Fixed Exchange Rates and Trade*

Michael W. Klein
Fletcher School, Tufts University, and NBER

and

Jay C. Shambaugh±
Dartmouth College

Abstract:

A classic argument for a fixed exchange rate is its promotion of trade. Empirical support for this, however, is mixed. While one branch of research consistently shows a small negative effect of exchange rate volatility on trade, another, more recent, branch presents evidence of a large positive impact of currency unions on trade. This paper helps resolve this disconnect. Our results, which use a new data-based classification of fixed exchange rate regimes, show a large, significant effect of a fixed exchange rate on bilateral trade between a base country and a country that pegs to it. These results suggest an economically relevant role for exchange rate regimes in trade determination since a significant amount of world trade is conducted between countries with fixed exchange rates.

JEL codes: F1, F3, F4
Keywords: exchange rate regimes, gravity model, trade, fixed exchange rate

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* We thank Eric Edmunds, Jim Feyrer, Nina Pavcnik, Andrew Rose, Douglas Staiger, and participants at the Dartmouth Junior Lunch, Dartmouth International Macro Summer Camp, and the NBER IFM program meeting, in particular our discussant Eric van Wincoop, for helpful suggestions. In addition, we thank two referees and the editor for very helpful comments. All errors are ours.
± Corresponding author: HB 6106, Dartmouth College, Hanover, NH 03755. tel 603-646-9345. fax 603-646-2122

I. Introduction

Until recently, the idea that a fixed exchange rate promotes trade was both well understood and not credible. Exchange rate policy has been influenced by the argument that pegging to, say, the US dollar fosters bilateral trade both with the United States and with all other countries that have a dollar peg. This argument is most compelling for trade with countries whose currencies' values cannot be hedged in forward markets. But, despite the logic of this view, and its use in policy debates, the empirical literature fails to present strong evidence that a reduction in exchange rate volatility is associated with an increase in trade.[1]

Those uncomfortable with this dissonance between received wisdom and statistical results may have taken some comfort by a newer branch of empirical research that uses gravity models to study the determinants of bilateral trade. Some of this research finds a big effect of currency unions on trade flows in the modern era.[2] Other work shows that the pre-World War I gold standard had an important role in promoting trade, and its demise contributed in an important way to the reduction in world trade in the interwar period.[3]

Yet a careful reading of the results from this research employing gravity models is less supportive than one might suspect of the policy argument that a country can promote its trade by establishing a fixed exchange rate.[4] The regressions on the effects of currency unions on trade use a dummy variable representing the presence of a currency union as well as a separate variable representing exchange rate volatility. While the coefficient on the currency union dummy variable is large and highly significant, the coefficient on exchange rate volatility tends to suggest that the effect of limiting exchange rate volatility, through a means other than the establishment of a currency union, is small.[5] Furthermore, results on fixed exchange rates

[1] There is a literature in which exchange rate volatility is used as a regressor in import and export equations and, generally, the coefficients on exchange rate volatility are either insignificant or small enough to suggest that a reduction in exchange rate volatility has a small effect on trade. See, for example, Cushman (1983, 1986, 1988), Gotur (1985), Hooper and Kohlhagen (1978), IMF (1984), Kenen and Rodrik (1986), Klein (1990), and Thursby and Thursby (1987).

[2] See, for example, Rose (2000), Rose and Van Wincoop (2001), Glick and Rose (2002), and Frankel and Rose (2002).

[3] See Estevadeordal et al. (2003) and Lopez-Cordova and Meissner (2004). See also Eichengreen and Irwin (1995) and Ritschl and Wolf (2003) for discussion of the interwar years.

[4] Frankel and Wei (1993) used a gravity model that included exchange rate volatility as a regressor, but their results suggest a limited role of exchange rate volatility on trade.

[5] Rose (2000) makes a distinction between the effects on trade of a currency union and of a fixed exchange rate, and distinguishes between these systems, writing "Sharing a common currency is a much more durable and serious commitment than a fixed rate." (pp. 10 – 11) Tenreyro (2003) writes "…the findings from currency unions do not generalize to other regimes with lower variability".

(rather than a currency union) drawn from the gold-standard period may not translate to the modern era because bilateral fixed exchange rates at that time were part of a more pervasive exchange rate system. Thus, these considerations, along with results from the earlier literature cited above, may raise doubts about the trade effects of a fixed exchange rate in the modern era since the empirical results that suggest a large effect of a currency union or the gold standard on trade also suggest a minor effect, at best, of limiting exchange rate volatility *per se*.

But the feasible policy set may not include the choice of a currency union, nor membership in a widespread fixed-exchange rate system, and unilateral dollarization is a drastic step. Rather, the realistic choice facing many policy-makers is whether or not to peg their currency to one of the major industrial countries. The question then arises of the effect of this choice on bilateral trade with the country to which they peg, with other countries that also peg to the same country, and with countries that do not share a common peg.

In this paper we address these questions, using a new dataset from Shambaugh (2004) that classifies *de facto* bilateral exchange rate arrangements in the post-Bretton Woods era. This data set enables us to create a fixed exchange rate series for use in a gravity model that is comparable to the currency union and gold-standard membership series used in research cited above.[6] We find a fixed exchange rate between two countries raises the amount of their bilateral trade, and that this effect is of the same order of magnitude as policies such as a regional free trade arrangement.[7] These results are especially relevant for policy since they

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[6] We also include exchange rate volatility as a regressor to ensure that fixed rates are not simply picking up the effect of reducing overall macroeconomic volatility. As will be shown, our core results are robust to the use of another *de facto* exchange rate classification scheme, the one developed by Reinhart and Rogoff (2004).
[7] In other related work, Fountas and Aristotelous examine US-UK trade from 1900-98 using exchange rate regime dummies in a cointegration framework of export equations and find the free float of 1919-24 has higher than predicted trade when compared to the pegs and managed floats of other eras. The single country pair, though, eliminates the possibility of using year effects to control for other factors, and one may question the labeling of 1973-98 as a managed float. Also, Brada and Mendez (1988) look at a limited sample of countries over a small number of years in the 1970's and find a negative impact of pegs. Their study, though, uses limited data, uses declared not actual exchange rate regimes, and does not include all the controls or fixed effects now seen in the literature today. Our study using expanded methodology and data as well as *de facto* exchange rate regimes generates opposite conclusions. In a paper distributed after Klein and Shambaugh (2004) was released, Lee and Shin (2004) examine a variety of linkages between the exchange rate regime and the economy. One linkage is trade, and they also find that a fixed exchange rate increases trade. They use a loose definition of pegging by combining all non-floating Reinhart and Rogoff codes and find that even indirect pegs can increase trade. The results, though, are only shown with country-pair fixed effects (CPFE), not other types of effects, and it appears with no fixed effects or with country-fixed effects (CFE) and country-year fixed effects (CYFE) effects, these results may not hold.

speak to the effects of a policy choice less dramatic than the abandonment of the national currency and more attainable than the institution of a widespread fixed exchange rate system.

II. Methodology

II.1 Estimation technique

The gravity model has been heralded as one of the most successful empirical frameworks in international economics.[8] A series of recent papers has augmented the standard gravity model to investigate the effect of a range of variables on bilateral trade, including membership in a currency union. We adopt this technique by regressing bilateral trade on a standard set of gravity model variables, as well as dummy variables that indicate whether two countries have a direct or indirect fixed exchange rate, a dummy variable that indicates whether one country has formed a currency union with its trading partner, and a variable representing the volatility of the exchange rate between the trading partners. Each observation in the regressions we run represents, for a particular year, a dyad, that is, a country-pair observation. The specification of the core regressions takes the form

$$\ln(T_{i,j,t}) = \alpha_1 X_{i,j,t} + \alpha_2 Z_{i,j} + \beta_1 F_{1,i,j,t} + \beta_2 F_{2,i,j,t} + \beta_3 CU_{i,j,t} + \beta_4 v_{i,j,t} + \beta_5 v_{i,j,t}^2 + \varepsilon_{i,j,t} \qquad (1)$$

where $\ln(T_{i,j,t})$ is the natural logarithm of trade between countries *i* and *j* in year *t*, $X_{i,j,t}$ represents a set of variables that vary over time, such as the product of the natural logarithm of income of countries *i* and *j* at time *t*, $Z_{i,j}$ represents a set of variables that do not vary over time, such as the natural logarithm of the distance between countries *i* and *j*, $F_{1,i,j,t}$ is a dummy variable equal to 1 if there was a fixed exchange rate (but not a currency union) between the two countries at time *t*, $F_{2,i,j,t}$ is a dummy variable equal to 1 if there was an indirect peg (discussed below), $CU_{i,j,t}$ is a dummy variable equal to 1 if one of the countries had a currency union with the other at time *t*, $v_{i,j,t}$ is a measure of volatility of the exchange rate between

[8] Anderson and van Wincoop (2003) begin their article with the statement "The gravity equation is one of the most empirically successful in economics." (p. 170) Anderson (1979) and Bergstrand (1985) provide early theoretical justifications for the gravity model.

countries *i* and *j* at time *t*, and $\varepsilon_{i,j,t}$ is an error term.[9] Other specifications add additional exchange rate regime variables discussed below.

This specification differs from the one used in research that considers the effect of a currency union on bilateral trade only by the inclusion of the terms $\beta_1 F_{1i,j,t}$ and $\beta_2 F_{2i,j,t}$. This, however, marks an important distinction between the manner in which we estimate the effect of a fixed exchange rate on trade and the manner in which that effect has been estimated both in the context of gravity models as well as in the older literature that estimates import or export equations. In both of those cases, the estimated effect of a fixed exchange rate on trade is calculated by multiplying the estimated coefficients on the exchange rate volatility terms, β_4 and β_5 in specification (1), by a given change in exchange rate volatility and exchange rate volatility squared, respectively. Results obtained in this fashion suggest only a minor effect of a fixed exchange rate on trade.

In contrast, the estimated effect of a currency union on trade from a gravity model, calculated as $\exp(\beta_3) - 1$ in a specification like that in (1), is reported as very large (as much as tripling trade, *ceteris paribus*) and highly statistically significant.[10] Quah (2000), in his comment on the original Rose (2000) paper, notes that this implies a large discontinuity in the effects on trade of restricting exchange rate volatility. In this paper, we estimate the effect of a fixed exchange rate on trade as $\exp(\beta_1) - 1$, in a manner completely analogous to way that the coefficient on the currency union dummy variable has been interpreted in gravity models that investigate that issue. This method recognizes reducing volatility from, say, 5% to zero may be qualitatively different than a reduction in volatility from 20% to 15%, even when allowing for

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[9] The actual set of variables that constitute $X_{i,j,t}$ used in the regressions in this paper include the product of the natural logarithm of income of countries *i* and *j* in period *t*, the product of the natural logarithm of income per capita of countries *i* and *j* in period *t*, a dummy variable indicating whether the two countries had a free trade agreement at time *t*, and another a dummy variable indicating whether one country was a colony of the other country at time *t*. The variables used in the regressions that do not vary over time, represented by $Z_{i,j}$ in (1), include the natural logarithm of the distance between countries *i* and *j*, the product of the natural logarithm of the land areas of countries *i* and *j*, dummy variables representing whether or not countries *i* and *j* share a common border or share a common language, and other dummy variables indicating whether one country had been a colony of the other, whether either country is landlocked, whether either country is an island, whether both countries had a common colonizer, and whether one of the countries was, at one time, a dependency, territory or colony of the other.

[10] For example, Frankel and Rose (2002) present an estimated coefficient on the currency union dummy variable of 1.38 with an associated standard error of 0.19 (see their Table 1) which implies that membership in a currency union triples bilateral trade, *ceteris paribus*, since $e^{1.38} - 1 = 2.97$.

non-linearities in the relationship between exchange rate volatility and trade.[11] Fixed rates may have an effect beyond that of reduced volatility for a number of reasons, most notably, the greater certainty they afford with respect to the domestic-currency price paid at the time of a delivery when that payment is made six months or more after a contract is signed. Even though currency pegs are impermanent, a forecast of a fixed exchange rate is likely more reliable than a forecast of an unpegged currency and, therefore, a fixed rate provides a greater degree of certainty which may be helpful in forming trading relationships.

Anderson and van Wincoop (2003) have provided a more robust theoretical foundation for the gravity model. In doing so, they note that one must consider not just the trade resistance or costs between any two countries (which are a function of distance, language, etc. and in this paper exchange rate regimes as well), but one must also recognize that different countries have different general resistance to trade. They show that omitting a variable that reflects each country's resistance to international trade leads to an inflation of the estimated effect of the reduction of trade due to national borders. A solution to the presence of such "multilateral resistance" is to include country fixed effects (CFE) when estimating the gravity model. As predicted by their theory, the empirical results presented in their paper demonstrate that the estimated effect of a border is significantly reduced when CFE are included. Following this insight, we present CFE estimates in this paper in which we effectively include about 140 dummy variables in the regression, one for each country, and any observation will have each of the two dummy variables representing the countries in its trade dyad equal to 1 while all the other country dummy variables will equal 0.

When discussing recent applications of the gravity model, many of which use CFE, Anderson and van Wincoop (2004) highlight the fact that separate country fixed effects should be included for each year in a panel setting as the multilateral resistance may change over time. In this case, thousands of dummies are added to the regression again with two dummies representing the countries in the dyad in the given year equal to 1 for any given observation. We refer to these estimates as country year fixed effects or CYFE.

[11] The partial derivative of trade with respect to either a fixed exchange rate or a currency union could include both the direct effect, $\exp(\beta_1) - 1$ or $\exp(\beta_3) - 1$, respectively, and the separately estimated effect of a reduction in exchange rate volatility, involving the coefficients β_4 and β_5. In practice, however, the estimated effect of exchange rate volatility on trade is small and we only refer to the estimated direct effects.

Despite the plethora of controls included in the gravity model and the CFE or even CYFE, there may be omitted variables that affect bilateral trade. The problem is that unobserved variables could be correlated with both the error term of a gravity model and the likelihood that two countries have a fixed exchange rate.[12] In this case, the estimated effect of fixed exchange rates on trade will be too large when using CFE estimation. Recognizing this, Glick and Rose (2002) argue for using country-pair fixed effects (CPFE) estimation, rather than OLS or CFE estimation. The CPFE estimates effectively include a dummy variable for each of the roughly 10,000 country pairs in the data set. Thus, any particularly strong bilateral tendency to trade is captured in the fixed effect and statistical identification comes after controlling for the average level of trade for a given pair.

A first glance at a column of results using CPFE in a gravity model may be disconcerting since this method does not offer estimates of the effect of variables that do not vary over the sample period (e.g. distance, or the other variables denoted $Z_{i,j}$ in (1)), and, therefore, the "gravity" (as represented by the distance term) disappears from the gravity model when it is estimated using CPFE estimation. In fact, the impact of distance is still in the regression, but it is captured by the fixed effect. The more significant aspect of this issue for our paper is that any country pair that has a fixed exchange rate for the entire sample period will not yield information in the estimate of the impact of a fixed exchange rate on trade. Rather, CPFE estimates identify the effect of fixed exchange rate on trade only from those country pairs that switch exchange rate status during the sample period. Thus, the coefficient on the direct peg variable in a CPFE regression represents the difference in trade due to a fixed exchange rate between two countries that, at one time, had a fixed exchange rate in place.[13] But, as it turns out, most fixed exchange rate regimes do not last for the entire sample, so we lose information from relatively few country pairs when we use CPFE estimation rather than CFE estimation.

Section II.2a: Exchange Rate Regime Classifications

The methodology outlined above differs from previous research studying the effect of fixed exchange rates on trade primarily through the variable used to assess the presence of a

[12] On a related note, Eichengreen and Irwin (1995) show that the estimated effect of trade blocs on trade is overstated when one does not control for the fact that, even before these trade blocs were instituted, there was significantly more trade between countries in a trade bloc in the inter-war period.

[13] This is distinct, however, from the dynamic effects of establishing, or ending, a fixed exchange rate. We discuss possible dynamic effects in Section IV.3, Entry and Exit of Pegs.

fixed exchange rate. As mentioned, our contribution is distinguished by its use of a dummy variable representing the presence of a fixed exchange rate between two countries. In this section we discuss the exchange rate classification scheme used in this paper and present some statistics on the number of fixed exchange rates as well as the characteristics of countries that peg their currencies.[14]

The *de facto* classification scheme described here, and used in our first set of results, is drawn from Shambaugh (2004) and is based on the behavior of countries' official exchange rates. A particular country is judged to have a *direct peg* with a certain base country in a given year if their bilateral exchange rate stays within a +/- 2 percent band.[15] In addition, if a country maintains a perfectly flat peg to the currency of a base country for 11 out of 12 months within a year, but then has a single change in its bilateral exchange rate, this "single change" observation is also coded as a direct peg. The logic in this case is that the currency of the country is pegged for the entire year but, at some point in that year, there is a realignment to a new peg. "Single change" pegs represent a small fraction of total pegs (roughly 4%), and thus, in practice, one can consider the pegs in our sample as very tight target zones.[16] Finally, exchange rates that are maintained within a +/- 2 percent band for only one year are not coded as a direct peg since a single year of stable exchange rates may be a random lack of volatility rather than a policy-driven peg. It is reasonable to think that the market responses to these single year pegs are distinct from those to longer-lived pegs. As discussed in the results section, we have experimented with a number of other volatility measures – such as quintiles of volatility – but the binary coding marking pegs and nonpegs always shows the strongest results.

A crucial aspect of this classification scheme is the identification of a base country. Base countries may include those that have a major currency, such as the United States, France, the United Kingdom, or Germany, as well as those that are important within a given region, such as India or Australia. Base countries can often be determined by reference to the official

[14] To test the robustness of these results, we also employ the *de facto* exchange rate classification scheme from Reinhart and Rogoff (2004) and the *de jure* regime classification scheme based on information published by the IMF in its *Annual Report on Exchange Arrangements and Exchange Restrictions*. These alternative classification schemes are discussed in more detail below in the section that presents results using them. Shambaugh (2004) provides more extensive commentary on different choices of exchange rate regime classifications.

[15] We have a separate category for currency unions and, therefore, there is no overlap between those dyads that are classified as having a currency union in a particular year and any dyad classified as having a fixed exchange rate in that year.

[16] See Shambaugh (2004) for more discussion. Changing the definition of bands from +/- 2% to +/- 1% had little effect on the number of observations coded as pegs.

declarations, or by historical relationships. In addition to the countries already mentioned, Belgium, Spain, Portugal, Italy, New Zealand, South Africa, India, and Malaysia are all bases at some point in time.[17]

Countries engaged in a direct peg with a base will also be involved in a number of *indirect pegs* with other countries. Two countries pegged to the same base will also be pegged to one another in a "sibling" relationship. For example, India and South Africa had this type of indirect peg when both were pegged to the US dollar. Another type of indirect peg is a "grandchild" relationship that exists between a base country, such as the United States, and another country pegged to a country that is itself pegged to the base. Bhutan had this type of exchange rate relationship with the United States during those years that its currency was pegged to the Indian rupee and the rupee was pegged to the dollar. In this case, there is also the indirect "aunt/uncle" relationship between Bhutan and South Africa , and the indirect "cousin" relationship between Bhutan and Lesotho, whose currency was pegged to the South African rand. In our regressions, we include an indirect peg dummy variable that equals 1 for a dyad that has any of the family of indirect pegs described in this paragraph along with a separate dummy variable that represents direct pegs.

Currency unions, in this paper, represent the "strict" currency union definition of Rose (2004).[18] Currency unions, direct pegs, and indirect pegs are all mutually exclusive, and any one observation can only be coded as one type of exchange rate regime. While currency union observations naturally generate direct pegs or indirect pegs in the coding due to their stable exchange rates, those observations are only considered currency unions, not pegs. At the same time, a group of countries in a currency union can all together peg to another base, such as the peg of the CFA countries to France.[19]

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[17] The biggest challenge in choosing a base country comes when considering the Bretton Woods era since most potential base countries were pegged to the US dollar. We rely on the few revaluations and devaluations that occurred during the Bretton Woods period, as well as the small variations in exchange rates during that time, to identify base countries. For example, a country that devalued against the dollar at the same time as the British pound in 1967 is judged as having Britain as its base country. A country would also be judged as having Britain as its base if it maintained a strict peg with the pound sterling while exhibiting some fluctuation with the United States dollar.

[18] Using a slightly more expansive currency union definition, as in Glick and Rose (2002), or adding a transitive currency union definition, makes very little difference in our estimates of the coefficient on the currency union variable and has virtually no impact on other reported results.

[19] See Levy-Yeyati (2003) for more on different types of currency unions.

Table 1 presents some statistics on the number of direct pegs, the number of indirect pegs, and the number of currency unions in the data set we use. This data set is based on information on 181 countries over the period 1973 – 1999, yielding 4381 country-year observations (rather than 181 × 27 = 4887 because some countries, like Estonia, did not exist for the entire sample period). As indicated in the second row of Table 1, there are 11,805 separate country pairs (rather than (181 × 180)/2 = 16,290 because of missing observations) and, over the 27 years of the sample, there are 168,868 observations. The third row of Table 1 shows that there are 1562 direct pegs in this sample, and 90 percent of these observations are industrial country / developing country dyads.[20] Given the fact that most countries contemplating pegging are developing countries considering pegging to an industrial base, it is useful that most of the data used to generate our results comes from that type of relationship. We also note that while the overall number of direct pegs may seem small in relation to the total number of observations, the number of direct pegs in a bilateral trade data set will necessarily be a small proportion of the number of overall observations since any country can have a direct peg with only one other country while it can trade with as many as 100 other countries. The relevant statistics regarding the frequency of pegs, therefore, are that roughly half the 4381 country year observations are coded as pegs, even in the post-Bretton Woods era, and 135 countries are involved in a peg at some point. The fact that almost 50 percent of the countries peg at any one time helps explain why there are 13,679 indirect peg observations, as indicated in the third panel of Table 1, since any direct peg can create a large number of indirect pegs,

The bottom panel of Table 1 indicates that 2055 observations include a currency union in the 1973 - 1999 sample. This number is not directly comparable to the number of observations with either a direct peg or an indirect peg since it includes all intertwining relationships within a multilateral currency union (e.g. among the countries in the CFA), but not dyads in which two countries have both, unilaterally, adopted the currency of a third country (e.g. the dyad of Panama and Liberia would not be coded as a currency union, even when both had a currency union with the United States). As shown in the table, 88 percent of these currency union observations are dyads between two developing countries.

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[20] Industrial countries are defined as those countries with an IFS number under 199 with the exception of Turkey. This includes the US, Canada, Japan, Australia, New Zealand, and Western European nations.

We focus our attention on the post-Bretton Woods era, as pegs in Bretton Woods were part of a world system with extensive capital controls and thus do not really mirror the unilateral pegs of today. However, we also report results on the full 1960-99 sample. Table 1 also shows summary statistics for these years; given the prevalence of pegs from1960-73, this leads to even more pegged observations.

As noted above, CPFE estimation identifies coefficients on direct pegs, indirect pegs, and currency unions from country pairs that switch regimes during the sample period. Of the 144 country pairs that ever have a direct peg from 1973-1999, 118 show a change in regime with 56 of these switching once, 25 switching twice (that is, both on and off a peg), and 37 switching more than twice. Thus, we are not simply identifying off a single break in most cases, but a more rich history of regime transitions. The multiple switches per pair result in a total of 257 switches over the period, comprised of 141 switches off of a peg and 116 switches onto a peg. [21]

Section II.2b: Pegged Country Characteristics

While dyads with a fixed exchange rate are a relatively small proportion of all dyads, they comprise a meaningful portion of the volume of world trade. Direct peg dyads account for 11% of average annual world trade in the post-Bretton Woods period, with a range of 7 % to 19% of trade in these years (the maximum value during the Bretton Woods era was 33% of world trade). This reflects the fact that a typical direct trade dyad includes one large, industrial country; the base country is ten times the size of the average country (and six times the size of the average industrial country) in a given year. [22]

We have already noted the relative preponderance of direct peg observations among dyads that include an industrial country and a developing country and the policy relevance of focusing on the possible trade-creating effects for this subsample of the data. Table 1 indicates

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[21] 2673 country pairs have an indirect peg at some time during the sample, and 146 country pairs are engaged in a currency union at some time during the sample. 2357 dyads switch indirect peg status and this relatively high proportion of switches, as compared to the case with direct pegs, reflects the fact that when a country changes from non-pegged to a peg, it triggers one regime switch for a direct peg, but it often creates many indirect peg switches. 62 country pairs switch currency union status in the post-Bretton Woods era, and all of these switch only once, with 42 of these observations representing the dissolution of a currency union and 20 representing the establishment of a currency union. Because of the intertwining relationships in currency unions, not all of these switches represent independent events, unlike the case with direct pegs. For example, 10 of the creations come from Mali joining the CFA and thus creating a currency union with each existing member.

[22] These results concerning the amount of trade represented by direct peg dyads contrast with the amount of trade represented by currency union dyads. The majority of currency unions observations consist of dyads with two developing countries, and thus currency unions comprise of a small portion of world trade.

that this subsample already represents a significant proportion of world trade. The statistics in the first panel of this table show that trade between industrial and developing countries accounts for 38 percent of overall annual trade in the post-Bretton Wood era.[23] Thus, the policy option we study is one that is frequently used and involves a meaningful portion of world trade.

III. Results:

III.1: Core Results

In this section, we use the gravity model to determine the effect of fixed exchange rates on trade, conditional on the role of other factors. As will be shown, results from estimating gravity models imply that fixed exchange rates have a statistically significant and economically important role in influencing trade.

Most of the results presented in this section are based on a sample of annual data from the post Bretton Woods period of 1973 to 1999.[24] We focus on this period because we are interested in relevant policy lessons for the present day, when the decision to peg a currency is, in most cases, a unilateral choice concerning a single bilateral relationship. In contrast, a country that pegged its currency to the dollar during the Bretton Woods era necessarily chose membership in a wide, multilateral system of pegged rates. Such a system neither exists today nor is likely to be instituted in the foreseeable future. However, results presented towards the end of this section draw on the experience of the Bretton Woods era as well.

The first set of results is presented in Table 2. When only year fixed effects and gravity controls are included (column 1 of Table 2), we see a strong statistical relationship between trade and direct pegs with a coefficient of 0.58 that is statistically significant from zero at the 99 percent level of confidence. As mentioned in Section II, though, OLS estimation, may misstate the true effect of fixed exchange rates on trade due to the presence of omitted variables and the failure to control for differences in multilateral resistance. Following Anderson and van Wincoop (2003) many studies now include country fixed effects as in column 2. The

[23] That percentage is the same if the sample is restricted to be rectangular (that is, that all countries appear in all years) and is 32% if trade involving "oil exporters" (as defined by the World Bank) is dropped.
[24] The exchange rate classification data comes from Shambaugh (2004). His post-Bretton Woods data was extended to the 1960-72 period for this paper. The exchange rate volatility data is the standard deviation of the monthly percentage change in the bilateral exchange rate; this is calculated using IMF exchange rate data (period end). We gratefully acknowledge that the trade data, gravity regressors, and currency union dummies from Rose (2004) were made available on Rose's website.

coefficient on the direct peg variable is about half as big in the country-fixed effects estimate (Column 2) as in the OLS estimate (Column 1). We still see significant results for both the direct peg and currency union variables while the indirect peg ceases to be significant. When CYFE are used (column 3), we no longer include controls that do not vary at the country-year level as these effects are soaked up in the constant. These results still show a significant result for the direct peg, and there is very little change from the results noted in column 2 as the coefficient for direct peg is 0.305 and is statistically significant from zero at the 95 percent level of confidence. We consider this specification to be the one best grounded in theory and it is the main specification we will test throughout the paper. [25]

As noted, we may worry about omitted variables at the country pair level. In this case, country pair fixed effects are used. These fixed effects will eliminate all non-country-pair-varying variables. We lose, though, all the cross-sectional information and rely exclusively on the time series to identify our effects. We still see significant effects for both the direct peg and the currency union with the direct peg coefficient of 0.19 statistically significant at 95%.[26] The indirect pegs are statistically insignificant in this sample once CFE or CPFE are introduced. We do not find robust evidence that an indirect peg has a strong effect on world trade. The currency union and direct peg coefficients are no longer statistically distinct once CPFE are included, but we do not focus on this result as the limited number of currency union switches makes it difficult to place too much emphasis on the CPFE estimates for currency unions in the 1973-99 era.[27]

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[25] The standard errors reported in the regressions are clustered at the country pair level. This both allows for different variance across the pairs and, more importantly, for an unstructured covariance within the clusters allowing for correlation across time. Bertrand, Duflo, and Mullainathan (2004) suggest clustering as the appropriate way to handle autocorrelation in panel differences-in-differences estimation techniques. They note that clustering in this manner is similar to a Newey-West setup but allows all lags to be potentially important. Kezdi (2002) makes a number of similar points in a more general panel fixed effects setup. We cannot cluster at the country level as two countries appear in each observation. Therefore, we have experimented with clustering on the larger country in the pair (so all US pairs would be in one cluster, etc.) and also separately clustering on the smaller country. The small country clusters produce standard errors quite similar to country pair clusters. Often, though, big country clustering yields smaller standard errors than those reported, but we take the more conservative approach and report the larger country pair cluster standard errors. Other approaches (uncorrected standard errors, heteroskedasticity consistent standard errors, or Newey West standard errors) always yield smaller standard errors than those we report here.

[26] The model suggests including both CYFE and CPFE simultaneously. Results are similar for the direct peg and weaker and insignificant for the currency union. We report the simple CPFE results for both comparability to the literature and because computational difficulties make precise estimates on the full sample difficult when both effects are included.

[27] Glick and Rose's (2002) results which first explored the impact of currency unions using country pair fixed effects had a longer time series and show 146 switches. In the post-1972 era, there are only 62 country pairs that

As would be expected from previous studies, the impact of exchange rate volatility is low over the various specifications in Table 1. The coefficient is negative and statistically significant, but the mean of volatility is only 0.059. Thus, reducing exchange rate volatility from the mean to zero suggests only a -1% to -2% impact on international trade relative to intranational trade. We have examined other volatility measures, such as the quintiles of volatility, but find that while other measures of volatility can be significant in some specifications, the direct peg measure always stays significant and clearly dominates these other measures. Removing the exchange rate volatility measure increases slightly (but not significantly) the coefficients on all exchange rate regime variables. Direct pegs and currency unions are still significant, and indirect pegs are still slightly negative and insignificant (with CFE, CYFE, or CPFE).[28] Removing the exchange rate regime dummies makes virtually no difference to the volatility coefficients.

The magnitudes of the coefficients are economically meaningful, as well as statistically significant. We interpret the coefficient on the direct peg in column 3 to mean that the geometric average across the two trade partners of the impact of a direct peg is to increase international trade with one another 36% relative to intranational trade.[29] While the effect is certainly smaller than a currency union when CYFE estimation is used, it is similar to other important trade factors, such as sharing a border or a common language, and is the same order of magnitude as entering a regional free trade agreement.[30]

These results are meaningful at the aggregate level as well as at the level of individual bilateral relationships. Eleven percent of world trade includes trade between countries with a direct peg. If all pegs were abandoned, this could have a consequential impact on trade overall. Furthermore, 40 percent of world trade is between industrial / developing pairs, and these

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have a regime switch for currency unions. Thus, we are leery of viewing our results as retesting the currency union effect and we view the currency union variable more as a control than a test variable. Longer sample results with CPFE show a higher currency union coefficient. More results with CPFE can be found in the working paper version of this paper, Klein and Shambaugh (2004).

[28] The volatility used is nominal because this is consistent with looking at a fixed nominal exchange rate. We use official rates because, again, this is consistent with the way the exchange rate regime variables are generated.

[29] International trade is 1.36 times higher (36% larger) because $e^{.305} = 1.36$. Feenstra (2002) provides a very useful discussion on the interpretation of coefficients in gravity models.

[30] Rose and van Wincoop (2001) use a solution to a nonlinear system of equations to determine the direct effect of currency unions and find that due to the impact on multilateral resistance, a currency union has less of an impact on country pairs that already trade a great deal, although, this smaller percentage impact on trade may still have large welfare impacts due to the larger base from which it starts. The same impact would operate here where country pairs that trade extensively will see a smaller percentage increase in trade when they peg.

dyads, which represent the bulk of our fixed rate observations, are ones where the choice of whether or not to peg the exchange rate is a relevant and central policy option.

We are also interested in whether these results are widely applicable across groups of countries. We address this question in Table 3 which presents CYFE estimates of the effect of fixed exchange rates, and currency unions, on bilateral trade between industrial countries and developing countries, as well as bilateral trade among industrial countries and bilateral trade among developing countries. The regressions show that the effect of direct pegs seems to be coming from the industrial / developing pairs. We see that direct pegs amongst industrial / industrial pairs actually show a negative coefficient, though there are fairly few observations on which to identify an effect. We do not place great emphasis on this result both because of the small number of pegs from which it is identified and because both the CFE and CPFE estimates of this coefficient are insignificantly different from zero. Industrial / developing pairs, where the bulk of the direct peg observations lie, show a strong impact. In addition, indirect pegs appear to be significantly positive for this group as well.[31]

Finally, we also note that the significant role that currency unions play in promoting trade that is evident from the results in Table 2 seems to arise as a result of bilateral trade among developing countries (Columns 3). This does not suggest that currency unions have no impact in other types of country pairs, it is simply a reflection that, as Table 1 showed, we have very few observations from which to draw information about currency unions impact on non-developing/developing pairs.[32]

As noted, we view the post Bretton Woods era as the most relevant, but we also examine data back to 1960, both for the full sample, and for the different types of pairs.[33]

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[31] A related way of looking at the question is to consider the impact of different base countries rather than different types of country pairs. Including different dummies for direct pegs to the US, UK, Germany, France, and other countries shows that direct pegs to the US, UK, France, and other countries all seem to have relatively similar positive impacts. On the other hand, direct pegs to Germany do not seem to increase trade once all the gravity controls are included. This result for Germany can be anticipated from the lack of an impact for industrial / industrial pairs (after 1973, nearly all are pegs to Germany). This does not mean EMS countries do not trade extensively, it is simply that their level of income, proximity, and other factors suggest they should trade extensively already, and the fixed exchange rates do not increase this level of trade.

[32] Recently, some studies have taken preliminary looks at the progress of trade under EMU, providing evidence on industrial / industrial trading pairs in currency unions. Micco et al (2003) find an impact of roughly 10%. See also Klein (2005) for a discussion of the impact of currency unions across different types of pairs.

[33] A number of caveats about the pegged exchange rate data for this pre-1973 period should be acknowledged. Pegging is pervasive in the Bretton Woods era, with 90% of the observations classified as direct pegs, indirect pegs, or currency unions. This leaves few excluded observations to separately identify the country year dummies

Table 4 shows the results. Direct pegs show an even stronger impact in the full sample with a coefficient of 0.473 as opposed to 0.305 on the shorter sample, with the coefficient now significant at 99%. This stronger relationship seems to come from increases in the coefficient in all three subgroups. For the overall sample, the indirect pegs are still insignificant and the currency union coefficient is largely unchanged. The currency union effect, though, is now positive and significant for industrial / developing pairs as well as developing / developing.

Overall, then, the results presented in Tables 2 through 4 suggest that direct pegs make a statistically and economically significant impact on trade flows. It is notable that these results differ so much from those presented in other research that indirectly addresses the role of fixed exchange rates on trade by considering the estimated effect of exchange rate volatility on trade. In fact, there is one way in which our results are consistent with this literature since we, too, find a quantitatively small (albeit statistically significant) effect of exchange rate volatility on trade. But our results also suggest that measured exchange rate volatility may not fully capture the increased certainty afforded by fixed exchange rates, even when controlling for country-pair fixed effects that may be correlated with both the level of trade and the choice of exchange rate regime. One likely explanation is that, while currency pegs do not last forever, the presence of a peg does typically provide a strong likelihood that, over the period of time between when contracts are signed and when payments are made, the exchange rate will be close to constant. In contrast, with floating exchange rate, those contemplating engaging in international trade may understand that current exchange rate stability is no guarantee of continued currency market quiescence.

IV. Robustness

This section presents results that address the robustness of the estimates presented above. We begin with an investigation of the robustness of our results to the use of alternative exchange rate classification schemes since the identification of a peg is at the center of our empirical analysis. Section IV.2 presents instrumental variables estimates that consider the endogeneity of the exchange rate regime. We then turn to an issue that is important for policy, in Section IV.3, the effect on trade of a transition from a fixed exchange rate to a flexible exchange rate, or from a flexible exchange rate to a fixed exchange rate as well as the impact of

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that are also included and, therefore, the effects of exchange rate regimes may be difficult to untangle from the fixed effects.

the length of time a peg has been in existence. This is followed by a consideration of the robustness of our estimates to the use of alternative econometric methodologies in Section IV.4, and Section IV.5 concludes with estimates based on subsamples of the data.

IV.1 Alternate classifications

We argue in section II.2 that using fixed exchange rate dummy variables based on the *de facto* classification of Shambaugh (2004) is a more appropriate way to test the impact of fixed exchange rates on trade than relying on exchange rate volatility measures. There are, however, other available classification schemes, and in this section we consider results obtained when using two of them; the *de facto* classification of Reinhart and Rogoff (2004), and a *de jure* classification based on countries' declared exchange rate status. The estimates obtained from a *de facto* classification different from the one used in Section III enables us to test the sensitivity of our results to the classification scheme. A comparison of results obtained with the Shambaugh (2004) *de facto* classification to those obtained with a *de jure* classification addresses the important question of whether the effects on trade of declaring a fixed exchange rate differ from those of actually maintaining a fixed exchange rate.

The *de facto* classification scheme of Reinhart and Rogoff (2004) is based on the probability that a market-determined exchange rate remains within a band over a five year window.[34] This classification scheme has five categories (fourteen in the detailed taxonomy) which, for comparability to Shambaugh's classification used in Section III, we collapse into two, the pegged category, and a non-pegged category that ranges from crawling pegs to freely floating countries.[35] The classification is available for 143 countries in our sample for a total of 3341 country / year observations, generating 123393 country pair year observations in our data set in the post Bretton Woods era.

The Reinhart-Rogoff classification, based on five year windows, exhibits more stability than the Shambaugh (2004) classification. Combined with the smaller country coverage, in the post-1972 data, this leads to only 76 country pairs coded as switches, while there are 118 switches under the Shambaugh classification. One might expect, therefore, a less significant

[34] A central part of the Reinhart and Rogoff (2004) system is their identification of the market-determined exchange rate. They define the market-determined exchange rate as either the official exchange rate, in a unified exchange rate system where no black market premium exists, the parallel rate (if it is determined in a market) in a multiple exchange rate system, or the black-market exchange rate, when it exists. We are grateful to Carmen Reinhart who makes the Reinhart Rogoff classification publicly available her website.

[35] Base countries are determined by declared status or by observing exchange rate behavior.

coefficient on the Reinhart-Rogoff direct peg dummy than on the Shambaugh direct peg dummy since the latter captures the possible effect on trade of year-to-year instability while, in the former, this instability may not alter the pegged status of a country. On the other hand, we might expect a more significant coefficient on the direct peg dummy based on the Reinhart – Rogoff classification if their market-based exchange rates better capture the relevant exchange rate used in international transactions than the official rate used by Shambaugh. Thus, there is not a strong *a priori* expectation on the relative size and significance of coefficients based on these two *de facto* classification schemes.

In addition to these two *de facto* classification schemes, we also use a *de jure* classification based on countries' declared exchange rate status, as reported to the IMF and as published, over time, in its *Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER)*. We classify an exchange rate arrangement as pegged if the AREAER lists it as a single currency peg, as having limited flexibility to one currency, or if the country is in a cooperative exchange rate arrangement (like the EMS). We classify all other AREAER categories, including those ranging from basket pegs to freely floating, as non-pegged.[36] We might expect that coefficients on direct peg dummy variables based on these *de jure* codes to be less significant than coefficients on direct peg dummy variables based on a *de facto* classification since the *de jure* classification is misleading at times. For example, Brazil declared a peg in the 1970's but did not maintain it, and South Korea maintained a tight peg for years in the 1980s and 1990s, but its government did not declare it as having a fixed exchange rate at that time. In these cases, the divergence between declared exchange rate status and actual exchange rate behavior may weaken the estimated link between identified *de jure* fixed exchange rates and trade.

Table 5 shows the results using alternative classifications with country year fixed effects included. For comparison purposes, this table includes, in Column 2, the results using the Shambaugh classification but with the smaller sample that is available when using the Reinhart-Rogoff classification.

A comparison of the results in Columns 1 and 2 shows that the coefficients on the direct peg dummy variables are very similar across the two classification schemes. The smaller data

[36] Base countries are determined by country's declarations, with the exception of the EMS for which we code Germany as the base country.

set has led to a slightly increased standard error for the Shambaugh codes, pushing it past standard confidence intervals. There is a bit more of a difference in the value of the coefficient on the indirect pegs, but the confidence intervals overlap at the 95% level of significance. Thus, overall the results are robust to using either of these two *de facto* exchange rate classification schemes.[37] Both sets of results support the contention that fixed exchange rates can increase trade,[38] and with the Reinhart Rogoff codes, even the indirect peg is weakly positive.

As predicted above, the results obtained using the *de jure* classification, presented in Column 3 of Table 5, are weaker than those that use either of the two *de facto* classifications.[39] The estimated effects of a *de jure* direct peg are both smaller than the respective results for either of the *de facto* pegs, and the coefficients on the *de jure* direct pegs are not significant. This suggests that simply declaring an exchange rate peg will not generate an increased trade flow, rather actually maintaining it is the important thing.[40]

IV.2 Instrumental Variables Estimation

The next concern that we address is the possible endogeneity of exchange rate regimes to trade. Of course, the use of country year effects controls for many factors and the use of country pair fixed effects already controls for the possibility that there are omitted variables that affect both the level of trade between two countries and their choice of their exchange rate regime. But one might argue that there are time-varying bilateral effects and, rather than bilateral trade responding to a change in the exchange rate regime, the exchange rate regime responds to an anticipated change in bilateral trade. We address these concerns by undertaking estimation using instrumental variables to explore the extent that these issues may be affecting our results.[41]

[37] A comparison of the results in Column 2 to those in Columns 3 of Table 2 shows that restricting the sample size, as is necessary when using the Reinhart – Rogoff classification, tends to make the results weaker.

[38] The similarity in results is not simply a consequence of a similarity in the two *de facto* classifications. In fact, the Reinhart-Rogoff and Shambaugh classification schemes have a substantial amount of disagreement. For example, there is disagreement on the status of 19% of the country-year observations in the post-1972 sample. In the subset of the country-pair observations where one or both countries are classified as having a direct peg by either Shambaugh or by Reinhart and Rogoff, there is disagreement on 43% of the observations.

[39] For comparison purposes, we limit the *de jure* sample to the same used in columns 1-2. In fact, *de jure* codes are available for most observations used in the full post 1972 sample. There is very little difference between the results shown here and the larger sample results.

[40] The Shambaugh *de facto* codes disagrees with the *de jure* in 28% of the observations where either the Shambaugh *de facto* classification or the *de jure* classification reported to the IMF reports a peg.

[41] Rose (2000) argues that "trade considerations seem irrelevant when a country decides whether to join or leave a common currency area," and as such, IV should not be necessary.

Previous research on the effects of currency unions on trade reports results obtained with instrumental variables estimates that are consistent with those obtained using OLS, namely that currency unions increase trade and there is only a weak effect of exchange rate volatility on trade. Rose (2000) uses inflation and monetary quantity variables as instruments and obtains results consistent with those from OLS. Alesina, Barro, and Tenreryo (2002) use, as an instrument, a dummy that indicates whether two countries share a common base country or the probability of that two countries share a common base, and find a strong effect of currency unions on trade. Tenreyro (2003) uses the same triangular approach to generating instruments in her work on exchange rate volatility and finds negligible impacts of volatility.[42] Frankel and Wei (1993) find a negative and significant effect of exchange rate volatility on trade when they instrument for this regressor using the standard deviation of relative money supplies, but the size of this effect is smaller when using IV than when using OLS.[43] Estevadeordal *et al.* (2003) raise the possibility that membership in the gold standard is more likely to be endogenous than the choice of the exchange rate regime in the modern era. They find, however, that the bilateral trade estimates obtained with OLS are robust to estimation in which membership in the gold standard is instrumented by a function that includes both countries' average distance from all the countries on the gold standard at the time.[44]

An appropriate instrument for our study will predict whether a country pegs its currency, but this variable itself will have no direct impact on trade, outside of its indirect effect through the channel of exchange rate regime choice. Our construction of an instrument draws on the insights of Estevadeordal *et al.* (2003) and Tenreyro (2003), and uses information about whether neighboring countries peg and, if so, to whom. We calculate, for a given pair of

[42] Such triangular approaches require eliminating observations with the base country. This would make examining direct pegs impossible. That is not a problem with currency unions because so many currency union observations are the interlocking relationships of countries sharing a currency union with one base (e.g. the bilateral relationships among CFA countries).

[43] Tenreyro (2003) raises the possibility that the relative money supplies will be moved by factors that also affect trade flows.

[44] One could try to look to the determinants of exchange rate regimes literature, but unfortunately, a large number of the variables considered in that literature are already being used as regressors in the gravity model (GDP, per capita GDP), or are trade related (terms of trade, openness), or could be related to trade (capital mobility, political stability), or finally, are more likely outputs of exchange rate regimes rather than exogenous predictors (reserves level, inflation). See Juhn and Mauro (2002) for a recent example in this literature. In addition, Rogoff et al (2003) note that "it is difficult to find empirical regularities between a large set of potential determinants of regime choice – including standard measures of the broader policy context – and countries actual regime choices." (p. 25) This makes it even more difficult to find proper instruments, but also makes one somewhat less worried about reverse causation.

countries, country *i* and country *j*, the percentage of countries in country *j*'s region that are directly pegged with country *i*. This percentage serves as our instrument.[45] Thus, we assume that sometimes a country will choose to peg to a base to help stabilize its exchange rate with its neighbors who may also have a peg. Such a decision is not related to trade with the base, but through the peg, may affect trade with the base. To employ this strategy, we calculate the percentage of each region pegged to each potential base. Then, for any pair where a potential base is a member, the percentage of the other country's region (excluding it) which is pegged to the base is used as the instrument for whether there is a direct peg.[46] A simple regression of direct peg on the instrument yields a positive coefficient and an R^2 of 0.36. Adding in all the other exogenous regressors increases the R^2 to 0.38.

The instrumental variable results presented in the first three columns of Table 6 should be compared to the respective columns in Table 2 for OLS with year dummies, CFE with year dummies, and CPFE with year dummies.[47] A comparison of the results shows that the coefficient on direct peg goes up when the IV regression is used.[48] In the third column, when pair fixed effects are used, the standard error rises enough such that the coefficient is no longer statistically different from zero at 95%, but it is significant at 90%. Thus, to the extent that one accepts the exogeneity of the instrument, these IV regressions appear to support the core specifications by showing that eliminating endogeneity does not weaken our results.

IV.3 Entry and exit of pegs

Estimates based on coding a country as a having either a pegged exchange rate or a flexible exchange rate may raise concerns that some important links between the exchange rate regime and trade are not captured. In particular, one concern is that an increased level of bilateral trade may prompt a country to institute a fixed exchange rate with its trading partner.

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[45] If country *j* is in fact a potential base and country *i* is not, then the percentage of country *i*'s region that is pegged to country *j* is used.

[46] If the other countries are pegging and this choice is correlated with other measures designed to increase trade, and these measures are correlated with unobserved measures in the local country, then this percentage is not a good instrument. We do, though, see many instances where a country has switched bases to be more like the other countries in the region (Ireland switching to a German base within the EMS, former British colonies in the Western Hemisphere switching to the US, and former Portuguese colonies switching to a French base to be more like their neighbors.). In addition, a regression that includes the instrument directly in the regression with all the other variables and country pair and year fixed effects, the coefficient on the instrument is not statistically different from zero, see table 7, column 4)

[47] CYFE requires adding too many exogenous variables as instruments. Given the similarity of the CFE and CYFE results, we consider the CFE results a reasonable proxy.

[48] If one instead instruments for currency unions, the coefficient on currency unions go up as well, but the standard error rises to the point that the result is not statistically significant when CPFE are included.

In this case, the estimated link between a fixed exchange rate and bilateral trade reflects the influence of the latter on the former. While we have tried to address these issues with IV estimation, we can also look at the dynamic patterns. Beyond this possibility, we are also interested in knowing whether the effects of a change in exchange rate status on trade are manifest immediately, or only with time.

We explore these issues by including four new dummy variables in the specification, representing the first year of a peg, the last year of a peg, the first year after abandoning a peg, and the last year before adopting a peg. Results are reported in table 7. The hypothesis that a peg is used to lock in a higher level of trade would be consistent with a finding of a positive coefficient on the dummy variable representing the last year before adopting a peg. The hypothesis that trade is significantly different in the immediate wake of adopting or abandoning a peg can be tested by considering the sign and significance of the coefficients on the dummy variables representing the first year of a peg and the first year after a peg is abandoned, respectively. In fact, however, we find that only the dummy for the first year of a peg is statistically significantly different from zero, and it is negative, indicating perhaps that the trade stimulating impact of a peg does not materialize immediately since the total coefficient (pegging plus the first year of pegging) is effectively zero (it is actually -0.069 with a standard error of 0.177). The fact that the other coefficients on these dummy variables are not significant suggests odd dynamics are not generating the results presented above. In particular, trade is not higher right before a peg begins, suggesting the concerns above do not show up in the data.[49] Also, trade in the year immediately after a peg ends (the first year of floating) is not different from any other year of where there is no peg, suggesting crises or messy exits do not drive our results. In fact, the point estimate is positive, though insignificant for the first year of floating.

The final column of table 7 allows us to more carefully consider the fact that the impact of a direct peg or currency union may phase in over time. We include a variable which is the inverse of the number of years pegged.[50] Thus, for the first year of a peg, this variable is equal to 1, in year 2 it is 0.5, etc., and it asymptotically approaches zero. The expected coefficient

[49] Because the classification only codes full year pegs as a peg, most years coded as the last year before a peg will also incorporate a number of months of the beginning of the peg (assuming not all pegs begin on January 1). Thus, we would expect the coefficient on the last year before a peg to be marginally positive, and despite that, it is negative and statistically insignificant.

[50] We thank Eric van Wincoop for suggesting this specification.

based on the above results would be for the coefficient to be negative suggesting the trade improving impact does not show immediately. In fact the results are quite strong with both 1 / (years pegged) and 1 / (years in CU) drawing large and significant negative coefficients. In both cases, if one adds the main coefficient (direct peg or currency unions) to the length of time coefficient with peg length set equal to one, we see a negative but insignificant sum (e.g. for direct pegs we add 0.451 to -0.637 getting a combined effect in year 1 of -0.186 which would not be significantly different from zero). As the length of the peg grew, the factor multiplied by the -0.637 would shrink making the total effect positive (in year 3 the total effect would be 0.24, by year 10 it would be 0.39).

IV.4 Alternate Econometric Techniques

Our central results are robust to varying the econometric methods used to obtain estimated effects of fixed exchange rates on trade. These results are not presented in a table, in order to save space, but can be summarized as follows. First we consider using random effects at the country pair level instead of fixed effects. Including random effects strengthens the direct peg and moves the indirect peg to a negative significant coefficient. However, the Hausman specification test rejects the hypothesis that there is no systematic difference between the random and fixed effects coefficients suggesting that fixed effects are appropriate. Second, results are largely unchanged when using data from every fifth year rather than annual data, an exercise undertaken in an effort to remove some of the serial correlation. Third, employing an AR(1) correction still results in large and significant effects of fixed exchange rates on trade, albeit smaller than the simple OLS results reported above.[51] We also include a lagged dependent variable to control for possible unobservable omitted variables, a strategy that seems to us to be less promising than the use of country pair fixed effects. But, as it turns out, there is a close correspondence to the OLS results presented in Section III and those obtained with a lagged dependent variable. The coefficient on direct peg is 0.10 and significant at 99% when a lagged dependent variable is included, and the coefficient on the lag is 0.8. This suggests a long run impact of roughly 0.5, not far from our original OLS estimates with time controls.

[51] As noted above, alternate means of handling autocorrelated errors, such as Newey-West standard errors only strengthen the results from those reported. The standard errors when just one lag is included are almost identical to heteroskedasticity robust standard errors and as lags included approach the maximum lags of the sample, the errors approach the reported results using country pair clusters.

These results suggest that the estimates presented in Section III are not merely a reflection of spurious correlations.

IV.5 Alternate sub-samples

Finally, we look at three other subsets of the data: trade with base countries, non-oil country trade, and trade among countries with over 1 million population. For the first, we may worry that non-pegged trade between, say, Ivory Coast and Thailand is simply not a relevant comparison to the pegged observations because most of our pegs are to large countries. We thus restrict our sample to trade with a country that is a base country (i.e. someone else pegs to this country) somewhere in the sample. This has little effect on the results; the coefficient on direct peg actually goes up slightly. We consider non-oil based trade because oil based trade may be atypical of other trade flows and because many oil exporters are pegged to the dollar and the price of oil is denominated in dollars.[52] Again, we find that eliminating oil exporters does not dramatically change the results. Finally, we may worry that extremely small countries are not representative of the full sample, and we should not let the behavior of tiny islands drive our conclusions. Eliminating countries with a population under 1 million in 1999 leave the core results completely unchanged for most specifications.

V Conclusion:

Countries peg for many reasons. Often the concern is macroeconomic stability and the provision of a nominal anchor. Still, one of the presumed benefits of a fixed exchange rate is that it should expand trade, at least with the base country. Empirical backing for this presumption, though, has proved elusive. This paper shows that when one focuses on bilateral exchange rate regimes as coded from *de facto* performance, rather than proxying for regimes by using bilateral exchange rate volatility, there are statistically and economically significant impacts on trade from a fixed exchange rate.

We find that, with few controls, pegging appears to increase trade by a great deal. These are clearly over-estimates and when more appropriate controls are included, the results suggest that international vs. intranational trade grows by up to 35% (when country year effects are included). These results seem robust to a variety of econometric checks, considerations of start and stop years, and alternate *de facto* classifications. We find that indirect pegs do not appear to have strong impacts on trade.

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[52] Oil exporters are defined by the World Bank as countries with more than 50% of their exports in the form of oil.

The magnitudes, on the order of 35%, may or may not be sufficient to offset some of the costs of fixing the exchange rate, but they are both statistically and economically relevant. Countries hoping to expand trade may choose the less restrictive and permanent fixed rate as opposed to a currency union. In addition, countries already pegged may have already captured some of the gains of increased trade that appear available from creating a currency union. On the other hand, the difficulty of maintaining a peg in the face of market pressure may lead countries to prefer the permanent link that a currency union can provide.

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Table 1. Sample Descriptions

	Sample for 1973 - 1999	Industrial / Industrial pairs 1973 - 1999	Industrial / Developing pairs 1973 - 1999	Developing / Developing pairs 1973 - 1999	Sample for 1960 - 1999
Total					
Observations	168868	6349	68108	94411	213391
# of country pairs	11805	276	3569	7960	11857
% world trade	100%	52%	38%	9%	100%
Direct Pegs					
Observations	1562	130	1407	25	2753
% of world trade	11%	7%	5%	0%	16%
# switchers	118	14	102	2	162
Indirect peg # of obs.	13679	332	1730	11617	45591
Indirect peg # of switches	2357	59	315	1983	5896
Currency Unions					
Observations	2055	6	193	1806	3055
% of world trade	<0.5%	<0.5%	<0.5%	<0.5%	2%
# switchers	62	1	9	52	129

Note: % of trade results are the average of annual results for the relevant time sample

Table 2. Core Results

	1 OLS, time	2 CFE, time	3 CYFE	4 CPFE, time
direct peg	0.586	0.324	0.305	0.194
	0.124**	0.145*	0.147*	0.089*
indirect peg	-0.351	-0.031	-0.071	-0.015
	0.050**	0.04	0.048	0.028
currency union	1.341	1.231	1.159	0.323
	0.158**	0.155**	0.156**	0.132*
exch rt volatility	-0.262	-0.271	-0.143	-0.205
	0.046**	0.039**	0.053**	0.032**
$(\text{exch rt volatility})^2$	0.007	0.007	0.004	0.006
	0.001**	0.001**	0.001**	0.001**
ldist	-1.212	-1.431	-1.436	
	0.025**	0.026**	0.026**	
lrgdp	0.968	0.059		0.445
	0.010**	0.066		0.061**
lrgdppc	0.392	0.322		0.007
	0.015**	0.063**		0.058
comlang	0.342	0.302	0.302	
	0.046**	0.050**	0.049**	
border	0.582	0.360	0.33	
	0.126**	0.123**	0.123**	
regional	1.050	0.529	0.533	0.265
	0.139**	0.163**	0.168**	0.072**
landl	-0.25	-0.155		
	0.035**	0.322		
island	0.007	2.168		
	0.040	0.228**		
lareap	-0.106	0.628		
	0.009**	0.045**		
comcol	0.337	0.547	0.567	
	0.073**	0.070**	0.069**	
curcol	0.741	0.104	-0.015	-0.032
	0.383+	0.480	0.374	0.452
comctry	-0.511	0.472	0.556	
	0.877	0.558	0.507	
colony	1.403	1.398	1.388	
	0.120**	0.120**	0.120**	
Observations	168868	168868	168868	168868
R^2	0.64	0.71	0.73	0.87
Number of country pairs FE				11805
Impact of reducing volatility from mean to zero	-1.5%	-1.6%	-0.8%	-1.2%

+ significant at 10% * significant at 5%; ** at 1%
standard errors clustered at country pair level
constant and fixed effects included but not reported

Table 3 Different country types

	1 indind	2 inddev	3 devdev
direct peg	-0.36	0.352	0.318
	0.143*	0.091**	0.849
indirect peg	-0.275	0.226	0.117
	0.083**	0.072**	0.063+
currency union	-0.056	0.424	0.916
	0.288	0.338	0.182**
exch rt volatility	-16.251	-4.196	-0.139
	5.932**	2.163+	0.068*
$(\text{exch rt vol})^2$	188.789	-9.448	0.004
	89.291*	12.103	0.002*
ldist	-1.119	-1.392	-1.613
	0.074**	0.053**	0.034**
comlang	0.228	0.445	0.166
	0.113*	0.062**	0.067*
border	-0.12	-0.053	0.496
	0.145	0.351	0.128**
regional	0.045	2.859	1.664
	0.102	0.266**	0.188**
comcol		0.04	0.695
		0.221	0.081**
curcol		0.244	
		0.372	
comctry		0.166	
		1.027	
colony	0.799	1.144	0.093
	0.225**	0.107**	0.167
Observations	6349	68108	94411
R^2	0.96	0.85	0.61

+ significant at 10%; * significant at 5%; ** at 1% standard errors clustered at country pair level
Note: indind is industrial only pairs. inddev is industrial / developing pairs. devdev is developing only pairs. Time fixed effects in all regressions. Country year effects in all columns. constant and fixed effects included but not reported

Table 4. Longer Time Series Results

	1	2	3	4
	Full	indind	inddev	devdev
direct peg	0.473	-0.258	0.483	0.509
	0.108**	0.126*	0.079**	0.824
indirect peg	-0.007	-0.257	0.074	0.180
	0.043	0.073**	0.056	0.057**
currency union	1.098	0.547	0.610	0.886
	0.126**	0.349	0.233**	0.154**
exch rt volatility	-0.155	-7.992	-4.714	-0.151
	0.054**	2.989**	1.877*	0.068*
(exch rt vol)^2	0.004	21.915	-7.403	0.004
	0.001**	6.804**	11.939	0.002*
ldist	-1.332	-1.074	-1.384	-1.516
	0.024**	0.069**	0.048**	0.031**
comlang	0.292	0.290	0.444	0.172
	0.044**	0.114*	0.057**	0.061**
border	0.270	-0.142	-0.142	0.393
	0.114*	0.136	0.359	0.117**
regional	0.671	0.097	2.859	1.844
	0.168**	0.090	0.260**	0.177**
comcol	0.586		0.006	0.671
	0.063**		0.204	0.075**
curcol	0.323	-0.188	0.647	
	0.287	0.395	0.283*	
comctry	0.257		-0.094	
	0.599		0.979	
colony	1.321**	0.840	1.116	0.101
	0.113	0.241**	0.097**	0.195
Observations	213391	9318	90011	114062
R^2	.73	.95	.85	.61

+ significant at 10%; * significant at 5%; ** at 1% standard errors clustered at country pair level
Note: indind is industrial only pairs. inddev is industrial / developing pairs. devdev is developing only pairs. Time fixed effects in all regressions. Country year effects in all columns. constant and fixed effects included but not reported

Table 5. Results across different classifications

	1	2	3
code	RR	JS	De Jure
direct peg	0.319	0.264	0.146
	0.157*	0.163	0.176
indirect peg	0.112	-0.07	-0.046
	0.064+	0.055	0.057
currency union	1.331	1.298	1.295
	0.178**	0.177**	0.178**
exch rt volatility	-0.086	-0.091	-0.091
	0.055	0.055+	0.055
$(\text{exch rt vol})^2$	0.002	0.002	0.002
	0.001	0.001	0.001
ldist	-1.308	-1.311	-1.311
	0.029**	0.029**	0.029**
comlang	0.34	0.344	0.345
	0.056**	0.056**	0.056**
border	0.517	0.512	0.513
	0.135**	0.135**	0.135**
regional	0.068	0.081	0.08
	0.185	0.185	0.185
comcol	0.625	0.625	0.624
	0.083**	0.083**	0.083**
curcol	-0.183	-0.172	-0.183
	0.413	0.424	0.426
colony	1.244	1.246	1.266
	0.124**	0.124**	0.127**
Observations	123393	123393	123276
R^2	0.76	0.76	0.76

+ significant at 10% * significant at 5%; ** significant at 1%
All columns include country year fixed effects. Fixed effects and constant included but not reported
standard errors clustered at country pair level

Table 6. IV regressions (instrument is percentage of region pegged to base)

	1 IV with time	2 IV with CFE, time	3 IV with CPFE, time	4 CPFE, time
direct peg	1.436	0.656	0.495	0.179
	0.216**	0.284*	0.288+	0.087*
indirect peg	-0.343	-0.027	-0.015	-0.015
	0.050**	0.040	0.017	0.028
currency union	1.352	1.249	0.334	0.32
	0.157**	0.155**	0.096**	0.132*
exch rt volatility	-0.253	-0.268	-0.204	-0.205
	0.046**	0.039**	0.021**	0.032**
(exch rt volatility)^2	0.007	0.007	0.006	0.006
	0.001**	0.001**	0.001**	0.001**
ldist	-1.211	-1.43		
	0.025**	0.026**		
lrgdp	0.966	0.058	0.444	0.444
	0.011**	0.066	0.029**	0.061**
lrgdppc	0.389	0.322	0.008	0.008
	0.015**	0.063**	0.027	0.058
comlang	0.328	0.299		
	0.046**	0.050**		
border	0.577	0.358		
	0.128**	0.124**		
regional	1.031	0.523	0.265	0.265
	0.141**	0.164**	0.055**	0.071**
landl	-0.251	-2.785		
	0.035**	0.375**		
island	0.006	-1.216		
	0.040	0.226**		
lareap	-0.108	0.630		
	0.009**	0.045**		
comcol	0.340	0.548		
	0.073**	0.070**		
curcol	0.733	0.093	-0.078	-0.037
	0.368*	0.465	0.197	0.452
comctry	-0.446	0.505		
	0.822	0.542		
colony	1.297	1.349		
	0.122**	0.129**		
% region pegged to base				0.156
				0.147
Observations	168868	168868	168868	168868
R^2	0.64	0.71	.50	0.87
Number of CPFE			11805	11805

+ significant at 10% * significant at 5%; ** significant at 1%

R^2 in column 3 is the "overall" R^2

Constant and fixed effects included but not reported

Table 7: Controls for Dynamics

	1	2	3	4	5
direct peg	0.302	0.341	0.31	0.314	0.451
	0.150*	0.149*	0.150*	0.153*	0.158**
indirect peg	-0.071	-0.071	-0.071	-0.071	-0.07
	0.048	0.048	0.048	0.048	0.048
currency union	1.158	1.159	1.159	1.159	1.344
	0.156**	0.156**	0.156**	0.156**	0.175**
exch rt volatility	-0.143	-0.143	-0.143	-0.143	-0.142
	0.053**	0.053**	0.053**	0.053**	0.053**
$(\text{exch rt volatility})^2$	0.004	0.004	0.004	0.004	0.004
	0.001**	0.001**	0.001**	0.001**	0.001**
ldist	-1.436	-1.436	-1.436	-1.436	-1.436
	0.026**	0.026**	0.026**	0.026**	0.026**
comlang	0.302	0.301	0.302	0.302	0.301
	0.049**	0.049**	0.049**	0.049**	0.049**
border	0.331	0.331	0.33	0.33	0.333
	0.123**	0.123**	0.123**	0.123**	0.124**
regional	0.534	0.535	0.532	0.533	0.533
	0.168**	0.168**	0.168**	0.168**	0.168**
comcol	0.567	0.567	0.567	0.567	0.565
	0.069**	0.069**	0.069**	0.069**	0.069**
curcol	-0.016	-0.015	-0.016	-0.015	-0.016
	0.374	0.373	0.372	0.374	0.371
comctry	0.556	0.564	0.558	0.556	0.691
	0.507	0.51	0.506	0.507	0.577
colony	1.389	1.386	1.386	1.387	1.382
	0.120**	0.120**	0.120**	0.120**	0.120**
Last year float	-0.184				
	0.199				
First year peg		-0.411			
		0.131**			
First year float			0.185		
			0.141		
Last year peg				-0.099	
				0.14	
Sum (peg + first or last year peg)		-.069		.215	
		.177		.149	
1/(# years direct peg)					-0.637
					0.214**
1/(#years in CU)					-2.245
					0.834**
Observations	168868	168868	168868	168868	168868
R^2	0.73	0.73	0.73	0.73	0.73

Country year fixed effects included in all regressions,
Constant and fixed effects included but not reported
+ significant at 10% * significant at 5%; ** significant at 1%
standard errors clustered at the country pair level