NBER WORKING PAPERS SERIES

A CROSS COUNTRY COMPARISON OF SEASONAL CYCLES AND BUSINESS CYCLES

J. Joseph Beaulieu

Jeffrey A. Miron

Working Paper No. 3459

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
October 1990

We thank Todd Clark for research assistance and David Cutler, David Weil, Steve Zeldes, and seminar participants at Harvard, Yale, Brown, Columbia, Johns Hopkins, Ohio State, Illinois, Penn, Berkeley, Rochester, MIT, Boston University and the NBER Macro Lunch Group for comments on an earlier draft. Financial support from NSF Grant SES-8710140 is gratefully acknowledged. This paper is part of NBER's research program in Economic Fluctuations and Financial Markets and Monetary Economics. Any opinions expressed are those of the authors and not those of the National Bureau of Economic Research.

NBER Working Paper #3459
October 1990

A CROSS COUNTRY COMPARISON OF SEASONAL CYCLES AND BUSINESS CYCLES

ABSTRACT

In a recent paper Barsky and Miron (1989) examine the seasonal fluctuations in the U.S. economy. They show that the key stylized facts about the business cycle characterize the seasonal cycle as well, and they suggest that the interpretation of many of these stylized facts over the seasonal cycle is easier than interpretation over the business cycle. The reason is that the ultimate sources of seasonal cycles are more readily identifiable than those of business cycles.

This paper uses the cross country variation in seasonal patterns to pin down the ultimate sources of seasonal variation more precisely than is possible from examination of U.S. data alone. We conclude that a Christmas shift in preferences and synergies across agents are the key determinants of the seasonal patterns around the world. The paper also establishes that, across developed countries, the key observations about aggregate variables that characterize the business cycle also characterize the seasonal cycle. Thus, the similarity of the seasonal cycle and the business cycle demonstrated by Barsky and Miron (1989) for the United States is a robust stylized fact.

J. Joseph Beaulieu
Department of Economics
MIT
E52-373
Cambridge, MA 02139

Jeffrey A. Miron
Department of Econmics
270 Bay State Road
Boston University
Boston, MA 02215

1. Introduction

In a recent paper, Barsky and Miron (1989) examine the seasonal fluctuations in the U.S. economy. They show that the key stylized facts about the business cycle characterize the seasonal cycle as well, and they suggest that the interpretation of many of these stylized facts over the seasonal cycle is easier than interpretation over the business cycle. The reason is that the ultimate sources of seasonal cycles are more readily identifiable than those of business cycles.

This paper uses the cross country variation in seasonal patterns to pin down the ultimate sources of seasonal variation more precisely than is possible from examination of U.S. data alone. The paper demonstrates that the main features of the seasonal patterns in most countries, including those in the Southern Hemisphere, are the same as in the United States, implying a world-wide seasonal cycle in economic activity. The most important features of this seasonal cycle are a fourth quarter boom in output, particularly December retail sales; a July or August trough in manufacturing production; and a first quarter trough in virtually all aspects of economic activity.

These results provide significant additional insight into the ultimate sources of seasonal fluctuations. The fact that the fourth quarter boom in output is driven especially by December retail sales, with this pattern occurring in both Northern and Southern Hemisphere countries, makes the key role of Christmas even more apparent than evidence from quarterly data for the U.S. in isolation. The extreme magnitude of the summer manufacturing slowdown, combined with the fact that its timing varies between July and August across countries, casts doubt on the importance of weather in explaining this slowdown. Similarly, the fact that both Northern and Southern Hemisphere countries display large seasonal troughs during the first quarter makes the role of winter weather significantly less compelling than observation of the U.S. by itself. We suggest that increasing returns or other synergies, rather than shifts in technology, are key factors in explaining observed seasonal movements.

The paper also establishes that, across developed countries, the key stylized facts about business cycles characterize the seasonal cycle as well. Over both the seasonal cycle and the business cycle, output movements across sectors are highly correlated, labor productivity is procyclical, production smoothing is essentially absent, and nominal money and real output move together. Thus, the similarity of the seasonal cycle and the business cycle demonstrated by Barsky and Miron (1989) for the United States is a robust stylized fact.

The remainder of the paper is organized as follows. Section 2 explains the estimation strategy, presents the seasonal patterns in key aggregate variables for a large group of countries, and discusses the likely reasons for the seasonal patterns observed. In Section 3 we document the similarity of the seasonal cycle and the business cycle in these countries with respect to several key stylized facts, and we interpret these stylized facts over the seasonal cycle in light of our conclusions of the ultimate causes of seasonal fluctuations. Section 4 discusses whether these conclusions about the nature of seasonal cycles apply to business cycles as well.

2. The Seasonal Patterns in Aggregate Variables Across Countries

The results in Beaulieu and Miron (1990a) indicate that the seasonality in aggregate U.S. time series is better characterized as stationary fluctuations around seasonal dummies than as unit roots at seasonal frequencies. These results also show that it is difficult to reject the hypothesis of a unit root at frequency zero. We have confirmed that these conclusions apply to aggregate data for the countries examined here (see also Osborn (1990)).[1] Thus, following Barsky and Miron (1989) and Beaulieu and Miron (1990b), we assume

$$x_t = \sum_{k=1}^{S} \xi_k d_t^k + \beta(B)\eta_t \tag{1}$$

[1] The tests for unit roots are conducted using the procedure developed in Hylleberg, Engle, Granger and Yoo (1990). The results of the seasonal unit root tests are in some cases sensitive to the treatment of residual autocorrelation. When one includes only those lags of the dependent variable necessary to produce an insignificant Q-statistic for the residuals, or, alternatively, only those lags that are significant if included in the regression, then one consistently rejects the presence of unit roots. If instead one includes a large number of lags to insure that no residual autocorrelation is present, then one rejects seasonal unit roots much less frequently. This last result presumably reflects low power.

where x_t is the log growth rate X_t, $\beta(B)$ is square summable, $S = 4$ or 12, and η_t is white noise. We estimate the ξ_k in (1) by OLS. Since $\beta(B)$ need not equal one, we correct the standard errors using the Newey and West (1987) procedure.[2]

Tables 1–3 present results for three key economic variables in over twenty-five countries.[3] The tables present three summary statistics from the regressions used to estimate the seasonal dummy patterns in addition to the patterns themselves. The summary statistics are the standard deviation of the fitted values of the regression, which is an estimate of the variability of the seasonal component of the series; the standard deviation of the residuals, which is an estimate of the variability of the business cycle component; and the R^2.[4] The entries in the last four (twelve) columns of the tables are the demeaned estimated coefficients on the seasonal dummies. The growth rates are measured at either quarterly or monthly rates.[5]

We note first that deterministic seasonals account for a striking fraction of the total variation in quarterly real GDP (80-90 percent), monthly industrial production (70-90 percent), and monthly retail sales (80-90 percent). As shown in Appendix Tables B1-B2, dummies also explain a large fraction of the variation in consumption and fixed investment. Overall, while seasonal dummies are important in explaining government purchases, exports and imports, they explain less of the total variation than for consumption and investment (see Tables B3-B5).

Table 1 shows that the pattern of seasonal variation in real GDP is strikingly similar across countries. Output falls sharply from the fourth quarter to the first quarter, grows strongly from the first to the second quarter, grows further going into the third quarter, and peaks in the fourth

[2] This procedure for calculating standard errors assumes there is no unit root in the stochastic component of $\Delta \ln X_t$. This assumption is violated if the secular growth in $\ln X_t$ is due to a deterministic time trend rather than a unit root. See Quah and Wooldridge (1988) for an analysis of the effects of overdifferencing.

[3] Osborn (1990) provides a similar set of results for the United Kingdom.

[4] Throughout this paper, we use both the terms "business cycle" and "non-seasonal" to refer to the non-seasonal dummy component of a series. See Beaulieu and Miron (1990a) and Miron (1990) for discussion of this approach. Ghysels (1988) shows that frequency domain decompositions of the variation in endogenous variables cannot be justified from the perspective of dynamic economic theory. Plosser (1979) analyzes models of stochastic seasonality.

[5] Appendix A describes the data.

quarter. There are some exceptions to this general pattern. In three countries (Australia, Japan, Sweden), output does not recover in the second quarter but remains near its low first quarter level. In other countries output does not change much from the second to the third quarter (Argentina, Italy, United States), and in three countries (Netherlands, Sweden, Taiwan) output falls significantly in the third quarter. Finally, in the fourth quarter output declines strongly in Canada and weakly in Germany. Nevertheless, there is a great deal of similarity across countries, particularly the fourth quarter increases and first quarter declines.

The seasonal patterns in GDP suggest two preliminary conclusions about the causes of seasonal fluctuations. As discussed by Barsky and Miron (1989), the fourth quarter boom in output implies a role for Christmas. The presence of a first quarter trough in output across Northern and Southern Hemisphere countries casts doubt on the likely role of the weather in explaining this trough, contrary to what Barsky and Miron suggest.

The patterns in retail sales (Table 2) provide strong confirmation for both of the conclusions suggested by the data on GDP. The most dramatic feature of the patterns is a large positive growth rate in December followed by a large negative growth rate in January, with this pattern consistent across Northern and Southern Hemisphere countries. This December to January behavior, even more than the fourth quarter to first quarter behavior of GDP, indicates a Christmas shift in consumption demand.[6] The fact that Australia and New Zealand both exhibit seasonal patterns strikingly similar to those of most Northern Hemisphere countries makes the potential role of the weather, at least for this component of economic activity, highly implausible.

The seasonal patterns in industrial production are presented in Table 3. The first significant characteristic is a winter slowdown, with production falling on average eight percent over the December to January period and then recovering in February. The second important feature is an

[6] Since the December increase and January decrease in retail sales occur in Japan, it is not entirely accurate to call this a "Christmas" effect. Also, in Spain there is a significant further increase in sales in January followed by a dramatic fall in February. The celebration of Christmas on Twelfth Night (January 6th) is common in Spain.

extreme slowdown in either July or August in almost all Northern Hemisphere countries, with this slowdown followed by an increase of approximately the same magnitude the following month. In fifteen of twenty countries, production declines by at least ten percent in either July or August, and in seven countries the decline is over twenty percent. Integration of the seasonals in the log growth rates confirms that the *level* of production is dramatically lower in July or August than in adjacent months in many of the countries considered above.

The summer slowdown in activity is perhaps the most interesting aspect of the seasonal patterns documented in this paper. One class of explanations relies on seasonal shifts in preferences or technology. For example, workers may prefer vacations during the summer, raising the shadow cost of labor and inducing firms to shift production to other periods. Alternatively, there may be shifts in the technology that dictate allocating production to higher productivity seasons. Braun and Evans (1990) and Chatterjee and Ravikumar (1990) present quarterly, seasonal real business cycle models based on these kinds of shifts in preferences and technology. In particular, Braun and Evans estimate an eight percent drop in productivity in the first quarter corresponding to the eight percent drop in GNP documented by Barsky and Miron, while Chatterjee and Ravikumar parameterize their model with a twenty percent drop in productivity in the first quarter. In both cases the models can account for many of the features of the quarterly seasonal patterns documented in Barsky and Miron (1989).

This class of models, however, appears less capable of dealing with the monthly facts presented above because the seasonal shifts required to fit the summer slowdown are implausible. Seasonal shifts in preferences and technology must at some level be due to the weather, yet the differences between the levels of production in July and August are extreme in comparison to any change in weather between the two months. Moreover, some countries experience July declines while others experience August declines even though July is the warmest month in all of the Northern Hemisphere countries considered here.

Rather than relying solely on large shifts in technology or preferences, it may be more accurate to explain the magnitude of the seasonals as the result of relatively small seasonal shifts in preferences or technology combined with increasing returns or other synergies. These synergies can arise through a number of mechanisms. It may be desirable to produce at the same time as an upstream or downstream firm in order to avoid stockpiling raw materials or holding inventories of work in progress and finished goods. Alternatively, different workers in the same family may wish to have vacations scheduled in the same period. Finally, firms may choose to close down completely so that maintenance or retooling can take place (Cooper and Haltiwanger (1990)).

The conclusion that synergies are probably important in explaining the magnitude of the summer slowdown does not mean that weather plays no role. Instead, it is likely that the weather pins down the *timing* of vacation periods as July or August even though it does not account for the magnitude of the declines. Since the seasonal cycle seems *a priori* an excellent candidate for a technology driven cycle, this result casts doubt on the plausibility of aggregate technology shocks in explaining the business cycle. We discuss this further in Section 4.

3. Stylized Facts

The discussion so far has examined the seasonal patterns in aggregate economic activity around the world and used the cross-sectional variation in these patterns to identify the major determinants of seasonal fluctuations. In this section we demonstrate that these seasonal fluctuations exhibit a number of key business cycle stylized facts, consistent with the results in Barsky and Miron (1989) and Beaulieu and Miron (1990b) for the United States. We also interpret these stylized facts over the seasonal cycle in light of our characterizations of the ultimate sources of seasonal fluctuations. Section 4 discusses whether these conclusions apply to the business cycle as well.

3.1 The Comovement of Output across Sectors

The most important business cycle stylized fact is the comovement of output across sectors.

As discussed above, seasonal dummies explain a large fraction of the variation in aggregate output, suggesting that seasonal movements are highly correlated across sectors as well. Tables B1-B5 make this point more directly by showing the seasonal patterns in consumption, investment, government purchases, exports and imports. The main features of the seasonal patterns in these variables are strikingly similar to those in overall GDP, particularly the fourth quarter increases and first quarter declines. There are important exceptions, most notably in investment in quarters other than the first, but the comovement of output across sectors characterizes the seasonal patterns in all the countries considered here.

As with the comovement of output over the business cycle, the comovement over the seasonal cycle suggests the presence of aggregate shocks to economic activity. We argue above that the most likely aggregate seasonal shocks are demand shifts related to Christmas and summer vacations combined with synergies across agents that make bunching of activity privately desirable. We also suggest that aggregate technology shifts are unlikely to be significant determinants of the aggregate seasonal cycles documented here.

3.2 Procyclical Labor Productivity

The second stylized fact that we consider is the cyclical behavior of labor productivity. Under constant returns and competition, the elasticity of output with respect to measured labor input is equal to labor's share in total output (approximately .75 in United States data for overall GNP). Estimates of this elasticity, however, always exceed labor's share and typically exceed unity. For example, Prescott (1986) obtains an elasticity of 1.1 for the United States, while Summers and Wadhwani (1987) estimate elasticities between 1.0 and 2.0 for most OECD countries.

To examine the cyclicality of labor productivity over the seasonal cycle, we first present the seasonal patterns in hours worked in manufacturing (see Table 4). The seasonal patterns in labor input match the patterns in manufacturing output, but with considerably smaller amplitude, suggesting that labor productivity is procyclical over the seasonal cycle.[7] Table 5 demonstrates this conclusion formally by reporting the estimated coefficient on hours from IV regressions of industrial production on hours worked in manufacturing, where seasonal dummies are the only instruments. The coefficients typically exceed one, indicating strong procyclicality of labor productivity over the seasonal cycle for most countries.[8]

Interpretation of these results is aided by recalling the seasonal patterns in industrial production discussed above. Since it is difficult to rationalize the behavior of production as resulting from changes in technology, it is unlikely that procyclical productivity over the seasons reflects shifts in technology, as in seasonal real business cycle models such as Braun and Evans (1990) and Chatterjee and Ravikumar (1990). Instead, it is plausible that the failure of labor input to move sufficiently with output over the seasons reflects labor hoarding, particularly that associated with vacations. In the third quarter many workers on paid vacations are counted as employed, and the hours for which firms pay are counted as hours worked. In comparing the third quarter and the fourth quarter, therefore, measured labor input does not change much but true labor input does, so output fluctuates more than measured labor input. Rather than paying workers to stay at the firm and not work, or incurring the costs associated with labor turnover, firms "store" hoarded labor at the beach.

3.3 The Absence of Production Smoothing

A third key stylized fact about the business cycle is the apparent absence of production smoothing. As documented by Blinder (1986) and others, production and sales move closely together over the business cycle, contrary to the implications of the production smoothing model. Indeed, production is usually more variable than sales, and the covariance of production and inventory investment

[7] As discussed in Miron and Zeldes (1989) industrial production series are often constructed using data on labor input. Therefore, estimates of labor productivity based on these data should be interpreted with caution.

[8] Tables B6-B8 we report analogous results using real GDP and employment; hours data are generally not available for the economy as a whole. The results indicate that the procyclicality of labor productivity is at least as strong over the seasonal cycle as it is over the business cycle.

is often positive.[9] Attempts to account for this absence of production smoothing through cost shocks find that while the data fail to reject models with unobservable cost shocks (Eichenbaum (1989)), they do reject models with observable cost shocks (Miron and Zeldes (1988)).

Figure 1 presents the seasonal patterns in manufacturing production and shipments for a number of countries. Consistent with the results in Miron and Zeldes (1988) and Beaulieu and Miron (1990b) for the U.S., the seasonals in the two variables are extremely similar in most cases. These results provide strong refutation of the production smoothing model over the seasonal cycle. The evidence is also difficult to reconcile from a cost smoothing perspective, both because the required seasonal pattern in costs is implausible and because there is no reason to expect the similarity of the seasonals in demand and costs that would be required to sustain such an explanation.

3.4 Nominal Money and Real Output

A final key stylized fact characterizing the business cycle is that nominal money and real activity are highly positively correlated. Table 6 addresses this issue over the seasonal cycle by displaying the seasonal patterns in the monthly money stock (M1). The most dramatic aspect of the seasonal patterns is large positive growth rates in December followed by large, negative growth rates in January. This behavior mimics the most dramatic fluctuations in GDP and especially retail sales, suggesting a strong comovement of money and output over the seasonal cycle. We address this issue more directly by considering IV regressions of nominal money on real output, with seasonal dummies as the only instruments. Table 7 presents results using quarterly GDP while Table 8 presents results using monthly retail sales. The coefficient estimates show a consistently strong, positive relation between the growth rate of nominal money and the growth rate of real

[9] West (1988) presents evidence against the production smoothing model in seven OECD countries. Fair (1989) suggests that much of the evidence against production smoothing results from inappropriate use of data on deflated nominal values. Using physical units data, he finds less evidence against production smoothing. Braun and Krane (1987) make a similar point. Kahn (1990), however, finds significant evidence against production smoothing using the physical units data analyzed by Fair as well as the physical units data from Blanchard (1983).

GDP or real retail sales.[10]

The most obvious interpretation of these results is that the relation between money and output over the seasonal cycle represents a prime example of the endogenous money mechanism discussed by King and Plosser (1984). In the fourth quarter, an exogenous increase in consumption spending drives up the demand for money, and both private banks and central banks respond by expanding the money stock.[11] This hypothesis is consistent with the observed absence of seasonals in nominal interest rates (see Table B11). The conclusion that money must be endogenous rather than exogenous with respect to the seasonal fluctuations in output is reinforced by the view (Lucas (1972)) that a regular, fully anticipated change in the money stock is unlikely to have real effects.

As discussed in Mankiw and Miron (1990), however, seasonal changes in money may have real effects on the economy if prices are sticky with respect to seasonal fluctuations in demand. As shown in Table B12, seasonals in prices are small in most countries, which is consistent with, but does not imply, sticky prices. Mankiw and Miron provide evidence that the change in seasonal monetary policy associated with the founding of the Fed is also associated with a significant change in the seasonal behavior of real output. This suggests the Fed's accommodation of seasonal asset demands has an independent effect on the seasonal behavior of output. The interpretation of the seasonal correlation between money and output is therefore still open to question.

4. The Seasonal Cycle and the Business Cycle

This paper uses the cross country variation in seasonal patterns to produce a strong characterization of the ultimate reasons for the seasonal variation in economic activity. We also demonstrate that the seasonal cycles in all countries display a number of key stylized facts about business cycles.

[10] Quarterly results for consumption are quite similar to those for GDP; see Table B9. In contrast to the results for GDP, retail sales, and consumption, there is not a strong association between monthly money and industrial production over the seasonal cycle; see Table B10. As Mankiw and Summers (1986) document using seasonally adjusted data for the United States, consumption is more highly correlated with money than is output over the business cycle.

[11] Barsky and Miron (1989) show that the fourth quarter increase in money in the U.S. is due both to increases in high-powered money and increases in the money multiplier.

Based on our characterization of the sources of seasonal fluctuations, we suggest interpretations of these stylized facts based on models previously used to explain business cycles. In particular, seasonal cycles are due to preference shifts and synergies rather than technology shocks; procyclical labor productivity reflects labor hoarding; and the comovement of production and sales provides strong evidence against production smoothing models of inventory accumulation.

The key remaining question is whether, armed with our interpretation of the seasonal cycle, and the similarity of the seasonal cycle to the business cycle, we can reach any conclusions about the nature of business cycles. For example, does the fact that synergies are important factors in the propagation of seasonal cycles imply they are important factors in the propagation of business cycles as well? This conclusion does not follow from the evidence provided above. Instead, it requires the assumption that the same economic propagation mechanism is operative over both cycles in producing the key business cycle stylized facts.

In Beaulieu, Mackie-Mason and Miron (1990), we demonstrate a strong correlation across countries between the amount of seasonal variation and the amount of business cycle variation in most of the aggregate series considered here.[12] The most natural explanation for this fact is that the same economic propagation mechanism is in fact operative over the seasonal cycle and the business cycle, even if the two cycles are due to different exogenous factors. If, for example, the seasonal fluctuations are due to synergies while business cycle fluctuations are due to technology shocks, cross-sectional correlations emerge only if countries with large technology shocks over the business cycle also are ones with important synergies over the seasonal cycle. There is no obvious reason for this condition to hold. If, instead, however, fixed costs of re-tooling or the desire to operate at the same time as an upstream or downstream industry are important considerations in determining the timing of a country's production, then they are likely to apply with respect to both seasonal and business cycle fluctuations.

[12] A similar result holds across 2-digit manufacturing industries in the United States.

To the extent one accepts that the same propagation mechanism is operative over the two kinds of cycles, it follows that the explanation for the business cycle stylized facts is the same as the explanation for these facts over the seasonal cycle. In order to make this conclusion compelling, it is of course necessary to provide explicit models that incorporate both seasonal and cyclical variation and then conduct more detailed tests of these models. The evidence provided above is meant to spur such future research.

References

Barsky, Robert B. and Jeffrey A. Miron (1989), "The Seasonal Cycle and the Business Cycle." *Journal of Political Economy*, 97, 3(June), 503-35.

Beaulieu, J. Joseph and Jeffrey A. Miron (1990a), "Seasonal Unit Roots and Deterministic Seasonals in Aggregate U.S. Data," manuscript, Boston University.

Beaulieu, J. Joseph and Jeffrey A. Miron (1990b), "Seasonality in U.S. Manufacturing," manuscript, Boston University.

Beaulieu, J. Joseph, Jeffrey K. MacKie-Mason, and Jeffrey A. Miron (1990), "Why Do Countries and Industries with Large Seasonal Cycles Also Have Large Business Cycles," *Quarterly Journal of Economics*, forthcoming.

Blanchard, Olivier J. (1983), "The Production and Inventory Behavior of the American Automobile Industry," *Journal of Political Economy*, 91, 365-400.

Blinder, Alan (1986). "Can the Production Smoothing Model of Inventory Behavior Be Saved?" *Quarterly Journal of Economics* 101, 431-54.

Braun, R. Anton and Charles L. Evans (1990), "Seasonality and Equilibrium Business Cycles Theories," manuscript, University of Virginia.

Braun, Steven and Spencer Krane (1987), "Measurement Issues in Production Smoothing: Evidence from Physical Units Data," manuscript, Federal Reserve Board.

Chatterjee, Satyajit and B. Ravikumar (1990), "A Stochastic Growth Model with Seasonal Perturbations," manuscript, University of Iowa.

Cooper, Russell and John Haltiwanger (1990), "Macroeconomic Implications of Machine Replacement: Theory and Evidence," manuscript, Boston University.

Eichenbaum, Martin (1989), "Some Empirical Evidence on the Production Level and Production Cost Smoothing Models of Inventory Investment," *American Economic Review*, 79, 4(Sept.), 853-64.

Fair, Ray C. (1989), "The Production Smoothing Model is Alive and Well," *Journal of Monetary Economics*, 24, 353-70.

Ghysels, Eric (1988), "A Study Toward a Dynamic Theory of Seasonality for Economic Time Series," *Journal of the Americal Statistical Association*, 83, 401(March), 168-72.

Hylleberg, S., R. Engle, C.W.J. Granger, and B.S. Yoo (1990), "Seasonal Integration and Co-Integration," *Journal of Econometrics*, 44.

Kahn, James A. (1990), "The Seasonal and Cyclical Behavior of Inventories," WP #223, Rochester Center for Economic Research.

King, Robert G. and Charles I. Plosser (1984), "Money, Credit and Prices in a Real Business Cycle," *American Economic Review*, 74, 363-80.

Lucas, Robert E., Jr. (1972), "Expectations and the Neutrality of Money," *Journal of Economic Theory*, 4, 103-24.

Mankiw, N. Gregory and Jeffrey A. Miron (1990), "Should the Fed Smooth Interest Rates? The Case of Seasonal Monetary Policy," NBER WP #3388.

Mankiw, N. Gregory and Lawrence H. Summers (1986), "Money Demand and the Effects of Fiscal Policies," *Journal of Money, Credit and Banking*, 18, 4(Nov.), 415-29.

Miron, Jeffrey A. (1990), "The Economics of Seasonal Cycles," manuscript, Boston University.

Miron, Jeffrey A. and Stephen P. Zeldes (1988), "Seasonality, Cost Shocks, and the Production Smoothing Model of Inventories," *Econometrica*, 56, 877-908.

Miron, Jeffrey A. and Stephen P. Zeldes (1989), "Production, Sales, and the Change in Inventories: An Identity that Doesn't Add Up," *Journal of Monetary Economics*, 24, 31-51.

Newey, Whitney and Kenneth West (1987), "A Simple, Positive Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix," *Econometrica*, 55, 703-8.

Osborn, Denise R. (1990), "A Survey of Seasonality in U.K. Macroeconomic Variables," manuscript, University of Manchester.

Plosser, Charles I. (1979), "The Analysis of Seasonal Economic Models," *Journal of Econometrics*, 10, 147-63.

Prescott, Edward C. (1986), "Theory Ahead of Business Cycle Measurement," *Carnegie-Rochester Conference Series*, vol. 25.

Quah, Danny and Jeff Wooldridge (1988), "A Common Error in the Treatment of Trending Time Series," Working Paper #483, M.I.T.

Summers, Lawrence H. and Sushil B. Wadhwani (1987), "Some International Evidence on Labor Cost Flexibility and Output Variability," Discussion Paper # 1353, Harvard Institute for Economic Research.

West, Kenneth D. (1988), "Evidence from Seven Countries on Whether Inventories Smooth Aggregate Output," NBER WP #2664.

Table 1: Real Gross Domestic Product, Log Growth Rates (Quarterly)								
	Sample Period	*Std. Dev. of Seasonals*	*Std. Dev. of Residuals*	R^2	Q1	Q2	Q3	Q4
Argentina	1977:2–1987:2	3.87	3.53	.546	-6.09	2.53	-.39	3.95
Australia	1960:2–1987:3	9.02	2.31	.938	-14.37	.09	4.05	10.23
Austria	1973:2–1987:3	9.07	1.12	.985	-15.60	6.52	5.66	3.42
Canada	1961:2–1987:3	6.17	2.07	.899	-6.76	4.59	7.49	-5.32
Finland	1970:2–1987:2	7.40	2.95	.863	-12.38	4.50	1.39	6.49
Germany	1960:2–1987:3	4.75	2.51	.782	-7.61	3.24	4.64	-.27
Italy	1970:2–1984:4	5.68	1.62	.924	-9.57	4.72	.78	4.07
Japan	1965:2–1987:1	10.83	2.19	.961	-17.22	.05	5.40	11.77
Netherlands	1977:2–1987:4	5.39	2.52	.821	-4.04	6.41	-6.31	3.93
Norway	1978:2–1987:4	3.28	1.93	.742	-4.17	-2.18	2.78	3.57
Sweden	1970:2–1987:3	11.56	1.87	.974	-9.38	.42	-9.81	18.76
Taiwan	1961:2–1987:3	3.56	3.44	.517	-3.54	1.02	-2.87	5.39
United King.	1955:2–1987:3	3.46	2.15	.721	-5.90	1.65	1.22	3.03
United States	1948:2–1985:4	5.13	1.84	.886	-8.17	3.96	-.56	4.77

Table 2: Real Retail Sales, Log Growth Rates (Monthly)

	Sample Period			*Std. Dev. of Seasonals*			*Std. Dev. of Residuals*			R^2		
Australia	1961:5–1987:11			12.73			3.17			.942		
Austria	1960:2–1987:10			17.80			5.53			.912		
Belgium	1969:2–1987:9			11.92			3.73			.911		
Canada	1960:2–1987:11			12.72			4.00			.910		
Denmark	1967:2–1987:11			12.83			5.57			.841		
Finland	1960:2–1987:9			15.71			6.21			.865		
France	1960:2–1987:12			20.32			6.32			.912		
Germany	1960:2–1987:11			15.02			4.60			.914		
Greece	1974:7–1987:10			10.62			5.29			.801		
Italy	1970:2–1987:8			19.26			5.52			.924		
Japan	1960:2–1987:10			16.50			2.93			.969		
Netherlands	1960:2–1987:11			8.76			5.89			.689		
Norway	1960:2–1987:11			15.56			4.94			.908		
New Zealand	1970:2–1987:10			11.32			6.57			.748		
Spain	1965:2–1987:9			23.20			8.35			.885		
Sweden	1973:2–1987:10			14.19			4.50			.909		
Switzerland	1960:2–1987:10			13.99			5.14			.881		
United King.	1960:2–1987:11			11.40			2.25			.963		
United States	1960:2–1987:12			11.03			2.83			.938		
Yugoslavia	1960:2–1987:11			14.24			10.19			.662		
	JAN	*FEB*	*MAR*	*APR*	*MAY*	*JUN*	*JUL*	*AUG*	*SEP*	*OCT*	*NOV*	*DEC*
Australia	-33.77	-5.70	7.15	-.41	6.63	-7.80	2.27	.66	-1.03	4.40	2.82	24.77
Austria	-52.38	-2.66	13.54	.05	-.08	-.77	4.80	-1.46	-.47	6.81	3.08	29.53
Belgium	-27.28	-3.88	14.56	.12	.34	1.46	-11.67	-.50	7.37	3.62	-6.78	22.65
Canada	-36.61	-4.27	14.59	4.66	6.41	-1.71	-4.95	-1.99	-.89	5.57	2.49	16.70
Denmark	-30.17	-10.79	9.00	1.04	4.89	-1.86	2.48	-1.64	-4.14	4.49	-2.40	29.11
Finland	-43.50	1.22	3.54	11.27	4.97	-2.69	-8.85	-.73	2.76	2.25	.47	29.29
France	-47.02	-18.32	15.94	-2.34	4.00	-.13	-5.15	-8.67	21.62	3.18	-3.02	39.92
Germany	-42.20	-3.34	17.26	-.20	-2.21	-4.44	3.90	-7.65	3.75	11.13	3.44	20.56
Greece	-23.18	2.11	-9.24	12.38	-9.35	-2.89	-4.28	4.98	.53	7.28	1.75	19.91
Italy	-47.07	-6.65	16.36	-1.42	.30	-1.12	-2.69	-13.25	19.20	8.16	-8.36	36.53
Japan	-43.12	-3.42	17.94	-2.89	-2.48	-.39	7.85	-7.95	-2.36	4.96	.80	31.06
Netherlands	-16.19	-13.87	15.78	.84	3.79	-4.48	.48	-6.50	4.45	7.74	.01	7.97
Norway	-44.96	-2.94	9.45	1.97	6.13	3.51	-4.46	.58	-.89	6.33	-1.92	27.21
New Zealand	-31.44	.13	11.18	-2.99	6.75	-8.34	3.43	.75	-.71	.63	2.57	18.02
Spain	10.61	-54.83	.14	2.03	7.13	1.83	28.90	-34.23	4.51	18.23	-11.41	27.10
Sweden	-38.99	-6.10	10.81	3.96	1.21	-1.98	-3.50	.90	-.11	8.98	-1.99	26.79
Switzerland	-33.40	-12.79	13.53	1.28	-1.69	-3.32	-3.19	-7.54	3.32	9.56	8.36	25.89
United King.	-32.78	-3.85	4.07	1.37	.67	-.92	3.18	-3.09	.57	4.32	6.14	20.30
United States	-30.65	-3.50	13.12	1.16	3.85	-.58	-2.04	1.08	-4.44	4.42	.27	17.31
Yugoslavia	-43.59	2.74	15.76	9.24	-8.48	6.80	1.62	3.28	1.53	.61	.02	10.46

Table 3: Industrial Production, Log Growth Rates (Monthly)

	Sample Period	*Std. Dev. of Seasonals*	*Std. Dev. of Residuals*	R^2
Australia	1963:2–1987:9	12.29	2.72	.953
Austria	1960:2–1987:11	6.56	3.37	.791
Belgium	1960:2–1987:9	10.49	4.55	.841
Canada	1960:2–1987:11	5.71	2.37	.847
Finland	1960:2–1987:11	16.44	5.08	.913
France	1960:2–1987:11	17.41	4.47	.938
Germany	1960:2–1987:11	7.02	3.56	.795
Greece	1962:2–1987:10	4.38	4.35	.503
Ireland	1975:8–1987:10	8.53	3.94	.824
Italy	1960:2–1987:10	22.53	9.23	.856
Japan	1960:2–1987:11	5.30	1.95	.880
Luxembourg	1960:2–1987:9	7.84	6.23	.613
Netherlands	1960:2–1987:11	6.74	3.64	.774
Norway	1960:2–1987:11	18.13	8.18	.831
Portugal	1968:2–1987:8	9.01	6.58	.652
Spain	1961:2–1987:9	13.94	8.38	.735
Sweden	1960:2–1987:11	32.95	5.61	.972
United King.	1960:2–1987:11	6.85	2.92	.846
United States	1960:2–1987:12	2.45	1.17	.813
Yugoslavia	1960:2–1987:11	9.00	3.37	.877

	JAN	*FEB*	*MAR*	*APR*	*MAY*	*JUN*	*JUL*	*AUG*	*SEP*	*OCT*	*NOV*	*DEC*
Australia	-21.41	33.47	-.16	-3.00	.19	-.59	1.44	.28	2.83	-.18	1.64	-14.50
Austria	-13.12	5.32	2.13	1.78	2.80	.18	-13.22	.57	10.00	2.36	3.80	-2.59
Belgium	-1.29	5.90	.24	1.70	-.65	-.84	-27.11	17.67	10.78	.05	3.07	-9.50
Canada	.07	6.72	-.40	-1.72	-.65	3.38	-13.70	4.36	7.78	.01	1.79	-7.66
Finland	-.03	1.29	-.07	2.29	-.46	-5.61	-41.79	36.99	6.96	1.68	1.63	-2.89
France	-.51	1.77	-.39	-.55	-2.84	1.68	-12.12	-36.54	45.68	3.76	1.83	-1.76
Germany	-8.62	6.32	1.50	1.88	-1.18	.61	-11.79	-4.58	15.84	1.74	4.29	-5.99
Greece	-7.19	4.93	2.30	-.69	1.96	4.76	-1.75	-3.46	8.50	-4.69	-1.55	-3.13
Ireland	-3.61	7.87	3.94	-.49	1.70	3.44	-9.84	-13.96	18.86	-.55	1.81	-9.16
Italy	1.46	4.37	.66	.25	.49	-.29	-4.30	-52.17	56.58	-1.04	1.48	-7.48
Japan	-10.88	5.78	7.93	-5.56	-2.21	3.27	.44	-5.91	5.84	-.60	-.67	2.57
Luxembourg	.26	4.98	.45	2.39	1.91	-.70	-6.02	-16.56	18.50	-.53	1.45	-6.12
Netherlands	-5.75	2.51	-.64	-.63	-3.62	-1.00	-17.11	5.59	10.28	6.64	3.74	-.01
Norway	4.61	5.74	-4.41	-6.69	-2.09	8.40	-44.76	38.75	7.64	2.33	2.64	-12.17
Portugal	-1.16	2.48	1.46	.97	-2.64	.55	-4.92	-19.23	23.62	1.72	-.34	-2.50
Spain	-.43	-.78	4.01	-3.33	2.83	-2.05	-2.68	-32.74	33.97	4.16	-.24	-2.72
Sweden	-4.38	1.60	1.17	5.05	-2.38	1.13	-84.48	75.17	6.65	2.95	1.34	-3.81
United King.	.24	6.27	1.42	-7.09	.92	.24	-9.40	-5.80	16.09	2.97	2.55	-8.42
United States	.15	2.60	.27	-.39	.11	2.35	-5.19	3.42	2.36	-.35	-2.22	-3.10
Yugoslavia	-17.29	4.30	10.82	-3.32	-1.22	2.89	-17.07	9.21	7.30	4.00	-5.71	6.09

Table 4: Total Hours in Manufacturing, Log Growth Rates (Quarterly)								
	Sample Period	*Std. Dev. of Seasonals*	*Std. Dev. of Residuals*	R^2	Q1	Q2	Q3	Q4
Austria (HH)	1969:2–1987:3	2.79	2.05	.649	-1.75	-.11	-2.70	4.56
Austria (EST)	1965:2–1987:3	3.48	1.82	.785	-1.52	-1.53	-2.90	5.95
Canada	1960:2–1987:3	2.16	1.80	.588	-.75	2.93	.76	-2.95
Germany	1965:2–1987:3	2.85	2.67	.533	-2.66	-1.08	-1.10	4.83
Greece	1962:2–1987:3	2.13	3.18	.310	-3.58	1.81	1.39	.38
Japan	1960:2–1987:3	5.17	1.37	.934	-6.48	7.62	-2.10	.96
Norway (males)	1960:2–1970:4	7.61	3.13	.855	-1.36	-5.86	-5.30	12.52
Sweden (HH)	1968:2–1986:2	11.83	3.13	.935	-3.19	-2.68	-13.27	19.14
Sweden (EST)	1968:2–1986:2	11.82	3.16	.933	-3.17	-2.75	-13.23	19.98
United States	1960:2–1987:4	1.67	1.82	.457	-2.87	1.39	.82	.66

Table 5: Relation Between Industrial Production and Hours, Log Growth Rates (Quarterly)			
	Sample Period	*Coefficient*	*Standard Error*
Austria (HH)	1969:2 –1987:3	2.91	(.18)
Austria (EST)	1965:2 –1987:3	1.95	(.10)
Canada	1960:2 –1987:3	-.02	(.15)
Germany	1965:2 –1987:3	2.36	(.12)
Greece	1962:2 –1987:3	1.68	(.23)
Japan	1960:2 –1987:3	.31	(.06)
Norway (males)	1960:2 –1970:4	1.13	(.07)
Sweden (HH)	1968:2 –1986:2	1.53	(.04)
Sweden (EST)	1968:2 –1986:2	1.53	(.04)
United States	1960:2 –1987:4	.51	(.10)

Notes to Tables 4-5:

1. The standard errors have been corrected using the Newey and West (1987) procedure.
2. Employment data are from establishment surveys unless otherwise noted; see Data Appendix for details.

Table 6: Money Stock, Log Growth Rates (Monthly)

	Sample Period	*Std. Dev. of Seasonals*	*Std. Dev. of Residuals*	R^2
Australia	1960:7 –1987:11	1.64	1.23	.638
Austria	1960:2 –1987:11	2.16	1.94	.554
Belgium	1976:1 –1987:12	2.31	1.31	.757
Canada	1960:2 –1987:12	1.96	1.50	.631
Denmark	1970:3 –1987:11	4.26	2.99	.671
Finland	1960:2 –1987:11	2.53	3.39	.358
France	1970:1 –1987:11	2.65	1.61	.731
Germany	1960:2 –1987:12	2.76	1.26	.827
Greece	1960:2 –1987:10	3.73	2.91	.622
Iceland	1960:2 –1987:10	2.20	4.46	.195
Ireland	1976:11–1987:12	2.91	1.81	.721
Italy	1962:1 –1987:11	2.35	1.77	.638
Japan	1960:2 –1987:11	3.90	1.57	.859
Netherlands	1960:2 –1987:10	1.77	1.58	.557
Norway	1966:2 –1987:10	2.23	1.96	.566
New Zealand	1977:4 –1987:10	4.51	3.09	.680
Spain	1960:2 –1987:11	3.31	1.17	.890
Switzerland	1960:2 –1987:11	1.74	1.41	.604
Taiwan	1968:2 –1987:12	3.60	3.17	.563
Turkey	1977:1 –1987:12	5.74	5.07	.562
United King.	1971:7 –1987:12	1.31	1.82	.340
United States	1960:2 –1987:12	1.47	.61	.852
Yugoslavia	1964:11–1987:10	1.02	2.47	.147

	JAN	*FEB*	*MAR*	*APR*	*MAY*	*JUN*	*JUL*	*AUG*	*SEP*	*OCT*	*NOV*	*DEC*
Australia	-.79	-.33	.01	-.81	-3.28	-.26	-.92	-.47	.58	1.35	.92	4.01
Austria	-3.78	.69	-.41	.97	1.18	1.80	-.26	.49	1.16	-4.42	3.64	-1.06
Belgium	-1.54	-2.39	1.77	1.63	1.35	3.46	-4.25	-2.25	.71	-1.56	-.10	3.18
Canada	-3.97	-3.17	.03	1.42	.22	1.28	1.43	-.47	.30	.15	-.90	3.67
Denmark	-9.37	-1.11	3.52	1.10	-.67	5.64	-6.73	-1.38	3.09	.00	.56	5.35
Finland	-4.55	-.97	-.76	.54	1.27	1.65	-2.67	-.45	.48	-1.73	.83	6.37
France	-3.98	-1.94	1.26	.31	-1.17	2.31	.52	-3.28	1.45	.26	-2.08	6.32
Germany	-7.51	.05	-.34	.74	1.27	1.16	-.36	-.64	-.42	-.25	5.59	.71
Greece	-8.21	-1.38	-1.35	4.17	-2.71	1.97	1.34	.69	.38	-1.22	-1.65	7.97
Iceland	-1.80	-.48	2.47	4.17	2.50	-1.85	.72	-3.40	-.57	.83	.22	-2.83
Ireland	-5.36	-3.51	2.84	-1.92	-.44	2.65	-1.21	.98	2.29	-2.04	.43	5.30
Italy	-4.05	-1.79	-.03	-.12	-.26	.28	.31	-1.67	.64	.04	-.05	6.68
Japan	-7.57	-2.67	4.00	.29	-.99	.84	-1.69	-2.25	1.26	-2.01	1.58	9.22
Netherlands	-.41	-.75	.80	2.09	4.38	-.12	-2.00	-2.44	-.47	-1.38	.44	-.11
Norway	-.48	-2.35	-2.25	-.02	-1.63	4.90	-.41	-1.70	.89	2.22	-2.13	2.97
New Zealand	-7.88	5.59	-6.40	2.77	-.27	-1.31	-1.33	1.93	-5.24	1.87	2.08	8.19
Spain	-7.51	-1.20	.75	-.20	-.45	2.18	1.40	-2.73	1.02	-.75	-.26	7.76
Switzerland	-3.44	-1.66	1.16	-.46	-.45	.79	-2.13	-.79	1.67	.90	1.34	3.07
Taiwan	3.43	-6.36	-3.53	-.59	.95	4.42	-4.28	.33	-.84	-.04	-.57	7.08
Turkey	-13.62	-1.89	-1.44	1.11	-.12	-.13	2.38	1.91	-1.78	1.95	-1.81	13.44
United King.	-3.51	-1.03	1.32	1.71	-.07	.10	.88	-.93	-.11	.13	.74	.77
United States	-.71	-3.23	.08	1.91	-2.20	1.08	.39	-.79	.49	.46	.69	1.84
Yugoslavia	.53	-.99	-.83	.59	-.90	-1.00	2.50	1.05	-1.39	-.29	-.25	.08

Table 7: Relation Between Money and GDP, Log Growth Rates (Quarterly)			
	Sample Period	*Coefficient*	*Standard Error*
Argentina	1977:2–1987:2	.45	(.33)
Australia	1960:2–1987:3	.23	(.03)
Austria	1973:2–1987:3	.31	(.04)
Canada	1961:2–1987:3	.36	(.04)
Finland	1970:2–1987:2	.65	(.12)
Germany	1968:2–1987:3	.68	(.06)
Italy	1970:2–1984:4	.68	(.08)
Japan	1965:2–1987:1	.39	(.02)
Netherlands	1977:2–1987:3	.52	(.06)
Norway	1978:2–1987:3	.35	(.22)
Sweden	1970:2–1987:3	.12	(.05)
Taiwan	1968:2–1987:3	-.36	(.11)
United King.	1963:2–1987:3	.54	(.14)
United States	1948:2–1985:4	.13	(.02)

Table 8: Relation Between Money and Retail Sales, Log Growth Rates (Monthly)			
	Sample Period	*Coefficient*	*Standard Error*
Austria	1960:2 –1987:10	.03	(.01)
Belgium	1976:1 –1987:9	.12	(.01)
Canada	1960:2 –1987:11	.11	(.01)
Denmark	1970:3 –1987:11	.21	(.03)
Finland	1960:2 –1987:9	.14	(.02)
France	1970:1 –1987:11	.11	(.01)
Germany	1960:2 –1987:11	.12	(.01)
Greece	1974:7 –1987:10	.34	(.05)
Italy	1970:2 –1987:8	.12	(.01)
Japan	1960:2 –1987:10	.21	(.01)
Netherlands	1960:2 –1987:10	.05	(.01)
Norway	1960:2 –1987:10	.06	(.01)
Spain	1965:2 –1987:9	.05	(.01)
Sweden	1973:2 –1987:10	.02	(.02)
Switzerland	1960:2 –1987:10	.11	(.01)
United King.	1971:7 –1987:11	.09	(.01)
United States	1960:2 –1987:12	.04	(.00)
Yugoslavia	1964:11–1987:10	-.01	(.01)

Notes to Tables 7-8:

1. The standard errors have been corrected using the Newey and West (1987) procedure.

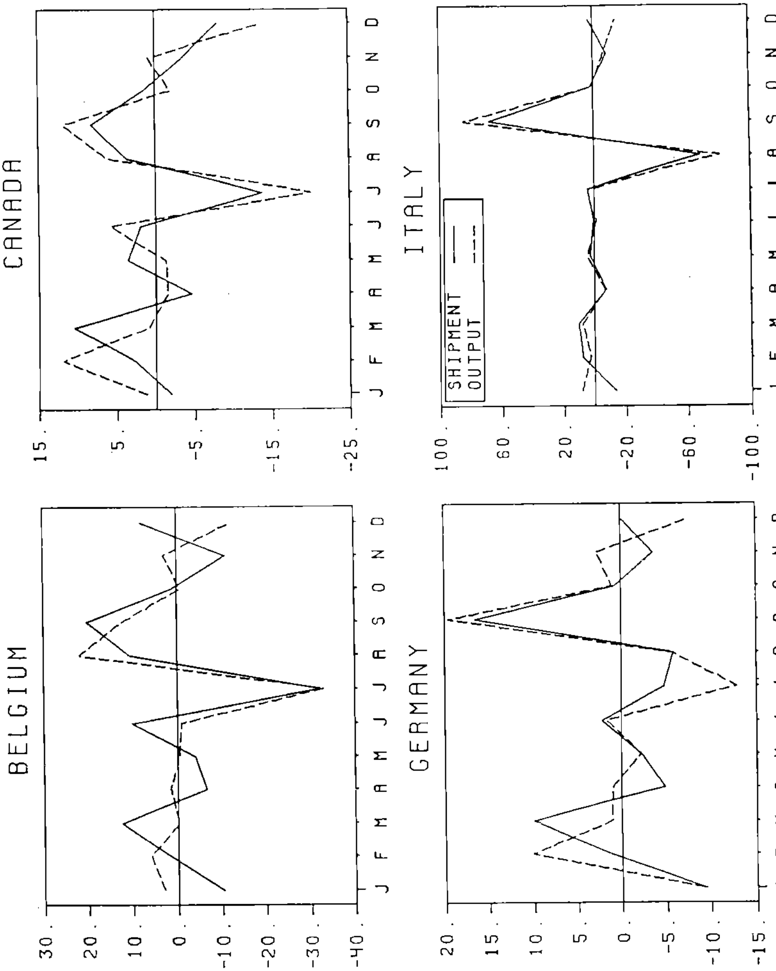
BELGIUM
CANADA
GERMANY
ITALY
SHIPMENT
OUTPUT
J F M A M J J A S O N D

Figure 1

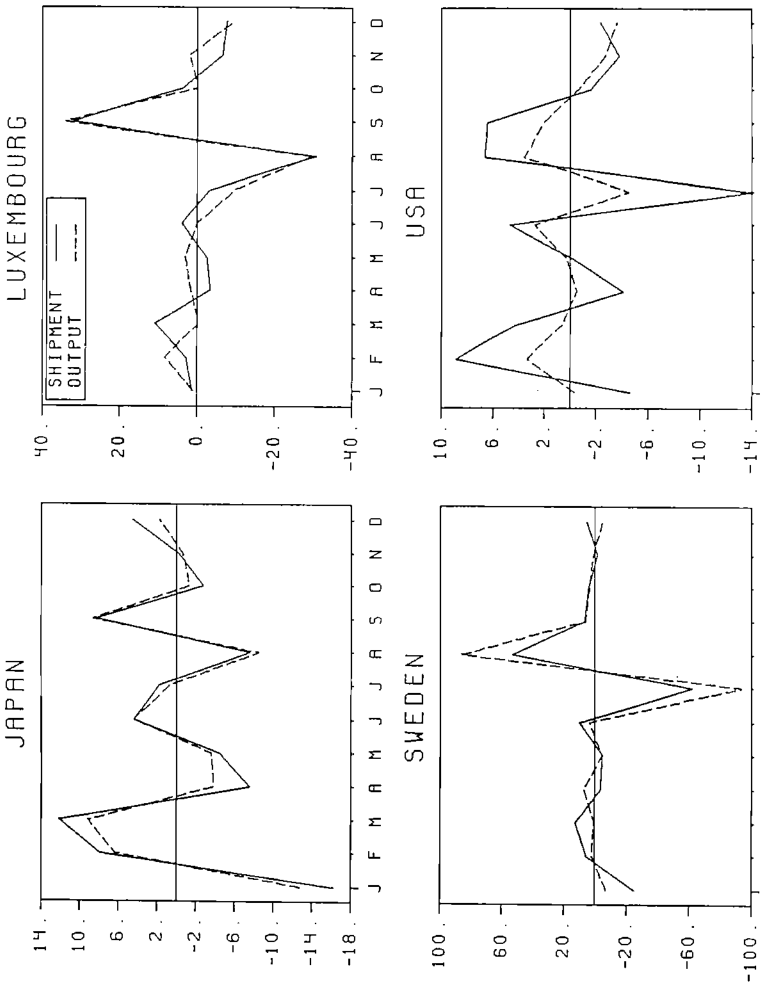

Figure 1, continued

APPENDIX A: SOURCES OF THE DATA

1. All time series data on aggregate variables are from the DRI databases *Current Economic Indicators*, *OECD Main Economic Indicators*, *Japan*, or *US Central*. The selection of countries is governed by the availability of data. We report results for any country for which we found data series of reasonable length and quality, and we report monthly results if such data are available and quarterly results otherwise. The main caveat regarding interpretation of the results is that the definitions and/or reliability of the data series may differ across countries.

2. In most cases the national accounts data are the real, seasonally unadjusted data series reported directly by DRI. For five countries (Australia, Finland, Netherlands, Norway, and the United States), we construct real, unadjusted data by dividing nominal unadjusted data by the seasonally unadjusted CPI. For a number of countries there are data on both real, unadjusted and nominal unadjusted NIA data. For these countries we have computed results using both measures and verified that the results are not sensitive to the distinction.

3. We examine GDP, rather than GNP, because GDP is available for a much larger number of countries. For the countries for which GDP and GNP are both available we have verified that the results reported in the paper are similar for the two series.

4. The data on industrial production are adjusted for the number of working days in all countries except Belgium, Japan, Spain, and Yugoslavia.

5. The results in Tables 4 and 5 use establishment measures of employment to calculate total hours, except where noted, in which case they use household measures. For Norway, the data on employment are for males only. In calculating labor hours in manufacturing, we use industry employment and industry hours (where industry is defined as manufacturing plus mining, utilities, and construction) for Austria, manufacturing employment and mining plus manufacturing hours for Germany, manufacturing employment and mining plus manufacturing hours for males for Norway, and industry employment and mining and manufacturing hours for Sweden. In most cases the results are for quarterly numbers or quarterly averages of monthly numbers. For Greece, however, we use second month of quarter data on both employment and hours.

6. The employment numbers in Table B6 are for the establishment measure of employment, except for Australia, where they are for the household measure. For those countries for which both household and establishment data are available the seasonal patterns are quite similar.

7 Data on M2 for Sweden exhibit seasonal patterns similar to those in M1 for other countries.

8. The nominal interest rate is the three month T-bill rate except for France (one month loan rate secured against interbank money), Germany (two to three month T-bill rate), and Japan (two month T-bill rate). For Sweden, the nominal interest rate data are missing for 1981:4.

9. Monthly data on the price level are not available for Australia or New Zealand, so the results reported for these two countries in Table 3 are for nominal retail sales. Given the widespread absence of seasonality in prices demonstrated in Table B12, it is unlikely that the failure to correct for price fluctuations has a significant effect on the estimated seasonal patterns. Quarterly results on the price level for these two countries do not reveal evidence of significant seasonality.

APPENDIX B: SUPPLEMENTARY TABLES

Table B1: Real Consumption, Log Growth Rates (Quarterly)

	Sample Period	*Std. Dev. of Seasonals*	*Std. Dev. of Residuals*	R^2	Q1	Q2	Q3	Q4
Argentina	1977:2–1987:2	4.19	4.83	.429	-2.00	-5.06	.97	6.10
Australia	1960:2–1987:3	6.11	1.14	.966	-9.93	3.20	.29	6.43
Austria	1973:2–1987:3	12.32	2.40	.963	-20.89	6.64	3.10	11.15
Canada	1961:2–1987:3	8.82	1.72	.963	-11.93	6.81	-4.84	9.96
Finland	1970:2–1987:2	4.36	2.54	.747	-5.07	3.85	-3.51	4.73
Germany	1968:2–1987:3	8.40	1.66	.963	-13.47	4.69	-.25	9.02
Italy	1970:2–1984:4	2.51	1.65	.698	-2.45	.80	3.72	-2.06
Japan	1965:2–1987:3	9.57	1.89	.962	-15.48	1.92	2.61	10.95
Norway	1978:2–1987:4	7.56	2.78	.881	-11.83	1.52	.90	9.40
Sweden	1970:2–1987:3	8.87	2.43	.930	-11.40	3.56	-4.57	12.41
Taiwan	1961:2–1987:3	9.72	2.63	.932	12.44	-14.21	3.64	-1.87
United King.	1955:2–1987:3	5.29	1.89	.887	-9.06	3.55	1.69	3.83
United States	1948:2–1985:4	6.62	1.95	.920	-10.33	4.27	-1.00	7.06

Table B2: Real Fixed Investment, Log Growth Rates (Quarterly)

	Sample Period	*Std. Dev. of Seasonals*	*Std. Dev. of Residuals*	R^2	Q1	Q2	Q3	Q4
Argentina	1977:2–1987:2	10.34	6.95	.689	-16.98	9.65	5.93	1.40
Australia	1960:2–1987:2	13.88	3.12	.952	-15.29	19.30	-10.45	6.44
Austria	1973:2–1987:3	30.35	3.18	.989	-47.32	35.36	12.71	-.75
Canada	1961:2–1987:3	12.54	3.32	.935	-15.70	17.50	4.95	-6.75
Finland	1970:2–1987:2	15.69	6.74	.844	-24.70	-1.34	8.94	17.10
Germany	1968:2–1987:3	18.29	4.60	.941	-27.88	22.84	-.43	5.47
Italy	1970:2–1984:4	5.67	2.81	.803	-1.55	2.41	-8.04	7.19
Japan	1965:2–1987:3	5.67	3.48	.726	-6.45	-2.51	8.84	.13
Netherlands	1978:2–1987:4	9.89	5.93	.735	-7.81	5.64	-10.80	12.98
Norway	1978:2–1987:4	12.99	18.86	.322	-19.00	17.55	2.70	-1.25
Sweden	1970:2–1987:3	19.43	3.51	.968	-26.04	16.38	-11.23	20.89
Taiwan	1961:2–1987:3	18.70	8.77	.820	-23.39	21.17	-12.87	15.09
United King.	1955:2–1987:3	4.62	4.24	.543	-3.08	-5.84	3.72	5.19
United States	1948:2–1985:4	8.72	3.75	.844	-12.32	12.33	.29	-.31

Table B3: Real Government Purchases, Log Growth Rates (Quarterly)								
	Sample Period	*Std. Dev. of Seasonals*	*Std. Dev. of Residuals*	R^2	Q1	Q2	Q3	Q4
Australia	1960:2–1987:3	8.78	3.71	.849	-8.69	11.37	-8.25	5.57
Canada	1961:2–1987:3	5.86	3.55	.731	4.05	-10.01	3.27	2.70
Finland	1970:2–1987:2	4.38	3.60	.597	-5.19	2.77	5.61	-3.19
Germany	1960:2–1987:3	7.02	2.46	.891	-11.07	2.26	.40	8.42
Italy	1970:2–1984:4	4.74	3.67	.625	-7.09	-.22	1.10	6.21
Japan	1965:2–1987:3	5.79	2.25	.869	-1.64	3.12	-8.43	6.95
Norway	1978:2–1987:4	.64	2.76	.051	-.89	.75	-.30	.43
Taiwan	1961:2–1987:3	6.02	6.84	.436	-4.57	6.78	-7.15	4.94
United King.	1955:2–1987:3	1.09	1.27	.428	.73	-1.58	-.40	1.25
United States	1948:2–1985:4	3.78	3.53	.535	-6.46	3.23	1.25	1.97

Table B4: Real Exports, Log Growth Rates (Quarterly)								
	Sample Period	*Std. Dev. of Seasonals*	*Std. Dev. of Residuals*	R^2	Q1	Q2	Q3	Q4
Argentina	1977:2–1987:2	17.54	10.39	.740	10.32	20.36	-5.38	-25.31
Australia	1960:2–1987:3	2.86	6.19	.176	-2.20	2.59	-3.42	3.03
Austria	1973:2–1987:3	9.18	5.28	.751	-.19	2.19	11.78	-13.77
Canada	1961:2–1987:3	8.54	5.59	.700	-10.39	13.11	-2.86	.13
Finland	1970:2–1987:2	6.47	6.98	.462	-9.88	1.14	.48	8.26
Germany	1960:2–1987:3	4.84	3.51	.655	-7.09	2.05	-1.17	6.21
Italy	1970:2–1984:4	9.81	7.27	.645	-14.67	8.58	-3.26	9.35
Japan	1965:2–1987:3	6.54	3.97	.731	-11.08	5.94	2.49	2.65
Norway	1978:2–1987:4	5.61	7.39	.366	-3.73	.37	-5.44	8.80
Sweden	1970:2–1987:3	8.90	4.64	.787	-8.13	3.95	-8.54	12.72
Taiwan	1961:2–1987:3	8.17	11.40	.339	-8.20	13.11	-.00	-4.91
United King.	1955:2–1987:3	2.37	4.46	.220	-3.04	2.76	-1.51	1.78
United States	1948:2–1985:4	5.12	5.21	.492	-2.47	4.29	-7.14	5.32

Table B5: Real Imports, Log Growth Rates (Quarterly)								
	Sample Period	*Std. Dev. of Seasonals*	*Std. Dev. of Residuals*	R^2	Q1	Q2	Q3	Q4
Argentina	1977:2–1987:2	4.90	10.67	.174	.41	-6.74	6.76	-.43
Australia	1960:2–1987:3	2.71	5.75	.181	-.42	1.30	3.22	-4.11
Austria	1973:2–1987:3	5.74	3.77	.699	-8.92	6.61	2.72	-.41
Canada	1961:2–1987:3	7.03	4.71	.690	-3.82	10.00	-8.53	2.35
Finland	1970:2–1987:2	6.95	8.72	.388	-11.36	2.58	1.31	7.46
Germany	1960:2–1987:3	3.11	3.96	.381	-4.23	3.11	2.81	-1.68
Italy	1970:2–1984:4	9.71	7.38	.634	-11.24	5.29	-7.06	13.01
Japan	1965:2–1987:3	2.13	3.74	.244	-2.71	.92	-1.15	2.94
Norway	1978:2–1987:4	5.72	5.96	.479	-7.45	3.14	-3.09	7.41
Sweden	1970:2–1987:3	6.73	4.13	.726	-8.24	2.02	-3.65	9.87
Taiwan	1961:2–1987:3	6.87	11.48	.263	-8.43	8.55	-4.68	4.55
United King.	1955:2–1987:3	1.64	3.98	.145	.34	1.90	.38	-2.62
United States	1948:2–1985:4	3.06	5.13	.262	-1.18	4.69	.18	-3.69

Table B6: Employment, Log Growth Rates (Quarterly)								
	Sample Period	*Std. Dev. of Seasonals*	*Std. Dev. of Residuals*	R^2	Q1	Q2	Q3	Q4
Australia	1965:2–1987:3	.43	.65	.307	-.23	.17	-.54	.61
Austria	1973:2–1987:3	1.53	.46	.917	-.64	1.45	1.39	-2.20
Canada	1965:2–1987:3	3.38	.81	.946	-3.18	3.76	2.94	-3.52
Finland	1970:2–1987:2	3.70	.88	.947	-2.08	4.97	1.78	-4.67
Germany	1965:2–1987:3	.85	.62	.651	-1.28	.71	.82	-.25
Italy	1970:2–1984:4	.87	.76	.567	-1.16	.22	1.25	-.31
Japan	1965:2–1987:3	.58	.71	.404	-.80	.65	-.29	.44
Sweden	1970:2–1987:3	1.14	.63	.765	-1.00	1.22	1.03	-1.25
United King.	1965:2–1987:2	.51	.61	.409	-.71	.70	.13	-.11
United States	1948:2–1985:4	1.50	.89	.739	-2.49	1.46	.25	.79

Table B7: Relation Between GDP and Employment, Log Growth Rates (Quarterly) Establishment Survey			
	Sample Period	*Coefficient*	*Standard Error*
Austria	1973:2–1987:3	2.19	(.29)
Canada	1965:2–1987:3	1.69	(.08)
Finland	1970:2–1987:2	.39	(.16)
Germany	1965:2–1987:3	5.01	(.52)
Italy	1970:2–1984:4	3.77	(.80)
Japan	1965:2–1987:1	13.34	(2.15)
Sweden	1970:2–1987:3	-4.61	(.58)
United King.	1965:2–1987:2	4.51	(.97)
United States	1948:2–1985:4	3.30	(.11)

Table B8: Relation Between GDP and Employment, Log Growth Rates (Quarterly) Household Survey			
	Sample Period	*Coefficient*	*Standard Error*
Australia	1965:2–1987:3	9.88	(2.21)
Austria	1973:2–1987:1	5.40	(.88)
Canada	1965:2–1987:3	1.59	(.07)
Finland	1970:2–1987:2	.28	(.16)
Germany	1965:2–1987:3	5.53	(.58)
Italy	1970:2–1984:4	2.71	(.39)
Japan	1965:2–1987:1	.94	(.17)
Sweden	1970:2–1987:3	-4.71	(.47)
United States	1948:2–1985:4	3.34	(.24)

Notes to Tables B7-B8:

1. The standard errors have been corrected using the Newey and West (1987) procedure.

Table B9: Relation Between Money and Consumption, Log Growth Rates (Quarterly)			
	Sample Period	*Coefficient*	*Standard Error*
Argentina	1977:2–1987:2	.17	(.39)
Australia	1960:2–1987:3	.24	(.05)
Austria	1973:2–1987:3	.19	(.03)
Canada	1961:2–1987:3	.42	(.04)
Finland	1970:2–1987:2	1.26	(.16)
Germany	1968:2–1987:3	.65	(.04)
Italy	1970:2–1984:4	-.34	(.15)
Japan	1965:2–1987:1	.47	(.02)
Norway	1978:2–1987:3	.08	(.07)
Sweden	1978:2–1987:3	.07	(.07)
Taiwan	1968:2–1987:3	.18	(.04)
United King.	1963:2–1987:3	.37	(.11)
United States	1948:2–1985:4	.11	(.01)

Table B10: Relation Between Money and Industrial Production, Log Growth Rates (Monthly)			
	Sample Period	*Coefficient*	*Standard Error*
Australia	1963:2 –1987:9	-.03	(.01)
Austria	1960:2 –1987:11	.15	(.02)
Belgium	1976:1 –1987:9	.02	(.01)
Canada	1960:2 –1987:11	-.18	(.02)
Finland	1960:2 –1987:11	.02	(.01)
France	1970:1 –1987:11	.04	(.01)
Germany	1960:2 –1987:11	.14	(.01)
Greece	1962:2 –1987:10	.13	(.04)
Ireland	1976:11–1987:10	.01	(.03)
Italy	1962:1 –1987:11	.01	(.00)
Japan	1960:2 –1987:11	.43	(.04)
Netherlands	1960:2 –1987:10	-.02	(.01)
Norway	1960:2 –1987:10	-.01	(.00)
Portugal	1979:1 –1987:7	-.07	(.01)
Spain	1961:2 –1987:9	.04	(.00)
Sweden	1960:2 –1987:11	-.01	(.00)
United King.	1971:7 –1987:11	-.05	(.03)
United States	1960:2 –1987:12	-.25	(.02)
Yugoslavia	1964:11–1987:10	-.07	(.02)

Notes to Tables B9-B10:

1. The standard errors have been corrected using the Newey and West (1987) procedure.

Table B11: Nominal Interes Rate, Levels (Monthly)				
	Sample Period	*Std. Dev. of Seasonals*	*Std. Dev. of Residuals*	R^2
Belgium	1960:2 -1987:12	.01	.05	.039
Canada	1960:2 -1987:12	.01	.05	.018
France	1971:2 -1987:12	.01	.06	.049
Germany	1971:7 -1987:12	.01	.02	.070
Ireland	1971:4 -1987:12	.02	.07	.103
Japan	1971:4 -1987:12	.00	.01	.027
Netherlands	1960:2 -1987:12	.01	.05	.069
Sweden	1960:2 -1987:12	.01	.06	.042
Switzerland	1970:5 -1986:3	.01	.04	.068
United King.	1960:2 -1987:12	.01	.06	.067
United States	1960:2 -1987:12	.01	.06	.009

	JAN	*FEB*	*MAR*	*APR*	*MAY*	*JUN*	*JUL*	*AUG*	*SEP*	*OCT*	*NOV*	*DEC*
Belgium	-.02	-.01	.01	-.01	-.01	-.00	.01	.00	.01	.01	-.01	.02
Canada	-.00	.01	-.01	.01	-.01	.01	.01	-.01	.00	-.01	-.00	.01
France	-.00	-.00	.00	-.02	.02	.02	-.02	-.00	.03	-.02	-.01	.00
Germany	.00	-.00	-.00	-.01	.01	.01	.01	-.00	.00	-.00	.01	-.01
Ireland	.00	-.02	-.02	-.05	.00	.00	.00	.02	-.02	.02	.03	.04
Japan	.00	-.00	-.00	.01	.00	-.00	.00	.00	-.00	.00	-.00	.00
Netherlands	-.03	-.01	-.01	-.01	.01	.01	.01	.01	.00	.02	-.01	.01
Sweden	.01	-.01	-.01	.04	-.01	.00	-.01	-.01	.01	-.01	-.01	-.01
Switzerland	-.03	-.00	-.00	.00	.01	.01	-.01	-.01	.01	.01	.01	.00
United King.	-.01	-.00	-.03	-.02	.00	.01	.02	-.01	.00	.01	.02	.00
United States	.00	.00	-.00	-.01	.00	-.00	.01	.01	-.01	-.00	.00	.00

Table B12: Consumer Price Index, Log Growth Rates (Monthly)												
	Sample Period			*Std. Dev. of Seasonals*			*Std. Dev. of Residuals*			R^2		
Austria	1960:2–1987:12			.32			.57			.239		
Belgium	1960:2–1987:12			.10			.38			.060		
Canada	1960:2–1987:12			.12			.38			.087		
Denmark	1967:2–1987:12			.25			.66			.122		
Finland	1960:2–1987:12			.23			.97			.052		
France	1960:2–1987:12			.09			.38			.051		
Germany	1960:2–1987:12			.21			.29			.345		
Greece	1960:2–1987:12			.99			.99			.500		
Italy	1960:2–1987:11			.15			.59			.060		
Japan	1960:2–1987:12			.51			.69			.357		
Luxembourg	1960:2–1987:12			.10			.44			.048		
Netherlands	1960:2–1987:12			.35			.61			.246		
Norway	1960:2–1987:12			.41			.80			.213		
Portugal	1960:2–1987:10			.53			1.44			.119		
Spain	1960:2–1987:12			.22			.76			.078		
Sweden	1960:2–1987:12			.22			.90			.054		
Switzerland	1960:2–1987:12			.17			.38			.164		
Turkey	1969:5–1987:12			1.56			3.29			.184		
United King.	1962:2–1987:12			.35			.61			.246		
United States	1960:2–1987:12			.07			.35			.036		
Yugoslavia	1960:2–1987:12			.85			3.19			.066		
	JAN	*FEB*	*MAR*	*APR*	*MAY*	*JUN*	*JUL*	*AUG*	*SEP*	*OCT*	*NOV*	*DEC*
Austria	.58	-.02	-.06	.05	-.07	.72	-.32	-.35	-.35	-.12	-.03	-.03
Belgium	.21	.07	-.14	.02	-.04	-.00	.11	-.15	.06	-.04	-.05	-.05
Canada	-.06	-.02	.04	.01	.04	.18	.18	-.05	-.30	.00	.04	-.08
Denmark	-.29	-.16	.20	.13	.45	-.18	.08	-.18	.22	-.01	.20	-.45
Finland	.50	.04	.08	.27	.00	.09	-.01	-.28	.00	-.09	-.23	-.38
France	.17	-.08	.01	.07	-.02	-.06	.07	-.07	.01	.11	-.05	-.16
Germany	.52	.06	-.00	.04	.03	.03	-.18	-.43	-.18	-.03	.10	.04
Greece	.07	-1.29	1.35	.53	-.30	-.28	-1.39	-1.63	1.45	.84	.04	.61
Italy	.14	.15	-.07	.00	-.01	-.25	-.25	-.14	.12	.21	.14	-.03
Japan	.56	-.20	.07	.62	-.09	-.60	-.32	-.35	.95	.33	-.90	-.05
Luxembourg	.11	.04	-.23	.05	.11	-.00	.01	-.17	.01	-.01	.03	.04
Netherlands	.17	.21	.23	.73	-.40	-.25	-.57	.03	.38	-.03	-.25	-.25
Norway	1.02	-.11	.34	-.32	-.21	.01	.48	-.57	.11	-.18	-.19	-.38
Portugal	.19	.19	.80	-.31	-1.13	-.83	-.29	.41	.46	.21	.14	.17
Spain	.27	-.40	.09	.15	-.12	-.49	.15	.08	-.01	-.02	.16	.12
Sweden	.55	.24	-.15	.09	-.30	.04	-.13	.10	-.05	-.09	-.18	-.12
Switzerland	.07	-.05	-.11	-.21	.24	.04	-.20	.05	-.09	-.03	.39	-.10
Turkey	2.04	.12	1.53	1.29	.64	-3.76	.34	-1.18	1.12	.29	-.70	-1.71
United King.	.14	-.05	-.04	1.06	-.08	-.06	-.34	-.32	-.28	.08	.00	-.10
United States	-.07	.06	-.01	.08	.03	.10	.07	-.05	.04	-.06	-.09	-.09
Yugoslavia	1.15	-.08	-.02	-.35	.04	.09	-1.82	-1.15	.12	1.08	1.13	-.17

Table B13: Real Interes Rate, Levels (Monthly)

	Sample Period	*Std. Dev. of Seasonals*	*Std. Dev. of Residuals*	R^2
Belgium	1960:1 -1987:9	.04	.33	.012
Canada	1960:1 -1987:9	.08	.29	.064
France	1971:1 -1987:11	.12	.32	.114
Germany	1971:6 -1987:9	.12	.20	.279
Japan	1971:3 -1987:10	.36	.54	.311
Netherlands	1960:1 -1987:9	.20	.40	.210
Sweden	1960:1 -1985:12	.15	.39	.135
Switzerland	1970:4 -1987:9	.07	.28	.061
United King.	1960:1 -1987:9	.21	.44	.187
United States	1960:1 -1987:9	.05	.25	.041

	JAN	*FEB*	*MAR*	*APR*	*MAY*	*JUN*	*JUL*	*AUG*	*SEP*	*OCT*	*NOV*	*DEC*
Belgium	.02	.04	.01	-.03	.00	-.02	.04	.01	.05	-.03	-.07	-.03
Canada	-.02	-.03	-.08	-.13	-.10	.06	.13	.10	.02	.03	.04	-.00
France	.06	-.07	-.22	-.05	.08	-.12	.09	.02	-.05	.15	.19	-.08
Germany	-.04	-.01	-.05	.03	.14	.21	.16	.05	.00	-.16	-.18	-.16
Japan	.07	-.34	-.26	.35	.46	.34	-.30	-.64	.28	.47	-.26	-.18
Netherlands	-.39	-.20	-.05	.38	.24	.05	-.12	-.02	.19	.13	-.03	-.18
Sweden	.06	.16	.16	.15	.13	.02	-.00	.02	.04	-.20	-.31	-.22
Switzerland	.11	.02	-.04	-.04	.04	.09	.03	-.10	-.08	-.12	.04	.05
United King.	-.33	-.32	-.33	.14	.24	.30	.19	.07	.02	-.01	.01	.00
United States	-.04	-.03	-.06	-.07	-.05	-.03	.02	.05	.08	.08	.03	.01