namibia	Apr-96	US	Deprec.	1	10.08	-58.30	-135.914	-6.80	-6.91
Nepal	Dec-67	US	Both Depr.	1	11.50	-145.10	54.21589	-17.70	-18.02
Nepal	Oct-75	US	Both Depr.	2	6.04	-87.66	23.55546	-11.47	-11.80
Nepal	Oct-81	US	Depr. rate	1	10.22	4.50	55.215	-5.98	-5.48
Nepal	Dec-85	US	no change	1	17.57	-39.93	95.00213	-14.92	-14.59
Nepal	Jul-91	US	Deprec. AR	1	5.07	12.79	80.66537	-9.46	-6.22
Nepal	Feb-93	US	Appr. rate	5	4.04	-4.90	60.45314	-7.34	-7.00
Nicaragua	May-90	US		1	1.61	-12.58	2.076699	-53.47	8.36
Nicaragua	Mar-91	US	Both Depr.	7	16.11	-4.20	53.0158	-79.66	-26.59
Pakistan	May-72	US	Deprec. AR	11	27.15	93.15	37.59661	-39.42	-40.43
Pakistan	Feb-82	US	Both Depr.	2	5.60	-37.43	21.94029	-4.48	-5.02
Pakistan	May-89	US	Deprec.	1	5.16	202.90	129.219	-4.24	-5.88
Pakistan	Jul-93	US	Deprec. AR	1	8.68	14.47	17.74154	-4.25	-3.24
Pakistan	Nov-95	US	Depr. rate	1	3.13	-2.20	6.345199	-6.49	-5.49
Pakistan	Nov-96	US	no change	2	2.49	7.68	-7.43613	-5.30	-4.31
Paraguay	Jun-84	US	Both Depr.	1	8.02	-49.05	28.5543	-33.33	-31.14
Paraguay	Dec-86	US	Appr. rate	1	18.95	15.95	-32.9316	-41.82	-41.46
Paraguay	Mar-89	US	Deprec.	12	13.70	130.90	214.422	-45.27	-44.55
Paraguay	Oct-92	US	Appr. rate	1		10.49	63.62811	-39.35	-39.21
Peru	Jan-90	US		1	0.57	-2.58	60.74162	757.21	977.73
Peru	Aug-90	US	Deprec. AR	7	3.85	4.46	56.67842	-86.36	-32.93
Philippines	Jan-62	Japan	Deprec. AR	3	5.57	717.30	62.96822	-21.87	-24.07
Philippines	Mar-70	Japan	Deprec.	1	19.29	-2481.13	147.0413	-31.06	-29.29
Philippines	Oct-83	Japan	Deprec. AR	1	1.91	25.59	2.393659	-22.87	-22.65
Philippines	Jun-84	Japan	no change	1	4.16	-29.72	-5.24654	-18.00	-12.22
Philippines	Nov-90	Japan	Depr. rate	2	5.50	-1.89	11.51767	-8.44	-6.49
Poland	Sep-89	Germany		17	6.67	7.42	53.2254	-25.23	0.34
Portugal	May-78	Germany	Deprec. AR	1	7.51	6.27	36.42101	-5.34	-4.12
Portugal	Jun-82	Germany	Both Depr.	1	20.93	-20.01	-184.582	-6.09	-6.17
Rwanda	Apr-66	France	Both Depr.	1	0.62	-38.74	-136.657	-25.00	-26.02
Rwanda	Jan-74	France	Both Appr.	1	25.72	-28.45	45.903	-2.40	-2.15
Rwanda	Sep-83	France	Depr. rate	1	15.43	3.08	88.61034	-3.61	-4.52
Rwanda	Nov-90	France	Deprec.	1		129.68	205.3783	-32.74	-28.52
Samoa	Nov-75	US	Both Depr.	1	11.11	-66.09	-6.80867	-20.24	-22.36
Samoa	Jun-79	US	Depr. rate	6	9.72	6.86	52.65876	-17.47	-17.00
Samoa	Feb-83	US	Deprec.	1	36.45	-229.21	-200.407	-9.65	-8.56
Samoa	Aug-84	US	Deprec. AR	1	7.60	20.63	65.41858	-10.95	-11.67
Samoa	Jun-91	US	Deprec.	1	8.48	40.19	34.47053	-6.26	-8.78
Senegal	Jan-94	France	Deprec. AR	6	5.78	113.30	92.73589	-50.01	-43.79
Seychelles	Jul-79	France		4	3.95	12.54	25.89165	4.18	3.81
Seychelles	Mar-81	France		1	33.97	-1538.62	-164.31	7.23	7.49
Seychelles	Mar-91	France		1	25.23	-27.83	-10.0954	4.05	3.24
Sierra Leor	Jan-90	France	Deprec. AR	1	11.75	12.09	51.64072	-25.49	-13.44
Singapore	Feb-73	Japan	Apprec. DR	5	12.10	129.10	34.99404	-2.50	-0.10
Singapore	Jul-75	Japan	Both Depr.	1	2.21	-6.40	8.715549	-4.42	-4.45
Singapore	May-80	Japan	Both Appr.	14	22.49	-59.06	-15.2971	-5.68	-6.84

Singapore	Oct-85	Japan	Deprec. AR	7	15.12	154.15	74.04648	-5.48	-5.28
Slovak Rep	Jul-93	Germany	Deprec.	1	7.02	-34.72	29.9143	-5.73	-5.10
Solomon Is	Mar-81	US	no change	1	2.89	-20.99	-48.6532	-6.56	-6.35
Solomon Is	Aug-82	US	Both Depr.	1	7.76	-12.57	15.21716	-6.82	-5.26
Solomon Is	Sep-85	US	Deprec. AR	1	14.12	9.30	120.2252	-6.57	-5.77
Solomon Is	Dec-92	US	Appr. rate	1	20.40	-1.21	11.76237	-6.24	-5.15
South Afric	Feb-73	US		1	1.99	-66.46	-75.8763	6.79	7.76
South Afric	Sep-75	US	Deprec. AR	1	0.67	91.16	8.570518	-5.68	-6.13
South Afric	Apr-96	US	Depr. rate	5	4.53	3.29	7.568964	-6.80	-6.59
Spain	Jul-59	Germany	Both Depr.	1	25.03	-76.28	177.4344	-13.10	-13.35
Spain	Dec-67	Germany	Both Depr.	1	0.75	-32.85	-3.89016	-8.37	-8.37
Spain	Feb-76	Germany	no change	1	2.04	20.08	19.7754	-9.16	-8.63
Spain	Jul-77	Germany	no change	13	21.45	-63.72	12.99058	-15.69	-12.88
Sri Lanka	Nov-67	US	Deprec. AR	1	16.99	132.57	-14.4381	-9.72	-9.45
Sri Lanka	Oct-77	US	Deprec. AR	3	2.23	75.24	203.2377	-14.32	-14.33
Sri Lanka	Feb-83	US	Appr. rate	1	5.96	-1.80	130.1363	-4.79	-4.03
Sri Lanka	Jul-83	US	Appr. rate	1	6.92	-9.49	117.6067	-4.48	-3.96
Sri Lanka	Aug-89	US	no change	7	6.84	9.75	23.05117	-4.34	-2.24
Sri Lanka	Jan-93	US	Deprec.	1	3.43	-470.02	-12.0486	-8.42	-6.45
Sudan	Jun-78	France	no change	1	5.36	0.83	-1246.95	-10.00	-3.83
Sudan	Sep-79	France	Deprec.	1	3.17	31.26	-27.0671	-10.00	-7.62
Sudan	Nov-81	France	Deprec.	1	4.37	-610.12	72.39847	-33.91	-35.38
Sudan	Feb-85	France	Both Depr.	1		-48.96	20.40473	-38.21	-36.03
Sudan	Oct-91	France	Both Depr.	4	5.68	-54.70	240.7051	-65.30	-65.67
Swaziland	Feb-73	US		4	4.51	-31.93	-12.1569	6.79	6.85
Swaziland	Sep-75	US	Deprec. AR	1	8.88	88.67	21.06168	-5.68	-5.50
Swaziland	Jul-84	US	Deprec. AR	1	6.51	30.56	61.36135	-12.55	-11.07
Swaziland	Apr-96	US	Deprec.	1	5.74	-50.25	-7.5847	-6.80	-5.41
Sweden	Sep-77	Germany	Deprec.	1	15.55	297.96	31.97331	-8.06	-8.19
Sweden	Nov-92	Germany	Deprec.	4	12.31	555.75	66.58032	-3.52	-3.88
Switzerlanc	Aug-78	Germany		4	5.12	6.61	-2.18846	5.38	5.70
Thailand	Jul-73	Japan		11	13.71	-84.78	24.62805	2.61	2.79
Thailand	Nov-84	Japan	Both Depr.	14	33.44	-76.25	-157.567	-14.68	-14.75
Togo	Jan-94	France	Deprec. AR	9		56.70	43.91762	-50.01	-43.96
Turkey	Aug-70	Germany	Deprec. AR	1	7.61	62.42	87.56105	-30.26	-25.61
Turkey	Mar-78	Germany	Depr. rate	1	2.86	-12.33	46.59922	-24.52	-21.04
Turkey	Jun-79	Germany	no change	1	2.56	-18.95	28.73771	-17.42	-14.63
Turkey	Jan-80	Germany	Deprec.	2	12.48	-108.16	40.94495	-19.01	-11.51
Turkey	Apr-94	Germany	Deprec. AR	1	0.80	42.75	24.74371	-36.51	-20.90
Turkey	Jan-97	Germany	no change	1		1.94	-8.59341	-15.43	-10.92
Uganda	May-87	France	Depr. rate	8	8.35	6.72	31.38594	-63.25	-60.70
Uganda	Jul-88	France	Both Depr.	1	12.84	-12.01	14.60743	-59.99	-47.99
Uganda	Aug-91	France	Appr. rate	1	39.39	6.51	40.73044	-8.76	-6.76
United King	Nov-67	Germany	Both Depr.	1	11.18	-54.94	-6.44495	-5.35	-5.57
United King	Jul-79	Germany		15	23.54	387.59	82.80448	3.78	7.63
United King	Apr-85	Germany		6	18.09	10.58	-1.82065	3.38	5.39
United King	Oct-92	Germany	Deprec.	1	40.28	148.53	53.08989	-8.59	-8.34
Uruguay	Dec-82	US	Deprec.	1	16.30	-168.80	1130.307	-49.84	-42.44
Uruguay	Nov-89	US	Deprec. AR	1		8.83	36.7813	-25.07	-22.26
Venezuela	Jan-64	US	Deprec.	1	0.79	-378.13	327.3991	-12.62	-12.99
Venezuela	Mar-84	US	Both Depr.	1	6.05	-61.95	-1.44423	-37.60	-37.04

Venezuela	Dec-86 US	Deprec.	1	8.80	32.82	-222.241	-48.27	-47.70
Venezuela	Mar-89 US	Deprec. AR	2	2.81	34.93	73.12472	-59.36	-51.00
Venezuela	Jun-94 US	Unclear	1		7.33	10.35085	-21.50	-14.70
Venezuela	Dec-95 US	Deprec. AR	4		22.99	9.589063	-32.53	-28.41

Figure 1. In-sample Detrending Bias when Shocks are Permanent

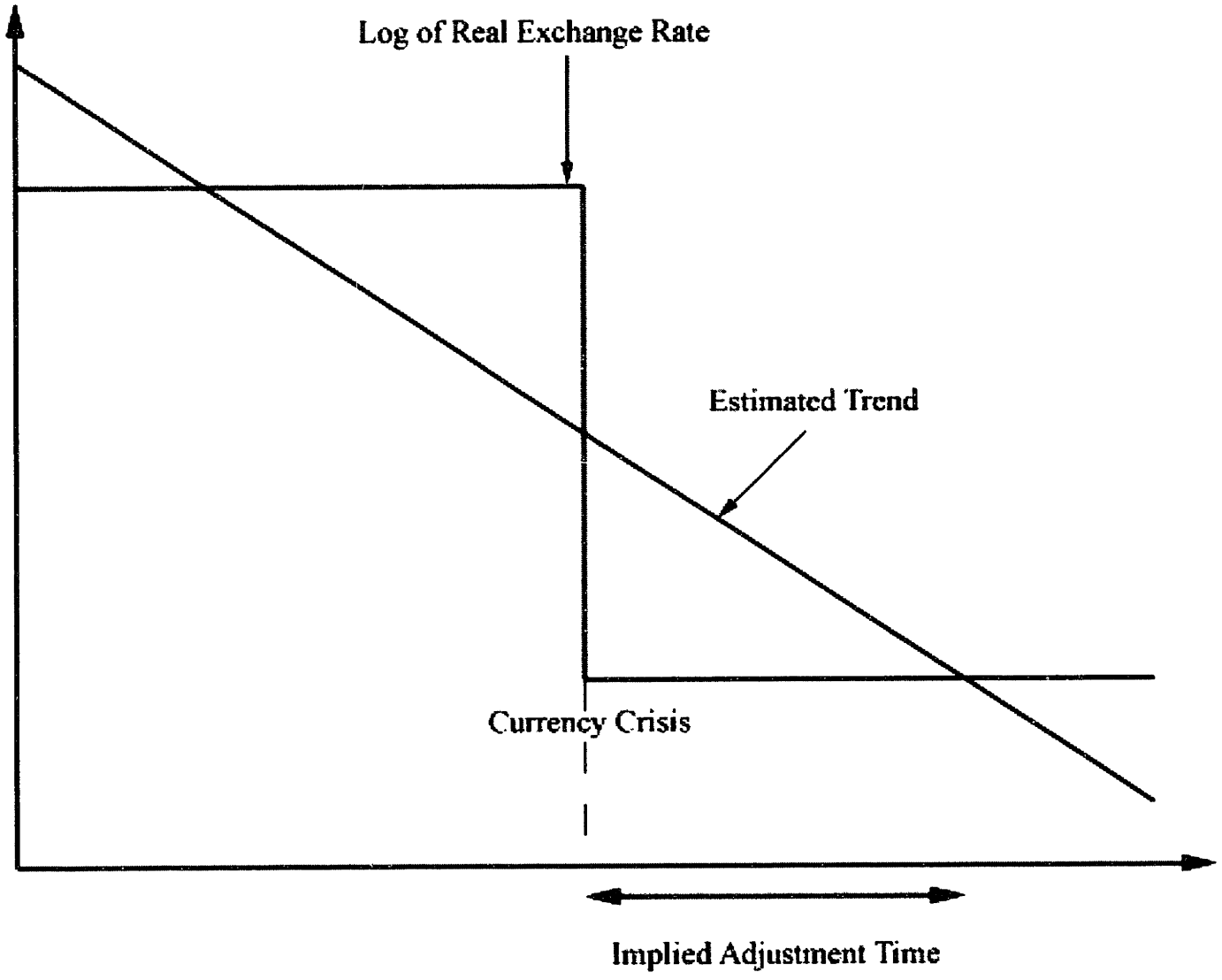


Figure 2. Contribution of Prices to the Adjustment

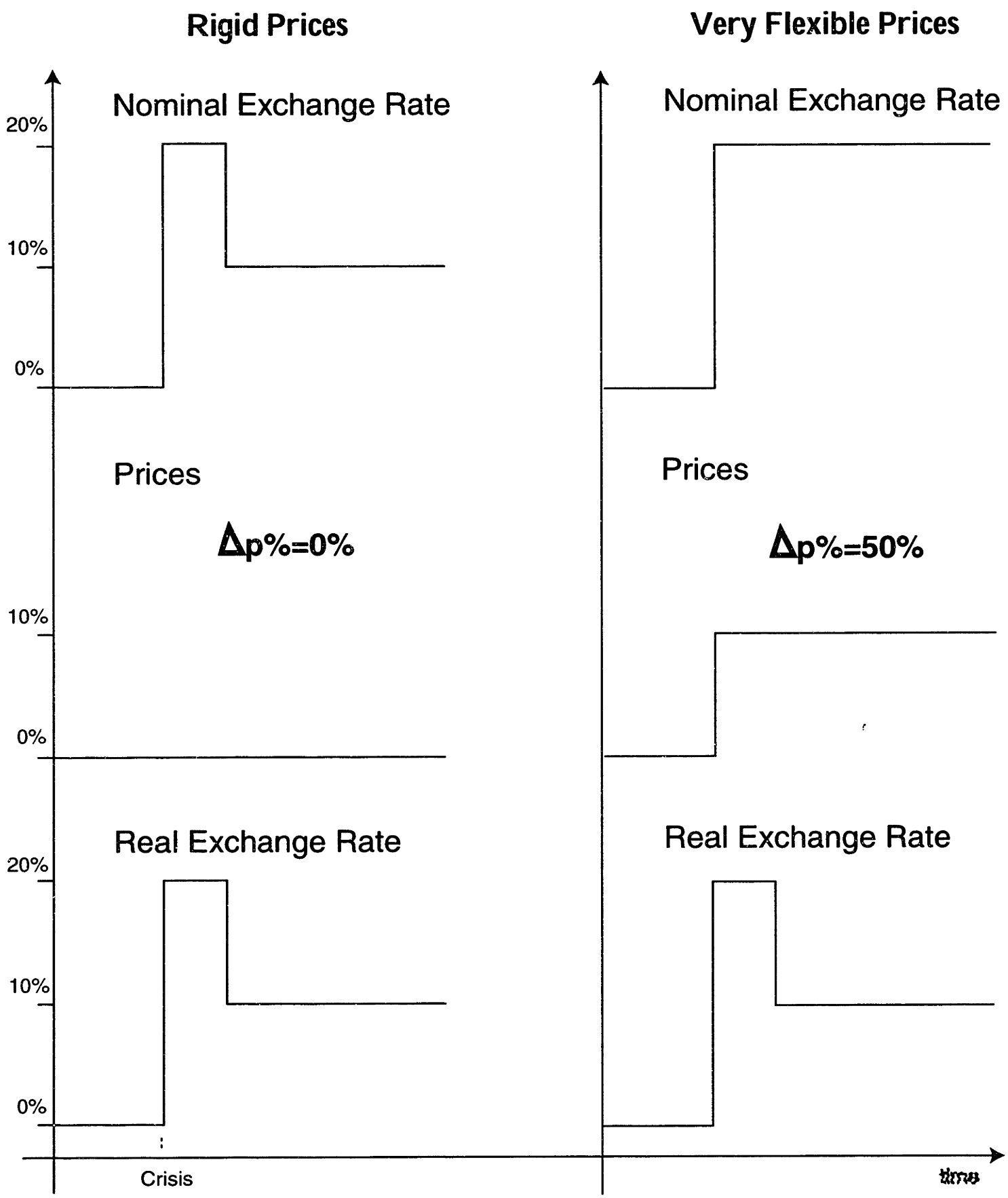


Figure 3. An Illustration of the Upward Bias in s_2 when the Change in Slope after a Crisis

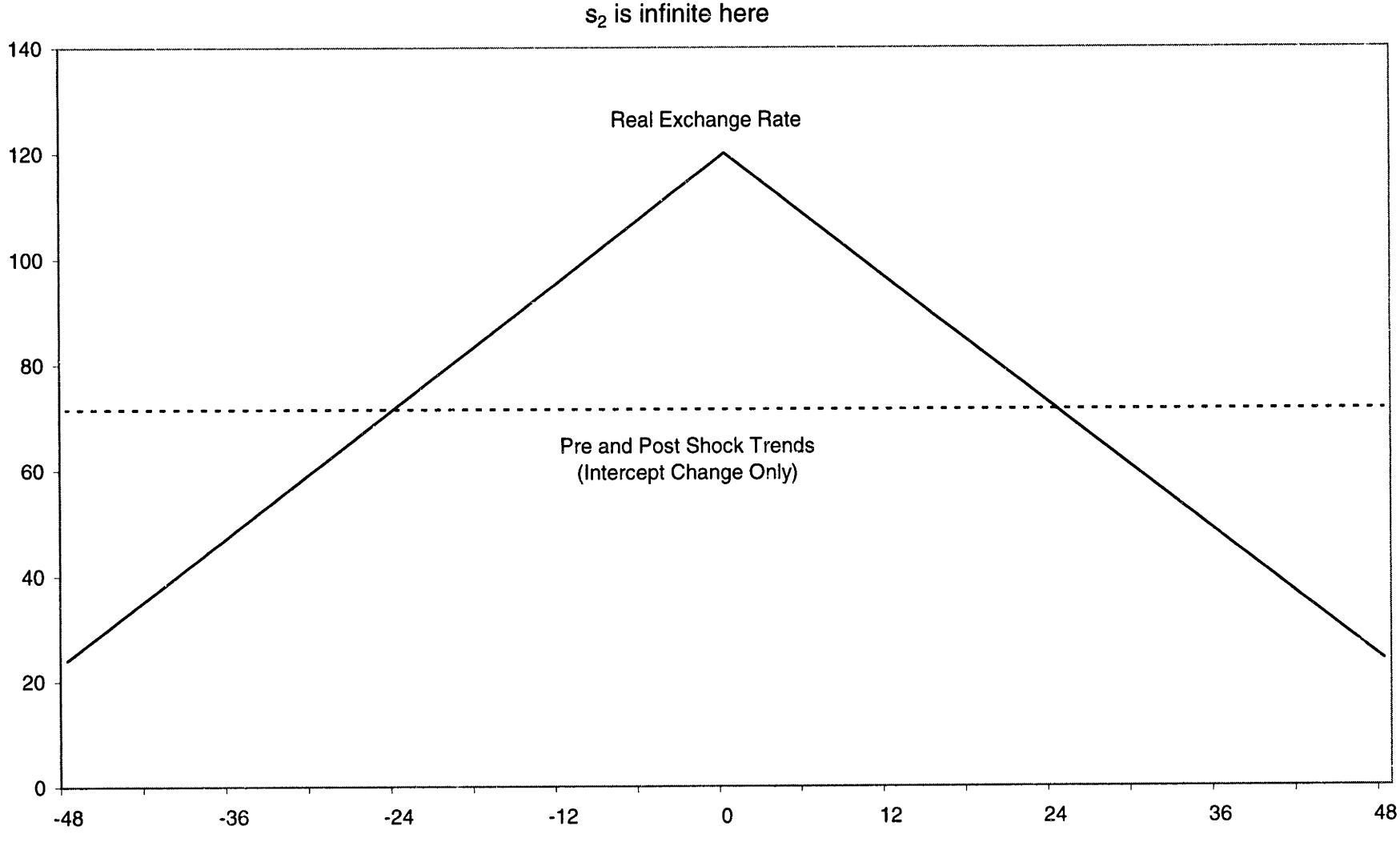
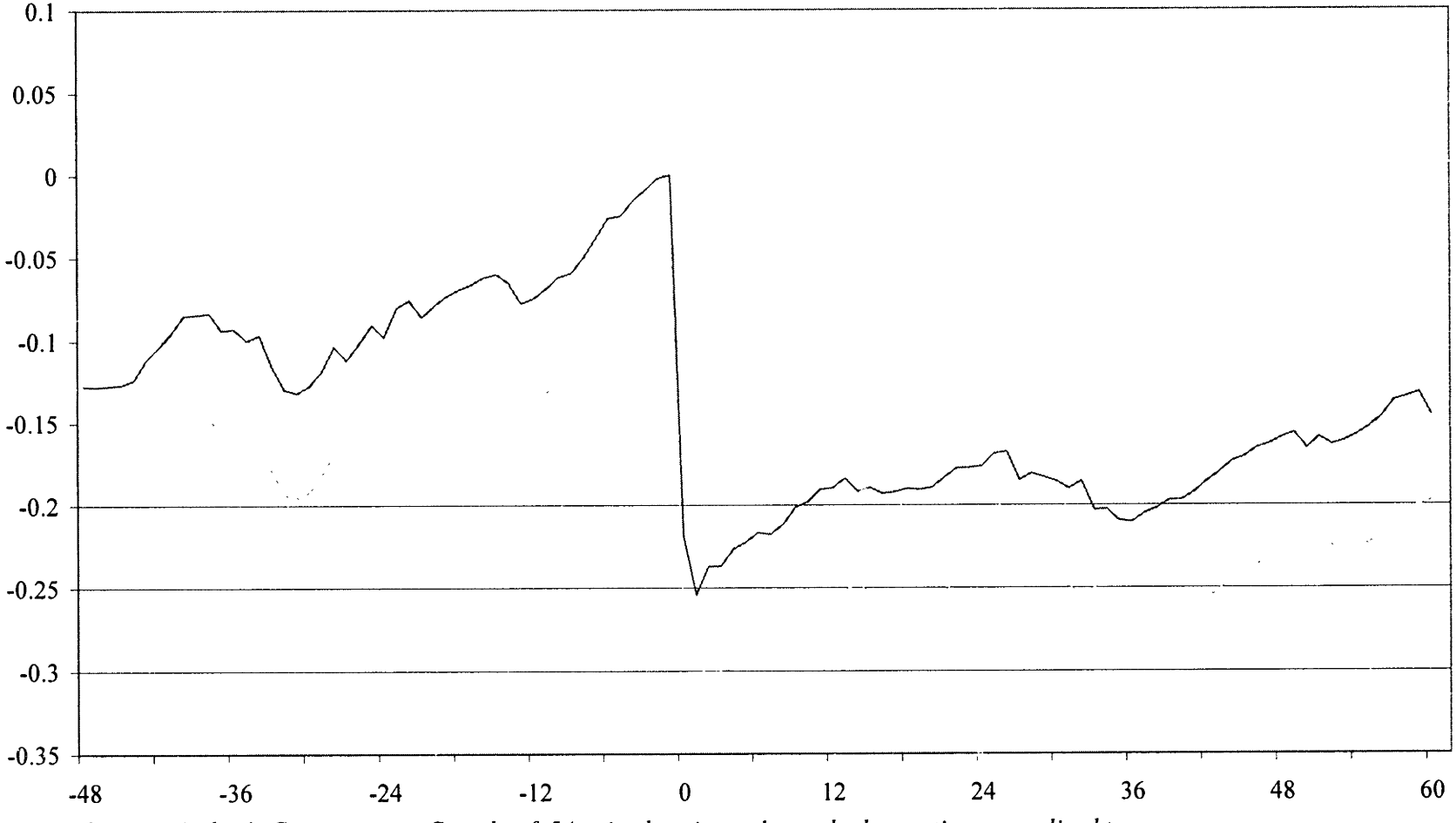


Chart 1. The Mean Real Devaluation Experience

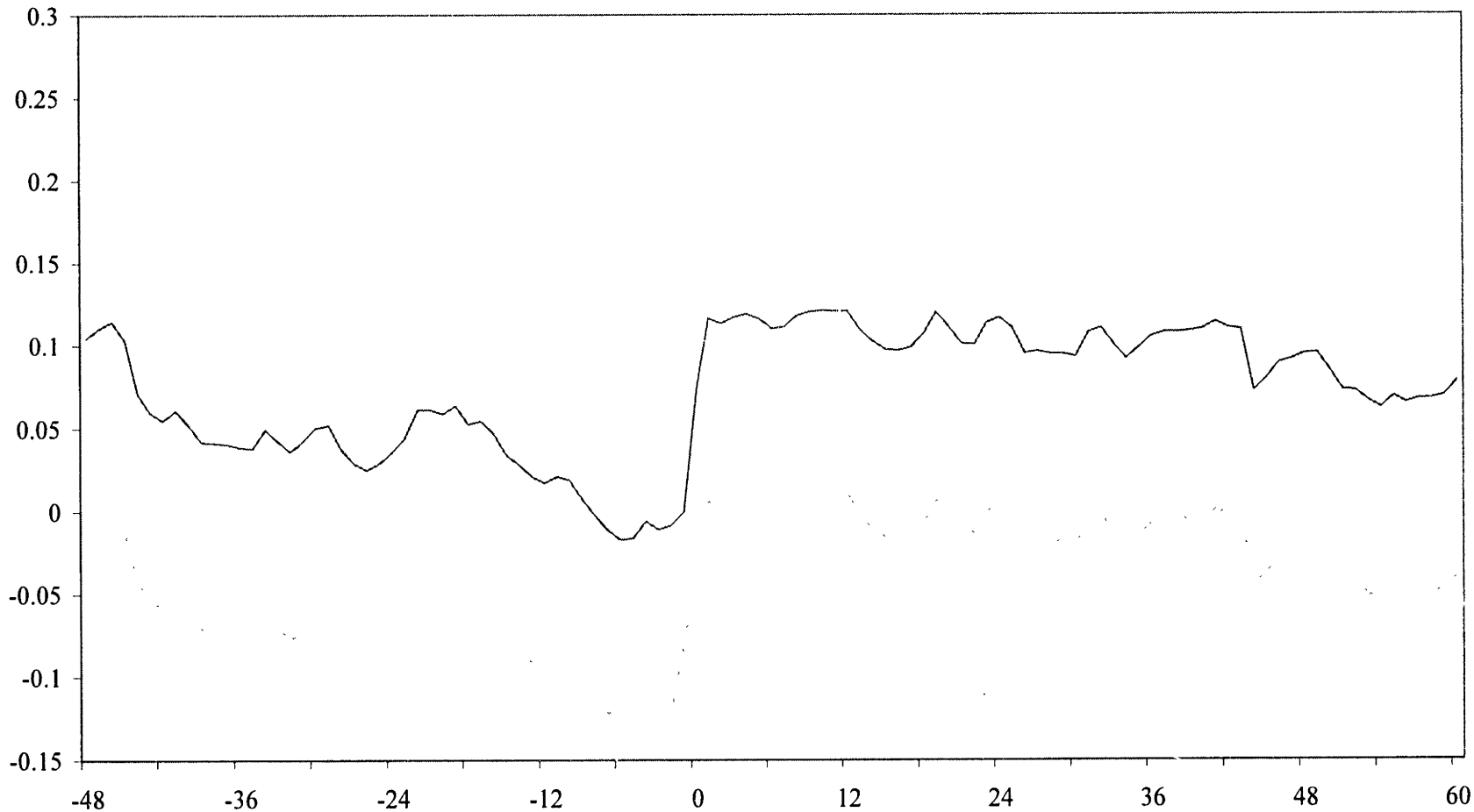
Time dummies and standard Errors from GLS Fixed Effects Estimation



Source: Author's Computations. Sample of 54 episodes, time=-1 month observation normalized to zero

Chart 2. The Mean Real Appreciation Experience

Time dummies and standard Errors from GLS Estimation



Source: Author's Computations. Sample of 10 episodes, time=-1 month observation normalized to zero

Chart 3. Europe 1992 Log Real Exchange Rate with German

Inverted Scale

Source: IMF. Author's Computations. Index=0 in August 1992

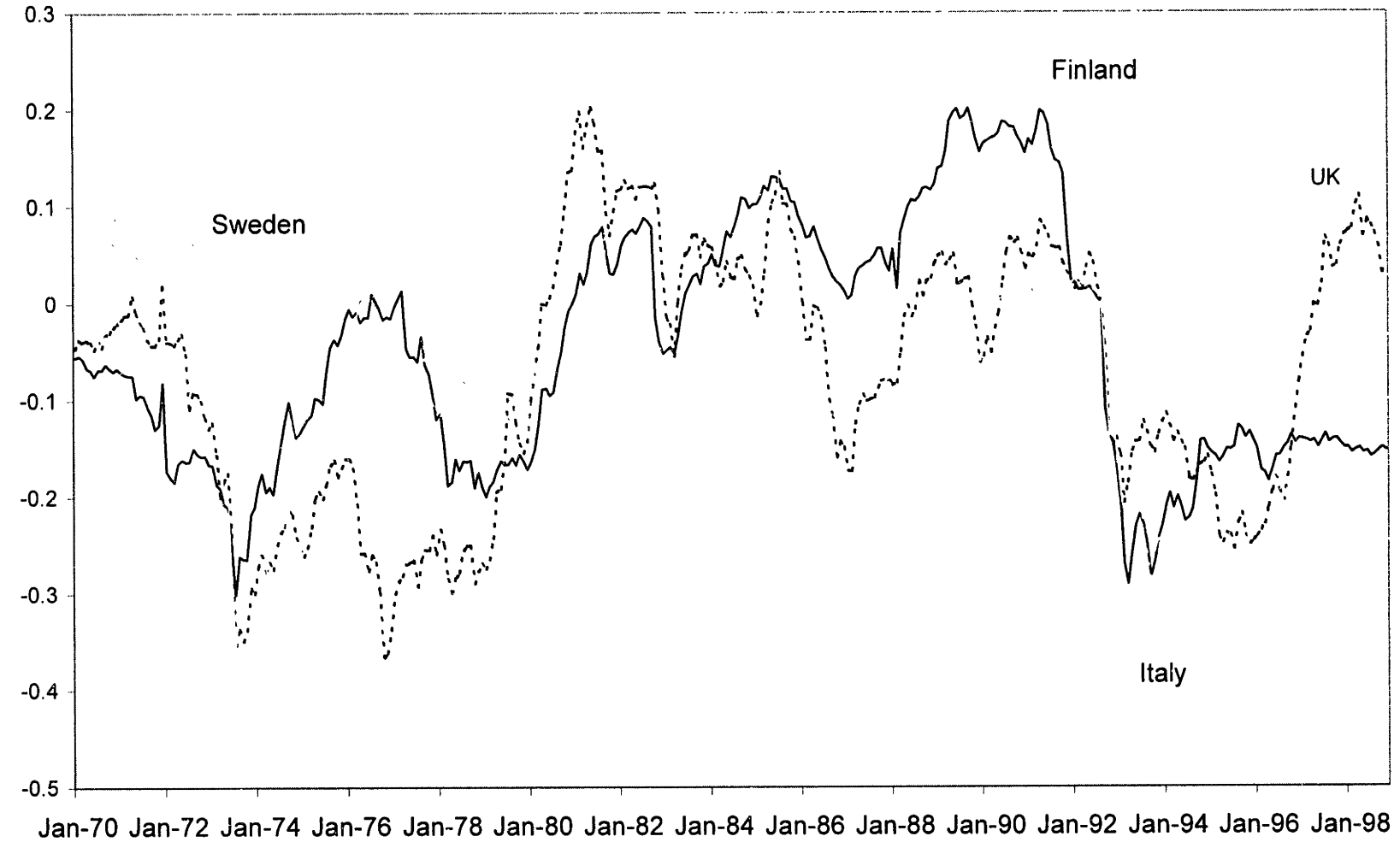


Chart 4. Franc CFA Real Exchange Rate with French Franc

Inverted Scale

Source: IMF. Author's Computations. Index=0 in December 1993.

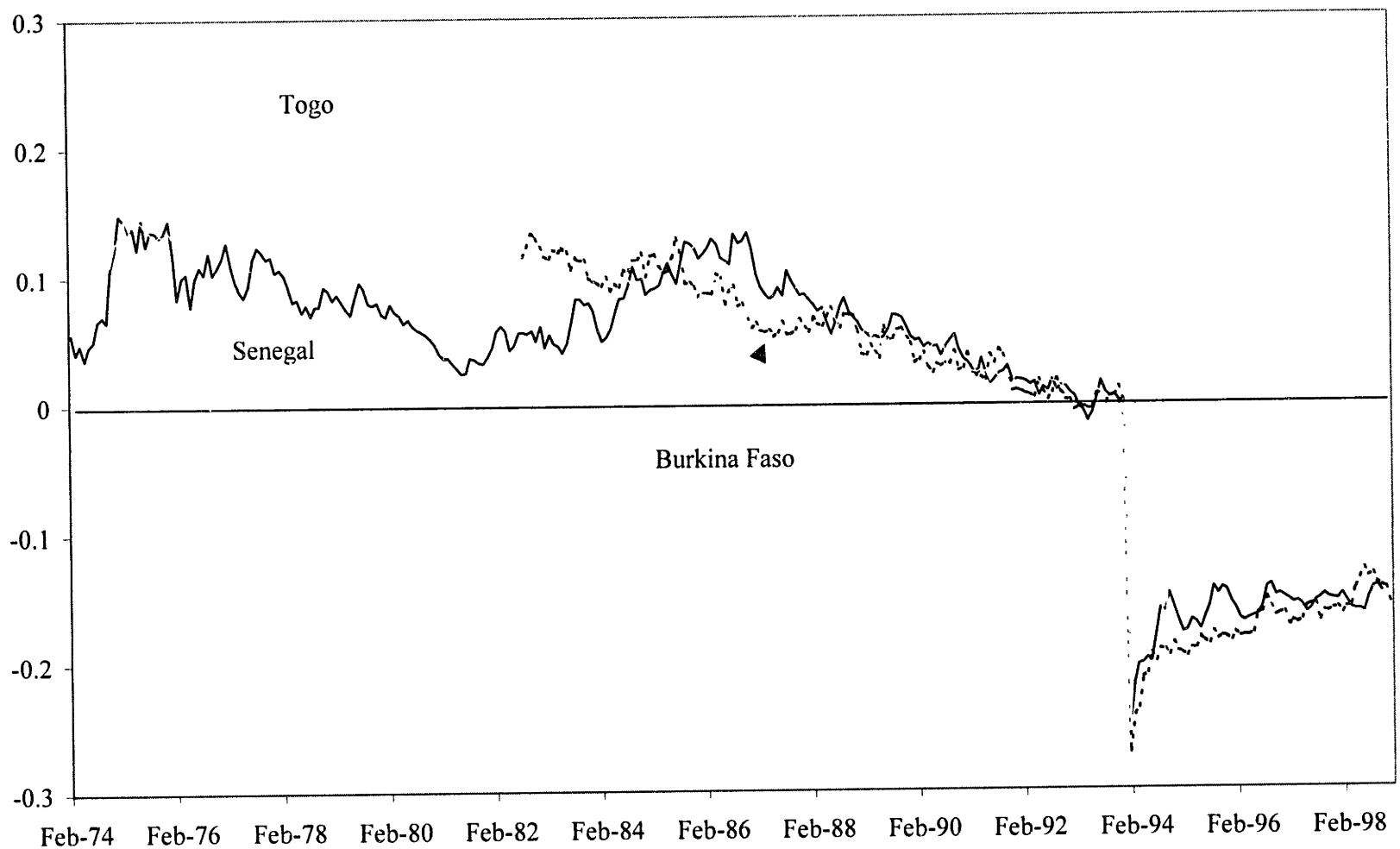
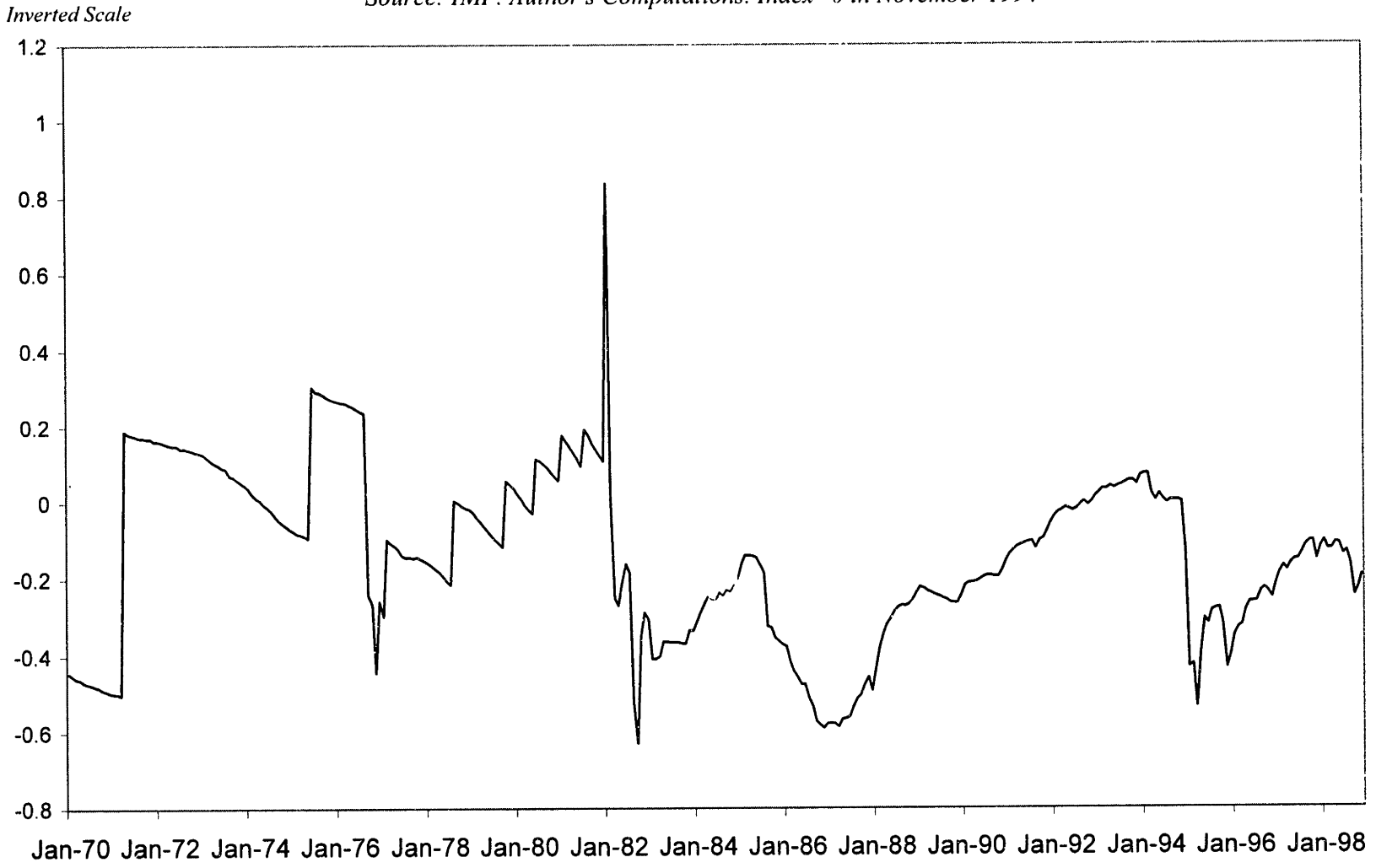


Chart 5. Mexico 1994 Log Real Exchange Rate with US $

Source: IMF. Author's Computations. Index=0 in November 1994



Chapter 3

Exchange rate Hysteresis in// US Labor Flows

3.1 Introduction

This chapter analyzes the response of job flows by new establishments and shutdowns to the level of the real exchange rate between 1973 and 1993, and finds robust evidence of hysteresis in the structure of US 2-digit manufacturing industries. Following a transitory 30% appreciation of the real exchange rate[1], employment in manufacturing industries is found to drop permanently by 1.61%, following a fall in the employment stock both of continuing firms, and of firms at the entry-exit margins. Starkly, the 1.46% drop in job destruction explains most if not all of these facts. While the employment impact loses its statistical significance when instruments are used to control for the endogeneity of the real exchange rate, the impact on job destruction and its shutdown component are robust to the specification used, including time effects. These results suggest that although the effects of the real exchange rate on US manufacturing job structure may appear quantitatively small, their persistence makes them an important determinant of

[1] The 30% figure corresponds roughly to the experience of the US economy during the appreciation of the dollar in the early 80s.

the reallocation process of (human) resources. This is particularly true in the tradable sector where employment decreases permanently by 3.78% when the real exchange rate appreciates transitorily by 30%, with almost two thirds of the adjustment coming from job destruction. Thus we find support for the classical view that exchange rate shocks relocate labor in and out of the tradable sector depending on whether it is a devaluation or an appreciation. Also, as could be expected from hysteresis models, shutdowns and start-ups systematically account for a disproportionate amount of the response of job destruction and job creation to changes in the real exchange rate.

These results corroborate in part the evidence found by Gourinchas in two closely related studies, [39] and [40], that real exchange rate matter for job and net employment flows. Using quarterly data for the US, he finds that a 10% appreciation destroys 0.44% of traded sectors employment *per quarter* with a mild, and not always significant, 0.17% concurrent rise in job creation. Our estimates are, however, lower than that found by [39], as a 10% real appreciation only causes a 0.41% increase in job destruction *per year*, with over half of it coming from shutdowns.

A puzzling result of empirical research is, aside maybe for extreme cases such as currency crises, the missing link between real exchange rate movements and that of other macroeconomic variables of real economic activity such as employment or the capital stock. This is a very striking result as almost any model of international economics would predict a very strong linkage, particularly in tradable industries. It is particularly true in neoclassical models as changes in the real exchange rate affect the marginal productivity of labor, typically positively in exportables and negatively in importables. This is evidenced by the strong positive theoretical correlation typically implied by RBC models, about 0.5, between the terms of trade and output[2]. Also, though the contemporaneous correlation between changes in the real exchange rate and, let's say changes in employment can be ambiguous, the addition of a sufficiently large number of lags should yield a strong association between real exchange rate and employment movements.

[2]See [2].

One often cited cause for this missing link between real exchange rate movements and that of other macroeconomic variables of real economic activity, is that firms can buy insurance against currency risk, either by buying forward or option contracts or by maintaining a multinational customer base, and thus can be greatly insulated from foreign exchange fluctuations when making labor or capital decisions. However, there is plenty of evidence that firms don't or can't fully hedge against currency risk, especially given the persistence of exchange rates over periods of 3-5 years or more. So, although currency hedging can potentially explain why tradable industries elasticities to the real exchange rate are not significantly different from that of non tradable sectors, and why the true costs of currency fluctuations are likely to be understated by looking at such elasticities, it doesn't seem able per se to explain their lack of statistical significance. Aside from these insurance possibilities, theoretical explanations for the missing channel can be divided in two (non necessarily exclusive) groups. One is that employment determination is a complex process, that the real exchange rate is but one link, and that the failure to control for hard to measure cyclical determinants such as non tariff barriers (NTBs) and composition effects accounts for the lack of identification of the real exchange rate link.

The second candidate line of explanation, and the one analyzed in this chapter, is the fact that the presence of large entry and exit fixed costs creates a non-linear response of macroeconomic variables to the real exchange rate. In that context, a depreciation, though it may be only temporary, if large enough will typically lead to the entry of new firms in the exportables sector as the net present value of profits rises above that of fixed costs. However, small disturbances will in general have little or no impact as the transitory profit streams anticipated to be small, and not sufficient to cover the entry costs (as well as the potential costs of exit). Also by putting equal weights between small and large disturbances, empirical researchers will miss that the, at least partial, irreversibility of exit and entry decisions will lead to a permanence of the response of economic activity to large disturbances, even when these disturbances are past. Unfortunately, despite its strong theoretical underpinnings, empirical evidence on hysteresis is still lacking. In

particular, evidence on the implied non linearity and persistence of its effects is often both scarce and confusing. Most tests of hysteresis include, at least implicitly, in their testing procedure assumptions about the feedback of the economic structure to the pricing mechanism. Thus the lack of clear empirical results may be due to the heterogeneity as well as the offsetting effects of the price mechanism on aggregate activity.

This chapter analyzes instead the response of entry and exit of establishments and in particular their labor input decision to movements in the real exchange rate. This approach has the advantage of directly testing for hysteresis effects: to identify the presence of hysteresis, I test for its defining characteristic i.e. whether or not the level, rather than the change in the level, of the real exchange rate has an impact on job flows. This is indeed found to be the case in many instances, as is summarized in section 5.1, and in the impulse responses of figures 2a to 2e.

3.2 Exchange rates, hysteresis and Jobs

The experience of the large and lasting appreciation of the dollar in the early 1980s created concern in the US that currency fluctuations were hurting US workers, especially as unemployment was particularly high in the 1970s and 1980s. Most open macroeconomy models if not all, imply a strong relationship between the levels of employment and that of the real exchange rate. Still, many early empirical studies have suffered from "Sargent's Law"[3], not being able to find much correlation between the real exchange rate and employment. Not too surprisingly the rejections have been especially strong for high frequency data. In addition, the response of trade flows and current accounts to the frequent and large fluctuations in the floating exchange rate period, has been limited. This seems at odds with the classical view that the real exchange rate is a principal determinant of the volume of trade. For example, while the dollar appreciated by about 50 percent with respect to a basket of currencies in the span of five years

[3]The expression is due to Backus in his comment to [39] who sums it as: "when you mix prices and quantities, the results stink".

(1980-85), the US. current account deficit soared and then continued to widen despite the large dollar depreciation that followed the Louvre and Plaza agreements, and which brought back the dollar to its 1980 value in less than three years. This persistence of trade imbalances, in particular between the United States, Japan, and Germany, and their apparent unresponsiveness to exchange rate changes, have led to a re-examination of the traditional adjustment processes.

Theoretical backing to explain this persistence comes naturally in economic environments with a combination of strategic interaction in oligopolistic markets and sunk costs. The theoretical predictions of hysteresis models are often summarized as follows:

- Path dependence of the industrial structure with respect to the real exchange rate i.e. temporary shocks to the real exchange rate can have permanent effects on the economy.
- Non linear responses of real activity (output, employment, capital, trade...) to the level of the real exchange rate.
- A negative correlation between real exchange rate uncertainty and the responsiveness of the entry and exit margins to real exchange rate fluctuations even when firms are risk neutral.
- Hysteresis in the equilibrium path of the real exchange rate induced by the hysteresis of the reallocation process.

The insight that real activity will respond non linearly to shocks to the real exchange rate, probably dates back to the first empirical studies of exchange rate elasticities, and was conjectured as early as 1950 by Orcutt[58]. In the presence of sunk (adjustment) costs, small real exchange rate shocks are not sufficient for firms to adjust, while large real exchange rate shocks will tend to induce a massive flow of adjustment. However, it is worth stressing that this implication depends greatly on the shape of the cross-sectional distribution of firms along the inaction band.

Kemp and Wan[47], present the first model of path dependence or hysteresis of the industrial structure when adjustment costs are non differentiable at the origin. The literature saw a lot of theoretical advances in the 1980s. Baldwin[4] introduced the basic sunk costs model which was further augmented, using the tools of stochastic calculus by Krugman[50] and Dixit[23]. When there are large sunk costs for firm to enter (or exit) the home market, there will be a wedge between the entry and the exit margins. As a consequence temporary large shocks will not only lead to an increase in the number of firms in the economy today, but the increase will be permanent as the new entrants have, at least on average, no incentives to leave the market once the shock is gone as the costs of entering have already been sunk, and it's better, at least up to a point, to wait than exiting to reenter and repay the entry costs.

By enriching the basic model of hysteresis with the tools of options pricing, Dixit[23] yielded the further insight that the wedge between the birth and shutdown margins is a decreasing function of the level of fundamental uncertainty faced by firms. Indeed the (at least partial) irreversibility of entry and exit decisions and uncertainty, create an option for firms to delay (dis)investment. When uncertainty increases, a potential firm at the previous entry margin, will prefer to exercise its option to wait before entering the market. Indeed, the increase in uncertainty increases both the probability of hitting very profitable shocks as well as very unprofitable ones. However, by delaying, since he can always exit when the outcome is unfavorable, the investor can solely benefit from the increase in favorable opportunities[4]. Similarly, when there are fixed costs of exit, firms will also tend to delay exit when uncertainty increases.

The insight that the real exchange rate, due to its endogeneity to the production structure, will display path dependence when the production structure displays hysteresis, is due to Baldwin and Krugman[5] and [50]. When resource reallocation is costly, the reluctance to move resources to the most productive sector, say tradable, will lead to

[4] Of course this is only true at the margin, as beyond that point the more the firm waits the more it will start losing favorable opportunities as well.

a lack of response of the real exchange rate to small economic disturbances. However, large disturbances, e.g. a large exogenous increase in foreign demand for home tradable, will induce an increase in the amount of inputs allocated to the tradable sector, which in turn will lead to a fall in the relative price of tradable, i.e. a real appreciation, as a marginal unit of non tradable goods become relatively more useful. More importantly, once the trade surplus shock is gone the real exchange rate will remain at its appreciated level as the costs of re-adjusting the inputs mix are too prohibitive. Yet, though the real exchange rate is endogenous in the two models cited, given by the marginal rate of substitution between non tradable and tradable consumption, both papers assume that the trade deficit follow an exogenous process. Still, Baldwin and Lyons[6] using a model of sticky price-monetary and sunk costs show that the feedback from industrial structure can lead to real exchange rate path dependence in a more microfounded environment.

Despite the potentially important implications of hysteresis for both theoretical modelers and policymakers, the empirical evidence on hysteresis is still limited and sometimes contradictory. In particular, most studies have focused on the effects of large real exchange rate shocks, or exchange rate uncertainty on price determination and trade flows. Baldwin[4], right after the devaluation of the dollar in the mid-80s, finds evidence of a structural break in the supply curve of US imports around 1982-3, interpreting this as support for increased competition at home due to the entry of foreign (especially Japanese) firms who suddenly found it worthwhile to establish a beachhead in the US with the large 82-85 appreciation of the dollar. Unfortunately, limited in time observations, it isn't conclusive as it doesn't control for other sources of macroeconomic changes. The same holds for Mann[56], who finds similar results both for 2-digit industries and for a small number of 4-digit industries. Bean[8] presents evidence of hysteresis in Great Britain during the 1979-81 British Pound overvaluation. In cross-country studies, the strongest piece of evidence is usually found in the case of Japanese exports or Japanese foreign investment in the US[5]. Some studies, however, are less supportive. For example,

[5]See for example Campa[15], Giovannetti and Samiei[37].

Parsley and Wei[59] find little evidence either for the implication that cumulative changes in exchange rates, in addition to levels, help determine import flows, or that Canadian or Japanese exporting firms' perceptions of exchange rate volatility affect their provision of imports into the US chemicals market.

This line of empirical work has two drawbacks. As modeled by Baldwin and Lyons[6], it fails to recognize the endogeneity of the real exchange rate to the industrial structure. Still as long as real exchange rate shocks lead the business cycle, which seems likely given that their volatility dwarfs that most of non financial variables, this shouldn'tt be too much of a concern. Also the use of instrumental variables should solve this[6]. Also, and maybe more importantly, it fails to test directly the link between the real exchange rate and industrial organization. Complex price mechanisms may wrongly lead to the rejection of hysteresis.

Some researchers have tried using some of the other implications of hysteresis. For example Campa[15] finds that, for a sample of 61 4-digit US wholesale industries, the likelihood that a foreign firm invests in home industries is negatively correlated with the amount of exchange rate volatility. Though this encouraging, it's interpretation is not straightforward. Also, though there is now a lot of empirical studies on the non-linearities of the real exchange rate process, mostly in the context of target zones, empirical work about the non-linear response of economic activity to the real exchange rate hasn't had much success. One reason is that there are both empirical and theoretical difficulties with that approach. On the empirical side, test of non-linearities are often based on adding quadratic and higher order terms. However, in such specifications, the results of non-linearities tests are typically very dependent on the distributional assumption made on the error term. On the theoretical side, the non-linearity at the micro level doesn't necessarily lead to a non-linearity at the macro level, which depends on the distribution of potential entrants and incumbents along their respective inaction range.

Thus the only way to test robustly for the empirical relevance of hysteresis is to use

[6]The existence of adequate instruments for the exchange rate is not trivial though.

data on entry and exit of inputs in and out of the economy. Ideally, one would like to track the various kinds of labor, capital or firms (i.e.e joint units) response to the exchange rate movements and check for persistence. Data on capital is often of arguable quality so jobs created by start-ups or destroyed by shutdowns offer probably the best ground for hysteresis empirical research. Also looking at the establishment rather than at the firm level has probably the advantage of being more accurate when separating units by their trade characteristics.

3.3 The Data

3.3.1 Sources

Though quarterly data is available for our purpose, the focus of this study is limited to annual data[7]. The high frequency movements of exchange rates, by increasing uncertainty and raising consequently the costs of hedging against currency risk, may affect investment decisions. However, the high frequency movements are often dominated by persistent low frequency movements that seem largely unanticipated and costlier to hedge against, and thus may be more relevant for evidence of exchange rate caused flows. This in particular true of the US experience with the dollar, which after a few downswings in the 70s in the wake of the oil shocks, appreciated by more than 50% in a matter of just a few years, between 1980 and 1984, before depreciating suddenly in 1985. By limiting our analysis to annual frequency data, ranging from 1973 to 1993, we thus have a better chance of capturing the direct relationship between the real exchange rate and the industrial structure. Of course, the downside is that it limits the number of observations and the statistical power of including many alternatives to our specification. Still, as emphasized by Gourinchas[39], there is a significant amount of real exchange rate disparities across

[7]Though this is not the reason for our focus on annual rather than quarterly data, it's worth noting that the LRD data on startups and shutdowns at the quarterly rate is potentially problematic due to the misreporting of births and shutdowns in the first quarter of each year and the smoothing techniques that Davis, Haltiwanger and Schuh use to correct for this over-reporting.

SIC2 industries, helping to achieve identification. This is confirmed in our analysis, that our results concerning manufacturing shutdowns seem robust to the addition of time fixed effects.

The gross job flows dissociated in four categories, job creation by start-ups and by continuing establishments, and job destruction by shutdowns and by continuing establishments, comes from the work of Davis, Haltiwanger and Schuh[8]. The NBER-CES/Census Manufacturing Industry Productivity Database data assembled by Bartelsman, Becker, and Gray[9] was used for data on value added, employment and labor costs. To compute the trade weighted real exchange rates, I also used nominal exports and imports data from the NBER Trade Database, as well as PPI[10] and nominal exchange rate information from the IMF International Financial Statistics (IFS). JP Morgan's "real broad" trade weighted US monthly currency index, based on a basket of 22 OECD and 23 emerging markets currencies, was used as an alternative to our industry-based real exchange rate. Aggregate control variables such as the manufacturing industrial capacity utilization rate, computed by the Board of Governors of the Federal Reserve System, the federal funds rate, total US GDP come from the FRED database of the Federal Reserve System[11].

We refer the reader to the work of Davis, Haltiwanger and Schuh[20] for details about gross job flows, as well as to their online documentation. The major issues for our purpose are the timing of gross job flows, the very significant changes in the SIC classification in 1987, and the data for the years 1989 to 1993. The annual flows are computed by comparing establishment employment growth between March 12 in year t and year t-1[12]. To avoid including data not necessarily known yet to economic agents, the other macroeconomic data (exchange rate, employment growth, federal funds rate,...) tends on average to when making their decisions. Still lagging by one year the right handside of our

[8] Available online, along many other useful information on gross job flows, from John Haltiwanger's homepage at http://www.bsos.umd.edu/econ/haltiwanger/download.htm.

[9] Available online, along with some documentation, at http://nberws.nber.org/nberprod/.

[10] Using CPIs instead of PPIs to compute the real exchange rates yielded similar results as those reported.

[11] Available online at http://www.stls.frb.org/fred/.

[12] The actual computation is a little bit more complex. See [20].

regressions doesn't seem to alter significatively our results. Since, as of now, information about start-ups and shutdowns job flows is only available at the SIC-2 Manufacturing level, we aggregated the SIC4 data from the NBER Productivity database and redefined the price deflators accordingly. Similarly the trade data was aggregated into SIC2 level data. An advantage of using SIC2 data, is that, with a few exceptions, most of the 1987 changes from the 1972 SIC classification, have been reshuffling within the SIC2 industries. As a consequence, we merged, without any modification, our trade data from the 1972 SIC classification to the 1987 SIC based NBER Productivity database.

To compute the industry specific real exchange rates, we first calculated country specific log real exchange rates for a large sample of countries using nominal exchange rate data and manufacturing PPIs from a large basket of countries extracted from the IFS database. Besides problems of availability, we didn't use SIC2 level PPIs as they are strongly endogenous. The log real exchange rate in a given SIC2 industry i was defined as a weighted average of the country specific log exchange rates. For industry i and country j weights, export and import shares of country j of total US shipments in industry i were used alternatively[13]. We used both fixed, splined and variable weights to control for the endogeneity of the changes in weights. All the log exchange rates were normalized to zero in 1987. Thus real exchange rate fluctuations come from the difference in the weights across industries (and the fact that the time profiles of real exchange rates differ significantly across countries), as well as in the changes in these weights when they are allowed to vary.

3.3.2 Tradables and Non-Tradables sectors

Due to the internal heterogeneity of the SIC-2 digit industries in their patterns of trade, it is difficult to dissociate them along their trade dimension in a convincing way[14]. Still,

[13]The weights were normalized to one by dividing by their sum since data on real exchange rates wasn't available for all countries for which we had trade information.

[14]This is even true for the SIC4 level.

from a theoretical angle, the real exchange rate is expected to have different implications for different sectors conditional on the amount and nature of the exposure to trade. Campa and Goldberg[16] distinguish three ways by which exchange rate movements can affect industries: export share, import competition, and materials costs. For that purpose, and to test the robustness of our aggregate results, we divided our 19 2-digit sectors into three groups: non-tradable, tradable and a remainder group. Tradables were further classified as exporters or import competing industries. Given our degree of aggregation, we can't use the same cutoffs as [20] or as [39]. Instead, we computed the export share, as the ratio (in percentage) of exports to output, and the import penetration ratio, as the ratio of imports to the sum of imports and domestic output, for each industry. Due to rising globalization of manufacturing trade, both the exports share and the penetration ratio have been rising for most industries, on average through the years in the sample. Still as evidenced in Table 1, there is a strong correlation (about 0.8 for both measures) between the rankings of each industry trade characteristics, and the disparities across sectors are increasingly large.

Table 1. SIC2 Industries Trade Characteristics[15]

	SIC	Exports Share		Imports Pen.		Classification
		Min	Max	Min	Max	
Food and Tobacco	20-21	2.5	5.4	3.1	4.0	Non Traded
Textile	22	2.3	7.6	4.4	12.2	RG
Apparel	23	1.0	7.4	5.7	30.9	RG
Lumber	24	3.9	9.3	5.8	9.8	RG
Furniture	25	0.5	6.1	2.4	12.1	RG
Paper	26	3.9	7.6	5.7	8.1	RG
Printing	27	1.1	2.4	0.8	1.5	Non Traded
Chemicals	28	7.1	14.8	3.1	8.1	RG
Petroleum	29	1.3	4.7	6.3	13.9	RG
Rubber	30	2.9	7.4	3.9	10.3	RG
Leather	31	1.6	16.1	17.0	57.6	Imp. Comp.
Stone,Clay, and Glass	32	2.3	6.1	3.2	8.8	RG
Primary Metals	33	2.6	13.1	7.5	18.2	RG
Fabricated Metals	34	3.6	6.9	2.1	6.7	Non Traded
Nonelectric Machinery	35	13.3	27.2	4.9	22.7	Exporters
Electric Machinery	36	6.3	23.5	7.1	24.1	Exporters
Transportation	37	8.8	20.9	9.7	20.3	RG
Instruments	38	11.6	21.1	6.2	17.4	RG
Miscellaneous	39	6.4	13.6	11.0	37.7	Imp. Comp.

Source: NBER Trade Database. Author's calculations and trade classification.

[15] Exports and Imports as a percentage share of the total value of industry shipments. Industry specific minima and maxima computed across all yearly observations between 1972 and 1994. RG denotes a sector of the remainder group which wasn't used for our industry specific regressions in section 5.2.

To check how job flows respond to real exchange rate fluctuations depending on the sector's trade behavior, we divided the sample in four subgroups: exporting, import-competing, non traded industries and a remainder group. We identified four tradable and three non tradable industries, representing almost 50% of total manufacturing employment. Printing and publishing is a natural choice as a non tradable industry, as imports and exports never represent more than 2.5% of the total market for these goods, and this is quite largely true among its subcomponents (SIC4), with maybe the exceptions of books: publishing, or publishing and printing (2731) and blankbooks, looseleaf binders and devices (2782). Food and kindred products, and tobacco was the second industry considered as non traded. There is more internal heterogeneity than in the previous industry, as for example imported wine and liquors as well as canned seafood products represent a very large amount of US consumption, and exports such as rice milling[16] or vegetable oil mills goods represent a large fraction of total production of these goods, more than half in the case of vegetable oil mills products in 1994. Fabricated metals was also considered a non traded goods industry as both its export share and its penetration ratio were consistently low throughout the sample. Again there was some heterogeneity, as sectors like cutlery (3421) and bolts, nuts, screws, rivets, and washers (3452) have import penetration ratios in excess of 20% in 1994, and military ordnance exports such as have a very significant export component.

Both industrial and commercial machinery and computer equipment (35) and electronic and other electrical equipment and components (except computers-36) were considered exporting industries as they both had the highest export shares. Still the US economy is also a large importer of goods from these two sectors especially from Japan. Also there was a very substantial amount across these sectors as export shares in 1994, reached a minimum among its SIC4 components at about 5%, for service industry machinery (3589), and for household appliances (not elsewhere classified- 3639) respectively

[16] Rice milling is constituted primarily of establishments engaged in cleaning and polishing rice, and in manufacturing rice flour or meal.

while the maximum was reached for oil and gas field machinery and equipment (3533), at 94%, and for phonograph records and prerecorded audio tapes and disks (3652), at 148%[17].

Finally two SIC2 industries, leather and its products (31) and miscellaneous manufacturing industries (39), were considered import competing due to the consistency of their high share of foreign products. Though heterogeneous, the leather sector is a consistent importer even at the SIC4 level with penetration ratios ranging from 23 to 89% in 1994. The miscellaneous manufacturing sector is more heterogeneous but is still dominated by industries with penetration ratios in excess of 25% and as large as 91% in the case of dolls and stuffed toys (3942).

This classification will enable us to check what are the empirical implications of real exchange rate fluctuations on economic sectors in function of their trading characteristics. Of course one needs to be cautious that these measures are likely to be just proxies as they don't control for other sources of market heterogeneity such as goods durability, market power or capital/labor intensities. Indeed, very competitive industries may have a small share of trade, but trade impacts may be more important than in less competitive sectors. For example, following the large devaluations of the Asian economies, very large drops in prices seem to have occurred in industries like textiles, pushing the import penetration ratio down (although the quantity effect compensated this greatly), while competing US manufacturing industries[18] clearly had to adjust whether through prices (drop in prices) or quantities (job destruction, reallocation).

3.3.3 Gross Job Flows

As reported in [20], the establishment entry and exit margins account for a significant share of job creation and job destruction. About 24% of job destruction is caused by plant shutdowns and 15% of job creation is due to start-ups alone. These are big numbers and

[17] This export share above 100% is probably due to transhipping reasons.

[18] However, related US service industries, are likely to have benefited from this drop in prices.

highlight the concentration of job flows at the entry and exit margins. Yet even more striking, as Table 2 shows, the contribution of start-ups and shutdowns to job flows fluctuations, as measured by their volatilities ratio, is about double that of their actual weight in job creation and destruction respectively. Manufacturing is a shrinking sector within the economy, and this is reflected by the negative net contribution of gross job flows by start-ups and shutdowns to employment growth. However, it's worth noting that continuing establishments contribute much less actively to the overall net destruction of jobs, as they even have a positive employment contribution in the case of non traded goods over the 1973-1994 period.

The level of gross job flows seem to vary little, at least at this degree of aggregation, across industries, while there is much more variation at the entry and exit margins. The level of traded goods job creation by start-ups is slightly greater than in the non traded goods sector. This is due to the fact that start-ups in import-competing industries have a very high level of gross job growth, more than 50% greater on average then other industries, especially in the miscalleneous industries branch (see table in annex). The discrepancy is even greater in terms of shutdowns' destruction, and the pace of import-competing industries is dwindling faster than the rest of manufacturing, consistent with the view that increased globalization is forcing the US to reallocate its human ressources in sectors where it has a technological advantage, and where, at least for a while, it faces less competition. Also the finding that the entry-exit margins contribute to the volatility of gross job flows well in excess of their employment weight, is true across industries, even though it is particularly strong in import-competing industries were start-ups job creation standard deviation is about 54 % of that of continuing establishments, and the equivalent figure for shutdowns job destruction is even higher at 57%.

Table 2. Gross Job Flows Characteristics

	Gross Job Creation							
	Start-ups				Continuing Establishments			
Sector	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation	Min	Max
Non Traded	1.33	0.58	0.05	2.28	7.31	1.37	5.04	10.28
Traded	1.53	0.69	0.15	2.62	8.21	2.32	4.93	14.31
Exporters	1.30	0.64	0.16	2.62	8.10	2.72	5.20	14.52
Import-Comp.	2.03	1.11	0.12	4.73	8.53	2.07	4.20	13.80

	Gross Job Destruction							
	Shutdowns				Continuing Establishments			
	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation	Min	Max
Non Traded	2.43	0.70	1.09	4.54	7.18	1.50	4.85	10.85
Non Traded	2.85	0.88	1.04	4.86	8.70	2.56	4.89	14.83
Exporters	2.11	0.83	0.69	3.91	8.33	3.05	3.98	15.23
Import-Comp	4.49	1.31	1.83	7.18	9.48	2.30	5.87	14.87

	Net Entry-Exit Employment Growth				Manufacturing Employment Share			
	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation	Min	Max
Non Traded	-1.10	0.67	-2.26	0.24	23.48	1.04	22.03	25.38
Traded	-1.31	0.93	-3.27	0.00	30.43	2.20	26.81	33.17
Exporters	-0.81	0.80	-2.76	0.54	20.93	1.68	18.52	23.56
Import-Comp.	-2.46	1.62	-5.30	0.51	9.50	1.11	7.89	11.20

Source: Gross job flows from Davis, Haltiwanger and Schuh, LRD. Author's calculations

3.4 Methodology

From what we saw earlier, theories of hysteresis have several implications for the response of the labor structure to real exchange rate fluctuations that differentiate them from other models. Still, the most stark one and the one that defines hysteresis is that transitory changes in the level of the real exchange rate should have permanent effects on the level of employment stock variables, or in other words that employment stock variables are a function of the integral of the exchange rate. For flow variables such as job creation and destruction, the implication is thus that they depend on the level of the real exchange rate instead of the change in its level, as is the case of path independent models.

To test for the presence of hysteresis effects using gross job flows, the following type of specification can be used:

$$JF_{it} = \alpha_i + \mu fx_{it} + \gamma(L)\Delta fx_{it} + \delta(L)Z_t + \epsilon_{it} \tag{3.1}$$

or alternatively:

$$JF_{it} = \alpha_i + \Theta(L)fx_{it} + \delta(L)Z_t + \epsilon_{it} \tag{3.2}$$

where JF_{it} is the gross flow of job creation (resp. destruction) as a share of industry i's employment, fx_{it} is the log of the industry specific real exchange rate, $\Delta fx_{it} = fx_{it} - fx_{it-1}$ denotes the change in the log of fx_{it} between t-1 and t, $\gamma(L)$ is a lag polynomial, $\delta(L)Z_t$ is a lag polynomial of macro control variables such as the manufacturing industrial capacity utilization rate, CUR_t, the lagged manufacturing employment growth rate[19], E_{t-1}, and the federal funds rate, i_t. ϵ_{it} is a random component, and $\Theta(L) = \mu + \gamma(L) - L\gamma(L)$ is a lag polynomial. The presence in $\gamma(L)\Delta fx_{it}$ of lags in addition to Δfx_{it} is

[19]Though the current manufacturing employment growth rate is used by [39], only lags were used in the specifications here. Indeed, if the fact that the manufacturing employment growth rate is a linear combination of the right handside variables can be neglected, it's clearly not the case at this level of aggregation.

there to allow for the presence of standard adjustment costs, to avoid rejecting the null hypothesis by limiting the richness of the job flow response. Typically, in practice we used 2 or 3 years of lags for each right-handside variable.

In this context, as figure 1 illustrates, the null hypothesis of no hysteresis in the response of US 2-digit industries to the real exchange rate is simply that $\widehat{\mu} = 0$. Indeed a transitory 10% appreciation of the real exchange rate will lead, approximately, to a -0.1*μ increase rate of job creation (resp. destruction). Within this setup, establishment births and shutdowns employment flows, as well as their net component, are the same before an appreciation of 10% and after the appreciation is undone by a 10% devaluation[20]. However, the employment structure of the industry will be irreversibly altered. This is particularly clear in terms of net employment flows. Indeed if net employment flows fall let's say from 0% to -1% in the wake of an appreciation, and rise back to 0% after the devaluation occurs, the employment stock will have dropped by approximately T% where T is the number of years the real exchange rate stayed at its appreciated level. For gross job flows, the finding that $\widehat{\mu} \neq 0$ means that a temporary rise in the real exchange rate will will lead to a "rejuvenated" establishment stock. If industry entrants and leavers are identical, the change in the age structure of establishments doesn't imply hysteresis. However, besides theoretical reasons, there is ample evidence that plants at the entry and exit margins are different. New establishments tend to imbed the latest technologies, while shutdowns are usually using inferior and obsolete technologies. Also as reported by Davis et al.[20], job creation and job destruction tend to be very persistent even over significant horizons. Start-ups tend to continue contributing positively to employment growth, with persistence rates of job creation over 2 years horizons of 69% compared to 52% for other firms[21], while shutdowns are predominantly firms with a track record of employment downsizing.

In the text, regression results are presented as in equation (3.2) to facilitate the

[20] NB: Of course, this is an approximation, exact for the change in logs, as percentages are not symmetric with respect to the origin.

[21] See table 4.6 p.79.

understanding of the impulse responses. In this case, the hypothesis of no hysteresis is simply that $\Theta(1) = 0$ i.e. that the sum of the coefficients of the lag polynomial is equal to zero.

As an alternative specification, we also used lags of the lefthandside variables as regressors. Yet the pattern of hysteresis was still significant, and the μ coefficients implied by these specifications[22] were in general not statistically different.

A potential difficulty in estimating an equation such as (3.1), is that the real exchange rate as well as the other macroeconomic determinants are endogenous. To the extent that the real exchange rate leads the business cycle and that the error terms ϵ_{it} are not autocorrelated this shouldn't affect our estimation. Still, as an attempt to control for endogeneity issues, we used in our regressions the three Hall-Ramey instruments: log changes in military spending and in the world oil price and a dummy for the political party of the president[23]. The use of these instruments led in general to a drop in the statistical significance of the coefficients as measured by their t-tests, while not affecting the size of the coefficients in a systematical way. Thus hysteresis is more readily rejected when the instruments are used. Also, it's worth noting that since the country specific real exchange rates are not computed using industry specific prices but aggregate manufacturing prices, the real exchange rates are in a way already instrumented.

The specification in equation (3.1), is potentially restrictive as forward looking investors will also use their best forecasts of future evolutions of the real exchange rate to determine to gauge the net present value of their current investment, to decide whether or not they would like to enter (or exit). A more robust way to test for the presence of hysteresis effects using gross job flows, is to use a more general specification of the form:

[22] For example if instead of equation (3.1) we use:

$$JF_{it} = \rho JF_{it-1} + \alpha_i' + \mu' fx_{it} + \gamma'(L)\Delta fx_{it} + \delta'(L)Z_t + \epsilon_{it}$$

then the implied hysteresis coefficient μ is equal to $\frac{\mu'}{1-\rho}$.

[23] See [43].

$$JF_{it} = \alpha_i + \mu fx_{it} + \gamma(L)\Delta fx_{it} + \vartheta(H)\Delta fx^e_{it+1} + \delta(L)Z_t + \epsilon_{it} \qquad (3.3)$$

where the added term $\vartheta(H)\Delta fx^e_{it+1}$ is a forward polynomial of anticipated future changes in the real exchange rate.

A difficulty with this approach in practice is that there is no good historical series of expected changes of the real exchange rate for a wide panel of countries. The standard way of solving this issue, despite the pitfalls of the Lucas critique, is to regress, within the sample, the change in the real exchange rate on its past values as well as that of its determinants, and to compute the corresponding forecasts. There are two problems however with using these forecasts as proxies in (3.3) to test for hysteresis. Econometrically, this may lead to a fragility of the results to mispecification of the true process of the real exchange rate. Secondly, as long as we allow future changes in the level of the real exchange rate to depend on the same righthanside variables as the labor flows, which seems natural, we have a problem of identification. Unfortunately regressing (3.3) without the $\vartheta(H)\Delta fx^e_{it+1}$ term, doesn't a priori solve for this when the level of the real exchange rate is an important predictor of its future changes. Indeed suppose that the true process of the real exchange rate is well described by an error-correction model of the type $\Delta fx_{it+1} = -\rho_i fx_{it} + \eta_{it+1}$ where η_{it+1} is a random component with zero expected mean prior to time t, and that $\vartheta(H) = \sum_{k=0} \vartheta_k H^k$.

Under these hypotheses, we can rewrite equation (3.3) with the same format as equation (3.1) with :

$$\mu = \beta - \sum_{k=0} \rho_i^{k+1} \vartheta_k$$

The true hypothesis of no hysteresis in that context is thus that $\widehat{\mu} = -\sum_{k=0} \rho_i^{k+1} \vartheta_k$. Of course, the trouble is that though the ρ_i could be estimated, the ϑ_k are unknown, and unless some additional structure is assumed we cannot perform the test correctly. Still, as evidenced by the literature on tests of PPP, it's worth noting that it's very hard

to reject the hypothesis that the real exchange rate isn't I(1) i.e. that for the US real exchange rate $\rho_t = 0$. In this particular case, the null hypothesis using equation (3.1) of $\widehat{\mu} = 0$ will be a well specified test of hysteresis effects.

The only way to effectively control for the forward expectations component is to bring outside sample information on the real exchange rate. One possibility would be to use variables uncorrelated with the expected change in the real exchange rate next year but correlated with the current level of the exchange rate. However, to the extent that there is some mean reversion in the exchange rate process, this is almost an impossible find. Alternatively, we can try proxies for the real exchange rate. Under the hypothesis of covered interest parity, the forward rate would be a very good candidate. Unfortunately historical data on forward rates is limited to only a small subset of US trading partners.

A more implementable version, which we tested, was to take interest differentials as a proxy for the expected rate of depreciation of the dollar with respect to each country. If uncovered interest parity (UIP) holds, this should be an unbiased estimator of expected nominal appreciation (depreciation). In parallel, we modeled the changes in the log price differential between the US and each country as following an AR process, different for each country pair. The difference between the (log of one plus) the interest differentials and the forecasts of the change in the log price differentials were then used to proxy for the expected log change in the real exchange rate level for each country. The resulting variables were then weighted, alternatively by export or by import shares, to compute a proxy for the real exchange rate of the US with respect to the rest of the world for each 2-digit industry. Our results weren't altered significantly by the addition of these proxies. Of course this may be caused by the failure of UIP to hold. Still, it's worth noting, and we'll come back to this as we conclude, even if the failure of the null hypothesis of $\widehat{\mu} = 0$ is not due to the presence of hysteresis but forward anticipations, our results show that the real exchange rate plays a significant role in the labor adjustment process. Indeed under that assumption, expected appreciations of the real exchange rate in the future years, will lead to very large drop in the amount of labor shed via shutdowns, typically of

one order of magnitude greater than implied by $|\widehat{\mu}|$, since the $\rho_i s$ are typically very close to zero (and positive). In a way, at a minimum our results show that there is maybe a trade-off between persistence and amplitude of the response of job flows to shifts in the exchange rate, but that exchange rates do matter empirically.

3.5 Entry and Exit Response to Exchange Rate Fluctuations

3.5.1 Results at a Glance

This section presents briefly the main results of our analysis of job flows response to movements in the real exchange rate for the US SIC2 industries. Table 3, and figures 2a through 2e show the impulse responses of employment and of the employment contributions of gross job flows[24], to real exchange rate shocks.

In response to a one year transitory 10% devaluation in the real value of the real exchange rate:

- Aggregate employment rises permanently by a significant 0.45%[25], following a rise in the employment stock both of continuing firms, and of firms at the entry-exit margins. The 0.41% drop in job destruction explains most if not all of these facts. Significatively, more than 50% of job destruction is due to shutdowns, though these firms represent less than a quarter of job destruction flows on average. The response of job creation is a bit more complex, as continuing firms increase their employment stock while start-ups hires contribute negatively to the employment stock.

- Employment, job creation and job destruction, all seem to rise initially, by 0.15%, 0.22% and 0.07% respectively. However, in the second year, job destruction falls

[24] i.e. the integral of job creation and start-ups flows, and the negative of the flow integral for job destruction and shutdowns.

[25] The effect is significant when using GLS, but loses its significance when instruments are used. See the next subsection.

sharply followed to a lesser extent by job creation. The drop in job creation is solely due to a drop in creation by start-ups, while the fall in job destruction mimics the earlier decrease in shutdowns layoffs with some lag.

- The response of job creation and job destruction to the real exchange rate are positively correlated, which supports the view of real exchange rate shocks as real-location shocks. As shown below, this interpretation is confirmed by our sectoral analysis across trade groups (tradable and non tradable). Still, the two gross job flows are not perfectly synchronized, due to different responses between continuing firms, and firms at the entry and exit margins.

- Shutdowns and Start-ups account for a disproportionate amount of the response of job destruction and job creation to changes in the real exchange rate.

Table 3. Impulse Responses Summary - All SIC2 industries

	Least Squares (GLS)				Instrumental Variables (2SLS)			
	fx_t	fx_{t-1}	fx_{t-2}	Sum	fx_t	fx_{t-1}	fx_{t-2}	Sum
Net Employment	1.51	2.26	0.76	4.53	-0.41	4.69	-1.41	2.88
Job Creation	2.23	-1.71	-0.10	0.42	1.41	-0.42	-1.27	-0.28
JC by Startups	1.11	-1.94	0.10	-0.73	0.91	-1.52	-0.28	-0.89
Job Destruction	0.72	-3.97	-0.87	-4.12	1.82	-5.11	0.14	-3.15
JD by Shutdowns	-0.61	-1.10	-0.49	-2.20	-0.32	-1.48	-0.14	-1.95

Source: See tables 4, 5 and 6[26].

[26]This table shows the response of net employment growth and gross job flows, for all establishments

- Tradable industries employment rises permanently by 1.06% due to a similar response of its two components: exporting and import competing industries, for which the effects are particularly statistically significant. Almost two thirds of the long-term effects in the employment stock come from job destruction and one third from job creation. Again shutdowns explain more than half of the response of gross job destruction.

- Job creation and job destruction responses are systematically disynchronized within the tradable sector. Thus the real exchange rate, as would be anticipated, acts as a "macro shock" for this sector and reallocates inefficient units of labor from non trading sectors to the tradable sector went it receives this positive real exchange rate shock (devaluation).

- Non Tradable industries almost systematically act counter to the tradable sector (at least with respect to the manufacturing mean-see figures 2a-2e). However none of the exchange rate effects are significant possibly due to the presence of the missing interaction with the remainder group i.e. the sectors that can be neither identified as tradable or non tradable.

3.5.2 Manufacturing Goods

This subsection presents the response of net employment growth and gross job flows for the manufacturing sector as a whole.

As table 4 and figure 2a show, regressing net employment flows on the level of the real exchange rate, there is some evidence that the number of individuals employed in the manufacturing industry depends significantly on the path of the real exchange rate. Estimating the response of net employment growth to the real exchange rate by GLS, a 10% appreciation in the real exchange rate is found to cause a 0.45% permanent decrease

and for startups-shutdowns, to the real exchange rate (fx_t), manufacturing employment growth rate (E_t), the rate of capacity utilization (CUR_t), and the federal funds rate (i_t). Estimation is done both by GLS, and by 2SLS using Hall-Ramey[43]'s instruments. Industry specific effects are included.

in the level of US manufacturing employment. The entry and exit margins contribute very largely and significantly to this adjustment. Yet, when instruments are used to control for exchange rate endogeneity, only macroeconomic indicators other than the real exchange rate seem to affect significantly net employment growth. This corroborates similar evidence by Gourinchas[39]. One interpretation is of course that the instruments enable us to dissociate the endogenous response of the real exchange rate to job creation flows, and that the apparent negative relationship between net or gross job creation is due to the fact that booms lead on average to a real exchange rate depreciation. A question with that interpretation is that it implies that booms are also times of low gross job creation, which runs in contradiction with the fact that gross job creation is procyclical if anything (see below). Still it's worth noting that when we exclude lags of manufacturing employment growth from the list of regressors, the level of the real exchange rate does matter in the IV estimation. The same holds for the contribution of start-ups and shutdowns to net employment growth although the rejection of hysteresis effects is weaker. For both estimation methods, employment rises when it was increasing the previous year, and when the interest rate is high, although this latter effect is sensitive to changes in the specification .

Table 4. Net Employment Growth Response by Establishment Type

	All Establishments		Start-ups-Shutdowns	
Regressor	Coeff.	S.E.	Coeff.	S.E.
Least Squares (GLS)				
fx_t	1.51	3.46	1.72	0.96
fx_{t-1}	2.26	4.33	-0.84	1.20
fx_{t-2}	0.76	3.02	0.58	5.8
Sum	4.53	2.27	1.46	0.63
Instrumental Variables (2SLS)				
fx_t	-0.41	3.42	1.24	0.96
fx_{t-1}	4.69	4.47	-0.03	1.25
fx_{t-2}	-1.41	3.13	-0.14	0.87
Sum	2.88	2.17	1.06	0.61

Source: See text[27]

The real exchange rate is not found to have any significant effect on the determination of gross job creation flows, as is shown in Table 5. However, the rejection of exchange rate level effects in startups hires is much weaker, and in fact, although the impact is small, the presence of hysteresis through startups job creation is significant when IV techniques are used. Indeed, a 10% devaluation if followed by an appreciation within a year will

[27]This table shows the response of net employment growth, i.e. job creation minus job destruction, for all establishments and for startups-shutdowns only, to the real exchange rate (fx_t), manufacturing employment growth rate (E_t), the rate of capacity utilization (CUR_t), and the federal funds rate (i_t). Estimation is done both by GLS, and by 2SLS using Hall-Ramey[43]'s instruments. Industry specific effects are included.

lead to a 0.1% decrease in start-ups' level of job creation[28]. However, when returning to its original parity 0.1% jobs will have been permanently destroyed in manufacturing. Also, if not offset immediately a 10% devaluation will lead in the following years to a 0.1% decrease in start-ups' employment contribution that will not be offset when the exchange rate returns to its previous parity. These figures are small as they only amount to about 10% of start-ups' job creation standard deviation. Still as deviations from parity typically last more than 3-5 years, the cumulated effect may not be negligible.

There are several potential explanations why job creation by start-ups increases with the (log) change in the real exchange rate, i.e. when the the real exchange rate depreciates. The most standard one is that a depreciation by making home products attractive boosts the creation of establishments in the sector benefiting from this positive income shock. We should expect this to be particularly strong in the exportables sector, and work in opposite ways in the non tradable sector as a depreciation increases price pressure from foreign competitors and raises the cost of imported materials (for non-tradable). Yet these effects may only last as long as the devaluation itself, as when the exchange rate re-appreciates inefficient units will be under pressure to exit. This highlights that a devaluation and the consequent increase in foreign price pressure on import-competing industries, while it increases the difficulty of refinancing inefficient units, also encourages the creation of more efficient units of production. Arbitrage behavior may be expected to have only transitory effects, however structural improvement should be more long lasting. Also to the extent that there is a technological lock-in effect due to the presence of sunk costs, we should expect the effects of innovation to be much stronger for start-ups than for continuing firms, a pattern seen in the data.

[28] Here the net impact is the sum of the -0.89 coefficient on fx_t and of the 1.80 coefficient on Δfx_t.

Table 5. Gross Job Creation Response by Establishment Type

	All Establishments		Start-ups	
Regressor	Coeff.	S.E.	Coeff.	S.E.
Least Squares (GLS)				
fx_t	2.23	1.80	1.11	0.66
fx_{t-1}	-1.71	2.26	-1.94	0.82
fx_{t-2}	-0.10	1.57	0.10	0.57
Sum	0.42	1.19	-0.73	0.43
Instrumental Variables (2SLS)				
fx_t	1.41	1.78	0.91	0.65
fx_{t-1}	-0.42	2.33	-1.52	0.84
fx_{t-2}	-1.27	1.63	-0.28	0.59
Sum	-0.28	1.13	-0.89	0.41

Source: See text[29]

The most impressive source of hysteresis in the response of labor movements to the real exchange rate was found in the pattern of gross destruction and in particular in shutdowns (see table 6 and figures 2d-2e). Not only can the hysteresis effects be quite large, accounting for about half a standard deviation of shutdowns' job destruction, but they are quite robust to changes in the specification. Indeed even when we added time dummies, the hysteresis coefficients were still significant. This reduces the likelihood that

[29] This table shows the response of job creation for all establishments and for startups only, to the real exchange rate (fx_t), manufacturing employment growth rate (E_t), the rate of capacity utilization (CUR_t), and the federal funds rate (i_t). Estimation is done by both by GLS, and by 2SLS using Hall-Ramey[43]'s instruments. Industry specific effects are included.

our results are simply due to the singularity of the dollar experience in the 1980s, and identification seems to be achieved by the cross-sectional variation. Again the response is complex, as both the current level of the exchange rate and the (log) change matter for destruction flows. We find that, at a 10% devalued level, job destruction is 0.41% lower and that more than half of the effect comes from shutdowns alone. Using IV techniques doesn't change significantly this picture, and reinforces the relative strength of shutdows in the adjustment process.

Table 6. Gross Destruction Response by Establishment Type

	All Establishments		Shutdowns	
Regressor	Coeff.	S.E.	Coeff.	S.E.
Least Squares (GLS)				
fx_t	0.72	2.23	-0.61	0.77
fx_{t-1}	-3.97	2.79	-1.10	0.96
fx_{t-2}	-0.87	1.94	-0.49	0.67
Sum	-4.12	1.47	-2.20	0.51
Instrumental Variables (2SLS)				
fx_t	1.82	2.18	-0.32	0.75
fx_{t-1}	-5.11	2.85	-1.48	0.98
fx_{t-2}	0.14	2.00	-0.14	0.69
Sum	-3.15	1.38	-1.95	0.48

Source: See text[30]

[30]This table shows the response of job destruction for all establishments and for shutdowns only, to the real exchange rate (fx_t), manufacturing employment growth rate (E_t), the rate of capacity utilization

The real exchange rate effects on job destruction, though they differ in magnitude, have the same sign as that on job creation. Real exchange rate shocks thus appear to behave as reallocation shocks both between continuing establishments and births-shutdowns, with entry and exit flows synchronized. The amount of temporary reallocation is the greatest in years when the real exchange rate just depreciated, while the converse holds for permanent (or hysteretic) reallocation. One possible interpretation for this result is that high prices of inputs when the currency is devalued makes irreversible reallocation costly during such periods.

3.5.3 Exports, Import Competing, and Non Tradable Goods

As we discussed earlier, there are several ways the real exchange rate affects economies. On the demand side, an appreciated home real exchange rate will tend to reduce the "competitiveness" of home products, and will reduce foreign demand for such goods. Conversely, foreign suppliers will have, other things equal, an increase demand for their goods. Thus we should expect that an appreciation lead to a decrease in employment in sectors dominated by exports. The same should hold in sectors dominated by import-competing establishments as these establishments find it harder to compete during an appreciation with cheap foreign imports. Lastly these effects are further reinforced by the cheapness of imported materials costs which tend to lead to a drop in home's goods supply curve.

When we carry out regressions by trade groups, none of the start-ups' exchange rate related coefficients appear statistically significant. However, looking at job destruction by shutdowns, we find robust evidence that the level of the real exchange rate matters, except in the case of non tradables. For both tradable sectors, a real devaluation leads to an increase in job destruction that leaves permanent scars on the production structure. The effect is especially strong in import-competing industries, a 10% devaluation leading to a

(CUR_t), and the federal funds rate (i_t). Estimation is done both by GLS, and by 2SLS using Hall-Ramey[43]'s instruments. Industry specific effects are included.

0.4% decrease in job destruction. Moreover, the impact carries out to the net contribution of start-ups and shutdowns, and a 10% real devaluation leads to an increase in the size of firms at the entry and exit margins in import-competing industries. This is well in line with the standard prediction of models of international trade, that a real devaluation by making foreign imports relatively expensive favors the expansion of home's import-competing industries. Interestingly enough, start-ups don't seem to be able to benefit much from real exchange rate fluctuations, as even the point estimate is close to zero. One interpretation is that, in the presence of important sunk costs of entry, incumbents will ward off entrants by cutting prices, pushing some of the inefficient incumbents out. Similarly though there may be new and more efficient[31] units entering, start-ups creation may move little as competition from incumbents is fiercer.

[31] The gains in efficiency can come either from better technology, or from a new range of goods specialization.

Table 7. Gross Job Flows and Employment Response by Trade Category

	fx_t		fx_{t-1}		fx_{t-2}		Sum	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
All Tradable Industries								
Net Employment	6.06	5.28	0.71	6.46	3.84	4.48	10.61	3.96
Job Creation	3.18	2.44	-0.46	2.99	1.33	2.08	4.05	1.83
JC by Start-ups	0.68	1.16	-0.57	1.42	-0.44	0.99	-0.32	0.87
Job Destruction	-2.88	3.38	-1.17	4.14	-2.50	2.87	-6.56	2.54
JD by Shutdowns	-2.34	1.24	-0.86	1.52	-0.51	1.06	-3.72	0.93
Exporting Industries								
Net Employment	3.51	11.33	2.06	10.87	4.98	9.19	10.55	10.05
Job Creation	2.04	4.33	-2.21	4.16	4.42	3.52	4.25	3.84
JC by Start-ups	-2.70	2.11	2.04	2.03	2.48	1.72	-2.25	1.88
Job Destruction	-1.47	8.05	-4.27	7.73	-0.56	6.54	-6.30	7.14
JD by Shutdowns	-0.53	1.74	-2.21	1.67	0.61	1.41	-2.13	1.55
Import Competing Industries								
Net Employment	9.20	5.91	-0.38	7.65	1.45	5.27	10.27	4.36
Job Creation	4.00	2.84	0.99	3.68	-1.76	2.54	3.22	2.10
JC by Start-ups	1.61	1.59	-0.72	2.06	-0.96	1.42	-0.07	1.17
Job Destruction	-5.20	3.85	1.37	4.98	-3.21	3.43	-7.04	2.84
JD by Shutdowns	-2.87	1.75	0.29	2.27	-1.64	1.56	-4.22	1.29
Non Tradable Industries								
Net Employment	-7.01	8.45	13.82	10.94	-5.79	7.42	1.03	4.89
Job Creation	-2.69	4.18	1.66	5.41	0.01	3.67	-1.03	2.42
JC by Start-ups	0.82	2.05	-4.26	2.65	2.01	1.80	-1.44	1.19
Job Destruction	4.31	5.38	-12.17	6.96	5.79	4.72	-2.06	3.11
JD by Shutdowns	0.70	1.87	1.16	2.42	-0.28	1.64	1.59	1.08

Source: Gross job flows from Davis, Haltiwanger and Schuh, LRD. Author's calculations[32]

[32]This table shows the response of job creation by startups, of job destruction by shutdowns, as well as of net employment growth by startups-shutdowns, to the log of the real exchange rate (fx_t). Estimation is done by OLS. The manufacturing employment growth rate (E_t), the rate of capacity utilization (CUR_t), the federal funds rate (i_t), as well as their lags, and industry specific effects are included.

The effects of a devaluation are particularly large and significant in the case of import competing industries. While we cannot reject that most of the reallocation in the exportable sectors is internal, i.e. new units replacing obsolete old ones, reallocation from importing sectors seems directed to the other sectors, and foremost to the non tradable sector. Indeed, the level of the real exchange rate has a statistically large and significant effect on the net contribution of start-ups and shutdowns employment net contribution. Only the non tradable sectors net a significant and positive increase in the contribution of start-ups and shutdowns to the employment stock. Also the non tradable sector is the only one, where there is a disynchronization between start-ups job creation and shutdowns job destruction. This is consistent with the view of real exchange rate as reallocative shocks between tradable and non tradable industries. The disynchronization in the occurs in the non tradable sector and not in the tradable, because real exchange rate shocks are direct positive shocks to the tradable industries, and only affect non tradable via general equilibrium effects. As a consequence, while during a devaluation, it is very costly to reallocate labor within the non tradable sector as the best profit or higher wage opportunities lay currently in the tradable sectors, the converse holds in the tradable industries as scrapping costs appear less. The singularity of important competing industries is not too surprising, as the US is, if not the, at least one of the foremost leaders in technology, and while it competes for exports in industries with a lot of value added and maybe a small number of competitors, while most of its imports are in commodity goods, with many competitors and potential entrants. However, in that context, exportables reallocation may be more lumpy at least at the microeconomic level.

3.6 Conclusion

There is evidence of hysteresis in the industrial structure, as the level rather than the change of the real exchange rate is affecting entry and exit gross job flows. The effects are particularly robust for job destruction by shutdowns. The numbers may appear small

in regards to gross employment fluctuations. Yet, at about 0.7 or 0.8%, the destruction of US manufacturing jobs via shutdowns in response to a 30% real appreciation of the dollar[33], represents about half a standard deviation of shutdowns job flows. By this metric, the real exchange rate is a significant force in job reallocation. Also the persistence of these effects, as destroyed firms during a period of appreciation are not re-created when the exchange rate returns to its original parity, implies that these effects are definitely relevant for academics and policymakers alike. As expected, the adjustments in response to movements in the real exchange rate are particularly large in tradable sectors, and in particular in import-competing industries.

Though, in tradable, start-ups flows seem to be less responsive than shutdowns to real exchange rate fluctuations, the evidence here shows that the finding of Gourinchas[39] for the US that creation and destruction tend to commove positively in the wake of real exchange shocks extends to the entry and exit margins. In contrast to aggregate shocks that seem to disynchronize the two flows, real exchange rates instead induce an important reallocation of labor in the tradable sector by destroying inefficient units.

These results show support for the predominance of exchange rate shocks as reallocation shocks from tradable to non tradable sectors with shutdowns playing a key role. In particular competition from foreign imports affects significantly the corresponding US industries, and the persistent effects of a devaluation are especially large.

Our data doesn't enable us to test wether the effects are due to changes in the number of firms entering or exiting the market, or to differences in plant size, i.e. the number of workers per establishment. It would be interesting to know what are the respective contributions of changes in the heterogeneity of the labor structure and of changes in the number of operating plants. In other words does the real exchange rate affect the size of projects or the number of projects or ideas? A look at average establishment size variations, using data for 1990-96 compiled by the Small Business Administration[34],

[33] Which is roughly the US experience during the first half of the 80s.
[34] See http://www.sba.gov/ADVO/stats/int_data.html.

shows that fluctuations in average establishment size are small, generally less than 10% for most manufacturing industries, whether looking at the whole economy or only establishments with smaller than 5 employees[35]. Given that employment changes are typically of a bigger order, it would seem that most of the variation in entry and exit flows should come from new plants or shutdowns rather than changes in size.

Also it would be useful to dissociate the nationality of the owners, as foreign investors may use home assets to hedge against future currency risk. Under this hypothesis, when the currency is devalued, shutdowns by local owners would be in part compensated by the creation of beachheads by foreign suppliers which are experiencing a positive income shock, and find it now possible to use FDI to hedge their risk as well as avoid trade barriers.

A limitation of our work is that the results are sensitive to the assumption that our proxy for anticipated changes in the real exchange rate adequately controls for these changes. Still, though it would reduce the persistence of changes in the production structure in response to real exchange rate fluctuations, it would increase their amplitude. Indeed, due the I(1) or near I(1) properties of the real exchange rate, the true impact of real exchange movements is typically of one order of magnitude greater than implied by $|\widehat{\mu}|$, as the $\rho_i s$ are typically very close to zero (and positive). In a way, at the minimum our results show that there is maybe a trade-off between persistence and amplitude of the response of job flows to shifts in the exchange rate , but that exchange rates do matter empirically for the employment structure.

Finally, one would like to have a richer dataset that enables to characterize the main differences and particularly the productivity differentials between new entrants in the wake of an appreciation and the exiting plants. This would enable us to compute the welfare costs of such job reallocation, and possibly attempt to gage what are the welfare costs of real exchange rate fluctuations for when insurance costs are included.

[35] Looking at small establishments has the advantage is maybe a good control as new entrants are usually of much smaller size than continuing firms.

Appendix.

SIC 2 industries Characteristics

	SIC	JCS	JDS	Firm Size	Esta. Size
Food and Tobacco	20	1.13	2.60	1.36	74.7
Textile	22	0.94	2.39	1.28	97.5
Apparel	23	2.22	4.76	1.09	39.6
Lumber	24	2.20	3.85	1.07	19.0
Furniture	25	1.63	3.15	1.09	41.7
Paper	26	0.77	1.53	1.59	98.3
Printing	27	1.71	2.51	1.10	24.1
Chemicals	28	0.99	1.67	1.60	79.8
Petroleum	29	0.65	1.77	2.04	60.2
Rubber	30	1.45	2.12	1.25	58.1
Leather	31	1.10	4.27	1.14	51.5
Stone,Clay, and Glass	32	1.50	2.50	1.37	30.4
Primary Metals	33	0.80	1.54	1.30	97.6
Fabricated Metals	34	1.22	2.19	1.12	39.1
Nonelectric Machinery	35	1.37	2.20	1.08	35.6
Electric Machinery	36	1.21	2.02	1.21	89.5
Transportation	37	0.77	1.42	1.20	146.6
Instruments	38	1.37	2.18	1.16	81.7
Miscellaneous	39	1.91	3.79	1.04	22.1

Source: U.S. Small Business Administration. Author's calculations[36].

[36]JCS denotes job creation by startups and JDS job destruction by shutdowns. Firm size denotes the number of establishments per firm, while establishment size denotes the number of employees by establishment. All figures are annual averages for the period 1990-1996. Data is available online at http://www.sba.gov/ADVO/stats/us90_96.exe.

Figure 2a. Employment Response to a 10% Temporary Shock - GLS Estimation

In percentage

10% positive (devaluation) exchange rate shock in period 0

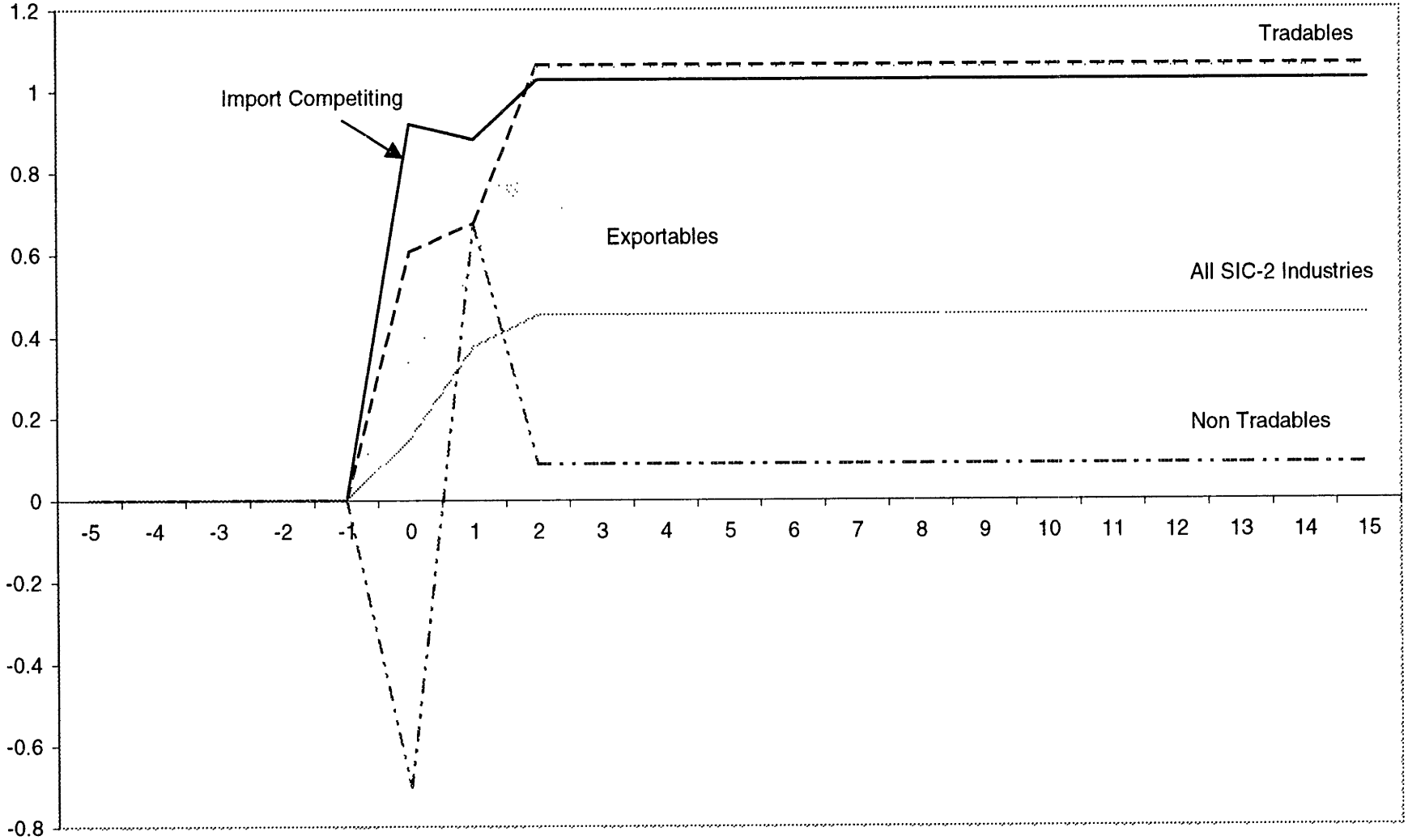


Figure 2b. Job Creation Employment Contribution - GLS Estimation

In percentage

In response to a 10% Temporary Shock -- 10% positive (devaluation) exchange rate shock in period 0

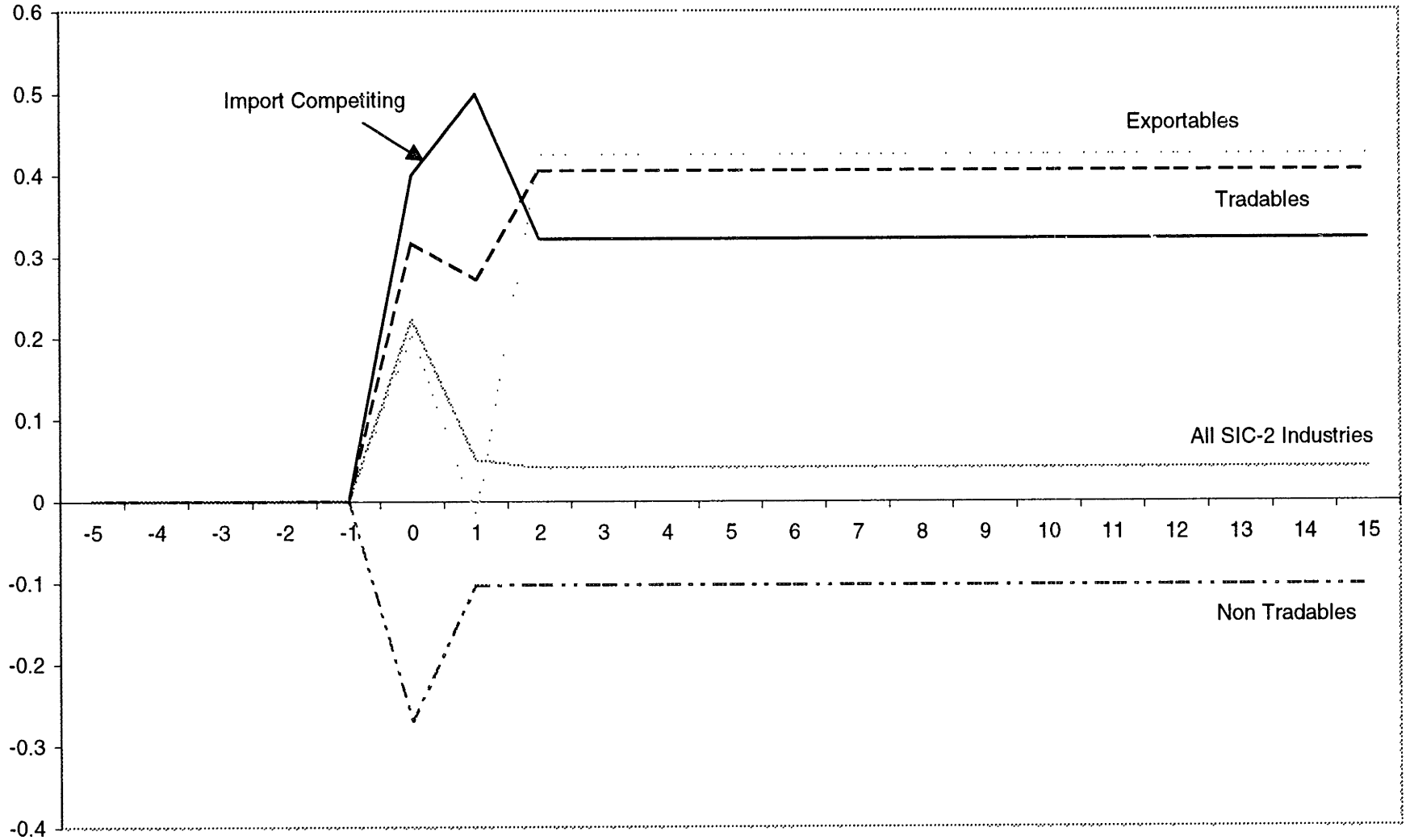


Figure 2c. Startups Employment Contribution - GLS Estimation

In percentage

In response to a 10% Temporary Shock -- 10% positive (devaluation) exchange rate shock in period 0

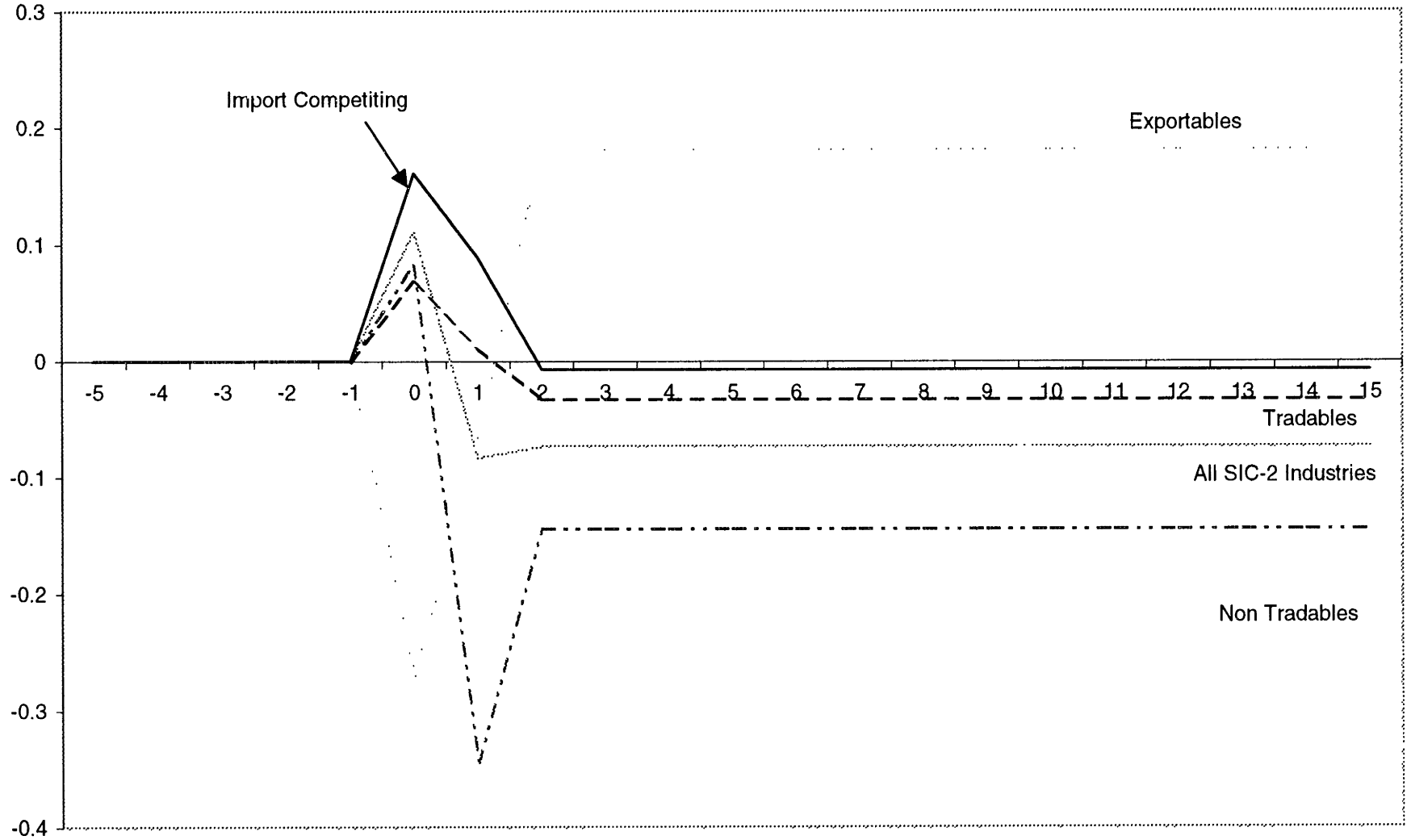


Figure 2d. Job Destruction Employment Contribution - GLS Estimation

In percentage

In response to a 10% Temporary Shock -- 10% positive (devaluation) exchange rate shock in period 0

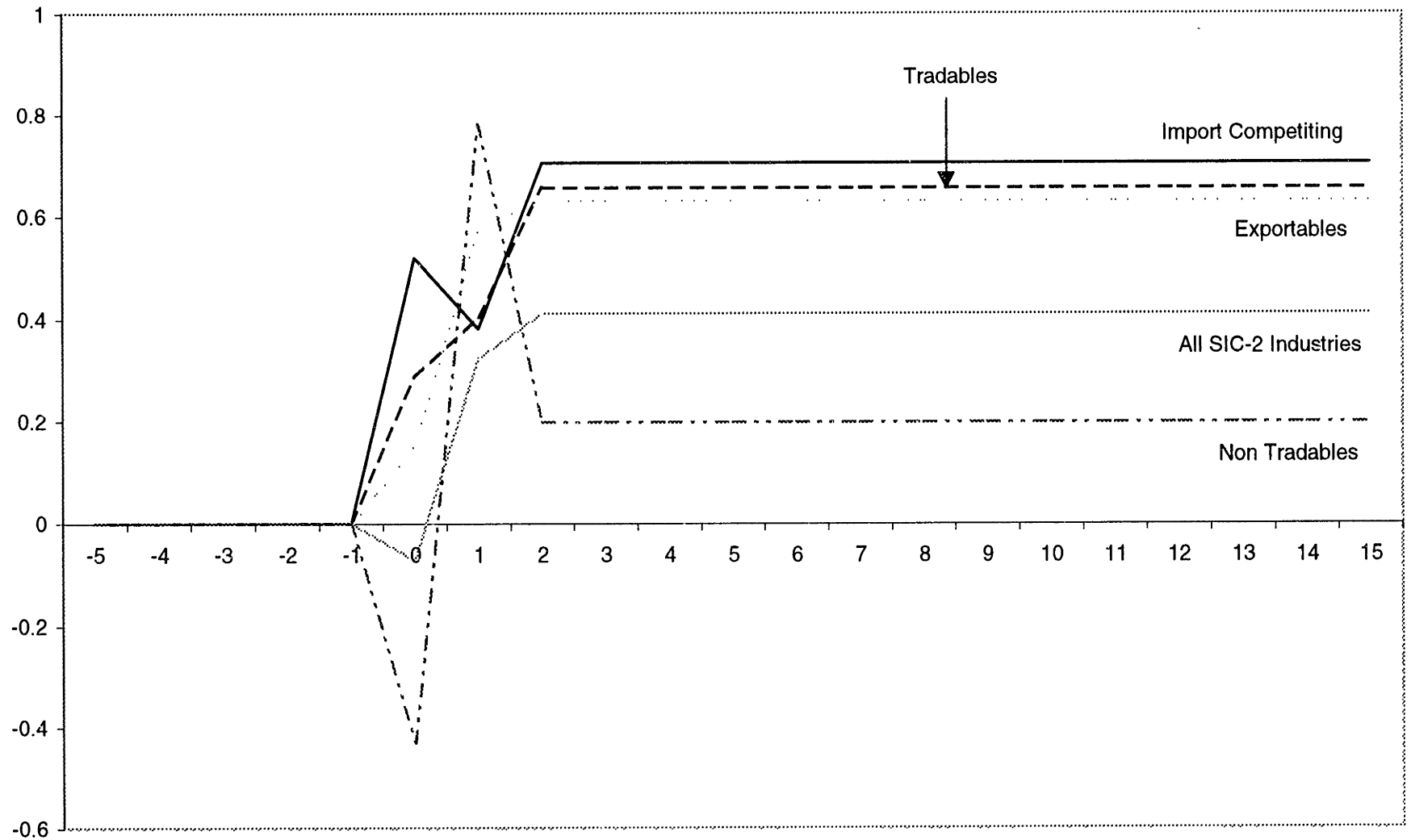
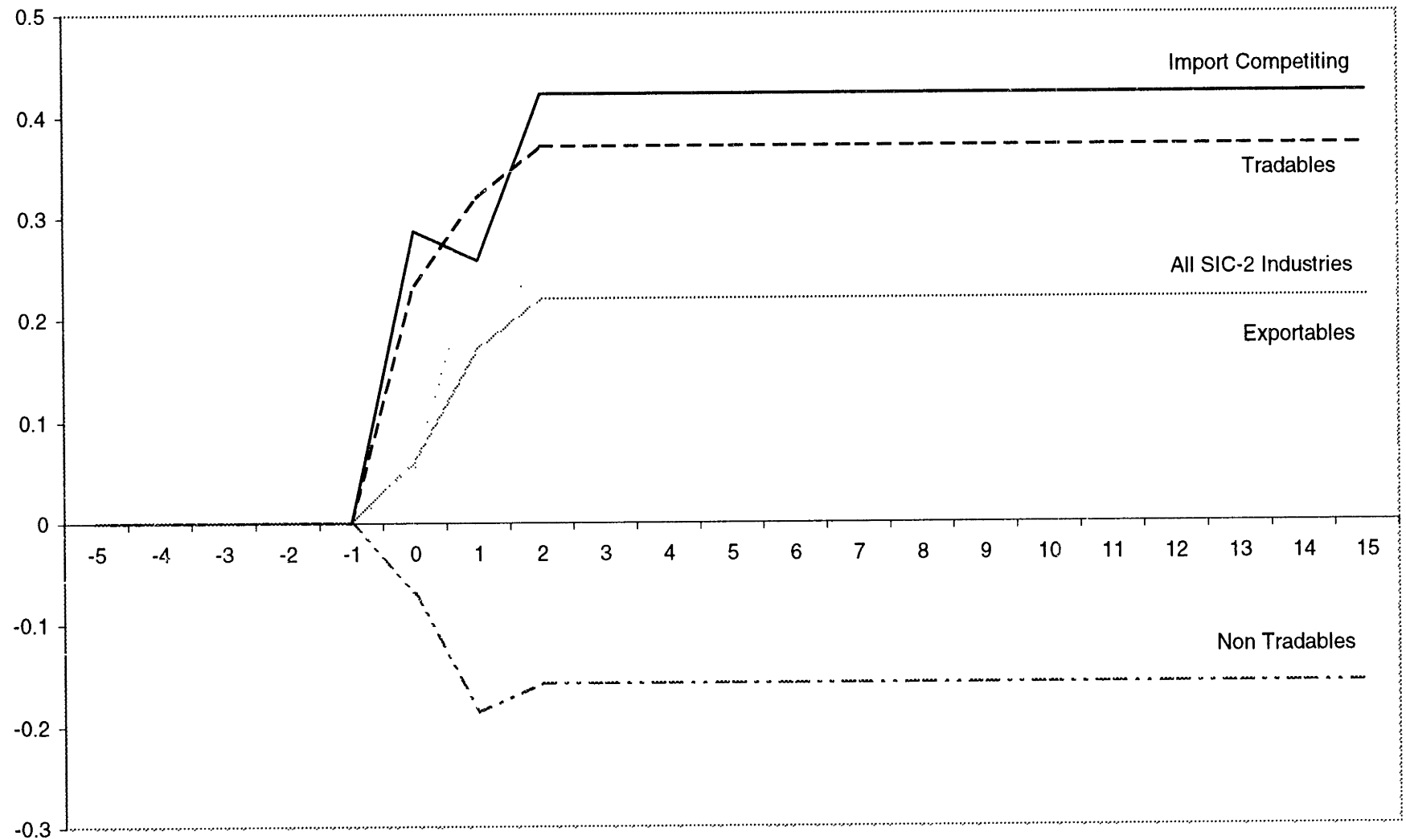


Figure 2e. Shutdowns Employment Contribution - GLS Estimation

In percentage

In response to a 10% Temporary Shock -- 10% positive (devaluation) exchange rate shock in period 0



Chapter 4

Pitfalls of a Tobin Tax

> "The introduction of a substantial Government transfer tax on all transactions might prove the most serviceable reform available, with a view to mitigating the predominance of speculation over enterprise in the United States...this would force the investor to direct his mind to the long-term prospects and to those only."
>
> John M. Keynes. 1935. The General Theory of Employment, Interest, and Money. Chapter 12.

4.1 Introduction

This chapter shows that the debate on the Tobin tax, which has focused predominantly on issues of implementability and inefficiencies, is misguided, as in a generic model of noise traders, neither the general equilibrium effects nor the endogenous exit of investors are likely to reduce return volatility. In fact, volatility is likely to increase, a prediction that is borne out in available evidence on transaction tax experiments. Finally, this chapter examines several alternatives to the Tobin tax which hold potentially better prospects.

There is a relatively wide consensus that asset prices and nominal exchange rate volatilities are too great compared to that of fundamentals. For example, Shiller[62] initiated some simple tests of "excessive volatility" in stock prices; while the tests have been refined over the years, notably with the techniques of non-stationary time series, all indicate that there exists much volatility that is unaccounted by fundamentals. On exchange rates, Frankel and Meese[34] find that "neither models based on economic fundamentals, nor simple time series models, nor the forecasts of market participants...seem able to predict better than the lagged spot rate...[and] the proportion of exchange-rate movements that can be explained even after the fact, using contemporaneous macroeconomic variables, is disturbingly low". This has sparked interest in ways to curb these volatilities in order to reduce negative effects and other associated phenomena, such as currency crises, excessive risk insurance costs, fads or underinvestment. Restrictions on capital movements, such as minimum reserve requirements on foreign exchange contracts and credit, or minimum stay requirements for foreign investment, currency trading restrictions etc., have been a popular regulation tool for policymakers in the past, especially in developing countries with strong governments[1]. Unfortunately, a major inconvenience of most capital flow (price or volume) restrictions is that they can fail to dissociate "bad" from "good" flows, and thus reduce the amount of much needed investments. Furthermore, time constraints may considerably increase risk for foreign investors, as they lose the ability to liquidate for a fixed period of time their assets to investors, who attribute now higher valuations to these assets, either because the investments have turned sour (and there is asymmetric information) or because of a sudden demand for liquidity.

As an alternative, James Tobin[65] proposed in 1972 a tax on asset transactions. First envisioned by Keynes in the General Theory, the Tobin tax presents an original alternative to most forms of capital controls. First, by increasing significantly the costs of multiple transactions, it aims to deter trading by short-run speculators, while leaving returns from long-run investments mostly unscathed. As a consequence it could, a priori,

[1] See for example [41].

effectuate the dichotomy between "bad" and "good" investments which eludes other forms of capital controls. A 0.1 or 0.25% transaction tax as is often debated, quite consequent as it ranges between 1 to 5 times the current transaction costs in US stockmarkets[2], would be large compared to average daily fluctuations in asset prices, yet small at the yearly or decade frequency. Thus a speculator, who thinks that the price of a given asset is going to increase by 0.1% tomorrow will not invest for just a day if there is a transaction tax in excess of 0.1% while he will still invest in long-run projects that, in the end, will more than compensate for the tax.

A second original trait of the proposal is its international cooperation dimension. To succeed, it would require countries to cooperate in universally enforcing these transaction costs, as traders could simply move off-shore to avoid paying the extra fees. Yet by being international it would have the advantage of limiting the use of capital controls as a tool by bad governments. Though these political economy concerns are important, we will not discuss them and refer the reader instead to the excellent discussions in [44].

This chapter analyzes the impact of a Tobin tax on financial markets in a generic model of asset pricing with noise traders. This environment is chosen, as it probably offers the most general setting in which asset trades are due to (real or irrational) differences in information, which, as of now, seems the main explanation for the volume of trades and asset price variations observed in practice. This framework also best fits the mechanism proponents of the Tobin tax have in mind. It is shown that in such an environment a transaction tax will tend to reduce volatility, if it reduces the proportion of short-term traders in the economy, as argued by its supporters.

However, several effects are shown potentially to offset this, when (as is likely given trades volume size and price volatilities) short-term traders dominate the market[3]. First, in general equilibrium, a transaction tax will push the price of the taxed assets down, as short-term holders have to be compensated. In turn, this will tend to drive volatility up,

[2] See the next section.

[3] In the sense, that their share of market participants ($1 - \mu$ in our model) tends to 1.

as lower prices will incite traders to take more risk.

Secondly, whereas the exit of short-term noise traders in response to a transaction tax argued by Tobin and others is likely to be dependent of the market specifics and only likely to hold for high tax rates, quite generally a transaction tax will lead to an exit of the least "noisy" investors. Furthermore, it will encourage agents with extreme views, as the others can no longer expect to survive in a taxed environment. Also, in general, the results will depend significantly on whether investors base their market participation on their ex-ante beliefs or on ex-posts returns. Yet even in the a priori more favorable (or "semi-rational"[4]) case where investors use an ex-post criterion to enter, a transaction tax will lead to a reduction in the noisiness of the economy only when the average investor is "bullish", while it will increase the economy's noisiness in "bearish" times. To the extent that the government has information about the bullishness of the market, it may prefer to use a procyclical (e.g. a positive tax only in times of bullishness) Tobin tax rather than a flat tax. Furthermore, in the presence of the semi-rationality, and in particular to the extent that market participation and portfolio size decisions are based on different priors distributions, the sunk cost aspect of a transaction tax may increase the rationale for informational cascades, as other traders infer information about the state of the economy, and the portfolio choices of other traders from order flow.

The impact of a transaction tax on total welfare is also shown to be ambiguous, as the reduction in the risk due to lesser asset prices tends to increase welfare, while the fall in the net present value of returns of the risky assets hurts investors. Yet, when risk aversion is small, a Tobin tax will improve welfare when noise traders are present - not because noise traders are curbed by the transaction tax, but because lowering the price of assets enables agents to trade their differences in opinion more easily.

These theoretical results are particularly important as most of the debate on the Tobin tax has focused on its implementability or inefficiencies in terms of liquidity provision.

[4] As we'll discuss in the text, there is some irrationality as the decision to enter-exit the market is based on a different expectations distribution from the one used to decide on the size of the participations. See section 3.6.3.

Most commentators, pro and con, seem to have accepted at face value that it could achieve its goal of volatility reduction[5]. For example, in what is perhaps the only previous theoretical modelling of the impact of such a tax on asset volatility, Frankel[33] shows that volatility depends positively on the elasticity of short-term investors' demand for foreign assets with respect to the expected future price, f_s, and negatively on the share of long-term investors μ[6]. He then uses these results to predict that, under the hypothesis that a Tobin tax should lead to a lower f_s and a higher μ, its enactment should lead to a greater volatility. In fact neither of these two hypotheses is shown to be true in our model: asset demands are likely to rise, and it could be mostly rational investors that end up being evicted.

Furthermore, these theoretical concerns seem to be borne out by the data. Indeed, direct evidence on transaction taxes indicates that they indeed increase volatility rather than decrease it, that they lead to a fall in asset prices, and that exit by traders, if anything, tends to increase volatility.

In short, this chapter posits that there are realistic concerns that a Tobin tax could in fact worsen the problem it is trying to address, and that there are alternative forms of intervention dependent on the goals of such intervention. The chapter is organized as follows. Section 2 reviews the existing empirical evidence on the relationship between transaction costs and asset price volatility. Section 3 presents a model of the impact of a transaction tax in a general equilibrium framework with noise traders. Section 4 presents some alternatives to the Tobin tax depending on its objective(s) - lower return volatility, lower market size etc.- and section 5 concludes.

[5] There are a few exceptions. See for example Lo and Heaton[54]. However, the mechanism envisionned is in general that a transaction tax by reducing liquidity could in turn increase volatility as it becomes more difficult to find a match between borrowers and lenders. This mechanism is quite different from the general equilibrium effects and entry and exit of noise traders analyzed here.

[6] We use here Frankel's notations.

4.2 Empirical Evidence

Despite the significant debate on the Tobin tax in recent years, few empirical studies have studied specifically whether a transaction tax would reduce the volatility of asset and foreign exchange prices. Instead most of the proponents of the tax use evidence on other forms of capital controls to justify their support. For example, Eichengreen and Wyplosz[28] claim that "all the evidence [on capital controls] points in the same direction" i.e. that "restrictions on international financial transactions have had statistically significant and economically important effects". Yet, their survey of the evidence covers only capital controls such as reserve requirements and not transaction taxes. Also, they only claim that capital controls matter - not that they are effective in reducing volatility. Instead, it is interesting to note that Eichengreen et al[27] find that the incidence of currency crises is higher when controls are present and that inflation, money growth, and the ratio of exports to imports were more variable both in times of currency crises and in "tranquil periods". Also Kaul et al[44], in their overview, argue that the "parallel increase in both the size and the instability of the foreign exchange market" over the last thirty years is evidence against the concerns that a transaction tax could fail to reduce volatility via lower short-term trading.

Still, there is much more direct evidence as to the potential efficacy of a Tobin tax as a remedy for overly high volatility. As a few case studies show, and in particular the works by Umlauf[67], and Jones and Seguin[45], there seems to be strong support empirically that an increase in transaction costs would in fact raise price volatility rather than reducing it.

On May 1, 1975, the New York Stock Exchange (NYSE) and the American Stock Exchange (AMEX) uniformly lowered their fixed commissions to reduced negotiated commissions, while the commission structure on all over-the-counter (OTC) transactions in the US remained unchanged. Jones and Seguin[45] used this event as a natural experiment to test how asset prices depend on volatility using OTCs as controls. With daily data, covering a total of 1872 securities traded on NYSE and AMEX, for one year be-

fore and one year after the change in commission basis, they examine daily volatility in five sample portfolios sorted by size. Calculating cross sectional mean market values for each portfolio and daily return standard deviations as their measure of volatility, they uniformly reject the hypothesis that the abolition of higher fixed commissions increases volatility. Instead they find that a reduction in transactions costs is associated with a decline in volatility and an increase in prices.

Similarly, Bessembinder and Kaufman[10] looking at 171 technology stocks[7] in 1994-95, find that percentage (effective or quoted) bid-ask half-spreads, measures of transaction costs, were approximately 11.5 basis points, or 50%, higher on the Nasdaq stock market than on the NYSE, while the mean standard deviation of daily returns was 51% larger for Nasdaq-traded companies. A shortcoming is of course that it doesn't control for firm heterogeneity, which may be related to the choice of being listed on Nasdaq or NYSE, with advantages of Nasdaq listing such as the presence of multiple market makers, the possibility that Nasdaq listing improves companies' visibility, lower listing fees, and a "prototype of future markets" computer-based trading system.

On October 24, 1983 the Swedish government announced the introduction of a 1% round-trip transaction tax on sales of securities, effective as of January 1, 1984. Similarly on March 11, 1986 the transaction tax was further increased to a 2% level. Umlauf[67] uses these two events as natural experiments of transaction tax shocks, to calibrate the effects of such taxes on the Swedish stockmarket, arguing that these shocks were mostly due to labor concerns rather than excessive volatility, and therefore largely exogenous for the issue at hand. Doing so, he finds some evidence that the variance of daily returns of stocks traded on the Stockholm stockmarket is significantly larger after the enactment of the transaction taxes than before, a result that seems robust to weighting by weekly variances or by NYSE or London Stock Exchange (FTSE) variances of daily returns[8]. While

[7] The sample was selected on the basis of their inclusion in the Red Herring 250 index, as of March 1996, and a minimum market capitalization of $300 million. About 31.4 million trades are represented. Approximately 60% of the companies were traded on Nasdaq, and 40% on the NYSE. Only 3 companies in the sample switched to NYSE during the study period.

[8] At least when the 1987 crash is excluded.

the introduction of a transaction tax in 1983 was announced as part of a budget package including budget cuts, the transaction tax increase to 2% is particularly interesting as there doesn't seem to have been any relevant policy measure announced or enacted by the Swedish government during that period. The experiment differs, however, from the Tobin tax proposal as it doesn't control for the displacement of trading to stockmarkets with cheaper costs of transaction and in particular towards the London Stock Exchange. Indeed after 1986, over 30% of the trading volume on the Stockholm stock exchange migrated to London. Still it is worth noting that while volatility increased in Stockholm, volatility of comparable shares was reduced in London. This is strong support for the view that volatility increases with a transaction tax, and that exit of traders may reinforce the phenomenon.

4.3 Transaction Tax and Noise Traders

This section analyzes the impact of a Tobin tax in an economy populated with noise traders. The framework is essentially the same as in the seminal work of De Long et al[21]. Besides a transaction tax, the main addition is the multiplicity of noise traders types. This addition is important as it will enable to enrich our discussion of traders entry and exit, and the impact of a Tobin tax. There is no fundamental uncertainty, as adding risky asset uncertainty doesn't alter the conclusions presented here[9]. We do not include labor supply decisions or bequest motives as they are unlikely to matter at the frequency of interest. We also do not include multiple risky assets. This is made more for the simplicity of exposition rather than anything else and, aside from some distributional issues, the analysis would be very similar.

Furthermore, we add long-term (L type in what follows) traders as investors who do not have to pay the transaction tax, and who only live one period. The one period assumption is just one of commodity, and is made in order to abstract from agents with

[9]The corresponding model is available from the author upon request.

heterogeneous horizons (easy to accommodate), and more importantly from consumption smoothing concerns (more messy). It is not essential for the discussion here. The hypothesis that L traders do not pay the transaction tax is extreme and is made to highlight the mechanism proposed by the adepts of a Tobin tax. It should bias our results in favor of such a transaction tax as, in general, long-term traders will be taxed as well, opening the way to the traditional criticisms of such taxation: liquidity reduction,...

This layout corresponds well to the setting that is used to justify the Tobin tax proposition. Indeed, there are both untaxed rational traders (L investors) and taxed noise traders (S investors), only the risky or speculative asset is taxed while the safe or long-term investment is untaxed, and most of the trade in the risky asset is due to a speculative motive (differences in opinions). Also this modelization has the advantage of being quite generic, and can be interpreted alternatively as a model of noise traders, or of rational agents with imperfect information or understanding.

4.3.1 The model

The economy is composed of overlapping generations that live 2 periods each. In each generation, agents invest in assets when young, and resell their assets to the new youth when old. All agents have the same constant absolute risk aversion preferences with coefficient γ, caring only about last period consumption. We'll assume throughout normally distributed disturbances so that it is as if investors of type i at time t solve the mean-variance certain equivalent problem:

$$MaxE_t[W_{t+1}|type = i] - \gamma Var_t[W_{t+1}]$$

where W_{t+1} is their wealth at t+1. Thus the program of each agent is a simple mean variance problem, so our results should serve as a good first-order appromixation for any differentiable preferences.

There are two assets in the economy, a safe asset, in perfectly elastic supply with non

stochastic return r, and a risky asset, in perfectly inelastic supply normalized to one, with return $\bar{r}$. Let p_t be the price at time t of the risky asset in terms of the safe asset (taken as numeraire).

There is a transaction tax, modeled as a proportional tax on the risky asset's value with constant rate τ, consistent with the proposal of Tobin and other proponents of such a tax.

Each generation is composed of two type of agents: L and S. There are μ Ls and $1-\mu$ Ss. Both types only live two periods. All agents are supposed to have an exogenously given initial wealth, W_{init}. This abstracts from labor supply decisions as well as bequests that don't seem essential for the question at hand. Although this doesn't affect the pricing of assets, note that the initial wealth amounts are allowed to be different across agent types. Let I denote the set of agents.

The key difference between the two types of agents is that only the Ss as subjected to the transaction tax.

To enrich the discussion of noise trader entry and exit, the Ss are supposed to be heterogeneous in their expectations as to the future risky asset price, either due to heterogeneous information, or due to miscomputations or misperceptions. Conversely, the Ls are supposed to be homogeneous, and have rational expectations. Again this favors the Tobin proposal as, here, the Ls do not contribute per se to asset volatility, while the converse is likely to hold in practice. Specifically, expectations of agent i are supposed to be given by:

$$E_t\left[p_{t+1}|agent=i\right] = E_t\left[p_{t+1}\right] + \rho_{t,i}$$

where $E_t\left[p_{t+1}\right]$ is the rational expectation at time t of the risky asset price next period, and $\rho_{t,i}$ is the degree of misperception of agent i at time t. Therefore if agent i is of type L his $\rho_{t,i}$ will be equal to zero at all times.

The $\rho_{t,i}$ are supposed to be normally distributed across Ss. Let F be their cumulative

distribution[10]. In a more generalized setting, the variance could also be misperceived. Still, doing so can be shown to be equivalent to our derivation in the case of an additive normally distributed error. And coming from the benchmark of risk-neutral financial markets, return level uncertainty seems the most relevant. Let λ_t^i denote the amount of risky asset bought by a type i agent at time t.

Ex-post, agent i's wealth is equal to the sum of the gross returns from the safe asset and from the risky asset i.e.

$$W^i = (W_{init}^i - p_t(1+\tau)\lambda_t^i)(1+r) + \lambda_t^i(\bar{r} + p_{t+1})$$

Each agent sets optimally his holdings of the risky asset so as to maximize his certain utility equivalent. The first order condition for this to be achieved implies that, each agent buys the following amount of the risky asset:

$$\lambda_t^i = \frac{\bar{r} + E_t[p_{t+1}] + \rho_{t,i} - p_t(1+\tau)(1+r)}{2\gamma Var_t[p_{t+1}]}$$

No constraint is imposed on the $\lambda_t^i s$, so that each agent's risky asset demand can be negative (i.e. they can short at will) as well as greater than one. As in [21] this is made for tractability only, and the results do not depend critically on this assumption.

Let $\rho_t = \int_{i \in I, i=ST} \rho_{t,i} dF(i)$ denote the mean state of misperception of short-term agents. Market clearing of the risky asset implies:

$$\bar{r} + E_t[p_{t+1}] + (1-\mu)\rho_t - p_t[(1-\mu)(1+\tau) + \mu](1+r) = 2\gamma Var_t[p_{t+1}]$$

Assuming no bubbles, forward integration yields the equilibrium price level of the risky asset as the discounted sum of the mean expected flow of dividends net of a risk premium:

[10] Thus we can have discrete as well as continuous types.

$$p_t = \sum_{k=0}^{+\infty} \frac{H^k}{[(1+\tau)(1+r)]^{k+1}} [\bar{r} + (1-\mu)\overline{\rho} + (1-\mu)\Delta\rho_t - 2\gamma Var_t [\Delta p_{t+1}]]$$

where $\overline{\rho}$ is the mean S misperception across time, while $\Delta\rho_t = \rho_t - \overline{\rho}$ is the deviation from this mean, and H is the forward expectational operator. The mean misperception deviation is suppose to follow an AR1 process such that:

$$\Delta\rho_t = \xi\Delta\rho_{t-1} + \chi_t$$

where $\chi_t \tilde{} \aleph(0, \sigma_\chi^2)$ is white noise, and ξ is a constant in (-1,1).

It's easy to check that there is a stationary equilibrium risky asset price such that $\forall t \; Var_t [\Delta p_{t+1}] = V$, where V is a constant independent of time. Solving the equation above, we find that, in equilibrium, the risky asset price is given as the discounted value of the expected mean return of the risky asset net of the cost of risk plus a stochastic term, the discounted value of net market misperceptions.

$$p_t = \frac{\bar{r} + (1-\mu)\overline{\rho} - 2\gamma V}{[(1-\mu)(1+\tau)+\mu](1+r)-1} + \frac{(1-\mu)\Delta\rho_t}{[(1-\mu)(1+\tau)+\mu](1+r)-\xi}$$

In all cases the tax rate and the return on the safe asset affect negatively the way expected flows are discounted, as both increase the value of using the alternative safe asset as a mean of storing wealth. In addition the persistence of the average misperception innovations affects positively the way net returns and misperceptions are discounted, as the more persistent the shocks the larger the value of an expected increase in the asset productivity.

4.3.2 Lower Volatility or Lower Prices?

In this subsection, the variance of prices is shown to be monotonically decreasing in the tax rate. However, the effect is due to the drop in the price level. When this is controlled

for, the impact of a transaction tax is shown to be a priori ambiguous on the taxed asset volatility. In fact and significantly, when investors are not too far from risk-neutrality, the benchmark in finance, a transaction tax increases volatility. This result seems quite independent of the modelization specifics, as it comes from the fact that the risk premium is a small fraction of the price level compared to the perceived mean return flow.

Using the previous price equation, we can solve for the conditional variance V, and for the unconditional variance of asset prices $\sigma^2_{p_t}$ across time as:

$$\sigma^2_{p_t} = \frac{(1-\mu)^2\sigma^2_\chi/(1-\xi^2)}{\left[[(1-\mu)(1+\tau)+\mu](1+r)-\xi\right]^2} \tag{4.1}$$

and

$$V = (1-\xi^2)\sigma^2_{p_t}$$

Equation (4.1) shows that a tax on the risky asset reduces the variance of its price level and the more noisy these traders are, the more volatile the risky asset price. Yet, the reason the variance of prices is reduced is not because of a reduction in the intrinsic "noisiness" of the economy and its asset traders, but because the direct effect of a transaction tax is to lead drop in the price level[11], as, like any other tax, holders of the asset need to be compensated for the tax change in order to continue to hold the asset. However, when people comment on the too important volatility of prices they generally think of the volatility of the percentage price change or return of the asset. Is it the case that, when we control for the changes in the price level, this volatility goes down?

To answer this question, a more meaningful measure of volatility is the ratio of the price level variance, $\sigma^2_{p_t}$, and its mean $\overline{p}$ (where $\overline{p} = E[p_t]$) i.e. $\sigma^2_{p_t/\overline{p}} = \sigma^2_{p_t}/\overline{p}^2$. Its square root, $\sigma_{p_t/\overline{p}}$, is sometimes referred to as the "relative standard deviation"[12]. Using the

[11] The impact on the mean price level $\overline{p}$ is not straightforward though, since a reduced variance V also raises the mean attractiveness of the asset.

[12] This measure is equivalent to the inverse of the Sharpe ratio but using the price level rather than returns as the variable of interest.

previous expressions, we have:

$$\sigma^2_{p_t/\overline{p}} = \frac{(1-\mu)^2\sigma^2_x}{(1-\xi^2)} * \frac{\left[1 - \frac{(1-\xi)}{[(1-\mu)(1+\tau)+\mu](1+r)-\xi}\right]^2}{\left[\overline{r}+\overline{\rho}-2\gamma V\right]^2} \tag{4.2}$$

Though this measure doesn't correspond exactly to return volatility, it was chosen because of several attractive features. First, it has a much simpler mathematical distribution than that of a ratio of two gaussians. Also as a measure of the distance of asset prices from their mean, it is maybe more closely related to "excessive movements in asset prices" and easily interpretable than the concept of return volatility. Finally, the two concepts are very closely related and choosing one or the other doesn't alter significantly our discussion of the effects of a Tobin tax. Indeed, under a small deviations hypothesis, the relative price change at time t+1 can be approximated as $\frac{\Delta p}{p} = 1 + \frac{\Delta p_{t+1}}{\overline{p}} - \frac{\Delta p_t}{\overline{p}}$ so that its variance is given as $\sigma^2_{\%p} = 2 * (1-\varkappa)\sigma^2_{p_t/\overline{p}}$, where $\varkappa$ is the unconditional correlation coefficient between future and current relative price changes, which is very similar to our concept.

As equation (4.2) illustrates, there are two direct effects of a transaction tax on return volatility. First, a transaction tax tends to reduce volatility, as the drop in the price level tends to reducte the mean risk premium (the $2\gamma V$ term). However, on the other hand, a transaction tax will tend to increase volatility, as the reduction in the price of the asset enables traders to take more risk and increase the size of their position of the risky asset (see section 3.4).

The direct impact of a transaction tax is theoretically ambiguous a priori. Log-differentiating the volatility in equation (4.2) with respect to the tax-rate (at $\tau = 0$, given the small tax envisionned), we find that:

$$\frac{1}{\sigma^2_{p_t/\overline{p}}}\frac{\partial\sigma^2_{p_t/\overline{p}}}{\partial\tau}\bigg|_{\tau=0} = \frac{2(1-\mu)(1+r)}{(1+r-\xi)}\left[\frac{1-\xi}{r} - \frac{4\gamma V_0}{\overline{r}+(1-\mu)\overline{\rho}-2\gamma V_0}\right]$$

where V_0 denotes the conditional gross receipts variance V evaluated at a zero trans-

action tax ($\tau = 0$).

Thus, the impact of a transaction tax on volatility depends on the relative weights of the inverse of the interest rate and of the risk premium on the price of asset. Although, the net effect is a priori ambiguous, to the extent that risk premia are generally small, especially with respect to the inverse of the interest rate, a transaction tax would be expected quite universally to raise volatility. This result should be relatively independent of the modelization. Indeed, quite generally a drop in the price level should be expected to lead to investors taking more risk, and this effect should dominate the diminution in volatility coming from the reduction in the risk premium (which tends to reduce the extent of the price decrease). This prediction is supported by the evidence that quite generally, the introduction of transaction tax leads to a very significant drop in the asset price.

4.3.3 The Keynes-Tobin Channel of volatility reduction

As we saw in the previous subsection, the direct effect of a transaction tax should be quite generally to increase volatility rather than increase it. However, so far, our approach which implicitly assumed an exogenous participation of S and L traders to financial markets failed to higlight the channel of volatility reduction stressed by Keynes and Tobin. Indeed, the argument of the proponents of a transaction tax in financial markets is two steps: first, a transaction tax will reduce the participation of noise traders or animal spirits motivated individuals. Second, the exit of these noise traders will reduce volatility.

The first step is likely to be true in most models where long-term traders can effectively avoid paying the tax, and entry and exit decisions are made rationally. The second step is less obvious, at least for "small" tax rates, as we will argue in the next subsections. Still, we can already highlight this channel, i.e. that a reduction in the proportion of noise traders will reduce volatity, within the context of our model. Log-differentiating the return volatility in equation (4.2) yields:

$$\frac{1}{\sigma^2_{p_t/\overline{p}}}\frac{\partial\sigma^2_{p_t/\overline{p}}}{\partial\mu}\bigg|_{given\tau\simeq 0} \simeq -\frac{2}{1-\mu} - \frac{4(1+r)(1-\xi)}{(1+r-\xi)}\left[\frac{\tau}{r} + \frac{8(1-\mu)\gamma V_0}{\overline{r}+(1-\mu)\overline{\rho}-2\gamma V_0}\right] \quad (4.3)$$

Again only zero and first-order terms are presented, given the small tax rate assumption made by Tobin and others in their proposal.

Thus unambiguously, we do indeed find that a reduction in the proportion of short-term noise traders reduces volatility. Again, there are several effects at work, all concurring to reduce volatility in response to a transaction tax. The two last components in the right handside of equation (4.3) are likely to be small in practice as they only have an effect via the discount rate or the risk premium. However, the first component is really what proponents of the Tobin tax have in mind, i.e. that a reduction in the proportion of noise traders reduces the gross contribution of noise traders to volatility. This contribution is linear in terms of dispersions, and we should thus expect that an x% reduction in the proportion of noise traders, reduces by x% the dispersion of the taxed asset returns.

4.3.4 Lower Transaction Amounts Volatility?

The equilibrium holdings of the risky asset by a short-term agent of type i are equal to:

$$\lambda_t^{ST,i} = 1 + \frac{1}{2\gamma V}\left[\rho_{t,i} - (1-\mu)\rho_t - \mu p_t(1+\tau)(1+r)\right] \quad (4.4)$$

and similarly, a long-term agent will optimally hold in equilibrium:

$$\lambda_t^{LT} = 1 - \frac{1}{2\gamma V}\left[(1-\mu)\rho_t + p_t(1+r)\left[(1-\mu)(1+\tau)-1\right]\right] \quad (4.5)$$

As equation (4.4) shows, a transaction tax will tend to increase the size of positions taken by noise traders, as the reduction in the price level, induces a fall in the relative riskiness of the taxed asset ($2\gamma V$ term). There is also an effect via the price level, however,

it will be negligible when noise traders initially dominate financial markets (i.e. $\mu \simeq 0$), which we take as our benchmark[13]. There are several reasons for this choice of $\mu \simeq 0$ for our study. First, it seems likely given the volatilities and the volumes observed in practice. Also it probably represents best the environment that the Tobin and others have in mind. Finally, since the core of the Tobin tax proponents' argument is that noise traders will be evicted from the market, focusing mostly on these traders shouldn't bias our analysis in any way.

In that context, in response to a transaction tax, agents with extreme beliefs, i.e such that $|\rho_{t,i}| >> |(1-\mu)\overline{\rho}|$, will take larger positions on the risky asset, all the more so if they are have a low risk aversion or if the variance V is initially small; "Optimistic" agents will take very long positions on the risky asset, while "pessimistic" agents will have very short positions. With our specification the agents purchase-sell decisions are independent of the asset real return component. This is due to our assumption that all the asymmetry in investors' perceptions are captured by their $\rho_{t,i}$ component.

This analysis shows that a danger from a Tobin tax is that, though it may fail to diminish price volatility, it is sure to increase positions' volatility. It's not clear whether this is an outcome that most proponents of such a tax would find desirable. In the wake of the recent Asian crises, many commentators have become wary of the large amounts of foreign exchange that (foreign) investors, and particularly currency hedge funds, can mobilize against national currencies, overshadowing the governments' reserves. The view of Malaysia's PM, Dr Mahatir, stated at the annual meetings of the IMF and World Bank in Hong Kong, that currency trading beyond the level needed to finance trade is "unnecessary, unproductive and immoral"[14] is of course extreme. Still the large amounts of currency that foreign operators can wield against the home currencies, is certainly one of the factor that has prompted many economists and others to call for

[13] There are several reasons for this choice. First, it seems likely given the volatilities and the volumes observed in practice. Also it probably represents best the environment that the Tobin tax proponents have in mind.

[14] The Economist September 27, 1997.

some form of a lender of last resort and capital controls. Though the effects may be small compared with increases in capital markets globalization, at least for developing economies, unfortunately, our analysis shows that a transaction tax will accentuate this problem not reduce it.

It is important to note that this result doesn't mean that trading volumes or turnover will be greater[15]. What it does mean is that the reduction in the asset price will enable traders to take more risky positions than previously.

4.3.5 Welfare considerations

To simplify the exposition of the welfare impact of a transaction tax, no long-term investor is supposed to be present, i.e. $\mu = 0$. This offers a good approximation to the true welfare gains given our benchmark that noise traders initially dominate the financial markets. The expected welfare levels of each agent of type i at time t, in terms of certain equivalent, is:

$$U^i = W^i_{init}(1+r) + \gamma V \left(1 + \frac{1}{2\gamma V}\left[\rho_{t,i} - \rho_t\right]\right)^2$$

i.e.

$$U^i = W^i_{init}(1+r) + \gamma V + \rho_{t,i} - \rho_t + \frac{1}{4\gamma V}\left[\rho_{t,i} - \rho_t\right]^2$$

Supposing that there is a perfect correlation between $\rho_{t,i}$ and ρ_t[16], the ex-ante unconditional utility level of an agent i is:

$$EU^i = E\left[U^i\right] = W^i_{init}(1+r) + \gamma V + \overline{\rho}_i - \overline{\rho} + \frac{\left[\overline{\rho}_i - \overline{\rho}\right]^2}{4\gamma V}$$

[15]There is in fact some evidence that a transaction tax tends to reduce equity turnover, see for example Jackson and O'Donnel. However, it is unclear whether the result comes from capital flight or from behavioral changes in local trading.

[16]Specifically, we suppose that $\Delta\rho_{t,i} = \eta\Delta\rho_{t-1,i} + \chi_t$ where χ_t is the common misperception disturbance.

and ex-ante total welfare, including the proceeds from the Tobin tax, is therefore[17]:

$$TW = E\left[\int_I U' dF(i)\right] = W^t_{init}(1+r) + \gamma V + \frac{Var_i[\overline{\rho}_i]}{4\gamma V} + \frac{\tau(1+r)[r+\overline{\rho}-2\gamma V]}{(1+\tau)(1+r)-1}$$

where $Var_i[\overline{\rho}_i]$ is the variance across agents of their mean misperception.

Differentiating around zero with respect to the tax rate yields[18]:

$$\left.\frac{\partial TW}{\partial \tau}\right|_{\tau=0} = 2\gamma V_0 \frac{(1+r)}{(1+r-\xi)}\left[\frac{Var_i[\overline{\rho}_i]}{(2\gamma V_0)^2} - 1\right] + \frac{(1+r)(\overline{r}+\overline{\rho}-2\gamma V_0)}{r}$$

The impact of a transaction tax on total welfare is a priori ambiguous as the reduction in the risk due to lesser asset prices tends to increase welfare, while the fall in the net present value of returns in the risky assets hurts investors. When differences of opinions across investors and time ($Var_i[\overline{\rho}_i]$) are large across time or when risk premia ($2\gamma V_0$) are small, a transaction tax will increase total welfare, as investors will be more willing to trade differences in opinion given that the equilibrium asset price will be lower. In general, we may expect this price effect to dominate the reduction of welfare due to the distortionary effects of taxation on investors' optimal portfolio choice. Thus, although a transaction tax is likely to fail to reduce volatility, it may well be welfare improving.

4.3.6 Endogenous Noise Trader Entry and Exit

In this section, we show that by neglecting the heterogeneity of noise traders, a transaction tax, though it may succeed in reducing the proportion of noise traders, it will lead to the elimination of the less noisy agents. This result seems quite general and robust to the modelization used. Thus rather than decreasing volatility, a transaction tax may well increase it, as is indeed observed in the data. Also, in the more favorable case where

[17] Here we suppose that the government invests the tax proceeds in the safe asset, to get the riskless return r.

[18] Here again we make the assumption that $\sigma^2_\chi \gg \sigma^2_\epsilon$.

entry is "semi-rational"[19], a procyclical transaction tax is found to be superior to a state independent tax.

In what follows, we limit our analysis to a partial equilibrium approach, for which we suppose that our results are a good approximation[20]. There are two reasons for this. First though the general equilibrium solution can be characterized implicitly, there is usually no simple closed form solution. Also our purpose is not so much to give a positive conclusion, which is likely to be model dependent, as to highlight the pitfalls of a Tobin tax in financial markets with noise traders, and show that, under quite general conditions, it can deter the most rational investors from participating and conversely increase the participation of more irrational investors.

Eliminating the "good" noise traders

In this section traders are supposed to exit the market as soon as their expected wealth, given their bias in the expected flow of receipts, falls below their reservation value. When the next best alternative is that of investing all their wealth in the safe asset, the condition for exit is at time t:

$$U_t^i - W_{init}^i(1+r) = \gamma V \left(1 + \frac{1}{2\gamma V}\left[\rho_{t,i} - (1-\mu)\rho_t - \mu p_t(1+\tau)(1+r)\right]\right)^2 < 0 \quad (4.6)$$

With this particular specification, there is never exit when the reservation value is equal to the revenues of investing all the wealth in the safe asset. Although, there can be exit with more general settings, the result that a transaction tax will not have any first-order effect, or at most a small one, on the entry and exit decision is quite robust as aside non-linearities, the mean-variance choice can always be seen as an approximation of the true agents' preferences around equilibrium.

[19] i.e. when entry-exit is based on the rational distribution, while the size of asset positions are based on the individual "animal spirits" distribution. See section 3.6.2.

[20] Specifically we suppose that entry-exit in and out of financial markets by investors doesn't alter the AR1 property of the path of ρ_t.

Why is there no exit in this setting? Since agents are behaving optimally they set their holdings to improve their wealth. As investing solely in the safe asset is always a possibility, it is necessary that the expected utility be at least as high than that of investing all in the safe asset.

Let's suppose that in fact that investors have a reservation utility $\overline{U} > W^i_{init}(1+r)$ if, for example, traders, when they don't use the two assets above, can use a third asset with payoff $\overline{U}$. One interpretation consistent with this is that investors switch from speculation (assets where they track other people's beliefs) to long-run investment (assets for which they are only concerned about their long-run fundamentals), as is often put forward by proponents of a transaction tax.

In this case, agents of type i will exit at time t if and only if:

$$\left|\rho_{t,i} - (1-\mu)\rho_t - \mu p_t(1+\tau)(1+r) - 2\gamma V\right| < \frac{1}{\gamma V}\sqrt{\frac{\overline{U} - W^i_{init}(1+r)}{2}}$$

which simplifies, in the benchmark case of $\mu \simeq 0$, to:

$$\left|\rho_{t,i} - \rho_t - 2\gamma V\right| < \frac{1}{\gamma V}\sqrt{\frac{\overline{U} - W^i_{init}(1+r)}{2}}$$

Thus contrary to the assumption of most of its supporters, a transaction tax will not eliminate the most noisy traders but those located closest to $(1-\mu)\rho_t - 2\gamma V$, as they are the ones who expect to benefit the least from trading with other investors with different expectations, as they defer the least from the risk adjusted mean misperception. There is even the danger that a transaction tax, rather than eliminating noise traders, may in fact eliminate the rational investors among the short-term traders. This will be the case when initially the mean misperception ρ_t is below $2\gamma V$, and the fall in the gross receipts V pushes $\rho_{t,i} = 0$ within the exit band.

Semi-Rational Entry-Exit decisions?

The bias in noise traders expectations, leads, a priori, to a theoretical ambiguity as to the rationale for entry and exit. In the previous subsection, noise traders decided ex-ante to enter the market if the expected value of their wealth, computed with their expectational bias, is superior to their reservation value. noisy entry-exit" in what follows. The use of the ex-ante distribution has the advantage of being self consistent: investors have some intellectual bias and it is the same across its decision spectrum. However, when the game is repeated very frequently as is the case in financial markets, it seems likely that before committing to a given trading activity, potential investors would decide about entering a market not so much based on their own priors as much on their averaging of previous entrants' experiences. There is a strong form irrationality there as agents use two independent distributions for two closely related choices: market participation and optimal portfolio choice. Yet, this seems a likely form of noise trading. Indeed this includes models were potential traders forget or put too little weight on others' assessments after entering a market either because of a self-confidence bias that develops through trading, or because traders once they have entered are subjected to a lot of irrelevant information and have difficulty filtering. a second solution concept, which can be argued as that coming of an infinitely repeated game outcome or inference from other players' strategies where agents learn the welfare level only of strategies played, is that noise traders decide their entry and exit decision based on the true distribution of future realizations. We refer to this solution concept as "semi-rational" entry-exit in what follows. Again, for the sake of simplicity, we limit our analysis to the benchmark where $\mu \simeq 0$.

If investors no longer consider the payoffs implied by their expectations, but base their entry and exit decisions based on their actual profit streams, then they will decide to abandon trade in the risky asset if and only if:

$$U_t^i - W_{init}^i(1+r) = \gamma V \left(1 + \frac{1}{2\gamma V}\left[\rho_{t,i} - \rho_t\right]\right)^2 - \rho_{t,i}\left(1 + \frac{1}{2\gamma V}\left[\rho_{t,i} - \rho_t\right]\right) < 0$$

or equivalently:

$$|\rho_{t,i}| > |\rho_t - 2\gamma V|$$

In this context, the decision rule above shows that rational investors will never exit from the market. The reason is that, similarly to the previous section, rational investors have always the possibility of investing solely in the safe asset and since the lack of expectations bias implies a perfect match between their ex-ante perceived outcome and the ex-post one, their payoff is necessarily at least as large as that of a portfolio only composed of the safe asset.

The lack of exit by rational investors doesn't however mean that a transaction tax will lead to a reduction in the amount of noise traders. In fact when markets are "pessimistic" on average ($\rho_t < 0$), a transaction tax, by lowering V, will in fact lead to an increase in the quantity of noise traders as the fall in the price level, by lowering the perceived variance of gross receipts, will lead to reduced risk for investors near the $\pm(\rho_t - 2\gamma V)$ cutoffs who will consequently find it profitable to join the financial markets.

The previous analysis indicates that a procyclical or at least a "boom"-triggered transaction tax could be more efficient than a time independent tax, provided that the elimination of noise traders reduces more volatility than the price level. However, there are some areas of concern with such a contingent policy. As in the case of monetary policy "fine tuning", it can create negative feedbacks from the financial markets, as investors or traders try to anticipate the times of tax policy changes, which could further increase the volatility of risky assets. Therefore a contingent policy would require that the government uses a very simple and common knowledge rule for enacting or suppressing a transaction tax, so as not to add noise of its own to the asset allocation process. Secondly, a contingent tax creates a problem for international cooperation as market sentiment may differ quite sharply across countries. Yet, to the extent that capital flows across countries can be curbed via other forms of taxation or subsidies, this could be accommodated too.

4.3.7 A tax as a transaction delaying mechanism?

Many proponents of the Tobin tax interpret it as a way of forcing traders to move away from the frenzy of their activity and take time to think about long-run opportunities. One interpretation is that a transaction tax suppresses transactions as traders exit from such markets. By endogenizing entry and exit in and out of the risky asset, we highlighted that although a transaction tax may force active short-term traders to exit, this will concern systematically the least noisy traders, at least when decisions are consistent, which will tend to inverse the effects on volatility. However, a second interpretation is that due to the sunk cost nature of a transaction tax, uncertainty will create an incentive for investors to delay their investments to avoid paying redundant taxes. So far, in our modelization, since the investment horizon of a given generation is restricted to one period, the optimal decision of an investor is simply of how much of the risky asset to buy, and whether to buy it or not when we endogenized entry and exit in the last subsection. However, when the planning horizon is larger another option for an investor facing a transaction tax is to wait and see if it may not be more attractive to delay for some time purchases of the asset, as the sunk cost aspect of a transaction tax creates a wedge between the entry and exit margins. A simple way to incorporate this within our previous analysis, while retaining most of the previous structure of our model[21], is to decompose each period as a (potentially infinite) succession of subperiods. This part analyzes how a transaction tax induced option to wait can affect asset volatility.

A priori, as long as it is proportional, a transaction tax shouldn't lead to any investment lumpiness either at the microeconomic or macroeconomic level, as there are no increasing returns from bunching investment decisions together. Indeed, as long as he has control not only on his entry-exit decision, but also on his asset quantity decision, an investor can use the latter to fine tune, at a constant marginal cost from the tax,

[21] Of course the AR1 property of returns and misperceptions will in general be lost as in reality the stochastic processes of the intra and inter periods will be linked. Still this doesn't change the essence of our results.

his portfolio. Thus transactions' delaying shouldn't play a decisive part on investment characteristics and volatility (see [14]). Yet, in the presence of noise traders or limited rationality, its role may be more important.

Consider the previous case of traders basing their entry decision on the ex-post outcome, while making their asset quantity decision on their ex-ante beliefs. In such an environment, when an investor decides to enter the market, instead of buying as little risky funds as possible (i.e. $\lambda \simeq 0$), he will base his risky asset purchases on his prior "information", which can be quite large ($\lambda = 2 + \frac{\rho}{2\gamma V}$ at one of the entry-exit margin). Thus investments will tend to be lumpy at the margin in such an economy. As surveyed in Gale[35], uncertainty and lumpiness at the margin are likely to create informational inefficiencies such as cascades and herd behavior. Indeed, anticipating on their ex-ante and ex-post changes in preferences, investors will now have an incentive to delay ex-ante their market participation to avoid their tendency to take large positions right after entry. In turn, a transaction tax is likely to increase the lumpiness at the margin, as investors will increase the size of their trades due to the cheaper asset price after entry and also will try to bunch to save on redundant taxes, and thus will worsen social learning inefficiencies. Therefore in addition to the previous reserves, a transaction tax may well increase the occurrence of inefficient informational cascades, and fail to reduce asset volatility as well as the higher moments of the return distribution. This is an important concern, as there is some evidence that there is a substantial social learning component in financial markets.

4.3.8 Short-Term vs Long-Term?

The main originality of a Tobin tax is that it claims to dichotomize between good and bad investors. The common identifying hypothesis among its proponents, is that short-term traders are the ones who bring excess volatility to asset prices. We saw in the previous subsections that there are doubts whether the outcome would be the one reached. Still, even if we put these considerations aside there are additional reasons why the en-

actment of a transaction tax could be ill-advised. The main one raised already by the first proponents of such a tax is that it may reduce the liquidity of financial assets (cf. [48]). However, in addition to the function of providing liquidity, short-term speculators also offer ways to long-term investors to smooth their asset returns, reducing both asset volatility and improving welfare. The key is that the competitive supply by short-term investors of more informed financial tools diminish substantially the uncertainty faced by long-term investors who face potentially important costs to participate in financial markets at high frequency. To illustrate this point of view we could modify the previous setup, by adding intermediaries and subperiods during which these intermediaries optimize the portfolio of investors. A transaction tax by raising the wage that short-term intermediaries need to be paid in order to provide their information, will reduce investors' demand for such information. Aside from the social learning consequences stressed in the previous subsection, this will in turn create inefficiencies in capital allocation, and reduce the supply of funds to the economy as the interest rate paid to investors will be lower.

It is worth looking at previous currency crises to see whether the "bad" investors were short-term ones, and whether a 0.1% or 0.25% transaction tax would have deterred them. For example, Soros' Quantum Fund was identified as one of the main actor behind the rush against the Pound in the ERM crisis of 1992. Is it a short-term trader in the sense of the Tobin tax proponent? Not really. The fund typically bets on what it considers departures from the equilibrium price to maximize the return to its (long-term) investors, and serves little liquidity purpose. And most recently, the fund has been betting against the dollar based on "long-term principles" that a very large trade deficit wasn't sustainable[22]. Also, it is unlikely that a 0.1% or 0.25% transaction tax would have deterred, the Quantum Fund or others from betting against the Pound, when gains from such speculation were expected to be in excess of 10%.

[22] see Krugman[53].

4.4 Alternatives to the Tobin Tax

Often the Tobin tax has been casted as a measure without alternatives, due to its unique capacity to distinguish between "bad" and "good" investors. While, the previous section showed that a transaction tax will in general fail quite short of this purpose, this section reviews some of the most promising alternatives to increase financial markets efficiency. We distinguish the measures according to the potential negative externality that they aim to correct: excessive return volatility, currency attacks, excessive market size, excessive risk taking behavior, bubbles and fads. Most are only discussed in the context of the foreign exchange market, as most of the Tobin tax debate has centered there.

- Extensive monetary integration. A single currency or a peg is, when sustainable, almost by definition the best way of reducing volatility as nominal exchange rate stop fluctuating. This a question that seems to be very much on the agenda of Latin American countries as they consider abandoning their currencies for the dollar. To a large extent the experience of the EMU, when fully enacted will be a good testing ground for the long-run effects. There are two important argument against money integration. First is the Keynesian argument that countries will lose the possibility of using monetary policy as a countercyclical adjustment tool when prices are slow to adjust, and second is that the possibility of realignments runs the risk of currency crises, as speculators try to force the enactment of such realignments. This later concern may be overstated, especially for developed economies. Though financial markets were less interconnected than they are today, it is still the case that uncalled for devaluations were rarer and apparently less potent, for example in terms of output response, during the fixed-exchange rate Bretton Woods era[23]. Also, as our work on real exchange rate adjustment shows that there is some support for the notion that prices are not that slow to adjust outside of crises. Still a nominal devaluation may be a good way of imposing severe and politically difficult reforms,

[23] See Edwards.

as evidenced by the experience of the CFA devaluation, and governments may prefer to keep some monetary control. This is particularly true when countries have problems coordinating their fiscal policy. Still the possibility to negotiate realignments with the rest of the monetary union should provide enough of such an emergency policy tool.

Money integration may be a good way of avoiding currency attacks, and help shifting away the focus from nominal to real quantities. This extreme form of taxation, would have none of the limitations of the Tobin tax, while achieving the outcome proposed by its proponents as far as exchange markets are concerned, as aside from the realignment possibility there would be no potential gain for traders to make profits. Additionally, the potential realignments could be limited in size and in frequency. The limited size would have the advantage of putting bounds on the expectations of traders, and would erase the possibility of extreme bids. The frequency constraint is of course there to make sure that the limited size is indeed limited, and would help stabilizing perceptions after a readjustment, as no other realignment could be expected for a while. Having limits on the size of the realignments is better than adjusting by fixed amounts, as a drawback of the latter is that, when the government's current exchange rate is not fully sustainable, more agents will be willing to bet against the government as the uncertainty about the policy outcomes is considerably reduced.

Furthermore, the government could impose the purchase of devaluation insurance, for example by making the buying of options against a potential devaluation necessary for investors, while repaying on average investors in the form of an investment subsidy paid with the options' income and forbidding exchange rate transactions outside of these insurance schemes. This would be of course potentially inefficient as, with agents' heterogeneity, some investors would get too much insurance, while some would abandon their investment opportunities because of a lack of funds. Also there would be administrative costs of the tax. To the extent that these in-

efficiencies are smaller than the gains from retaining the potential use of monetary policy countercyclically, this could be a second best initiative.

A concern about monetary integration specific to the current projects of adopting the dollar in some Latin American countries, is that these countries would have no control on the US Federal Reserve, which, in turn, would have no incentive to include these countries business cycles' as part of its monetary policy response function.

- Instantaneous and compulsory notification of contract exchanges to the relevant central banks. To the extent that no single trader has enough money to challenge by himself the position of the central bank, this information would give an advance notice to monetary authorities of building positions against its current policy. Also it would enable the central bank to extract the underlying strategies of each trader, and their exact holdings. Though it wouldn't enable the central bank to avoid abandoning an unsustainable policy, it would reduce the scope for a small group of currency traders to "bluff" the central bank. Of course, the difficulty of such a measure is that the information could be used by the government to net a profit. Therefore the minimization of the absolute value of profits from currency exchange should be one of the targets of central banks (e.g. repayment of any profits to market participants). However, the large sums involved are likely to give strong incentives to corruption of central banks officials privy to the information. Though the returns to such information is likely to be less than for currency markets, it's worth noting that, for example, private information is required in the US from plants in censuses by the US Bureau of the Census without obvious problems. As is done for the census, upon receipt each account could be assigned a random number to maintain the privacy of trades even within the central bank. A question is whether a number should be given at the trader or at the firm level. Privacy would prefer the trader level as it would be harder to identify the source in case some account positions are accidentally leaked. However, knowing firms' global

positions can enable the central bank to understand the overall strategy of the firm if any.

The main danger of such a reform is that, especially in thin markets, individual large traders may be capable of isolating the use of a systematic response function by the central bank to its inflow of information. Traders may then be able to manipulate the central bank. This can be damaging when large traders can collude, or when traders can swap assets across borders without declaring it as a currency transaction. Though these two points are of concern, they are far from insurmountable, all the more so that it is a priori easy for the central bank to make it hard for individual traders to reconstruct its response function.

- Taxing profits from currency attacks. If attacking currencies is a source of negative externalities, a simple policy is to tax the revenues from such speculative attacks. A first step is of course to define what a currency attack really is. The best would be to have clear-cut and rigid criteria, such as a percentage variation which can be country dependent, so as not to minimize uncertainty about the tax rules or their implementation. The idea is not novel, and has been already discussed in various forms. For example, Spahn[63]'s in his two-tier variant of the Tobin tax, proposes to tax at a high rate transactions at times of exchange rate turbulence. However, only a tax on profits rather than transactions will be considered, as it has the advantage of not taxing further the losers in a currency crisis. There are two main issues with such a proposal: one is whether currency attacks are indeed times of speculation by "bad" speculators, and then the second is a set of political economy considerations.

  Are the winning speculators in a currency attack "bad" traders? The answer lies in whether the exchange rate movement was unwanted by the local government and "forced" by traders, or whether it was started by the local government . In the first case, taxing profits is very appealing. However, in the other case, bad governments

would avoid being punished, and would be shunted from market arbitrage.

A workable solution is to use clear-cut criteria for what defines an unwanted speculative attack, and tax the profits of the winners in a very significant way. The tax as well as the crisis type (trader forced or bad governance) determination should be administered by an international body as the IMF, and the tax proceeds could serve to finance its lending of last resort operations. To be fully convincing, it would be important that such a tax be accompanied by penalties on bad governance. One way, as is already largely the case today, is to make international rescue packages fully conditional on the implementation of "good" policies.

The biggest difficulty from such a tax (but it is also the case for the Tobin proposal) is its implementability, as national governments would lose some control over their respective financial markets. Also national traders are likely to lobby against the introduction of a transaction tax, as they face a large chance to lose from its enactment. Still the welfare gains could make it politically feasible.

- Improving the Public Understanding of the True Economic Model. As seen earlier, a fundamental flaw of the Tobin tax is that it has no learning component, and the "wait and see" attitude it can create will in general only reduce information sharing. Increasing our understanding of the economy's determinants is a priori a good way of achieving both efficiency and volatility reduction. Indeed, the bias in the expectations in our noise traders model can be interpreted as a sign of irrationality, but also as a sign of very significant lack of information about the true model of the economy. To the extent that there is underinvestment by the private sector in long-term fundamentals research, in favor of short-term models of other participants' behavior, a subsidy to increase our understanding of assets prices determinants could diminish agents' uncertainty about the economy's true model.

A first effort is to improve both the availability and the quality of macroeconomic statistics, especially for developing economies, which often lack transparency. As stressed in an article in The Economist, "too many emerging economies are still too secretive. Only 39 countries post their economic statistics on the IMF's new electronic bulletin-board. Few countries (rich or poor) publish details of their forward foreign-exchange operations. Worse, much important information is simply not collected, or collected too late. Aggregated information on firms foreign indebtedness, for instance, simply does not exist. Sorting out these statistical shortcomings is an obvious priority"[24]. It was particularly obvious in Mexico in 1994, as the Bank of Mexico had the long-standing habit of releasing the state of its international reserves only three times a year (in April, October and November).

A second effort is to improve the understanding of the use of these statistics among market participants. A striking occurrence in the aftermath of currency crises is that frequently they were plenty of signs that the economy was headed for a downturn well before the crisis happened. And a large part of the debate about the level of an exchange rate seems to be more about the true model of the economy rather than about the quality of the statistics. Very often research on exchange rates is viewed with a lot of skepticism by practitioners, as macro based models typically fail to explain more than 10% of the data's variance. Work in the line of Evans and Lyons[32], should contribute to change this perception, as when some microstructure characteristics, and in particular order flow, is included, they can explain about half of the variance of the exchange rate path. Within that framework it remains to identify what sort of microstructural model accounts for the pattern in the data, and bridge the micro and macro divide.

Can this be done? Probably not, and there will always be some disagreement among traders as to the real economic model. Still, as of today, databases on exchange rates that enable the identification of traders' strategies and interactions

[24] "The Perils of Global Capital" April 11, 1998.

at the micro level are still inexistent.. The construction of such databases, either in the form of surveys or of the compulsory notification of trade contracts mentioned above, would enable current traders as well as potential entrants to reduce the number of potential candidate models. To the extent that this information is already entered electronically by participants for their own use, it shouldn't be too costly to implement and distribute.

4.5 Conclusion

The Tobin tax is beginning to be popular among policymakers, particularly so after the huge turmoil in East Asian countries in 1997-1998. One of the main reasons behind its rising popularity has been the lack of a satisfying alternative. The aim of this chapter was to show, both that there are some alternatives which offer good chances of success, and that the claim of the Tobin tax proponents of a decline in asset volatility is largely overblown. The theoretical work seems validated empirically by the fact that volatility typically rises when a transaction tax is enacted, and that the exit of traders doesn't modify this result. Also in the particular case, of semi-rationality, where a Tobin tax could effectively reduce the amount of noise of the economy, a procyclical tax will be more effective. Still, aside liquidity issues a Tobin tax may be worthwhile in environments with almost risk neutral investors, as agents benefit greatly from cheaper trading.

It would be important to know whether the increase in volatility is due to a reduction in liquidity as proposed by some opponents to the Tobin tax, or is due to the general equilibrium and entry-exit of noise traders effects analyzed in this chapter. To test between the two alternatives, one way is to use a measure of liquidity to control for its changes, when regressing volatility on changes in the transaction tax. Alternatively, one can check whether a change in liquidity can explain empirically the positive association between a transaction tax and volatility.

Impact of Noise Traders on price deflated Volatility

Log-differentiating equation (4.2) with respect to the tax rate at $\tau = 0$ we have that:

$$\frac{1}{\sigma^2_{p_t/\overline{p}}} \frac{\partial \sigma^2_{p_t/\overline{p}}}{\partial \tau}\bigg|_{\tau=0} = 2\,\frac{1}{A_0}\frac{\partial A}{\partial \tau}\bigg|_{\tau=0} + \frac{4\gamma V_0}{\overline{r}+\overline{\rho}-2\gamma V_0}\,\frac{1}{V_0}\frac{\partial V}{\partial \tau}\bigg|_{\tau=0}$$

where $A = \left[1 - \frac{(1-\xi)}{[(1-\mu)(1+\tau)+\mu](1+r)-\xi}\right]$ and A_0 is the value of A at $\tau = 0$.

We have:

$$\frac{1}{A_0}\frac{\partial A}{\partial \tau}\bigg|_{\tau=0} = \frac{(1-\xi)(1-\mu)(1+r)}{r(1+r-\xi)}$$

and:

$$\frac{1}{V_0}\frac{\partial V}{\partial \tau}\bigg|_{\tau=0} = -\frac{2(1-\mu)(1+r)}{(1+r-\xi)}$$

Thus the result presented in the text that:

$$\frac{1}{\sigma^2_{p_t/\overline{p}}} \frac{\partial \sigma^2_{p_t/\overline{p}}}{\partial \tau}\bigg|_{\tau=0} = \frac{2(1-\mu)(1+r)}{(1+r-\xi)}\left[\frac{1-\xi}{r} - \frac{4\gamma V_0}{\overline{r}+(1-\mu)\overline{\rho}-2\gamma V_0}\right]$$

where V_0 is the conditional gross receipts variance V evaluated at a zero transaction tax ($\tau = 0$).

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