Monetary union, price level convergence, and inflation: How close is Europe to the United States?

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Abstract: I document the pattern of price dispersion across European and U.S. cities from 1990 to 2001. I find a striking decline in dispersion for traded goods prices in Europe, most of which took place between 1991 and 1994. The level of traded goods price dispersion in the euro area is now quite close to that of the United States. I examine several possible explanations for the decline in Europe: harmonization of tax rates, convergence of incomes and labor costs, liberalization of trade and factor markets, and increased coherence of monetary policy. Surprisingly, there is only weak correlation between changes in the dispersion of traded goods prices and nominal exchange rates. I also investigate the determinants of national inflation rates in Europe. Although some is explained by price level convergence, conventional factors are more important. There is no evidence of a Balassa-Samuelson effect on inflation. Finally, after showing that prices in likely next-round entrants into the euro zone are well below prices in Western Europe, I discuss the potential inflationary consequences of accession into monetary union for Eastern Europe.

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I. Introduction

The elimination of euro zone national currencies in early 2002 culminated a remarkable 50 years of policies designed to integrate European economies. Highlighting this process were the creation of customs unions in the 1950's, exchange rate targeting of the “snake” and EMS, the liberalization of trade, capital, and labor markets, along with a significant harmonization of tax policy in the 1992 “Single Market” initiative, and launch of the euro in January 1999 (Table 1).

Extant work in international economics suggests that such far-reaching policy initiatives should have a strong effect on the European economic landscape. Greater exchange rate stability may increase trade and capital flows (Obstfeld and Rogoff (1998, 2000), Bacchetta and van Wincoop (2000)). Policies aimed at weakening the forces giving rise to “border effects” should have a large influence on trade flows and deviations from purchasing power parity (Mussa (1986), McCallum (1995), Engel and Rogers (1996, 2001)). Adoption of a common currency, one such policy, is estimated to have large positive effects on trade flows, income, business cycle synchronization, and real exchange rate stability. [1]

There is good reason to expect some price convergence in Europe. Traded goods prices ought to be less dispersed in light of progress toward a single market and adoption of a common currency. Non-traded goods prices also may have become less dispersed. The Balassa (1964)-Samuelson (1964) hypothesis provides an explanation why. Suppose that the initially low-price countries are also relatively poor countries. If there is convergence of productivity levels, the initially poor / low-price countries will experience faster productivity growth compared to the wealthier, high-price countries. Assume this convergence takes place in the traded goods sector, while productivity in non-tradeables is either unchanged or converging at a much slower rate. A rise in productivity in the traded goods sector raises output and wages in that sector, which in turn pushes up wages and prices in the non-traded goods sector.[2] Because convergence of productivity and living standards implies that the productivity gains are

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[1] Although just how large has been debated. See Rose (2000), Persson (2001), Tenreyro (2002), Frankel and Rose (2002), and Rose and Engel (2002). Theory suggests that these effects are reinforcing, as countries that are initially highly integrated (for whatever reason) have relatively more to gain from forming a currency union (Mundell (1961), Alesina and Barro (2002)).

[2] This is due to the assumption that labor is mobile between sectors. The absence of a price increase in the traded goods sector follows from the assumption that the law of one price holds for the traded good. For a textbook

greater in the low-price countries, non-traded goods prices will be rising faster there than in countries where prices are already high.

Thus, upon forging closer economic ties, countries with initially low prices might experience relatively rapid price increases, through tradeables, non-tradeables, or both. If convergence works mostly through tradeables, then its implications may be transitory, part of a potentially-brisk transition toward a common price level in the region. However, to the extent that price convergence occurs through the relatively gradual process of productivity convergence, the implications may be long-lived.

Surveying the academic literature in the mid-1990s, Rogoff (1996) concluded, "international goods markets, though becoming more integrated all the time, remain quite segmented, with large trading frictions across a broad range of goods. ... International goods markets are highly integrated, but not yet nearly as integrated as domestic goods markets." In this paper I assess how far European economic integration has come. Using a relatively new data set of prices of comparable items in Europe and the U.S., I document the pattern of price dispersion across European cities from 1990 to 2001, and compare levels of European dispersion to those of U.S. cities.[3]

Several results stand out. First, there has been a striking decline in the dispersion of traded goods prices over the period 1990-2001 in Europe. Even rather conservative calculations suggest the decline is more than one-half.

Second, much of this decline took place between 1991 and 1994; evidence of further price convergence since 1998 is relatively scant. In light of the empirical literature on real and nominal exchange rates (e.g., Mussa (1986) and Engel (1999)), it is surprising that elimination of nominal exchange rate changes within the euro zone has not been associated with a decline in traded goods price dispersion (and that price dispersion *fell* dramatically around the ERM crisis). I explore interpretations of this finding and discuss its implications for the debate over fixed versus floating exchange rates.

Third, in the original 11 members of Europe's Economic and Monetary Union (EMU-11), traded

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treatment of the classic model, see Obstfeld and Rogoff, (1996, ch. 4).

[3]Treating (reduced) price dispersion as a proxy for (increased) economic integration follows a large strand of the academic literature, though it is obviously not the only proxy.

goods price dispersion is quite close to that of the U.S. as of 2001. Indeed for some measures, traded goods price dispersion in the EMU-11 is *below* that of the United States.

In addition, I find that prices are consistently less dispersed in the EMU-11 than in the full sample of 17 European countries, although the broader sample of European countries has experienced a comparable decline in price dispersion. As for non-tradeables, I find a slight decline in dispersion in Europe, much less than for tradeables. In the United States, there has been an increase in dispersion for non-tradeables, due to housing prices, and no evidence of convergence for traded goods (whose dispersion has been low all along).

I demonstrate that all of the price dispersion results are remarkably robust. I then present evidence related to several possible explanations for the pattern of European price dispersion. I find that reduced traded goods price dispersion is closely associated with a cross-country harmonization of tax rates and decline in income dispersion, and to a lesser extent, with a rise in trade openness and increased coherence in monetary policy. I devote considerable attention to the fiscal and exchange rate explanations. As noted above, I find an apparent anomaly in that the largest declines in traded goods price dispersion coincide with *increased* exchange rate volatility around the ERM crisis, while adoption of the euro has not been associated with further convergence of traded goods prices. However, I also present evidence suggesting that nominal exchange rates moved in the early 1990's in a way that helped equilibrate traded goods prices across countries, implying an important role for exchange rates even if the dispersion measures are only weakly correlated.

Having documented the pattern of price convergence in Europe and explored possible sources, I then investigate an implication of convergence: with prices initially different across countries, convergence to a common level of prices implies higher inflation in countries where prices are initially low.[4] Thus, by analogy to the literature on convergence and income growth, price level convergence or

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[4]This was highlighted in European Central Bank (ECB) President Wim Duisenberg's September 6, 2000 speech "Are Different Price Developments in the Euro Area a Cause for Concern?" (http://www.ecb.int/). Cross-country inflation differentials may be a source of concern, as differences in national inflation rates imply differences in real interest rates. This could be destabilizing, as countries with low (ex-post) real interest rates are presumably those for which less stimulus is warranted.

"inflation catch-up", may be a factor explaining cross-country differences in inflation. In panel regressions, I generally find a negative relationship between the current price level and future CPI inflation rate -- even when controlling for conventional determinants of inflation -- an effect that is stronger after 1997. However, most of the variation in inflation is explained by conventional factors, rather than price convergence. I find no evidence of a Balassa-Samuelson effect on European inflation.

Throughout the paper I provide evidence on a question that has provoked much debate in the currency union and trade literature: *is there anything special about monetary union per se?* (Rose, 2000, Persson, 2001, Tenreyro, 2002). I find for the most part that results from the EMU-11 countries are very similar to those from the full sample of 17 European countries. In addition, I find that traded goods price dispersion is only weakly correlated across time with nominal exchange rate variability. This suggests there is nothing uniquely special about monetary union *per se*, at least not for the convergence of prices. Instead, price convergence seems to be influenced more by "real side" factors that accompany or even precede the formal adoption of a common currency.

With this in mind, I conclude by discussing implications of the above results for eastward expansion of the euro area. I use the EIU data to show that prices in several cities in Eastern Europe are still well below the (west) European average, despite a considerable amount of price convergence toward the rest of Europe during the 1990s. Further integration with the EU could boost inflation in Eastern Europe by at least a couple of percentage points, but, my results suggest, this may well be independent of the new entrants' formal adoption of the euro.

II. The Data

There is little empirical evidence on the extent of price convergence in Europe, nor much work on the importance of price level convergence as an explanation for cross-country differences in inflation or an assessment of Eastern Europe. Cecchetti, Mark, and Sonora (2001) estimate half-lives of deviations from PPP across U.S. cities using the aggregate consumer price index, and discuss implications of their U.S. estimates for price convergence in Europe. Parsley and Wei (1996) also examine the dynamic convergence of prices across U.S. cities by estimating half-lives of deviations from the law of one price. Canzoneri, Cumby, Diba, and Eudey (2000) examine the factors that give rise to long-run inflation differentials in Europe, as does Romer (1993) for a very broad sample of countries, but neither examines price level convergence.

Much of the reason for the relative lack of work in these areas is that there are precious few data sets of *actual prices*, as opposed to price indexes, of comparable items across a sufficiently-broad range of countries and years.[5] In this paper I use a data set that is arguably the most comprehensive of its kind in terms of time, country and item coverage. The data are collected by the Economist Intelligence Unit (EIU), whose survey teams record local prices of dozens of tightly specified items such as "white bread (1 kilogram)", "men's haircut", and "cardigan sweater" in over one hundred cities worldwide.[6] I use data from 25 European cities -- from all 12 current euro area members and five other nations --and 13 U.S. cities.[7] The data are annual from 1990 to 2001.

Although the EIU database has superb coverage, it does not contain a price quote for every city and every item in every year. It would be misleading to use a sample whose composition changes substantially over time or were radically different between the U.S. and Europe. Because of this, I use two different criteria for deciding whether or not to include an item in the sample, and, as described below, take great pains to show that the data are reliable and the results are robust. The first criterion is a "100% cut-off rule", in which an item is included only if a price is recorded in every year for all 38

[5]Canzoneri, Cumby, Diba, and Eudey (2000), Cecchetti, Mark, and Sonora (2001), and the papers on PPP above all use price indexes, and so cannot make direct comparisons of prices at any point in time. Crucini, Telmer, and Zachariadis (2001) do examine actual prices for a large sample of items in European cities, looking at 1975, 1980, 1985, and 1990. These authors focus on explaining the cross-section of deviations from the law of one price, attempting to distinguish between "border" effects and "brand" effects, rather than on price convergence over time.

[6]The EIU calculates cost-of-living indexes primarily for multinational corporations that move employees around the world. Some additional information about the database is provided in Economist Intelligence Unit (1998) and on the CityData page at http://eiu.com/. The intellectual ancestors of the current paper (Rogers (2000), Rogers, Hufbauer, and Wada (2001)) make use of the data set, as do Hufbauer, Wada and Warren (2002) and Parsley and Wei (2002). Compared to the data set used by Crucini, Telmer, and Zachariadis (2001), mine contains fewer items but a larger and more recent sample period and more cities (as well as including the U.S.).

[7]For Europe: Amsterdam, Barcelona, Madrid, Berlin, Dusseldorf, Frankfurt, Hamburg, Munich, Brussels, Dublin, Helsinki, Lisbon, Luxembourg, Lyon, Paris, Milan, Rome, Vienna (comprising the "EMU-11" sample), Athens, Copenhagen, Geneva, Zurich, London, Oslo, and Stockholm. The U.S.: Atlanta, Boston, Chicago, Cleveland, Detroit, Houston, Los Angeles, Miami, New York, Pittsburgh, San Francisco, Seattle, Washington DC.

cities. The other is a "75%" cut-off rule. In this case, an item is included as long as there are price quotes *in every year* for at least 30 cities. I find similar dispersion results for both, and so depict results using the broader sample under the 75% rule.

To search for errors in the data, I screen in two ways. First, I inspect every (common currency) price that is at least three standard deviations away from the cross-cities mean for that item in that year. Second, I inspect every observation more than three standard deviations from the mean over time for that city and item. The screening flags many observations. A few of these are obvious typos and are deleted.

The resulting sample of items is listed in Appendix Table A-1. There are 139 items in total, 37 of which are designated "non-tradeable". Of course, all items have both tradeable and non-tradeable components. Even for homogenous items like "head of lettuce", the final retail price will embody costs of non-tradeable inputs required to bring the good to market.[8] Analogously, some of the inputs used to produce a "men's haircut", the classic non-traded good, are clearly tradeable (scissors, combs). To some extent, this is unimportant because I report many of the price dispersion results on an item-by-item basis. Nevertheless, because it is important to highlight the distinction between traded and non-traded goods (or "more tradeable" and "less tradeable" goods), and because it is cumbersome to report results for 139 items in 12 years, it is worthwhile categorizing items as above. The results are highly robust in any case.

Naturally, survey teams attempt to sample prices from comparable retail outlets. Prices for most items are sampled from two different outlets, a "high-price" and "low-price" outlet, and are reported separately in the survey. For example, food and beverage prices are sampled from convenience stores and supermarkets. I have examined prices from both types of outlets, but the reported results are based on the supermarket type outlets, which are likely to be more comparable across cities.

Constructing the price dispersion measures

Let $P_{i,k,t}$ denote the price of item i in city k, year t, where i=1,139; k=1,38; and t=1990-2001. The basic unit for my calculations of price dispersion is the de-meaned price,

$$p_{i,k,t} = P_{i,k,t} / \mathbf{P}_{i,t}$$

[8]For evidence on the importance of such considerations, see Burstein, Neves, and Rebelo (2001)

where $\mathbf{P}_{i,t}$ is the cross-city mean price of item in i year t. All prices are expressed in U.S. dollars.[9]

I construct indexes from the individual prices using two different weighting schemes. First, the "equal-weighted" price index, $p^e(g)_{k,t}$, is a simple average of the de-meaned prices $p_{i,k,t}$ in the particular item group, g. I calculate indexes for several groups -- all-items, tradeables (T), and non-tradeables (N), as well as sub-groups like "food and non-alcoholic beverages", "apparel and footwear", "tradeables excluding alcoholic beverages" -- but report results for tradeables and non-tradeables.

Second, I use a "CPI weighting" scheme. Under this, I first assign items to a sub-category of each country's CPI (categories are harmonized across Europe, but the weights differ by country). I use this categorization to obtain *country-specific* and *year-specific* weights for each item. Appendix table A-1 lists the sub-category each item is assigned to, as well as the item's weight in a representative year, 2000. These are listed separately for the U.S. and the average of the EMU-11 countries. The "CPI-weighted" price index, $p^c(g)_{k,t}$ is the sum of the weighted, de-meaned prices in the item group g.

I normalize all resulting indexes to make the cross-city mean equal to 1.0 in each year for each index. For countries with more than one city in the sample, the national price index is constructed using a population weighted-average of the individual city indexes.

The basic unit of my price convergence analysis is the standard deviation across cities

$$\sigma(i)_t = \{ [n\, \Sigma_k(p_{i,k,t})^2 - (\Sigma_k(p_{i,k,t}))^2] / [n(n-1)] \}^{1/2}$$

for item i, or analogously for the price indexes

$$\sigma(g)_t = \{ [n\, \Sigma_k(p(g)_{k,t})^2 - (\Sigma_k(p(g)_{k,t}))^2] / [n(n-1)] \}^{1/2}$$

where the summations are over cities k, and n is the number of cities in the sample. I compute the standard deviations separately for each year t=1990-2001, and separately for (i) all 25 European cities, (ii) the 18 cities in the original 11 EMU countries, and (iii) the 13 U.S. cities.[10]

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[9]The EIU reports prices in local-currency, U.S. dollars and euros, with conversions at the market exchange rate prevailing at the time of the survey. For some things later in this paper I will use local currency prices. Note that by de-meaning I make the price dispersion results invariant to the choice of currency denomination. Expressing all prices $P_{i,k,t}$ in euros rather than dollars, for example, will have no bearing on the de-meaned price $p_{i,k,t}$.

[10]I also calculate maximum-minimum spreads and inter-quartile ranges, and show that results are robust to these alternative measures of dispersion. One might also imagine reporting speed-of-adjustment coefficients from a regression of the change in price on the lagged price, as in Parsley and Wei (1996),Cecchetti, Mark, and Sonora

I test for a statistically significant difference in dispersion between two time periods or two samples of cities (say A and B), using a standard F-test for the equality of two variances,

$$[\sigma^2(T)_A/(n_A - 1)] / [\sigma^2(T)_B/(n_B - 1)] \sim F(n_A - 1, n_B - 1).$$

III. Evidence on Price Convergence

Aggregated price level indexes

Figure 1 depicts the standard deviation of the traded goods price index across locations, $\sigma(T)_t$, for the three different sets of locations -- all 25 European cities, the 18 cities in the EMU-11 countries, and the 13 U.S. cities. Separate calculations are made in each year 1990 to 2001. Results for equal-weighted price indexes are in the top panel, cpi-weighted indexes in the lower panel.

There are several noteworthy results. First is the striking decline in dispersion in Europe. According to the top panel, $\sigma(T)_t$ declined from 0.170 in 1990 to 0.078 in 2001 for the EMU-11 cities. A large decline is also evident for the full sample of 25 European cities. Second, it is apparent that most of the decline in price dispersion took place by 1993 ($\sigma(T)_{1993} = 0.090$). The F-statistic for equal variances in 1990 versus 2001 is 4.75 and that for 1990 versus 1993 is 3.57. Comparing this to the 1% critical value of 3.25, in each case the null hypothesis of equal dispersion in those years is easily rejected.

There is much less evidence of convergence after 1998, when the EMU-11 countries were in place. The change in $\sigma(T)_t$ from 0.085 in 1998 to 0.078 in 2001 is insignificantly different from zero.

The bottom panel of Figure 1 indicates that these results are robust to the weighting scheme used to construct the price index. The decline in price dispersion in the EMU-11 is even larger with the CPI-weighted index, with $\sigma(T)_t$ falling from 0.183 to 0.062 between 1990 and 2001. The main difference across weighting schemes is that EMU-11 dispersion is closer to All Europe under CPI-weighting and closer to the U.S. under equal weighting. This is unsurprising, as the CPI weights for the EMU-11 are

(2001) and others. The information from this is little different from what I report below. Also, it is unnecessary to rely on such “conditional” convergence measures, when I can calculate unconditional measures using actual prices.

much more similar to the All Europe sample (much of which *is* the EMU-11) than the U.S. sample.[11]

The process of convergence in the EMU-11 has brought the level of traded goods price dispersion down to that of the United States. The equal-weighted price indexes (top panel) indicate that traded goods price dispersion in the EMU-11 in 2001 is actually *lower* than in the United States -- 0.078 vs. 0.089 -- while the results using cpi-weighted indexes show the reverse (0.062 for EMU-11 vs. 0.056 for the U.S.). These are not statistically significantly different. This is markedly different from the situation in 1990, where the (equal-weighted) traded goods price dispersion measures of 0.170 for the EMU-11 and 0.060 for the United States produce an F-statistic for equal variances of 5.69.

Appendix figure A-0 shows that these results are robust to an alternative measure of dispersion, the spread between the highest and lowest price city. A large decline in dispersion is evident during 1991-1993, while there is little change after 1998. Notice that traded goods price dispersion is slightly lower in the U.S. than the EMU-11 for *both* cpi-weighted and equal-weighted price indexes, according to this alternative measure of dispersion.

What does the comparison with the United States imply about future price convergence in Europe? Might the drop in traded goods price dispersion in Europe have run its course? Although it is surely useful to think of the United States, a long-standing monetary union, as a benchmark for euro area price dispersion, there is much greater distance between my U.S. city pairs (1261 miles on average) than European pairs (670 miles for all Europe, 609 for the EMU-11). Since deviations from the law of one price are larger for more distant locations (Engel-Rogers (1996, 2001)), it is plausible to expect further reductions in price dispersion in Europe, even if EMU-11 price dispersion is already at U.S. levels.

Figure 2 presents analogous calculations for non-tradeables. Between 1991 and 1994, when traded goods price dispersion in Europe fell dramatically, non-tradeables price dispersion was either unchanged or rising slightly. There is a modest decline in dispersion in the EMU-11 after 1998, but on balance non-tradeables prices are not much less dispersed at the end of the sample than the beginning.

[11]There is no obvious economic explanation for the relatively large jump in price dispersion between 1999 and 2000 in the All Europe sample under cpi weighting. Clearly, the small increase in dispersion in the non-EMU countries that is observed under the equal weighting scheme is accentuated by use of cpi weights

For the U.S., where housing comprises nearly 30% of the overall index, non-tradeables prices have become more dispersed, especially under CPI weighting.

Item-by-item evidence

I also calculate dispersion for the individual items. The upper left panel of Figure 3 compares the dispersion of each item for the EMU-11 cities in 1990 and 2001.[12] To be specific, the panel displays $\sigma(i)_{1990}$-$\sigma(i)_{2001}$ for each item i across the EMU-11 cities. If prices for an item became less dispersed over the period, the entry lies above zero. The bottom two panels display $\sigma(i)_{1990}$-$\sigma(i)_{1993}$ and $\sigma(i)_{1998}$-$\sigma(i)_{2001}$ for the EMU-11, respectively, while the upper right panel displays $\sigma(i)_{1990}$-$\sigma(i)_{2001}$ for U.S. cities.

Figure 3 indicates that the results above are not an artifact of aggregation. In the EMU-11 there is a large decline in price dispersion over the period 1990-2001 (upper left panel). The number of items experiencing a drop in dispersion is far greater than the number with a rise in dispersion, 115 versus 24. As seen in the bottom two panels, a large amount of the decline in dispersion took place between 1990 and 1993, certainly when compared to the post-1998 period. Averaging the change in dispersion across all items, the contribution to the full-sample decline in dispersion is 59% from the 1990-1993 period and 18% from 1998 to 2001. For the U.S., there is a much smaller change in price dispersion over the period 1990-2001 (upper right panel). Consistent with the results from the price indexes, there are more items for which dispersion has risen than fallen (92 to 47).

In Figure 4 I compare price dispersion in the EMU-11 to the U.S. in 1990 and again in 2001. I report $\sigma(i)_{1990,\ EMU\text{-}11}$-$\sigma(i)_{1990,US}$ and $\sigma(i)_{2001,\ EMU\text{-}11}$-$\sigma(i)_{2001,US}$, so that entries lying above zero are those for which dispersion is greater in the EMU-11 than the United States. In 1990, price dispersion is greater in the EMU-11 than the U.S. for 114 of the 139 items (and for 89 of the 102 tradeable items). Price dispersion is clearly closer to being equal in 2001. In this year, price dispersion is greater in the EMU-11 for 79 items and greater in the U.S. for 60 items.

How reliable are the EIU data?

Although use of a relatively new data set opens up possibilities for shedding light on outstanding

[12]Although it is difficult to inspect results for particular items given the labeling challenges, items are arranged in such a way that the non-tradeables lie toward the right. The precise order of items is listed in table A-1.

questions, readers must be convinced the data is sound. In the appendix, I present extensive evidence on the reliability of the EIU data. First, I show that in my price indexes (a) low-price countries tend to be relatively poor countries and (b) there is a positive cross-country correlation between productivity growth and the change in the relative price of non-traded goods to traded goods; the EIU data thus share important characteristics with the Penn World Tables and OECD intersectoral data sets. Second, the correlation between EIU price changes and the annual official CPI inflation rate is positive and fairly large. Third, calculating the implied law-of-one price exchange rate for each EIU item, I show that the resulting implied PPP rates are comparable to the PPPs reported by the OECD. Finally, I show that the Figure 1 results are robust to an analysis that relies on the EIU data only in one arbitrarily chosen year, 1995. Specifically, I construct "pseudo" prices for the years 1990-94 and 1996-01 for every country and every item, by projecting official inflation rates of each CPI sub-component listed in table A-1 onto the EIU prices in 1995. As shown in figure A-3, the price indexes constructed from these "pseudo" prices display the same general pattern of dispersion as the actual EIU prices.

Epilogue: lower price dispersion yes, but expensive countries do not become cheap in a decade

The results above constitute robust evidence of a sizable decline in European price dispersion over the period 1990-2001, especially for traded goods. In a relative sense, expensive countries are becoming cheaper and inexpensive countries more dear. Figure 5 gives an idea of how much this has affected the cross-country *ordering* of price levels, depicting each nation's overall price level in 1990 versus 2001. Clearly, (in)expensive locations by and large remain (in)expensive. The plot displays the tendency towards convergence: Portugal's price level was nearly 35% below average in 1990 but less than 20% below average in 2001, Finland was 35% above average in 1990 but slightly below average in 2001.[13] However, what is most striking is that, even among countries that are becoming more integrated, inexpensive countries do not swap places with expensive ones, at least not in 12 years.

[13]The plot is little changed if we use traded goods prices. In that case, the U.K. and France are located in the upper-left quadrant instead of the upper-right in Fig. 5, but none of the others lies in a different quadrant.

IV. Why the Decline in European Price Dispersion?

A glance at Figure 1 invariably prompts the question, why did traded goods price dispersion fall in Europe? Several possibilities spring to mind, including harmonization of tax rates, liberalization of trade and factor markets, increased coherence in monetary policy, convergence of incomes, and convergence of labor costs.[14] To organize thoughts, suppose that final goods prices, inclusive of tax, are determined by a profit-making monopolist as a mark-up over costs (omitting time subscripts)

$$P_{ik} = (1+\tau_{ik})\beta_{ik}\alpha_{ik}(w_{ik})^{\phi i}(q_{ik})^{1-\phi i} \quad (1)$$

where the tax rate is denoted τ_{ik}. There are two components to costs, non-tradeable "labor" and tradeable "capital", whose prices are given by w and q, respectively. With Cobb-Douglas technology, ϕ_i measures the share of labor in final output of item i. The mark-up is denoted β, while α measures total productivity of the final goods sector.

Harmonization of tax policy

The EIU price data are final retail prices, inclusive of tax, and thus reduced dispersion of prices could be due to reduced dispersion of tax rates, τ_{ik}. For European consumers, the crucial tax is the value-added tax (VAT), a general consumption tax assessed when value is added to goods and services. The tax is levied as a percentage of the item's value. Every member state of the European Union is mandated to have a value-added tax (First VAT Directive, April 1967). However, the laws determining the VAT are national laws, and rates have varied across time and across countries.

The first two columns of Table 2 display the cross-country standard deviation of the VAT (standard rate) for the EMU-11 and All Europe in each year. In the EMU-11, this falls from 3.69% in 1990 to 2.31% in 2001, in part due to the EU mandating a minimum standard VAT rate of 15%

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[14]Sorting among these is inherently difficult. First, the explanations are not mutually exclusive. Convergence of fiscal policies, for example, would certainly be a key factor allowing monetary policy to be more coherent. Further, there is an important element of endogeneity between the above factors and price dispersion, and there is little to guide us concerning the dynamics of their relationship. It may be that some unobservable factor caused a simultaneous decline in price dispersion and income dispersion. On top of this, my sample period is relatively short. Lacking the ability to measure everything that could possibly affect price dispersion, I consider many plausible explanations, characterizing their (contemporaneous) correlation with traded goods price dispersion. This provides evidence about which explanations may be consistent with the pattern of price dispersion. Clearly a deeper, more structural investigation would constitute a useful follow-up paper.

beginning January 1993. As shown in the final two rows, the correlation between the cross-EMU-11 standard deviation of VAT rates and standard deviation of the traded goods price index (the series displayed in Figure 1) is large and positive, greater than 0.90.[15] Bearing in mind the caveats above, this correlation at least suggests that the harmonization of fiscal policy was not unimportant.[16]

Nevertheless, note that VAT is also levied on many of the non-tradeable items, prices of which did not converge to the same extent. Could a tax explanation still be important, given the difference in outcomes for tradeables and non-tradeables? Prior to 1993, European households purchasing items abroad had to pay VAT twice, once at the point of "origin" and again at the point of "destination" (for all purchases above the specified "free allowance"). When the Single Market became a reality on January 1, 1993, EU consumers were required to pay VAT only at the point of origin.[17] Since the new VAT law on imports would naturally affect prices of tradeables more than non-tradeables, it could explain the difference in results.

In the All Europe sample, traded goods price dispersion fell by roughly the same amount as in the EMU-11, but VAT rate dispersion fell much less (column 2 of Table 2), largely as a result of Sweden and Denmark raising their already above-average VAT rates in 1992 and Norway doing the same in 1993. As a result, the correlations with price dispersion are only 0.30 and 0.54 for All Europe.[18]

Finally, although the results above are suggestive, their computation ignores potentially useful information on the *levels* of prices and tax rates. If countries which lowered tax rates as part of the fiscal harmonization were also countries that experienced price increases, for example, the positive correlation

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[15]The correlations in Table 2 are between *national* measures of tax policy, incomes, etc., and the cross-*city* measures of price dispersion presented in Figure 1, which is the item of interest. The same conclusions would emerge if I instead report correlations with cross-*country* measures of price dispersion, where the national price indexes are a population-weighted average of the city price indexes for the five countries with more than one city in the sample. The correlations between cross-city and cross-country standard deviations of the traded goods price indexes over 1990-2001 are 0.985 and 0.996 (cpi-weighted and equal-weighted, respectively) for the EMU-11 and 0.984 and 0.998 for all Europe.

[16]In addition, concern about reverse causation (in this case running from less dispersed prices to more harmonized tax policy) is less for this explanation than for the others to follow.

[17]Automobiles were infamously exempted from the rule; see **www.eurunion.org/legislat/VATweb.htm**.

[18]Recalling that the standard error of a correlation coefficient is $N^{-0.5}$, where N is the number of observations (12 here), only correlations of about 0.6 or larger are significantly different from zero.

between dispersion measures would be misleading. So, I calculate correlations between the levels of VAT rates and traded goods prices, p(T). The correlation is the coefficient β_1 from the regression

$$p(T)_{k,t} = \beta_0 + \beta_1 VAT_{k,t} + \beta_2 Y_{k,t} + \beta_3 Open_{k,t} + \beta_4 W_{k,t} + \beta_5 (S_{k,t} - \mathbf{S}_k) + e_{k,t}\,, \qquad (2)$$

where I also include the levels of the other variables considered later in this section: real per capita GDP relative to the U.S. in PPP dollars, trade openness, unit labor costs, and the nominal exchange rate expressed as a deviation from the period average rate.[19]

For the EMU-11, β_1 is 0.021 for the equal weighted price index and 0.012 for the cpi-weighted index. A "back-of-the-envelope" calculation suggests these correlations are possibly important. Recall that between 1990 and 2001 $\sigma(p(T)^e)_t$ declined by 0.092 (from 0.170 to 0.078) and $\sigma(p(T)^c)_t$ fell by 0.121. Further, note that the standard deviation of VAT rates fell by 1.38 (first column of Table 2). The estimated correlations thus imply that the decline in VAT rate dispersion, *ceteris paribus*, could account for 14 to 32 percent (= 1.38*0.021/0.092) of the decline in traded goods price dispersion. For the All Europe sample the β_1's are 0.004 and 0.008, each of which is economically unimportant. Clearly, there is more to the decline in price dispersion than simply the harmonization of tax policy, even if one accepts the upper-end calculation on the variance share.

Convergence of incomes

As noted above, convergence of prices could be a result of convergence of incomes, which in turn might be due to either a convergence of productivity (more similar α_k's) or factor endowments (more similar ϕ_k's). The next 3 columns of Table 2 present standard deviations of GDP per capita (in PPP dollars and expressed as a ratio to the U.S., as above).[20] According to the first, income in the EMU-11 became *more* dispersed over the period, opposite to the trend in price dispersion. However, this is very sensitive to the inclusion of Luxembourg, which grew rapidly during the sample period. As

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[19]I implement both OLS and instrumental variables estimation, which lead to similar conclusions. Reported results are for the OLS estimates.

[20]Ideally, we would use measures of α_k and ϕ_k directly since there are many determinants of income (and so a severe endogeneity problem). However, it is very difficult to estimate productivity levels and factor endowments across countries, mainly because measuring the capital stock is so problematic. Similarly, the difficulties measuring the mark-up, β in eq. 1, leave the analysis of its role beyond the scope of this paper.

indicated in the next two columns, excluding Luxembourg the standard deviation of per capita GDP across the EMU-11 and All Europe *fell* from 1990 to 2001, and the correlation with the cross-country dispersion of traded goods price indexes becomes large and positive.[21] Thus, there is evidence of income convergence, suggesting at least that this factor is not inconsistent with the decline in price dispersion.

Convergence of labor costs

All else constant, a drop in dispersion of input prices w_k or q_k will lead to a drop in dispersion of final output prices. The 6th column of Table 2 displays the cross-country standard deviation of unit labor costs for production workers in the EMU-11. Labor cost dispersion rose in the first half of the decade, just as price dispersion was falling sharply. Overall, the correlations with price dispersion are negative, suggesting that this is not likely an important explanation of my main results.[22] Results for the All Europe sample (not shown) are very similar. These results are perhaps not surprising, since it is generally recognized that in Europe labor markets are very rigid and in practice labor mobility has been rather limited, despite the 1992 liberalization.

Open-economy influences

To borrow again from Rogoff's (1996) influential survey, "[The large trading frictions across a broad range of goods] may be due to transportation costs, threatened or actual tariffs, non-tariff barriers, information costs, or lack of labor mobility. As a consequence of various adjustment costs, there is a large buffer within which nominal exchange rates can move without producing an immediate proportional response in relative domestic prices." The final columns of Table 2 address the extent to which changes in trade flows and nominal exchange variability within Europe may have been associated

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[21] As a check on income convergence, I look at the relationship between GDP per capita in 1990 and the average annual GDP growth rate over 1991-2001 (Appendix Figure A-4). For the EMU-11, the correlation is positive (= 0.04); for the full sample of European countries the correlation is negative but small at -0.10. But Luxembourg is an outlier again. Excluding Luxembourg, the correlation is -0.45 for the EMU-11 and -0.46 for All Europe, indicating convergence. Happily, **the results on *price dispersion* are very robust to excluding Luxembourg** (as are results for the other variables in Table 2). The correlation between the equal-weighted traded goods price dispersion measure for the EMU-11 with and without Luxembourg is 0.99994. This is no surprise, as Luxembourg price levels are right at the European average.

[22] The correlation between the *level* of traded goods prices and labor costs from estimates of eq. (2) is always positive, but, using the same *ceteris paribus* experiment I applied to VAT rates above, the correlations imply that decreases in labor costs account for a very small part of traded goods price movements.

with the drop in dispersion of traded goods prices.

Trade liberalization

Referring back to equation (1), if some intermediate inputs are tradeable, then all factors affecting the cost of transporting items across locations k will affect final goods prices p_{ik}, consistent with Rogoff's quote. There are nearly insurmountable difficulties coming up with summary empirical measures of the trading frictions Rogoff has in mind. Data on tariffs, non-tariff barriers, and shipping costs abound, of course, but any single measure would inevitably be insufficient on some grounds. (How to aggregate tariff rates on individual items or handle prohibitive tariffs? How binding are NTBs?, etc.) Some authors despair of the possibility of measuring trade policy at all (Pritchett (1996)), and instead use actual trade flows as a measure of openness (e.g., Dollar and Kraay (2002) among many others). Although this is not ideal as a measure of trade frictions, it is commonly-used and well-understood.

Thus I examine the relationship between trade flows within Europe and traded goods price dispersion. I calculate for each country total trade with the rest of the EU as a percent of GDP, for each year 1990-2001. Germany, France, and Italy have the lowest ratios, around 20 percent on average, while Ireland, Belgium, and Luxembourg average more than 70 percent. In column 7 (8) of Table 2, I report the cross-EMU-11 (cross-Europe) mean for each year. This measure of average trade flows is negatively correlated with traded goods price dispersion (around -0.3 to -0.4; see last two rows), though not statistically significant. This negative association of trade flows and price dispersion suggests that one can ascribe some of the decline in price dispersion as due to trade liberalization, absent a better measure of overall trading frictions, and mindful of the caveats at the start of the section.

Coherence of European monetary policy

No investigation of cross-country price dispersion would be complete without looking at nominal exchange rates. From equation (1), in international markets the mark-up β will fluctuate with the exchange rate, by an amount that depends on the degree of exchange rate pass-through (Goldberg and Knetter, 1997). The vast empirical literature on exchange rates and prices, including notable contributions by Mussa (1986) and Engel (1999), suggests that the decline in -- and then elimination of -- nominal exchange rate variability within the euro zone would have been associated with significant convergence of traded goods prices.

Define the log real CPI-based exchange rate, q, conventionally as the difference between the logs of the common currency national price indexes,

$$q \equiv s + p^* - p$$

where s is the log nominal exchange rate, p the log price level, and an asterisk represents the foreign variable. Mussa (1986) presented extensive evidence that q and s are very highly correlated. Engel (1999) decomposed q into two components, deviations from the law of one price in traded goods, x, and the relative ratios of tradeables to non-tradeables prices, y:

$$q = [p(T)^* + s - p(T)] + \alpha[(p(N)^*-p(T)^*) - (p(N)-p(T))] \equiv x + y$$

where p(T) and p(N) denote logs of tradeables and non-tradeables prices, and α is the share of non-tradeables in consumption. Using several different sub-categories of the CPI as proxies for p(T) and p(N), Engel finds that the ratio of root mean squared errors

$$\text{RMSE}(x) / [\text{RMSE}(x) + \text{RMSE}(y)]$$

is very large -- quite close to 1.0 -- for major country currencies against the dollar, at both short and long horizons. Mussa's (1986) and Engel's (1999) results are often attributed to sticky prices.

In light of such evidence, it is not unreasonable to suppose that the pattern of traded goods price dispersion in Figure 1 is closely related to changes in nominal exchange rate variability. The final two columns of Table 2 present the cross-country standard deviation of the average monthly change in each country's exchange rate versus the European currency basket (ECU, then euro) in year t. For the EMU-11, this is of course 0.00 beginning with the launch of the euro in 1999. Relating nominal exchange rate dispersion to price dispersion, we see that overall the correlation is positive but, at no more than 0.32, is not nearly as large as that for the tax and income measures. The relationship goes the "wrong way" early in the sample, because the large drop in price dispersion from 1991 to 1993 occurs simultaneously with the ERM crisis, yet when exchange rate changes went to zero after 1998, there was not much of a drop in price dispersion.

These results are noteworthy and perhaps surprising. One possible explanation is that the prices of the items in my sample aren't as sticky as they are in the data exploited elsewhere in the literature. To check this, I calculated the year-to-year, local currency price change for each item in the EIU data set for each of the 18 EMU-11 cities. This gives a total of 1,518 observations per city (138 items times 11 years of price changes). The average number of **zero** price changes per city is 376, fully 25% of the sample.[23]

Alternatively, the low correlation between the dispersion measures for nominal exchange rates and traded goods prices might not be viewed as such an anomaly if, e.g., the increased nominal exchange rate variability in the early 1990s helped restore equilibrium among traded goods prices. This would be the case if the relatively high-price countries (or time periods), say, also had overvalued currencies. This appears to be the case. In equation (2), the estimate of β_5, the coefficient on the deviation of the nominal exchange rate from its period average, is negative in all specifications I considered.[24] Thus, episodes of high traded goods prices are associated with currencies that eventually experience depreciation. This suggests that nominal exchange rate movements had an important influence on traded goods prices, irrespective of the fact that the variability measures discussed above sometimes go the "wrong way".

V. Inflation in Europe

Figure 6 displays consumer price inflation rates for selected euro area countries and the (officially-weighted) average for the EMU-11, from 1990 to 2001. Inflation declined steadily for the first part of the period as countries strove to meet Maastricht guidelines. In 1997 inflation ranged a mere 1.9 percent in Italy and Portugal to 1.2 percent in Ireland. Inflation began to rise after 1997, however, and sizable cross-country differences re-emerged, with the low-price, "periphery" countries of Portugal, Ireland (not shown), and Spain experiencing higher rates. The fact that this divergence of inflation coincided with the realization of the euro area prompted some to wonder if there was a causal

[23]Cecchetti (1985) finds more price stickiness than this in his sample of 38 newsstand magazines from 1953-79. On average only 20% change prices each year (the range is from 2% to 50%). Kashyap (1995) examines retail catalog prices of 12 items over a 35 year period, and finds that on average 25% of items change prices per year. The items in my sample are much more heterogenous than either the Cecchetti or Kashyap sample, of course, making direct comparison of the degree of price stickiness difficult.

[24]Of course, the deviation from period average is only a proxy for currency overvaluation. There is no consensus definition of an equilibrium exchange rate. Nevertheless, given that this deviation is by definition mean zero for all countries, it does indicate the direction in which the exchange rate will move during the sample.

relationship between the two that was primarily a manifestation of price level convergence.

In this section I examine the extent to which cross-country differences in European inflation can be explained by price level convergence. By analogy to the literature on convergence and economic growth (see Forbes (2000) for a recent contribution), this involves looking for a negative relationship between current price levels and future CPI inflation. Using EIU data to get meaningful cross-country comparisons of price levels at a point in time makes this feasible.

Unconditional relationship between inflation and initial price levels

The scatter plot in Figure 7 relates European price levels in 1990 to average CPI inflation from 1991-2001. The negative pattern shows that subsequent inflation has been higher in countries that had relatively low prices in 1990. The correlation is quite similar for the EMU-11 and All Europe samples. An OLS regression of the average CPI inflation rate for 1991-2001 on a constant and the 1990 EIU price level for the full cross-section yields a highly significant, negative coefficient on the price level and an adjusted R^2 of 0.27.[25] These full-sample ("long-run"), unconditional results say nothing about the dynamic relationship between initial price levels and future inflation, nothing about the sub-period stability of the price level-inflation relationship, and of course nothing about the importance of initial price levels compared to other factors that affect inflation. I take up these topics next.

Conditional relationship between inflation and initial price levels

Table 3 presents regressions for Europe to determine whether the negative correlation between initial price levels and subsequent inflation remains important once additional variables are taken into account. I consider several specifications of a fixed-effects panel regression which can be written:

$$\pi_{k,t+1} = \beta\, p(O)_{k,t} + \theta X_{\mathbf{k,t}} + \alpha_k + \eta_{t+1} + u_{k,t+1} \qquad (3)$$

where the dependent variable is the percent change in the country's consumer price index from Q4 of year t to Q4 of year t+1. Explanatory variables include $p(O)_{k,t}$, country k's overall price level in year t, as

[25]The regression coefficient implies that a country whose price level was one standard deviation below average (i.e., a price level about 0.85) experienced an average inflation rate from 1991 to 2001 that was more than one percentage point higher than the Europe-wide mean (of 3.2 percent). By comparison, the same regression for the U.S. sample produces an insignificant coefficient on the 1990 price level (t-stat=-0.96) and an adjusted R^2 of zero.

calculated from the EIU data above,[26] the country and year fixed effects, α_k and η_{t+1}, and various time-t control variables in the vector X: output gap, per capita GDP relative to the U.S., productivity growth, openness to non-EU trade, a measure of fiscal stance, and, because inflation is relatively persistent, $\pi_{k,t}$ and its lags as needed to soak up serial correlation in the residuals.

Several of the explanatory variables were discussed above. The output gap is included for customary reasons. Relative per capita GDP accounts for the tendency of low-price countries to be relatively poor countries. Productivity growth should be positively related to inflation according to Balassa-Samuelson, as discussed above, but one might alternatively argue that rapid productivity growth spawns many “good” price declines (e.g., computers) and would be associated with lower inflation. Openness is measured as total merchandise trade with the rest of the world less total trade with other members of the European Union, as a share of GDP. This is designed to capture exposure to inflation imported from abroad, either directly or through the effects of the weak euro, suggesting that openness should be positively correlated with inflation.[27] The fiscal measure is the “general government financial balance” as a percent of GDP. We would expect this to be negatively correlated with inflation, i.e., that larger deficits are associated with higher inflation. The appendix describes the data sources.

It is important to emphasize that the price level on the right hand side of (3), $p_{k,t}$, is constructed from the EIU data while inflation, $\pi_{k,t+1}$, is the change in the official CPI, the variable of interest to policymakers, and not the EIU price level. As discussed in the appendix, this gives us less reason to worry about bias in least-squares estimates of β that might otherwise have arisen from, e.g., correlated measurement error. Specifications with a lagged dependent variable are subject to bias, however, as is well-known from Nerlove (1967), Nickell (1981), Sevestre and Trongon (1985) and others. Monte Carlo evidence indicates that in panels of my size the bias of the coefficient on π_{kt} (which isn’t the focus of this

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[26]All estimates below use the cpi-weighted price index, but as I show in the working paper version, results are robust to the weighting scheme used to construct $p(O)_{k,t}$.

[27]Romer (1993) examines the cross-sectional relationship between openness and long-run inflation in a very broad sample of countries, while postulating a mechanism that is much different from the one I have in mind (see Lane (1997) also). Romer’s cross-section inflation regressions also include per capita income, revolutions and coups, a measure of central bank independence, and regional dummies. Among the 18 highly developed countries, Romer finds the openness-inflation relationship is insignificant (p. 883).

paper) can be severe, while the bias for the other coefficients in the regression tends to be minor (Arellano and Bond (1991), Kiviet (1995), Judson and Owen (1996)). On the other hand, since the EIU price level and CPI are not completely orthogonal there is still reason to worry about bias in estimating β in (3). Thus, I also implement a generalized method of moments (GMM) estimator suggested by Arellano and Bond (1991), as described in the appendix. This corrects for the bias introduced by a lagged endogenous variable, while also permitting a degree of endogeneity in the other regressors.

Baseline regressions: Table 3

In Table 3 I present estimates of various specifications of equation (3). The first four columns contain results estimated on the full sample period 1990-2001 while the remaining three columns are for 1997-2001. I report least-squares coefficient estimates, heteroskedasticity-consistent standard errors in parenthesis, and p-values from an LM test for residual autocorrelation. I also present two estimates of the contribution of $p_{k,t}$ to explaining variation in $\pi_{k,t+1}$. Each is the change in the regression R^2 with and without $p_{k,t}$ (the partial R^2). The first estimate is the partial R^2 when *all* regressors are otherwise included, while the second is the partial R^2 when *only a constant* is included. This provides a plausible range of the importance of price level convergence to explaining inflation variability.

The first specification in Table 3 is for all 17 European countries. It includes time effects but no country effects and no lags of the dependent variable. In this simple specification, the price level, output gap, income, and fiscal variables are significant and of the expected sign. Productivity growth is negative but insignificant. The coefficient on p_{kt} is -4.49 and highly significant. The range of partial R^2 estimates indicates that $p_{k,t}$ explains from five to seventeen percent of the variation in $\pi_{k,t+1}$.

An LM test strongly rejects the hypothesis that the residuals from specification 1 are serially uncorrelated. I add lags of the dependent variable until the test rejects at 5%. The outcome is reported in column 2. The addition of three lags of $\pi_{k,t+1}$ diminishes much of the explanatory power of the regressors from specification 1. The coefficient on $p_{k,t}$ is still significant at 10% but falls to -1.20. In addition, the lower end of the partial R^2 range for p_{kt} is now essentially zero. The coefficient on the output gap is also much smaller in specification 2, though still significant, while per capita GDP, productivity growth, and the fiscal balance are all insignificantly different from zero. Openness now enters positively, but is insignificant even at 10%.

In specification 3 I add country fixed effects.[28] The period-t price level now has essentially no explanatory power for time t+1 inflation. The output gap remains positive and significant. Openness also remains positive and becomes significant at 5%. Two big changes that appear with the addition of country effects are that productivity growth and the fiscal balance become negative and significant at the 3% level or better. The negative correlation between inflation and productivity growth, which is found throughout, is opposite to that predicted by the Balassa-Samuelson hypothesis.

The country fixed effects are important enough to warrant further examination. When added to either specification 1 or specification 2, the country dummies strongly diminish the explanatory power of certain variables (price level and per capita GDP) and increase it for other variables. Their inclusion also increases the adjusted R^2 by .25 over specification 1 (not shown). In light of this, I examine the correlation between the estimated country effects and the mean values of the variables in **X**. In Figures A-5 and A-6, I display a scatter plot of the estimated country effects from specification 3 against the period-average price level and per capita GDP, respectively. In each case, the relationship is negative, with respective correlations of -0.40 and -0.51. Countries with the largest (or smallest negative) estimated effects are those with the lowest average price level and lowest per capita GDP level (Greece, Spain, and Portugal), while the high-price, high-income countries like Switzerland are those for which the country fixed effect is smallest. The scatter plots suggest that the country effects are proxying for price levels and GDP (and maybe other factors).

Next I examine if the results differ when attention is restricted to the EMU-11. In general they do not. The period-t price level is negative, significant, and economically fairly important in simple specifications, but much of this goes away when I add lags of the dependent variable and/or country fixed effects. In the fourth column of Table 3 I report a specification with time effects, no country effects, and lagged dependent variables sufficient to make the residuals serially uncorrelated. The results

[28]Although each of the estimated country effects (not shown) is individually insignificant even at 15%, and the adjusted R^2 increases very little compared to specification 2, an F-test rejects at any plausible confidence level the hypothesis that the country dummies are zero as a group.

are very comparable to its kin in column 2: the coefficient on p_{kt} is negative, around -1.0, significant at 10% but economically quite small, while most of the other variables are not statistically different from zero. The partial R^2 range puts an upper-bound estimate of the contribution of p_{kt} at 12%.

Finally, I consider if the results differ during the sub-period 1997-2001, and find that they do, perhaps unsurprisingly given Figure 7. The final three columns of Table 3 present selected estimates. The first two are for the All Europe and EMU-11 samples, each with time effects but no country effects, while the final specification adds country fixed effects to the EMU-11 regression.[29] These specifications are akin to those of columns 2-4. The period-t price level effect is considerably more important in the 1997-2001 sub-period. The negative coefficient estimates on p_{kt} are now both statistically and economically important and the partial R^2 values suggest a contribution to explaining inflation variability in the vicinity of twenty percent. The effects of the output gap and income are estimated to be large and significant despite the much smaller sample size. Openness enters positively, significantly so for the EMU-11. When country effects are added to the regression, much of the explanatory power of these variables is removed, as was true above.

Robustness – Table 4

The European Central Bank does not weight the inflation rates of each member nation equally, either in their thinking or in the formal construction of the area-wide inflation aggregate. To account for this, I examine weighted least squares (WLS) estimates, in which the residuals are weighted by the country's population. The WLS point estimates are generally very close to the OLS estimates of Table 3, but in most cases have much larger standard errors. Two examples are in the first two columns of Table 4, where I present specifications for the All Europe and EMU-11 samples, respectively, during the post-1997 sub-period. These are analogous to the 5th and 6th columns of Table 3. The WLS coefficients on the period-t price level are -4.97 and -6.83 (only the former is significant at 10 percent), compared to the OLS estimates of -5.20 and -5.75. According to the partial R^2 estimates, the amount of inflation variation explained by the period-t price level is very small.

[29]In all 3 regressions, lags of $\pi_{k,t+1}$ are not needed to remove serial correlation and are insignificant anyway.

The final four columns present the Arellano-Bond (1991) GMM estimates, again for both the All Europe and EMU-11 samples (see the appendix for discussion). The specifications differ according to the treatment of the variables in **X**. In the first two, all **X** variables are assumed to be predetermined, and hence are instrumented for. In the final two regressions, the variables in **X** are treated as exogenous. The EIU price level is always instrumented for, as is the lagged dependent variable.

The output gap (productivity growth) enters positively (negatively) and usually significantly, in these regressions. In the first two specifications, where all right-hand side variables are instrumented for, the fiscal balance is negative and openness positive with t-statistics as large as 1.6. The coefficients on the EIU price level are -4.17 and -6.61 for the EMU-11, similar to the point estimates found in least squares estimates for this sample, but the t-statistics are only around -1. Across all four specifications, none of the other coefficients is significant even at very "generous" significance levels.

In sum, the negative and economically significant effect of the initial price level on future CPI inflation found in simple specifications is not robust to more substantive analyses of their relationship. Conventional determinants like the output gap are significant. The effect of productivity growth is uniformly found to be negative, contrary to the predictions of the Balassa-Samuelson hypothesis.

Implications for expansion of the euro area?

The concern that increased economic integration from joining the euro area might result in higher inflation in poor and low price countries is likely to be an even greater policy concern as expansion brings full membership, potentially, to countries such as the Czech Republic, Hungary, and Poland. In Table 5 I show that the equal-weighted price levels for Budapest, Warsaw, Prague, Bucharest, and Belgrade (calculated in the manner above using data from the same EIU sample) are all around 30-50 percent below the European average, despite the fact that prices in these East European cities rose considerably during the 1990s. This puts their price levels around those of Portugal and Greece in 1990. To the extent that these countries' experience is any guide, my analysis suggests that continued relatively rapid price increases are on the way for Eastern Europe as it becomes further integrated with the EU. The fact that results for the All Europe and EMU-11 samples are quite similar to each other (throughout the paper) also suggests that these inflationary consequences are largely independent of whether or not the East European countries formally adopt the euro.

VI. Conclusion

This paper provides strong evidence of price level convergence in Europe, especially for traded goods, much of which took place around the long-planned "completion" of the Single Market in January 1993. Currently, traded goods price dispersion is quite close to, and by some measures is slightly *below*, that of the United States. I show that the decline in European price dispersion coincided with increased harmonization of VAT rates and a decline in income dispersion within Europe, and to a lesser extent, with increased trade flows and exchange rate stability. The relatively low correlation between dispersion measures for traded goods and nominal exchange rates results from the relationship going the "wrong way" early in the sample (the large drop in price dispersion from 1991 to 1993 occurs simultaneously with the ERM crisis) and the fact that there is little change in price dispersion after 1998, when exchange rate changes went to zero. Although these results seem surprising, I present evidence to suggest that the nominal exchange rate changes that did occur helped restore equilibrium among traded goods prices.

In addition, in panel regressions explaining European inflation I find a fairly robust negative relationship between initial price levels and future inflation, as implied by price level convergence. However, the initial price level is not uniformly important, and factors other than price convergence explain most of the cross-country inflation differences. I find no evidence of a Balassa-Samuelson effect on European inflation, as the regressions uniformly uncover a negative correlation between productivity growth and inflation.

Finally, I find for the most part that results from the EMU-11 countries are very similar to those from the full sample of 17 European countries, suggesting that there is nothing uniquely special about monetary union *per se*, at least not for the convergence of prices. Instead, price convergence seems to be influenced more by "real side" factors that accompany or even precede the formal adoption of a common currency. This runs counter to the literature on the trade-creation effects of currency unions.

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Table 1; European Economic Integration Timeline

Year	Initiative	Description
1957	Treaty of Rome	Established customs unions
mid-1970's	The "snake"	Informal joint float of several EU currencies vs. dollar
March 1979	European Monetary System	Formal network of mutually pegged exchange rates (Fra., Ger., Ita., Den., Ire., Lux., Nld.)
1986	The Single European Act ("Europe 1992")	Enabled eventual completion of the internal market; remove internal barriers to trade, capital, and labor
December 1991	Maastricht Treaty meeting	Envisioned economic and monetary union (EMU) to begin 1/99; specified convergence criteria for EMU admission; call for harmonization of social policy "stage 2" to begin 1/94
1989-92	EMS developments	Spain ('89), Britain ('90), Portugal ('92) added; Italy and Britain leave after 9/92 crisis.
January 1993	The "single market"	Harmonization of the value-added tax (VAT); the internal market is realized.
1997	Stability & growth pact	Specifies medium-term budgetary objectives for EMU
May 1998	EMU members decided	Aut., Bel., Fin., Fra., Ger., Ire., Ita., Lux., Nld., Por., Spn.
January 1999	Euro launched	Single monetary policy for all EMU, set by ECB; all monetary policy actions and most large-denomination private payments conducted in euros; national currencies "irrevocably fixed", continue to circulate for 3-year transition
2001	Expansion of EMU	Greece joins (1/01); possible next-round entrants identified
Jan.-Mar. 2002	Euro circulates	National currencies removed from circulation

Table 2; Potential Explanations of European Price Convergence

	VAT Rate (σ)[1]		GDP per capita (σ)[2]			L Costs(σ)[3]	Trade (mean)[4]		ΔExch. rate (σ)[5]	
				(Ex. Luxembourg)						
	EMU-11	Eur.	EMU-11	EMU-11	Eur.	EMU-11	EMU-11	Eur.	EMU-11	Eur.
1990	3.69	4.56	1.59	1.28	1.46	5.46	0.46	0.41	0.43	0.60
1991	3.44	4.39	1.62	1.15	1.37	5.46	0.45	0.40	0.69	0.65
1992	2.66	4.41	1.65	1.12	1.33	5.72	0.43	0.39	1.54	1.68
1993	2.53	4.44	1.81	1.07	1.30	5.79	0.40	0.36	1.70	1.59
1994	2.60	4.41	1.80	1.04	1.27	6.32	0.43	0.38	0.71	0.77
1995	2.52	4.42	1.77	0.99	1.23	7.74	0.45	0.41	1.16	1.14
1996	2.56	4.43	1.75	0.94	1.19	7.29	0.45	0.40	0.71	0.82
1997	2.60	4.44	1.86	0.91	1.16	6.23	0.47	0.42	0.55	0.84
1998	2.47	4.40	1.90	0.91	1.13	6.31	0.48	0.43	0.41	0.92
1999	2.47	4.22	1.95	0.94	1.11	6.14	0.51	0.45	0.00	0.41
2000	2.41	4.20	2.06	1.01	1.12	5.52	0.55	0.48	0.00	0.48
2001	2.31	4.22	1.87	1.03	1.14	5.29	0.48	0.47	0.00	0.36
$\rho(\sigma(p^c))$[6]	.93	.30	-.88	.84	.84	-.22	-.41	-.26	.32	.07
$\rho(\sigma(p^e))$[6]	.96	.54	-.80	.80	.92	-.19	-.30	-.41	.15	.12

Notes: 1. Cross-country standard deviation of the standard rate of VAT (source: European Commission). 2. Cross-country standard deviation (x 10) of GDP per capita in U.S. dollars at PPP exchange rates, expressed as a ratio to the U.S. (source: IMF). 3. Cross-country standard deviation of unit labor costs for production workers. Includes pay for time worked, other direct pay (eg. holiday pay), employer expenditures on legally required insurance programs and other labor taxes; in euros (source: EIU). 4. Cross-country average of annual ratio of total within-EU trade (exports plus imports) to GDP (source: IMF Direction of Trade Statistics database). 5. Cross-country annual average of the standard deviation of the monthly change in the nominal exchange rate versus the ECU (1990-98) or the euro (since 1999) (source: EIU). 6. The correlation over 1990-end between the variable in the column and the dispersion of the cpi-weighted or equal weighted price index.

Table 3: Explaining Inflation in Europe

Dependent variable = $\pi(k,t+1)$

	Europe (90-01)	Europe (90-01)	Europe (90-01)	EMU-11 (90-01)	Europe (97-01)	EMU-11 (97-01)	EMU-11 (97-01)
Price level (k,t)	-4.49 (1.01)	-1.20 (0.71)	0.03 (1.07)	-1.09 (0.63)	-5.20 (0.73)	-5.75 (1.20)	-3.67 (5.92)
Output gap (k,t)	0.22 (0.05)	0.09 (0.04)	0.17 (0.06)	0.04 (0.04)	0.29 (0.06)	0.21 (0.07)	0.08 (0.17)
Per capita GDP (k,t)	-2.79 (0.84)	0.01 (0.61)	2.29 (2.77)	-0.29 (0.64)	-1.89 (0.72)	-1.66 (0.95)	-5.16 (7.56)
Productivity growth (k,t)	-0.05 (0.10)	-0.01 (0.04)	-0.10 (0.04)	-0.03 (0.02)	-0.02 (0.07)	-0.10 (0.07)	-0.07 (0.08)
Fiscal balance (k,t)	-0.15 (0.07)	-0.01 (0.03)	-0.13 (0.04)	-0.03 (0.03)	0.08 (0.03)	0.10 (0.08)	-0.06 (0.08)
Openness (k,t)	-3.92 (1.65)	1.45 (0.94)	7.09 (3.41)	0.95 (0.88)	0.52 (1.20)	2.22 (1.26)	10.9 (6.95)
π (k,t)	---	0.25 (0.11)	0.08 (0.09)	0.60 (0.04)	---	---	---
π (k,t-1)	---	0.25 (0.08)	0.21 (0.07)	---	---	---	---
π (k,t-2)	---	0.08 (0.07)	0.12 (0.06)	---	---	---	---
Time effects?	yes	yes	yes	yes	yes	yes	yes
Country effects?	no	no	yes	no	no	no	yes
Adjusted R^2	0.45	0.75	0.77	0.74	0.60	0.66	0.74
R^2 due to p(k,t) [1]	(.05 .17)	(.003 .17)	(.00 .17)	(.01 .12)	(.19 .24)	(.13 .19)	(.00 .19)
Serial correlation [p-value] [2]	[.00]	[.34]	[.02]	[.30]	[.97]	[.91]	[.00]
# obs.	187	153	153	121	68	44	44

Notes: heteroskedasticity-consistent standard errors are in parenthesis. [1] The change in the regression R^2 with and without the price level term, p(k,t). Two values are reported, one of which is the change in regression R^2 with and without p(k,t) when all of the regressors are included, while the other is the change in the regression R^2 with and without p(k,t) when only the intercepts are included. [2] p-values from LM tests of the null hypothesis of no 4^{th}-order (2^{nd}-order) serial correlation in the regressions using the 1990-01 (1997-01) samples.

Table 4: Inflation Regressions – Robustness

Dependent variable = $\pi(k,t+1)$

	Weighted least squares		Arellano-Bond [1]		Arellano-Bond [2]	
	Europe (97-01)	EMU-11 (97-01)	Europe (97-01)	EMU-11 (97-01)	Europe (97-01)	EMU-11 (97-01)
$P^{Overall}$ (k,t)	-4.97	-6.83	0.83	-4.17	-2.95	-6.61
	(3.06)	(7.51)	(2.44)	(5.28)	(3.19)	(6.52)
Output gap (k,t)	0.31	0.27	0.35	0.31	0.41	0.33
	(0.18)	(0.29)	(0.12)	(0.18)	(0.14)	(0.21)
Per cap. GDP (k,t)	-1.36	-0.38	-1.21	4.77	-4.13	5.42
	(1.36)	(1.62)	(6.25)	(8.59)	(7.16)	(9.59)
Prod. growth (k,t)	-0.08	-0.06	-0.22	-0.29	-0.14	-0.30
	(0.11)	(0.17)	(0.09)	(0.11)	(0.09)	(0.11)
Fiscal balance (k,t)	0.06	-0.01	-0.08	-0.11	-0.11	-0.16
	(0.09)	(0.20)	(0.06)	(0.15)	(0.07)	(0.18)
Openness (k,t)	1.38	3.07	9.77	7.97	-4.19	4.32
	(3.05)	(3.59)	(6.02)	(6.96)	(8.23)	(8.00)
π (k,t)	---	---	-0.06	-0.30	-0.08	-0.30
			(0.13)	(0.22)	(0.18)	(0.24)
Adjusted R^2	0.89	0.94	---	---	---	---
R^2 due to p(k,t)	(.00 .04)	(.00 .02)	---	---	---	---
Autocorrelation [p]	[.40]	[.38]	[.29]	[.31]	[.31]	[.38]
# obs.	68	44	68	44	68	44

See the notes to Table 3. Time effects are included in all least squares specifications. The regression specification is equation (A4) in the appendix; [1] All right-hand side variables are assumed to be predetermined and hence are instrumented for. [2] Only p(k,t) and π(k,t) are assumed to be predetermined and instrumented for; the remaining variables in X are treated as exogenous.

Table 5: Eastern Europe

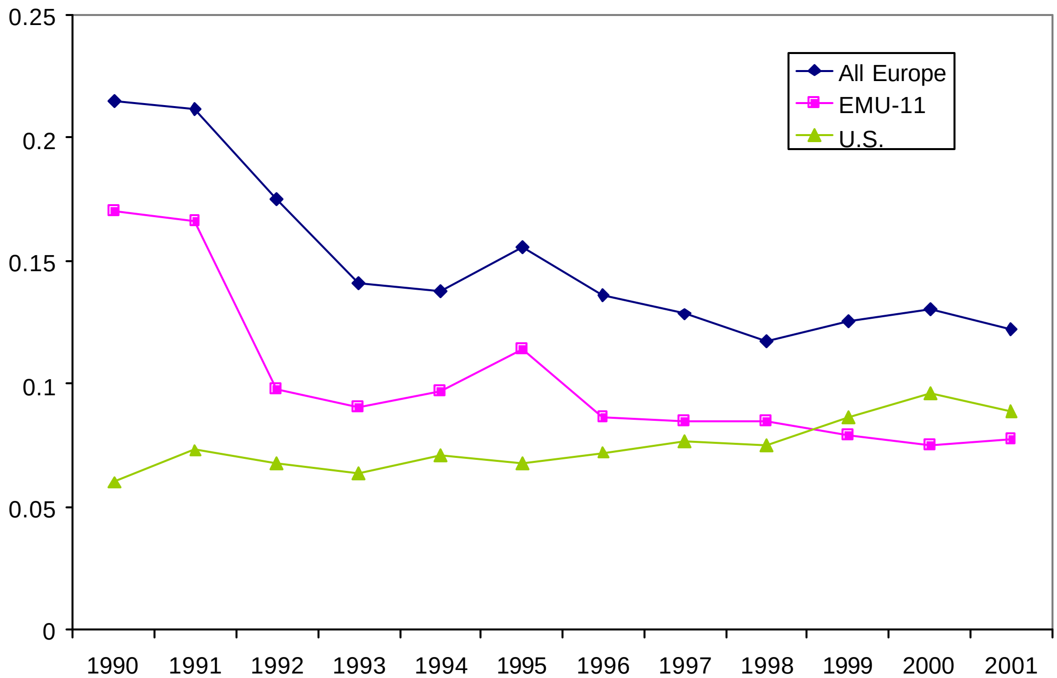
Price indexes for Lisbon and five East European cities
(European average = 1.0 in each year, for each index)

City	Price Index	1990	2001
Lisbon	Traded	0.69	0.86
	Non-traded	0.64	0.75
Budapest	T	0.44	0.53
	N	0.32	0.53
Prague	T	0.32	0.71
	N	0.17	0.72
Warsaw	T	0.30	0.66
	N	0.25	0.53
Bucharest	T	na	0.61
	N	na	0.48
Belgrade	T	na	0.60
	N	na	0.41

Note: indexes are normalized so that the “All Europe” average equals 1.0 for the each index in each year. “Equal weighting” is used to construct the indexes.

Figure 1: Traded Goods Price Dispersion in Europe and the United States

Equal Weights



CPI weights

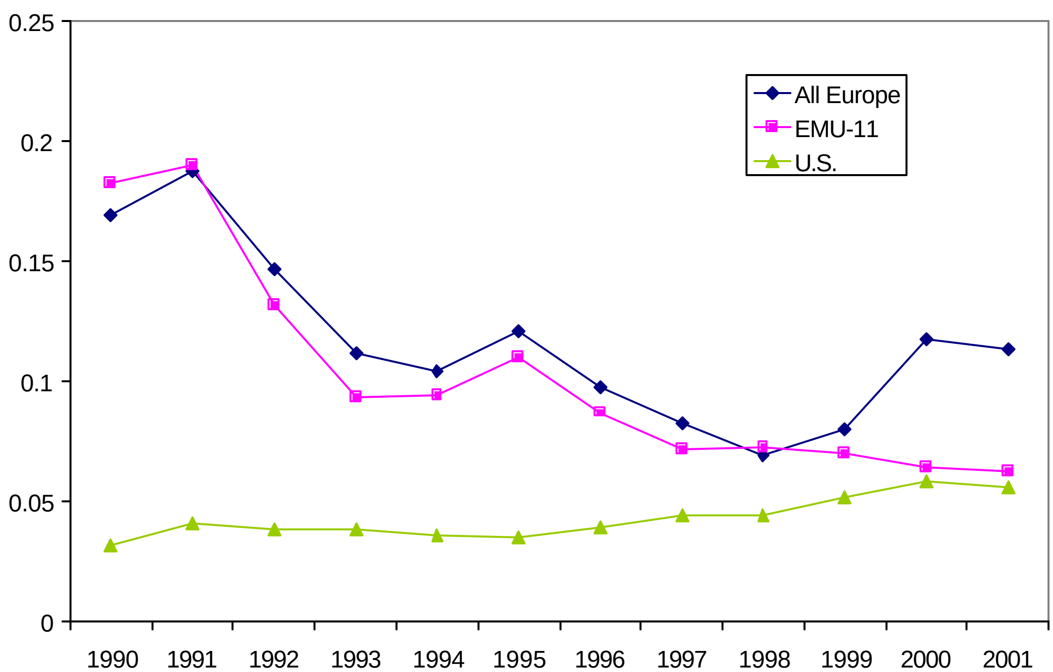
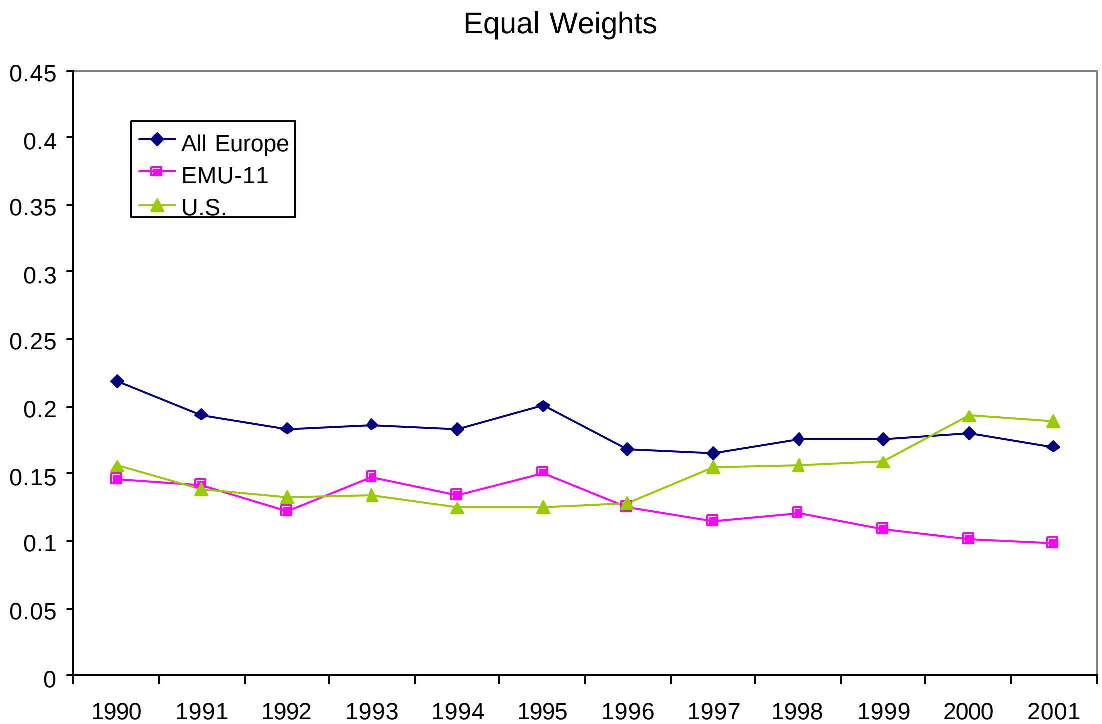


Figure 2: Non-Tradeables Price Dispersion in Europe and the United States



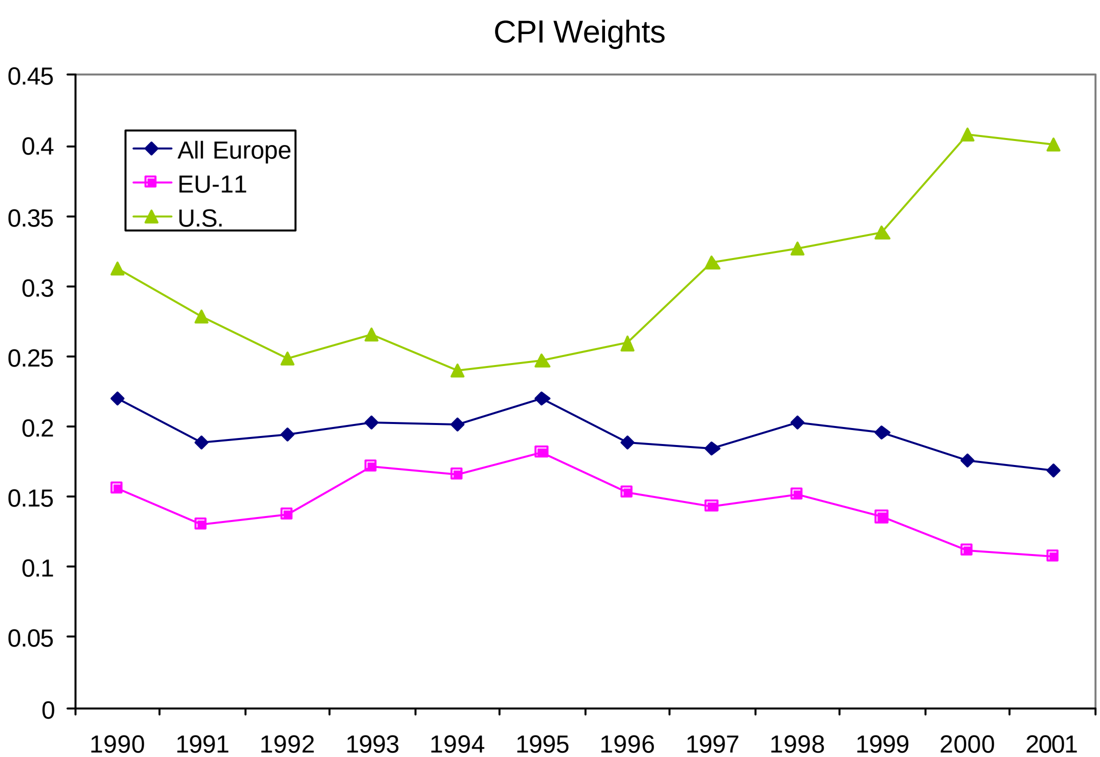


Figure 3: Price Dispersion by Item
(difference at two points in time)

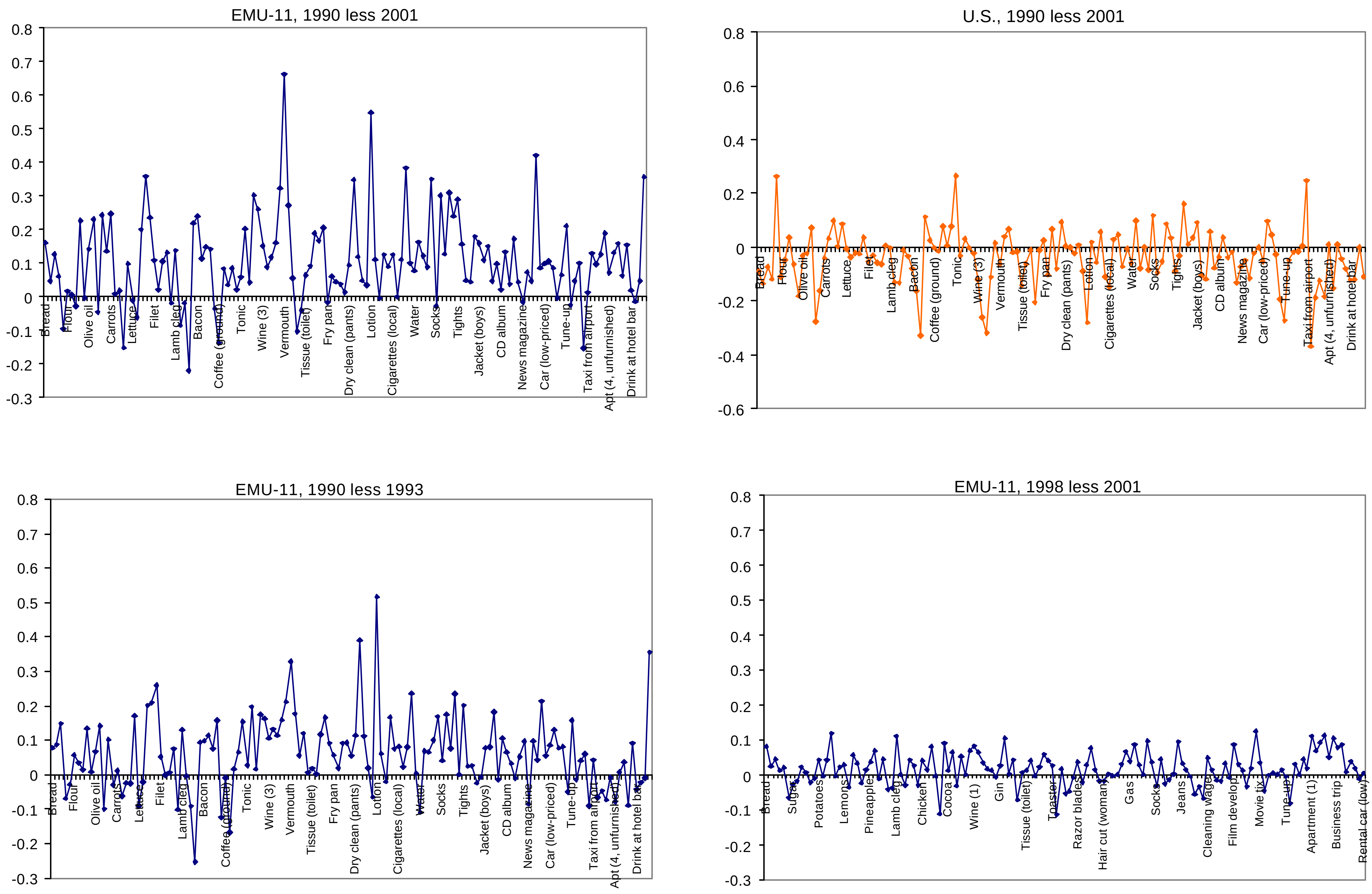
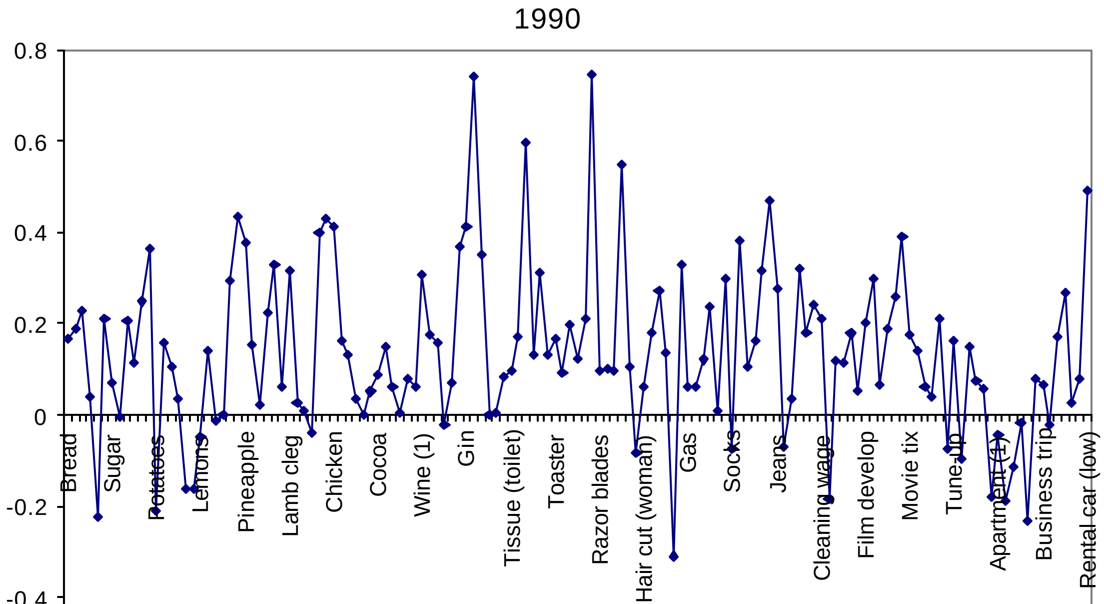


Figure 4: Price Dispersion in the EMU-11 versus the U.S., by Item



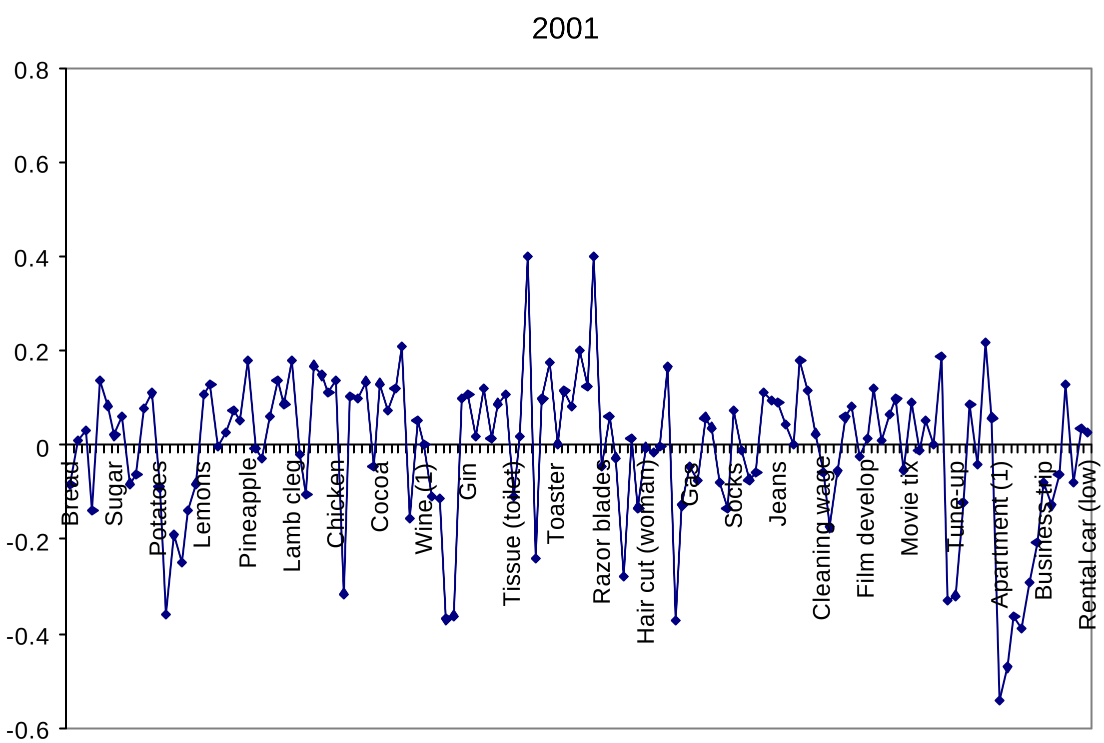


Figure 5: European Price Levels in 1990 and 2001

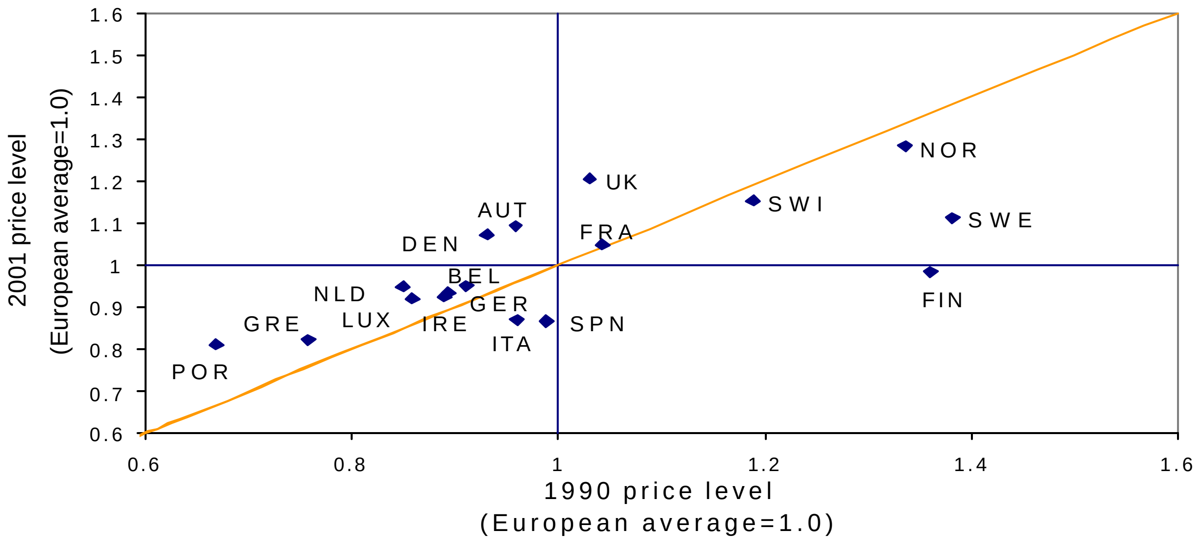


Figure 6: Inflation in the EMU-11

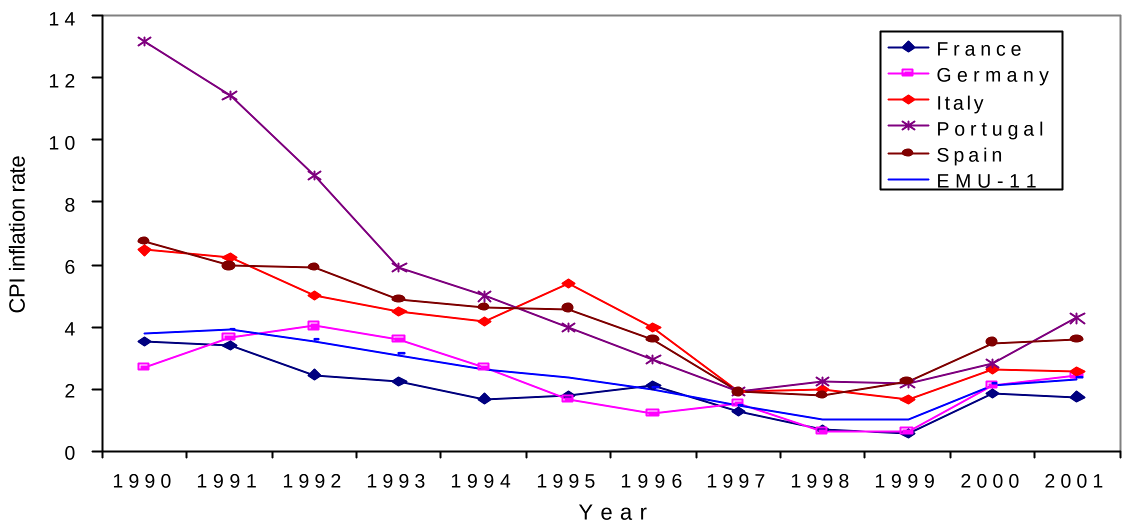
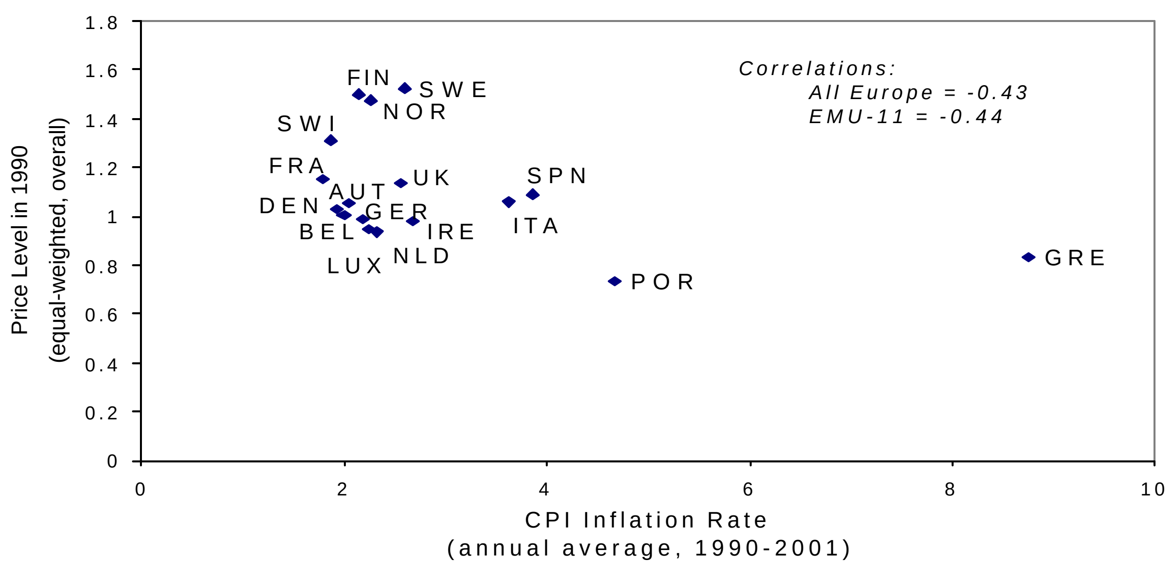


Figure 7: Initial Price Level and Subsequent Inflation (Europe)



Appendix:

I. How reliable are the EIU data? (Below)

II. Econometric issues (Below)

III. Tables

A-1. List of items in the EIU data set and year 2000 weights in price index (euro area avg. and U.S.)

IV. Figures

A-0. Traded goods price dispersion in the EMU-11 with alternative measure of dispersion
A-1. Scatter plot of income and price levels in Europe
A-2. Scatter plot of productivity growth and change in relative price of non-tradeables in Europe
A-3. Traded goods price dispersion in the EMU-11 with "pseudo-data" and actual EIU data
A-4. Scatter plot of 1990 income and 1991-2001 GDP growth rate
A-5. Scatter plot of estimated country dummies from panel regressions and EIU price levels
A-6. Scatter plot of estimated country dummies from panel regressions and GDP per capita

V. Data sources

CPI inflation rates, output gaps, and unit labor costs are from the OECD's Economic Outlook database. Per capita GDP relative to the U.S. is calculated at PPP exchange rate by the IMF, and was obtained from the IMFs World Economic Outlook database, available at **www.imf.org.** The merchandise imports and exports used to construct our openness measures were obtained from the IMFs Direction of Trade Statistics database. The "fiscal" variable is the general government financial balance, as a percent of GDP, is taken from the OECD's Economic Outlook database.

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I. How reliable are the EIU data?

At a heuristic level, constructing the indexes and selling them to multi-national corporations is big business for the EIU, one it has remained in for over twenty years. The indexes are published regularly in the Economist. My work with the underlying data seems to pass the "sniff test". For example, New York is always the most expensive of the U.S. cities, with an overall (cpi-weighted) price level typically 30 to 50 percent above the U.S. average. San Francisco is second, over-taking Chicago in 1997 presumably as a by-product of the boom in Silicon Valley, with housing prices rising notably fast. Pittsburgh and Atlanta are the lowest-price cities in the U.S. sample. For housing items such as apartment rents, prices in New York and San Francisco are as much as 10 times higher than in Pittsburgh; their non-tradeables indexes overall are nearly 2 ½ times higher than Pittsburgh's.

Another reason to have faith in the EIU data is that the price indexes I construct from the raw data share two important characteristics with other price level data sets that are highly-regarded and widely-used. First, low-price countries tend to be relatively poor countries, consistent with the Balassa-Samuelson proposition and as found by Kravis and Lipsey (1983) and Summers and Heston (1991). Figure A-1 depicts the positive relationship between GDP per capita and the overall, equal-weighted price index for Europe. Second, there is a positive cross-country correlation between the change in the relative price of non-traded goods to traded goods in the EIU data set and productivity growth (Figure A-2). This correlation is also found by DeGregorio, Giovannini, and Wolf (1994), who constructed price indexes for tradeables and non-tradeables from the OECD's inter-sectoral database.

One might be suspicious of the EIU data if its prices did not show the same general trend as official price data. To check for this, I did two things. First, I calculated the local-currency percentage price change from the previous year of every item in every year and every city. Averaging across items in each year produces a measure of overall price changes in city k. The correlation between the EIU price changes and the annual official CPI inflation rate over the period 1991-2001 is positive for every country, is greater than 0.34 in all countries but Ireland, and averages 0.50 for all European countries taken together. One would not expect perfect correlation, of course, if only because the sample of items in the EIU survey differs from what is in the CPI basket, or for the reasons discussed in Burstein, Eichenbaum, and Rebelo (2002).

Second, and interesting on its own, I calculated the implied law-of-one price exchange rate versus the U.S. dollar for every item in every city and year (for the "foreign" price, I used a simple average of the U.S. city prices). Averaging across items in each year produces a PPP exchange rate for each city. Aggregating across cities, as above, I compute a weighted-average PPP for the EMU-11. I compare these to OECD calculations of their "PPPs for GDP" (see http:/www.oecd.org/std/ppp/ for details). Both of these produce a swing in the PPP rate of about 40% over 1990-2001, which is unsurprising given the 42% change in the (weighted-average) nominal exchange rate versus the dollar. According to the EIU data, the EMU-11 currencies were overvalued by 27% in 1990, 12% just prior to the launch of the euro (1998), and undervalued by10% in 2001. By comparison the OECD reports a 15% euro overvaluation in 1990, an appropriately-valued euro in 1998, and a 25% undervaluation in 2001. Hence, although there is a gap between the EIU relative price levels and those used by the OECD, the difference is quite steady over time at about 12-15%, and hence would be unimportant for price *dispersion* measures.

Still, one might worry that my main results are an artifact of the data collection procedure, fearing perhaps that the large decline in price dispersion through 1994 was a result of more systematic data collection on the part of EIU survey teams. In an attempt to reassure on these grounds, I repeated the analysis of price dispersion in the EMU-11 after constructing "pseudo price levels" in a way that relies on the EIU data only in one year. To be specific, I undertook the following procedure:

(1) begin with local-currency values of the EIU prices for each item and city in 1995;
(2) obtain the official inflation rates of each CPI sub-component listed in table A-1, for every country in every year[27];
(3) construct "pseudo prices" for each item in each year 1990-1994 and 1996-2001 by projecting the official inflation data on the actual 1995 EIU prices;
(4) convert local-currency pseudo prices into dollars using the exchange rates provided in the EIU survey;
(5) calculate equal-weighted price indexes from the pseudo-data, as above;
(6) calculate the dispersion of the (pseudo) equal-weighted price indexes, as above.

The results, depicted in Figure A-3, indicate that the same general pattern of dispersion is observed in the pseudo-data, especially the sizable decline early in the sample. The correlation between the two dispersion measures depicted in the figure is 0.85.

[27]The components are the CP01 through CP11 categories listed in Table A-1. Early in the sample, inflation rates for several of the CPI components are unavailable for some countries. In those cases I used the inflation rate of "goods" for the tradeable items or "services" for non-tradeables.

II. Econometric issues

To see the problem with the standard fixed-effects estimator, rewrite equation (2)

$$p(cpi)_{k,t+1} = p(cpi)_{k,t} + \beta\, p(EIU)_{k,t} + \theta \mathbf{X}_{\mathbf{k,t}} + \alpha_k + \eta_t + u_{k,t+1} \qquad \text{(A1)}$$

This highlights the distinction between the EIU price level and CPI. If p(cpi) = p(EIU) = p, then

$$p_{k,t+1} = \gamma p_{k,t} + \theta \mathbf{X}_{\mathbf{k,t}} + \alpha_k + \eta_t + u_{k,t+1} \qquad \text{(A2)}$$

where $\gamma=(1+\beta)$. The standard estimation procedure is to start by eliminating the fixed effect α. This can be done in several ways, but typically one begins by removing the time mean of (A2) from (A2) itself

$$(p_{k,t+1} - p_k) = \gamma(p_{k,t} - p_k) + \theta(\mathbf{X}_{\mathbf{k,t}} - \mathbf{X}_{\mathbf{k}}) + u_{k,t+1}$$

where p_k and $\mathbf{X}_{\mathbf{k}}$ are the period average values. Because these averages contain future values of $p_{k,t}$ and $\mathbf{X}_{\mathbf{kt}}$ by construction, the error term $u_{k,t+1}$ is correlated with $(p_{k,t} - p_k)$ and, perhaps, $(\mathbf{X}_{\mathbf{k,t}} - \mathbf{X}_{\mathbf{k}})$ as well. Least-squares estimates of β (or γ) are clearly biased, even if k approaches infinity (assuming that t does not; here t=11).

In versions of (2) with $\pi_{k,t}$ on the right-hand side, things look similar

$$\pi_{k,t+1} = \varphi\pi_{k,t} + \beta\, p^{EIU}{}_{k,t} + \theta \mathbf{X}_{\mathbf{k,t}} + \alpha_k + \eta_t + u_{k,t+1} \qquad \text{(A3)}$$

Of course, in practice p(cpi) and p(EIU) are not the same. As noted in the text, this lessens the concern about biased least-squares estimates of β since there is less reason to think $p(EIU)_k$ and u_k are correlated. However, the two are not likely to be orthogonal either, since $\Delta p(cpi)$ and $\Delta p(EIU)$ have a correlation of about 0.5.

The Arellano-Bond suggestion for correcting the bias is to remove period means from each variable (to control for the time effects), first-difference the resulting variables to eliminate the country-effects, and then use lagged levels of all variables as instruments. Expressing variables as deviations from country means and rewriting (A3)

$$\pi_{k,t+1} - \pi_{k,t} = \varphi(\pi_{k,t} - \pi_{k,t-1}) + \beta(p^{EIU}{}_{k,t} - p^{EIU}{}_{k,t-1}) + \theta(\mathbf{X}_{\mathbf{k,t}} - \mathbf{X}_{\mathbf{k,t-1}}) + (u_{k,t+1} - u_{k,t}) \qquad \text{(A4)}$$

The instruments used are the lagged levels corresponding to the variables on the right-hand side of equation (A4). I estimate (A4) by instrumental variables over the period 1997-2001, treating as predetermined (and hence instrumenting for), alternatively (i) all variables on the right-hand side of (A4) or (ii) only p and π. I use as instruments lagged levels of all variables treated as predetermined.

Table A-1

EIU item	European category	US category	Avg. EMU-11 Weight (2000)	US Weight (2000)
Food & Non-Alcoh. Bevgs. (CP01)				
White bread, 1 kg	Bread and cereals	Cereals and bakery products	0.683	0.334
Butter, 500 g	Oils and fats	Fats and Oils	0.197	0.085
Margarine, 500g	Oils and fats	Fats and Oils	0.197	0.085
White rice, 1 kg	Bread and cereals	Cereals and bakery products	0.683	0.334
Spaghetti (1 kg)	Bread and cereals	Cereals and bakery products	0.683	0.334
Flour, white (1 kg)	Bread and cereals	Cereals and bakery products	0.683	0.334
Sugar, white (1 kg)	Sugar, jam, honey, chocolate, confection.	Sugar and sweets	1.295	0.406
Cheese, imported (500 g)	Milk, cheese and eggs	Dairy and related products plus eggs	0.951	0.393
Cornflakes (375 g)	Bread and cereals	Cereals and bakery products	0.683	0.334
Milk, pasteurised (1 l)	Milk, cheese and eggs	Dairy and related products plus eggs	0.951	0.393
Olive oil (1 l)	Oils and fats	Fats and Oils	0.197	0.085
Peanut or corn oil (1 l)	Oils and fats	Fats and Oils	0.197	0.085
Potatoes (2 kg)	Vegetables	Fresh vegs + 0.5 (processed fruits & vegs)	0.375	0.155
Onions (1 kg)	Vegetables	Fresh vegs + 0.5 (processed fruits & vegs)	0.375	0.155
Tomatoes (1 kg)	Fruit	Fresh fruits + 0.5 (processed fruits & vegs)	0.205	0.111
Carrots (1 kg)	Vegetables	Fresh vegs + 0.5 (processed fruits & vegs)	0.375	0.155
Oranges (1 kg)	Fruit	Fresh fruits + 0.5 (processed fruits & vegs)	0.205	0.111
Apples (1 kg)	Fruit	Fresh fruits + 0.5 (processed fruits & vegs)	0.205	0.111
Lemons (1 kg)	Fruit	Fresh fruits + 0.5 (processed fruits & vegs)	0.205	0.111
Bananas (1 kg)	Fruit	Fresh fruits + 0.5 (processed fruits & vegs)	0.205	0.111
Lettuce (one)	Vegetables	Fresh vegs + 0.5 (processed fruits & vegs)	0.375	0.155
Eggs (12)	Milk, cheese and eggs	Dairy & related products and eggs	0.951	0.393
Peas, canned (250 g)	Vegetables	Fresh vegs + 0.5 (processed fruits & vegs)	0.375	0.155
Peaches, canned (500 g)	Fruit	Fresh fruits + 0.5 (processed fruits & vegs)	0.205	0.111
Sliced pineapples, can (500 g)	Fruit	Fresh fruits + 0.5 (processed fruits & vegs)	0.205	0.111
Beef: filet mignon (1 kg)	Meat	Meats	0.431	0.156
Beef: steak, entrecote (1 kg)	Meat	Meats	0.431	0.156
Beef: stewing, shoulder (1 kg)	Meat	Meats	0.431	0.156
Beef: roast (1 kg)	Meat	Meats	0.431	0.156
Beef: ground or minced (1 kg)	Meat	Meats	0.431	0.156
Lamb: leg (1 kg)	Meat	Meats	0.431	0.156
Lamb: chops (1 kg)	Meat	Meats	0.431	0.156
Pork: chops (1 kg)	Meat	Meats	0.431	0.156
Pork: loin (1 kg)	Meat	Meats	0.431	0.156
Ham: whole (1 kg)	Meat	Meats	0.431	0.156
Bacon (1 kg)	Meat	Meats	0.431	0.156
Chicken: fresh (1 kg)	Meat	Meats	0.431	0.156
Frozen fish fingers (1 kg)	Fish and seafood	Fish and seafood	0.790	0.202
Fresh fish (1 kg)	Fish and seafood	Fish and seafood	0.790	0.202
Instant coffee (125 g)	Coffee, tea and cocoa	Beverage materials including coffee & tea	0.119	0.066
Ground coffee (500 g)	Coffee, tea and cocoa	Beverage materials including coffee & tea	0.119	0.066
Tea bags (25 bags)	Coffee, tea and cocoa	Beverage materials including coffee & tea	0.119	0.066
Cocoa (250 g)	Coffee, tea and cocoa	Beverage materials including coffee & tea	0.119	0.066
Drinking chocolate (500 g)	Coffee, tea and cocoa	Beverage materials including coffee & tea	0.119	0.066
Coca-Cola (1 l)	Minrl. water, soft drinks, fruit & veg juices	Juices and non-alcoholic drinks	0.260	0.229
Tonic water (200 ml)	Minrl. water, soft drinks, fruit & veg juices	Juices and non-alcoholic drinks	0.260	0.229
Mineral water (1 l)	Minrl. water, soft drinks, fruit & veg juices	Juices and non-alcoholic drinks	0.260	0.229
Orange juice (1 l)	Minrl. water, soft drinks, fruit & veg juices	Juices and non-alcoholic drinks	0.260	0.229

EIU item	European category	US category	Avg. EMU-11 Weight (2000)	US Weight (2000)
Alcoholic Bevgs. & Tobacco (CP02)				
Wine, common table (1 l)	Wine	Wine at home	0.357	0.095
Wine, superior quality (700 ml)	Wine	Wine at home	0.357	0.095
Wine, fine quality (700 ml)	Wine	Wine at home	0.357	0.095
Beer, local brand (1 l)	Beer	Beer, ale, & other malt bevgs. at home	0.440	0.227
Beer, top quality (330 ml)	Beer	Beer, ale, & other malt bevgs. at home	0.440	0.227
Scotch whisky, six years old (700 ml)	Spirits	Distilled spirits at home	0.143	0.028
Gin, Gilbey's or equivalent (700 ml)	Spirits	Distilled spirits at home	0.143	0.028
Vermouth, Martini & Rossi (1 l)	Spirits	Distilled spirits at home	0.143	0.028
Cognac, French VSOP (700 ml)	Spirits	Distilled spirits at home	0.143	0.028
Liqueur, Cointreau (700 ml)	Spirits	Distilled spirits at home	0.143	0.028
Cigarettes, Marlboro (pack of 20)	Tobacco	Tobacco and smoking products	1.168	0.602
Cigarettes, local brand (pack of 20)	Tobacco	Tobacco and smoking products	1.168	0.602
Pipe tobacco (50 g)	Tobacco	Tobacco and smoking products	1.168	0.602
Miscellaneous (CP12)				
Soap (100 g)	Personal care	Personal care	0.316	0.436
Toilet tissue (two rolls)	Personal care	Personal care	0.316	0.436
Aspirins (100 tablets)	Personal care	Personal care	0.316	0.436
Razor blades (five pieces)	Personal care	Personal care	0.316	0.436
Toothpaste with fluoride (120 g)	Personal care	Personal care	0.316	0.436
Facial tissues (box of 100)	Personal care	Personal care	0.316	0.436
Hand lotion (125 ml)	Personal care	Personal care	0.316	0.436
Lipstick (deluxe type)	Personal care	Personal care	0.316	0.436
Man's haircut (tips included) *[N]*	Personal care	Personal care	0.316	0.436
Woman's cut & blow dry (tips incl.) *[N]*	Personal care	Personal care	0.316	0.436
Furnish. & Household Equip. (CP05)				
Laundry detergent (3 l)	Gds & serv- routine household maint.	Housekeeping supplies	1.212	0.572
Dishwashing liquid (750 ml)	Gds & serv- routine household maint.	Housekeeping supplies	1.212	0.572
Insect-killer spray (330 g)	Tools & equip. for house & garden	Tools, hardware, outdoor equip. & supp.	0.266	0.369
Light bulbs (two, 60 watts)	Tools & equip. for house & garden	Tools, hardware, outdoor equip. & supp.	0.266	0.369
Frying pan (Teflon or good equivalent)	Household appliances	Appliances	0.702	0.204
Electric toaster (for two slices)	Household appliances	Appliances	0.702	0.204
Hourly rate, domestic cleaning help *[N]*	Domestic & household services	Household operations	0.358	0.412
Maid's monthly wages (full time) *[N]*	Domestic & household services	Household operations	0.358	0.412
Babysitter's rate per hour *[N]*	Domestic & household services	Household operations	0.358	0.412
Recreation and Culture (CP09)				
Batteries (two, size D/LR20)	Recreation and culture	Recreation	1.163	0.761
Compact disc album	Recreation and culture	Recreation	1.163	0.761
Television, colour (66 cm)	Recreation and culture	Recreation	1.163	0.761
Kodak colour film (36 exposures)	Recreation and culture	Recreation	1.163	0.761
Cost of developing 36 color pictures *[N]*	Recreation and culture	Recreation	1.163	0.761
Daily local newspaper *[N]*	Recreation and culture	Recreation	1.163	0.761
Internat. weekly news magazine (Time)	Recreation and culture	Recreation	1.163	0.761
Paperback novel (at bookstore)	Recreation and culture	Recreation	1.163	0.761
Four best seats at theatre/concert *[N]*	Recreation and culture	Recreation	1.163	0.761
Four best seats at cinema *[N]*	Recreation and culture	Recreation	1.163	0.761
Communications (CP08)				
Telephone and line, monthly rental *[N]*	Telephone & telefax equip. & serv.	Telephone services	2.416	2.765

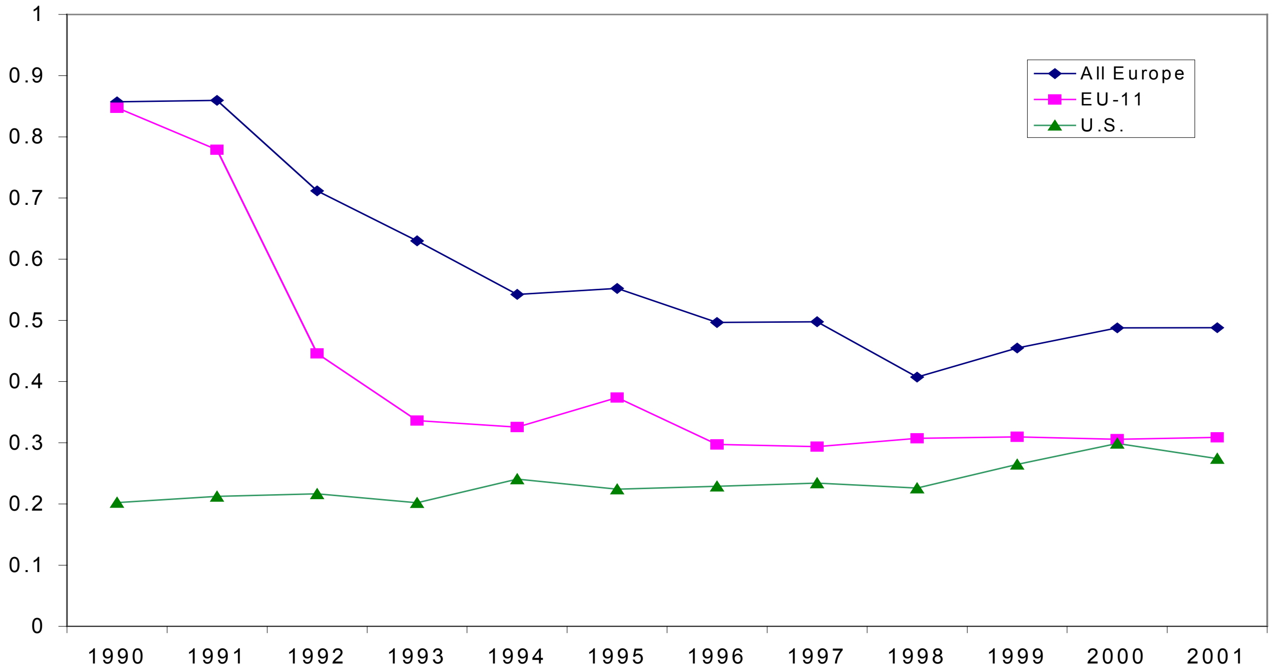
[N] - denotes classification as non-traded

EIU item	European category	US category	Avg. EMU-11 Weight (2000)	US Weight (2000)
Clothing and Footwear (CP03)				
Laundry (one shirt) *[N]*	Clean, repair, hire of clothing	Laundry and dry cleaning services	0.051	0.070
Dry cleaning, man's suit *[N]*	Clean, repair, hire of clothing	Laundry and dry cleaning services	0.051	0.070
Dry cleaning, woman's dress *[N]*	Clean, repair, hire of clothing	Laundry and dry cleaning services	0.051	0.070
Dry cleaning, trousers *[N]*	Clean, repair, hire of clothing	Laundry and dry cleaning services	0.051	0.070
Business suit, two piece, medium weight	Garments	Apparel not including footwear	0.509	0.344
Business shirt, white	Garments	Apparel not including footwear	0.509	0.344
Men's shoes, business wear	Garments	Apparel not including footwear	0.509	0.344
Mens raincoat, Burberry type	Garments	Apparel not including footwear	0.509	0.344
Socks, wool mixture	Garments	Apparel not including footwear	0.509	0.344
Dress, ready to wear, daytime	Garments	Apparel not including footwear	0.509	0.344
Women's shoes, town	Footwear including repair	Footwear	0.604	0.330
Women's cardigan sweater	Garments	Apparel not including footwear	0.509	0.344
Women's raincoat, Burberry type	Garments	Apparel not including footwear	0.509	0.344
Tights, panty hose	Garments	Apparel not including footwear	0.509	0.344
Child's jeans	Garments	Apparel not including footwear	0.509	0.344
Child's shoes, dresswear	Footwear including repair	Footwear	0.604	0.330
Child's shoes, sportswear	Footwear including repair	Footwear	0.604	0.330
Girl's dress	Garments	Apparel not including footwear	0.509	0.344
Boy's jacket, smart	Garments	Apparel not including footwear	0.509	0.344
Boy's dress trousers	Garments	Apparel not including footwear	0.509	0.344
Housing, Water and Electricity (CP04)				
Electricity, monthly bill *[N]*	Electricity	Electricity	2.644	3.302
Gas, monthly bill *[N]*	Gas	Utility natural gas service	1.350	1.493
Water, monthly bill *[N]*	Water supply	Water and sewerage maintenance	0.806	0.885
Furnished residential apartment: 1 bedrm *[N]*	Actual rentals for housing	Owners' equiv. rent of primary residence	1.005	4.524
Furnished residential apartment: 2 bedrm *[N]*	Actual rentals for housing	Owners' equiv. rent of primary residence	1.005	4.524
Unfurnished residential apt: 2 bedrms *[N]*	Actual rentals for housing	Owners' equiv. rent of primary residence	1.005	4.524
Unfurnished residential apt: 3 bedrms *[N]*	Actual rentals for housing	Owners' equiv. rent of primary residence	1.005	4.524
Unfurnished residential apt: 4 bedrms *[N]*	Actual rentals for housing	Owners' equiv. rent of primary residence	1.005	4.524
Unfurnished residential house: 3 bedrms *[N]*	Actual rentals for housing	Owners' equiv. rent of primary residence	1.005	4.524
Transport (CP07)				
Low priced car (900-1299 cc)	Transport	Transportation	1.441	1.649
Compact car (1300-1799 cc)	Transport	Transportation	1.441	1.649
Family car (1800-2499 cc)	Transport	Transportation	1.441	1.649
Deluxe car (2500 cc upwards)	Transport	Transportation	1.441	1.649
Yearly road tax or registration fee *[N]*	Transport	Transportation	1.441	1.649
Cost of a tune up (but no major repairs) *[N]*	Transport	Transportation	1.441	1.649
Annual premium for car insurance *[N]*	Transport	Transportation	1.441	1.649
Regular unleaded petrol (1 l) *[N]*	Transport	Transportation	1.441	1.649
Taxi: initial meter charge *[N]*	Transport	Transportation	1.441	1.649
Taxi rate per additional kilometre *[N]*	Transport	Transportation	1.441	1.649
Taxi: airport to city centre *[N]*	Transport	Transportation	1.441	1.649
Business trip, typical daily cost *[N]*	Transport	Transportation	1.441	1.649
Hire car, weekly rate *[N]*	Transport	Transportation	1.441	1.649
Restaurants and Hotels (CP11)				
Three course dinner for four people *[N]*	Restaurants and hotels	Food + lodging away from home	2.160	1.729
One drink at bar of first class hotel *[N]*	Restaurants and hotels	Food + lodging away from home	2.160	1.729
Two-course meal for two people *[N]*	Restaurants and hotels	Food + lodging away from home	2.160	1.729
Simple meal for one person *[N]*	Restaurants and hotels	Food + lodging away from home	2.160	1.729
Hilton-type hotel, 1 rm, 1 night incl. brkfst. *[N]*	Restaurants and hotels	Food + lodging away from home	2.160	1.729
Moderate hotel, 1 rm, 1 night incl. brkfst *[N]*	Restaurants and hotels	Food + lodging away from home	2.160	1.729

[N] - denotes classification as non-traded

Figure A-0: Alternative Measure of Price Dispersion: Max – Min Spread (Traded Goods)

Equal Weights



CPI Weights

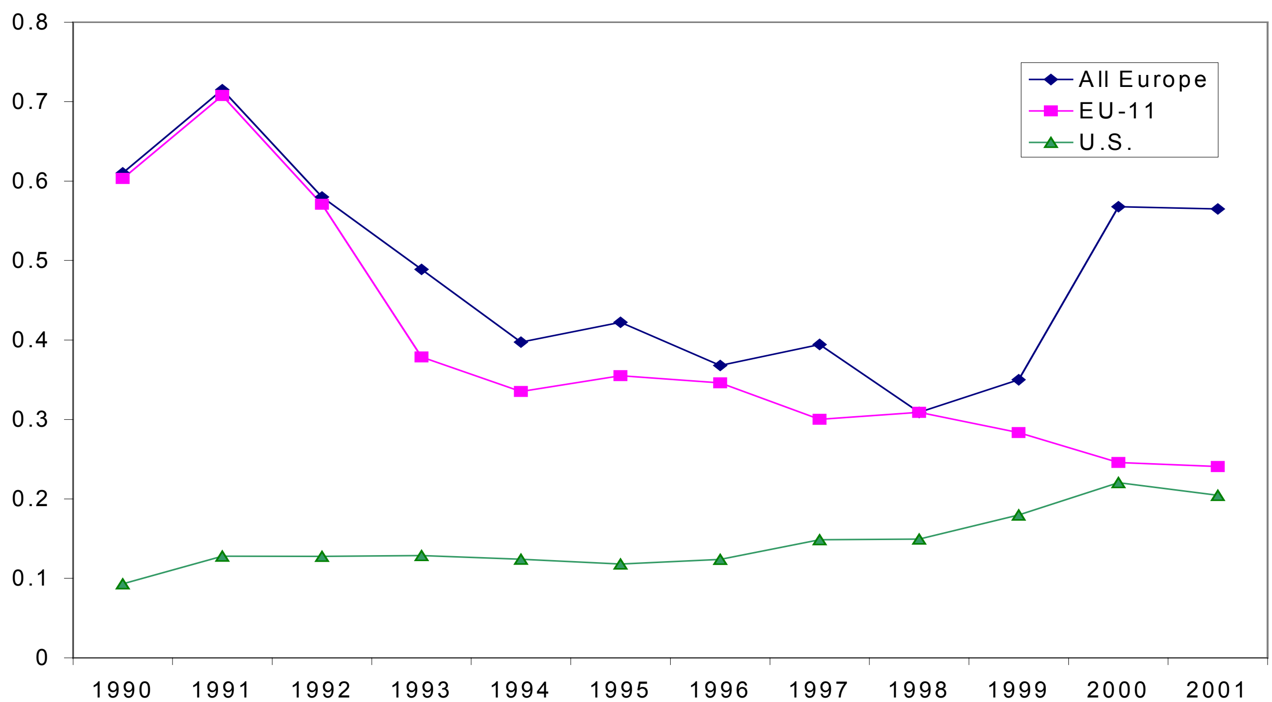


Figure A-1: Income and Price Level (All Europe)

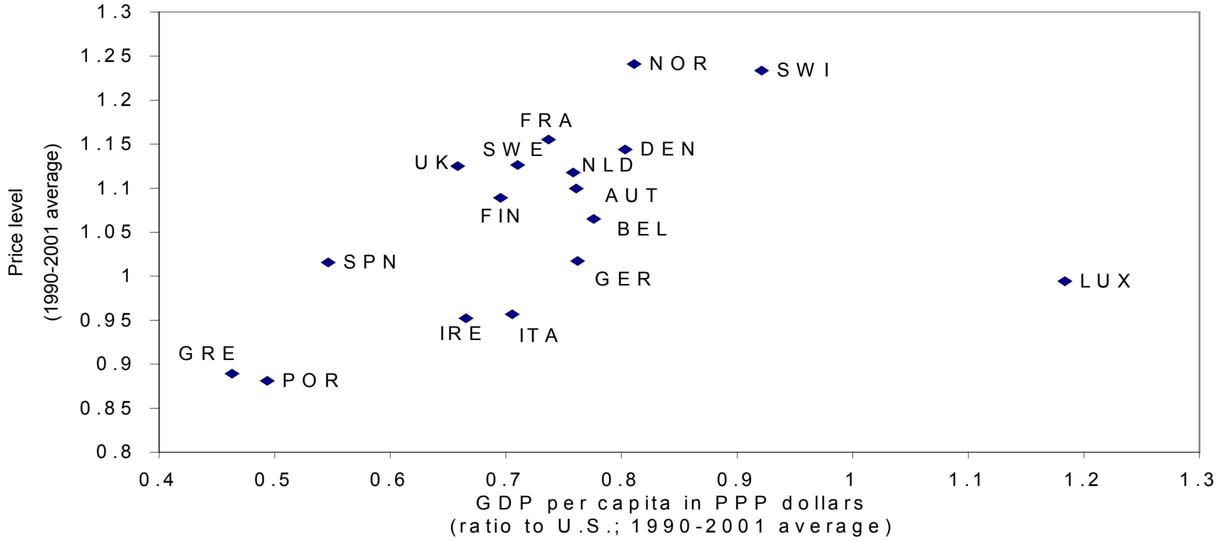


Figure A-2: Productivity and the Relative Price of Non-Tradeables
("All Europe" sample)

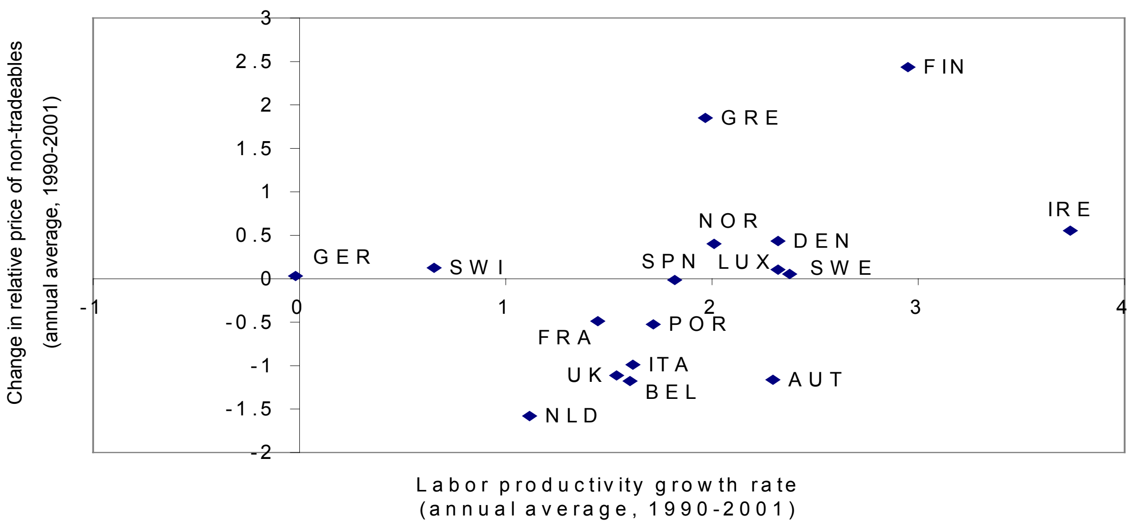


Figure A-3: Traded Goods Price Dispersion, EMU-11
(actual EIU data vs. "pseudo" data constructed with 1995 base)

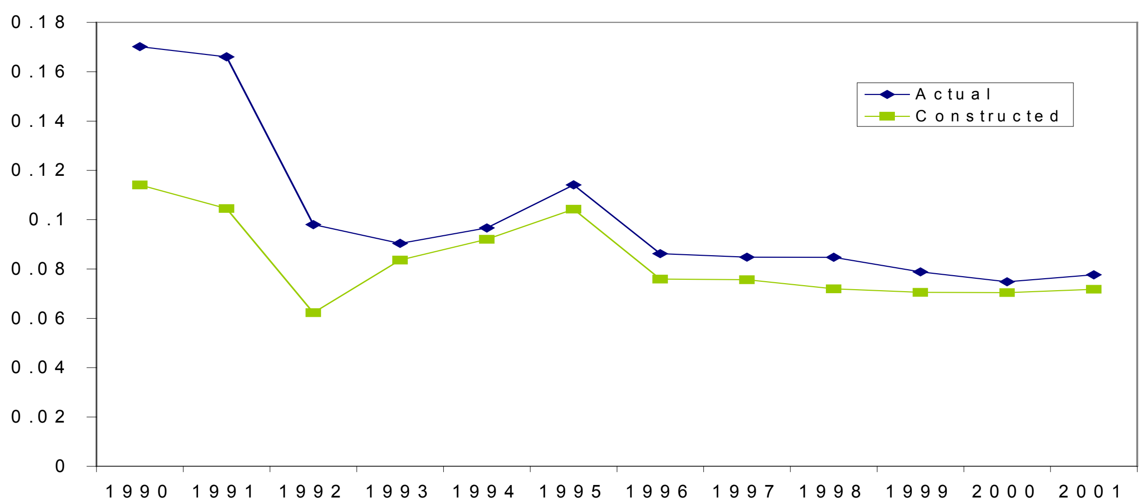


Figure A-4: Initial Income and Subsequent Growth

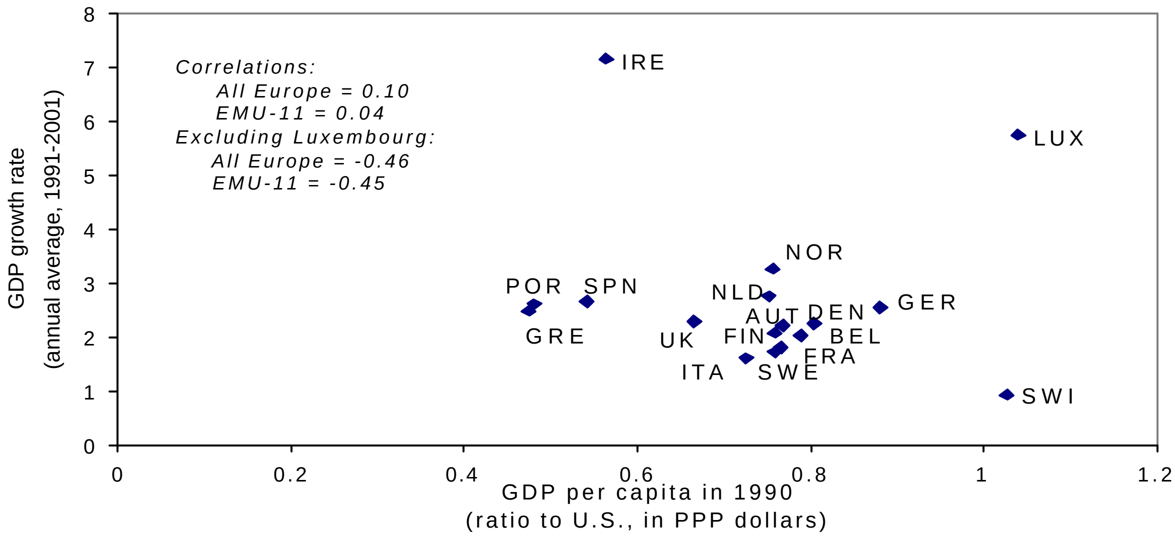


Figure A-5: Country Effects and Price Levels

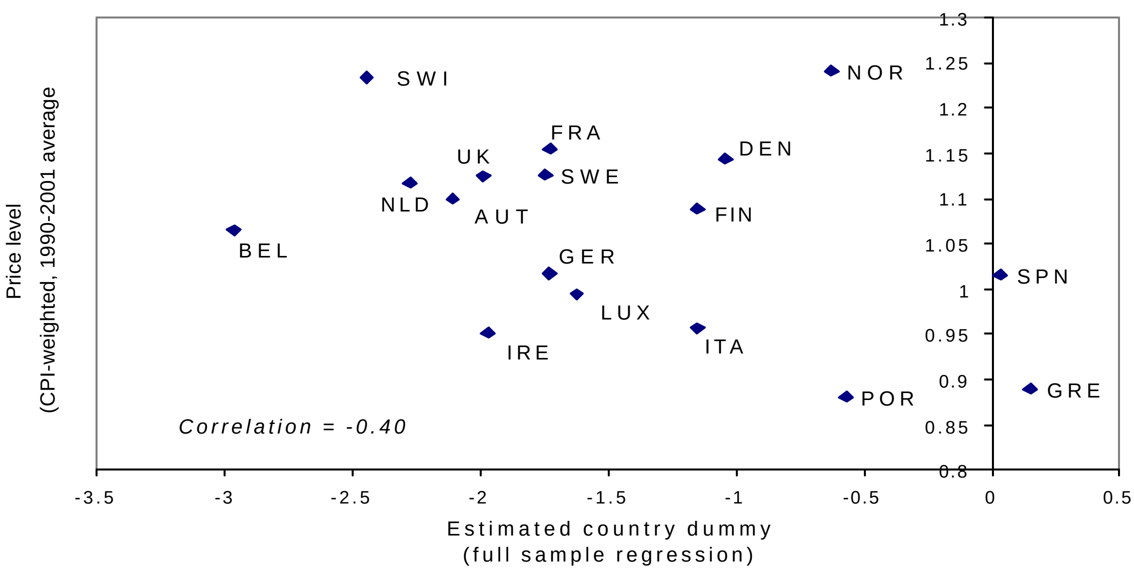


Figure A-6: Country Effects and Income