

July 2004

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## Recommended Citation

Hallwood, Paul; Marsh, Ian W.; and Scheibe, Jörg, "An Assessment of the Case for Monetary Union or Official Dollarization in Argentina, Brazil, Chile, Uruguay and Venezuela" (2004). *Economics Working Papers*. 200413.  
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University of  
Connecticut

*Department of Economics Working Paper Series*

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Working Paper 2004-13

July 2004

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## **Abstract**

We use a data set covering the whole period of Argentina's currency board and most of that spanned by the Mercosur trade agreement to examine the case for either a Latin American monetary union or monetary union with the USA (through official dollarization). Our econometric evidence using VAR techniques indicates that macroeconomic shocks are still so highly asymmetric in Latin America and between Latin American countries and the USA as to make monetary union or official dollarization somewhat doubtful policies.

**Journal of Economic Literature Classification:** F31, F33, F41, F42

**Keywords:** dollarization, monetary union, Argentina, Brazil, Chile, Uruguay, Venezuela

## **AN ASSESSMENT OF THE CASE FOR MONETARY UNION OR OFFICIAL DOLLARIZATION IN ARGENTINA, BRAZIL, CHILE, URUGUAY AND VENEZUELA**

### *Abstract*

We use a data set covering the whole period of Argentina's currency board and most of that spanned by the Mercosur trade agreement to examine the case for either a Latin American monetary union or monetary union with the USA (through official dollarization). Our econometric evidence using VAR techniques indicates that macroeconomic shocks are still so highly asymmetric in Latin America and between Latin American countries and the USA as to make monetary union or official dollarization somewhat doubtful policies.

The choice of monetary and exchange rate regimes in Latin America is a recurrent policy issue. For example, in 2000 both Ecuador and El Salvador officially dollarized their economies, in 2002 Argentina abandoned its decade old currency board, and in early-2003 it held discussions at the Ministerial level with Brazil to explore some sort of common currency arrangement.<sup>1</sup> We use data on output and price levels of five Latin American countries - Argentina, Chile, Brazil, Uruguay and Venezuela, to assess the case for monetary union either with the USA – through official dollarization, or, between Latin American countries through the adoption of a common currency arrangement. We think that our findings are relevant to future discussions over currency arrangements in Latin America.

In view of the endogenous optimal currency area hypothesis of Frankel and Rose (1998) – which asserts that recent economic history is irrelevant to the choice of currency regime – in section 2 we examine the theoretical and empirical evidence for it, concluding that it ought to be set aside. Even so, an interesting question is did Latin American countries

become more suitable for monetary union during the course of the 1990s? Argentina's ten-year adherence to its currency board, as well as the formation of the Mercosur trade block aimed at increasing trade integration between the members suggests that they might have done. We find that this was not the case because macroeconomic shocks between the five Latin American countries and between them and the USA did not become more symmetric.

In this paper aggregate macroeconomic shocks are identified in a bivariate VAR system, defined across the price level and output (real GDP). We justify our use of this methodology – in fact, used earlier by Bayoumi and Eichengreen (1994) - on three grounds. First, as we discuss in section 5, it remains a valid technique. Secondly, we use quarterly data spanning the period 1980-2002 that is more up-to-date, covers the whole period of Argentina's currency board, and allows for a 'finer' assessment of the timing of economic shocks than is possible in the annual data used by Bayoumi and Eichengreen (1994). Thirdly, we introduce some tests for robustness of estimated shocks that seem not to have been used before.

The paper continues as follows. In section 2 we review some recent theoretical and empirical work on the endogenous optimal currency area hypothesis, finding that both theoretical and empirical support for it is weak. In section 3 we review the evidence in Latin American data on an important element in the endogenous optimal currency area hypothesis – positive association between bilateral trade intensity and business cycle correlation. We find that statistically significant results supporting this association are

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<sup>1</sup> "Brazil, Argentina consider forming a common currency", May 5<sup>th</sup>, 2003, Bloomberg.com.

scarce. We also review the work of others on macroeconomic asymmetries in Latin America. Using various methodologies and older data sets than ours these findings are also hardly supportive of the case for either monetary union within Latin America or with the USA through official dollarization. Section 4 describes the econometric method used in this paper. Section 5 reviews the data. Section 6 reports results, and section 7 draws conclusions.

## *2: Are optimal currency areas endogenous?*

Until Frankel and Rose (1998), asymmetry of macroeconomic shocks between countries was thought to be relevant to the choice of currency regime (see Eichengreen and Bayoumi, 1994). However, Frankel and Rose (1998), argue that the history of macroeconomic asymmetries – especially low correlation of business cycles or high asymmetry of permanent (supply) macroeconomic shocks – is irrelevant because optimum currency areas are endogenous. That is, the ‘Lucas critique’ applies as macroeconomic shocks will quickly become symmetric. If this was true then one monetary policy will be suitable for all country members of a currency area. As we are convinced that the endogenous optimum currency area hypothesis receives little or no support in empirical evidence we wish to dispose of it before offering our assessment of the case for monetary union in Latin American.

Although influential Frankel and Rose (1998) offer no evidence supporting the assertion that entry into a monetary union will dramatically alter business cycle correlation: their

econometric results do not include any control variable for monetary union. A review of recent literature on the endogenous optimum currency area hypothesis is instructive.

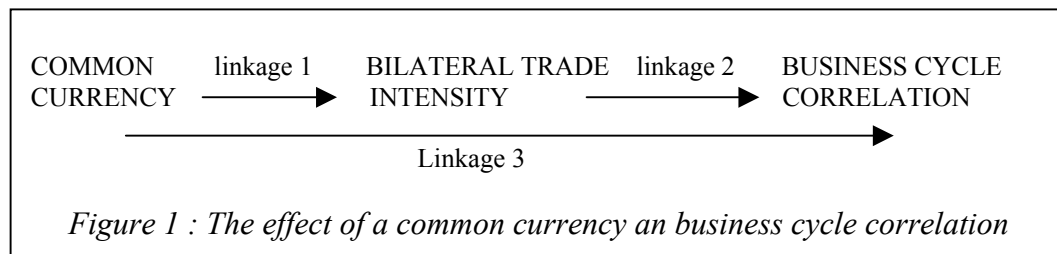
Hughes-Hallett and Piscitelli (2002) show that there is no theoretical necessity for positive association between currency union and business cycle correlation - linkage 3 in figure 1. Indeed, they show that business cycle correlation could *decrease* following monetary union. This could occur if an economically volatile and small country that was quite different in economic structure partnered with a large economically stable country – the USA for instance. Several Latin American countries would seem to fit this description, as Latin American countries are more dependent on primary production than is the USA; they are economic volatility compared to the USA, and the two largest Latin American countries, Argentina and Brazil, are relatively closed economies<sup>2</sup>.

Another relevant theoretical proposition concerns the effect of international capital market integration on industrial specialization: high capital market integration encouraging greater specialization. Thus, Kalemli-Ozcan, Sorensen and Yosha (2000, and references therein) argue that in a financially isolated country a high variance of GDP encourages the development of a well diversified economy as a means of insuring against production risk – so reducing the variance of income and consumption. But another type of production risk insurance is through integrated international capital markets in which

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<sup>2</sup> Also notable for *not* expecting a strong theoretical positive association between trade intensities and business cycle correlation is recent work in the area of dynamic general equilibrium real business cycle modeling. In Zimmermann (1997) and Fichtner (2003), rather than being transmitted through international trade, contemporaneous and lagged spillovers of real productivity shocks generate correlation of international business cycles. The simulations in both of these papers find strong support for the maintained hypothesis that productivity shocks cause international business cycles and little or no support for an effect of increasing trade intensities on business cycle correlation.

cross-investment reduce the variance of income and consumption. Thus, international and inter-regional borrowing serves to stabilize consumption in the face of non-permanent industry specific shocks. A testable hypothesis therefore is that national and regional specialization increases as, respectively, international and inter-regional capital market integration increases. Kalemlı-Ozcan, Sorensen and Yosha (2000) find support for this hypothesis.<sup>3</sup> These arguments support Krugman (1993), who argues that following monetary union increasing specialization in production will cause shocks to become more asymmetric, with the implication that business cycles become less correlated. Moreover, Kose, Prasad and Terrones (2003), in finding that globalization (i.e., increasing international goods and capital market integration) is not associated with increasing business cycle correlation, suggest that this may be due to the counteracting effects of simultaneously increasing trade and capital market integration.



The empirical evidence on the endogenous optimum currency area hypothesis is hardly any more supportive of it than are the theoretical underpinnings. Two indirect linkages are involved in the effect of the adoption of a common currency on business cycle correlation. The first, as shown in figure 1, is from the adoption of a common currency to increased bilateral trade intensity – a common currency reducing transaction costs. The

<sup>3</sup> The theoretical model of Heathcote and Perri (2002) also indicates that business cycle correlation will



second is from increased bilateral trade intensity to increased business cycle correlation – presumably working through the foreign trade multiplier. Frankel and Rose (1998) offer supportive evidence only for linkage 2, and they are supported in this by Yamarik and Ghosh (2002).

The linkage from the adoption of a common currency to increased bilateral trade intensity – linkage 1, is supported by Glick and Rose (2002) who find that after controlling for other variables joining a currency union at least doubles the level of bilateral trade. However, they find long lags – of over a decade - in the relationship. Long lags destroy the force of the Lucas critique because the conditions for a well functioning monetary union take such a long time to establish themselves. From a political perspective, the “in the long-run we are all dead critique” applies as in practice no politician or political party will be willing idly to standby while an economy is devastated and rioters are on the streets for want of a currency depreciation or monetary expansion.<sup>4</sup>

The linkage between currency union and business cycle correlation – linkage 3 in figure 1, is critical in the endogenous optimum currency area hypothesis. Not surprisingly, given the weak support for linkages 1 and 2, the empirical evidence does not suggest high

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decline when financial market integration increases.

<sup>4</sup> Glick and Rose (2002) estimate the effect of currency union membership on trade integration using a large data set of countries that have *left* currency unions. They find that trade integration with the remaining members falls by about one-half from the boosted level associated with monetary union in the year or so immediately following exit. However, this initial impact is followed by recovery in trade intensity such that even about 20 years after leaving a currency union, in a statistical sense, it cannot be concluded that trade intensity has been affected by the change in currency regime. The finding of Frankel and Rose (2000) also supports that lags are long in the currency union-trade integration-business cycle correlation nexus. They find that it takes twenty years for a one- percent increase in the ratio of trade to GDP to increase real per capita income by one-third of one percent.

correlations. Rose and Engel (2000) investigate the effect of currency union membership on business cycle correlation in a large data set. They find that membership tends to increase business cycle correlation by about 0.1, and conclude that "while economically and statistically significant, the size of this effect is small in an absolute sense" (2000, page 19).

Also relevant is that Frankel and Rose (2000) find that the beneficial effects of a currency union work *only* through trade creation and not through macroeconomic influences or the tying of monetary policy to a non-inflationary trade partner. They also note that an implication of this (that also squares with the theoretical considerations in Hughes-Hallett and Piscitelli, 2002), is that a currency union would better be with the largest trade partner. In our Latin American data set Europe, not the USA, is the largest trade partner.

### *3: Some Latin American evidence on trade intensities and business cycle correlations*

Table 1 gives an indication of openness and trade integration with various economies of the four Mercosur countries, Argentina, Brazil, Paraguay and Uruguay, the associate member Chile and a sixth country, Venezuela. The USA is often regarded as a relatively closed economy with an average ratio of imports and exports to GDP of about 10%. This ratio is identical to that of Brazil, while Argentina's is slightly lower. In comparison, both Paraguay and Uruguay are more open economies. As initial trade intensity is important - because a doubling or trebling of it is the presumed means of creating increased business cycle correlation, it is noticeable that the trade intensities of none of

the Mercosur members with the USA is greater than an average for exports and imports of about 3%. Those for Argentina and Uruguay were especially low, being a good deal less than 2%. It is also striking that for Argentina, Paraguay and Uruguay that the USA is only the third largest trade partner behind Europe and Mercosur, while for Brazil the USA is the second largest trade partner also behind Europe. On the basis of these trade intensities of Mercosur full members it is hard to say that a monetary union with the USA is the natural choice - especially as Frankel and Rose (2000) have found that the beneficial effect of currency union works only through trade creation. Not that we are suggesting it, monetary union with Europe might be more appropriate than with the USA. Or, as Fratianni (2002) and Alexander and Furstenberg (2000) have suggested, Mercosur members are perhaps more suited to creating their own common currency than to adopting the US dollar: Mercosur is a larger trade partner for all Mercosur members other than Brazil.<sup>5</sup>

Chile and Venezuela are more open economies and with much more trade as a proportion of GDP with the USA than are the others in Table 1. On the basis of trade propensities alone these two countries are the most suited to official dollarization. Even so, Chile's largest export market is Europe - though the USA is close behind, and the USA is the largest source country for Chile's imports.

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<sup>5</sup> Carrillo and Li (2002) Tobit panel data to estimate a gravity trade model find that Mercosur had a significant though small impact on intra-member trade intensity but in only one product classification – capital intensive goods - but not in other reference price goods, differentiated goods or homogeneous

**Table 1: Exports and Imports as Percentages of GDP, 2000**

From To	USA		ARG		BRAZIL		PAR		URU		CHILE		VENEZ	
	Exp	Imp	Exp	Imp	Exp	Imp	Exp	Imp	Exp	Imp	Exp	Imp	Exp	Imp
TOTAL	7.2	12.6	9.4	8.9	10.0	10.0	14.4	36.4	11.8	17.8	25.7	23.8	28.9	12.4
USA	-	-	1.1	1.8	2.4	2.3	0.5	5.9	1.0	1.7	4.4	4.7	14.7	4.5
EUROPE	1.8	2.4	1.7	2.3	2.8	2.7	1.9	3.6	2.0	3.4	6.7	4.4	1.4	2.1
MERCOS	0.2	0.2	2.9	2.7	1.4	1.4	8.9	19.2	5.3	7.8	8.4	2.5	1.1	0.8
ARG	<0.1	<0.1	-	-	1.1	1.2	4.2	8.3	2.1	4.3	0.9	0.4	<0.1	0.2
BRAZIL	0.2	0.1	2.4	2.4	-	-	4.6	10.8	2.7	3.4	1.4	1.9	1.0	0.6
PAR	<0.1	<0.1	0.2	0.1	0.1	0.1	-	-	0.4	0.1	0.1	0.1	0.2	0.2
URU	<0.1	<0.1	0.3	0.1	0.1	0.1	0.2	<0.1	-	-	0.1	0.1	<0.1	0.1
CHILE	<0.1	<0.1	0.9	0.2	0.2	0.2	0.8	0.6	0.3	0.3	-	-	0.2	0.2
VENEZ	0.1	0.2	0.1	<0.1	0.1	0.2	0.1	1.1	0.1	0.8	0.3	0.3	-	-

Source: IMF, *Direction of Trade Yearbook*, 2001

In an apparently unpublished paper Ahumada and Martirena-Mantel (2001) apply the Frankel and Rose (1998) techniques to the Mercosur four, two Mercosur Associates - Chile and Bolivia, and the USA to ascertain the effect of increasing trade intensities on business cycle correlations. Their data period is 1970-1999 in annual data and 1986-1999 in quarterly data. Business cycles are calculated using three different detrending methods, and trade intensities were calculated using total trade in the denominator (i.e. not GDP). OLS and IV regression models are both used - the instruments being the same as in Frankel and Rose (1998). In the annual data, applied only to the four Mercosur full-members because of data availability considerations, Ahumada and Martirena-Mantel (2001) could not find any statistically significant results supporting the hypothesis of a positive association between trade intensity and business cycle correlation. They suggest that "the effects of Mercosur could be too recent to be reflected in this sample period" (page 12) - implicitly recognizing that endogeneity does not happen overnight - or, even after nine years of the Mercosur regional trade agreement. In quarterly data applied to

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goods. The percentage share of capital intensive goods on the Carrillo and Li (2002) definitions is not exactly clear must have been a good deal less than 22%.

their full set of countries Ahumada and Martirena-Mantel (2001) again find that "no significant estimates were obtained" (page 12).<sup>6</sup>

Other work on business cycle correlation in Latin America includes Hochreiter and Siklos (2002) who use a simple loss function – where there are two elements, the standard deviations and correlations of output growth between a center country and a ‘candidate’ country – to examine suitability for monetary union. Using data from the 1980s and 1990s they find in their set of Latin American countries that ‘losses’ increased from one decade to the next – suggesting a decline in suitability for monetary union with the USA.<sup>7</sup>

Karras (2000) using annual data on real output for nineteen North, Central and South American countries over the period 1950-1997 decomposes shocks into common and country-specific using the methodology pioneered by Stockman (1988). He finds that while common shocks are sizeable they are small relative to country-specific shocks. Moreover, the correlation between country-specific shocks and those of the USA is quite low. Indeed, few strongly positive statistically significant correlations show up. A

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<sup>6</sup> In bilateral before/after Mercosur-creation country comparisons Ahumada and Martirena-Mantel (2001) find some evidence of a positive association between trade intensities and business cycles. However, the evidence is inconsistent across methods of discerning business cycles, and the magnitude of changes varies greatly between country pairs. Thus, while for Argentina-USA there is a positive association between trade intensities and business cycle correlations on all three measures of business cycles, this is not the case in the bilateral comparisons of Brazil-USA, Uruguay-USA or Chile-USA. In fact, in each of these three cases trade intensity averages between 1987-1992 and 1993-1999 do not change, while business cycle correlation on all measures falls for both Brazil and Chile, rising on all measures only for Uruguay. Moreover, even in the 1993-1999 period, business cycle correlation remains low or negative in most bilateral comparison - a representative figure is the median correlation of 0.16, 0.20 and 0.27 depending on the detrending technique.

<sup>7</sup> Hochreiter and Siklos (2002, page 196) pointing to the endogenous optimal currency area literature suggest that there may be some optimal sequencing of policy coordination on trade, finance and monetary policy that could ready countries for monetary union, but that this might take years.

majority (10 of 18 countries) had negative correlations. All four Mercosur members had negative correlations with the USA. Interestingly, the correlation for the officially dollarized country, Panama, was also negative.<sup>8</sup> These low and negative country-specific shock correlations make a weak case for monetary union in Latin America with the USA.

Similarly, so do the finding of Bayoumi and Eichengreen (1994) who pioneered the use of the Blanchard Quah (1989) econometric methodology on Latin American data. In a data set of eleven Latin American countries and the USA they find only four statistically significant positive correlations of permanent (supply) shocks (out of a possible 66 cross correlations), none of them involving the USA. Nor were there any between the four Mercosur members. The picture for temporary (demand) shocks is similar - with only six significant positive correlations, only one involving the USA and, again, none between the Mercosur countries.<sup>9</sup>

As we too use the Blanchard-Quah methodology to a Latin American data set some justification for doing so is needed. First, the Bayoumi and Eichengreen's data period ended in 1990 - which was before Mercosur was created. This is important because the existence of the Mercosur trading block is concurrent with increasing trading propensities

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<sup>8</sup> It is also interesting that during the financially disturbed years 1997-98 the spread on Panamanian dollar denominated Brady bonds was larger than that on Chilean sovereign debt of similar maturity (Edwards, 2002). Thus, dollarization does not necessarily lead to lower interest rates than other exchange rate regimes. Moreover, Edwards and Magendzo (2002) find that while dollarization reduces inflation rates relative to non-dollarized countries in their large data set it is also associated with lower rates of per capita income growth.

<sup>9</sup> Even if real economic variables are not highly correlated Berg, Borensztein and Mauro (2002) suggest that the case for monetary union may be rescued if financial variables between countries are highly correlated – perhaps making a common monetary policy sensible. However, they find little or no evidence of positive co-movement between Latin American financial variables such as interest rate spreads over US treasury bonds, and forward exchange rates.

between the four members. Moreover, according to Frankel and Rose (1998) an increase in trading propensity is supposed to make countries more suitable for currency union between themselves. Thus, our analysis of temporary and permanent shocks in the Mercosur area should throw some light on whether they are becoming anything close to forming an optimum currency area, or, whether there is still a case for each of them retaining their own exchange rate and monetary instruments.

Secondly, the period 1991-2002 is the period of Argentina's currency board based on the US dollar. While we recognize that a currency board is not the same thing as currency union, it does amount to a higher degree of monetary integration than under most other alternatives including floating exchange rates and pegged rates even within a narrow fluctuation band. We also know, of course, that there is some skepticism about how much Argentine monetary policy was disciplined under its currency board. However, it is worth noting that the peso-dollar foreign exchange market was an open one with Argentines being allowed to hold dollar deposits - which they did on a large scale. Also, in lasting about 12 years it lasted about the same length of time as did European ties to the US dollar under the Bretton Woods System following the reduction in exchange controls at the end of the 1950s.<sup>10</sup> And nor was the currency board afflicted by the frequent currency realignments that featured so strongly in the European Monetary System during the 1980s and 1990s.

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<sup>10</sup> Argentine currency board, 1991-2002 also lasted longer than did the adherence to the monetary discipline of the gold standard than did many countries during the inter-war period.

Thirdly, we apply various diagnostic tests not used by Bayoumi and Eichengreen (1994) to our econometric estimates. This allows us to reveal the “best” - or, most statistically acceptable - estimates of temporary and permanent shocks. These are then used to calculate the various correlation coefficients of interest.

#### 4: *Econometric Analysis*

To reveal macroeconomic shocks, some econometric modeling is required. Using a methodology developed by (Blanchard and Quah 1989) and extended by Bayoumi (1991), Bayoumi and Eichengreen (1992; 1993; 1994a; 1994b), and Bayoumi and Taylor (1995) we identify aggregate shocks from a bivariate VAR system, defined across the price level (we use CPIs<sup>11</sup>) and output (real GDP). In vector notation, the evolution of log first differences of real output ( $Y$ ) and prices ( $P$ ) is represented by an infinite moving average system of structural innovations, which, as we discuss, can be interpreted as temporary and permanent shocks:

$$X_t = \begin{bmatrix} \Delta Y_t \\ \Delta P_t \end{bmatrix} = \sum_{m=0}^{\infty} L^m \begin{bmatrix} a_m^{11} & a_m^{12} \\ a_m^{21} & a_m^{22} \end{bmatrix} \begin{bmatrix} \varepsilon_t^Y \\ \varepsilon_t^P \end{bmatrix} \quad (1)$$

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<sup>11</sup> Blanchard and Quah (1989) use first log-differences of real GDP and the level of the unemployment rate, Bayoumi and Eichengreen (1992) specify their model in terms of first log-differences of real GDP and the GDP deflator. Bayoumi and Taylor (1995) use real GDP and the CPI. We also use the CPI since data for the GDP deflator is not available for the entire period some of the South American countries we analyze. Indeed, consumer prices, producer prices and the GDP deflator are highly correlated (>0.89) for the periods where available as the countries under examination are rather closed economies.



$L$  is the lag operator and the  $\varepsilon$  terms are unobservable structural shocks identified by superscripts as either temporary or permanent.<sup>12</sup> The aforementioned papers show in detail how the structural disturbances are recovered from the reduced form estimation. Essentially, two restrictions are necessary. First, the shocks are assumed to be orthogonal. Second, temporary shocks are so defined since they do not have permanent impacts on output. This implies the restriction that  $\sum_{m=0}^{\infty} a_m^{11} = 0$ .

The VAR methodology in general and the identification restrictions in particular come with caveats which are well documented in the literature. First, VARs with their limited number of variables are criticized for being overly simplistic. Although we agree with this point in general, we believe that the framework we use is well contained and warrants a bivariate analysis – and hence gives meaningful shock identifications. Lippi and Reichlin (1993) draw attention to the potential existence of non-standard moving-average representations.<sup>13</sup> Lütkepohl (1993) makes the more telling point that impulse response analyses based on VARs have to be used with caution because of the likely omitted variable effects. This is one technical reason why we concentrate in this paper on looking at the nature of the shocks impinging on the economies rather than the adjustment process to those shocks. An important condition for the use of the Blanchard

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<sup>12</sup> Blanchard and Quah, Bayoumi and Eichengreen in their various papers, and Bayoumi and Taylor interpret temporary and permanent shocks as demand and supply disturbances. There are potential caveats to this dichotomy – which Blanchard and Quah discuss in detail – as supply shocks could be temporary (e.g. a temporary shift in productivity) while demand shocks could have permanent effects (e.g. where there are hysteresis effects). We want to steer clear of potential interpretational and semantic ambiguities and so couch our analysis in terms of temporary and permanent shocks without making the additional step to demand and supply shocks. Nevertheless we note that the AD-AS interpretations does tend to find support in post-World War II data (Keating and Nye, 1998).

<sup>13</sup> See also the reply by Blanchard and Quah (1993).

and Quah analysis is stationary first difference data of GDP and prices.<sup>14</sup> This condition has been overlooked in some of the earlier literature, and we try to carefully test for stationarity in our VAR data.

### 5: Data

Before attention turns to an in depth VAR analysis of the temporary and permanent (demand and supply) shocks to the major Latin American countries, a discussion of the data is in order. We use first differences of seasonally adjusted quarterly log GDP and the log CPI in our regressions. Table 2 indicates the sources of our data. Where published GDP data is not seasonally adjusted we use the X12 method to de-seasonalize the data.

	<b>GDP</b>	<b>Method of seasonal adjustment of GDP<sup>15</sup></b>	<b>CPI</b>
<b>US</b>	IMF-IFS, 80Q1-02Q4	--	IMF-IFS, 80Q1-02Q4
<b>Argentina</b>	IMF-IFS, 80Q1-02Q4	X12	IMF-IFS 80Q1-02Q4
<b>Brazil</b>	IMF-IFS, 90Q1-02Q4	--	IMF-IFS, 80Q1-02Q4
<b>Chile</b>	IMF-IFS, 80Q1-02Q4	X12	IMF-IFS, 80Q1-02Q4
<b>Uruguay</b>	Datastream, 88Q1-02Q4	X12	IMF-IFS, 80Q1-02Q4
<b>Venezuela</b>	Datastream, 93Q1-02Q4	X12	DataStream, 80Q1-02Q4

Table 2: Data sources

Estimations using the Blanchard-Quah framework require stationary first differences of the data, an assumption that most Latin American countries violate for periods (of economic crisis usually) during the 1980s and 1990s for inflation data. We explicitly test for stationarity and improve on earlier work which has been rather cavalier in this respect

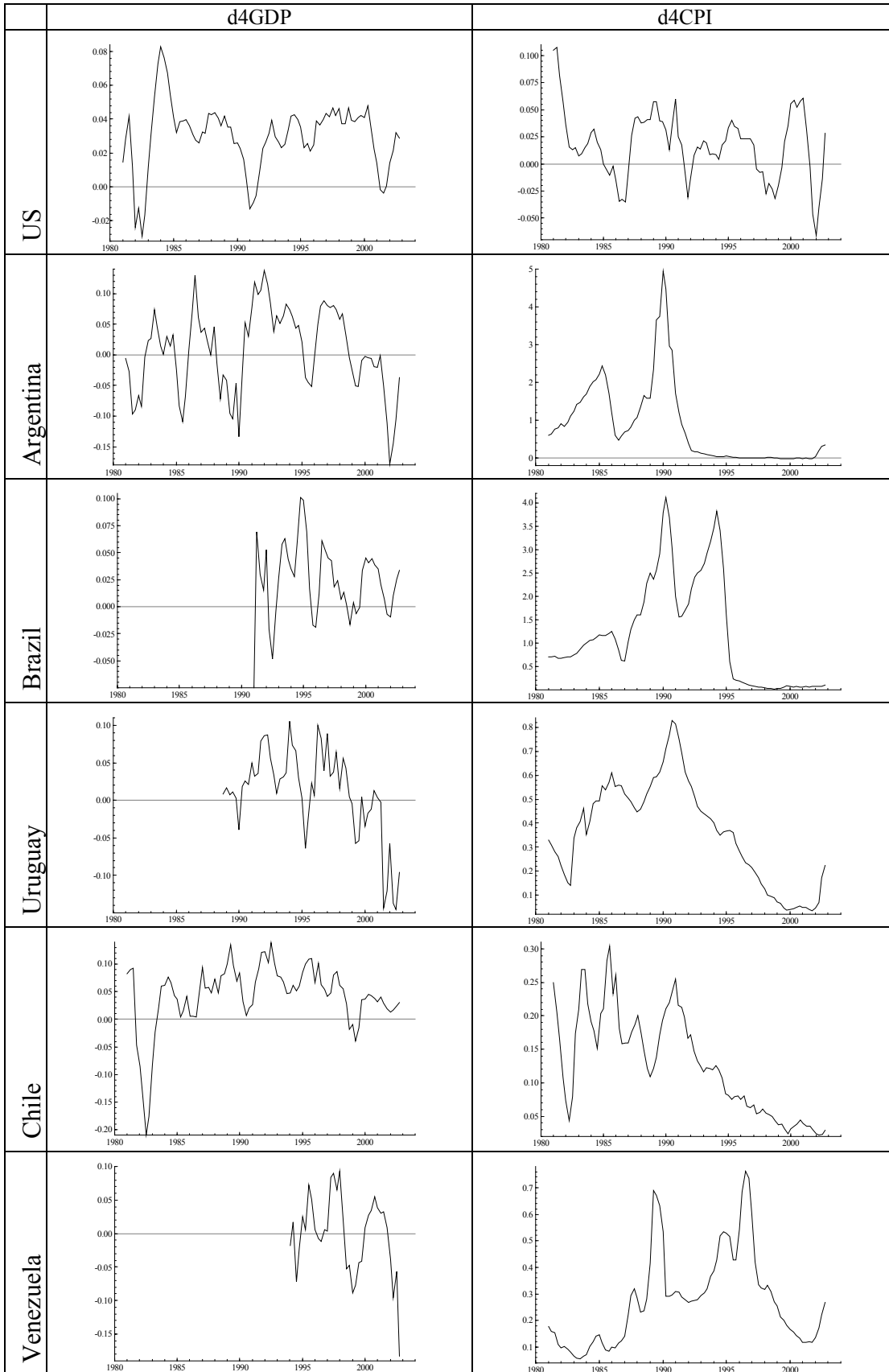
<sup>14</sup> Another condition is that the level of GDP and prices do not cointegrate.

<sup>15</sup> The countries indicated with ‘—’ publish seasonally adjusted GDP data.

and which often included periods of clearly non-stationary first difference data. Figure 1 shows the annual inflation rates of our six economies.

Thus, excluding periods of high inflation (8% per quarter or more) and economic crisis, we select stable periods for our VAR estimations and test for stationarity of quarterly first differences of the CPI with Dickey-Fuller test with up to 5 lags. Table 3 gives the results of the DF tests and the periods chosen for analysis.

Figure 1: annual GDP growth and inflation rates



Country	Series	Period	# of observations	DF-stats	ADF-stats (1 lag)
US	d1GDP	90Q1-02Q4	52	-5.590**	-3.765**
	d1CPI			-5.961**	-5.628**
Argentina	d1GDP	91Q3-01Q4	36	-10.70**	-5.451**
	d1CPI			-13.77**	-10.71**
Brazil	d1GDP	95Q1-02Q4	32	-5.381**	-5.858**
	d1CPI			-2.709	-3.236* (lag 2)
Uruguay	d1GDP	91Q1-01Q4	44	-10.43**	-7.027**
	d1CPI			-3.552*	-3.783**
Chile	d1GDP	91Q1-01Q4	44	-6.700**	-11.06**
	d1CPI			-5.756**	-4.571**
Venezuela	d1GDP	95Q1-02Q4	32	-8.106**	-5.023**
	d1CPI			-1.874	-3.667*

*Tests include a constant. The critical values are -2.90/-2.93/-2.96 at the 5% significance level (\*) for 92/42/32 observations and -3.51/-3.59/-3.65 at the 1% level (\*\*). The null-hypothesis is a unit root in the data.*

Table 3: Unit-root test on first differenced data

Apart from the US, no country has more than 10 to 11 years of useable data for our econometric analysis. Indeed, Venezuela does not offer any lengthy period for analysis and we settle for the period 1995Q1-2001Q4 and try to capture the downward trend in inflation with a trend in the VAR. Similarly, inflation in Uruguay and Chile displays a clear downward trend and we include a trend for both countries in the VAR later.<sup>16</sup> For Argentina we limit our analysis to the period of the currency board (1991Q3-2001Q4). Brazil reached an acceptable level of inflation stability only after 1995Q1.

## 6: Country Analysis

We model the bivariate VAR with 4 lags and include a trend in the regressions for Chile, Uruguay and Venezuela in order to capture the rather successful attempts of both

<sup>16</sup> Although the Venezuela data is somewhat unstable we retain this country in our data set because it has received relatively little attention in econometric analyses of Latin America.

countries authorities to consistently decrease inflation over the estimation period.<sup>17</sup> In Hallwood, Marsh and Scheibe (2004) we have tested for the robustness of the shock estimates over different estimation periods within (but not between) a given country, regardless of the estimation period as long as the first differenced data is stationary and avoids periods of economic upheaval. Unfortunately, the often short windows of stationary difference data for the economies under analysis here do not allow for much sensitivity analysis across different estimation periods and the careful selection of the estimation period is therefore essential.

Table 4 shows the regression results. All in all the fit of the regressions is good for first differenced data. Chile, Uruguay and Venezuela show negative trends in the inflation variable which are all significant at least at the 80% level. Our interest in the regressions lies with the structural shocks identified by the long-run restrictions on the data. Figures 2a and 2b plot the shocks, and Tables 5 and 6 summarize them statistically.

Figures 2a and 2b showing, respectively, the revealed permanent and temporary disturbances, demonstrate clearly that there is no common pattern of shocks emerging for any of the countries during anytime in the 1990s and early-2000s. The correlations in Table 5 confirm this view. None of the South American countries has shock correlations with contemporaneous or lagged US shocks that exceed 30% at best. Most correlations are close to zero or negative. Not even the more US oriented countries, Chile and Argentina show vaguely positive correlations with their North American trading partner.

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<sup>17</sup> Inclusion of a trend in the Dickey-Fuller tests gives equally high confidence in rejecting the null-hypothesis of a unit-root.

Table 4: VAR estimations

Independent Variables	US, 90Q1-02Q4 <sup>18</sup>		Argentina, 91Q3-01Q4	
	$\Delta Y_t$	$\Delta P_t$	$\Delta Y_t$	$\Delta P_t$
Constant	0.0067**	-0.002	-0.006	-0.0029
Trend	--	--	--	--
$\Delta Y_{t-1}$	0.159	0.688**	0.579**	0.147**
$\Delta Y_{t-2}$	0.242	0.408	-0.054	-0.014
$\Delta Y_{t-3}$	0.105	0.283	0.384*	-0.003
$\Delta Y_{t-4}$	-0.018	-0.766**	-0.269	0.047
$\Delta P_{t-1}$	-0.136*	0.465**	-0.455	0.082
$\Delta P_{t-2}$	0.026	-0.062	-1.337**	0.353**
$\Delta P_{t-3}$	-0.128	0.260*	0.714	0.030
$\Delta P_{t-4}$	0.037	-0.128	0.893**	0.115
R-squared	0.78	0.54	0.54	0.83
sigma	0.0048	0.0086	0.017	0.0058
DW	2.05	1.70	1.91	2.12

\* and \*\* denote significance at the 90% and 95% level respectively

Independent Variables	Brazil, 95Q1-02Q4		Uruguay, 91Q1-01Q4	
	$\Delta Y_t$	$\Delta P_t$	$\Delta Y_t$	$\Delta P_t$
Constant	-0.0045	0.003	0.142	0.238
Trend	--	--	-0.0037*	-0.0006
$\Delta Y_{t-1}$	-0.117	-0.409**	-0.318*	-0.036
$\Delta Y_{t-2}$	-0.087	0.145	-0.194	0.042
$\Delta Y_{t-3}$	0.298	0.204	-0.075	0.005
$\Delta Y_{t-4}$	-0.397**	-0.315*	-0.363*	0.0003
$\Delta P_{t-1}$	0.593*	0.902**	-0.764	0.762*
$\Delta P_{t-2}$	0.487	0.026	-0.16	-0.128
$\Delta P_{t-3}$	-0.624*	0.079	-0.016	0.203
$\Delta P_{t-4}$	0.209	-0.148	0.217	-0.076
R-squared	0.63	0.89	0.30	0.098
sigma	0.0094	0.009	0.029	0.0085
DW	2.05	1.46	2.06	1.96

\* and \*\* denote significance at the 90% and 95% level respectively

Independent Variables	Chile, 91Q1-01Q4		Venezuela, 95Q1-02Q4	
	$\Delta Y_t$	$\Delta P_t$	$\Delta Y_t$	$\Delta P_t$
Constant	0.052	0.0275**	0.0008	0.050
Trend	-0.001	-0.0005*	-0.001	-0.0013
$\Delta Y_{t-1}$	0.081	0.018	-0.339	-0.012
$\Delta Y_{t-2}$	0.053	-0.001	0.325	-0.200
$\Delta Y_{t-3}$	0.044	0.093	0.267	0.057
$\Delta Y_{t-4}$	-0.104	0.016	-0.064	0.257
$\Delta P_{t-1}$	-0.216	0.039	-0.597*	1.317
$\Delta P_{t-2}$	-0.316	-0.199	0.955*	-0.867
$\Delta P_{t-3}$	0.253	0.083	-0.909	0.186
$\Delta P_{t-4}$	-0.411	0.209*	0.542*	0.021
R-squared	0.62	0.94	0.55	0.958
sigma	0.014	0.006	0.0319	0.251
DW	1.94	1.98	1.83	2.18

\* and \*\* denote significance at the 90% and 95% level respectively

<sup>18</sup> The intervals refer to the period of data used, the estimation period starts 4 periods later due to the 4 lags in the VAR.

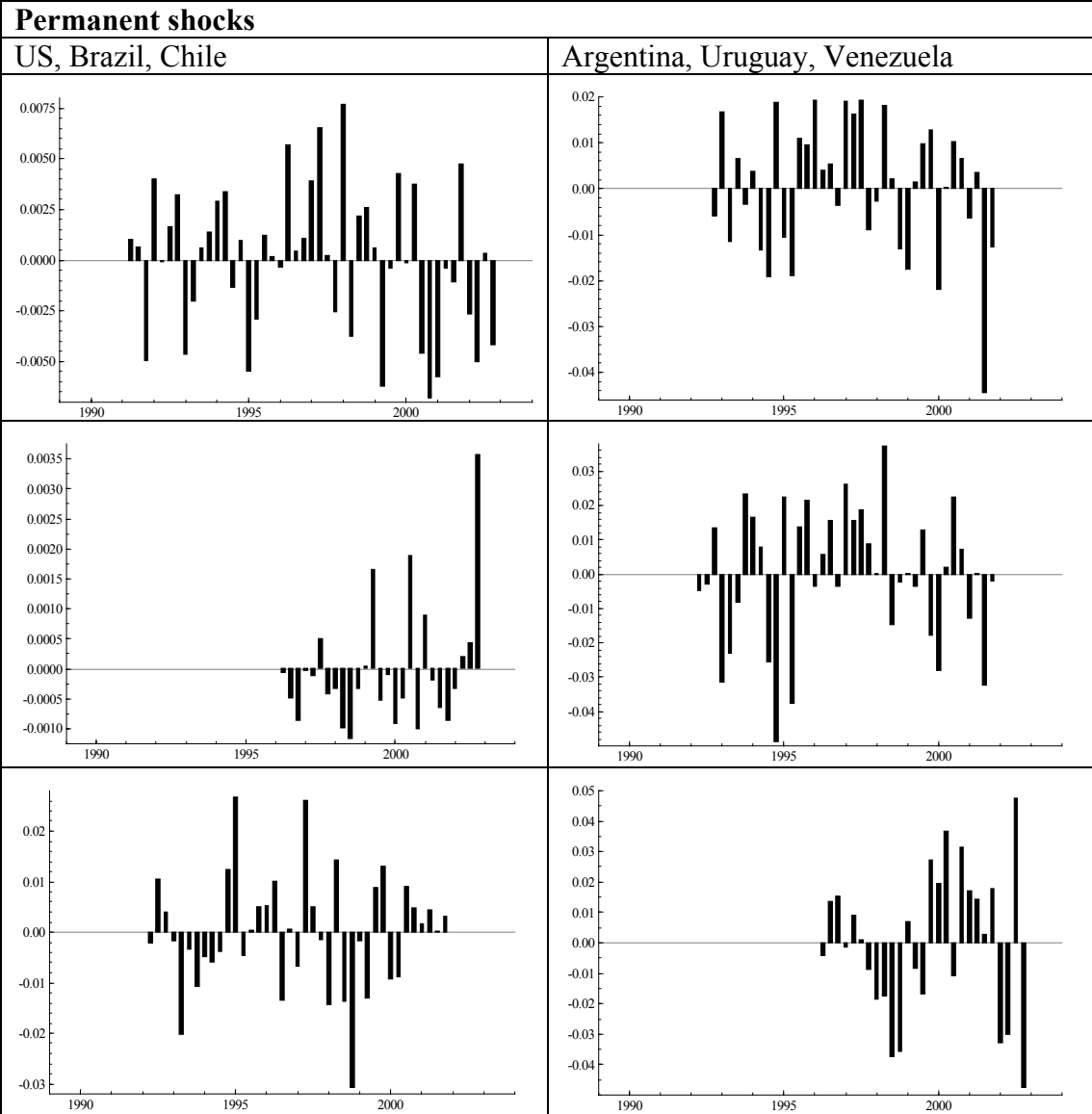


Figure 2a: Permanent shocks



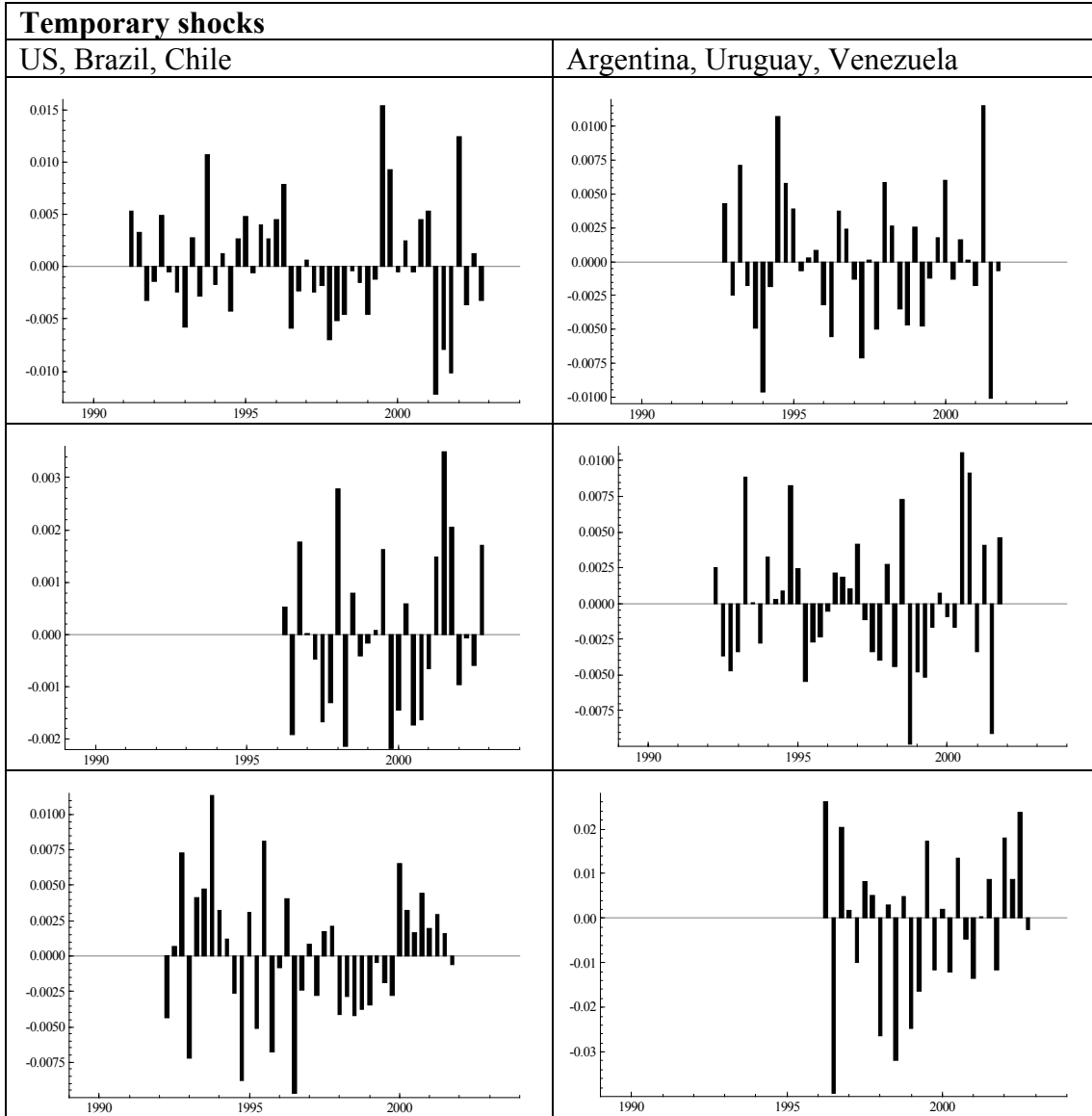


Figure 2b: temporary shocks

Permanent shocks	US (t)					Argentina	Brazil	Chile	Uruguay
	1990-2002	US (t-1)	US (t-2)	US (t-3)	US (t-4)	1991-2001	1995-2002	1991-2001	1991-2001
US (t)	1.00								
Argentina	0.07	0.13	0.07	0.27	0.20	1.00			
Brazil	- 0.38	0.02	- 0.27	0.19	0.08	0.22	1.00		
Chile	- 0.08	0.08	- 0.10	- 0.11	0.26	0.35	0.07	1.00	
Uruguay	0.10	0.33	- 0.08	0.16	0.06	0.38	0.17	0.22	1.00
Venezuela	0.16	- 0.18	- 0.07	- 0.14	- 0.06	- 0.05	- 0.28	0.32	- 0.20

Temporary shocks	US (t)					Argentina	Brazil	Chile	Uruguay
	1990-2002	US (t-1)	US (t-2)	US (t-3)	US (t-4)	1991-2001	1995-2002	1991-2001	1991-2001
US (t)	1.00								
Argentina	- 0.16	0.11	0.14	0.09	0.16	1.00			
Brazil	- 0.25	- 0.46	- 0.05	0.27	- 0.10	- 0.14	1.00		
Chile	0.21	0.05	0.27	0.03	- 0.22	- 0.11	- 0.01	1.00	
Uruguay	0.11	0.06	- 0.13	0.18	0.65	0.36	- 0.07	- 0.01	1.00
Venezuela	0.31	- 0.11	0.12	- 0.04	- 0.04	- 0.18	0.02	0.54	- 0.10

Table 5: Correlation of permanent and temporary shocks<sup>19</sup>

In terms of permanent shocks, Brazilian, Chilean and Uruguayan disturbances seem somewhat correlated with Argentina, and some of the countries have cross-correlations among each other of the magnitude of 0.3, too. For temporary disturbances a similar but weaker pattern emerges. Table 6 shows that the magnitude of the identified shocks in Latin America during the calm and stable selected periods is similar to those of the US disturbances. However, restricting the analysis to ‘crisis-free’ periods biases the standard deviations significantly downwards and Table 6 must be read with this bias kept in mind. The focus of the cross-country analysis must thus lie with the correlation of disturbances that our selected data periods allow us to estimate accurately.

The correlation of shock-disturbances draws a clear picture: a dollarization of the region does not follow, independent monetary policy is necessary in the face of the asymmetries

in shocks. Compared against the backdrop of dollarization, a regional Latin American monetary union seems a (relatively) better solution. Especially Argentina and Uruguay are rather closely integrated, both trade and disturbance wise. Chile bears some resemblance to the shock patterns to its eastern neighbors, as does to a lesser extent Brazil. Venezuela with its high dependence on oil exports follows a different economic cycle and has suffered more from internal political instability than the other countries in our sample. None of the countries in our sample form an obvious monetary union. However, compared against the members of the European Monetary Union, whose shock correlations before German unification in 1989 were of the range 0.2-0.5 at best (see Bayoumi and Eichengreen 1992), the Mercosur countries plus Chile are not doing that badly.

	US	Argentina	Brazil	Chile	Uruguay	Venezuela
<b>Temporary shocks in %</b>						
St. Dev	0.56	0.49	0.16	0.33	0.48	1.70
Min	-1.22	-0.88	-0.22	0.88	-1.00	-3.93
Max	1.54	-1.10	0.35	0.74	1.06	-2.62
<b>Permanent shocks in %</b>						
St. Dev	0.35	1.54	0.1	1.15	2.74	2.42
Min	-0.68	-4.63	-0.12	-3.08	-9.26	-4.77
Max	0.77	2.42	0.36	2.67	4.46	4.77

Table 6: Summary statistics of temporary and permanent shocks<sup>20</sup>

## 7: Conclusions

In our econometric results we find that shock asymmetry between Latin American countries is perhaps not as bad as it could be – they are often moderately positive.

<sup>19</sup> The relevant time periods are those of Table 3 minus the first four quarters (which are used as lags in the VAR). check the years in the table.

<sup>20</sup> The relevant time periods are those of Table 3 minus the first four quarters (which are used as lags in the VAR).

However, monetary union in Latin America should, we think, stay as a long-term project if the relevant polities so desired. In the meantime we think that these countries would be advised to maintain monetary independence, while at the same time attempting to ‘harmonize’ their macroeconomies. Such a period of harmonization might not be all that different from that leading up to the adoption of a single currency in the European Union that, beginning with the creation of the European Monetary System in 1979 of managed exchanges rates, took about 20 years before the single currency – the euro - was adopted. How Latin American countries choose to discipline their monetary policy is clearly an important issue that is beyond the scope of this paper. However, we do not think handing their monetary policies over to a third party – the USA or some future Latin American central bank would be sensible at under current conditions.

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