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Product Variety and Economic Growth: Empirical Evidence for the OECD Countries

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Utilizing panel data for 19 member countries of the Organization for Cooperation and Development (OECD), we find support for the hypothesis that a greater degree of product variety relative to the United States helps to explain relative per capita GDP levels. The empirical work relies upon some direct measures of product variety calculated from six-digit OECD export and import data. Although the issue is far from being settled, the emerging conclusion is that the index of relative product variety across countries is significantly correlated with relative per capita income levels. [JEL F41, F43, C23]

One of the biggest challenges in economics today is to explain what causes different levels of per capita income in various countries. The first family of economic growth models trying to answer that question is organized around the basic neoclassical growth model devised by Robert Solow and Trevor Swan more than forty years ago. Their models describe an economy of perfect competition, whose output grows in response to larger inputs of physical and human capital and raw labor. This economy obeys the law of diminishing returns: each new bit of physical and human capital yields a slightly lower return than the one before.

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Together, these assumptions give the traditional neoclassical growth model two crucial implications. First, the long-run growth rate depends upon technical progress, a variable that the model itself makes no attempt to explain. The second implication is that poorer countries should grow faster than rich ones. The reason is diminishing returns: since poor countries start with less physical and human capital, they should reap higher returns from investment.

The other main approach, which has also spawned an extended family of models, goes by the name of endogenous growth theory. The idea is to endogenize technical progress, that is, to bring improvements in productivity, notably due to innovation, imitation, product variety, human capital, and public infrastructure, fully inside the model—so that ongoing economic growth emerges as a natural consequence. One important implication of these models is that economic growth is in the sphere of policy. Recently, so-called semi-endogenous growth models incorporating features of both families have been presented.

The empirical literature on economic growth has recently been enriched by various papers that provide direct tests of endogenous growth models using time-series and panel data sets. These studies have produced conflicting evidence in that two of them, specifically Jones (1995) and Evans (1997), find evidence against the endogenous growth hypothesis while two papers by Kocherlakota and Yi (1996, 1997) provide supportive evidence. The conclusions of the first two papers are largely based on the finding that shocks to the investment rate tend to be permanent while shocks to the growth rate are transitory. This finding is interpreted as running contrary to standard endogenous growth models, while it is consistent with the recent semi-endogenous growth literature. On the other hand, Kocherlakota and Yi (1996, 1997) present evidence from the United Kingdom and the United States that suggests that permanent changes in policy variables influence the growth rate permanently, even though the growth rate appears stable over time.

In this paper we present new empirical evidence on the determinants of economic growth across countries, focusing upon the impact of product variety. Given the importance of product variety in the recent economic growth literature, one would think that there are several well-known empirical papers studying whether greater product variety in fact does increase a country's per capita income level in practice. Sadly, this is not the case.[1] To the best of our knowledge, there is only one disaggregated study analyzing the link between product variety and growth in Korea and Taiwan.[2] In other words, the empirical evidence for the

[1]One indicator is that none of the most well-known international datasets used in the empirical growth literature (the Heston-Summers dataset, the Barro-Lee dataset, and the World Bank World Development Indicators database) contains any information on product variety over time and/or across countries. Another indicator is that the up-to-date survey of the new growth evidence by Temple (1999) does not contain any work on product variety. The reason for this state of affairs is probably that direct measures of product variety are difficult to obtain and therefore empirical work in this area seems to be a risky business.

[2]Compare Feenstra and others (1999) with Feenstra, Yang, and Hamilton (1999). In a related paper, Weinhold and Rauch (1997) have constructed a Herfindahl specialization index for 28 different manufacturing industries to analyze the link between openness, specialization, and productivity growth. Owen and Wren-Lewis (1993) and Driver and Wren-Lewis (1999) have analyzed the impact of variety and quality upon foreign trade using rough proxies such as cumulated investment and R&D flows.

growth model emphasizing product variety as a potential channel for economic growth is much less persuasive than is commonly believed and therefore the profession's faith in the merits of product variety may be hasty.

I. Product Variety and Economic Growth

In order to illustrate the interaction between product variety and economic growth we adapt a simple semi-endogenous growth model put forward by Jones (1998).[3] We suppose that countries produce a homogeneous output good, Y, using labor, L, and a range of differentiated capital goods, x_j. Production in the final goods sector is given by

$$Y = L^{1-\alpha} \int_0^n x_j^{\alpha} dj \tag{1}$$

where $0 < \alpha < 1$ and

$$\int_0^{n(t)} x_j(t)\, dj = K(t), \tag{2}$$

that is, the total number of differentiated intermediate goods used in production is equal to the total supply of capital, K.[4] Intermediate products are treated symmetrically throughout the model, so that $x_j = x$ for all j. Therefore intermediate goods are used the same amount, x, and we can determine x as

$$x = \frac{K}{n}. \tag{3}$$

The final goods production function can then be rewritten as:

$$Y = nL^{1-\alpha}x^{\alpha} \tag{4}$$

$$Y = nL^{1-\alpha}n^{-\alpha}K^{\alpha} \tag{5}$$

$$Y = K^{\alpha}(nL)^{1-\alpha}. \tag{6}$$

Thus, aggregate production for the economy takes the familiar Cobb-Douglas form and the degree of product variety, n, enters the production function just like

[3]The model draws on the original theoretical analysis concerning the production of and the demand for "variety" and "quality" by Grossman and Helpman (1991).

[4]A similar production technology has been considered by Easterley and others (1994).

labor-augmenting technology and therefore is the ultimate engine of growth. The standard capital accumulation constraint is given by

$$\dot{K} = s_K Y - \delta K, \tag{7}$$

where s_K is the investment share of output and δ is the rate of depreciation. The development of product variety over time is modeled as

$$\dot{n} = \phi A^{\gamma} n^{1-\gamma}, \tag{8}$$

where ϕ is a reduced-form coefficient that reflects, among other things, the share of labor devoted to research and development. We assume $\phi > 0$, $\psi > 0$, and $0 < \gamma < 1$. The last two terms in equation (8) suggest that the change in product variety is a weighted average of the world frontier level of product variety, A, and the individual country's degree of product variety, n. In the following empirical part of the paper we think of the United States as the technological frontier. Equation (8) can be rewritten by dividing both sides by n:

$$\frac{\dot{n}}{n} = \phi \left(\frac{A}{n} \right)^{\gamma}. \tag{9}$$

Equation (9) makes clear that the growth rate of product variety in the economy is positively related to the ratio (A/n). The closer an individual country's degree of product variety, n, is to the world frontier of variety, A, the smaller the ratio A/n, and the smaller is the growth rate of n. Finally, we assume that the world frontier expands at a constant rate g, that is,

$$\frac{\dot{A}}{A} = g \tag{10}$$

and that the labor force of the economy grows at the constant rate m. In order to solve for the steady state growth path, we proceed in the usual fashion. Along the balanced growth path we have $g = g_y = g_n = g_A$, that is, the long-run growth rate is given by the (exogenous) growth rate of the technological frontier, A.[5] Steady state output per capita y^* along the balanced growth path is given by

$$y^*(t) = \left(\frac{s_K}{m + g + \delta} \right)^{\alpha/1-\alpha} n^*(t) \tag{11}$$

[5]Even with no differences across countries in the long-run growth rate, one can explain a large variation in rates of growth with transition dynamics.

or

$$y^*(t) = \left(\frac{s_K}{m+g+\delta} \right)^{\alpha/1-\alpha} \left(\frac{\phi}{g} \right)^{1/\gamma} A^*(t). \tag{12}$$

The model proposes two answers to the question of why different economies have different steady state income levels. First, the model emphasizes the importance of product variety, providing a "new growth theory" interpretation of the basic neoclassical growth model since the steady state income level, y^*, depends upon the degree of product variety, n. In the model, increased product variety accelerates increases in per capita income levels by more fully realizing dynamic economies of scale. Second, the initial term in brackets in (11) and (12) is similar to the basic Solow model. This term implies that countries investing more in physical capital will be richer.[6] In order to understand the mechanics of the model, let us consider a country that decides to open up its economy to the rest of the world. We can model this as an increase in ϕ. According to (12), a higher value of ϕ raises y^*. Starting from steady state, the higher ϕ causes the growth rate of n to be higher than g along the transition to the new steady state. Over time, however, the ratio A/n is decreasing, and therefore the growth rate of n returns to g. In other words, policy changes like opening up the economy (interpreted as an increase in ϕ) have a long-run *level* effect but no long-run *growth* effect, just as in the original Solow model. It is this link between product variety and per capita income that we shall test below.

II. Measuring Product Variety Across OECD Countries

The question we would like to address in this empirical section is how to pick a value of n, that is, how to measure the "supply-side" factor product variety. In order to get a direct measure of the variety of products across countries, the following two questions have to be addressed:

1. Which methodology can be used to estimate the degree of product variety across countries?
2. What highly disaggregated data do we have on differentiated products that are consistent across countries?

In the following empirical work we adapt the methodology developed by Feenstra (1994) and Feenstra and Markusen (1994). They have shown how an exact measure of product variety can be constructed from a CES production function when the inputs enter non-symmetrically. The procedure considers two units

[6]In extensive sensitivity analyses of cross-country growth regressions, Levine and Renelt (1992) and Sala-i-Martin (1997) have shown that investment in physical capital is the most robust variable explaining cross-country growth differences. Explaining differences in the level of income across countries by appealing to differences in n and s_K, however, obviously begs new questions. Why is it that some countries invest more in physical capital than others and why do individuals in some countries spend more time to develop new intermediate goods? This model cannot address these questions. A more complete model answering these questions has to assume utility-maximizing individuals to choose to work in either the final-goods sector or in the intermediate goods sector expanding product variety. In order to simplify the analysis, we will not develop this more complete model here.

of observations denoted by s and t representing either two time periods or two countries. Suppose that output y_t in period t (country t) is given by the production function

$$y_t = f\left(x_t, I_t\right) = \left[\sum_{i\in I_t} \alpha_i x_{it}^{(\sigma-1)/\sigma}\right]^{\sigma/(\sigma-1)}, \tag{13}$$

where σ denotes the elasticity of substitution, x_{it} is the quantity of input i in period t (country t), and the total set of inputs in period t (country t) is denoted by I_t. For example, when the inputs available in period t (country t) are numbered 1 through N_t, then $I_t = \{1,\ldots, N_t\}$. The corresponding cost function is

$$c\left(p_t, I_t\right) = \left[\sum_{i\in I_t} b_i p_{it}^{(\sigma-1)/\sigma}\right]^{\sigma/(\sigma-1)}, \tag{14}$$

where p_{it} are the prices of the inputs and $b_i = a_i^{\sigma}$. A standard definition of an input index is the change in nominal expenditure (E_t/E_s) deflated by an input price index, where $E_t=\Sigma p_{it}x_{it}$. Following Feenstra, Markusen, and Zeile (1992), Feenstra (1994), Feenstra and others (1999), and Feenstra, Yang, and Hamilton (1999), we chose the set of intermediate products common to both periods (countries) as $I = I_s \cap I_t$. The quantity index for intermediate inputs is then measured by

$$Q\left(p_s, x_s, p_t, x_t\right) = \frac{\frac{E_t}{E_s}}{P\left(p_s, x_s, p_t, x_t\right)}, \tag{15}$$

where $P(\cdot)$ is the input price index given by the Sato (1976)–Vartia (1976) formula. Total factor productivity, TFP, is defined as the difference between the growth of output and this input index, that is,

$$TFP_{st} = \ln\left(\frac{y_t}{y_s}\right) - \ln\left(\frac{\frac{E_t}{E_s}}{P\left(p_s, x_s, p_t, x_t\right)}\right) \tag{16}$$

$$TFP_{st} = \frac{1}{(\sigma-1)}\Delta PV_{st}, \tag{17}$$

where the change in product variety ΔPV_{st} is defined as follows (Feenstra, 1994), Proposition No. 1:

$$\Delta PV_{st} = \ln\left(\frac{\dfrac{\sum_{i\in I_t} p_{it}x_{it}}{\sum_{i\in I} p_{it}x_{it}}}{\dfrac{\sum_{i\in I_s} p_{is}x_{is}}{\sum_{i\in I} p_{is}x_{is}}}\right). \tag{18}$$

To interpret equation (18), consider the case where the set of inputs is growing over time, that is, we have two sets $I_s = \{1,\ldots, N_s\}$ and $I_t = \{1,\ldots, N_t\}$ with $N_t > N_s$. In this case the common set of products is $I = I_s$ and the denominator is 1. The numerator will exceed unity, indicating that product variety has increased over time. In the special case where all inputs enter (13) and (14) symmetrically, the numerator in (18) simplifies to N_t/N_s. The two observations s and t in (13)–(18) can either be interpreted as two successive observations in time or as two countries. The first interpretation allows us to construct an index of product variety in a specific country over time, while the second interpretation allows us to construct the level of product variety across countries.

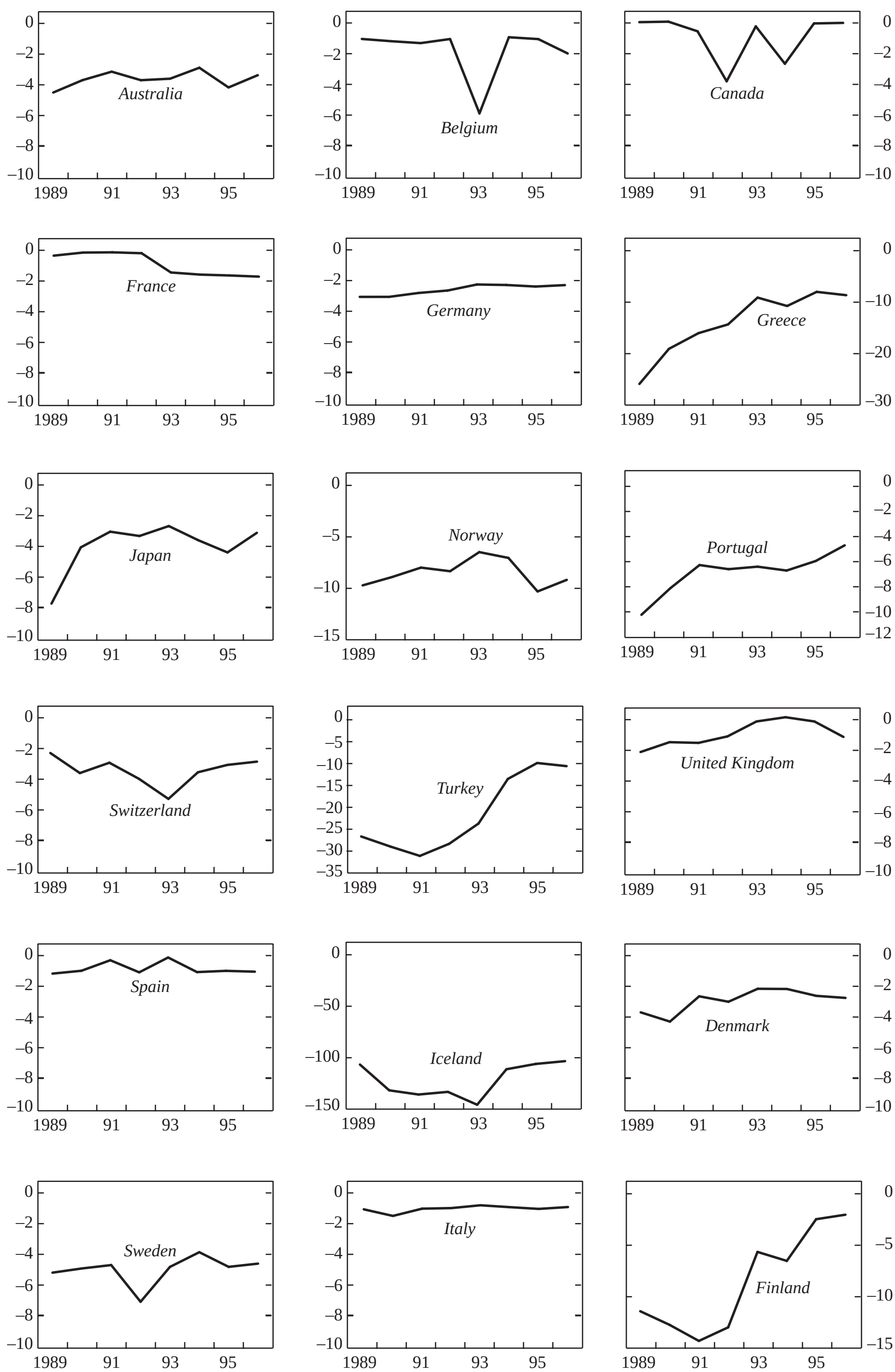
The procedure above is implemented using highly disaggregated annual world export and import data at the six-digit industry level for the years 1989 to 1996 for 19 OECD countries.[7] The most important advantage of these data is that the classification of goods is consistent across countries. On the other hand, these data obviously have problems. First, the time-series dimension of the data (eight years) is rather short. Second, some intermediate goods produced at home are not traded internationally. Nevertheless, we believe the topic to be of such economic and social significance that a willingness to experiment with trade data is justified, especially since the most important goods are probably exported and/or imported.[8] Our first measure of product variety is export variety in country i ($i = 1,\ldots, 18$) relative to the United States (ΔPV_{EX}). The results for 1989–96 are summarized in Figure 1, which we invite the reader to review. The first impression is that export variety in all countries under investigation is lower than in the United States.[9] The degree of relative export differentiation is highest in Canada, followed by France, the United Kingdom, Germany, Denmark, and Italy. In contrast to this group of

[7]The classification distinguishes about 6,400 commodities according to the Harmonized System (HS). Data were collected from the OECD database International Trade by Commodities Statistics—ITCS Classification, Paris 1997. All data are expressed in current US$ and start in 1989, the year that HS data were first reported. In principle it would be preferable to use national production data but they are neither available at a sufficiently disaggregated level nor are the available data consistent across countries.

[8]In their extensive discussion of quality and variety, Grossman and Helpman (1991), Coe and Helpman (1995), and Bayoumi, Coe, and Helpman (1999) have focused on levels of investment in R&D at home and abroad. A clear problem here is that the lag between R&D expenditures and the production of new varieties could be very long. Furthermore, it is also the case that many improvements in quality and variety can be realized without any R&D expenditure being incurred. In particular, increases in variety can occur through imitation, which involves little or no R&D expenditure.

[9]Negative (positive) values for the index indicate lower (higher) product variety than in the United States. The negative numbers are a result of the log transformation in (18).

Figure 1. Relative Product Variety Based upon Total Exports



countries, the degree of export variety is much lower in Greece, Portugal, Norway, and Turkey. The lowest ratio is for Iceland. One problem with indicators of product variety focusing solely upon export data is that even when differentiated inputs are not produced at home, they are in principle available in other countries through trade. In other words, product variety in any country does not only depend on exports but potentially also upon imports. As a second measure of relative product variety we have therefore calculated product variety relative to the United States based upon exports and imports ΔPV_{EXIM}. The results are given in Figure 2. With the distinguishable exception of Iceland, relative product variety in the various countries now looks much more like that in the United States. Finally, we have also calculated both product variety measures for secondary industries, which rely much more on differentiated products and therefore fit the idea of endogenous growth much more clearly than primary industries, which rely more heavily on natural resources ($\Delta PV_{EX\text{-}SEC}$ and $\Delta PV_{EXIM\text{-}SEC}$).[10] The results for this subsample of the whole dataset are given in Figures 3 and 4.

III. Econometric Results

This paper utilizes an estimation method that exploits the full time dimension of the data by using all the information from a full panel rather than just the time-averaged information from a cross-section. The proper specification of the regression model depends upon equation (11). Consider writing (11) for one country, and then taking the ratio of that equation with the analogous one for the United States. We then obtain the relative GDP of the two countries on the left, and obtain the relative savings/investment rates on the right (with $m + g + \delta$ canceling out in the two countries), along with the relative number of product varieties. All variables are expressed relative to the United States since we think of the United States as the technological frontier.[11] The relative investment share, IY, is added to the regressions to capture different per capita income levels arising from different levels of investment in physical capital.[12] In addition to the product variety indices that are the variables of immediate interest, additional control variables were included in the regressions. The "fixed effects" are controlled for directly through country-specific dummies. The advantage of including "fixed effects" is that we are explicitly holding constant a bunch of factors that are very difficult to control for in cross-country comparisons (either because we are not sure of what these factors are or because we do not have the necessary data). This is important because it allows us to get a clearer picture of the interactions among the variables highlighted by the theoretical model presented above. A final ingredient is

[10]Industrial coverage groups industries into "Primary Products" (textile products, wood products, paper and printing, rubber products, primary metal, leather products, and stone, clay and glass) and "Secondary Products" (food products, beverages and tobacco, apparel, chemicals and plastics, fabricated metal products, machinery, electrical products, transportation equipment, and instruments).

[11]Canova and Marcet (1995) argue that such a normalization should also eliminate a significant part of the cyclical noise in the data.

[12]Y_{it} and IY_{it} were calculated using data from the World Development Indicators 1998 database.

Figure 2. Relative Product Variety Based upon Total Exports and Imports

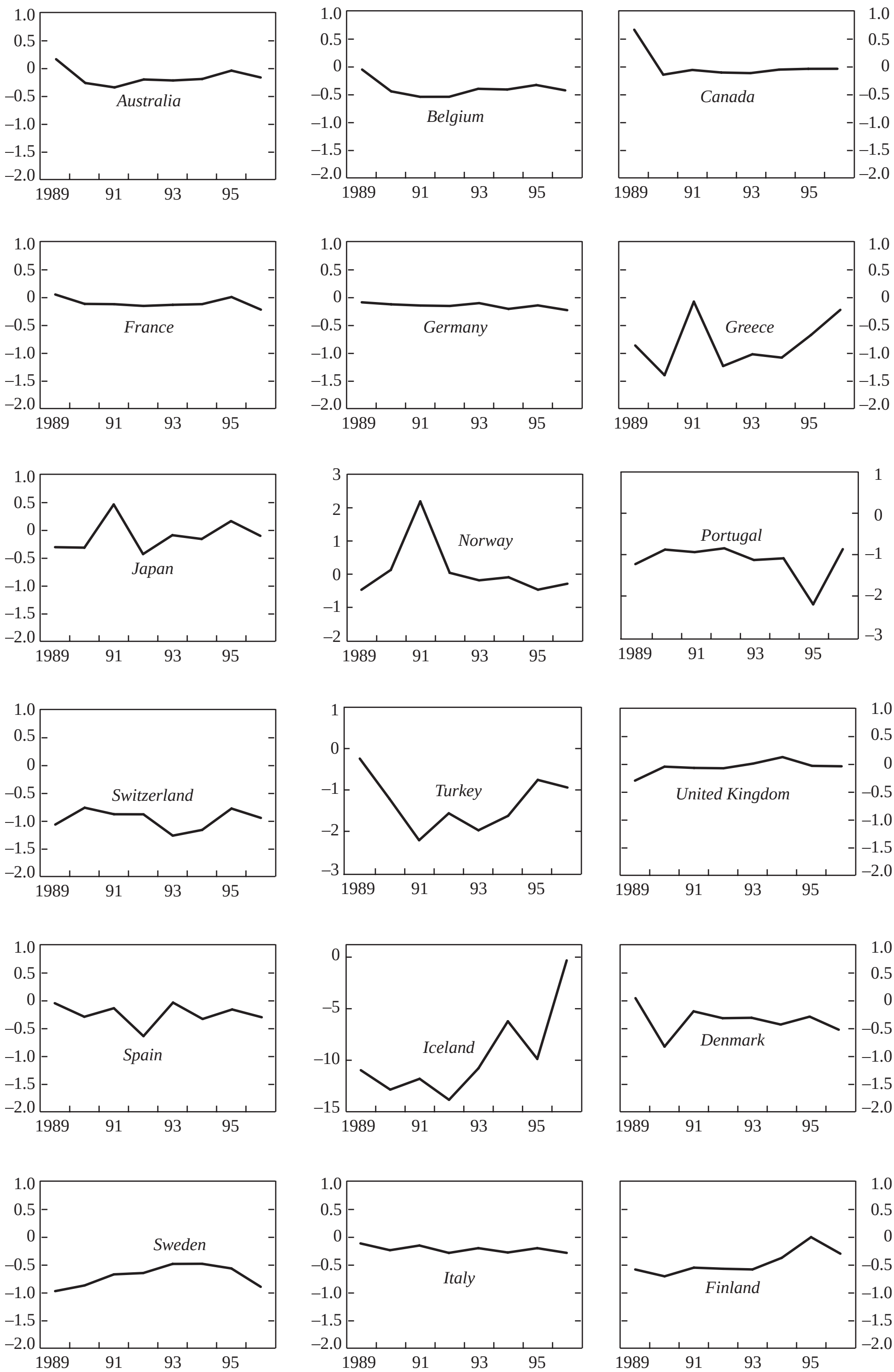


Figure 3. Relative Product Variety Based upon Exports of Secondary Products

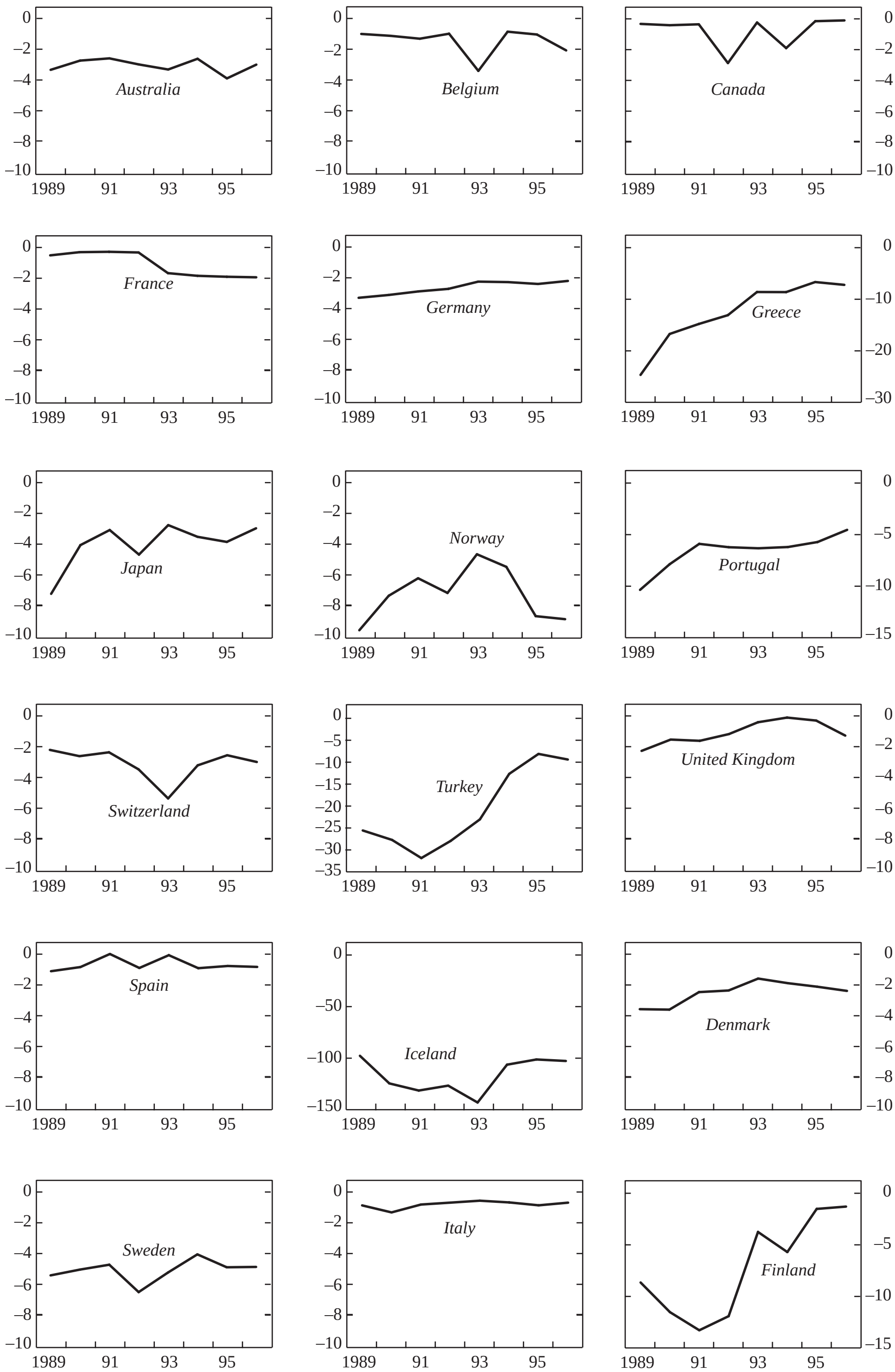
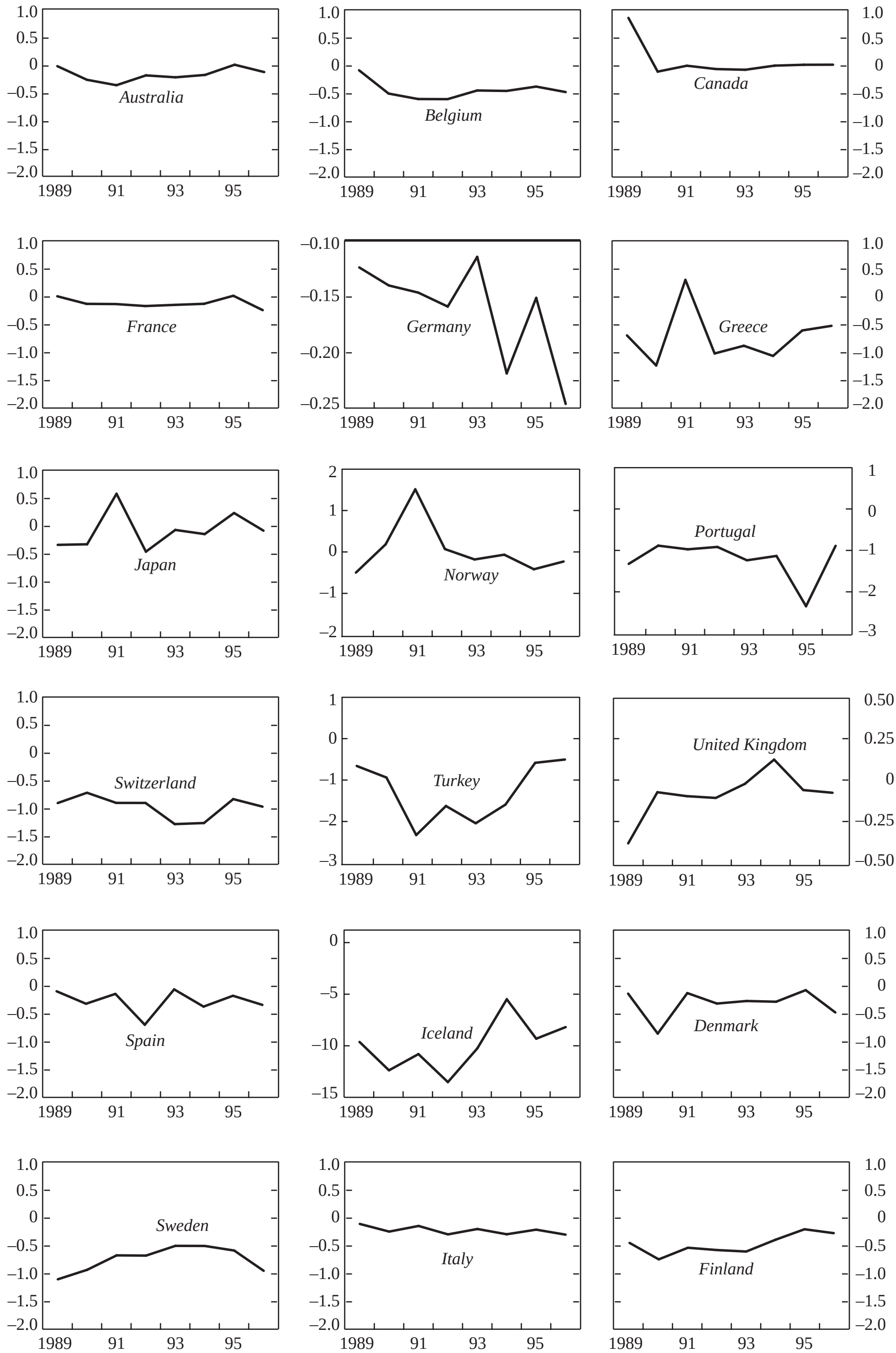


Figure 4. Relative Product Variety Based upon Exports and Imports of Secondary Products



country-specific time trends. The basic model for country i and time t thus becomes

$$Y_{it} = \alpha_i + \delta_i T + \beta\, IY_{it} + \gamma \Delta PV_{it} + \varepsilon_{it} \quad i = 1,\ldots, 18,\ t = 1989,\ldots, 1996 \qquad (19)$$

where Y_{it} is per capita GDP in country i relative to the United States in percent (purchase power parity, constant 1987 international $), IY_{it} is defined as the share of investment in GDP in country i relative to the United States in percent, and ΔPV_{it} is product variety relative to the United States. The α_i (δ_i) parameters represent the fixed effects (country-specific time trends).[13] The country effects control for any persistent differences across countries, such as initial conditions, higher level of technical know-how, cultural differences, higher government investment expenditures, or freer access to knowledge.[14] One potential problem with equation (19) is that the variables need to be treated as endogenous.[15] In order to deal with this simultaneity bias, we have produced *IV* estimates of equation (19) that allow for heteroscedasticity of general form. Prior to estimating equation (19) we have, however, analyzed the univariate time-series properties of the variables under consideration. Im, Pesaran, and Shin (1995) have presented an ADF-type unit root test that increased the power of univariate unit root tests by exploiting the panel structure of the data. The test is an average ADF test derived from the individual ADF tests performed for each country separately. It thereby also allows for slope heterogeneity. Under the null hypothesis of a unit root this statistic has a standard normal distribution and is valid in the presence of heterogeneity across units as well as residual serial correlation across time periods. Under the alternative of stationarity, this statistic diverges to negative infinity. Table 1 presents the t-bar statistic.

All t-bar statistics easily reject the null of nonstationarity. This implies that we do not have to consider cointegration tests for panel data. The *IV* estimation results are available in Table 2.

Table 2 leads to two main conclusions. First, all coefficients are signed in a manner consistent with the theoretical model. The coefficients of the relative investment share and the product variety measures are significant in all four equations.[16] This implies that investment in physical capital does not carry all the information relevant for economic growth. Second, an interesting result is that the

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[13]The methodology followed by the vast majority of researchers up to 1995, that is, cross-sectional regression, was based on the hypothesis of a growth process characterized by a smooth path toward a steady state. As Islam (1995) and Caselli, Esquivel, and Lefort (1996) have demonstrated empirically that this underlying hypothesis is invalid, we have used panel data estimates, which are not subject to this restrictive hypothesis on the growth process and allow for heterogeneity in steady state output levels.

[14]Since we include country dummy variables, we cannot include initial per capita GDP, which also varies across countries but not over time.

[15]We have used lagged variables as instruments. The fact that we are chronically short of good instrument variables has led to the widespread employment of oil prices as instruments. We have not used oil prices in our work because recent research (compare Hooker, 1996) has indicated that oil prices are endogenous variables.

[16]This result is consistent with the empirical evidence for Korea, Taiwan, and Japan in Feenstra and others (1999) and Feenstra, Yang, and Hamilton (1999).

Table 1. Panel Unit Root Tests for the Sample of 18 OECD Countries

	Without Trend	With Trend
Y	–43.66	–15.23
IY	–23.79	–19.04
ΔPV_{EX}	–19.57	–15.18
ΔPV_{EXIM}	–41.31	–13.43
$\Delta PV_{EX\text{-}SEC}$	–31.76	–12.99
$\Delta PV_{EXIM\text{-}SEC}$	–51.38	–16.54

Note: The statistics have been calculated using demeaned data.

coefficients are similar for all products and for secondary products. Overall, the generally positive association between product variety and per capita income provides some degree of confirmation for the semi-endogenous growth model presented above.[17] One potential problem of the specification in equation (19) is that relative GDP in levels is used as the dependent variable. The equation is therefore explaining the cross-sectional variation in the level of GDP across countries, but it is difficult to refer to (19) as a "growth" regression. Given this potential shortcoming, we will also test whether changes in product variety are correlated with the increase in total factor productivity growth, again measured in each country relative to the United States. These additional estimates may be seen to contribute by virtue of the direct link to equation (17). Total factor productivity (TFP) is defined as

$$TFP_{it} = \frac{Y_{it}}{\left(K_{it}^{\beta} L_{it}^{1-\beta}\right)}, \tag{20}$$

where Y_{it} is value added at factor costs in constant prices in the business sector of country i in period t, K_{it} is the stock of business sector capital in constant prices of country i in period t, L_{it} is employment in the business sector of country i in period t, and β and $1-\beta$ are the average income shares of capital and labor over the period of investigation.[18] The growth rate of TFP_{it} is defined as

[17]As the paper measures product variety in traded goods and not only capital goods, an alternative interpretation of this result, however, is the demand theory formulated by Linder (1961), where high income countries have a more advanced and differentiated consumption structure. According to Linder's (1961) theory, the causal link runs from real income per capita to the degree of product variety. Barker (1977) acknowledges the contribution of Linder (1961) and develops a similar variety hypothesis according to which consumers love variety and therefore exports and imports tend to increase more than proportionally with real income per capita. Schott (2000) has recently also pointed out that more advanced countries have greater product variety. In other words, he interprets the causation from GDP to product variety, rather than the reverse, as done in this paper.

[18]All data are from the OECD *Analytical Database*. Missing data do not allow us to construct TFP indices for Greece, Iceland, Portugal, or Turkey.

Table 2. Cross-Sectional Variation in the Level of GDP Across OECD Countries

IY	0.18 (8.3)	0.14 (7.3)	0.18 (8.0)	0.16 (7.6)
ΔPV_{EX}	0.11 (2.6)	—	—	—
ΔPV_{EXIM}	—	0.39 (3.4)	—	—
$\Delta PV_{EX\text{-}SEC}$	—	—	0.09 (2.6)	—
$\Delta PV_{EXIM\text{-}SEC}$	—	—	—	0.37 (2.3)
$N \times T$	126	126	126	126

Notes: White's heteroscedasticity-consistent *t*-values are given below the coefficients. The sample period is 1990–96. The country-specific fixed effects and the country-specific time trends are included but not reported. *F*-statistics indicate that both sets of dummy variables are significant at the 1 percent level. See text for data definitions and sources. Alternatively, we also estimated (19) with AR1-*IV* methods but the ρ-coefficient turned out to be insignificant.

$$\Delta TFP_{it} = \frac{TFP_{it} - TFP_{i,t-1}}{TFP_{i,t-1}}. \tag{21}$$

Finally, the growth rate of TFP in country *i* relative to the United States is defined as

$$\Delta TFP_{it/US,t} = \Delta TFP_{it} - \Delta TFP_{US,t}. \tag{22}$$

Equation (17) was estimated on a panel of relative TFP growth and product variety growth rates for "secondary products" for the business sector of 14 OECD countries over the entire period of investigation, 1990–96.[19] Estimation was performed by instrument variables (*IV*) and the results are presented in Table 3.

The first feature of Table 3 is that coefficients of all three product variety measures calculated using total secondary exports ($\Delta\% PV_{EX\text{-}SEC}$), total secondary imports ($\Delta\% PV_{IM\text{-}SEC}$) and secondary exports and imports ($\Delta\% PV_{EXIM\text{-}SEC}$) are of the expected sign and statistically significant. A second feature is the insignifi-

[19]We have used product variety measures for "secondary products" because we would expect the hypothesis of endogenous growth to apply more to secondary than primary industries (compare Feentra and others, 1999).

Table 3. *IV* Regression Results for the Growth Rate of Relative TFP

$\Delta\%PV_{EX\text{-}SEC}$	0.68 (4.65)	—	—
$\Delta\%PV_{IM\text{-}SEC}$	—	0.78 (4.0)	—
$\Delta\%PV_{EXIM\text{-}SEC}$	—	—	2.52 (3.62)
Constant	–0.002 (–0.35)	–0.002 (–0.45)	–0.0005 (–0.08)
$N \times T$	84	84	84

Notes: The dependent variable is the change in relative total factor productivity ($\Delta TFP_{it/US,\ t}$) for 14 countries. $\Delta\%PV_i$ is the annual growth rate of product variety of type i (i = *EX-SEC*, *IM-SEC*, *EXIM-SEC*). White's heteroscedasticity-consistent t-values are given below the coefficients. The sample period is 1990–96. Country-specific fixed effects are included but not reported. F-statistics indicate that both sets of dummy variables are significant at the 1 percent level. Refer to the main text for variable definitions and data sources. Lagged variables have been used as instru-

cance of the overall constant, which implies that there are no other trendmatic influences on relative TFP growth. Our conclusion can therefore be simply stated. The results suggest that the growth rate of product variety helps to explain relative TFP growth rates.

IV. Conclusions

Understanding growth is surely one of the most important tasks in economics. This paper is part of an upsurge of empirical work on growth and tries to shed some light on the relative merit of models emphasizing the importance of product variety. The distinctive feature of this paper consists in calculating direct measures of product variety relative to the United States for 18 OECD countries from 1989 to 1996. Although the issue is far from being settled, the emerging conclusion is that the index of relative product variety is significantly correlated with relative per capita income levels.[20] The empirical results have some implications for the debate between openness and growth, which normally is rather silent on the issue of the mechanism through which this robust empirical relationship occurs. In this paper we have identified one channel through which increased trade may lead to growth, namely, a strongly outward-oriented trade regime makes a greater variety of products and technologies available. However, the assessment of the perfor-

[20]One remaining problem is that even the most disaggregate trade data currently available may hide substantial intra-aggregate heterogeneity (see Schott, 2000).

mance of the various product variety indices for a larger set of countries and longer time spans is important and has to be investigated when additional data become available. We leave this for future research. In the meantime, maintaining outward-oriented pro-trade policies can have significant benefits.

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