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BUSINESS CYCLES AND LONG-RUN GROWTH

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In this survey, we discuss the effect of macroeconomic fluctuations on long-run growth from both a theoretical and empirical perspective. We emphasize the 'opportunity cost' approach, which states that firms will intertemporally substitute productivity-enhancing activities for regular production activity during recessions. We provide aggregate evidence in favour of the opportunity-cost approach.

I. INTRODUCTION

Anybody who has taken a macroeconomics class has been taught business cycle theory and growth theory. Some might have wondered what the two have in common. It looks as if the economist's long run and short run were alien to each other, almost incompatible.

It is fair to say that most macroeconomists believe that business cycles and long-run growth are largely independent phenomena. Long-run growth is determined by improvements in productivity and defines the 'natural' path of aggregate activity. In the short run, output fluctuates around this path. These fluctuations are typically unaffected by long-run growth. Conversely, they have no long-run impact on productivity. In a recent session at the American Economic Association congress, where prominent

macroeconomists coming from different perspectives were asked what they agreed upon, the most pervasive answer turned out to be 'monetary policy matters in the short run but not in the long run'. This answer illustrates how widespread is the view that business cycles are irrelevant except in the short term. Thus arguing that they are not is controversial. Yet some traditional, less mainstream, theorists did not think of business cycles and of the growth process as separate phenomena. For Schumpeter, recessions were the time when the economy restructured and reorganized, when inefficient production units disappeared, thus freeing resources for new ones. Hence the growth process was intimately related to economic fluctuations. Many executives and business people actually think along these lines. A Volkswagen official told the author that his firm benefited from the Deutschmark's overvaluation because it brought discipline to his

firm and forced it to rationalize production. In the end, according to this person, Volkswagen was able to produce the same output with half the people. Thus it appears that during recessions activities are taking place which permanently affect the economy's productive level, and that the fruit of these activities may only show up later when the economy is back to a boom.

Identifying the effects of fluctuations on long-run productivity potentially carries important implications for economic policy. Over the last 20 years, under the influence of Robert Lucas and other proponents of the 'new classical macroeconomics', macroeconomists have gradually de-emphasized the importance of both business cycles and short-run stabilization policy. New classical macroeconomists argue that the scope for macroeconomic stabilization is limited, because it essentially involves 'fooling' people by creating inflation in excess of expectations. Furthermore, the gains from stabilization policy are also limited, since they involve reducing the magnitude of small fluctuations around a trend which is unaffected by such policy. Indeed, some new classical economists, namely the proponents of the 'real business cycles' (RBC) approach, view fluctuations as the economy's optimal response to productivity shocks. Any attempt to dampen them, therefore, would be regarded as misguided and counter-productive. Thus it looks as though macroeconomic policy is not that big a deal, much less so than policies that may affect long-run productivity, such as education and innovation policies, or the structure of the tax system. However, if one believes that short-run fluctuations have long-run effects, this conclusion is reversed and macroeconomic policy should be taken far more seriously.

II. THEORIES

Interest in the long-run effect of business cycles was revived recently as part of the interest in endogenous growth. While long-run growth was traditionally thought of as entirely driven by some unexplained trend of technical progress, endogenous growth theory explicitly takes into account the fact that technical progress itself has economic

determinants, and depends on the incentives to innovate, to acquire education, and on the acquisition of knowledge as a by-product of economic activity ('learning by doing'). All these channels are clearly dependent on many aspects of the economy.

The most straightforward application of the endogenous growth approach to business cycles is the idea of learning by doing, i.e. that, while producing, people often have new ideas and are able to design more efficient ways of organizing production (see Stadler, 1990). One implication is that at any point in time the stock of knowledge and, therefore, the economy's technology frontier depends on the cumulated stock of past economic activity. Thus people learn more in expansions, when output is greater, than in recessions. Consequently, according to this view, fluctuations have a long-run effect on productivity which is of the same sign as their short-run effect on activity. Recessions are bad and expansions are good.

Other, slightly more sophisticated mechanisms can generate similar linkages. For example, if firms are prevented from borrowing to finance expenditure on research and development, then they will use their profits to finance them. Therefore they will invest less in research and development in recessions as their profits fall. If workers who experience long spells of unemployment lose skills permanently, then a recession may permanently lower the average quality of the work-force. This 'unlearning by not doing' is simply the negative of 'learning by doing', although in principle its effects on productivity should only last until the workers who have been hit eventually retire. However, their loss of skill may be partially transmitted to subsequent generations because of externalities across workers.

Yet another approach, that of the 'opportunity cost' (OC), states that recessions are just the right time for firms to engage in some activities that may raise their productivity in the long run.¹ These may include restructuring, training, implementation of new technologies, and relocation. The central idea is that these activities are costly in terms of forgone current production (because they disrupt normal production activities), while their benefit is in the

¹ Hall (1991), who argues that firms will accumulate 'organizational capital' during recessions, Davis and Haltiwanger (1990, 1992), who argue that recessions may be the appropriate time for labour reallocation, Aghion and Saint-Paul (1991, 1993), and Gali and Hammour (1991); see also Bean (1990).

form of a greater flow of revenues spread over the whole future. Therefore, in a recession when output is currently low, the cost of such activities is low relative to their benefit, which includes increased production in the future when the economy is back to an expansionary phase. An important aspect of this mechanism is, therefore, the *intertemporal substitution* of productivity-enhancing activities (PEAs) for direct production activities, which are postponed to better times.

Two important things should be kept in mind. First, for this view to be valid as a representation of the firm's behaviour, it must be the case that firms have some fixed or semi-fixed resources that, rather than shedding in slumps, they prefer to use for other activities than production, including PEAs. Similarly, in booms it must be costly for firms to buy from the market the resources they need to undertake PEAs. That is, internal resources must be less costly for a firm than external ones, implying it faces a trade-off between production and PEAs. This difference in costs between using internal as against external resources may in turn derive from the need to train/screen workers (which is particularly relevant for overhead labour), or to install physical capital, or to comply with regulations making hiring and firing costly. Thus the relevance of the phenomena emphasized by the OC approach in principle depends on institutions.²

There is a close connection between the OC approach and the theory of labour hoarding. The latter tries to explain why measured productivity is strongly procyclical (which implies that firms apparently move toward the interior of their production possibility frontier in slumps), and argues that one input—effort—is unobservable to the statistician and that, because of turnover costs, it is more profitable for firms to reduce effort in slumps than fire workers. An alternative to reducing effort, however, is simply to shift the tasks performed by these workers from direct production to activities that increase the firm's long-run productivity. This, in the short run, is almost observationally equivalent to labour hoarding, with the additional implication that the shadow activities undertaken in recessions eventually show up as greater total factor productivity.

Even if there are no adjustment costs preventing individual firms from freely adjusting factors of production to their needs, the same opportunity cost mechanism may, in principle, operate at the aggregate level and be mediated to individual agents through the price mechanism. That is, in periods where the value of producing is low, the return to production (for workers, wages) will fall relative to alternative activities (such as human capital accumulation, whose return is determined by future wages), and the economy will reallocate resources to these alternative activities. This argument may bear some relevance as far as education decisions are concerned, for we know that the duration of education tends to lengthen in recessions. However, almost all other sectors—barring leisure—move together with aggregate GDP, so that if PEAs take place in recessions, the associated reallocation of resources has to take place within firms. One possible exception is labour reallocation itself. As argued by Davis and Haltiwanger (1990, 1992), job destruction is more countercyclical than job creation, so that if we measure job reallocation by the sum of the two, it is countercyclical. Job reallocation may then be viewed as an investment into better matches between firms and workers, thus contributing to higher productivity in the long run. Davis and Haltiwanger also argue (using a model with a representative agent) that this may be due to the fact that recessions are the right time for labour reallocation. However, it is far from obvious that the countercyclical pattern of job reallocation is due to intertemporal substitution by optimizing agents. Job and worker search are uncoordinated activities which are not bought and sold by a market and which involve many externalities: it is hard to identify the relative price which makes search attractive in slumps relative to production. Furthermore, vacancies fall in recessions: thus it does not seem that firms substitute worker search for production. This may simply be because vacancies are typically filled very quickly, so that they are not an investment in the very long run. Therefore this countercyclical pattern of gross job reallocation may just be due to the simple fact that job destruction involves fixed and proportional costs (closing a plant, severance payments), while hiring costs sharply increase with both the firm's and the aggregate hiring rates, because of

² Another important adjustment cost faced by firms is the cost of entering the market. As argued by van Ewijk (1994), the OC effect may be washed out by exit of firms from the market in deep recessions. Thus, while moderate recessions may be beneficial for growth, this may not be true of deep recession, which may harm growth.

congestion externalities in the search process. This differential structure of adjustment costs explains why hirings are smoother than separations.

The second important point one must keep in mind is that for a downturn to increase PEAs, it must be perceived as temporary. This is simple to understand: the costs of PEAs are in terms of current forgone output, while the benefits are in terms of the whole path of current and future output. A *permanent* reduction of output by, say, 10 per cent lowers the cost of PEAs by 10 per cent, but, since I will sell 10 per cent less for ever, it also reduces the return to PEAs by the same 10 per cent. The terms of trade between production and PEAs are thus unaffected and so is the share of resources devoted to PEAs. By contrast, a temporary reduction reduces the costs by more than it reduces the benefits of PEAs, thus increasing the incentives to engage in them.

Beyond the OC approach, there are other approaches that insist on the virtues of recessions or sometimes of volatility. Let us mention three of them.

Lame ducks: recessions are likely to eliminate the most inefficient production sites (see Caballero and Hammour, 1994, 1996). Thus the age structure of capital is presumably younger, and productivity larger, at the end of a recession than at the beginning. This argument however brings up several questions. First, why is it that these inefficient production sites exist in the first place? Why do the most efficient sites not underbid them and attract all the labour force? The answer must be that it is costly for the most efficient sites to grow and create new positions. But, if less productive jobs exist because more productive jobs are costly to create, then cutting the least productive jobs does not necessarily increase the number of more efficient jobs. It ultimately depends on how the resources freed by the closing of inefficient plants make it easier for new jobs to be created in the better plants. This crucially depends, in the end, on whether it is easier for the most efficient sectors to hire from the pool of unemployed workers than to poach new workers directly from the least efficient sectors. The analysis therefore boils down to the efficiency of the

search process which matches workers to positions. Economists know that, depending on the parameters which characterize the response of hirings to unemployment and vacancies and depending on the bargaining powers of employers relative to employees, the search process may generate too few or too many job offers.³ Thus there is no presumption that the faster destruction of inefficient sites in recessions is a desirable phenomenon. Second, there is no a priori reason to believe that this mechanism will generate a long-term effect of macroeconomic fluctuations on productivity. A temporary recession would just temporarily alter the age structure of capital, after which the economy would gradually return to steady state as production units aged, with no trace of the recession in the long run; just like a war leaves holes in the age distribution of a population that eventually vanish, with no effect on the long-run growth rate of population which depends only on the underlying rates of fertility and mortality. Only if externalities are introduced can the elimination of lame ducks have permanent effects on productivity. This would occur, for example, if the most modern production sites were also the ones with the greatest potential for learning, and if this learning generated positive spill-overs on future production sites.

Financial discipline: a large literature in finance theory focuses on the agency problem of limiting managers' supposed tendency to 'slack' and 'have a nice life'.⁴ This literature insists on the disciplinary role of corporate debt (as opposed to shares) in controlling managers: debt automatically transfers control rights to creditors in case of bankruptcy, thus ensuring tight monitoring of the firm, which in turn creates adequate incentives for managers. From this starting point it is possible to show theoretically that bad times, by making bankruptcy more of a threat, increase the managers' incentives to restructure and implement the most efficient technologies. However, this process has limits: if bankruptcy is too near then the return to PEAs become very low as the prospects of liquidation eliminate any managerial incentives. Thus it is for intermediate levels of debt that discipline effects are strongest.

³ See Hosios (1990). Mortensen and Pissarides (1994) analyse job creation and job destruction in the context of search models.

⁴ This is not the place to review this literature. The reader can refer to Jensen and Meckling (1976). Empirical evidence on the 'discipline of debt' effect is provided, for example, in Nickell *et al.* (1992).

Darwinian selection: Harris Dellas (1992) has argued that the economic environment affects the quality of economic agents' information about the best use of their talent. In a booming environment talent may be misallocated because people perceive high returns everywhere, and therefore are less likely to select the activity for which they are best fitted. Consequently, argues Dellas, recessions may have a positive long-run impact on productivity. By making the environment harsher, recessions force people to allocate their talent in the best possible way. The problem with this argument is that it may be turned upside down. What really matters is whether the returns to a given individual of different economic activities are more spread in recessions than in expansions, that is, whether the relative return to the best activity increases in recessions. There is no a priori reason why this should be so. Just as expansions compress returns by driving them up, recessions compress them by driving them down. In a depressed environment, labour demand is low in all sectors, which makes it difficult for people to find jobs in their best sector. If anything, this theory suggests that selection is most efficient in normal times, when the economy is neither in a boom nor in a recession, with the implication that stabilizing business cycles is likely to increase the long-run growth rate of output. Indeed, this argument is formally very similar to the one put by Milton Friedman (1968) and Robert Lucas (1972) about misperceptions and the Phillips curve. Inflation, according to Friedman, means that agents cannot perfectly sort out increases in the relative price of the good they produce from increases in the general price level. Similarly the Darwinian selection argument states that in a boom people do not know if an activity has a high return because there is a boom or because they have a comparative advantage for that activity.

Going back to the OC approach, there are two other important issues that it raises. The first one is

whether, assuming that some PEAs are undertaken to a greater extent during recessions, they really have a long-run effect, or whether technical change, that would have taken place no matter what, is simply implemented earlier. While the answer has to be empirical, conceptually this refers to two different views of the world. In one view, improvements that can be intertemporally substituted are not an engine of growth: the set of such improvements is bounded. Because they are costly to implement, however, the firm will want to smooth them and the optimal timing of improvements will be affected by economic fluctuations. Long-run growth is ultimately unaffected by such decisions, and driven by shifts in the set of available techniques that are either exogenous or the outcome of innovative activity unrelated to the business cycle. The other view of the world assumes that the scope for productivity improvements is unbounded, either because firms see an infinite set of possible PEAs, or, more plausibly, because restructuring is associated with the discovery of new possibilities for productivity improvements. Each recession would then shift the frontier of available PEAs and have a long-run effect on productivity.

The other issue is that each recession or expansion is not an isolated phenomenon, so one has to think about how the long-run effects of individual episodes aggregate together into a long-run growth rate.⁵ Potentially this generates scope for both the amplitude and the frequency of fluctuations to affect the long-run growth rate, although theory offers few guidelines because the net effect will depend on non-linearities. If PEAs are proportional to the 'cycle', and if the 'cycle' is on average zero, the PEAs will also be on average zero regardless of the structure of the cycle.⁶ That is, the OC approach may be valid, but if the long-term effects of a recession are offset by the long-term effects of the subsequent expansion, then there will be no effect of fluctuations on long-run growth. The structure of

⁵ A reverse view holds that observed fluctuations can be recovered from simple random walk models. See Pagan's contribution in this issue.

⁶ A simple model may illustrate this point:

$$\begin{aligned} y_t^* &= y_{t-1}^* + a_{t-1} + g + \varepsilon_t \\ y_t &= y_t^* + c_t \\ a_t &= \beta c_t \end{aligned}$$

where all variables are in logs, y_t^* is potential output, y_t current output, c_t the cycle (an aggregate demand shock), ε_t an aggregate supply shock, and a_t the amount of PEAs. Clearly, as long as c_t has a zero mean, the unconditional mean of the growth rate is g , independent of the structure of the stochastic process followed by c_t .

fluctuations will affect long-run growth only insofar as PEAs react to the cycle in a non-linear fashion, in which case the prediction depends very much on the shape of the non-linearity.

III. MEASUREMENT

In the previous section, we have discussed the various channels through which short-term economic fluctuations may affect the long-term growth path of the economy. Since these channels create sometimes positive, sometimes negative linkages, empirical work is necessary to sort out which mechanism is most relevant. In this section we focus on the 'opportunity cost' approach.

There are two fundamental problems when one starts thinking empirically about the long-run effects of business cycles: one is associated with the measurement of productivity, the other with the measurement of the cycle.

Ideally, to test the theory one would like a measure of the true productive capacity of the economy; that is, the level of output which the current state of technical knowledge allows the economy to reach under full utilization of resources. This is traditionally measured by economists using 'total factor productivity' (TFP) or the 'Solow residual', which isolates the contribution of technical change to economic growth. TFP growth is simply computed by removing the contribution of employment growth and physical capital accumulation from total output growth. A naïve test would be to look at the behaviour of TFP, and to examine whether it grows faster or more slowly in recessions than in expansions. It is usually found that TFP growth is strongly procyclical. While this evidence apparently contradicts the OC approach, there is now wide agreement that most, if not all, of the observed procyclicality of the Solow residual is due to labour hoarding (see Burnside *et al.*, 1993; Basu and Fernald, 1995). This means that the true labour input is overestimated in slumps because part of it is accommodated by reducing work effort, a component of labour input which is unobserved by statisticians. Since labour input is subtracted from total growth to yield TFP growth, TFP is underestimated in recessions. As we argued above, there is a close link between the idea of labour hoarding and the OC approach, since TFP

growth can also be underestimated if, instead of reducing effort, firms reallocate part of their workforce to PEAs that only show up later in the measurement of output.

Another important reason why a procyclical pattern of TFP growth is not inconsistent with the OC approach is that part of this pattern may be explained by supply (productivity) shocks, while the OC approach is only relevant when dealing with demand shocks. This issue is closely connected to the problem of defining the cycle, to which we now turn.

To understand how cycles affect long-run growth, we first have to define what it is. A naïve answer would be fluctuations around some smooth trend. However, this definition has several shortcomings, particularly when one is interested in the 'OC' approach. First, if the trend is interpreted as deterministic, then by construction the cycle, which will consist of a mean-reverting process, cannot have any long-run impact. Thus there are ways to think of the cycle that are incompatible from the start with any attempt to test the OC approach or, for that matter any theory linking cycles to growth. Second, under the influence of the RBC school, economists have pointed out that shocks to productivity may account for short-run macroeconomic fluctuations. That is, business cycles can be thought of as arising in response to changes in the pace of technical progress. Traditional economic thinking considered the trend as both deterministic and an equilibrium phenomenon, and the cycle as random and a disequilibrium phenomenon. The RBC school has claimed that it is possible to reproduce observed macroeconomic fluctuations with an equilibrium model where all shocks come from changes in productivity growth. Thus, both the trend and the cycle arise from the same source (shocks to productivity). Indeed, the very pro-cyclicality of the Solow residual is one of the regularities that motivated the RBC approach. If fluctuations are driven mostly by demand shocks, there is no *a priori* reason why the state of technical knowledge should improve in expansions. This view of the world, in its purest form, is again incompatible with testing the OC approach since it rules out any exogenous source of fluctuations other than productivity itself. More generally, productivity shocks are a source of fluctuations which it is very important to account for

Table 1
Summary of Four Studies on the Long-run Effects of Business Cycles

Study	Data	Identification	Long-run effect (%)
Bean (1989)	Britain, annual 1855–1987	Demand shocks = military expenditure	–0.04
Gali and Hammour (1991)	USA, annual 1890–1987	No impact effect of demand shocks on TFP	–0.7
Saint-Paul (1993)	22 OECD countries, annual 1950–88	No impact effect of demand shocks on TFP	–0.3 (median)
Malley and Muscatelli (1996)	20 US sectors, annual 1959–91	No impact effect of demand shocks on TFP	–0.5 (aggregate)

when testing the OC approach. Surely an expansion arising from technical progress is unlikely to lead to a fall in productivity in the long run. Another reason why it is essential to treat fluctuations arising from productivity shocks separately is that these shocks are likely to have permanent effects on output, and thus will not be associated with intertemporal substitution in PEAs.

Thus in order to test the OC theory, one has to define the cycle in such a way that the two following conditions are satisfied. First, shocks to productivity must be eliminated from the cycle, even though they may generate interesting dynamics that would be considered as fluctuations if one is interested in, say, forecasting GDP. Therefore, the hypothesis is best formulated as a statement that ‘aggregate demand’ shocks have long-term effects on productivity. Second, the cycle must be constructed in a way that allows it to have long-run effects on productivity, which is at variance with the way it is traditionally constructed. To illustrate this point, it is useful to consider how Blanchard and Quah (1989) suggest that output should be decomposed between a trend and a cycle. They define the trend as the path that output would follow in the absence of aggregate demand shocks; that is, if driven only by productivity shocks. When it comes to technically identifying aggregate demand shocks, to distinguish them from productivity shocks, they assume that demand shocks have no long-term effect on output. Clearly this is not applicable to testing for long-run effects of demand shocks.

We now turn to the empirical evidence. The OC view is supported by four studies: Bean (1990), Gali and Hammour (1991), Saint-Paul (1993), and Malley and Muscatelli (1996). The first study uses changes in military expenditures as a measure of demand shocks, and estimates the impact of such changes on output by a standard regression technique. The other three studies use a technique similar to Blanchard and Quah’s, which they amend by assuming that, rather than having no long-run effect on output, demand shocks have no contemporary effect on TFP. The underlying assumption is that PEAs only show up gradually in the measurement of TFP. Saint-Paul goes one step further in testing the OC approach in its explicit form by looking at the cross-country correlation between the size of the effect of demand expansion on productivity and a measure of the transitoriness of demand shocks. He finds weak support for the prediction that the effect is stronger in countries with more transitory fluctuations.

The estimates of the long-term effects of output implied by these studies are reported in Table 1. The Bean findings are not directly comparable to the other studies because he focuses on military expenditures and finds that a permanent rise in military expenditures by 1 per cent of GDP reduces the long-run growth rate by 0.04 per cent. The other three studies find similar orders of magnitude for the long-run effects of demand shocks, although the estimates in Saint-Paul substantially differ across countries and are often imprecisely estimated.

While aggregate evidence seems surprisingly supportive of the OC approach, it is difficult to identify one type of PEA which significantly rises in a recession. For example, it is generally believed that research and development (R&D) activities are pro-cyclical. While this may be overstated, there is certainly no evidence that R&D activities increase in slumps. For example, Saint-Paul (1993) finds no clear cyclical pattern of R&D once supply shocks are controlled for. Similarly Geroski and Walters (1995) find a mildly procyclical pattern of R&D.

Furthermore, the above-mentioned studies fail to correct properly for capacity utilization. On the one hand, this may prejudice them, since not correcting TFP for capacity utilization may make it more procyclical. On the other hand, under the assumption of a zero contemporaneous impact of demand shocks on TFP, some part of demand shocks may be interpreted as supply shocks which may be problematic. Indeed, Saint-Paul's (1993) results are much weakened by correcting for capacity utilization, although this is essentially due to the poor performance of the instrumental variables used for such correction rather than because of the preceding argument.

More support for the OC approach is found in Durnee *et al.* (1996), who find that the share of non-production workers in manufacturing employment is strongly countercyclical. If reorganization activities and other PEAs are undertaken by non-production workers then this is indeed what one should expect from OC theory. One might object, however, that this may simply be the sign that non-production workers are costlier to hire and fire, perhaps because they are better trained and/or because their skills are more specific to the firm. However, their findings are unlikely to be solely explained by differences in the cyclical responses of production and non-production workers.⁷

The most supportive microeconomic study for the OC approach is that by Nickell *et al.* (1995), who

find that a worsening of the firm's situation does lead to the introduction of productivity improving innovations of various kinds.

Another noteworthy empirical regularity that has been found in the literature is some interaction between long-run growth and the frequency of fluctuations. Saint-Paul (1993) thus finds that countries where fluctuations are more transitory tend to grow more slowly. This evidence has been confirmed by Fatas (1994). An obvious criticism would be that long-run growth is the outcome of cumulative permanent positive supply shocks, so that more growth would be associated with more persistent fluctuations. But this criticism is in principle void as far as the results in Saint-Paul (1993) are concerned, because supply shocks are filtered out before the frequency of the cycle is computed. As for the effect of volatility, a recent paper by Ramey and Ramey, who use a large cross-section of countries, finds a negative correlation between the variance of economic fluctuations and long-run growth, while Saint-Paul (1993) using his different methodology and the smaller sample of OECD countries, had found only an insignificant coefficient, although negative too.

IV. CONCLUSION

In this paper we have discussed various hypotheses regarding the long-run effects of business cycles on productivity. We have focused on the opportunity-cost approach, which states that firms will intertemporally substitute productivity-enhancing activities for direct production activities during recessions. We can conclude from this discussion that while the bulk of macroeconomists reject the idea that demand shocks have long-run effects on productivity, whether positive or negative, the OC approach is not inconsistent with the aggregate evidence. More empirical work is needed to identify exactly which PEAs are countercyclical and the order of magnitude of the productivity effects of these activities.

⁷ Another approach to testing the opportunity cost theory is to use data from the stock market. See Saint-Paul (1995).

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