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ABSTRACT

It is well known that business cycles in OECD countries exhibit a remarkable degree of synchronization. Much less known is that the peak of the OECD cycle is associated with high prices of labour-intensive products and low prices of capital-intensive ones. We document this cyclical behavior of product prices and argue that it offers an important clue as to why business cycles are so synchronized. Positive shocks in one or more countries raise the prices of labour-intensive products and, as a result, the demand for labour throughout the industrialized world. This generates increases in wages, employment and output in all industrial countries. Through this channel, shocks are positively transmitted across countries, creating a force towards the synchronization of business cycles.

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It hardly seems necessary to document that business cycles are strongly synchronized among industrial countries. Table 1 reports the time-series correlations of annual real per capita output growth with OECD average growth excluding that country, over the period 1960-1996, for all OECD countries. These correlations are substantial, averaging 61% in the G7 and 47% in the full OECD sample. One might think that these correlations are high because the sample period includes the large increases in the price of oil in the 1970s which constituted a large adverse shock for most of the OECD economies. However, the second column of Table 1 shows that even if we exclude the 1973-1981 period from our sample, the cross-country growth correlations average 54% and 46% percent in the G7 and the full OECD samples, respectively. These figures justify the notion of an OECD cycle.

Since much of the fluctuations in output can be traced back to fluctuations in employment and hours worked, it is not surprising that labour market indicators also exhibit a strong correlation among industrial countries. Table 2 documents this for a sample of 12 countries for which internationally-comparable indicators are available. The correlations of annual growth rates of manufacturing hours, employment and real wages with OECD average per capita output growth excluding that country are quite high, averaging 41%, 43%, and 24%, respectively. A natural interpretation of this set of correlations is that shifts in the demand for labour tend to occur at the same time in all countries.

Why are shifts in the demand for labour highly correlated across countries? Part of the answer is that shocks to labour productivity are positively correlated across countries. But this cannot be the whole story. Figure 1 shows that output growth correlations exceed those of productivity shocks in 22 out of 24 countries.[1] Either there are other shocks to the labour demand that are highly correlated across countries or there are channels of transmission of shocks that generate correlations in income growth in excess of those of the underlying shocks.

[1] This is by no means a new observation. See Backus, Kehoe and Kydland (1995) who argue that the finding that GDP growth rates are more correlated across countries than Solow residuals is one of the main puzzles that arise when one attempts to interpret the data from the perspective of the stochastic growth model. We follow the standard but admittedly controversial practice of interpreting Solow residuals as a measure of productivity shocks.

In this paper, we argue that the cyclical behavior of product prices offers an important clue to understand how shocks are positively transmitted across countries. By the cyclical behaviour of product prices, we refer to the observation that OECD booms are associated with increases in the price of labour-intensive products and decreases in the price of capital-intensive products. This can be shown by estimating the following regression model:

$$\Delta \ln p_{ict} = (\beta_1 + \beta_2 \cdot x_{ic}) \cdot \Delta \ln Y_t + (\lambda_1 + \lambda_2 \cdot x_{ic}) \cdot \Delta \ln y_{ct} + f_{ic} + u_{ict}$$

where $\Delta \ln p_{ict}$ denotes the growth rate of the price index of output in industry i in country c in year t relative to the consumer price index in country c in year t; x_{ic} is the average over time of labour's share in value-added in industry i and country c; $\Delta \ln Y_t$ and $\Delta \ln y_{ct}$ and denote real per capita GDP growth rates in the OECD and in country c in year t, respectively; and f_{ic} and u_{ict} are a country- and industry-specific fixed effect and a well-behaved error, respectively. We estimate the model using data on 28 manufacturing sectors in a sample of 20 OECD economies over the period 1963-1995.

The results reported in Table 3 point to three conclusions. First, across all specifications, the estimate of β_2 is positive and significantly different from zero, which we interpret as evidence that the sensitivity of product price changes to OECD growth is higher for labour-intensive products. For instance, if we take two products with labour shares of 10 and 70 percent (roughly corresponding to the bottom and top deciles in our sample), the first column of Table 3 suggests that a one percentage point increase in OECD growth leads to a change in their prices of –1.2 and 0.6 percent, respectively. Second, the cyclical pattern in product prices is driven primarily by OECD-wide shocks and not by domestic shocks. This may be seen in the second and fourth columns of Table 3, where we relax the restriction $\lambda_1=\lambda_2=0$ and find that these coefficients are not significantly different from zero. Third, the cyclical behavior of product prices is not driven by the oil shocks of the 1970s. The last two columns of Table 3 indicate that our results are qualitatively unaffected but slightly smaller in absolute value when we drop the oil-shock years from the sample.

When viewed as a whole, this evidence is consistent with the view that there is a channel of transmission of business cycles that works through changes in relative product prices. In particular, individual countries find that positive shocks abroad lead to increases in the prices of labour-intensive commodities, raising wages and stimulating employment and output at home. Through this channel, shocks are positively propagated across countries, contributing to the creation of the OECD cycle. International commodity trade plays a crucial role in our argument, since it creates a link between product prices in different countries.

In the remainder of this paper, we develop a stylized model that formalizes this channel of transmission through relative product prices, and examine some of its limitations.[2] To highlight this channel, the model features a single source of interaction among countries: commodity trade based on differences in effective factor endowments. As a result, we abstract from other transmission channels that arise in models that feature other sorts of commodity trade, factor movements and/or financial linkages. For a discussion of these alternative transmission channels, we refer the reader to Mussa (1979) and Backus, Kehoe and Kydland (1995), who provide useful reviews of how shocks are transmitted across countries in the Mundell-Fleming and the stochastic growth models, respectively.

[2] This model has been extended in various directions and studied in greater detail in Kraay and Ventura (1998).

1. A Stylized Model of Trade and Fluctuations

We consider a world (named the "OECD") consisting of a continuum of countries with mass one; two industries producing perishable products, the L-industry and the K-industry; and two factors of production, labour and capital. All countries have the same technology, preferences and factor endowments. Countries only differ in the state of their business cycle, as measured by an index of productivity, π. We allow countries to trade goods, but assume that there is no trade in financial assets and factors are immobile. For simplicity, we also rule out capital accumulation. Since goods are perishable, this implies that countries do not save

Each country is populated by a continuum of consumers, each of whom is endowed with a unit of capital. Consumers decide how much to consume and save, and whether or not to work. Let θ be the constant (and common across consumers) elasticity of substitution between L- and K-products, so that the ratio of spending on L- and K-products is $\left(\frac{p_L}{p_K}\right)^{1-\theta}$; where p_L and p_K are the prices of L-and K-products. The parameter θ determines how much prices need to change to convince consumers to vary their relative consumption of L- and K-products. To produce a unit of the K-product, $e^{-\pi}$ units of capital are required. To produce one unit of L-products, $e^{-\varepsilon\cdot\pi}$ ($\varepsilon>0$) workers are needed. The parameter ε determines the factor bias associated with productivity fluctuations. If $\varepsilon<1$, the productivity of labour relative to capital is low when π is high and high when π is low.[3]

Consumers differ in their opportunity cost of work or reservation wage. Let 1/z denote the reservation wage of a consumer with index z, where $z\in[1,\infty)$ follows a Pareto distribution, i.e. $F(z)=1-z^{1-\mu}$ ($\mu>1$). The parameter μ determines the dispersion of reservation wages. A consumer with index z works if and only if w>1/z,

[3] Kraay and Ventura (1998) show that it is possible to re-interpret π as (minus) the nominal interest and the factor bias ε as resulting from the assumption that cash-in-advance constraints might be more binding in one industry than the other. The transmission channel highlighted here does not depend on whether the source of the factor bias is technological factors or cash-in-advance constraints.

where w is the wage rate.[4] Therefore, aggregate employment is $1-F(w^{-1})=w^{\mu-1}$ and the wage-elasticity of the labour supply is μ-1.[5] Since the wage is nothing but the value of the L-products a worker can produce, i.e. $w=p_L\cdot e^{\varepsilon\cdot\pi}$, the productions of L- and K-products are $p_L^{\mu-1}\cdot e^{\mu\cdot\varepsilon\cdot\pi}$ and e^{π}, respectively. Finally, we define y as the income of the country, i.e. $y=p_L^{\mu}\cdot e^{\mu\cdot\varepsilon\cdot\pi}+p_K\cdot e^{\pi}$.

Business cycles arise as π fluctuates randomly. We refer to changes in π as productivity shocks. The index π is the sum of a global component, Π, and a country-specific component, π-Π. Each of these components is an independent Brownian motion reflected on the interval $[-\delta,\delta]$ with zero drift and instantaneous variances equal to σ and 1-σ respectively, with δ>0 and 0<σ<1. Let the country-specific components be independent and uniformly distributed on $[-\delta,\delta]$. This means that the cross-sectional distribution of π-Π is time-invariant.[6] While π has been defined as an index of domestic productivity, Π serves as an index of OECD average productivity. It is straightforward to show that the instantaneous correlation between domestic shocks, dπ, and OECD shocks, dΠ, is $\sqrt{\sigma}$.[7] The parameter σ therefore regulates the extent to which the variation in domestic productivity is due to global or country-specific components, i.e. whether it comes from dΠ or d(π-Π). Figure 2 shows possible sample paths of π under three alternative assumptions regarding σ.

[4] One way to generate the consumption and labour supply choices of these consumers is to assume the following utility function: $E\int_0^{\infty}U\left(\left(c_L(z)^{\frac{\theta-1}{\theta}}+c_K(z)^{\frac{\theta-1}{\theta}}\right)^{\frac{\theta}{\theta-1}}-\frac{I(z)}{z}\right)\cdot e^{-\rho\cdot t}\cdot dt$; where U(.) is any well-behaved function; I(z) is an indicator function that takes value 1 if the consumer works and 0 otherwise; and $c_L(z)$ and $c_K(z)$ are the consumptions of L and K products of a consumer with index z.

[5] When the wage reaches one, the entire population is working and the labour supply is vertical. We assume that all countries are always operating in the elastic section of their labour supply. This can be ensured through some alternative (and innocuous) parameter restrictions.

[6] See Harrison (1990), Chapter 5.

[7] This is true except when either π or Π are at their respective boundaries. These are rare events since the dates at which they occur constitute a set of measure zero in the time line.

Let p be the relative price of L-products in terms of K-products. Using the ideal consumer price index as the numeraire, $\left(p_L^{1-\theta} + p_K^{1-\theta}\right)^{\frac{1}{1-\theta}} = 1$, we can write the prices of the L- and K-products as $p_L = \left(1 + p^{\theta-1}\right)^{\frac{1}{\theta-1}}$ and $p_K = \left(1 + p^{1-\theta}\right)^{\frac{1}{\theta-1}}$, respectively. Also, let Y be OECD average income, i.e. $Y = \int_{-\delta}^{\delta} y \cdot \frac{d(\pi - \Pi)}{2 \cdot \delta}$. A few manipulations show that innovations or shocks to the growth rates of Y and p take this form (See Appendix):

$$\text{(1)} \qquad d\ln Y - E[d\ln Y] = \frac{\theta \cdot \varepsilon \cdot \mu \cdot S + (\theta + \mu - 1) \cdot (1 - S)}{\theta + (\mu - 1) \cdot (1 - S)} \cdot d\Pi$$

$$\text{(2)} \qquad d\ln p - E[d\ln p] = \frac{1 - \varepsilon \cdot \mu}{\theta + (\mu - 1) \cdot (1 - S)} \cdot d\Pi$$

where S is the OECD share of labour in income. Equations (1) and (2) characterize the OECD cycle, i.e. how the OECD growth rates of output and relative prices, dlnY and dlnp, vary with average productivity, $d\Pi$. Not surprisingly, Equation (1) shows that increases in average productivity lead to higher than average growth rates. Equation (2) shows that increases in average productivity lead to increases in the relative price of the L-industry if and only if $1>\varepsilon \cdot \mu$. Increases in the production of the K-industry are proportional to increases in the productivity of capital, i.e. proportional to Π; while increases in the production of the L-industry are proportional to increases in both the productivity of workers and their number; i.e. proportional to $\varepsilon \cdot \mu \cdot \Pi$. If $1>\varepsilon \cdot \mu$, increases in OECD average productivity require that the relative price of L-products increase to maintain market equilibrium. From now on, we shall proceed under the empirically relevant assumption of $1>\varepsilon \cdot \mu$.

2. Transmission Through Relative Product Prices

Innovations or shocks to the growth rate of income in each country take this form:

$$\text{(3)} \qquad d\ln y - E[d\ln y] = [1 - s\cdot(1-\varepsilon\cdot\mu)]\cdot d\pi + [s\cdot(\mu-1)\cdot(1-S) + s - S]\cdot\frac{1-\varepsilon\cdot\mu}{\theta+(\mu-1)\cdot(1-S)}\cdot d\Pi$$

where s is the country's share of labour in income. Equation (3) shows how the growth rate reacts to shocks at home and abroad. For our purposes, the key result in Equation (3) is that, holding constant domestic growth, shocks abroad are positively transmitted to the domestic economy if and only if $s > \frac{S}{1+(\mu-1)\cdot(1-S)}$. This condition combines the effects of two channels of transmission of shocks. Both channels work through changes in relative product prices. Since we have assumed that $1>\varepsilon\cdot\mu$, the price of L-products is procyclical. Consequently, positive shocks abroad raise wages at home, stimulating employment and production. This wage effect is measured by $\frac{s\cdot(\mu-1)\cdot(1-S)\cdot(1-\varepsilon\cdot\mu)}{\theta+(\mu-1)\cdot(1-S)}\cdot d\Pi$. In addition, positive shocks abroad constitute favourable (unfavourable) movements in the terms of trade for exporters of L-products (K-products), i.e. countries for which s>S (s<S). This terms-of-trade effect is measured by $\frac{(s-S)\cdot(1-\varepsilon\cdot\mu)}{\theta+(\mu-1)\cdot(1-S)}\cdot d\Pi$.[8]

How much do these transmission channels contribute to the creation of the OECD business cycle? To answer this question, we calculate the correlation coefficient between domestic and the OECD average growth rates, i.e. dlny and dlnY, that the model predicts under reasonable parameter values. This calculation requires us to make assumptions regarding S, s, σ, μ, ε and θ. Since the average labour share in the OECD is 0.53 and its standard deviation is 0.04, we set S=0.53 and consider

[8] A shock at home has two effects. First, increased productivity raises production of both industries. This effect is measured by $(s\cdot\varepsilon+1-s)\cdot d\pi$ and, not surprisingly, coincides with the Solow residual, i.e. that fraction of the GDP growth rate that cannot be accounted for by changes in factor inputs. Second, increased productivity raises wages at home and, therefore, employment and production in the L-industry. This effect is measured by $s\cdot(\mu-1)\cdot\varepsilon\cdot d\pi$. Both effects are expansionary.

three values for s, s={0.49,0.53,0.57}. We have calculated Solow residuals for all the countries in Table 1 and found that the cross-country correlation of Solow residuals is 0.32. Since the theory predicts this correlation to be equal to $\sqrt{\sigma}$, we set σ=0.1024.

Table 4 shows the correlation coefficients that arise for different values of θ, ε and μ. Given the observed correlation of productivity shocks of 0.32, the model can explain the observed correlation of growth rates of 0.47. However, this requires us to assume a strong factor bias in the nature of productivity shocks ($\varepsilon \approx 0$); and either a less than unit elasticity of substitution among commodities ($\theta \approx 0.5$) or a high elasticity of the labour supply ($\mu - 1 \approx 1$). Otherwise, the effects emphasized here seem to generate cross-country correlations in growth rates that are smaller than those observed in the data. But this should not be surprising. Unless one adopts the extreme position that business cycles are *only* transmitted through changes in relative product prices, there is no reason to believe that this particular channel should account for all of the observed correlations in outputs.

To understand the role that commodity trade plays in the creation of the OECD cycle, it is useful to briefly discuss the benchmark case of autarky. If countries are not allowed to trade, it is easy to see that innovations or shocks to the growth rates of income and relative prices in a country with index π would take this form (See Appendix):

$$(4) \qquad d\ln y - E[d\ln y] = \frac{\theta \cdot \varepsilon \cdot \mu \cdot s + (\theta + \mu - 1) \cdot (1 - s)}{\theta + (\mu - 1) \cdot (1 - s)} \cdot d\pi$$

$$(5) \qquad d\ln p - E[d\ln p] = \frac{1 - \varepsilon \cdot \mu}{\theta + (\mu - 1) \cdot (1 - s)} \cdot d\pi$$

The reader will immediately notice that these are nothing but Equations (1) and (2), which now apply to every country and not only to OECD averages. In a world of autarky, relative product prices are determined by the domestic relative production of L- and K-products and therefore depend only on domestic shocks. We have already seen in Table 3 that the cyclical pattern in product prices is driven by OECD-wide shocks and not domestic ones. Moreover, in such a world there are no channels of transmission, and the cross-country correlation of income growth rates is exactly equal to those of shocks, i.e. $\sqrt{\sigma}$. Figure 1 already made the point that income correlations are larger than those of the (measures of) underlying shocks. Commodity trade is instrumental in creating an environment in which changes in relative prices depend on OECD-wide shocks and the cross-country correlations of income growth rates exceed those of the underlying shocks (See Equations (2) and (3), respectively).

To sum up, our argument goes as follows: Favourable shocks in one or more OECD countries lead to increases in the relative prices of labour-intensive products and, therefore, raise wages, employment and output in the rest of the OECD. First, we presented evidence showing that periods of high growth in the OECD are associated with increases in the relative prices of labour-intensive products in all countries. Second, we developed a stylized model that illustrates how this cyclical behavior of product prices creates a channel of positive transmission of shocks that might be one of the (possibly many) factors behind the OECD cycle. Going beyond the details of the model, it should be apparent that the key ingredients of our argument are: (1) During booms labour-intensive products become relatively scarce and therefore the demand for labour increases in all countries; (2) Wages and employment respond positively to increases in the demand for labour. Any model that combines these two features would rationalize our claim that the cyclical behavior of product prices provides an important clue on how shocks are transmitted across OECD countries.

Appendix: Solution Details

In this appendix we derive all the equations of the paper. We shall use the result that, if $X=F(Z_1,Z_2)$ where Z_1 and Z_2 are Wiener processes and F(.) is a continuous and twice-differentiable function, Ito's lemma implies that:

$$\text{(A5)} \qquad dX - E[dX] = \frac{\partial F}{\partial Z_1} \cdot dZ_1 + \frac{\partial F}{\partial Z_2} \cdot dZ_2$$

See Harrison (1990), Chapter 4. Equate the ratio of OECD expenditure in L and K products, $\left(\frac{p_L}{p_K}\right)^{1-\theta}$, to the ratio of production values $\frac{\int_{-\delta}^{\delta} p_L^{\mu} \cdot e^{\mu \cdot \varepsilon \cdot \pi} \cdot \frac{d(\pi - \Pi)}{2 \cdot \delta}}{\int_{-\delta}^{\delta} p_K \cdot e^{\pi} \cdot \frac{d(\pi - \Pi)}{2 \cdot \delta}}$, to find that:

$$\text{(A2)} \qquad p^{1-\theta} = p^{\mu} \cdot \left(1 + p^{1-\theta}\right)^{\frac{\mu-1}{\theta-1}} \cdot e^{(\mu \cdot \varepsilon - 1) \cdot \Pi} \cdot \frac{e^{\delta \cdot \varepsilon \cdot \mu} - e^{-\delta \cdot \varepsilon \cdot \mu}}{\varepsilon \cdot \mu \cdot \left(e^{\delta} - e^{-\delta}\right)}$$

This equation implicitly defines p (or lnp) as a function of Π. Apply the implicit function theorem to (A2) to find that:

$$\text{(A3)} \qquad \frac{\partial \ln p}{\partial \Pi} = \frac{1 - \varepsilon \cdot \mu}{\theta + (\mu - 1) \cdot (1 - S)}$$

where $S = \frac{p^{1-\theta}}{1 + p^{1-\theta}}$. Since the income of a π country and the average OECD income are $y = p_L^{\mu} \cdot e^{\mu \cdot \varepsilon \cdot \pi} + p_K \cdot e^{\pi}$ and $Y = \int_{-\delta}^{\delta} y \cdot \frac{d(\pi - \Pi)}{2 \cdot \delta}$, we find that:

$$\text{(A4)} \qquad y = p^{\mu} \cdot \left(1 + p^{1-\theta}\right)^{\frac{\mu}{\theta-1}} \cdot e^{\mu \cdot \varepsilon \cdot \pi} + \left(1 + p^{1-\theta}\right)^{\frac{1}{\theta-1}} \cdot e^{\pi}$$

(A5) $$Y = p^{\mu} \cdot \left(1+p^{1-\theta}\right)^{\frac{\mu}{\theta-1}} \cdot e^{\mu\cdot\varepsilon\cdot\Pi} \cdot \frac{e^{\delta\cdot\varepsilon\cdot\mu} - e^{-\delta\cdot\varepsilon\cdot\mu}}{\varepsilon\cdot\mu} + \left(1+p^{1-\theta}\right)^{\frac{1}{\theta-1}} \cdot e^{\Pi} \cdot \left(e^{\delta} - e^{-\delta}\right)$$

These equations implicitly define y and Y (or lny and lnY) as functions of π and Π (either directly or through p). Apply the implicit function theorem to (A4) and (A5) to find that:

(A6) $$\frac{\partial \ln y}{\partial \pi} = 1 - s\cdot\left(1-\varepsilon\cdot\mu\right) \quad ; \quad \frac{\partial \ln y}{\partial \Pi} = \left[s\cdot(\mu-1)\cdot(1-S) + s - S\right]\cdot\frac{1-\varepsilon\cdot\mu}{\theta+(\mu-1)\cdot(1-S)}$$

(A7) $$\frac{\partial \ln Y}{\partial \Pi} = \frac{\theta\cdot\varepsilon\cdot\mu\cdot S + (\theta+\mu-1)\cdot(1-S)}{\theta+(\mu-1)\cdot(1-S)}$$

where $s = \frac{p_L^{\mu}\cdot e^{\mu\cdot\varepsilon\cdot\pi}}{p_L^{\mu}\cdot e^{\mu\cdot\varepsilon\cdot\pi} + p_K\cdot e^{\pi}}$. Equations (1)-(3) follow directly from (A1) and either (A7), (A2) or (A6), respectively. To obtain Equations (4)-(5), notice that in autarky the ratio of expenditures of a country with index π must equal the ratio of the value of productions of that country. As a result, Equation (A2) must be replaced by:

(A8) $$p^{1-\theta} = p^{\mu}\cdot\left(1+p^{1-\theta}\right)^{\frac{\mu-1}{\theta-1}}\cdot e^{(\mu\cdot\varepsilon-1)\cdot\pi}$$

It is now straightforward to proceed from here to Equations (4)-(5).

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Table 1
The OECD Cycle: Output Fluctuations

	Correlation of Real Per Capita GDP Growth With OECD Average Excluding that Country	
	Full Sample (1960-96)	Non-Oil Shock Sample (1960-72, 1982-96)
G7		
Canada	0.69 ***	0.79 ***
France	0.74 ***	0.67 ***
Germany	0.66 ***	0.53 ***
Italy	0.54 ***	0.54 ***
Japan	0.50 ***	0.47 **
United Kingdom	0.61 ***	0.39 **
United States	0.50 ***	0.36 *
Rest of OECD		
Australia	0.52 ***	0.56 ***
Austria	0.53 ***	0.54 ***
Belgium	0.62 ***	0.66 ***
Denmark	0.58 ***	0.42 **
Finland	0.41 **	0.55 ***
Greece	0.58 ***	0.57 ***
Iceland	0.15	0.20
Ireland	0.31 *	0.25
Luxembourg	0.29 *	0.07
Netherlands	0.67 ***	0.66 ***
New Zealand	0.29 *	0.27
Norway	0.31 *	0.37 **
Portugal	0.39 **	0.18
Spain	0.54 ***	0.61 ***
Sweden	0.50 ***	0.73 ***
Switzerland	0.54 ***	0.66 ***
Turkey	-0.06	0.02
G7 Average	0.61	0.54
Rest of OECD Average	0.42	0.41
OECD Average	0.47	0.46

This table reports the correlation of annual real per capita GDP growth with OECD average real per capita GDP growth excluding that country, for the indicated periods. Annual data on real per capita GDP at PPP and population are taken from Penn World Table, Version 5.6 (codes RGDPCH and POP), and are extended through 1996 using World Bank data on real per capita GDP at PPP and population (codes NYGDPCAPPPKD87 and SPPOPTOTL). * (**) (***) indicate significance at the 10% (5%) (1%) level respectively.

Table 2
The OECD Cycle: Labour Market Fluctuations

	Correlations with OECD Average Real Per Capita GDP Growth of Growth in:		
	Manufacturing Employment	**Manufacturing Hours**	**Manufacturing Real Wages**
	Full Sample (1960-96)		
G7			
Canada	0.61 ***	0.61 ***	0.16
France	0.44 ***	0.52 ***	0.07
Germany	0.40 **	0.46 ***	0.41 **
Italy	0.31 *	0.40 **	0.14
Japan	0.39 **	0.53 ***	0.33 **
United Kingdom	0.58 ***	0.61 ***	-0.11
United States	0.49 ***	0.42 ***	0.31 *
Other			
Belgium	0.44 ***	0.49 ***	0.32 **
Denmark	0.57 ***	0.39 **	0.23
Netherlands	0.33 **	0.24	0.44 ***
Norway	0.17	0.04	0.27 *
Sweden	0.37 **	0.24	0.26
G7 Average	0.46	0.51	0.19
G12 Average	0.43	0.41	0.24
	Non-Oil Shock Sample (1960-1972, 1982-1996)		
G7			
Canada	0.71 ***	0.66 ***	0.38 **
France	0.44 **	0.49 ***	0.24
Germany	0.32 *	0.33 *	0.46 **
Italy	0.41 **	0.39 **	0.26
Japan	0.30 *	0.40 **	0.41 **
United Kingdom	0.63 ***	0.57 ***	0.09
United States	0.38 **	0.24	0.38 **
Other			
Belgium	0.49 ***	0.38 **	0.59 ***
Denmark	0.41 **	0.25	0.36 **
Netherlands	0.41 **	0.24	0.53 ***
Norway	0.26	0.16	0.45 **
Sweden	0.59 ***	0.37 **	0.61 ***
G7 Average	0.46	0.44	0.32
G12 Average	0.45	0.37	0.40

This table reports the correlation of annual growth rates in each variable with OECD average real per capita GDP growth, excluding that country. Annual indices of hours worked, employment and wages in manufacturing are from the United States Bureau of Labour Statistics, International Labour Statistics (codes 0003, 0006, 0022, and 0024, available at ftp://ftp.bls.gov/pub/time.series/in/) Real wage growth is obtained by deflating by the consumer price index as reported by the IMF International Financial Statistics (code 64...zf). * (**) (***) indicate significance at the 10% (5%) (1%) level respectively.

Table 3
Labour Intensity and Price Cyclicality

(Dependent Variable is Growth in Price Index of Industry i in Country c at Time t)

	Full Sample (1960-96)		Non-Oil Shock Sample (1960-72, 1982-96)	
OECD Growth	-1.462 (0.621)**	-2.009 (0.743)***	-0.752 (0.440)*	-1.363 (0.775)**
OECD Growth x Labour Intensity	2.965 (0.833)***	3.120 (0.937)***	1.916 (0.670)***	2.128 (1.003)**
Domestic Growth		0.478 (0.446)		0.501 (0.588)
Domestic Growth x Labour Intensity		0.207 (0.617)		0.143 (0.727)
Number of Observations	16418	16418	11494	11494

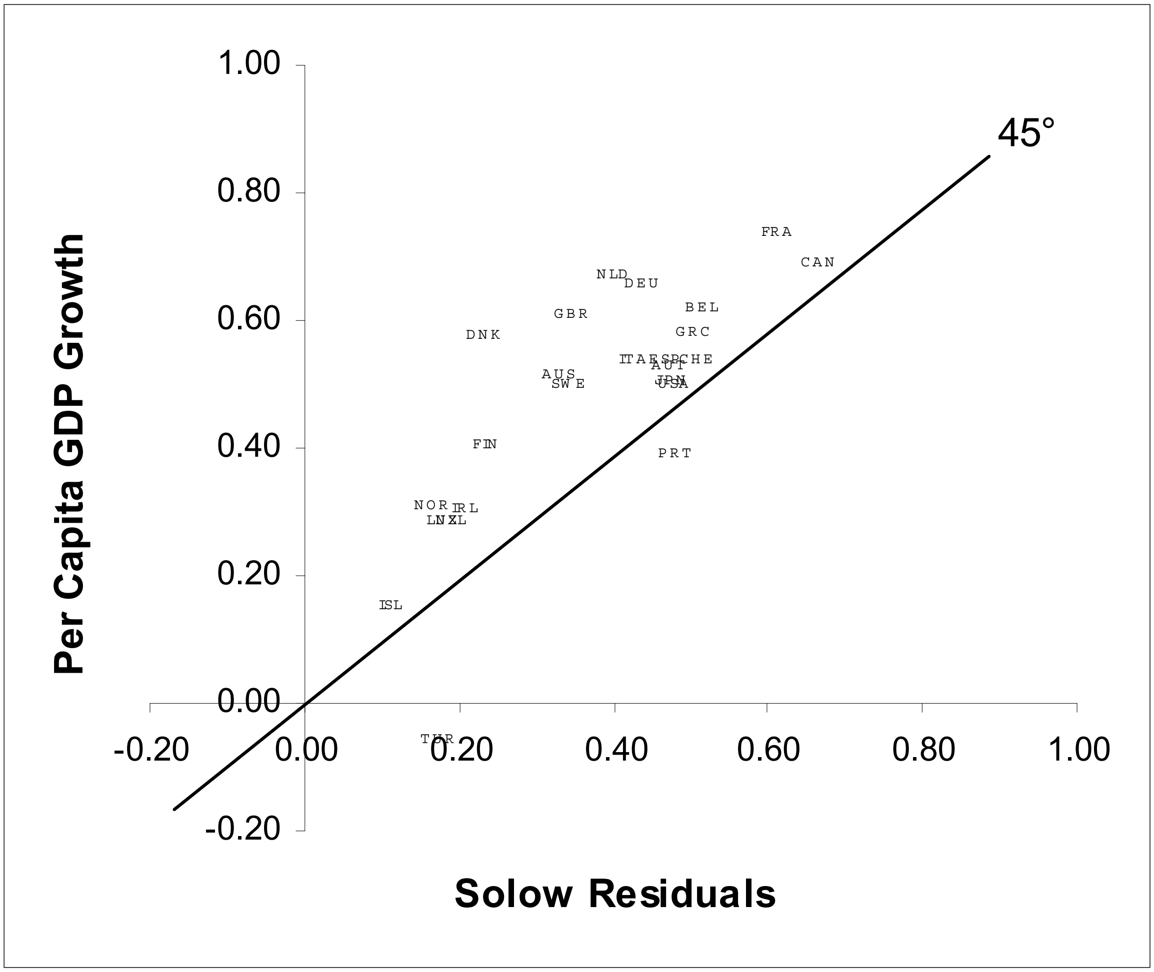
Standard errors are corrected for heteroskedasticity and serial and cross-sectional dependence using the procedure suggested by Driscoll and Kraay (1998). * (**) (***) indicates significance at the 10% (5%) (1%) level. Country-industry fixed effects are removed by taking deviations from country-industry means. The price and labour-intensity data cover 28 three-digit ISIC manufacturing sectors in 20 OECD countries for all available years over the period 1963-1995 (Iceland, Luxembourg, Switzerland and Turkey are excluded due to inadequate data coverage), and are drawn from the United Nations Industrial Development Yearbook. The dependent variable is the growth rate of the implicit gross output deflator (constructed as the growth in nominal local currency gross output less growth in the real industrial production index) relative to growth in the consumer price index. Labour intensity is measured as the share of employee compensation in value added. OECD and domestic growth are constructed as in Table 1.

Table 4
Theoretical Growth Correlations

S=0.53 σ=0.1024		ε=0.5			ε=0.25			ε=0		
		s=0.49	s=0.53	s=0.57	s=0.49	s=0.53	s=0.57	s=0.49	s=0.53	s=0.57
	μ=1.0	0.31	0.32	0.33	0.31	0.32	0.33	0.30	0.32	0.35
θ=1.0	μ=1.5	0.32	0.33	0.33	0.34	0.35	0.36	0.35	0.38	0.41
	μ=2.0	0.32	0.32	0.32	0.34	0.35	0.36	0.39	0.42	0.45
	μ=1.0	0.30	0.32	0.34	0.29	0.32	0.35	0.27	0.32	0.37
θ=0.5	μ=1.5	0.33	0.33	0.34	0.35	0.36	0.38	0.38	0.42	0.46
	μ=2.0	0.32	0.32	0.32	0.36	0.37	0.38	0.42	0.46	0.51
	μ=1.0	0.24	0.32	0.40	0.17	0.32	0.46	0.07	0.32	0.55
θ=0.1	μ=1.5	0.34	0.35	0.36	0.38	0.41	0.45	0.44	0.52	0.60
	μ=2.0	0.32	0.32	0.32	0.38	0.40	0.42	0.49	0.55	0.61

This table reports the theoretical correlation coefficient between domestic and OECD average growth, dlny and dlnY, which is $\rho(s) = \dfrac{1}{\sqrt{1 + \dfrac{1-\sigma}{\sigma} \cdot \left[\dfrac{1 - s \cdot (1 - \varepsilon \cdot \mu)}{1 - s \cdot (1 - \varepsilon \cdot \mu) + \left[s \cdot \left(S + \mu \cdot (1 - S) \right) - S \right] \cdot \dfrac{1 - \varepsilon \cdot \mu}{\theta + (\mu - 1) \cdot (1 - S)}} \right]^2}}$, for the indicated parameter values.

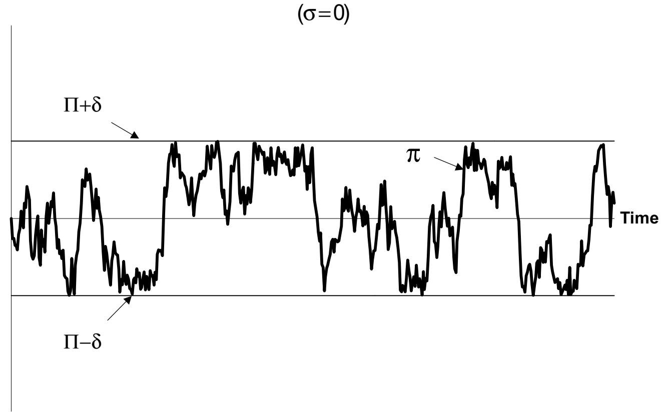
Figure 1
GDP Growth and Solow Residual Correlations
(1960-1996)



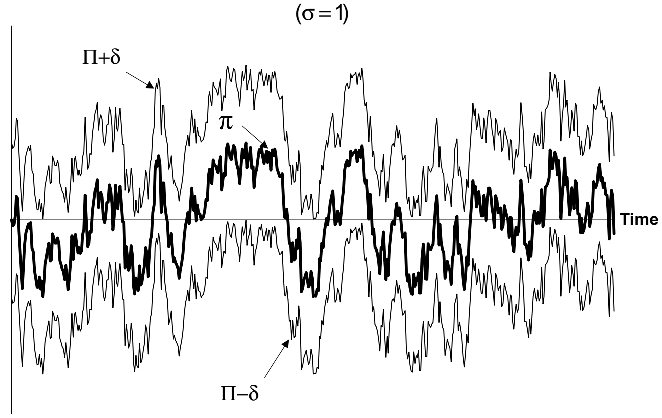
This figure plots the correlation of annual real per capita GDP growth with OECD average growth excluding that country (on the vertical axis) against the correlation of annual Solow residuals with OECD average Solow residuals excluding that country (on the horizontal axis). Real per capita GDP growth correlations are drawn from Table 1. Solow residuals are constructed as the growth in total real GDP, less the economy-wide share of wages in GDP times growth in total civilian employment, less one minus the share of wages in GDP times growth in the total capital stock. The share of wages in GDP is constructed using current price local currency compensation of employees and GDP by expenditure components taken from the OECD National Accounts (codes M0COM and M0GDPE). Total civilian employment is drawn from the OECD Labour Force Statistics. The total capital stock is in 1987 constant local currency units and is drawn from Nehru and Dhareshwar (1993) and is updated to 1995 using World Bank data. The OECD average Solow residual is constructed as a population-weighted average of country Solow residuals. Due to missing data on employment, Solow residual correlations are computed over the period 1960-1995. 22 out of 24 countries lie above the 45-degree line, and the null hypothesis that the growth rate correlations are equal to the Solow residual correlations is easily rejected. The p-value associated with a simple sign test is less than 0.01.

Figure 2
Sample Paths of the Productivity Index

Country-Specific Variation Only
($\sigma=0$)



Global Variation Only
($\sigma=1$)



Both Country-Specific and Global Variation
($0<\sigma<1$)