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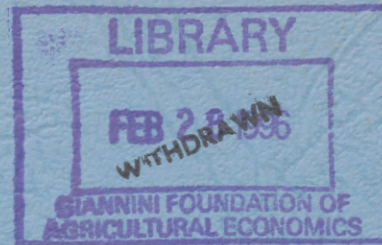
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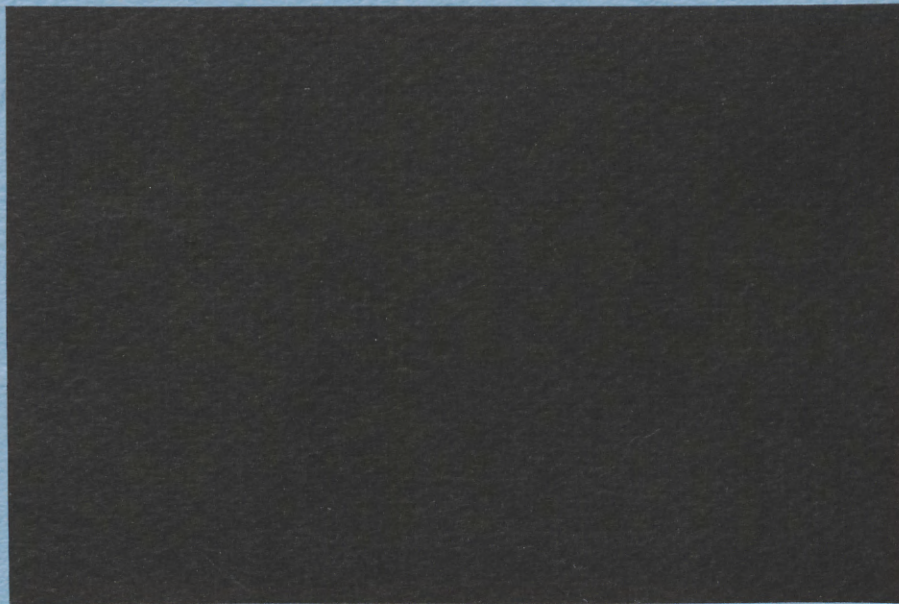
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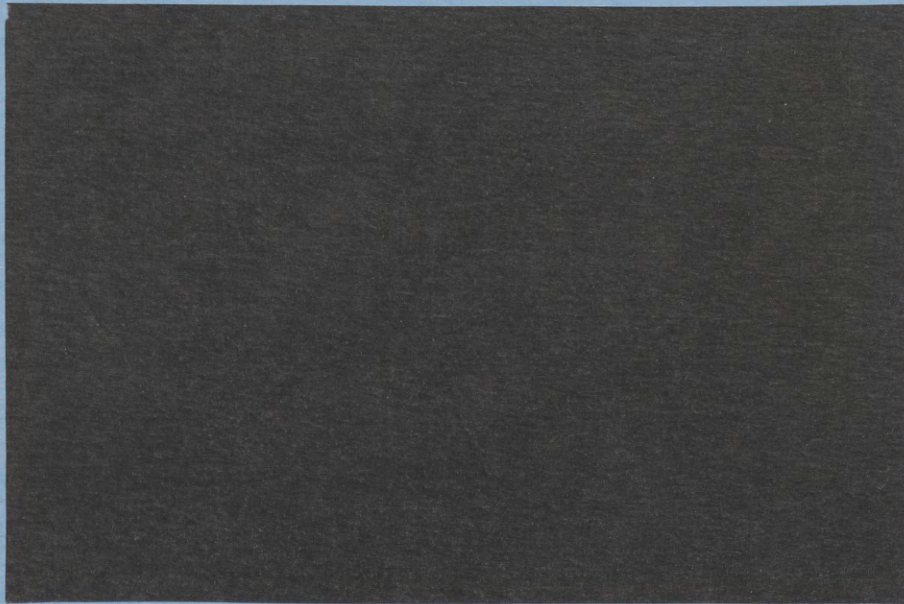
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Founded by Raymond R. Sackler, M.D., and Mortimer D. Sackler, M.D.

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TRADE LIBERALIZATION AND INCOME EQUALIZATION:
A LONG-RUN PERSPECTIVE

by

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A B S T R A C T

An examination of the impact of trade reform on the behavior of income differentials among countries provides the setting for the utilization of an income convergence test that differs from the conventional cross-country regressions. The existence, or non-existence, of convergence involves joint estimation of augmented Dickey-Fuller type equations using seemingly unrelated regression (SUR) techniques. Monte Carlo simulations are used to calculate the critical values which are in turn used to determine the significance of convergence. The findings here provide support for a link between trade liberalization and income convergence.

I. INTRODUCTION

This paper examines the relationship between trade liberalization and income convergence among countries. It represents an attempt at validating and corroborating the Ben-David (1993) results showing a very strong link between the two. As in that paper, the focus will be on the trade reforms that occurred in Europe during the postwar period. The primary difference between the two papers is methodological and therein lies the primary contribution of this paper. It introduces an alternative to the conventional method for determining the existence of income convergence among relatively small groups of countries.

In most studies that focus on the income convergence issue, the common practice has been, and in many cases still continues to be, based on estimation of cross-country regressions that examine the relationship between countries' average rates of growth over a period and their starting levels of income, plus a host of other variables than one wishes to control for (see for example: Baumol, 1986; Barro, 1991; Mankiw, Romer and Weil, 1992; etc.). A negative relationship between the growth rates and the respective initial income levels is understood to imply convergence.

These cross-country regressions have come under some criticism by Friedman (1992) and Quah (1993) for having regression to the mean tendencies that bias the results. The convergence concept that is developed here is conceptually closer to the Friedman (1992) and Hotelling (1933) notion that depicts, in Hotelling's words as quoted by Friedman, "a consistent diminution of variance . . . among individual" countries.

In Ben-David (1993), convergence was determined by *pooling* the countries within the given groups. A variant of the Ben-David (1993) convergence measure is introduced here that makes it possible to account for the existence of contemporaneous shocks through simultaneous estimations (using the seemingly unrelated regression method) of augmented Dickey-Fuller (ADF) equations. Since the usual ADF critical values do not apply in such a framework, we use Monte Carlo simulations to derive critical values for determining the significance of the results.

The convergence model is developed in the next section and the outcomes of the estimation appear in section three. Section four concludes.

Despite the differences in the convergence measures, the findings in this paper corroborate the Ben-David (1993) results showing a strong relationship between periods of trade liberalization and periods of income convergence.

II. THE CONVERGENCE MODEL

Let $y_{i,t}$ be the log real per capita income of any country i (within a group comprising n countries) and \bar{y}_t equal the group average log real per capita income in year t . Convergence or divergence of incomes may be described by

$$(1) \quad y_{i,t} - \bar{y}_t = \phi (y_{i,t-1} - \bar{y}_{t-1}) + \epsilon_{i,t}$$

where a result of $\phi < 1$ indicates convergence. Pooling together countries within specified groups, Ben-David (1993) uses this equation to examine the behavior of income differentials over time within the groups.

Pooling however, raises the question of whether outcomes might have been affected by contemporaneous shocks that pooling cannot account for. Therefore, instead of pooling the countries, this paper examines the convergence question by *jointly* estimating Equation (1) for each country within a given group and calculating the critical values needed for testing whether ϕ is less than unity.

Letting $z_{i,t}$ equal $y_{i,t} - \bar{y}_t$, the testable hypothesis about convergence within a group of countries can be summarized by $z_{i,t} = \phi z_{i,t-1}$ which in an augmented Dickey-Fuller (ADF) framework (Nelson and Plosser, 1982), can be written as

$$(2) \quad z_{i,t} = \phi_i z_{i,t-1} + \sum_{j=1}^p \delta_{ij} \Delta z_{i,t-j} + e_{i,t}$$

where $\Delta z_{i,t} = z_{i,t} - z_{i,t-1}$. In this case, the convergence implication of $\phi_i < 1$ boils down to a test of the unit root hypothesis. For a simple Dickey-Fuller test, $p = 0$.

Since the usual Dickey-Fuller table values for a unit root test are constructed under the assumption of $\phi_i = 1$ and $p = 0$ for $i = 1, \dots, n$ countries, this may have an effect on the small sample distribution (Evans, 1989). Hence, Monte Carlo simulations are conducted to obtain precise significance levels by tailoring the experiment to the specific data series used here.

The testing methodology of this model is distinct as well, with the Dickey-Fuller test being performed jointly in an n -country system. There are both economic and statistical reasons for doing so. The economic reason is quite intuitive in that the EEC countries are highly interdependent. This implies that the error covariance structure of $e_{i,t}$ is not a diagonal one,

which allows shocks to transmit across countries. As for the statistical reason, the simulation is carried out in a GLS framework using the seemingly unrelated regression method, which has been found to improve the power of the test vis-a-vis the OLS equation by equation method (Abuaf and Jorion, 1990). The simulation is carried out subject to constraints that the coefficients on $z_{i,t-1}$ be equal across all countries.

III. RESULTS

From a historical standpoint, the six countries¹ that later formed the European Economic Community (EEC) began to liberalize trade soon after the end of the Second World War within the framework of the Organization for European Economic Cooperation (OEEC, the predecessor of today's OECD). This liberalization received a considerable boost with the creation of the EEC in the late fifties. By comparison, there were considerable restrictions on trade between these countries during the prewar years.

The distinction between the pre- and postwar income gaps (z_i 's) is highlighted in Figures 1 and 2. While there does not appear to have been any noticeable narrowing of this gap prior to the Second World War, there seems to be considerable convergence towards the mean following the War.

¹ These six original member countries of the EEC include Belgium, France, West Germany, Italy, Luxembourg and the Netherlands.

An estimation of Equation 2 bears this out (Table 1). While income differentials remained relatively constant between 1900 and 1933, this was not the case between 1950 and 1985 as the EEC countries exhibited a marked reduction in the income gaps.

The SUR estimates of Equation 2 for the prewar period were made using Maddison's (1989) data. The simulation is carried out in a GLS framework (SUR) subject to constraints that the autoregressive parameter ϕ be equal across all countries. Because of the data's lack of the reliability during World War I, the middle observations from 1914 to 1919 are omitted from the analysis. Furthermore, since Maddison does not provide data on Luxembourg, the analysis

is conducted on the five remaining countries. As a check of how much this omission may bias the results, Equation 2 was estimated during the postwar using Summers and Heston (1991) data as well, first without Luxembourg, and then including the country. As stated above, the results

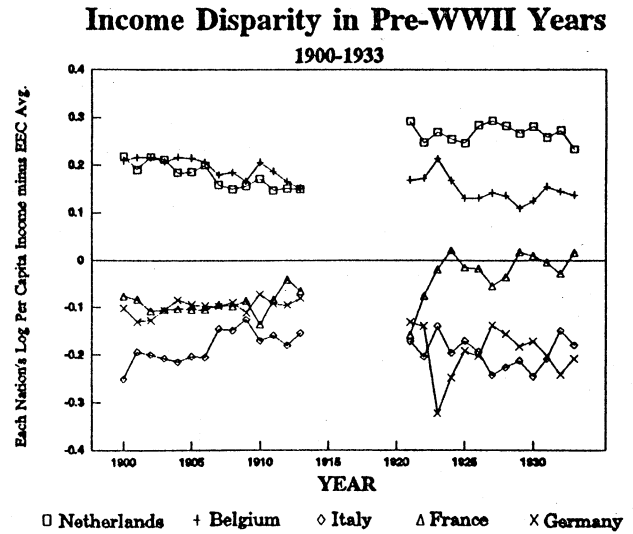


Figure 1

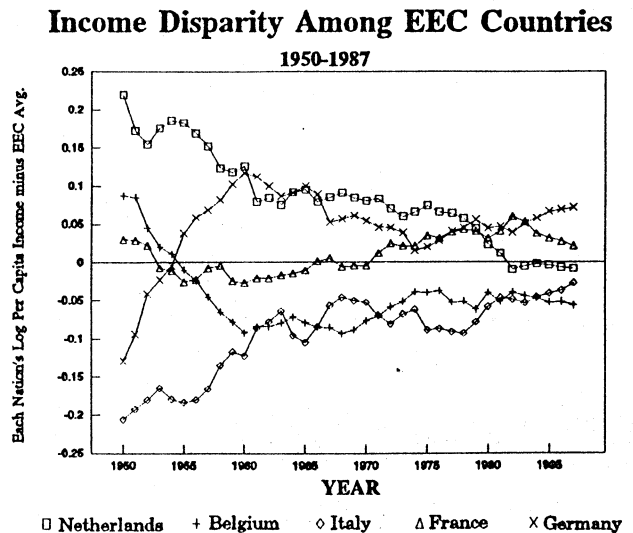


Figure 2

Table 1 **Unit Root Test Results:**
Comparison of Prewar to Postwar Results in the EEC

$z_{i,t} = \phi_i z_{i,t-1} + \sum_{j=1}^p \delta_{ij} \Delta z_{i,t-j} + e_{i,t}$						
Group	Period	p	$\hat{\phi}$	Calculated $t_{\hat{\phi}}$	Critical t for $H_0: \phi=1$	
					2%	10%
Maddison (1989) Data						
EEC5	1900-1933	2	.963	-1.69	-3.02	-2.17
EEC5	1947-1987	1	.937	-5.24 ***	-2.99	-2.10
Summers and Heston (1991) Data						
EEC5	1950-1988	1	.939	-4.36 ***	-2.69	-1.99
EEC6	1950-1988	1	.940	-5.11 ***	-2.93	-2.09

*** Significantly different from unity at the one percent level.

EEC5: France, Belgium, Germany, Italy and the Netherlands.

EEC6: EEC5 plus Luxembourg.

The sampling distribution is based on 2000 replications. The data are generated using (a) given covariance = var-cov($z_{i,t}$), and (b) actual initial values. Three different lags ($p=1,2,3$) are tried, but the final selection of p is based on the white noise residuals and the conventional significance of t -values.

indicate significant convergence only during the postwar period.

The Summers and Heston data, which are based on purchasing power parities rather than official exchange rates, are particularly useful for measuring annual disparities among

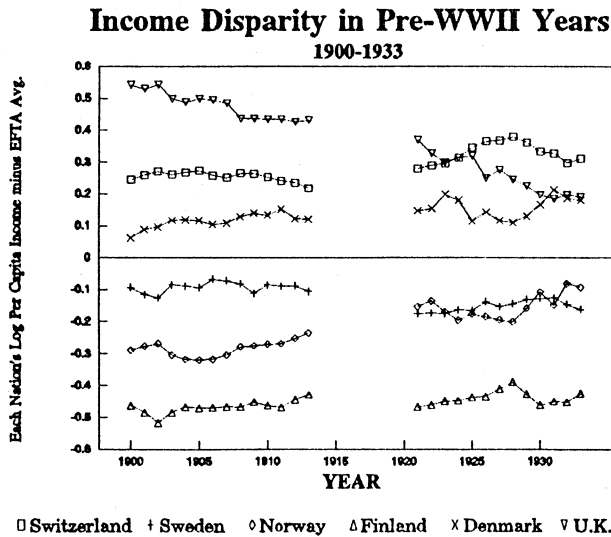


Figure 3

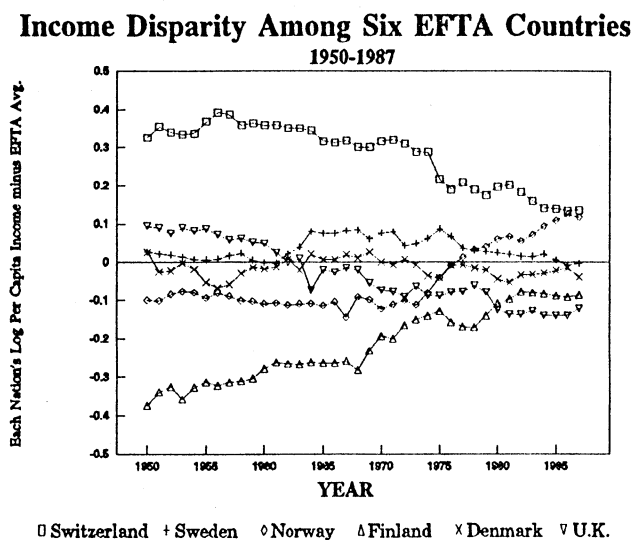


Figure 4

countries.² The results from these data support the postwar Maddison results and the estimated ϕ 's are nearly identical.

The uniqueness of these results may be evaluated through a comparison with the outcomes from several other country groupings. Another group of countries that significantly liberalized trade during the postwar period were the countries of the European Free Trade Association, or EFTA.³ These countries removed trade barriers not only among themselves, but also with their main trade partners, the countries of the EEC.

As in the case of the EEC, the visual evidence (Figures 3 and 4) indicates fairly stationary gaps for each of the countries prior to WWII. These gaps

² The Summers and Heston data cover only the postwar period.

³ These countries include Austria, Denmark, Finland, Norway, Portugal, Sweden, Switzerland, and the United Kingdom. For the analysis here, Portugal and Austria will be dropped. The former, because it not only received extensive exemptions from the EFTA requirements to liberalize trade, in some cases it was even allowed to raise barriers. Austria is also an outlier since it represents a country that was once one of Europe's wealthiest and as a result of two World Wars, it became a relatively poor. During the postwar, the country rebounded to its previously wealthy status, hence producing very significant postwar convergence that biases the results. Omitting Austria removes this pro-convergence bias.

became much smaller during the postwar period. Equation 2 was estimated for EFTA and the results are reported in Table 2. Here too, significant convergence occurred only during the postwar period while no reduction in the income gap is evident for the prewar years.

Could these results be part of a pan-European postwar convergence that might have occurred between other, non-EEC and non-EFTA countries that did not engage in substantial trade liberalization? If so, then the convergence may be a European phenomenon that could be

Table 2 Unit Root Test Results:
Comparison of Prewar to Postwar Results in EFTA

$z_{i,t} = \phi_i z_{i,t-1} + \sum_{j=1}^p \delta_{ij} \Delta z_{i,t-j} + e_{i,t}$						
Group	Period	p	$\hat{\phi}$	Calculated $t_{\hat{\phi}}$	Critical t for $H_0: \phi=1$	
					2%	10%
Maddison (1989) Data						
EFTA6	1900-1933	0	1.00	.74	3.06	2.06
EFTA6	1947-1987	0	.978	-4.26 ***	-3.22	-2.32
Summers and Heston (1991) Data						
EFTA6	1950-1988	2	.979	-3.23 ***	-2.87	-2.14

*** Significantly different from unity at the one percent level.

EFTA6: Denmark, Finland, Norway, Sweden, Switzerland, and the United Kingdom.

The sampling distribution is based on 2000 replications. The data are generated using (a) given covariance = var-cov($z_{i,t}$), and (b) actual initial values. Three different lags ($p=1,2,3$) are tried, but the final selection of p is based on the white noise residuals and the conventional significance of t -values.

totally unrelated to freer trade. Alternatively, might these results be reflective of a general convergence trend among all relatively developed countries, even if these countries did not liberalize trade to the extent that the EEC countries did? Here too, an affirmative answer would weaken the empirical evidence for a link between liberalization and equalization.

To test these two alternative proposals, two additional benchmark groups were tested. The first comprised all six of the remaining European countries from the Summers and Heston (1991) sample that did not belong to either the EEC or to EFTA before 1980.⁴ In addition to this European comparison group, another group of 11 countries was created comprising countries with per capita incomes in 1960 that were at least 25% of the world's wealthiest country, the United States, per capita income that year.⁵ While this group included middle to high income countries, these countries were not bound together by the type of trade agreements that governed intra-EEC trade.

An estimation of Equation 2 for the two benchmark groups indicates no significant convergence behavior during the postwar period for either group (Table 3).⁶ This contrasts with the significant postwar convergence within the two groups that did engage in substantial trade liberalization (the EEC and EFTA results are replicated in Table 3 for comparison purposes).

⁴ Spain, Turkey, Greece, Cyprus, Portugal, and Malta.

⁵ These countries include Australia, Uruguay, Barbados, New Zealand, Argentina, Chile, Mexico, Israel, Japan, Spain and South Africa. EEC and EFTA countries, along with the United States and Canada (who also extensively liberalized trade from the mid-sixties) as well as countries that are primarily oil-producers were excluded from this group.

⁶ The top three countries out of the benchmark group of 11 countries were also tested as a separate group and in this case, as in the other benchmark cases, no convergence was evident.

Table 3

Unit Root Test Results:
Comparison of Postwar Results Between Different Groups

$$z_{i,t} = \phi_i z_{i,t-1} + \sum_{j=1}^p \delta_{ij} \Delta z_{i,t-j} + e_{i,t}$$

Group	Period	p	$\hat{\phi}$	Calculated $t_{\hat{\phi}}$	Critical t for $H_0: \phi=1$	
					2%	10%
Liberalized Trade						
EEC6	1950-1988	1	.940	-5.11 ***	-2.93	-2.09
EFTA6	1950-1988	2	.979	-3.23 ***	-2.87	-2.14
Did Not Liberalize Trade						
EURO6	1960-1985	1	.990	-1.85	-3.37	-2.38
WORLD11	1960-1985	2	.999	-.03	-9.59	-5.54

Data Source: Summers and Heston (1991).

*** Significantly different from unity at the one percent level.

EEC6: France, Belgium, Germany, Italy, Luxembourg and the Netherlands.

EFTA6: Denmark, Finland, Norway, Sweden, Switzerland, and the United Kingdom.

EURO6: This is a European comparison group. It contains all the remaining European countries from Summers and Heston sample that did not belong to either the EEC or to EFTA before 1980. These countries include: Spain, Turkey, Greece, Cyprus, Portugal, and Malta.

WORLD11: This comparison group is based on the level of development in the beginning of the period. It includes all the non-oil producing countries with 1960 per capita incomes above 25% of the wealthiest country's per capita income in 1960. These countries are: Australia, Uruguay, Barbados, New Zealand, Argentina, Chile, Mexico, Israel, Japan, Spain and South Africa. Excluded from this group are the countries that experienced extensive postwar liberalization: EEC, EFTA and the U.S. and Canada.

The sampling distribution is based on 2000 replications. The data are generated using (a) given covariance = var-cov($z_{i,t}$), and (b) actual initial values. Three different lags ($p=1,2,3$) are tried, but the final selection of p is based on the white noise residuals and the conventional significance of t -values.

IV. CONCLUSIONS

This paper addressed the issue of the link between trade liberalization policies and reductions in cross-country income disparities by introducing a new methodology for testing convergence within groups of countries over time.

The convergence model allows for the analysis of smaller groups of countries and utilizes information within the sample period as well as its initial and terminal years. Joint estimation using the SUR method takes into account the possibility of contemporaneous shocks across countries, while exact significance levels are calculated (using Monte Carlo simulations) to allow for reliable ADF tests on the specific data series.

The results from this estimation corroborate the Ben-David (1993) findings of significant postwar convergence among the member countries of the EEC, as well as among the EFTA member countries. While the postwar period was characterized by extensive trade liberalization within these groups, the prewar years were not. The countries that later formed the two groups enjoyed no particular trade benefits with their future group partners prior to the second World War and no convergence was apparent in either group during that period either.

One benchmark comparison group examined here, but not in the Ben-David (1993) paper, also provides evidence of how the absence of trade reforms coincided with an absence in income convergence. By effectively splitting up the Summers and Heston (1991) European country sample into three equally-sized groups of countries (the EEC, EFTA and "everybody else"), with postwar convergence a prominent feature of the first two groups, the remaining countries provide an interesting comparison group. The lack of significant convergence among this latter group helps dispel the notion that the postwar convergence experienced by the first two groups was the

product of a European-wide convergence. In fact, the lack of postwar convergence among the remaining European countries (as well as among other relatively developed countries that had not carried out widespread trade liberalization) is similar to the lack of prewar convergence within the EEC and EFTA.

Why did the convergence occur? One possibility is via the channels described by Heckscher (1919) and Ohlin (1933) and in the factor price equalization proposition (Samuelson, 1948 and 1949; Helpman and Krugman, 1985) which specifies that the removal of trade impediments may lead to a reduction in commodity price differentials across countries and to a subsequent reduction in factor price differentials. The results in this paper would appear to provide support for this aspect of the Heckscher-Ohlin model and the factor price equalization proposition.

The Linder (1961) hypothesis suggests that the causality between trade and income similarity may in fact be just the opposite, *i.e.* that similar countries tend to trade more rather than the other way around. But if that is the case, then why did the future EEC and EFTA countries not exhibit convergence during the half century prior to their liberalization of trade? Furthermore, if similarity is a necessary condition for convergence, it is certainly not a sufficient condition, nor is regional proximity, as is evidenced by the lack of convergence among the two comparison groups that were examined. Nothing occurred within either the European benchmark group, or the developed country benchmark group, that lead to either extensive trade liberalization, nor to income convergence. In the instances when trade barriers were removed however, the income gaps among the liberalizing countries were reduced substantially.

Did this income convergence come at the expense of slower growth by the groups' wealthier countries? Ben-David and Papell (1994) provide evidence that, in fact, the opposite

appears to have been the case. *Each* of the EEC and EFTA countries exhibited much faster growth after the onset of the trade reforms, with growth rates nearly double the preliberalization rates.

In summary, while the methodological framework used here adds a degree of precision, as well as an additional European reference group, the main conclusions of Ben-David (1993) still stand. Groups of countries that engaged in substantial trade reform also exhibited significant income convergence. Those that did not exhibit the former showed no evidence of the latter.

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